Flora and Fauna Survey of the Proposed Tailings Storage Facility (TSF4)

Billabong Gold Pty Ltd

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Template 2.8.1

Contents

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
BAM Act	State *Biosecurity and Agriculture Management Act 2007*
BC Act	State *Biodiversity and Conservation Act 2016*
Billabong Gold	Billabong God Pty Ltd
BoM	Bureau of Meteorology
CLUSTER	Hierarchical Clustering
DAFWA	Department of Agriculture and Food Western Australia
DBCA	Department of Biodiversity, Conservation and Attractions
DotEE	Department of the Environment and Energy
DPIRD	Department of Primary Industries and Regional Development
DRF	Declared Rare Flora
ELA	Eco Logical Australia
EP Act	State *Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas
ha	hectare
IBRA	Interim Biogeographical Regionalisation for Australia
km	kilometre
m	metre
mm	millimetre
P	Priority
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
SIMPER	Similarity Percentages
SIMPROF	Similarity Profile
TEC	Threatened Ecological Community
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WoNS	Weed of National Significance

Executive Summary

Eco Logical Australia was engaged by Billabong Gold Pty Ltd to undertake a Detailed and Targeted flora and vegetation survey and a Level 1 fauna survey to support the development of a new Tailings Storage Facility at Billabong's Plutonic Gold Operations. The survey area, approximately 106 hectares in size, is located adjacent to the current tailings storage facility at the Plutonic Gold Operations in Kumarina, Western Australia. A field survey was undertaken from the 1st to 4th April by Sarah Dalgleish (Botanist) and Jeni Morris (Ecologist).

A total of 43 taxa from 26 genera and 17 families were recorded from 10 quadrats established across the survey area. Average native perennial species richness per quadrat was 14.2, ranging from a low of 9 to a high of 18. The majority of taxa recorded were representative of the Fabaceae (11 taxa) and Scrophulariaceae (5 taxa) families. *Acacia* and *Eremophila* were the best represented genera throughout the survey area with 8 and 5 taxa recorded, respectively.

No Threatened flora species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* or the State *Biodiversity Conservation Act 2016* were recorded from within the survey area. One Priority 3 flora species, *Sida picklesiana*, was recorded from 139 point locations within the survey area; totalling 251 individuals. One introduced (weed) flora species, **Bidens bipinnata*, was recorded within the survey area; this species is not listed as a Declared Pest listed under the State *Biosecurity and Agriculture Management Act 2007* or as a Weed of National Significance.

Three intact vegetation communities were delineated and mapped within the survey area, covering a total area of 90.1 hectares (85% of the total area surveyed). Tracks, cleared areas and cleared areas with regrowth covered the remaining 15.9 hectares (15%). No vegetation communities delineated within the current survey area were inferred to represent any known or potential conservation significant communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the State *Biodiversity Conservation Act 2016* or by the Department of Biodiversity, Conservation and Attractions. Vegetation communities recorded include:

- ApEfTt: *Acacia pteraneura*, *Psydrax latifolia* and *Acacia fuscaneura* low woodland on orange clay-loam minor drainage;
- AfGbPo: *Acacia fuscaneura*, *Acacia pteraneura* and *Grevillea berryana* low open woodland on orange clay-loam wash plain; and
- AcElEe: *Acacia* ?*cuthbertsonii* subsp. *cuthbertsonii*, *Acacia pteraneura* and *Psydrax latifolia* tall sparse shrubland on orange clay-loam wash plain.

Vegetation condition within the survey area ranged from Degraded to Good based on the vegetation condition scale adapted from Keighery and Trudgen provided in the Environmental Protection Authority *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Vegetation was observed to mostly be in Good condition (58.2 hectares; 54.9%). Vegetation of Poor and Degraded condition mostly occurred in pockets of mulga woodland associated with minor drainage areas.

Primary disturbances present within the survey area were associated with grazing and trampling of vegetation by cattle and camels. These disturbances were particularly prevalent within vegetation

communities AfGbPo and ApEfTt. Other disturbances observed included numerous mustering/vehicle tracks, cattle and rabbit scats and weeds.

A total of 22 fauna species were recorded within the survey area, comprising 16 birds, four mammals and two reptiles. Introduced fauna species recorded included Cattle (*Bos Taurus*), Australian Feral Camel (*Camelus dromedarius*) and European Rabbit (*Oryctolagus cuniculus*). No Threatened or Priority fauna species listed under the Federal *Environment Protections and Biodiversity Conservation Act 1999*, the State *Biodiversity Conservation Act 2016* or by the Department of Biodiversity, Conservation and Attractions were recorded from within the survey area.

Two fauna habitats were delineated and mapped within the survey area, namely 'open mulga woodland on sheet plain wash' and 'mulga woodland on minor drainage'. Open mulga woodland on sheet plain wash was the most commonly occurring fauna habitat, covering 77.0 hectares (72.7%) of the survey area. The mulga woodland on minor drainage fauna habitat covered 13.1 hectares (12.4%) of the survey area, and was associated with a north-south orientated minor drainage line.

For the purposes of the current flora, vegetation and fauna survey, adequate data has been collected to define and assess the presence, extent and significance of species and communities within the survey area. Based on the values identified, it is unlikely that proposed works would appreciably reduce the representativeness of individual taxa or vegetation associations within the local area or indeed across the broader landscape.

1. Introduction

1.1 Project background

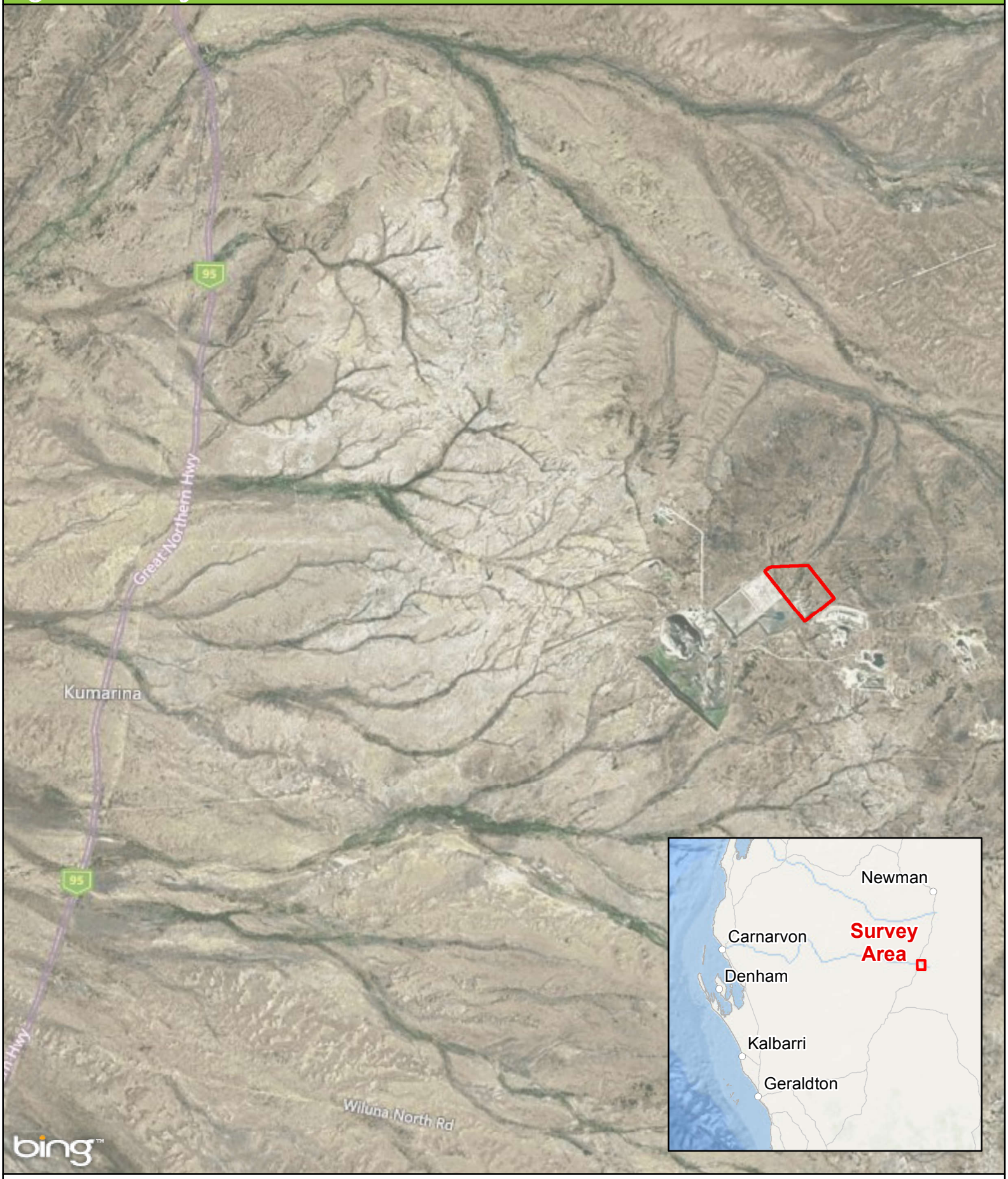
Eco Logical Australia (ELA) was engaged by Billabong Gold Pty Ltd (Billabong Gold) to undertake a Detailed and Targeted flora and vegetation survey and a Level 1 fauna survey to support the development of a new Tailings Storage Facility (TSF4) at Billabong's Plutonic Gold Operations.

The survey area comprises an area approximately 106 hectares (ha) in size and is located adjacent to the existing Plutonic Gold Mine near Kumarina, Western Australia, approximately 180 kilometres (km) north of Meekatharra (**Figure 1**).

The objectives of this project were as follows:

- Undertake a desktop assessment to identify the potential occurrence of any Federal or State conservation listed flora, fauna or communities;
- Undertake a Detailed and Targeted flora and vegetation survey in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a), including:
    - Identification and mapping of vegetation communities, including identification of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs);
    - Completion of a full species inventory (including weeds), and mapping of any Federal or State listed Threatened, Priority or other significant flora;
    - Assessment and mapping of vegetation structure, cover and condition; and
    - Assessment and mapping of Declared Pest species listed under the State *Biosecurity and Agriculture Management Act 2007* (BAM Act) and Weeds of National Significance (WoNS).
- Undertake a Level 1 fauna survey in accordance with the EPA Technical Guidance: *Terrestrial Fauna Surveys* (EPA 2016b), including:
    - Broad level fauna habitat mapping;
    - Targeted fauna searches and mapping of any Federal or State listed Threatened, Priority and other conservation listed fauna species present and their habitat; and
    - Opportunistic observations of any other fauna species.
- Preparation of a standalone summary report detailing the findings of the desktop assessment and field survey; and
- Provision of data including relevant mapping at an appropriate scale and associated data files.

Figure 1: Survey area location



Legend

Survey Area

0 1 2 4

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: SM Date: 12/04/2019

2. Methodology

2.1 Desktop review

2.1.1 Database searches

The following Commonwealth and State databases were searched for information relating to conservation listed flora, fauna and ecological communities in order to compile and summarise existing data to inform the field survey. **Table 1** below presents the database searches undertaken around the central coordinate metres (m) 748993E, m 7198725N. Applied buffers below are considered suitable based on flora and fauna assemblages expected to occur within the survey area.

Table 1: Database searches undertaken for the survey area

Database	Reference	Buffer (km)
Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act.	Department of the Environment and Energy (DotEE) 2019a	20
Department of Biodiversity, Conservation and Attractions (DBCA) and Western Australian Museum (WAM) NatureMap online database.	DBCA 2007-2019	20
DBCA Threatened and Priority flora database searches for Declared Rare Flora (DRF) listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority Flora.	DBCA 2019a	50
DBCA Threatened and Priority fauna database searches for Scheduled fauna listed under the EPBC Act or latest WA Wildlife Conservation (Specially Protected Fauna) Notice and Priority Fauna.	DBCA 2019b	60
DBCA Threatened and Priority Ecological Communities' database search.	DBCA 2019c	40

In addition, the following documents, provided by Billabong, were also reviewed:

- *Plutonic Gold Mine Rare Flora Assessment* – WorleyParsons Services Pty Ltd (2012); and
- *Flora and Vegetation Assessment of the Hermes Project Haul Road* – Mattiske Consulting Pty Ltd (2016).

2.1.2 Likelihood of occurrence assessment

A likelihood of occurrence assessment was undertaken to identify conservation listed flora and fauna species that possibly occur within the survey area, identified from a review of key datasets and literature, as specified above. Conservation codes, categories and criteria for flora and fauna protected under the EPBC Act and the State *Biodiversity Conservation Act 2016* (BC Act) are provided in **Appendix A**. Criteria used for this assessment is presented in **Appendix B**.

2.2 Field survey

2.2.1 Survey team and timing

A Detailed and Targeted flora survey and a Level 1 fauna survey was conducted by Sarah Dalgleish (Botanist) and Jeni Morris (Ecologist) from 1st - 4th April 2019. The survey team's relevant qualifications, experience and licences are provided in **Table 2** below.

Table 2: Survey team

Name	Qualification	Relevant experience	Licences
Sarah Dalgleish	BSc. Environmental Management (Hons.)	Sarah has over eight years' experience conducting Detailed and Targeted flora and Level 1 fauna surveys across Western Australia. Sarah has extensive experience undertaking surveys in the Gascoyne and surrounding bioregions.	Flora collection licence: SL012349 DRF licence: 194-1719
Jeni Morris	BSc. Conservation and Wildlife Biology	Jeni has three years' experience conducting flora and fauna surveys across Western Australia, including Targeted and Detailed flora surveys and Level 1 fauna survey and habitat assessment.	Flora collection licence: SL012347 DRF licence: 196-1718

2.2.2 Flora and vegetation survey

A Detailed and Targeted flora and vegetation survey was conducted in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

The number of quadrats established to describe vegetation communities was informed using aerial imagery as well as being assessed in the field. Dominant vegetation communities were described, with respect to dominant species, structure and overall condition. The survey involved the use of 20 x 20 m quadrats as recommended for the Gascoyne bioregion (EPA 2016a). Photos were taken from the north-western corner of each quadrat. Where relevant, opportunistic sampling of species not recorded within the quadrats was undertaken.

A total of ten quadrats were established across the survey area (**Figure 2**). The following data was recorded within each quadrat:

- Site details (site name, site number, observers, date and location);
- Environmental information including slope, aspect, bare ground, rock outcropping, soil colour and type, litter layer, topographical position and time since last fire event; and
- Biological information including vegetation structure and condition, degree of disturbance, species present and species percentage cover.

A targeted survey was undertaken within the survey area to identify and record and conservation significant flora or communities potentially occurring, including:

- Threatened flora or TECs listed under the EPBC Act;
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice under the BC Act;
- PECs endorsed by the Western Australian Minister for the Environment; or

- Priority (P) flora recognised by DBCA.

The Targeted survey also included searches for any State or Federally listed weeds including WoNS and Declared Pests listed under the BAM Act.

The survey methodology involved personnel walking transects across the survey area, with transects spaced (on average) 20-50 m apart. Locations of survey transects is shown in **Figure 2** below. Flora species able to be identified in the field were recorded, and voucher specimens of unfamiliar species were collected for later identification. All collections were assigned a unique collecting number. For conservation significant identified in the field, the following was recorded:

- A colour photograph;
- GPS location;
- Population size estimate;
- Location of population boundaries;
- Associated habitat/landscape element;
- Time and date observed;
- Observer details; and
- A voucher specimen suitable for use as a reference specimen (if appropriate to do so for conservation significant flora).

Flora specimen identification was undertaken by ELA botanist Sarah Dalgleish, with assistance from Dr Jeff Cargill where required. The Western Australian Herbarium (WAH) was also utilised to confirm additional specimens. Species identification utilised taxonomic literature and keys and where required specimens were confirmed using the WAH reference collection. Suitable material that meets WAH specimen lodgement requirements, such as flowering material and range extensions, will submitted along with Threatened and Priority Report forms to DBCA, as required by conditions of collection licences issued under the BC Act.

Nomenclature used for the flora species within this report follows the WA Plant Census as available on FloraBase (DBCA and WAH 2018).

2.2.3 Fauna survey

The Level 1 fauna survey was conducted in accordance the EPA *Technical Guidance: Terrestrial Fauna Surveys* (EPA 2016b). An assessment of fauna habitat in terms of its ability to support and sustain populations of fauna, along with an assessment of the likelihood of occurrence of conservation significant fauna species, was undertaken during the survey. The habitat characteristics and fauna database records used in assessing likelihood of occurrence for fauna included:

- Vegetation community, structure and condition;
- Soil and landform type;
- Extent and connectivity of bushland;
- Fauna species habitat preferences;
- Proximity of conservation significant fauna records; and
- Signs of species presence.

Opportunistic recordings of fauna species were made at all times during the field survey. These included visual sightings of active fauna such as reptiles and birds; records of bird calls; and signs of species presence such as tracks, diggings, burrows, scats and any other signs of fauna activity.

Nomenclature used for the vertebrate fauna species within this report follows the WAM Checklist of the Vertebrates of Western Australia (WAM 2018). Where common names were not stated for certain species, the following references were consulted:

- Amphibians and reptiles: Bush et al. (2010);
- Reptiles: Wilson and Swan (2013);
- Birds: Morcombe (2007); and
- Mammals: Menkhorst and Knight (2011).

2.3 Data analysis

2.3.1 Flora species accumulation curve

A flora species accumulation curve was undertaken to indicate adequacy of the survey effort (Clarke and Gorley 2006). 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. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered adequate.

2.3.2 Vegetation communities

Plymouth Routines in Multivariate Ecological Research v6 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites based on their species composition (Clarke and Gorley 2006). To down weight the relative contributions of quantitatively dominant species a 4_{th} root transformation was applied to the species percentage cover dataset. Introduced species (weeds), specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component) were excluded from the data set prior to analysis. In addition, annuals were also removed from the dataset prior to 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. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities.

2.4 Limitations

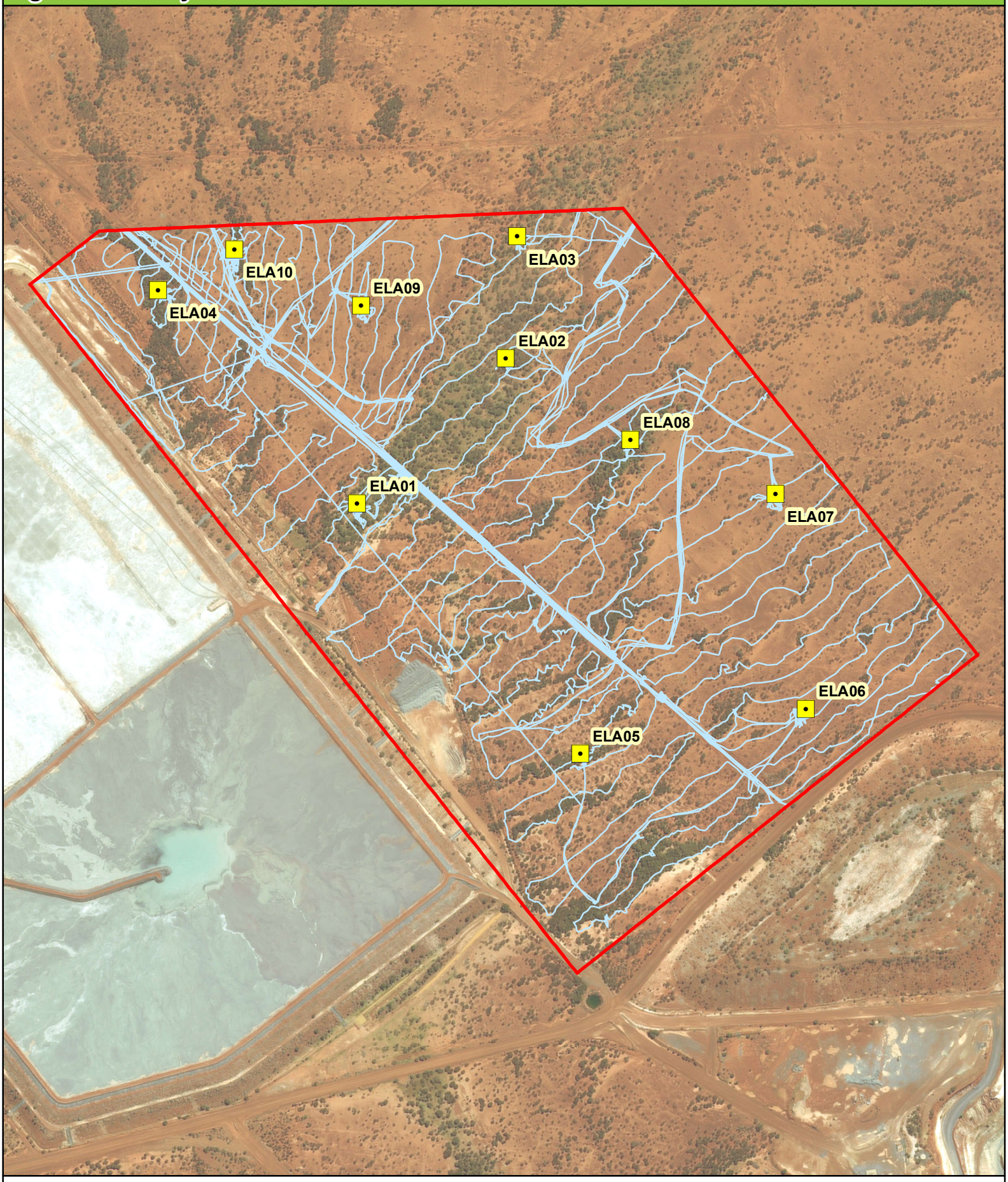
The EPA *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the Detailed and Targeted flora and vegetation and survey and the Level 1 fauna survey for the survey area summarised in **Table 3** below.

Table 3: Survey limitations

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**. Previous reports for the region were provided where applicable. Broad-scale vegetation mapping at a scale of 1:1,000,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. Available information was sufficient to provide context at varying scales and therefore were not considered a limitation.
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint**. The survey requirement of a Detailed and Targeted flora and vegetation survey and a Level 1 fauna survey in accordance with relevant State and Federal legislation and EPA guidance documents was adequately met.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint**. . Adequacy of sampling effort was tested via a species accumulation curve; approximately 79% of the flora potentially present within the survey area were recorded, which is considered to be an acceptable level of sample effort to compile a comprehensive flora inventory and subsequently accurately delineate vegetation communities present within the survey area.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint**. The survey area was fully covered to meet requirements outlined in the scope of works. Quadrat locations were pre-selected using high resolution aerial photography, and confirmed in the field, to ensure all apparent vegetation communities identified were sampled, with multiple replications where possible. Site selection and replication was considered adequate to accurately analyse and discriminate sites based on species composition and subsequently delineate vegetation community boundaries.
Mapping reliability.	**Not a constraint**. Coverage of the survey area was considered to be good. High quality aerial maps were used for both the survey and subsequent vegetation mapping. Due to the nature of vegetation in the survey area, mapping boundaries of individual communities were discrete, and thus are considered accurate.
Timing, weather, season, cycle.	**Potential constraint**. Although the survey was undertaken in the appropriate season as specified by the EPA *Technical Guidance*: *Flora and Vegetation Surveys for Environmental Impact Assessment* (2016), rainfall in the three months prior to the survey was below the long-term average, resulting in the absence of annual flora species. The absence of annual species within the survey did not hinder the ability to accurately delineate individual vegetation communities, as these are based on the dominance and composition of perennial flora.
Disturbances (fire, flood, accidental human intervention, etc.).	**Potential constraint**: Disturbances within the survey area included grazing by cattle, camels and rabbits, damaged vegetation caused by cattle/camel trampling, vehicle and cattle tracks and minimal weeds. Grazing and trampling of flora species by cattle and camels is considered a potential constraint as it has the potential to prevent flora species being detected or identified.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint**. The survey effort was adequately met. The area was searched for conservation significant species by field staff undertaking transects across the survey area spaced adequately apart. This method provides an accurate assessment of habitat characteristics and likelihood of conservation significant species. The number of quadrats established was sufficient to determine the vegetation communities present and to identify any vegetation of conservation significance.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint**. The number of personnel conducting this field survey in the given time was adequate to undertake the required level of survey. Additional resources, including equipment available, additional support and personnel were adequate.
Access problems (i.e. ability to access survey area).	**Not a constraint**. All relevant areas within the survey area were able to be accessed and surveyed.

Potential Survey Limitation	Impact on Survey
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint**. The personnel conducting this field survey were both suitably qualified to identify specimens, having previously undertaken flora and fauna surveys in the Gascoyne bioregion of Western Australia.

Figure 2: Survey effort



Legend

- Survey Area
- Quadrat
- Transect

0 75 150 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: SM Date: 12/04/2019

3. Results

3.1 Desktop review

3.1.1 Climate

The survey area is located in the Gascoyne bioregion (Augustus subregion [GAS02]) as defined by the Interim Biogeographic Regionalisation for Australia (IBRA; DotEE 2019a). This subregion is described as having an arid climate with predominantly winter rainfall in the west, and summer rainfall in the east (Bastin and the ACRIS Management Committee 2008). The survey area receives, on average, a total of 238.4 millimetres (mm) of rainfall per year, with most rainfall occurring during the months of January, February and March (35.6 mm, 49.7 mm and 35.7 mm respectively; Bureau of Meteorology [BoM] 2019; **Table 4**).

In the 12 months preceding the field survey, the area received a total of 136.2 mm which is below the long-term average of 238.1 mm (BoM 2019). A total of 15.0 mm of rainfall was recorded in the three months prior to the field survey in April 2019, which is substantially lower than the long-term average for the same period (120.6 mm; BoM 2019).

Table 4: Rainfall data recorded at the Neds Creek weather station (7103) 12 months prior to the field survey compared to the long-term average (BoM 2019)

Month	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
Total monthly rainfall 2018-2019 (mm)	0.0	0.0	31.2	2.4	4.0	0.2	36.4	32.4	14.6	2.2	5.4	7.4	136.2
Average monthly rainfall 1947-current	20.5	17.8	22.2	11.9	7.2	2.4	6.4	11.8	17.3	35.6	49.7	35.3	238.1

3.1.2 Geology, landform and soils

Geology within the Gascoyne bioregion is characterised by middle Proterozoic rocks, mainly sandstone, and some granite (Beard 1990). Topography is mountainous, with low ranges divided by broad, flat valleys (Beard 1990). Soils are chiefly shallow earthly loams overlying red-brown hardpan on the plains, with shallow stony soils on the ranges (Beard 1990).

The survey area contains one land system as described by Hennig *et al.* (1994), namely the 'Horseshoe Land System', characterised by gently undulating stony plains and low rounded hills based on Proterozoic metamorphic rocks, with somewhat saline drainage foci and alluvial tracts (Hennig *et al.* 1994). The total extent of this land system is 4976.31 ha, of which the survey area covers 102.08 ha (2.05%). The Horseshoe Land System is further divided into seven distinct land units. Landform and soil characteristics of these land units are described in **Table 5** below.

Table 5: Land units of the Horseshoe Land System (Hennig *et al.* 1994)

Unit no.	Unit	Description	Soils
1	Stony plains with lower rises (30%)	Gently undulating plains, low rounded rises and low hills to 25 m relief covered with a variable ironstone, quartz or shale mantle.	Shallow dark red or reddish-brown earthy sands or hardpan sandy clay loams.
2	Gravelly plains (10%)	Gently sloping gravelly surfaced plains occurring as remnants of old surfaces covering high parts of unit 1.	Gravelly loamy sands to sandy loams.
3	Hardpan plains (20%)	Very gently sloping plains on red-brown hardpan.	Shallow hardpan loams locally with sparse quartzy mantles, overlying hardpan.
4	Saline plains (25%)	Almost flat, saline, low lying plains (slopes < O.S%) with variable mantles of mixed composition.	Hard-setting duplex types, reddish brown or dark red clay loams or sandy clay loams over light clay or light medium clay to 60 cm deep; pH 7.0-8.S with an alkaline trend.
5	Groves (3%)	Irregularly shaped densely vegetated groves, situated in lower areas of unit 3 and 7, extending to 0.5 km long and < 200 m wide.	Red earths to > 100 cm; pH 6.0-7.0 with a neutral or acidic reaction trend.
6	Drainage foci (<2%)	Restricted shallow non-saline depressions or weakly saline claypans generally < 200 m in diameter and occurring within units 3 and 4.	Red clays similar to unit 4 but with a higher clay content.
7	Drainage tracts (10%)	Gently sloping drainage tracts to 200 m wide, becoming broader downslope (up to 400 m) with transverse grove formations and infrequent channels.	Deep red earths, loams or clays similar to unit 4.

3.1.3 Interim Biogeographic Regionalisation for Australia

IBRA divides Western Australia into 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation (DotEE 2019b). The survey area is located in the Gascoyne bioregion, which is described as having low, rugged ranges and broad, flat valleys, with vegetation dominated by open mulga low woodlands (Bastin and the ACRIS Management Committee 2008).

The Gascoyne bioregion is further divided into three subregions: Ashburton (GAS01), Carnegie (GAS02) and Augustus (GAS03). The survey area occurs within the Augustus (GAS03) subregion, which is characterised by 'rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys' and 'Mulga woodland with *Triodia* on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland' (Desmond, Kendrick and Chant 2001).

3.1.4 Rangeland land systems mapping

Rangeland Land Systems mapping prepared by the Department of Primary Industries and Regional Development (DPIRD; formerly Department of Agriculture and Food Western Australia [DAFWA]; DPIRD 2019), provides and inventory and condition survey of lands in the Pilbara region (Hennig *et al*., 1994) at a 1: 250 000 scale. These surveys describe the biophysical characteristics of each region and

subsequently divide each region into land systems; land systems being defined as repeating patterns of topography, soils and vegetation.

The survey area contains one land system as described by Hennig *et al.* (1994), namely the 'Horseshoe Land System' (**Table 6**; **Figure 3**). The Horseshoe Land System is further divided into seven distinct land units. Vegetation characteristics of these land units are described as follows:

- Stony plains with lower rises: Very scattered or scattered mixed shrublands dominated by *Acacia aneura*.
- Gravelly plains: Scattered tall shrublands dominated by *Acacia aneura* and *A. linophylla*.
- Hardpan plains: Very scattered mixed shrublands dominated by *Eremophila fraseri* or *Solanum lasiophyllum*.
- Saline plains: Scattered saline low shrublands dominated by *Halosarcia* spp. or scattered to moderately close mixed shrublands on partly saline areas dominated by *Acacia cuspidifolia*.
- Groves: Closed woodlands dominated by *Acacia aneura*.
- Drainage foci: Moderately close mixed or low shrublands dominated by *Acacia tetragonophylla*; or claypans bare of vegetation.
- Drainage tracts: Variable mixed shrublands.

Table 6: Rangeland Land Systems of the survey area (DPRID 2019)

Land system	Description	Current extent (ha)	Proportion of current extent within the survey area (%)
Horseshoe Land System	Gently undulating stony plains and low rounded hills with partially saline drainage foci and alluvial tracts supporting acacia and eremophila tall shrublands, and chenopod low shrublands .	181,441.57	0.06

3.1.5 Beard's (1975) vegetation mapping

Vegetation type and extent have been mapped at a regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, the Department of Primary Industries and Regional Development (DPIRD; previously DAFWA) has compiled a list of vegetation extent and types across WA (Shepherd et al. 2002).

One vegetation association occurs within the survey area, namely 'Gascoyne Ranges 29 - Sparse low woodland; mulga, discontinuous in scattered groups' (Government of Western Australia 2017; **Figure 4).** This vegetation association has more than 99% of its total pre-European extent remaining within the Augustus subregion (**Table 7**; Government of Western Australia 2017).

Table 7: Beard (1975) vegetation associations of the survey area

Vegetation association	Description	Pre-European extent (ha) within the Augustus subregion	Current extent (ha) within the Augustus subregion	Proportion of pre-European extent remaining (%)	Proportion of current extent within the survey area (%)
Gascoyne Ranges 29	Sparse low woodland; mulga, discontinuous in scattered groups	2,188,768.66	2,185,968.53	99.87	0.005

3.1.6 Previous surveys undertaken in the vicinity of the survey area

Two previously survey reports provided by Billabong Gold were reviewed, with results summarised as follows:

WorleyParsons Resources and Energy was commissioned in 2012 to assess rare flora populations known to occur at the Plutonic Gold mine. Populations of two Priority flora species, *Eremophila lantana* (P3) and *Eremophila micrantha* (Previously P1; not currently listed) were investigated and numbers updated to reflect current populations. This survey recorded no additional species of conservation significance.

Mattiske Consulting was commissioned in 2015 to undertake a Level 1 flora and vegetation assessment of the Hermes Project Haul Road survey area, which extends over 50 kilometres to the northeast from M52/685 to the Plutonic Gold Mine along Miscellaneous Licence tenements. This assessment recorded 113 vascular plant taxa, representative of 60 plant genera and 23 families, which was calculated to represent 78.18% of the potential flora present. No Threatened flora species listed under the EPBC Act or BC Act (Formerly the State *Wildlife Conservation Act 1950*) were recorded from this assessment. One significant species, *Euphorbia ?sarcostemmoides*, listed as Priority 3 by DBCA was potentially recorded from one location, however was not able to be confirmed due to lack of flowering and fruiting material.

Mattiske (2015) recorded one introduced plant taxon, **Bidens bipinnata*, from 6 sites across the Hermes Project Haul Road survey area. Ten vegetation communities were defined within the survey area, consisting of seven *Acacia* scrub communities, one *Eremophila* and *Senna* low shrubland community, one *Melaleuca glomerata* thicket community and one *Acacia cyperophylla* var. *cyperophylla* and *Corymbia candida* subsp. *dipsodes* woodland community. No conservation significant vegetation communities were inferred as occurring within the Hermes Project Haul Road survey area.

3.1.7 Areas of conservation significance

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under section 51B of the State *Environmental Protection Act 1986* (EP Act). ESAs include areas declared as World Heritage, included on the Register of the National Estate[1], defined wetlands, and vegetation containing rare (Threatened) flora and TECs.

[1] Note the Register of National Estate was closed in 2007 and is no longer a statutory list. The Register of National Estate has been replaced by the National Heritage List under the EPBC Act.

PECs are biological flora or fauna communities that are recognised to be of significance, but do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under legislation.

A DBCA Threatened and Priority Communities database search (DBCA 2018c) identified seven conservation significant ecological communities recorded within a 40 km radius of the survey area (**Table 8**). There are no known occurrences of ESAs, TECs or PECs within the survey area.

Table 8: Conservation significant ecological communities within a 40 km radius of the survey area (DBCA 2019a)

Community ID	Community description	Conservation code		Closest occurrence to the survey area (km)
		EPBC Act	Endorsed by the WA Minister / listed by DBCA	
Doolgunna Calcrete	Doolgunna calcrete groundwater assemblage type on Gascoyne palaeodrainage on Doolgunna Station	-	P1	34.9
Perched spring-fed swamps	Perched spring-fed peat-based swamps on hillslopes of the Durack Range area	-	P1	30.9
Blech LS	Blech Land System	-	P3	16.7
Jingle LS	Jingle Land System	-	P3	33.9
Robinson Range BIF	Robinson Range vegetation complexes (banded ironstone formation)	-	P1	38.1
Three Rivers Calcrete	Three Rivers calcrete groundwater assemblage types on Gascoyne palaeodrainage on Three Rivers Station	-	P1	35.6
Three Rivers Plutonic Calcrete	Three Rivers Plutonic calcrete groundwater assemblage types on Gascoyne palaeodrainage on Three Rivers Station	-	P1	25.7

3.1.8 Flora and fauna species of conservation significance

An initial 17 conservation listed flora species and 14 conservation listed fauna species were identified as possibly occurring within the survey area, based on the database searches undertaken in Section 2.1.1 and using criteria outlined in **Appendix B**.

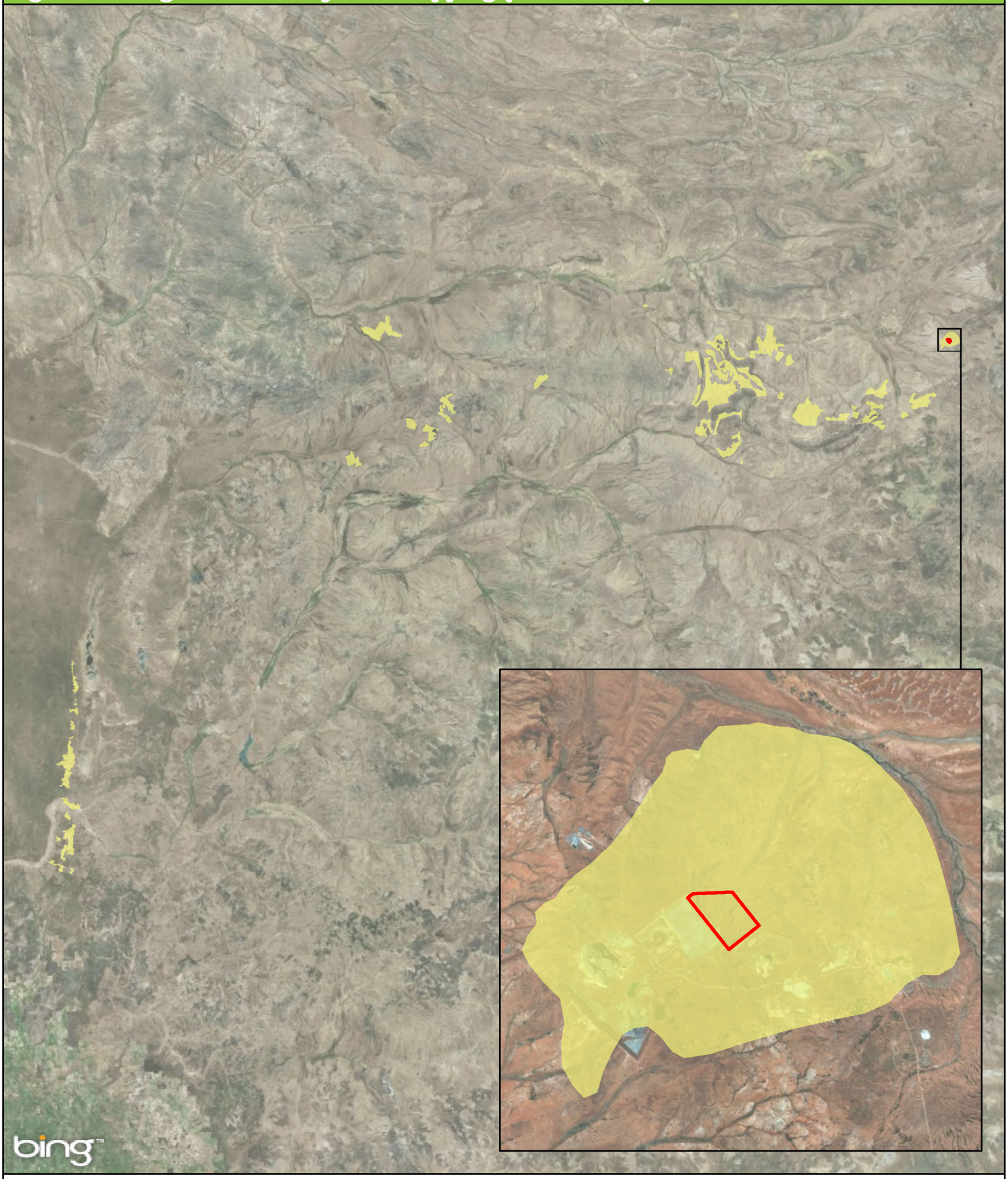
Conservation significant flora species identified from database searches undertaken include six Priority 1 species, ten Priority 3 species and one Priority 4 species. The closest occurrences of conservation listed flora species are *Eremophila demissa* (P1), located 8.8 km to the south/southwest of the survey area, and *Maireana prosthecochaeta* (P3), located approximately 11.4 km to the south/southeast of the survey area (DBCA 2019a).

Conservation significant fauna species identified from database searches undertaken include two species listed as Vulnerable under the EPBC Act (*Leipoa ocellata* [Malleefowl] and *Polytelis alexandrae* [Princess Parrot]), eight species listed as Migratory under the EPBC Act/BC Act, one species listed as Vulnerable under the BC Act, one species listed as 'other specially protected fauna' under the BC Act and three species listed as P4 by DBCA. The closest occurrence of a conservation listed fauna species is

a *Dasycercus blythi* (Brush-tailed Mulgara; P4) record located approximately 16.9 km to the northeast of the survey area (DBCA 2019c).

Marine species were not considered in the likelihood of occurrence assessment as the survey area does not contain core habitat that these species solely rely on for survival. Likelihood of occurrence assessment tables are presented in **Appendix C** and **Appendix D**.

Figure 3: Rangeland Land System mapping (DPIRD 2019)



Legend

Survey Area

Rangeland Land System

Horseshoe Land System

0 20 40 80

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Figure 4: Beard's (1975) vegetation associations

Legend

Survey Area

Figure 3: Beard's (1975) Vegetation Associations

- Carnegie Salient - 18
- Gascoyne Ranges - 18
- Gascoyne Ranges - 29
- Gascoyne Ranges - 39

0 1.5 3 6

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

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3.2 Flora and vegetation survey

3.2.1 Flora overview

A total of 43 taxa from 26 genera and 17 families were recorded within the survey area . A complete flora species matrix is provided in **Appendix E**. Average native perennial species richness per quadrat was 14.2, ranging from a low of 9 (ELA09) to a high of 18 (ELA01). No annual flora species were recorded during the field survey. The majority of taxa recorded were representative of the Fabaceae (11 taxa) and Scrophulariaceae (5 taxa) families. *Acacia* and *Eremophila* were the best represented genera throughout the survey area with 8 and 5 taxa recorded, respectively. Quadrat site data is presented in **Appendix F**.

3.2.2 Accumulated Species – Sites Surveyed (Species-Area Curve)

A species accumulation curve (**Figure 5**) was used to evaluate the adequacy of sampling (Clarke and Gorley 2006). Only species data recorded from defined quadrats were used; no opportunistic flora collections were included. The asymptotic value was determined using Michaelis Menten modelling. Using this analysis, the incidence-based coverage estimator of species richness was calculated to be 55.63. Based on this value, and the total of 44 species recorded within quadrats, approximately 79.4% of the flora species potentially present within the survey area were recorded, which is considered to be an acceptable level of sample effort.

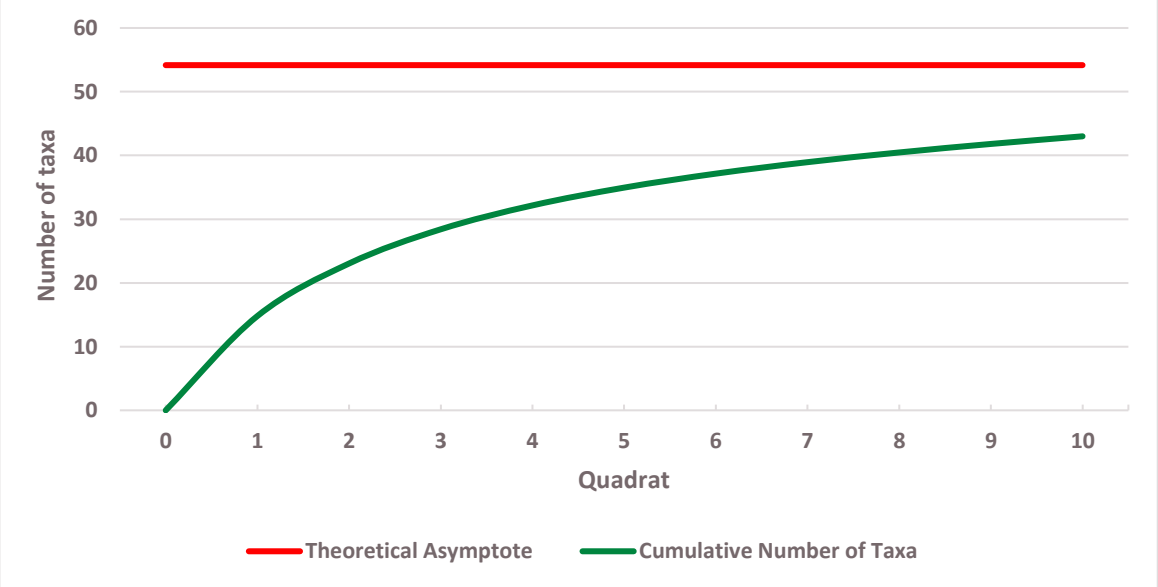


Figure 5: Averaged randomised species accumulation curve

3.2.3 Conservation significant flora

No Threatened flora species listed under the EPBC Act or BC Act were recorded from within the survey area. One Priority 3 flora species, *Sida picklesiana*, (M. Hislop; ACC/7990/E; WA Herbarium) was recorded from 139 point locations within the survey area; totalling 251 individuals. This species was recorded most commonly within the AfGbPo community (138 individuals from 63 locations) and the AcElEe vegetation community (109 individuals from 75 locations), with only four individuals recorded from one location within the ApEfTt community. Locations of *Sida picklesiana* (P3) are shown in **Figure 6** and provided in **Appendix G**.

Of the 17 conservation listed flora species identified from the desktop assessment as possibly occurring within the survey area, one species was found to occur within the survey area (*Sida picklesiana*; P3). The remaining 16 species were considered unlikely to occur within the survey area. This assessment was based on availability of suitable habitat, proximity of previous records and adequacy of survey effort. The flora likelihood of occurrence assessment is presented in **Appendix C**.

Figure 6: *Sida picklesiana* (Priority 3) recorded within the survey area

3.2.4 Introduced flora

One introduced (weed) flora species was recorded as occurring within the survey area, namely **Bidens bipinnata*. This species is not listed as a Declared Pest listed under the State BAM Act or a WoNS. This weed was recorded at a low density (0.1-1% cover) throughout the ApEfTt and AfGbPo vegetation communities and was recorded in all quadrats with the exception of ELA04.

3.2.5 Vegetation communities

Similarity Profile Analysis (SIMPROF) separated the ten quadrats into three statistically dissimilar groupings (Global R = 4.9; Significance level of sample statistic, p = 0.001; **Appendix G**). Based on this result, three in-tact vegetation communities were delineated and mapped within the survey area:

- ApEfTt: *Acacia pteraneura*, *Psydrax latifolia* and *Acacia fuscaneura* low woodland on orange clay-loam minor drainage;
- AfGbPo: *Acacia fuscaneura*, *Acacia pteraneura* and *Grevillea berryana* low open woodland on orange clay-loam wash plain; and

- AcElEe: *Acacia* ?*cuthbertsonii* subsp. *cuthbertsonii*, *Acacia pteraneura* and *Psydrax latifolia* tall sparse shrubland on orange clay-loam wash plain.

Vegetation communities are described in full in **Table 9** and presented in **Figure 8**.

The most widespread vegetation community was AcElEe, which occurred across 56% (59.4 ha) of the survey area. No vegetation communities delineated within the current survey area were inferred to represent any or potential conservation significant communities listed under the EPBC Act, the BC Act or by DBCA. Areas comprising tracks, cleared areas and cleared areas with regrowth covered 15.9 ha (15%) of the survey area (**Figure 8**).

Table 9: Vegetation communities recorded within the survey area

Image	Vegetation description	Quadrats	Extent within the survey area (ha)	Portion of the survey area (%)
	**ApEfTt**: *Acacia pteraneura*, *Psydrax latifolia* and *Acacia fuscaneura* low woodland over *Acacia tetragonophylla*, *Eremophila forrestii* subsp. *forrestii* and *Eremophila galeata* mid sparse shrubland over *Solanum lasiophyllum* and *Sida* sp. low isolated shrubs and *Themeda triandra* low sparse tussock grassland on orange clay-loam minor drainage.	ELA01, ELA02, ELA03	13.1	12.4
	**AfGbPo**: *Acacia fuscaneura*, *Acacia pteraneura* and *Grevillea berryana* low open woodland over *Eremophila forrestii* subsp. *forrestii*, *Eremophila latrobei* subsp. *latrobei* and *Eremophila clarkei* mid isolated shrubs over *Ptilotus obovatus*, *Solanum lasiophyllum* and *Sclerolaena* ?*eriacantha* low isolated shrubs on orange clay-loam wash plain.	ELA04, ELA05, ELA08, ELA10	17.6	16.6

Image	Vegetation description	Quadrats	Extent within the survey area (ha)	Portion of the survey area (%)
	**AcElEe**: *Acacia* ?*cuthbertsonii* subsp. *cuthbertsonii*, *Acacia pteraneura* and *Psydrax latifolia* tall sparse shrubland over *Eremophila latrobei* subsp. *latrobei*, *Eremophila* clarkei and *Senna* ?*artemisioides* subsp. x *sturtii* mid isolated shrubs over *Sida picklesiana* (P3) and *Ptilotus schwartzii* low isolated shrubs and *Eragrostis eriopoda* low isolated tussock grasses on orange clay-loam wash plain.	ELA06, ELA07, ELA09	59.4	59.4
Tracks, cleared areas and cleared areas with regrowth			15.9	15.0
Total			106.0	100

3.2.6 Vegetation condition

Vegetation condition within the survey area ranged from Degraded to Good condition (**Table 10**). Ratings were based on the vegetation condition scale adapted from Keighery (1994) and Trudgen (1988) provided in the EPA *Technical Guidance*: *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

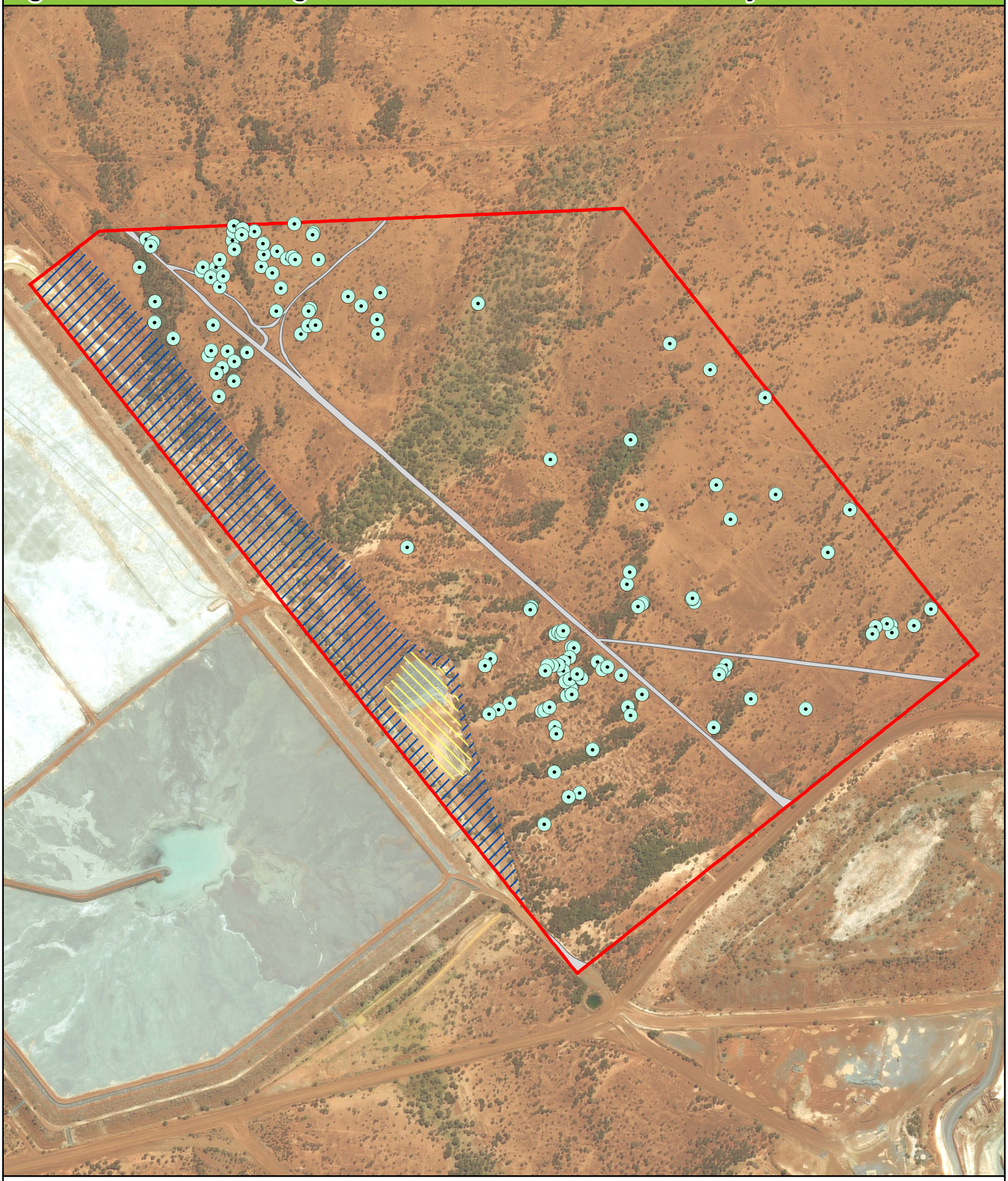
Vegetation was observed to mostly be in Good condition (58.2 ha; 54.9%). Areas of Poor and Degraded condition occurred in pockets of mulga woodland and the north-south orientated minor drainage line.

Primary disturbances present within the survey area were associated with grazing and trampling of vegetation by cattle and camels. These disturbances were particularly prevalent within vegetation communities AfGbPo and ApEfTt. Other disturbances observed included numerous mustering/vehicle tracks across the survey area, cattle and rabbit scats and minimal weeds. Previously cleared areas, including those with rehabilitation/regrowth, and tracks covered 15.9 ha (15%) of the survey area.

Table 10: Vegetation condition recorded within the survey area

Condition	Area (ha)	Proportion of the survey area (%)
Good	58.2	54.9
Poor	29.6	27.9
Degraded	2.2	2.2
Regrowth, cleared areas and tracks	15.9	15.0
Total	106.0	100

Figure 7: Conservation significant flora recorded within the survey area



Legend

- Survey Area
- Tracks
- Cleared / Regrowth
- Cleared

Conservation Significant Flora

- *Sida picklesiana* (DBCA listed Priority 3)

0 75 150 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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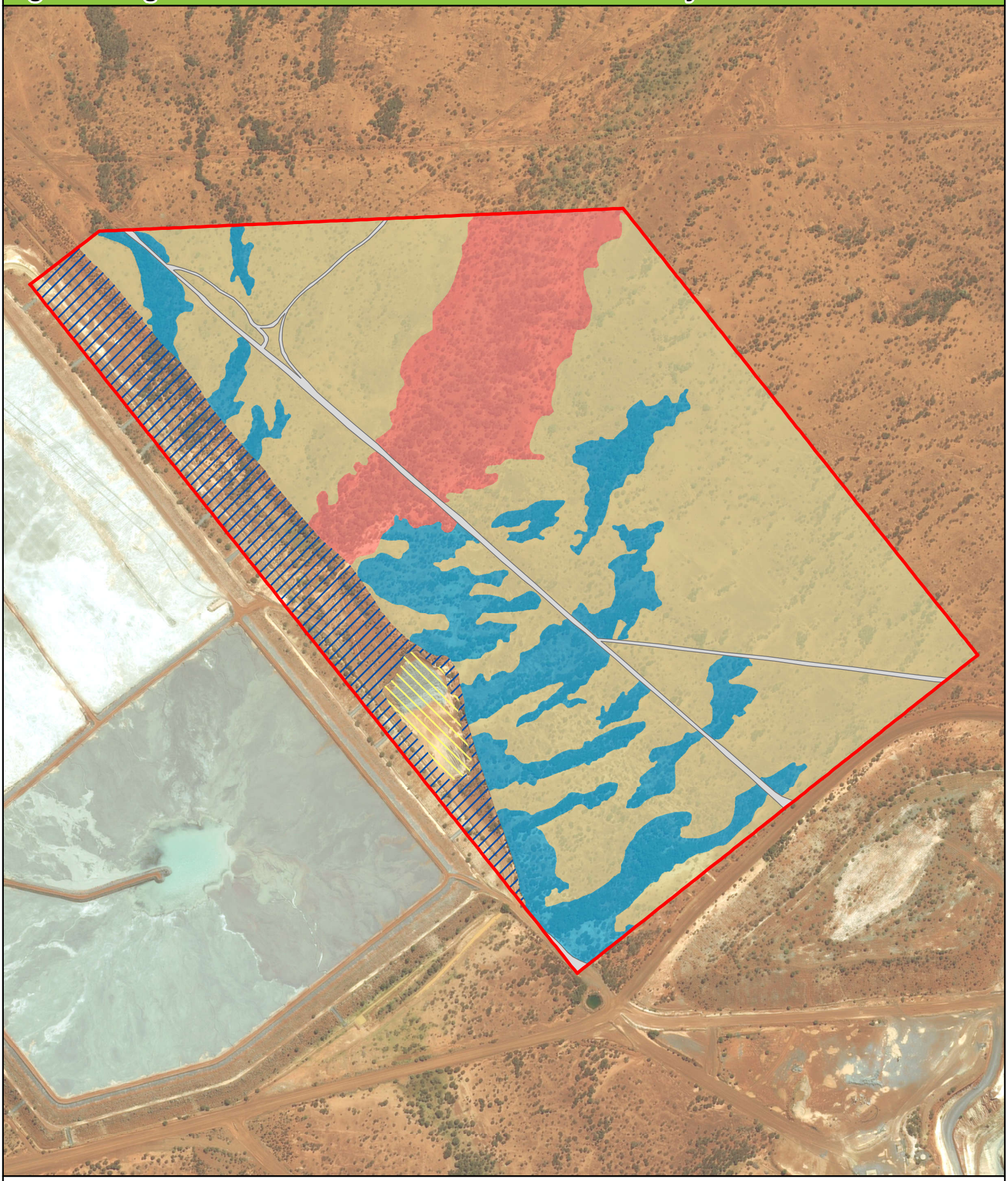
Figure 8: Vegetation communities recorded within the survey area



Legend

- Survey Area
- Tracks
- Cleared / Regrowth
- Cleared

Vegetation Communities

- AcElEe: *Acacia ?cuthbertsonii* subsp. *cuthbertsonii, Acacia pteraneura* and *Psydrax latifolia* tall sparse shrubland
- AfGbPo: *Acacia fuscaneura, Acacia pteraneura* and *Grevillea berryana* low open woodland
- ApEfTt: *Acacia pteraneura, Psydrax latifolia* and *Acacia fuscaneura* low woodland

0 75 150 300
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Figure 9: Vegetation condition recorded within the survey area

Legend

- Survey Area
- Tracks
- Cleared / Regrowth
- Cleared

Vegetation Condition

- Good
- Poor
- Degraded

0 75 150 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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3.3 Fauna survey

3.3.1 Fauna habitat

Two fauna habitats were recorded and mapped within the survey area:

- Open mulga woodland on sheet plain wash (77 ha; 72.7% of the survey area); and
- Mulga woodland on minor drainage (13.1 ha; 12.4% of the survey area).

3.3.2 Fauna overview

A total of 22 fauna species (19 native and three introduced) were recorded within the survey area. This number comprised 16 bird species, four mammal species and two reptile species. Bird species were predominantly observed within the mulga woodland on minor drainage fauna habitat, where a definitive canopy was present and vegetation cover was thickest. Evidence of mammal species (scats, tracks) was observed across the survey area, with no specific habitat preferences observed.

Introduced fauna species observed from scats and tracks within the survey area included Cattle (*Bos taurus*), Australian Feral Camel (*Camelus dromedarius*) and European Rabbit (*Oryctolagus cuniculus*). A fauna species list is provided in **Appendix I**.

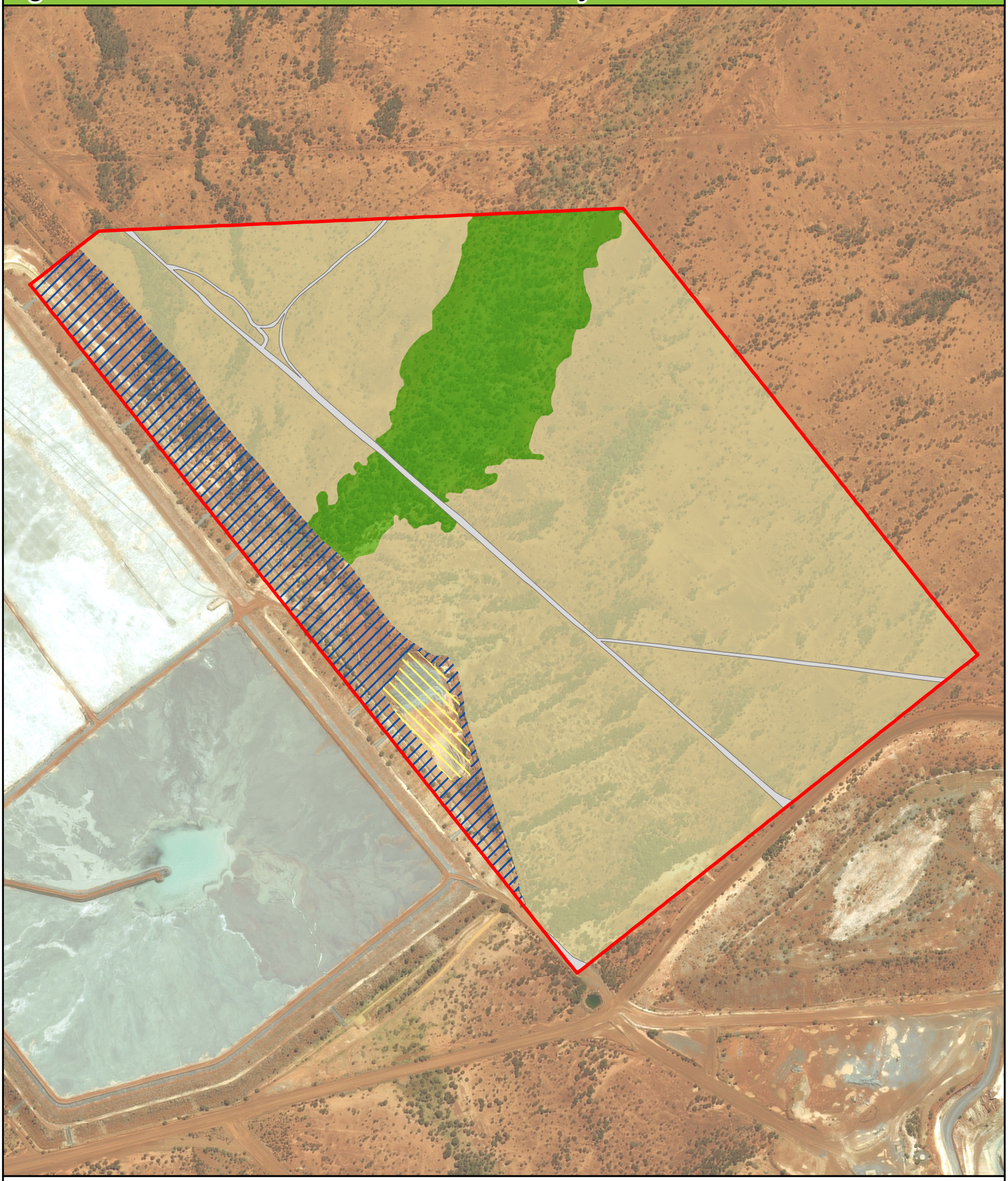
3.3.3 Conservation significant fauna

No direct (observations) or indirect (scats, tracks, diggings) evidence of conservation significant fauna species were recorded within the survey area. Of the 14 conservation listed fauna species identified in the desktop assessment as possibly occurring within the survey area, all were found to be unlikely to occur based on species habitat requirements and adequate survey effort undertaken within the survey area.

More specifically, eight of the 14 species identified as possibly occurring are migratory bird species requiring coastal or wetland habitats. Species including the Princess Parrot (*Polytelis alexandrae*), Malleefowl (*Leipoa ocellata*), Brush-tailed Mulgara (*Dasycercus blythi*) and Crest-tailed Mulgara (*Dasycercus cristicauda*) are more commonly known from sand dune/sand flat habitats, which do not occur within the survey area. The Peregrine Falcon (*Falco peregrinus*) and the Grey Falcon (*Falco hypoleucos*) are known to have a wider and more varied range of habitat, however are still considered as unlikely to occur within the study area due to lack of access to appropriate nesting habitat, water and preferred prey species.

The fauna likelihood of occurrence assessment is presented in **Appendix D**.

Figure 10: Fauna habitat recorded within the survey area



Legend

- Survey Area
- Tracks
- Cleared / Regrowth
- Cleared

Fauna Habitat

- Mulga woodland on minor drainage
- Open mulga woodland on sheet wash plain

0 75 150 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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4. Discussion/summary

4.1 Flora and vegetation

A total of 43 taxa from 26 genera and 17 families were recorded from 10 quadrats established across the survey area. Average native perennial species richness per quadrat was 14.2, ranging from a low of 9 to a high of 18. These figures are comparable to Mattiske (2016) which recorded an average species richness of 11.57 (ranging from 5 to 22 species per quadrat); along Miscellaneous Licence tenements approximately 50 kilometres to the northeast of the Plutonic Gold Mine. A species accumulation curve determined that approximately 79.4% of the flora species potentially present within the survey area were recorded, resulting in sufficient data to define and assess the presence, extent and significance of vegetation communities within the survey area.

No Threatened flora species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* or the State *Biodiversity Conservation Act 2016* were recorded from within the survey area. One Priority 3 flora species *Sida picklesiana*, was recorded within the survey area. Priority 3 species are poorly known species that are known from several or few but widespread locations with the species or species habitat not appearing to be under imminent threat (DBCA 2019). This species was recorded from 139 point locations within the survey area; totalling 251 individuals. At a regional scale, this species is found in the Murchison and Gascoyne IBRA regions in an area near the townships of Wiluna, Meekatharra and Leinster (Figure 4). Most records come from locations near Wiluna, Mt Keith and Doolgunna Station (Markey *et al.* 2011). *Sida picklesiana* is known from 41 records, extending over a range of approximately 250 km (DBCA 2007-2019), indicating that this species is not locally restricted. In addition, *S. picklesiana* (P3) was recorded, to varying extents, across all three intact vegetation types. These communities extend well outside the bounds of the survey area, being components of a broader contiguous suite of mulga woodland/shrubland vegetation.

Three vegetation communities were recorded from within the survey area, broadly comprising a mixture of *Acacia*, *Psydrax* and *Grevillea* low woodland and shrubland on plains and minor drainage. Majority of the survey area comprised the AcElEe vegetation community on wash plain, with pockets of the AfGbPo community scattered across the western half of the survey area. Vegetation community ApEfTt correlated to a minor drainage line running north to southeast within the survey area. No vegetation communities delineated within the current survey area were inferred to represent any known or potential conservation significant communities listed under the EPBC Act, the BC Act or by DBCA.

Vegetation communities delineated and mapped within the survey area were not considered to be locally restricted. Mattiske (2016) recorded similar species assemblages , soils and landforms (*Acacia*, *Grevillea* and *Psydrax* on flats and drainage/washouts) within their study area, approximately 50 km to the north-east. More broadly, one Pre-European vegetation association occurs within the survey area, Gascoyne Ranges 29, described as “sparse low woodland; mulga, discontinuous in scattered groups” (Beard 1975). All three vegetation communities mapped within the survey area broadly correlate to this vegetation association, with mulga present in each community occurring in scattered groups, and AfGbPo and ApEfTt occurring as low woodland. This vegetation association has more than 99% of its total pre-European extent remaining within the Gascoyne bioregion (Government of Western Australia 2018). Similarly, the survey area contains one Rangeland Land System as described by Hennig *et al.*

(1994), namely the 'Horseshoe Land System. Several characteristics of the seven land units comprising this Land System are represented within the survey area, including:

- Stony plains with lower rises: Very scattered or scattered mixed shrublands dominated by *Acacia aneura*;
- Hardpan plains: Very scattered mixed shrublands dominated by *Eremophila fraseri* or *Solanum lasiophyllum*; and
- Drainage foci: Moderately close mixed or low shrublands dominated by *Acacia tetragonophylla*; or claypans bare of vegetation.

The percentage impact to Pre -European vegetation associations (Gascoyne Ranges 29) and Rangeland Land Systems (Horseshoe) as a result of the proposal is low(Beard's (1975; Hennig *et al.* 1994; DPIRD 2019). Each of the above systems is well represented across the broader landscape, with the survey area representing a small percentage of the current extent of each (0.005% and 0.06%, respectively). Therefore, it is unlikely that proposed works within the survey area would appreciably reduce the representativeness of either vegetation association in the local area or indeed at a regional scale.

Vegetation within the survey area ranged from Good to Degraded condition, with majority of the survey area recorded as being in Good condition. Areas of Poor to Degraded condition comprised patches of mulga woodland on plains and minor drainage, with the most prevalent disturbances observed being that of feral animals (cattle grazing and trampling of vegetation by cattle and camels), combined with dry conditions. Other more minor disturbances included cattle tracks, mustering/vehicle tracks, cattle/rabbit scats and the presence of minimal weeds. Disturbances within the survey area did not provide any major constraints to the survey proper (i.e. ability to delineate vegetation communities), however, intensive grazing may have reduced the total number of species present within the survey area, particularly grasses and annual species.

One introduced (weed) flora species was recorded within the survey area, namely **Bidens bipinnata*. **B. bipinnata* is not listed as a Declared Pest listed under the BAM Act or as a WoNS. This species was recorded at a low density (<1%) within the AfGbPo and ApEfTt vegetation communities from quadrats ELA01, ELA02, ELA03, ELA05, ELA08 and ELA10. It is likely that this weed is being spread within the survey area via the movement of cattle and other introduced fauna species.

Based on the results of the flora and vegetation survey and the values identified, it is unlikely that proposed works would appreciably reduce the representativeness of individual taxa or vegetation associations within the local area or indeed across the broader landscape.

4.2 Fauna

The survey area broadly comprised a mixture of *Acacia*, *Psydrax* and *Grevillea* low woodland and shrubland on plains and minor drainage. Two fauna habitats were described and mapped within the survey area, these being 'open mulga woodland on sheet plain wash' and 'mulga woodland on minor drainage'.

No direct (observations) or indirect (scats, tracks, diggings) evidence of conservation significant fauna species were recorded within the survey area. Of the 14 conservation listed fauna species identified in the desktop assessment as possibly occurring within the survey area, all were found to be unlikely to

occur based on species habitat requirements and adequate survey effort undertaken within the survey area. More specifically, eight of the 14 species identified as possibly occurring are migratory bird species which requiring coastal or wetland habitats. Species including the Princess Parrot (*Polytelis alexandrae*), Malleefowl (*Leipoa ocellata*), Brush-tailed Mulgara (*Dasycercus blythi*) and Crest-tailed Mulgara (*Dasycercus cristicauda*) are more commonly known from sand dune/sand flat habitats, which do not occur within the survey area. The Peregrine Falcon (*Falco peregrinus*) and the Grey Falcon (*Falco hypoleucos*) are known to have a wider and more varied range of habitat, however are still considered as unlikely to occur within the study area due to lack of access to appropriate nesting habitat, water and preferred prey species.

Habitat within the survey area was found to be unlikely to support any conservation significant fauna species. Based on results of the fauna survey and fauna values identified within the survey area, it is unlikely that proposed works would appreciably reduce or impact the representativeness of individual species or supporting habitat within the local area or across the broader landscape.

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Appendix A Framework for conservation significant flora and fauna ranking

CATEGORIES OF THREATENED SPECIES UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Species listed as 'conservation dependent' and 'extinct' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa 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.
Critically Endangered (CE)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (M)	Not an IUCN category. Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • the agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA); • the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or • the agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).

CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

The Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Specially protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

Threatened species (T)
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

Category	Code	Description
Critically Endangered species	CR	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
Endangered species	EN	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.

Category	Code	Description
Vulnerable species	VU	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild, as follows:

Category	Code	Description
Extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
Extinct in the wild species	EW	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

Categories are detailed below.

Category	Code	Description
Migratory species	MI	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Species of special conservation interest (conservation dependent fauna)	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Other specially protected species	OS	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Priority species (P)

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Category	Code	Definition
Priority 1	P1	*Poorly-known species* Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	P2	*Poorly-known species* Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	P3	*Poorly-known species* Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	P4	*Rare, Near Threatened and other species in need of monitoring* (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within survey area from DBCA database search results and/or from previous surveys of the survey area, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
Likely	The species has not previously been recorded from within the survey area. However, (to qualify requires one or more criteria to be met): • the species has been recorded in close proximity to the survey area, and occurs in similar habitat to that which occurs within the survey area • core habitat and suitable landforms for the species occurs within the survey area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present • there is a medium to high probability that a species uses the survey area
Potential	The species has not previously been recorded from within the survey area. However, (one or more criteria requires to be met): • targeted surveys may locate the species based on records occurring in proximity to the survey area and suitable habitat occurring in the survey area • the survey area has been assessed as having potentially suitable habitat through habitat modelling • the species is known to be cryptic and may not have been detected despite extensive surveys • the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys The species has been recorded in the survey area by a previous consultant survey or there is historic evidence of species occurrence within the survey area. However, (one or more criteria requires to be met) • doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution) • coordinates are doubtful
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the survey area and • it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded • it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the survey area through DBCA database searches. The species has not been recorded in the survey area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.
Does not occur	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the survey area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat. The survey area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within survey area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix C Flora likelihood of occurrence assessment

Species	Conservation status		Habitat	Source[1]	Likelihood of occurrence	Justification
	EPBC Act	BC Act / DBCA listing				
Eremophila arguta	-	P1	Found between Mt Augustus and Neds Creek, growing with *Grevillea, Acacia* and *Eremophila fraseri*. Plants appear to be confined to seasonally damp areas along drainage lines and depressions.	DBCA	Unlikely	Potentially suitable habitat with some of the associated species however this species would have been detectable during the extensive targeted search of the survey area also the closest record is 43 km away.
Eremophila demissa	-	P1	Found north and north-east of Meekatharra, growing on silcrete plains with *Eremophila lachnocalyx* and *E. citrina*.	DBCA, Nature Map	Unlikely	Habitat marginally suitable and the closest record is approx. 10 km away. This species would have been detectable during the extensive targeted search of the survey area if present.
Eucalyptus semota	-	P1	A mallee endemic to the arid Gascoyne Region of Western Australia, where restricted to the Marymia Hill area and disjunct to the south-west near Neds Corner. It is found in clayey gullies descending from laterite mesas.	DBCA, Nature Map	Unlikely	No suitable habitat within the survey area, this species would have also been detectable during the targeted search of the survey area if present. No *Eucalyptus* species were recorded in the survey area also the closest record of this species is 23 km away.
Micromyrtus mucronulata	-	P1	Recorded in the Paynes Find area of the Eremaean Botanical Province, on the summit or lower slopes of a hill, usually with *Allocasuarina* and *Acacia* dominant, sometimes with *Micromyrtus ninghanensis*.	DBCA, Nature Map	Unlikely	No suitable habitat within the survey area. The closest record is 36 km from the survey area. This species would have also been detectable during the targeted search of the survey area if present.
Ptilotus actinocladus	-	P1	Has been collected from Doolgunna Station, Woodlands Station and Belele Station in WA, with only a single collection known from each of the latter two locations, from 1973 and 1965, respectively. The habitat has been described as flat, seasonally inundated plains with sparse vegetation.	DBCA	Unlikely	Potentially suitable habitat within the survey area however the closest record is 43 km from the survey area. Additionally, high grazing pressure from cattle, camels and rabbits in the survey area would also reduce the ability for this species to persist.

Species	Conservation status		Habitat	Source[1]	Likelihood of occurrence	Justification
	EPBC Act	BC Act / DBCA listing				
Rhodanthe sphaerocephala	-	P1	Clayey loam. On flats.	DBCA, Nature Map	Unlikely	Suitable habitat within the survey area however the closest record is 24 km from the survey area. Additionally, high grazing pressure from cattle, camels and rabbits in the survey area would also reduce the ability for this species to persist.
Gunniopsis propinqua	-	P3	Stony sandy loam. Lateritic outcrops, winter-wet sites.	DBCA	Unlikely	Marginally suitable habitat within the survey area and the closest record is 50 km from the survey area. Additionally, high grazing pressure from cattle, camels and rabbits in the survey area would also reduce the ability for this species to persist.
Hemigenia tysonii	-	P3	Red sand, sandy clay, lateritic sand. Flats, sand dunes, hills.	DBCA, Nature Map	Unlikely	Potentially suitable habitat however this species would have been detectable during the extensive targeted search of the survey area also the closest record is 30 km away.
Hemigenia virescens	-	P3	Brown, ironstone gravel, low shrubland.	DBCA, Nature Map	Unlikely	Potentially suitable habitat however this species would have been detectable during the extensive targeted search of the survey area also the closest record is approx. 20 km away.
Homalocalyx echinulatus	-	P3	Laterite. Breakaways, sandstone hills.	DBCA, Nature Map	Unlikely	No suitable habitat within the survey area and the closest record is 30 km from the survey area. This species would have also been detectable during the targeted search of the survey area if present.
Maireana prosthecochaeta	-	P3	North western WA from Cue north to the Gascoyne River. Grows in moist salt places, found on rough hilly country, growing on top of hills.	DBCA, Nature Map	Unlikely	No suitable habitat within the survey area. The closest record is 12 km from the survey area. This species would have also been detectable during the targeted search of the survey area if present.

Species	Conservation status		Habitat	Source[1]	Likelihood of occurrence	Justification
	EPBC Act	BC Act / DBCA listing				
Prostanthera ferricola	-	P3	Infrequent in sparse *Acacia aneura* shrubland on gently inclined mid and upper slopes and crests of banded ironstone and basalt, in shallow red-brown skeletal sandy loam soils, occasionally found in gullies or on quartz.	DBCA	Unlikely	No suitable habitat within the survey area. The closest record is 48 km from the survey area. This species would have also been detectable during the targeted search of the survey area if present.
Ptilotus luteolus	-	P3	Occurring in the southern Gascoyne and Murchison IBRA regions, preferring rocky slopes, screes, and ridges.	DBCA, Nature Map	Unlikely	No suitable habitat within the survey area and the closest record is 35 km from the survey area. This species would have also been detectable during the targeted search of the survey area if present.
Sauropus sp. Woolgorong (M. Officer s.n. 10/8/94)	-	P3	Open medium shrub growing to 0.4 m tall. Red sand. Plains. Red sandy clay loam with granitic pebbles.	DBCA, Nature Map	Unlikely	Habitat marginally suitable and the closest record is approx. 32 km away. This species would have been detectable during the extensive targeted search of the survey area if present.
Sida picklesiana	-	P3	*Sida picklesiana* has been recorded from open *Acacia* (*A. aneura, A. quadrimarginea, A. pruinocarpa, A. balsamea*) woodlands and shrublands on a variety of substrates, often on exposed, rocky habitats on hills of BIF and granite breakaways, on foot slopes of BIF hills, on stony plains (ironstone and quartz) and near creek lines. Soil types include deeper sandy clays on plains and hardpan and shallow or skeletal sandy clay loams overlying rock. Plants have been observed growing in rock crevices when on outcrops.	DBCA, Nature Map	Recorded	Suitable habitat within the survey area, including several associated species and the closest record is 12 km away. This species was recorded within the survey area.
Thryptomene sp. Leinster (B.J. Lepschi & L.A. Craven 4362)	-	P3	Crest, upper slope, ridge. Ironstone >50% outcropping cover over ironstone.	Nature Map	Unlikely	No suitable habitat within the survey area. This species would have also been detectable during the targeted search of the survey area if present.
Goodenia berringbinensis	-	P4	Associated with ephemeral wetlands (granite or clay-based).	DBCA	Unlikely	No suitable habitat within the survey area and the closest record is 50 km from the survey area. Additionally, high grazing pressure from cattle, camels and rabbits in the survey area would also reduce the ability for this species to persist.

[1]DBCA (2018a); NatureMap (DBCA 2007-2018); PMST (DotEE 2018a)

Appendix D Fauna likelihood of occurrence assessment

Species	Common name	Conservation status		Habitat	Source[1]	Likelihood of occurrence	Justification
		EPBC Act	State listing				
Polytelis alexandrae	Princess Parrot	VU	P4	Sand dunes and sand flats in the arid zone of western and central Australia. It occurs in open savanna woodlands and shrublands that usually consist of scattered stands of Eucalyptus, Casuarina or Allocasuarina trees; an understorey of shrubs such as Acacia, Cassia, Eremophila, Grevillea, Hakea and Senna; and a ground cover dominated by Triodia species.	DBCA, PMST, Naturemap	Unlikely	No suitable habitat present
Leipoa ocellata	Malleefowl	VU	VU	The Malleefowl is found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias. A sandy substrate and abundance of leaf litter are required for breeding.	DBCA	Unlikely	No suitable habitat present
Actitis hypoleucos	Common Sandpiper	IA	M	Wide range of coastal wetlands and some inland wetlands. Is mostly found around muddy margins or rocky shores and rarely on mudflats.	DBCA, PMST, Naturemap	Unlikely	No suitable habitat present
Calidris acuminata	Sharp-tailed Sandpiper	IA	M	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	PMST	Unlikely	No suitable habitat present
Calidris melanotos	Pectoral Sandpiper	IA	M	Prefers shallow fresh to saline wetlands, coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland.	PMST	Unlikely	No suitable habitat present
Calidris ruficollis	Red-necked Stint	IA	M	Coastal areas, including sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores.	DBCA, Naturemap	Unlikely	No suitable habitat present
Charadrius veredus	Oriental Plover	IA	M	Coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands.	PMST	Unlikely	No suitable habitat present

Species	Common name	Conservation status		Habitat	Source[1]	Likelihood of occurrence	Justification
		EPBC Act	State listing				
Motacilla cinerea	Grey Wagtail	IA	M	Inhabits fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. It is also found in more lowland watercourses where there are artificial waterfalls, weirs, millraces or lock gates.	PMST	Unlikely	No suitable habitat present
Motacilla flava	Yellow Wagtail	IA	M	Range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra. In the north of its range it is also found in large forest clearings.	PMST	Unlikely	No suitable habitat present
Tringa nebularia	Common Greenshank	IA	M	Inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass.	DBCA	Unlikely	No suitable habitat present
Falco hypoleucos	Grey Falcon	-	VU	The distribution of this species is restricted largely to areas of the highest annual average temperatures where there is an average annual rainfall of less than 500 mm. It favours lightly timbered and untimbered lowland plains that are crossed by tree-lined watercourses, but frequents other habitats including grassland and sand dune habitats.	DBCA, Naturemap	Unlikely	No suitable habitat present
Falco peregrinus	Peregrine Falcon	-	OS	Peregrine falcons prefer open habitats, such as grasslands, tundra, and meadows. They are most common in tundra and coastal areas and rare in sub-tropical and tropical habitats. They nest on cliff faces and crevices. They have recently begun to colonize urban areas because tall buildings are suitable for nesting in this species, and because of the abundance of pigeons as prey items.	DBCA, Naturemap	Unlikely	No suitable habitat present
Dasycercus blythi	Brush-tailed Mulgara, Ampurta	-	P4	This species occupies spinifex (Triodia spp.) grasslands, and burrows in flats between sand dunes.	DBCA, Naturemap	Unlikely	No suitable habitat present
Dasycercus cristicauda	Crest-tailed Mulgara, Minyiminyi	-	P4	The Crest-tailed Mulgara occurs on sand dunes with a sparse cover of Sandhill Canegrass (Zygochloa paradoxa) or areas around salt lakes with Nitre Bush (Nitraria billardieri).	DBCA, Naturemap	Unlikely	No suitable habitat present

[1]DBCA (2018b); NatureMap (DBCA 2007-2018); PMST (DotEE 2018a)

Appendix E Flora species matrix

Family	Known name	ELA01	ELA02	ELA03	ELA04	ELA05	ELA06	ELA07	ELA08	ELA09	ELA10
Amaranthaceae	*Ptilotus obovatus*	X				X		X	X	X	X
Amaranthaceae	*Ptilotus schwartzii*						X	X	X		
Apocynaceae	*Marsdenia australis*	X									
Asteraceae	**Bidens bipinnata*	X	X	X		X			X		X
Asteraceae	*Asteraceae* sp.	X	X	X							
Chenopodiaceae	*Rhagodia eremaea*		X		X						X
Chenopodiaceae	*Sclerolaena ?eriacantha*				X						X
Convolvulaceae	*?Convolvulus clementii*			X							
Convolvulaceae	*Duperreya sericea*	X	X	X	X				X		
Euphorbiaceae	*Euphorbia boophthona*						X				
Euphorbiaceae	*Euphorbia australis*				X						
Fabaceae	*Acacia pruinocarpa*				X				X		X
Fabaceae	*Acacia ramulosa* var. *ramulosa*	X	X		X	X					
Fabaceae	*Acacia tetragonophylla*	X	X	X				X			
Fabaceae	*Acacia ?cuthbertsonii* subsp. *cuthbertsonii*						X	X		X	
Fabaceae	*Acacia ?ramulosa* var. *linophylla*									X	X
Fabaceae	*Acacia ayersiana*				X	X					
Fabaceae	*Acacia fuscaneura*		X	X	X	X			X		X
Fabaceae	*Acacia pteraneura*	X	X	X		X	X	X	X	X	X
Fabaceae	*Fabaceae* sp.	X	X	X							
Fabaceae	*Indigofera ?chamaeclada* subsp. *chamaeclada*				X						
Fabaceae	*Senna ?artemisioides* subsp. *×sturtii*			X	X		X		X		X
Loranthaceae	*Amyema* sp.				X						
Malvaceae	*Hibiscus ?sturtii*				X						
Malvaceae	*Sida* sp.	X	X	X		X					

Family	Known name	ELA01	ELA02	ELA03	ELA04	ELA05	ELA06	ELA07	ELA08	ELA09	ELA10
Malvaceae	*Sida picklesiana* (P3)						X	X	X	X	X
Poaceae	*Eragrostis eriopoda*						X	X			
Poaceae	*Themeda triandra*	X	X	X							
Poaceae	*Tripogonella loliiformis*			X							
Proteaceae	*Grevillea berryana*					X			X	X	X
Proteaceae	*Hakea lorea* subsp. *lorea*		X								
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*		X	X		X		X	X		
Rubiaceae	*Psydrax latifolia*	X	X	X	X	X	X	X	X	X	X
Rubiaceae	*Psydrax suaveolens*			X							
Santalaceae	*Exocarpos aphyllus*	X	X								
Santalaceae	*Santalum spicatum*	X									
Sapindaceae	*Dodonaea ?petiolaris*				X	X					
Scrophulariaceae	*Eremophila latrobei* subsp. *latrobei*				X	X	X	X	X	X	X
Scrophulariaceae	*Eremophila clarkei*				X	X	X	X		X	X
Scrophulariaceae	*Eremophila forrestii* subsp. *forrestii*	X	X	X	X	X			X		X
Scrophulariaceae	*Eremophila galeata*	X	X	X				X			
Scrophulariaceae	*Eremophila gilesii* subsp. *variabilis*	X									
Solanaceae	*Solanum lasiophyllum*	X	X	X	X		X				X

Appendix F Quadrat site data

Site name and number	Date	Site type	Observer
ELA01	01/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Poor	Grazing, cattle and vehicle tracks	Old (>20 years)	Mulga woodland
Habitat description	Landform unit	Aspect	Slope %
Mulga on drainage	Minor drainage	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
n/a	n/a	15	55
Easting		Northing	
748643		7198814	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pteraneura	40	M	Shrub, cycad, grass-tree, tree-fern
Acacia tetragonophylla	3	M	Shrub, cycad, grass-tree, tree-fern
Eremophila forrestii subsp. *forrestii*	3	M	Shrub, cycad, grass-tree, tree-fern
Acacia ramulosa var. *ramulosa*	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila galeata	1	M	Shrub, cycad, grass-tree, tree-fern
Fabaceae sp.	1	M	Shrub, cycad, grass-tree, tree-fern
Psydrax latifolia	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila gilesii subsp. *variabilis*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Exocarpos aphyllus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus obovatus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Santalum spicatum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Sida sp.	0.1	M	Shrub, cycad, grass-tree, tree-fern
Solanum lasiophyllum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Themeda triandra	1	G	Other grass
Asteraceae sp.	0.1	G	Forb
**Bidens bipinnata*	0.1	G	Forb
Duperreya sericea	0.1	G	Vine
Marsdenia australis	0.1	G	Vine

Site name and number	Date	Site type	Observer
ELA02	01/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Poor	Grazing, cattle scats	Old (>20 years)	Mulga woodland
Habitat description	Landform unit	Aspect	Slope %
Mulga on drainage	Minor drainage	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
n/a	n/a	20	60
Easting		Northing	
748891		7199055	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pteraneura	50	M	Shrub, cycad, grass-tree, tree-fern
Acacia fuscaneura	5	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Psydrax latifolia	5	M	Shrub, cycad, grass-tree, tree-fern
Acacia ramulosa var. *ramulosa*	2	M	Shrub, cycad, grass-tree, tree-fern
Acacia tetragonophylla	2	M	Shrub, cycad, grass-tree, tree-fern
Eremophila forrestii subsp. *forrestii*	1	M	Shrub, cycad, grass-tree, tree-fern
Fabaceae sp.	1	M	Shrub, cycad, grass-tree, tree-fern
Hakea lorea subsp. *lorea*	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila galeata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Exocarpos aphyllus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Rhagodia eremaea	0.1	M	Shrub, cycad, grass-tree, tree-fern
Sida sp.	0.1	M	Shrub, cycad, grass-tree, tree-fern
Solanum lasiophyllum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Themeda triandra	0.1	G	Other grass
**Bidens bipinnata*	0.5	G	Forb
Asteraceae sp.	0.1	G	Forb
Cheilanthes sieberi subsp. *sieberi*	0.1	G	Fern
Duperreya sericea	0.1	G	Vine

Site name and number	Date	Site type	Observer
ELA03	01/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Poor	Grazing, cattle tracks and scats	Old (>20 years)	Mulga woodland
Habitat description	Landform unit	Aspect	Slope %
Mulga on drainage	Minor drainage	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
n/a	n/a	2	85
Easting		Northing	
748910		7199257	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pteraneura	20	M	Shrub, cycad, grass-tree, tree-fern
Acacia fuscaneura	4	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eremophila forrestii subsp. *forrestii*	3	M	Shrub, cycad, grass-tree, tree-fern
Acacia tetragonophylla	1	M	Shrub, cycad, grass-tree, tree-fern
Psydrax latifolia	1	M	Shrub, cycad, grass-tree, tree-fern
Sida sp.	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila galeata	0.5	M	Shrub, cycad, grass-tree, tree-fern
Senna ?artemisioides subsp. *×sturtii*	0.5	M	Shrub, cycad, grass-tree, tree-fern
Fabaceae sp.	0.1	M	Shrub, cycad, grass-tree, tree-fern
Psydrax suaveolens	0.1	M	Shrub, cycad, grass-tree, tree-fern
Solanum lasiophyllum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Themeda triandra	1	G	Other grass
Tripogonella loliiformis	0.5	G	Other grass
Asteraceae sp.	0.1	G	Forb
**Bidens bipinnata*	0.1	G	Forb
Cheilanthes sieberi subsp. *sieberi*	0.1	G	Fern
?Convolvulus clementii	0.1	G	Vine
Duperreya sericea	0.1	G	Vine

Site name and number	Date	Site type	Observer
ELA04	02/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Poor	Grazing, cattle activity and trampled vegetation	Old (>20 years)	Mulga woodland
Habitat description	Landform unit	Aspect	Slope %
Mulga on wash plain	Wash plain	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
n/a	n/a	10	25
Easting		Northing	
748313		7199167	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia ayersiana	15	M	Shrub, cycad, grass-tree, tree-fern
Acacia fuscaneura	15	M	Shrub, cycad, grass-tree, tree-fern

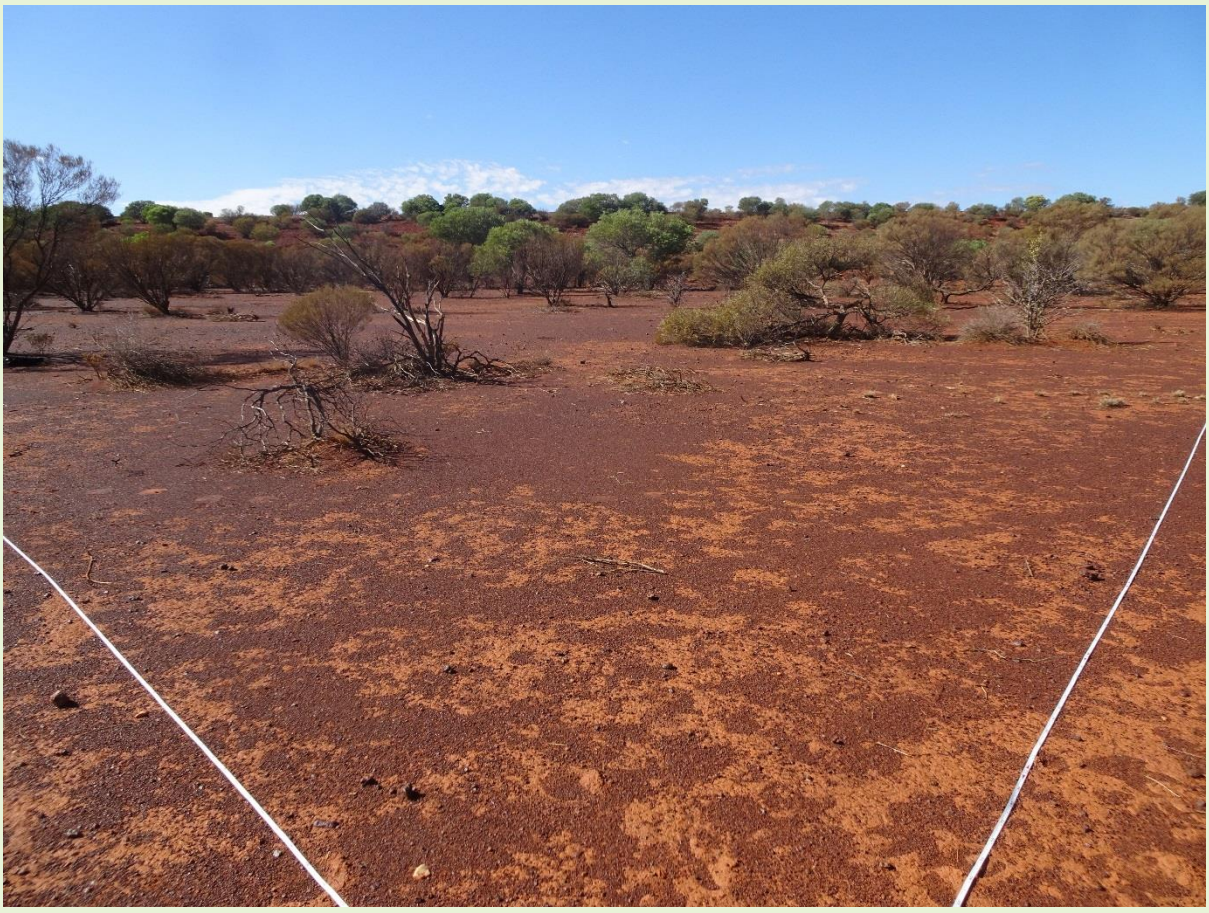
Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pruinocarpa	10	M	Shrub, cycad, grass-tree, tree-fern
Acacia ramulosa var. *ramulosa*	3	M	Shrub, cycad, grass-tree, tree-fern
Dodonaea ?petiolaris	1	M	Shrub, cycad, grass-tree, tree-fern
Psydrax latifolia	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila clarkei	0.75	M	Shrub, cycad, grass-tree, tree-fern
Eremophila forrestii subsp. *forrestii*	0.5	M	Shrub, cycad, grass-tree, tree-fern
Eremophila latrobei subsp. *latrobei*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hibiscus ?sturtii	0.1	M	Shrub, cycad, grass-tree, tree-fern
Indigofera ?chamaeclada subsp. *chamaeclada*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Rhagodia eremaea	0.1	M	Shrub, cycad, grass-tree, tree-fern
Sclerolaena ?eriacantha	0.1	M	Shrub, cycad, grass-tree, tree-fern
Senna ?artemisioides subsp. *×sturtii*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Solanum lasiophyllum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Amyema sp.	0.1	G	Forb
Euphorbia australis	0.1	G	Forb
Duperreya sericea	0.1	G	Vine

Site name and number	Date	Site type	Observer
ELA05	02/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Poor	Grazing, heavy cattle damage, trampled vegetation	Old (>20 years)	Mulga woodland
Habitat description	Landform unit	Aspect	Slope %
Mulga on wash plain	Wash plain	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
n/a	n/a	5	35
	Easting	Northing	
	749014	7198397	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Grevillea berryana	5	M	Shrub, cycad, grass-tree, tree-fern
Psydrax latifolia	5	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia fuscaneura	4	M	Shrub, cycad, grass-tree, tree-fern
Acacia pteraneura	3	M	Shrub, cycad, grass-tree, tree-fern
Acacia ramulosa var. *ramulosa*	2	M	Shrub, cycad, grass-tree, tree-fern
Acacia ayersiana	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila clarkei	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila forrestii subsp. *forrestii*	1	M	Shrub, cycad, grass-tree, tree-fern
Dodonaea ?petiolaris	0.1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila latrobei subsp. *latrobei*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus obovatus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Sida sp.	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Bidens bipinnata*	1	G	Forb
Cheilanthes sieberi subsp. *sieberi*	0.1	G	Fern

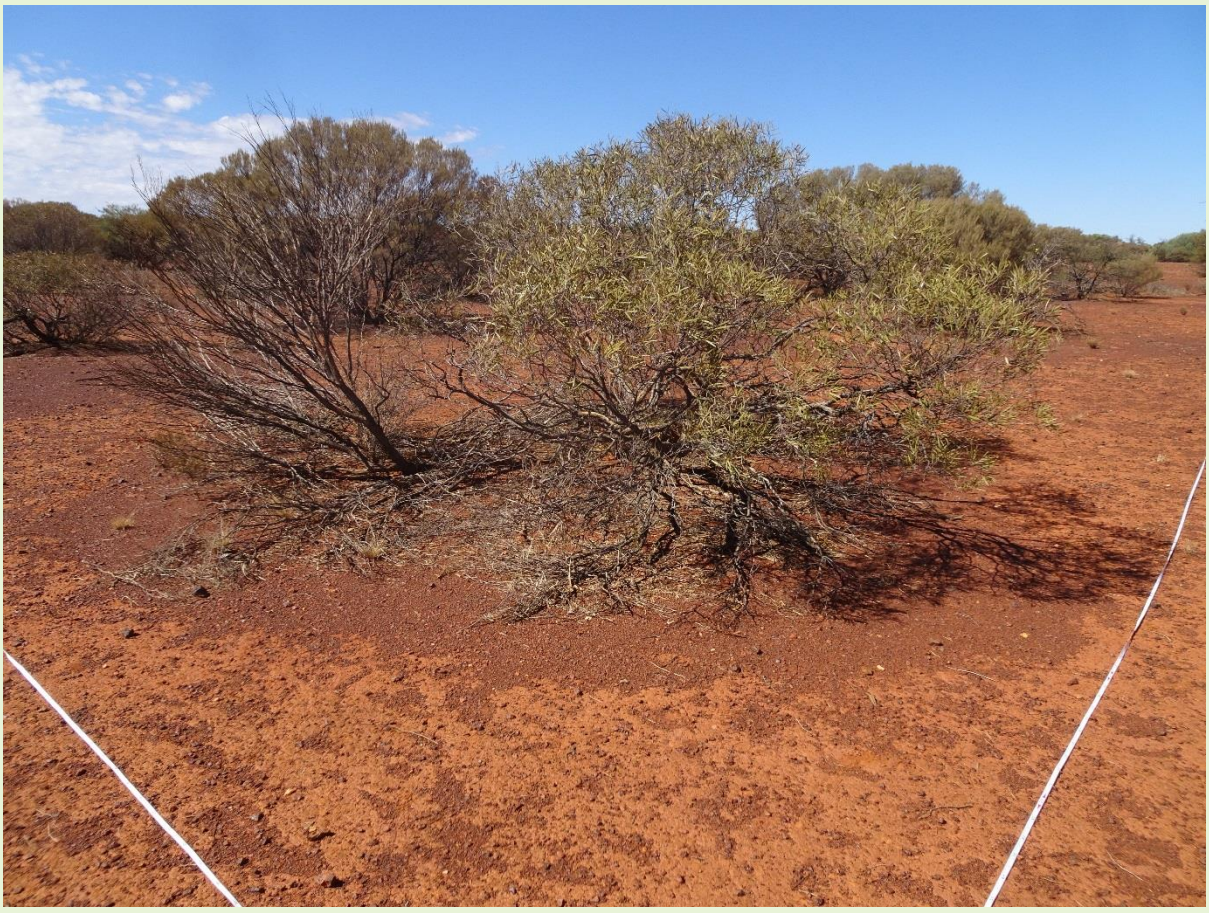
Site name and number	Date	Site type	Observer
ELA06	02/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Good	Tracks and cattle signs	Old (>20 years)	Sparse mulga shrubland
Habitat description	Landform unit	Aspect	Slope %
Sparse mulga shrubland on plain	Wash plain	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Ironstone	Surface gravel	1	90
Easting		Northing	
749389		7198473	



Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia ?cuthbertsonii subsp. *cuthbertsonii*	3	M	Shrub, cycad, grass-tree, tree-fern
Acacia pteraneura	2	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Psydrax latifolia	1	M	Shrub, cycad, grass-tree, tree-fern
Sida picklesiana (P3)	1	M	Shrub, cycad, grass-tree, tree-fern
Eragrostis eriopoda	0.5	M	Shrub, cycad, grass-tree, tree-fern
Eremophila latrobei subsp. *latrobei*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila clarkei	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus schwartzii	0.1	M	Shrub, cycad, grass-tree, tree-fern
Senna ?artemisioides subsp. *×sturtii*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Solanum lasiophyllum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Euphorbia boophthona	0.1	G	Forb

Site name and number	Date	Site type	Observer
ELA07	02/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Good	Tracks, cattle, rabbits and camel signs	Old (>20 years)	Sparse mulga shrubland
Habitat description	Landform unit	Aspect	Slope %
Sparse mulga shrubland on plain	Wash plain	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Ironstone	Surface gravel	1	85
Easting		Northing	
749339		7198829	



Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia ?cuthbertsonii subsp. *cuthbertsonii*	5	M	Shrub, cycad, grass-tree, tree-fern
Acacia pteraneura	5	M	Shrub, cycad, grass-tree, tree-fern

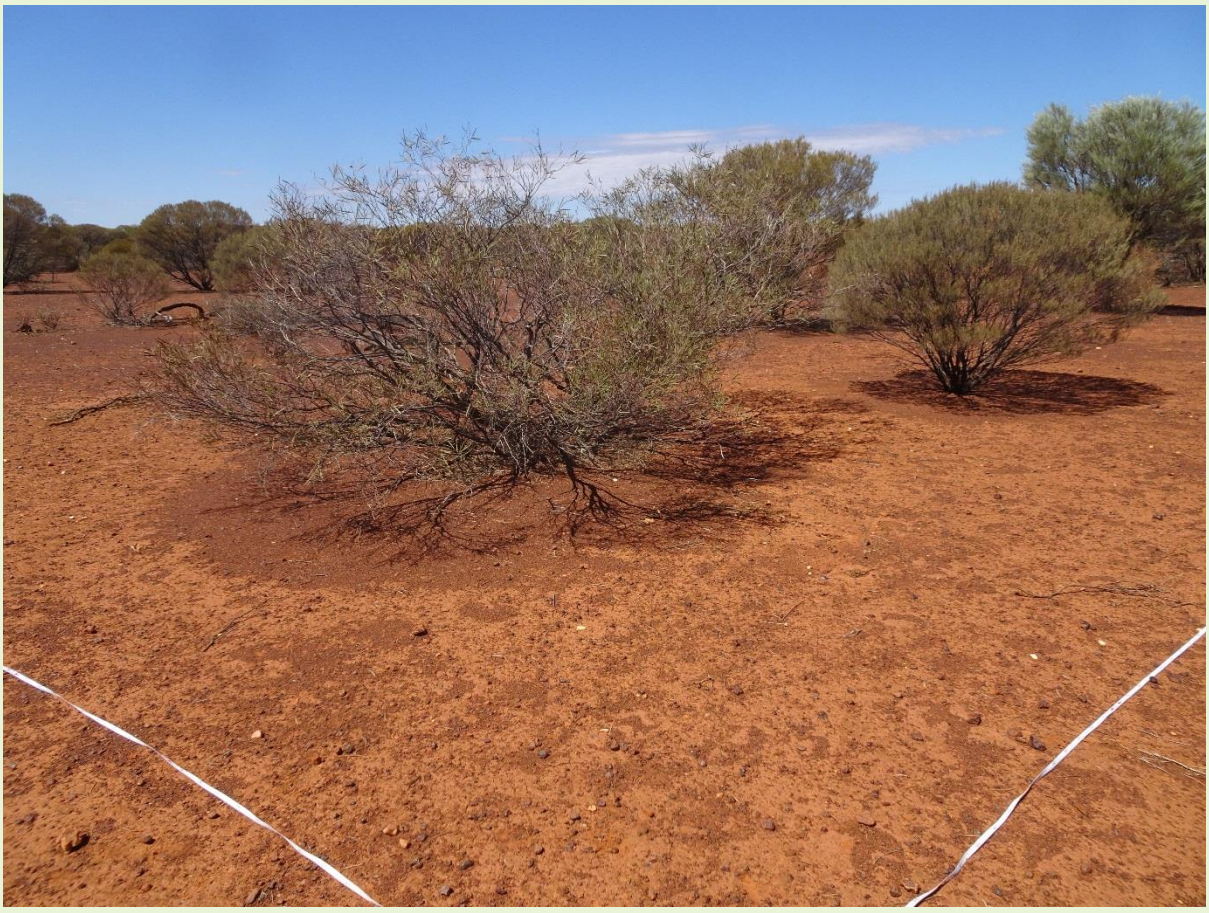
Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia tetragonophylla	1	M	Shrub, cycad, grass-tree, tree-fern
Psydrax latifolia	1	M	Shrub, cycad, grass-tree, tree-fern
Sida picklesiana (P3)	1	M	Shrub, cycad, grass-tree, tree-fern
Eragrostis eriopoda	0.5	M	Shrub, cycad, grass-tree, tree-fern
Eremophila latrobei subsp. *latrobei*	0.25	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus schwartzii	0.25	M	Shrub, cycad, grass-tree, tree-fern
Eremophila clarkei	0.1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila galeata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus obovatus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Cheilanthes sieberi subsp. *sieberi*	0.1	G	Fern

Site name and number	Date	Site type	Observer
ELA08	02/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Poor	Grazing, trampled vegetation	Old (>20 years)	Mulga woodland
Habitat description	Landform unit	Aspect	Slope %
Mulga on wash plain	Wash plain	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
n/a	n/a	10	25
Easting		Northing	
749098		7198919	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pteraneura	30	M	Shrub, cycad, grass-tree, tree-fern
Grevillea berryana	10	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Psydrax latifolia	5	M	Shrub, cycad, grass-tree, tree-fern
Acacia pruinocarpa	3	M	Shrub, cycad, grass-tree, tree-fern
Acacia fuscaneura	2	M	Shrub, cycad, grass-tree, tree-fern
Eremophila forrestii subsp. *forrestii*	2	M	Shrub, cycad, grass-tree, tree-fern
Eremophila latrobei subsp. *latrobei*	1	M	Shrub, cycad, grass-tree, tree-fern
Sida picklesiana (P3)	1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus obovatus	0.5	M	Shrub, cycad, grass-tree, tree-fern
Senna ?artemisioides subsp. *×sturtii*	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Bidens bipinnata*	1	G	Forb
Cheilanthes sieberi subsp. *sieberi*	0.1	G	Fern
Duperreya sericea	0.1	G	Vine

Site name and number	Date	Site type	Observer
ELA09	02/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Good	Tracks and cattle signs	Old (>20 years)	Sparse mulga shrubland
Habitat description	Landform unit	Aspect	Slope %
Sparse mulga shrubland on plain	Wash plain	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Ironstone	Surface gravel	1	80
Easting		Northing	
748650		7199142	



Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pteraneura	15	M	Shrub, cycad, grass-tree, tree-fern
Acacia ?cuthbertsonii subsp. *cuthbertsonii*	5	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Grevillea berryana	2	M	Shrub, cycad, grass-tree, tree-fern
Psydrax latifolia	1	M	Shrub, cycad, grass-tree, tree-fern
Sida picklesiana (P3)	1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila latrobei subsp. *latrobei*	0.25	M	Shrub, cycad, grass-tree, tree-fern
Acacia ?ramulosa var. *linophylla*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila clarkei	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus obovatus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus schwartzii	0.1	M	Shrub, cycad, grass-tree, tree-fern

Site name and number	Date	Site type	Observer
ELA10	02/04/2019	20 x 20 m	SD & JM
Vegetation condition	Disturbance notes	Age since fire	Vegetation type
Good	Grazing	Old (>20 years)	Mulga shrubland
Habitat description	Landform unit	Aspect	Slope %
Mulga shrubland on plain	Wash plain	n/a	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Clay loam	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
n/a	n/a	25	15
Easting		Northing	
748440		7199235	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pteraneura	35	M	Shrub, cycad, grass-tree, tree-fern
Acacia fuscaneura	15	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Sida picklesiana (P3)	2	M	Shrub, cycad, grass-tree, tree-fern
Eremophila forrestii subsp. *forrestii*	0.25	M	Shrub, cycad, grass-tree, tree-fern
Acacia pruinocarpa	0.1	M	Shrub, cycad, grass-tree, tree-fern
Acacia ?ramulosa var. *linophylla*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila latrobei subsp. *latrobei*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Eremophila clarkei	0.1	M	Shrub, cycad, grass-tree, tree-fern
Grevillea berryana	0.1	M	Shrub, cycad, grass-tree, tree-fern
Psydrax latifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ptilotus obovatus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Rhagodia eremaea	0.1	M	Shrub, cycad, grass-tree, tree-fern
Sclerolaena ?eriacantha	0.1	M	Shrub, cycad, grass-tree, tree-fern
Senna ?artemisioides subsp. ×sturtii	0.1	M	Shrub, cycad, grass-tree, tree-fern
Solanum lasiophyllum	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Bidens bipinnata*	0.1	G	Forb

Appendix G Locations of *Sida picklesiana* (P3) within the survey area

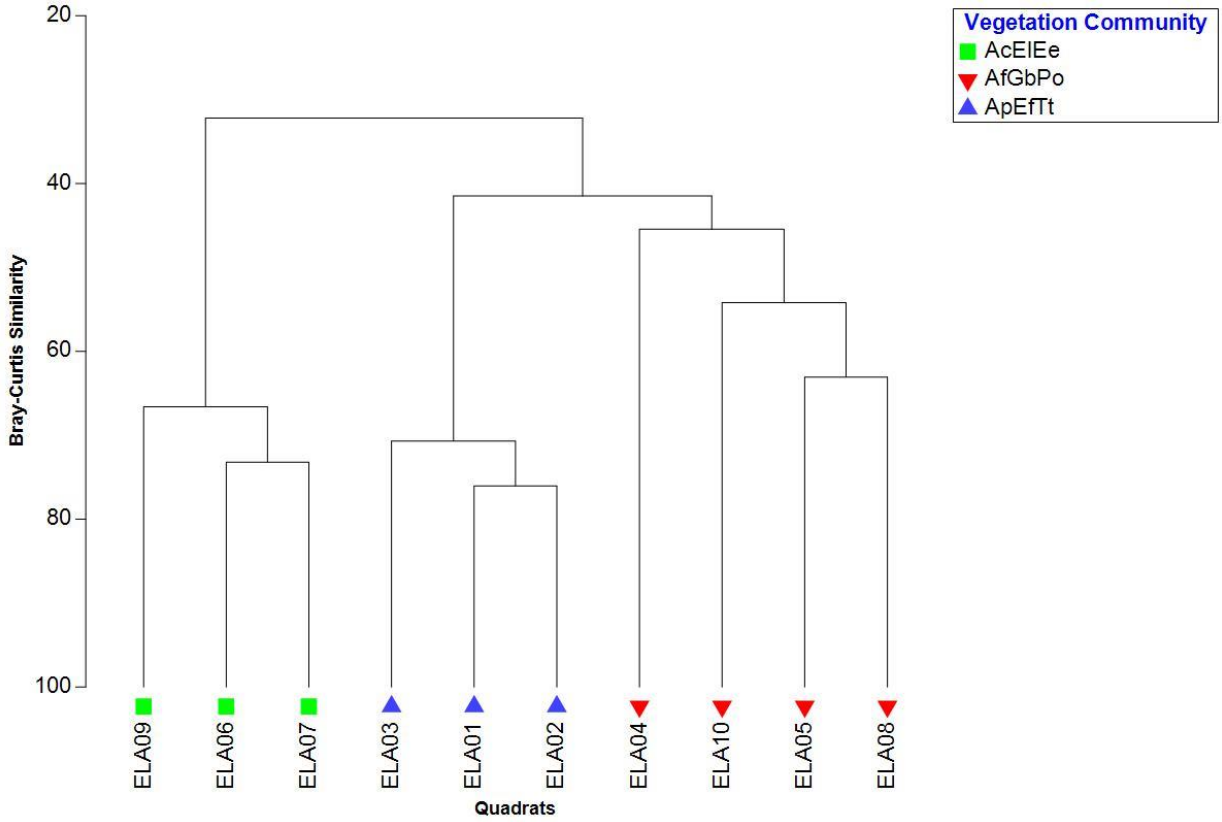
Species	Easting	Northing	Community	Number of plants
Sida picklesiana (P3)	748931	7198637	AcElEe	1
Sida picklesiana (P3)	748865	7198556	AcElEe	1
Sida picklesiana (P3)	748856	7198544	AcElEe	1
Sida picklesiana (P3)	748955	7198470	AcElEe	2
Sida picklesiana (P3)	748992	7198494	AcElEe	1
Sida picklesiana (P3)	749000	7198497	AcElEe	1
Sida picklesiana (P3)	749051	7198538	AcElEe	3
Sida picklesiana (P3)	749059	7198542	AcElEe	1
Sida picklesiana (P3)	749082	7198529	AcElEe	1
Sida picklesiana (P3)	748972	7198442	AcElEe	1
Sida picklesiana (P3)	749264	7198788	AcElEe	1
Sida picklesiana (P3)	749203	7198650	AcElEe	1
Sida picklesiana (P3)	749199	7198655	AcElEe	1
Sida picklesiana (P3)	749201	7198657	AcElEe	1
Sida picklesiana (P3)	749462	7198804	AcElEe	1
Sida picklesiana (P3)	749425	7198732	AcElEe	1
Sida picklesiana (P3)	749530	7198611	AcElEe	2
Sida picklesiana (P3)	749532	7198600	AcElEe	1
Sida picklesiana (P3)	749524	7198614	AcElEe	1
Sida picklesiana (P3)	749505	7198608	AcElEe	1
Sida picklesiana (P3)	749499	7198597	AcElEe	1
Sida picklesiana (P3)	749569	7198611	AcElEe	1
Sida picklesiana (P3)	749597	7198638	AcElEe	1
Sida picklesiana (P3)	748396	7199195	AcElEe	2
Sida picklesiana (P3)	748384	7199199	AcElEe	1
Sida picklesiana (P3)	748387	7199206	AcElEe	1
Sida picklesiana (P3)	748409	7199205	AcElEe	1
Sida picklesiana (P3)	748402	7199192	AcElEe	1
Sida picklesiana (P3)	748400	7199189	AcElEe	1
Sida picklesiana (P3)	748415	7199173	AcElEe	1
Sida picklesiana (P3)	748421	7199192	AcElEe	1
Sida picklesiana (P3)	748473	7199265	AcElEe	1
Sida picklesiana (P3)	748484	7199208	AcElEe	1
Sida picklesiana (P3)	748488	7199227	AcElEe	1
Sida picklesiana (P3)	748487	7199245	AcElEe	2
Sida picklesiana (P3)	748510	7199232	AcElEe	1
Sida picklesiana (P3)	748502	7199196	AcElEe	1
Sida picklesiana (P3)	748517	7199171	AcElEe	1
Sida picklesiana (P3)	748509	7199133	AcElEe	1
Sida picklesiana (P3)	748550	7199095	AcElEe	1
Sida picklesiana (P3)	748527	7199220	AcElEe	1
Sida picklesiana (P3)	748537	7199222	AcElEe	1

Species	Easting	Northing	Community	Number of plants
Sida picklesiana (P3)	748540	7199219	AcElEe	1
Sida picklesiana (P3)	748539	7199278	AcElEe	1
Sida picklesiana (P3)	748571	7199263	AcElEe	1
Sida picklesiana (P3)	748570	7199260	AcElEe	1
Sida picklesiana (P3)	748579	7199218	AcElEe	1
Sida picklesiana (P3)	748565	7199138	AcElEe	1
Sida picklesiana (P3)	748563	7199133	AcElEe	1
Sida picklesiana (P3)	748562	7199109	AcElEe	1
Sida picklesiana (P3)	748574	7199109	AcElEe	1
Sida picklesiana (P3)	748629	7199157	AcElEe	1
Sida picklesiana (P3)	748678	7199095	AcElEe	1
Sida picklesiana (P3)	748676	7199119	AcElEe	1
Sida picklesiana (P3)	748682	7199164	AcElEe	4
Sida picklesiana (P3)	749013	7198333	AcElEe	1
Sida picklesiana (P3)	748954	7198281	AcElEe	5
Sida picklesiana (P3)	748975	7198431	AcElEe	2
Sida picklesiana (P3)	749240	7198844	AcElEe	1
Sida picklesiana (P3)	749321	7198990	AcElEe	8
Sida picklesiana (P3)	749117	7198812	AcElEe	2
Sida picklesiana (P3)	749229	7199036	AcElEe	1
Sida picklesiana (P3)	748964	7198887	AcElEe	1
Sida picklesiana (P3)	749163	7199079	AcElEe	1
Sida picklesiana (P3)	748415	7199218	AcElEe	1
Sida picklesiana (P3)	748428	7199066	AcElEe	1
Sida picklesiana (P3)	748419	7199039	AcElEe	1
Sida picklesiana (P3)	748410	7199029	AcElEe	1
Sida picklesiana (P3)	748396	7199059	AcElEe	1
Sida picklesiana (P3)	748401	7199067	AcElEe	1
Sida picklesiana (P3)	748405	7199110	AcElEe	13
Sida picklesiana (P3)	748727	7198740	AcElEe	1
Sida picklesiana (P3)	749389	7198473	AcElEe	1
Sida picklesiana (P3)	749339	7198829	AcElEe	1
Sida picklesiana (P3)	748650	7199142	AcElEe	1
Sida picklesiana (P3)	748933	7198642	AfGbPo	1
Sida picklesiana (P3)	748931	7198638	AfGbPo	1
Sida picklesiana (P3)	748975	7198595	AfGbPo	1
Sida picklesiana (P3)	748972	7198597	AfGbPo	1
Sida picklesiana (P3)	748978	7198600	AfGbPo	2
Sida picklesiana (P3)	748983	7198598	AfGbPo	1
Sida picklesiana (P3)	748986	7198602	AfGbPo	1
Sida picklesiana (P3)	748999	7198575	AfGbPo	1
Sida picklesiana (P3)	749004	7198574	AfGbPo	1
Sida picklesiana (P3)	748996	7198558	AfGbPo	3
Sida picklesiana (P3)	748987	7198550	AfGbPo	3
Sida picklesiana (P3)	748986	7198536	AfGbPo	1

Species	Easting	Northing	Community	Number of plants
Sida picklesiana (P3)	748978	7198545	AfGbPo	2
Sida picklesiana (P3)	748968	7198544	AfGbPo	2
Sida picklesiana (P3)	748960	7198544	AfGbPo	1
Sida picklesiana (P3)	748956	7198536	AfGbPo	1
Sida picklesiana (P3)	748897	7198482	AfGbPo	1
Sida picklesiana (P3)	748878	7198472	AfGbPo	1
Sida picklesiana (P3)	748863	7198464	AfGbPo	1
Sida picklesiana (P3)	748950	7198469	AfGbPo	3
Sida picklesiana (P3)	748963	7198475	AfGbPo	2
Sida picklesiana (P3)	748999	7198506	AfGbPo	1
Sida picklesiana (P3)	748990	7198518	AfGbPo	2
Sida picklesiana (P3)	748997	7198521	AfGbPo	1
Sida picklesiana (P3)	749016	7198523	AfGbPo	2
Sida picklesiana (P3)	749009	7198530	AfGbPo	1
Sida picklesiana (P3)	749043	7198551	AfGbPo	1
Sida picklesiana (P3)	749118	7198649	AfGbPo	3
Sida picklesiana (P3)	749117	7198647	AfGbPo	1
Sida picklesiana (P3)	749110	7198642	AfGbPo	1
Sida picklesiana (P3)	749253	7198537	AfGbPo	2
Sida picklesiana (P3)	749256	7198545	AfGbPo	1
Sida picklesiana (P3)	749248	7198536	AfGbPo	1
Sida picklesiana (P3)	749244	7198530	AfGbPo	1
Sida picklesiana (P3)	749297	7198489	AfGbPo	1
Sida picklesiana (P3)	749236	7198442	AfGbPo	1
Sida picklesiana (P3)	748293	7199253	AfGbPo	1
Sida picklesiana (P3)	748304	7199247	AfGbPo	1
Sida picklesiana (P3)	748301	7199241	AfGbPo	1
Sida picklesiana (P3)	748995	7198326	AfGbPo	2
Sida picklesiana (P3)	748971	7198367	AfGbPo	1
Sida picklesiana (P3)	749035	7198405	AfGbPo	2
Sida picklesiana (P3)	749093	7198476	AfGbPo	5
Sida picklesiana (P3)	749098	7198462	AfGbPo	4
Sida picklesiana (P3)	749117	7198497	AfGbPo	5
Sida picklesiana (P3)	749091	7198679	AfGbPo	1
Sida picklesiana (P3)	749097	7198700	AfGbPo	4
Sida picklesiana (P3)	748436	7199251	AfGbPo	10
Sida picklesiana (P3)	748437	7199265	AfGbPo	5
Sida picklesiana (P3)	748440	7199276	AfGbPo	7
Sida picklesiana (P3)	748438	7199287	AfGbPo	6
Sida picklesiana (P3)	748453	7199269	AfGbPo	3
Sida picklesiana (P3)	748452	7199260	AfGbPo	2
Sida picklesiana (P3)	748338	7199087	AfGbPo	1
Sida picklesiana (P3)	748307	7199114	AfGbPo	6
Sida picklesiana (P3)	748308	7199149	AfGbPo	1
Sida picklesiana (P3)	748282	7199206	AfGbPo	8

Species	Easting	Northing	Community	Number of plants
Sida picklesiana (P3)	748460	7199065	AfGbPo	3
Sida picklesiana (P3)	748439	7199049	AfGbPo	2
Sida picklesiana (P3)	748414	7198992	AfGbPo	2
Sida picklesiana (P3)	748439	7199016	AfGbPo	2
Sida picklesiana (P3)	749098	7198919	AfGbPo	1
Sida picklesiana (P3)	748440	7199235	AfGbPo	1
Sida picklesiana (P3)	748844	7199146	ApEfTt	4
Total number of plants recorded				**251**

Appendix H Hierarchical clustering dendrogram



Appendix I Fauna species list

Species	Common name	Sign
	Birds	
Artamus personatus	Masked Woodswallow	Heard
Barnardius zonarius	Australian Ringneck	Observed
Chlamydera guttata	Western Bowerbird	Observed
Chrysococcyx basalis	Horsfield's Bronze-cuckoo	Heard
Coracina novaehollandiae	Black-faced Cuckoo Shrike	Heard
Corvus coronoides	Australian Raven	Observed
Cracticus tibicen	Australian Magpie	Observed
Grallina cyanoleuca	Magpie-lark	Observed
Lichenostomus virescens	Singing Honeyeater	Heard
Malurus lamberti	Variegated Fairywren	Heard
Manorina melanocephala	Noisy Miner	Observed
Microeca fascinans	Jacky Winter	Observed
Ocyphaps lophotes	Crested Pigeon	Observed
Pachycephala rufiventris	Rufous Whistler	Heard
Phaps chalcoptera	Common Bronzewing	Observed
Rhipidura leucophrys	Willy Wagtail	Observed
	Mammals	
**Bos taurus*	Cattle	Scats, grazing
**Camelus dromedarius*	Australian Feral Camel	Tracks
Macropus fuliginosus	Western Grey Kangaroo	Scats
**Oryctolagus cuniculus*	European Rabbit	Scats
	Reptiles	
Ctenophorus sp.	Dragon	Observed
Varanus gouldii	Sand Goanna	Observed

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