

Flora and Fauna Survey of Lots 701-704 Boodarie
Strategic Industrial Area, Port Headland

Hastings Technology Metals Ltd

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Template 2.8.1

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Abbreviations

Abbreviation	Description
BAM Act	State <i>Biosecurity and Agriculture Management Act 2007</i>
BC Act	State <i>Biodiversity Conservation Act 2016</i>
BoM	Bureau of Meteorology
CLUSTER	Hierarchical Clustering
DAFWA	Department of Agriculture and Food Western Australia
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DPIRD	Department of Primary Industries and Regional Development
DRF	Declared Rare Flora
ELA	Eco Logical Australia
EP Act	State <i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESAs	Environmentally Sensitive Area
ha	hectare
Hastings	Hastings Technology Metals Limited
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometre
m	metre
mm	millimetre
P	Priority
PECs	Priority Ecological Community
PMST	Protected Matters Search Tool
PRIMER	Plymouth Routines in Multivariate Ecological Research v6
SIA	Strategic Industrial Area
SIMPER	Similarity Percentages
SIMPROF	Similarity Profile
TECs	Threatened Ecological Community
WA	Western Australia
WAH	Western Australian Herbarium

Abbreviation	Description
WAM	Western Australian Museum
WAOL	Western Australian Organism List
WoNS	Weeds of National Significance

Executive Summary

Hastings Technology Metals Limited plan to mine and process rare earth elements as part of the Yangibana Rare Earths Project, located approximately 270 kilometres east-northeast of Carnarvon in the Shire of Upper Gascoyne, Western Australia. Hastings are evaluating options to locate the processing plant within the Boodarie Strategic Industrial Area near Port Hedland, Western Australia. The Boodarie Strategic Industrial Area is an industrial development site approximately 12 kilometres south of Port Hedland that is being developed for mineral processing and heavy industry within the Pilbara region. The Project Area defined by Hastings is Lot 701 (126) Boodarie Station Access Road, Boodarie within the Boodarie SIA with an area of approximately 53.2 hectares. Eco Logical Australia was commissioned to undertake a Detailed and Targeted flora and vegetation survey and a Basic fauna survey of the Project Area in order to provide updated biological information to support environmental approvals.

A desktop review was undertaken to inform the field survey and to identify the likelihood of occurrence of conservation significant flora, fauna and ecological communities, listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the State *Biodiversity Conservation Act 2016* and by the Department of Biodiversity, Conservation and Attractions, within the Project Area. The field survey was conducted by Senior Botanist Jeff Cargill and Ecologist Jeni Morris on the 9th and the 10th July 2020 and was conducted in accordance with the Environmental Protection Authority *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016) and *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (2020).

A total of 49 taxa (47 native and two introduced) from 41 genera and 23 families were recorded from the Project Area. The majority of taxa recorded were representative of the Fabaceae (five taxa) and Poaceae (seven taxa) families. No Threatened (Declared Rare) or Priority flora species 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 were recorded within the Project Area. Two introduced (weed) species were recorded from opportunistic collections during the field survey, namely **Aerva javanica* and **Calotropis procera*. Of these, **Calotropis procera* is listed as a Declared Pest s22(2) under the State *Biosecurity and Agriculture Management Act 2007* and was recorded from one location during the field survey (661290m E; 7741131m S).

One broad vegetation community was identified within the Project Area, described as **AcAsTe**: *Acacia coleii*, *Hakea lorea*, *Acacia sericophylla* tall sparse shrubland over *Acacia stellaticeps*, *Pluchea ferdinandimuelleri*, *Corchorus walcottii* mid sparse shrubland over *Triodia epactia*, *Triodia schinzii* low open hummock grassland and *Sorghum timorense* low open tussock grassland. This community was mapped across majority of the Project Area (48.6 hectares; 91.4% of the Project Area). This vegetation community is not 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 within the Project Area (48.6 hectares; 91.4% of the Project Area) is classed as Excellent condition based on the vegetation condition scale adapted by Trudgen (1988), as provided in the EPA

Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (2016). A total of 4.6 hectares (8.6% of the Project Area) was classed as tracks and cleared areas. Disturbances present within the Project Area were associated with grazing of vegetation, clearing and minor weeds.

One fauna habitat was described and mapped within the Project Area, namely Fauna habitat 1: Isolated to sparse shrubland of *Acacia* spp. and *Grevillea* spp. over stony clay plain. This fauna habitat is not considered as being locally restricted within the region.

A total of 11 fauna species were recorded during the field survey, comprising eight birds, two mammals and one reptile. No Threatened or Priority fauna species 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 were recorded within the Project Area during the survey. One introduced mammal species, **Felis catus* (Feral Cat) was recorded as occurring within the Project Area from tracks.

1. Introduction

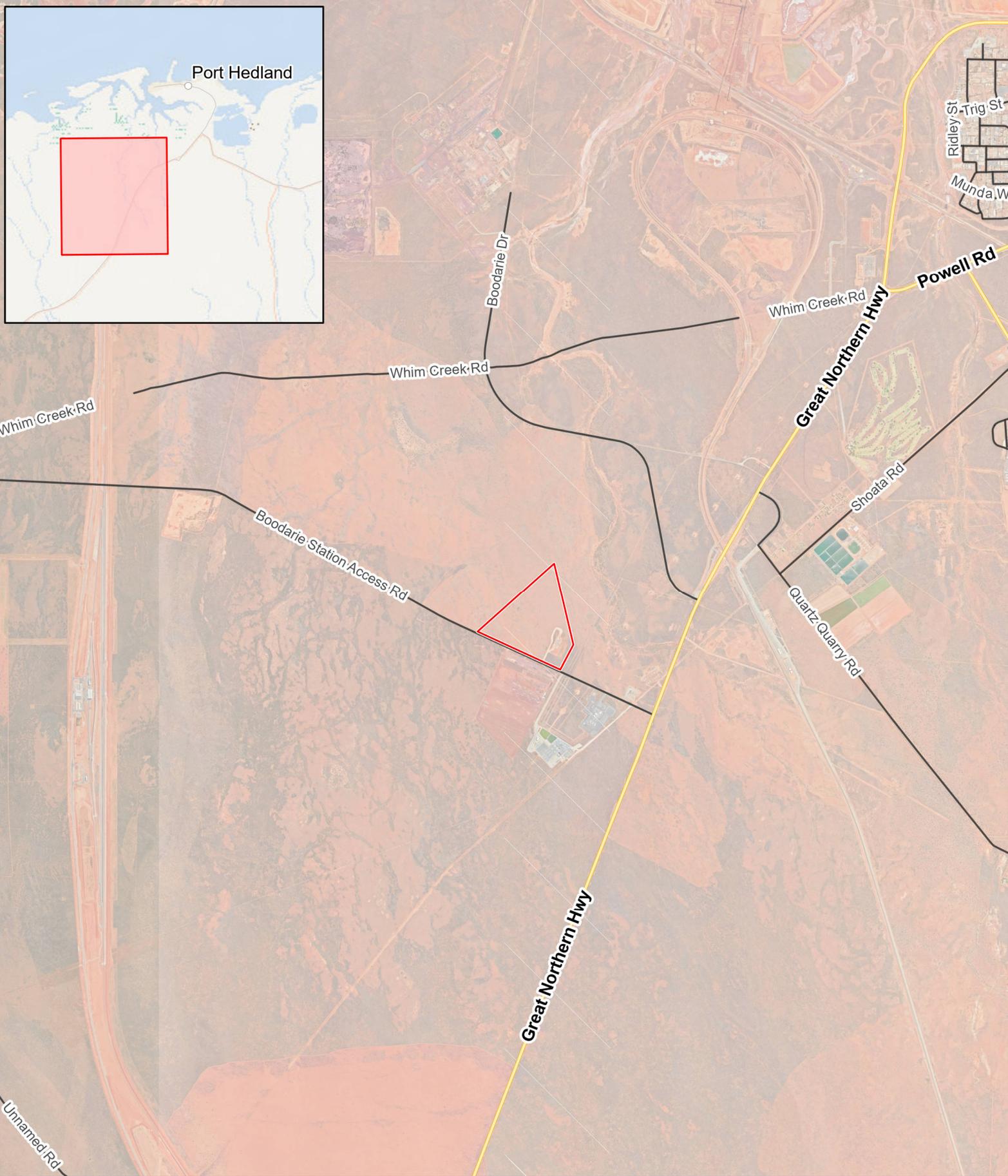
1.1 Project background

Hastings Technology Metals Limited (Hastings) plan to mine and process rare earth elements as part of the Yangibana Rare Earths Project, located approximately 270 kilometres (km) east-northeast of Carnarvon in the Shire of Upper Gascoyne, Western Australia (WA).

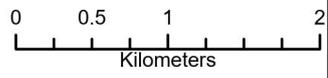
Hastings are evaluating options to locate the processing plant within the Boodarie Strategic Industrial Area (SIA) near Port Hedland, WA. The Boodarie SIA is an industrial development site approximately 12 km south of Port Hedland that is being developed for mineral processing and heavy industry within the Pilbara region. The Project Area defined by Hastings is Lot 701 (126) Boodarie Station Access Road, Boodarie within the Boodarie SIA with an area of approximately 53.2 hectares (ha; **Figure 1**).

Eco Logical Australia (ELA) was commissioned to undertake a Detailed and Targeted flora and vegetation survey and a Basic fauna survey of the Project Area in order to provide updated biological information to support environmental approvals.

Figure 1: Project Area Location



- Legend**
- Project Area
 - Roads**
 - Distributor Road
 - Access Road



Datum/Projection:
GDA 1994 MGA Zone 50
Scale: 1:50,000 @ A4
Project Number: 16264



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. Database searches for the Boodarie SIA Project Area (inclusive of the Project area for this survey), undertaken around central coordinates (NW) metres (m) 661079E, m 7741283N, are presented in **Table 1** below. Applied buffers below are considered suitable based on flora and fauna assemblages expected to occur within the Project Area.

Table 1: Database searches undertaken within the Project Area

Database	Reference	Buffer (km)
Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act.	Department of Agriculture, Water and the Environment (DAWE) 2021a	20
Department of Biodiversity, Conservation and Attractions (DBCA) and Western Australian Museum (WAM) NatureMap online database.	DBCA 2007-2021	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 2020a	100
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 2020b	30
DBCA Threatened and Priority Ecological Communities' database search.	DBCA 2020c	50

2.1.2 Previous surveys

In addition, the following document as provided by Hastings was also reviewed:

- GHD, LandCorp, *Report for Proposed Boodarie Industrial Area, Flora and Fauna Assessment, June 2010.*

2.1.3 Likelihood of occurrence assessment

A likelihood of occurrence assessment was undertaken prior to undertaking field surveys, and updated following field surveys, to identify conservation listed flora and fauna species that possibly occur within the Project 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 and vegetation survey and a Basic fauna survey were conducted by ELA Senior Botanist Jeff Cargill and Ecologist Jeni Morris on the 9th and the 10th July 2020. The survey teams' relevant qualifications, experience and licenses are provided in **Table 2** below.

Table 2: Survey team

Name	Qualification	Relevant experience	Licenses
Dr. Jeff Cargill	BSc. Hons. PhD. Environmental Sciences	Jeff has over 13 years' experience conducting botanical and ecological studies throughout Western Australia including baseline (Reconnaissance and Targeted) flora and vegetation studies, Targeted Threatened and Priority species surveys, MNES surveys, weed assessments and vegetation rehabilitation and monitoring programs.	Flora collection: FB62000138 DRF permit: TFL 48-1920
Jeni Morris	BSc. Conservation and Wildlife Biology	Jeni has over six years' experience conducting fauna surveys across Western Australia, including baseline (Level 2) and Basic (Level 1) fauna surveys and habitat assessments, Targeted Threatened species surveys and rehabilitation monitoring programs. Jeni has 4 years' experience undertaking flora and vegetation surveys in WA, including Detailed and Targeted surveys, Targeted Threatened and Priority species searches and weed assessments.	Flora collection: FB62000070 DRF permit: TFL 13-1920

2.2.2 Flora and vegetation survey

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

The number of quadrats established to describe vegetation types was informed using aerial imagery as well as being assessed in the field. Dominant vegetation types were described, with respect to dominant species, structure and overall condition. The survey involved the use of 50x50 metre (m) quadrats as recommended for the Pilbara bioregion (EPA 2016). 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 five quadrats were established across the Project 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 flora and vegetation survey was undertaken within the Project Area to identify and record conservation significant flora or communities potentially occurring, including:

- Threatened flora or Threatened Ecological Communities (TECs) listed under the EPBC Act;
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice under the BC Act;
- Priority Ecological Communities (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 Weeds of National Significance (WoNS) and Declared Pests listed under the State *Biosecurity and Agriculture Management Act 2007* (BAM Act).

The Targeted survey methodology involved personnel walking transects across the Project Area, with transects spaced (on average) 20-50 m apart. Locations of survey transects is shown below in **Figure 2**. 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. Where conservation significant flora were recorded, transects were extended outside of the Project Area to map population boundaries. For conservation significant species 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 Daniel Brassington. Species identification utilised taxonomic literature and keys and where required specimens were confirmed using the Western Australian Herbarium (WAH) reference collection. Suitable material that meets WAH specimen lodgement requirements, such as flowering material and range extensions, will be 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 2021).

2.2.3 Fauna survey

A Basic (Level 1) fauna survey was conducted in accordance with the EPA *Technical Guidance: Terrestrial Fauna Surveys* (EPA 2020). 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 2021). 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 4th 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

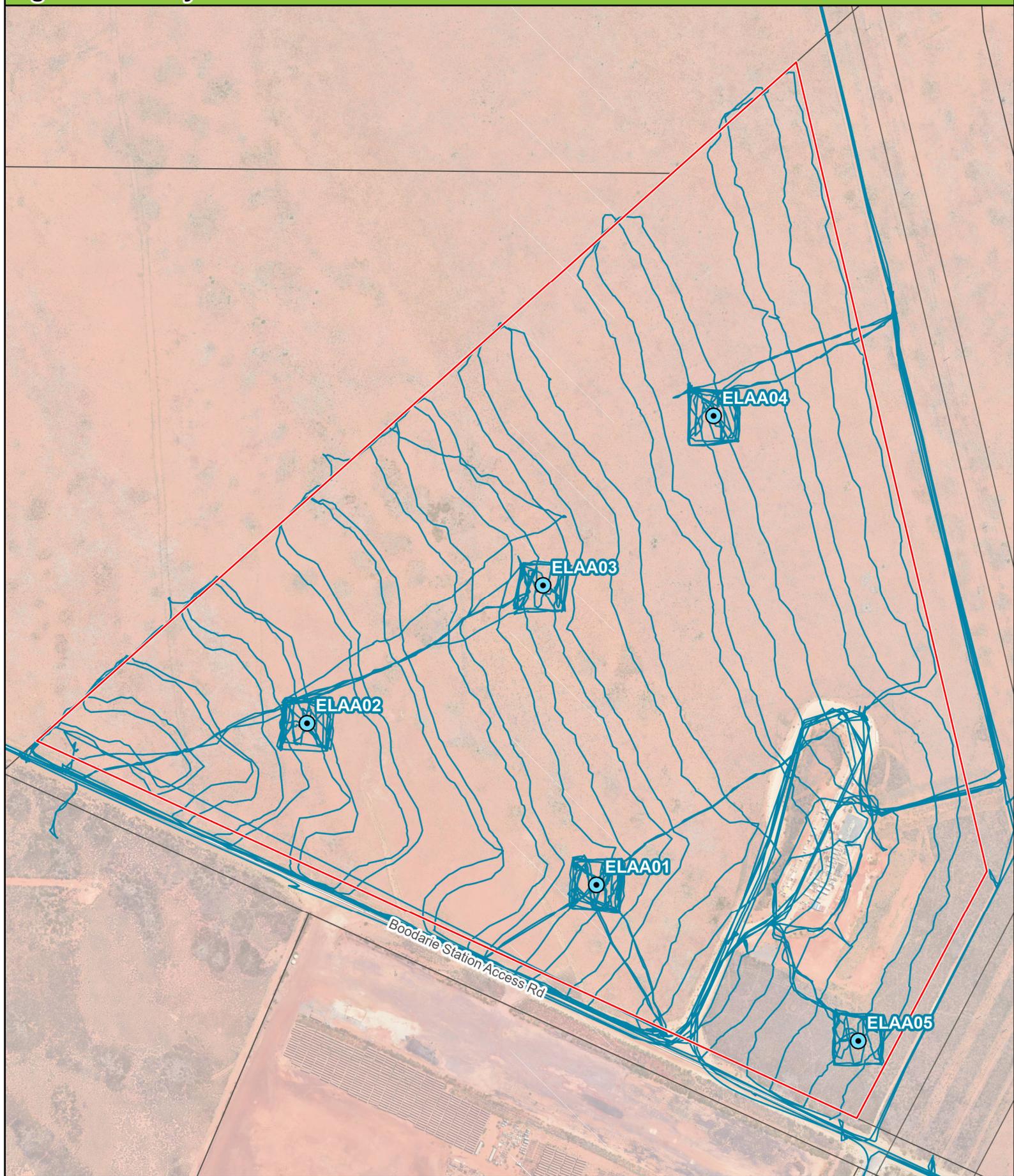
The EPA *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the Detailed and Targeted flora and vegetation survey and the Basic fauna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

Table 3: Survey limitations

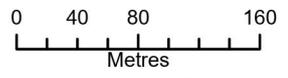
Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	Not a constraint. Previous reports for the region were provided where applicable. Broad-scale vegetation mapping at a scale of 1:1,000,000 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 Basic 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 85% of the flora potentially present within the Project 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 Project Area.
Completeness and further work which might be needed (i.e. was the relevant Project Area fully surveyed).	Not a constraint. The Project 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.
Mapping reliability.	Not a constraint. Coverage of the Project 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 Project Area, mapping boundaries of individual communities were discrete, and thus are considered accurate.
Timing, weather, season, cycle.	Not constraint. Although rainfall in the two months prior to the survey was below the long-term average for the same time period, significant rainfall was recorded in January (43.6 mm), February (103.2 mm) and March (28 mm) of 2020 (BoM 2020), resulting in very good survey conditions during the time of the field survey.
Disturbances (fire, flood, accidental human intervention, etc.).	Not a constraint: Disturbances within the Project Area included minor grazing and trampling from cattle. These disturbances did not lower the confidence of delineating vegetation communities currently occurring within the project area.
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 Project 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. In addition, further transects were undertaken outside the project area to provide additional information relating to the extent of Priority flora locations.
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.

Potential Survey Limitation	Impact on Survey
Access problems (i.e. ability to access Project Area).	Not a constraint. All relevant areas within the Project Area were able to be accessed and surveyed.
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 Pilbara bioregion of Western Australia.

Figure 2: Survey Effort



- Legend**
- Project Area
 - Quadrat (50m x 50m)
 - GPS Tracks
 - Cadastral Boundary



Datum/Projection:
GDA 1994 MGA Zone 50
Scale: 1:5000 @ A4
Project Number: 16264



3. Results

3.1 Desktop Review

3.1.1 Climate

The Pilbara Region has an arid and tropical climate with wet summer season (November to April) and dry winter season (May to October). The wet summer seasons experience cyclones and an annual average rainfall of 320 millimetres (mm) maximum average temperatures of 36°C in March (Port Hedland Airport, Bureau of Meteorology (BoM); weather station number 4032; located approximately 10 km to the northeast of the Project Area; BoM 2020).

In the 12 months preceding the field survey, the area received a total of 216.2 mm of rainfall, which is below the long-term average (316.9 mm; **Table 4**; BoM 2020). A total of 37.6 mm of rainfall was received in the three months prior to the field survey in June, which is below the long-term average for the same time period (71.2 mm). Although the Port Hedland Airport weather station had not received any significant rainfall in the three months prior to the field survey, significant falls were received in January (43.6 mm), February (103.2 mm) and March (28 mm) of 2020 (BoM 2020). As a result, survey conditions at this time were considered to be very good.

Table 4: Rainfall data recorded at the Port Hedland Airport weather station (4032) in the 12 months preceding the field survey compared to the long-term average (BoM 2020)

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Total monthly rainfall 2019-2020 (mm)	0	0.8	1	0	0.4	1.6	43.6	103.2	28	13.8	23.8	0	216.2
Average monthly rainfall 1942 – current (mm)	10.4	4.6	1.2	1.0	2.5	18.4	63.4	88.9	55.3	21.5	26.6	23.1	316.9

3.1.2 Geology, landforms and soils

The Project Area is situated within the De Grey -Roebourne Lowland Zone of the Fortescue Province (Tille 2006). The De Grey – Roebourne Lowlands comprises alluvial plains and sand plains (and some floodplains and stony plains) on alluvial and marine deposits over rocks of the northern Pilbara Craton. Red deep sandy duplexes with red loamy earths and some red/brown noncracking clays, cracking clays, red sandy earths and red deep loamy duplexes. Spinifex grasslands with kanji and tussock grasslands (Tille, 2006).

One soil unit has been mapped across the Project Area, namely alluvium 38485, which is described as ‘Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted’ (Department of Primary Industries and Regional Development [DPIRD] 2021a).

3.1.3 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia (IBRA) currently classifies 89 bioregions across Australia, based on a range of biotic and abiotic factors such as climate, vegetation, fauna, geology and landform (Thackway and Cresswell 1995; DAWE 2021b). These bioregions are currently further refined into 419 sub-regions representing more localised and homogenous geomorphological units in each bioregion (DAWE 2021b). IBRA divides Western Australia into 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation (DAWE 2021b).

The Project Area is situated in the Pilbara bioregion, which is further divided into four subregions, namely Chichester (PIL01), Fortescue Plains (PIL02), Hamersley (PIL03) and Roebourne (PIL04). The Project Area occurs within the Roebourne (PIL04) subregion, which is described as Quaternary alluvial plains with grass savanna of mixed bunch and hummock grasses and dwarf shrub steppe of *Acacia translucens* over *Triodia pungens*. Samphire, *Sporobolus* and Mangal can occur on marine alluvial flat.

3.1.4 Rangeland land systems mapping

The DPIRD Land System mapping for the pastoral area of Western Australia (version April 2018) places the Project area within one land systems (Hennig *et al.* 1994; van Gool *et al.* 2005). The majority of the Project Area falls within the Uaroo Land System, (**Table 5; Figure 3**).

The Uaroo Land System (RGEUAR) is summarised as broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered acacia shrubs. The Uaroo Land System corresponds with the soil landscape zone 281.

Table 5: Rangelands Land Systems of the Project Area (van Gool *et al.* 2005)

Land System	Total current extent mapped in Western Australia	Extent (ha) mapped within the Project Area	Proportion of total current extent (%) within the Project Area
Uaroo Land System (RGEUAR)	59,062.46	53	0.09

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, DPIRD (previously the Department of Agriculture and Food Western Australia [DAFWA]) has compiled a list of vegetation extent and types across WA (Shepherd *et al.* 2002).

One vegetation association is mapped as occurring across the Project Area, namely ‘Abydos Plain_589’, described as short bunch – grass savanna and grass steppe (**Table 6; Figure 4**). This vegetation association has more than 99% of its pre-European extent remaining in the Augustus subregion (Government of Western Australia 2019).

Table 6: Beard's (1975) vegetation associations of the Project Area

Vegetation association	Description	Pre-European extent (ha) within the Pilbara region	Current extent (ha) within the Pilbara region	% remaining within the Pilbara region	Proportion of total extent (%) within the Project Area
Abydos Plain_589	Short bunch-grass savanna/ Grass Steppe	675,391.80	671,327.48	99.4	0.007

3.1.6 Previous surveys

An overview of prior studies undertaken in the vicinity of the Project Area is provided below in **Table 7**.

Table 7: Overview of previous studies undertaken in proximity to the Project Area

Reference	Survey type and location	Conservation significant species or communities
Landcorp, <i>Report for Proposed Boodarie Industrial Area, Flora and Fauna Assessment, June 2010</i> (GHD, 2010)	Detailed and Targeted flora surveys undertaken within and surrounding the Project Area.	No Declared Rare or Priority Flora Species recorded Range extension flora: <i>Stemodia lathraia</i>

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, defined wetlands, and vegetation containing rare (Threatened) flora and TECs. 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.

No PECs or TECs intersect or are located in close proximity to the Project Area. No World Heritage Areas, National Heritage or Ramsar wetlands are located within or in close proximity to the Project Area (DBCA 2020c).

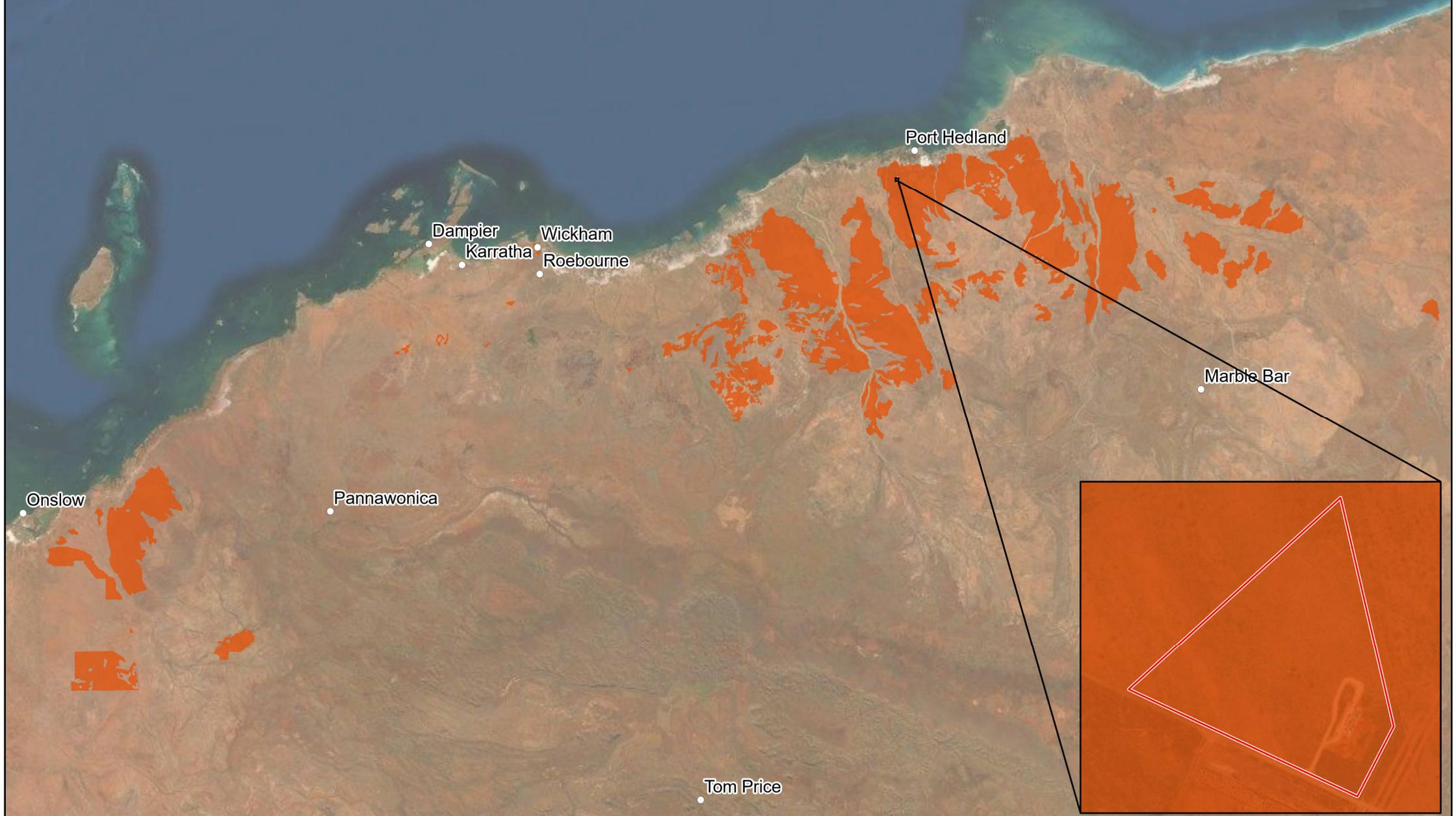
3.1.8 Flora and fauna species of conservation significance

An initial 11 conservation listed flora species and 65 conservation listed fauna species were identified as possibly occurring within the Project 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 two species listed as P1 by DBCA, one species listed at P2 by DBCA, six species listed as P3 by DBCA and two species listed as P4 by DBCA. The flora likelihood of occurrence assessment is presented in **Appendix C**. Locations of flora species of conservation significance previously recorded in proximity to the project area is provided in **Figure 5** below.

Conservation significant fauna species identified from database searches undertaken include 56 species listed under the EPBC Act and BC Act, two species listed under the BC Act only, one species listed as P1 by DBCA, one species listed as P3 by DBCA and five species listed as P4 by DBCA. The fauna likelihood of occurrence assessment is presented in **Appendix D**. Locations of fauna species of conservation significance previously recorded in proximity to the project area is provided in **Figure 6** below.

Figure 3: Rangelands Land System mapping of the Project Area (van Gool *et al.* 2005)



Legend

- Town
- Project Area
- Uaroo Land System

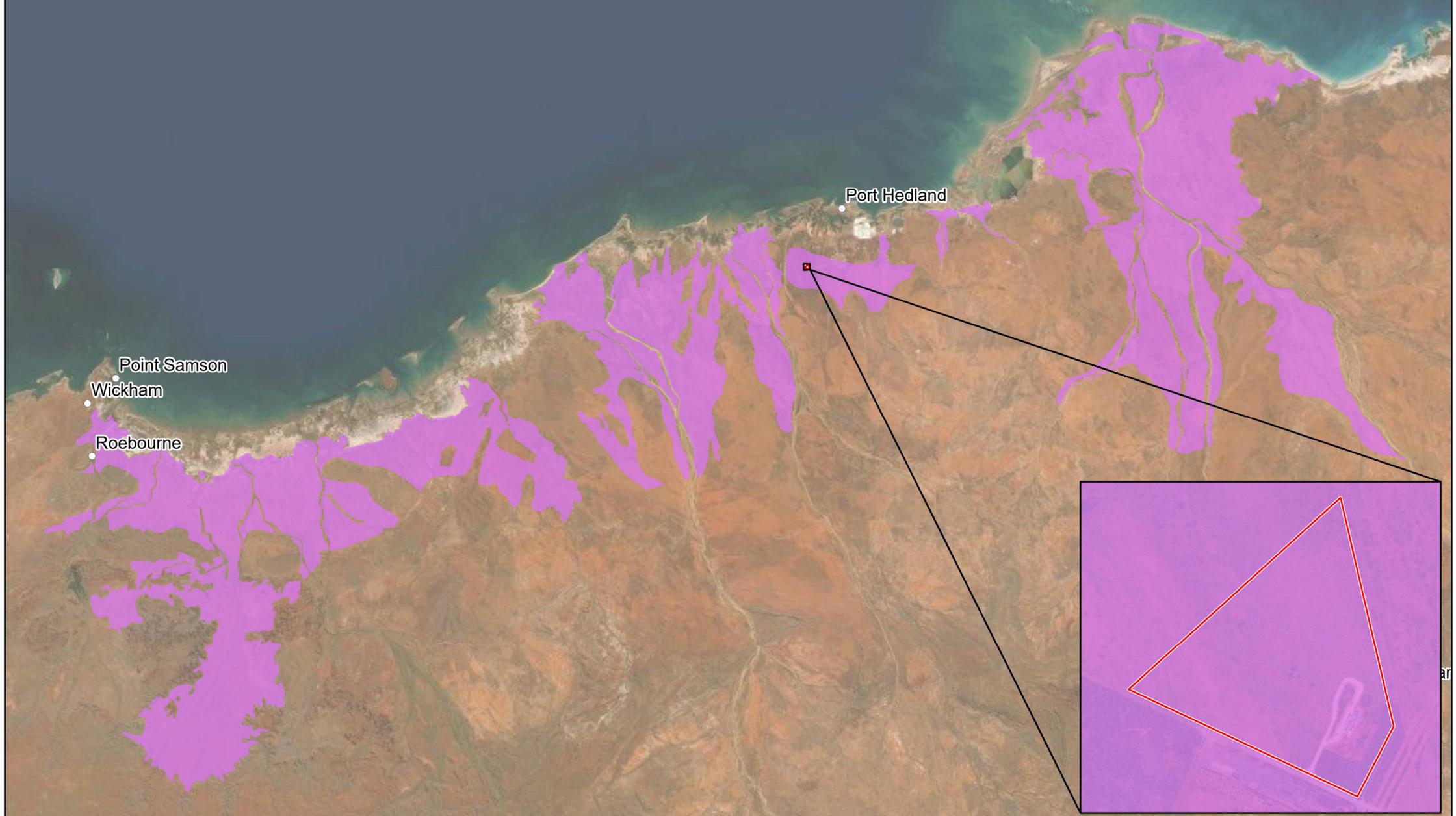
0 15 30 60
Kilometers

Scale: 1:2,000,000 @ A4
Datum/Projection:
GDA 1994 MGA Zone 50
Project: 20PER16264

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Prepared by: GM Date: 21/09/2020

Figure 4: Beard's (1975) vegetation associations of the Project Area



Legend

- Town
- Beard (1975) Vegetation Association**
 - Abydos Plain 589
 - Project Area

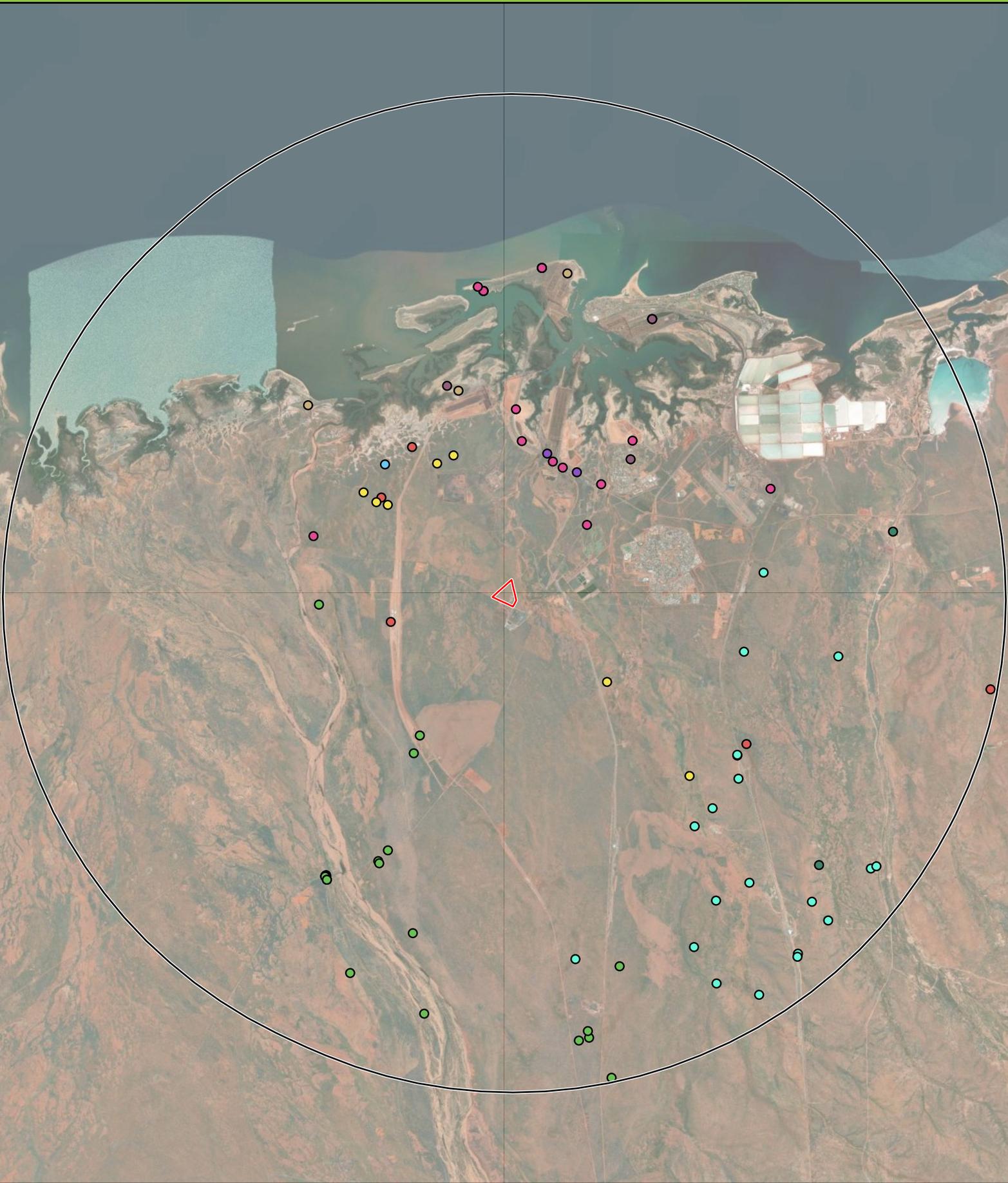
0 5 10 20
Kilometers

Scale: 1:1,000,000 @ A4
Datum/Projection:
GDA 1994 MGA Zone 50
Project: 20PER16264

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Figure 5: Background conservation significant flora search results (DBCA 2020a)



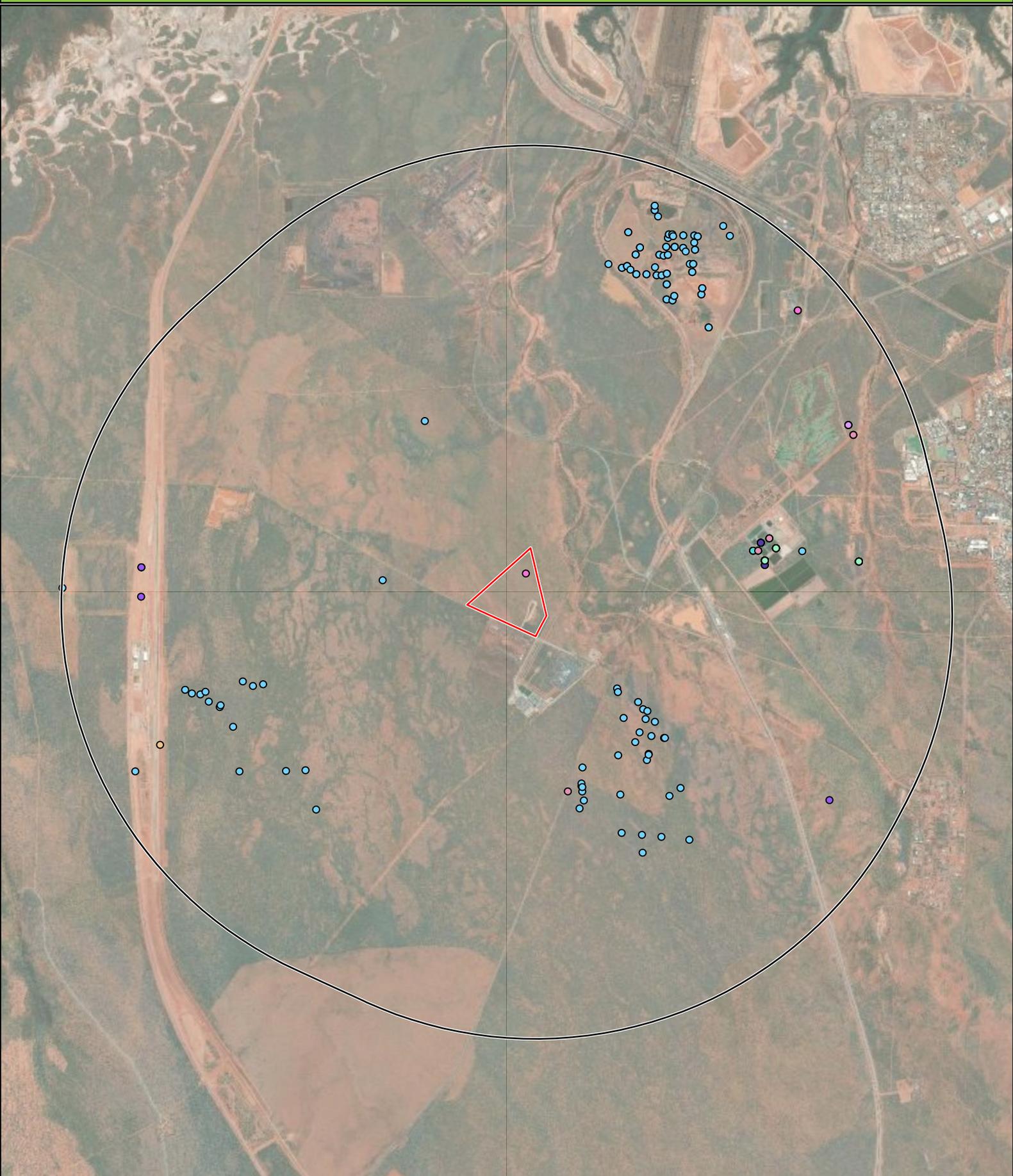
Legend
 Project Area
 20km Search Area

- Background Flora Search Results (DBCA 2020a)**
-  *Tephrosia rosea* var. Port Hedland (A.S. George 1114) (P1)
 -  *Gomphrena pusilla* (P2)
 -  *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (P3)

-  *Eragrostis crateriformis* (P3)
-  *Gomphrena leptophylla* (P3)
-  *Gymnanthera cunninghamii* (P3)
-  *Heliotropium muticum* (P3)
-  *Rothia indica* subsp. *australis* (P3)
-  *Bulbostylis burbridgeae* (P4)
-  *Goodenia nuda* (P4)

0 2.5 5
 Kilometers
 Datum/Projection:
 GDA 1994 MGA Zone 50
 Scale: 1:200,000 @ A4
 Project Number: 16264

Figure 6: Background conservation significant fauna search results (DBCA 2020b)



Legend

Project Area

5km Search Area

Background Fauna Search Results (DBCA 2020b)

- Eastern curlew (*Numenius madagascariensis*, CR)
- Curlew Sandpiper (*Calidris ferruginea*, CR)
- Bilby (*Macrotis lagotis*, VU)
- Brush-tailed mulgara (*Dasyercus blythi*, P4)
- Crest-tailed mulgara (*Dasyercus cristicauda*, P4)
- Bar-tailed godwit (*Limosa lapponica*, MI)

- Barn swallow (*Hirundo rustica*, MI)
- Caspian Tern (*Hydroprogne caspia*, MI)
- Common Sandpiper (*Actitis hypoleucos*, MI)
- Common greenshank (*Tringa nebularia*, MI)
- Crested tern (*Thalasseus bergii*, MI)
- Grey plover (*Pluvialis squatarola*, MI)
- Grey-tailed tattler (*Tringa brevipes*, MI)
- Gull-billed tern (*Gelochelidon nilotica*, MI)
- Little curlew (*Numenius minutus*, MI)
- Long-toed Stint (*Calidris subminuta*, MI)

- Oriental pratincole (*Glareola maldivarum*, MI)
- Red-necked stint (*Calidris ruficollis*, MI)
- Ruddy turnstone (*Arenaria interpres*, MI)
- Sharp-tailed sandpiper (*Calidris acuminata*, MI)
- Terek sandpiper (*Xenus cinereus*, MI)
- Whimbrel (*Numenius phaeopus*, MI)
- White-winged black tern (*Chlidonias leucopterus*, MI)
- Wood sandpiper (*Tringa glareola*, MI)
- Peregrine falcon (*Falco peregrinus*, OS)

0 1 2
Kilometers

Datum/Projection:
GDA 1994 MGA Zone 50
Scale: 1:60,000 @ A4
Project Number: 16264

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Prepared by: GM Date: 18/01/2021

3.2 Flora and Vegetation Survey

3.2.1 Flora overview

A total of 49 taxa (47 native and two introduced) from 41 genera and 23 families were recorded from the Project Area. The majority of taxa recorded were representative of the Fabaceae (five taxa) and Poaceae (seven taxa) families. Average species richness per quadrat was 21.4 species, ranging from a low of 14 species at ELA A02 to a high of 26 species at ELA A05. *Ptilotus* and *Acacia* were the best represented genera with four and three taxa recorded, respectively. A flora species list and flora species by quadrat matrix is presented in **Appendix E** and **Appendix F**. Quadrat data is presented in **Appendix G**.

3.2.2 Accumulated species – site surveyed (species area curve)

A species accumulation curve (**Figure 7**) 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 41.19. Based on this value, and the total of 35 species recorded within quadrats, approximately 85% of the flora species potentially present within the Project Area were recorded, which is considered to be an acceptable level of sample effort.

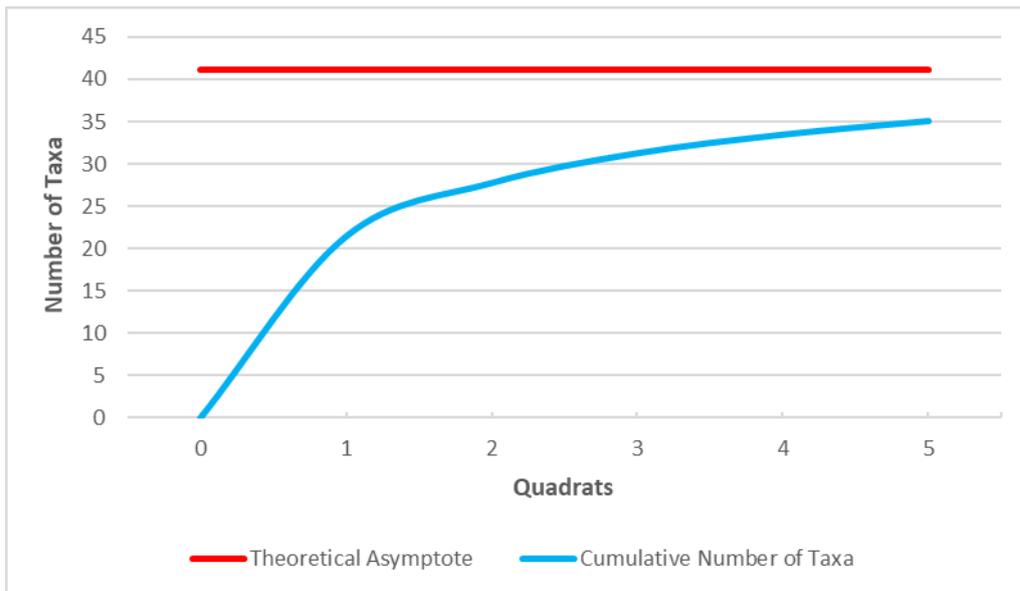


Figure 7: Averaged randomised species accumulation curve

3.2.3 Conservation significant flora

No Threatened flora species listed under the EPBC Act or the BC Act, or Priority flora species listed by DBCA were recorded within the Project Area. Of the eleven species identified from the desktop assessment as possibly occurring within the Project Area, four are considered as having the potential to occur, namely *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095; listed as P1 by DBCA), *Bonamia oblongifolia* (listed as P3 by DBCA), *Heliotropium muticum* (listed as P3 by DBCA) and *Rothia indica* subsp. *australis* (listed as P3 by DBCA). This assessment is based on the presence of available habitat for this species within the Project Area and the inconspicuous nature of these species, reducing their

detectability in the field. The remaining seven species are considered as being unlikely to occur. The flora likelihood of occurrence assessment is provided in **Appendix C**.

3.2.4 Introduced flora

Two introduced (weed) species were recorded from opportunistic collections during the field survey, namely **Aerva javanica* and **Calotropis procera*. Of these, **Calotropis procera* is listed as a Declared Pest s22(2) under the BAM Act. Declared Pests with a legal status of s22(2) “must satisfy any applicable import requirements when imported and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia” (DPIRD 2021b). **Calotropis procera* was recorded from one location during the field survey (661290m E; 7741131m S; **Plate 1**). **Aerva javanica* is not listed as a WoNS or a Declared Pest under the BAM Act and is listed on the Western Australian Organism List (WAOL) Database as a S-11 (permitted) species (DPIRD 2021b).

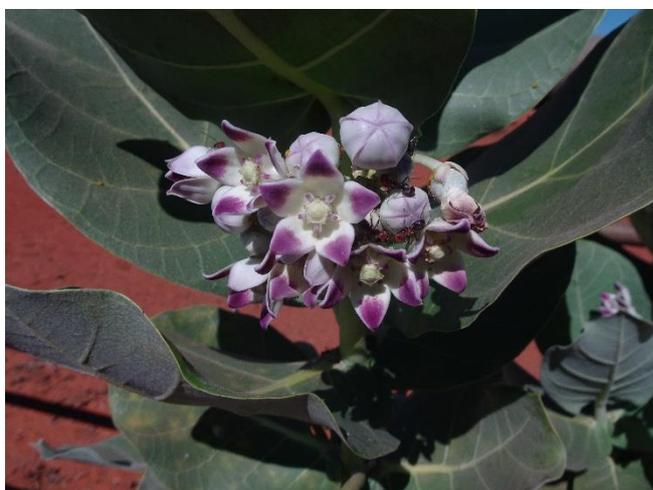


Plate 1: Introduced (weed) species, **Calotropis procera*, recorded within the Project Area

3.2.5 Vegetation communities

SIMPROF separated the five quadrats into one statistically similar grouping (Global R = 46.37; significance level of sample statistic, $p = 0.005$; **Appendix H**). Based on this result, one in-tact vegetation community was delineated and mapped within the Project Area, as described in **Table 8**. This vegetation community occurred across 91.4% (48.6 ha) of the Project Area, while the remaining 8.6% (4.6 ha) was classed as tracks or cleared areas. Subtle changes in vegetation structure were observed within the Project Area, related to fire scars. (e.g. vegetation to the south-east were largely unburnt). Species composition was however, analogous across the site and as such one vegetation community was delineated and mapped.

No vegetation types delineated within the Project Area were inferred to represent any or potential conservation significant communities listed under the EPBC Act, the BC Act or by DBCA.

Location of vegetation communities within the Project Area is presented in **Figure 8** below.

Table 8: Vegetation types recorded within the Project Area

Image	Vegetation type description	Quadrats	Extent within the Project Area (ha)	Portion of the Project Area (%)
	<p>AcAsTe: <i>Acacia colei</i>, <i>Hakea lorea</i>, <i>Acacia sericophylla</i> tall sparse shrubland over <i>Acacia stellaticeps</i>, <i>Pluchea ferdinandi-muelleri</i>, <i>Corchorus walcottii</i> mid sparse shrubland over <i>Triodia epactia</i>, <i>Triodia schinzii</i> low open hummock grassland and <i>Sorghum timorense</i> low open tussock grassland.</p>	<p>ELA A01, ELA A02, ELA A03, ELA A04, ELA A05</p>	<p>48.6</p>	<p>91.4</p>
<p>Tracks, cleared areas and cleared areas with regrowth</p>			<p>4.6</p>	<p>8.6</p>
<p>Total</p>			<p>53.2</p>	<p>100</p>

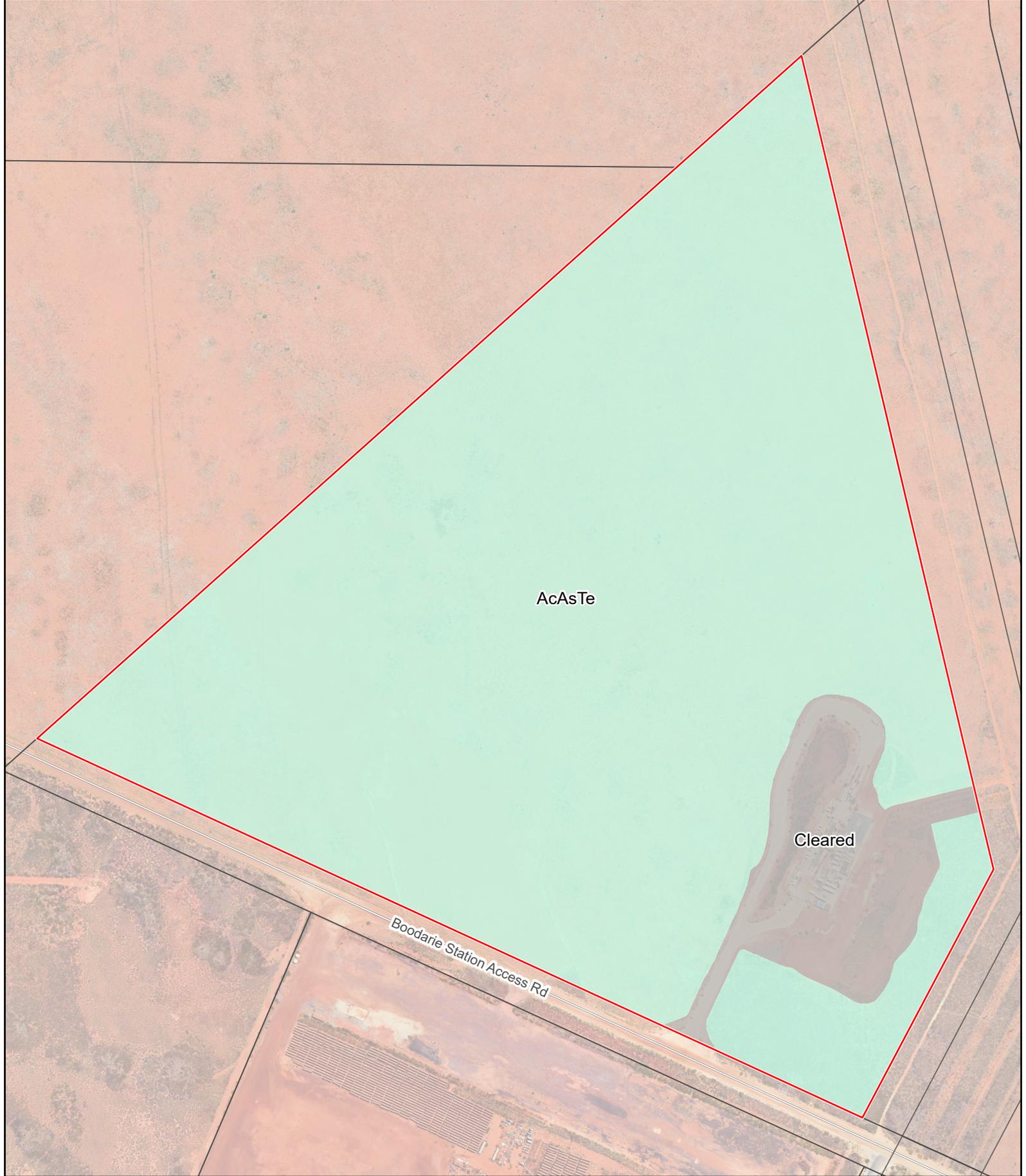
3.2.6 Vegetation condition

Vegetation within the Project Area is classed as Excellent condition based on the vegetation condition scale adapted by Trudgen (1988), as provided in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016; **Table 9; Figure 9**). A total of 4.6 ha (8.6% of the Project Area) was classed as tracks and cleared areas. Disturbances present within the Project Area were associated with fire scar, grazing of vegetation, clearing and minor weeds.

Table 9: Vegetation condition recorded within the Project Area

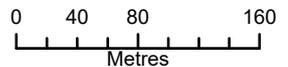
Condition	Area (ha)	Proportion of the Project Area (%)
Excellent	48.6	91.4
Very Good	0	0
Good	0	0
Poor	0	0
Degraded	0	0
Completely Degraded	0	0
Tracks, cleared areas	4.6	8.6
Total	53.2	100

Figure 8: Vegetation communities recorded within the Project Area



Legend
Project Area
Cadastral Boundary

Vegetation community
AcAsTe (*Acacia colei*, *Hakea lorea*, *Acacia sericophylla* tall sparse shrubland over *Acacia stellaticeps*, *Pluchea ferdinandimuellerei*, *Corchorus walcottii* mid sparse shrubland over *Triodia epactia*, *Triodia schinzii* low open hummock grassland and *Sorghum timorense* low open tussock grassland)
Cleared



Datum/Projection:
GDA 1994 MGA Zone 50
Scale: 1:5000 @ A4
Project Number: 16264

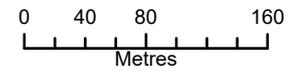


Figure 9: Vegetation condition recorded within the Project Area



Legend
Project Area
Cadastral Boundary

Vegetation Condition
Excellent
Cleared



Datum/Projection:
GDA 1994 MGA Zone 50
Scale: 1:5000 @ A4
Project Number: 16264



3.3 Fauna Survey

3.3.1 Fauna habitat

One fauna habitat was recorded and mapped within the Project Area, namely Fauna habitat 1: Isolated to sparse shrubland of *Acacia* spp. and *Grevillea* spp. over stony clay plain (48.6 ha; 91.4% of the Project Area). The remaining 4.6 ha (8.6% of the Project Area) was classed as Cleared (**Figure 10**).

3.3.2 Fauna overview

A total of eleven fauna species were recorded from the Project Area. This number comprised eight birds, two mammals and one reptile (**Table 10**). One introduced mammal species, **Felis catus* (Feral Cat) was recorded within the Project Area from tracks.

Table 10: Fauna species recorded within the Project Area

Type	Species	Common name	Observation
Bird	<i>Artamus cinereus</i>	Black-faced Woodswallow	Directly observed
Bird	<i>Corvus coronoides</i>	Australian Raven	Directly observed
Bird	<i>Cracticus tibicen</i>	Australian Magpie	Directly observed
Bird	<i>Eolophus roseicapilla</i>	Galah	Directly observed
Bird	<i>Falco berigora</i>	Brown Falcon	Directly observed
Bird	<i>Grallina cyanoleuca</i>	Magpie-lark	Directly observed
Bird	<i>Merops ornatus</i>	Rainbow Bee-eater	Directly observed
Bird	<i>Ocyphaps lophotes</i>	Crested Pigeon	Directly observed
Mammal	<i>*Felis catus</i>	Feral Cat	Tracks
Mammal	<i>Macropus rufus</i>	Red Kangaroo	Scats, tracks
Reptile	<i>Ctenophorus nuchalis</i>	Central Netted Dragon	Directly observed

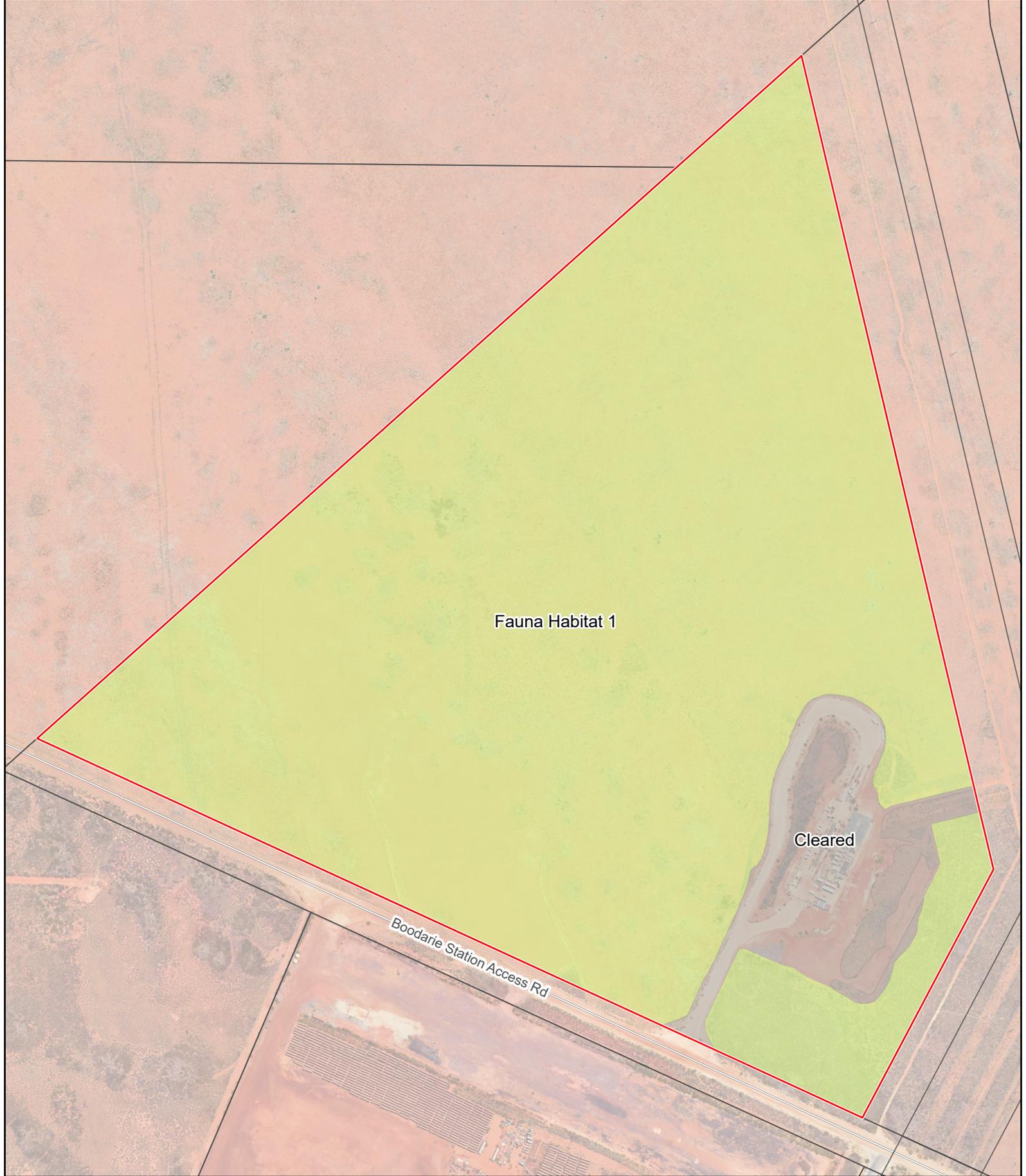
3.3.3 Conservation significant fauna

No direct (observations) or indirect (scats, tracks, diggings) evidence of conservation significant fauna species were recorded within the Project Area. Following the field survey, the likelihood of occurrence of fauna species identified from the desktop assessment as possibly occurring within the Project Area was updated.

Of the 65 conservation significant fauna species identified as possibly occurring within the Project Area, four species are considered having the potential to occur, based on the species habitat preferences and proximity of records to the Project Area, namely *Hirundo rustica* (Barn Swallow; listed as Migratory under the EPBC Act and BC Act), *Ctenopus angusticeps* (Airlie Island Ctenopus; listed as P3 by DBCA), *Dasyercus blythi* (Brush-tailed Mulgara; listed as P4 by DBCA) and *Dasyercus cristicauda* (Crest-tailed Mulgara, listed as P4 by DBCA). A previous record of the Crest-tailed Mulgara is located within the Project Area, while a record of the Brush-tailed Mulgara is located 2.5 km to the east of the Project Area. Suitable habitat for the Barn Swallow is present within the Project Area, with a number of records located within 3 km of the Project Area. Marginal suitable habitat for the Airlie Island Ctenopus occurs within the Project Area, with a recent record located approximately 10 km to the north of the Project

Area. The remaining 61 species were considered unlikely to occur. The fauna likelihood of occurrence assessment is presented in **Appendix D**.

Figure 10: Fauna habitat types recorded within the Project Area



Legend
Project Area
Cadastral Boundary

Fauna Habitat
Fauna Habitat 1 - *Acacia* and *Hakea* tall sparse shrubland over mixed mid sparse shrubland over *Triodia* low open hummock grassland and low open tussock grassland on flat sandplain
Cleared

0 40 80 160
Metres
Datum/Projection: GDA 1994 MGA Zone 50
Scale: 1:5000 @ A4
Project Number: 16264

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Prepared by: GM Date: 18/01/2021

4. Discussion/Summary

4.1 Flora and vegetation

A total of 49 taxa (47 native and two introduced) from 41 genera and 23 families were recorded from the Project Area. The majority of taxa recorded were representative of the Fabaceae (five taxa) and Poaceae (seven taxa) families. Average species richness per quadrat was 21.4 species, ranging from a low of 14 species at ELA A02 to a high of 26 species at ELA A05. *Ptilotus* and *Acacia* were the best represented genera with four and three taxa recorded, respectively. A species accumulation curve determined that approximately 85% of the flora species potentially present within the Project Area were recorded, resulting in sufficient data to define and assess the presence, extent and significance of vegetation types within the Project Area.

No Threatened flora species listed under the EPBC Act or the BC Act, or Priority flora species listed by DBCA were recorded within the Project Area. Of the eleven species identified from the desktop assessment as possibly occurring within the Project Area, four are considered as having the potential to occur, namely *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095; listed as P1 by DBCA), *Bonamia oblongifolia* (listed as P3 by DBCA), *Heliotropium muticum* (listed as P3 by DBCA) and *Rothia indica* subsp. *australis* (listed as P3 by DBCA). This assessment is based on the presence of available habitat for this species within the Project Area and the inconspicuous nature of these species, reducing their detectability in the field.

Two introduced (weed) species were recorded from opportunistic collections during the field survey, namely **Aerva javanica* and **Calotropis procera*. Of these, **Calotropis procera* is listed as a Declared Pest s22(2) under the BAM Act. Declared Pests with a legal status of s22(2) “must satisfy any applicable import requirements when imported and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia” (DPIRD 2021b). **Calotropis procera* is a perennial shrub to tree growing up to 4 m tall with smooth pale grey-green stems and a white milky sap. Flowers are purple to white with five waxy petals (DPIRD 2021b). This species distributed over much of northern Australia, in particular in Queensland, northwest WA and in northern parts of the NT. **Calotropis procera* was recorded from one location during the field survey (661290m E; 7741131m S). **Aerva javanica* is not listed as a WoNS or a Declared Pest under the BAM Act and is listed on the Western Australian Organism List (WAOL) Database as a S-11 (permitted) species.

One broad vegetation community was identified within the Project Area, described as **AcAsTe**: *Acacia coleii*, *Hakea lorea*, *Acacia sericophylla* tall sparse shrubland over *Acacia stellaticeps*, *Pluchea ferdinandii-muelleri*, *Corchorus walcottii* mid sparse shrubland over *Triodia epactia*, *Triodia schinzii* low open hummock grassland and *Sorghum timorense* low open tussock grassland. This community, mapped across majority of the Project Area (48.6 ha; 91.4%) broadly represents aspects of Beard’s (1975) ‘Abydos Plain 589’ vegetation association, described as short bunch grass savanna / grass steppe, with the presence of tussock grasses (bunch grass; *Sorghum timorense*) and grass steppe (*Triodia* species) within the **AcAsTe** vegetation community. This pre-European vegetation community has more than 99% of its extent remaining within the Pilbara region of Western Australia (Government of Western Australia 2019) and is not considered as locally restricted.

The Project Area falls within the Uaroo Land System, which is summarised as broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered acacia shrubs. Characteristics of this Land System is represented within the **AcAsTe** vegetation community, including the presence of sandy plains and spinifex hummock grasslands. This land system is well represented across the broader landscape, with the Project Area representing a small percentage of the current extent of each; specifically, 0.09%. Therefore, it is unlikely that proposed works within the Project Area would appreciably reduce the representativeness this land system in the local area or indeed at a regional scale.

Vegetation within the Project Area (48.6 ha; 91.4% of the Project Area) is classed as Excellent condition based on the vegetation condition scale adapted by Trudgen (1988), as provided in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). The remaining 4.6 ha (8.6% of the Project Area) comprised tracks and cleared areas. Disturbances present within the Project Area were associated with grazing of vegetation, clearing and minor weeds. Disturbances within the Project Area did not provide any major constraints to the survey proper (i.e. ability to delineate vegetation communities).

4.2 Fauna

One fauna habitat was described and mapped within the Project Area, namely Fauna habitat 1: Isolated to sparse shrubland of *Acacia* spp. and *Grevillea* spp. over stony clay plain. This fauna habitat is not considered as being locally restricted within the region.

A total of 11 fauna species were recorded during the field survey, comprising eight birds, two mammals and one reptile. No Federal or State listed Threatened or Priority fauna species listed by DBCA were recorded within the Project Area during the survey. Of the 65 conservation significant fauna species identified as possibly occurring within the Project Area, four species are considered having the potential to occur, based on the species habitat preferences and proximity of records to the Project Area, namely *Hirundo rustica* (Barn Swallow; listed as Migratory under the EPBC Act and BC Act), *Ctenotus angusticeps* (Airlie Island Ctenotus; listed as P3 by DBCA), *Dasyercus blythi* (Brush-tailed Mulgara; listed as P4 by DBCA) and *Dasyercus cristicauda* (Crest-tailed Mulgara, listed as P4 by DBCA). A previous record of the Crest-tailed Mulgara is located within the Project Area, while a record of the Brush-tailed Mulgara is located 2.5 km to the east of the Project Area. Suitable habitat for the Barn Swallow is present within the Project Area, with a number of records located within 3 km of the Project Area. Marginal suitable habitat for the Airlie Island Ctenotus occurs within the Project Area, with a recent record located approximately 10 km to the north of the Project Area. The remaining 61 species were considered unlikely to occur.

One introduced mammal species, **Felis catus* (Feral Cat) was recorded as occurring within the Project Area from tracks.

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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: <ul style="list-style-type: none"> • 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	M	<p>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).</p> <p>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.</p> <p>Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
Species of special conservation interest (conservation dependent fauna)	CD	<p>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).</p> <p>Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
Other specially protected species	OS	<p>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).</p> <p>Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>

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	<p><i>Poorly-known species</i></p> <p>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.</p>
Priority 2	P2	<p><i>Poorly-known species</i></p> <p>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.</p>
Priority 3	P3	<p><i>Poorly-known species</i></p> <p>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.</p>
Priority 4	P4	<p><i>Rare, Near Threatened and other species in need of monitoring</i></p> <p>(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.</p> <p>(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.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Appendix B Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within Project Area from DBCA database search results and/or from previous surveys of the Project Area, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
Likely	<p>The species has not previously been recorded from within the Project Area. However, (to qualify requires one or more criteria to be met):</p> <ul style="list-style-type: none"> the species has been recorded in close proximity to the Project Area, and occurs in similar habitat to that which occurs within the Project Area core habitat and suitable landforms for the species occurs within the Project 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 Project Area
Potential	<p>The species has not previously been recorded from within the Project Area. However, (one or more criteria requires to be met):</p> <ul style="list-style-type: none"> targeted surveys may locate the species based on records occurring in proximity to the Project Area and suitable habitat occurring in the Project Area the Project 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 <p>The species has been recorded in the Project Area by a previous consultant survey or there is historic evidence of species occurrence within the Project Area. However, (one or more criteria requires to be met)</p> <ul style="list-style-type: none"> 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	<p>The species has been recorded locally through DBCA database searches. However, it has not been recorded within the Project Area and</p> <ul style="list-style-type: none"> 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. <p>The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the Project Area through DBCA database searches.</p> <p>The species has not been recorded in the Project Area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.</p>
Does not occur	<p>The species is not known to occur within the IBRA bioregion based on current literature and distribution.</p> <p>The conspicuous species has not been recorded in the Project Area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat.</p> <p>The Project Area lacks important habitat for a species that has highly selective habitat requirements.</p> <p>The species has been historically recorded within Project Area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.</p>

Appendix C Flora likelihood of occurrence assessment

Species	Conservation status		Habitat	Source ¹	Likelihood of occurrence	Justification
	EPBC Act	BC Act / DBCA				
<i>Abutilon</i> sp. Pritzelianum (S. van Leeuwen 5095)	-	P1	Sandy plain, orange brown sand.	Naturemap	Potential	Potential habitat occurs within the Project Area. Species is low and potentially inconspicuous.
<i>Tephrosia rosea</i> var. Port Hedland (A.S. George 1114)	-	P1	Coastal sand dunes, orange to light brown sand.	Naturemap	Unlikely	Project Area does not contain suitable habitat for this species.
<i>Gomphrena pusilla</i>	-	P2	Fine beach sand. Behind foredune, on limestone.	Naturemap	Unlikely	Project Area does not contain suitable habitat for this species.
<i>Bonamia oblongifolia</i>	-	P3	Sandy or gravelly soils.	Naturemap	Potential	Potential habitat occurs within the Project Area. Species is low and potentially inconspicuous.
<i>Eragrostis crateriformis</i>	-	P3	Clayey loam or clay. Creek banks, depressions.	Naturemap	Unlikely	Project Area does not contain suitable habitat for this species.
<i>Gomphrena leptophylla</i>	-	P3	Sand, sandy to clayey loam, granite, quartzite. Open flats, sandy creek beds, edges salt pans & marshes, stony hillsides.	Naturemap	Unlikely	Project Area does not contain suitable habitat for this species.
<i>Gymnanthera cunninghamii</i>	-	P3	Sandy soils.	Naturemap	Unlikely	Species is conspicuous and would have been detected during the field survey if present.
<i>Heliotropium muticum</i>	-	P3	Red/brown/orange sandy plain	Naturemap	Potential	Potential habitat occurs within the Project Area. Species is low and potentially inconspicuous.
<i>Rothia indica</i> subsp. <i>australis</i>	-	P3	Sandy soils. Sandhills and sandy flats.	Naturemap	Potential	Potential habitat occurs within the Project Area. Species is low and potentially inconspicuous.
<i>Bulbostylis burbidgeae</i>	-	P4	Granitic soils. Granite outcrops, cliff bases.	Naturemap	Unlikely	Project Area does not contain suitable habitat for this species.
<i>Goodenia nuda</i>	-	P4	Mulga hardpan plain area on edge of depression, minor drainage. Red clayey loam.	Naturemap	Unlikely	Project Area does not contain suitable habitat for this species.

Appendix D Fauna likelihood of occurrence assessment

Species	Common name	Conservation status		Source ¹	Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA				
<i>Limosa lapponica</i> subsp. <i>menzbieri</i>	Bar-tailed Godwit (northern Siberian)	CR, M	CR	DBCA 2020b, Naturemap, PMST	The bar-tailed godwit (northern Siberian) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR, M	CR, M	DBCA 2020b, Naturemap, PMST	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Calidris tenuirostris</i>	Great Knot	CR, M	CR, M	DBCA 2020b, Naturemap, PMST	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Source ¹	Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA					
<i>Numenius madagascariensis</i>	Eastern Curlew	CR, M	CR, M	DBCA 2020b, Naturemap, PMST	Within Australia, the eastern curlew has a primarily coastal distribution. During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Zosteraceae). Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes within the mangroves.	Unlikely	No suitable habitat is present for this species within the Project Area	
<i>Pezoporus occidentalis</i>	Night Parrot	EN	CR	PMST	Most habitat records are of <i>Triodia</i> (Spinifex) grasslands and/or chenopod shrublands in the arid and semi-arid zones. Shrubby samphire and chenopod associations, scattered trees and shrubs, <i>Acacia aneura</i> (Mulga) woodland, treeless areas and bare gibber as associated with sightings of the species.	Unlikely	Closest record of this species is located more than 200km to the south of the Project Area. Habitat within the Project Area is marginal at best, having been burnt in the last 5-10 years.	
<i>Calidris canutus</i>	Red Knot	EN, M	EN, M	DBCA 2020b, Naturemap, PMST	In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps.	Unlikely	No suitable habitat is present for this species within the Project Area	

Species	Common name	Conservation status		Source ¹	Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA				
<i>Charadrius mongolus</i>	Lesser Sand Plover	EN, M	EN, M	DBCA 2020b, Naturemap, PMST	In non-breeding grounds in Australia, this species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometime occurs in short saltmarsh or among mangroves. The species also inhabits saltworks and near-coastal salt pans, brackish swamps and sandy or silt islands in riverbeds.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Dasyurus hallucatus</i>	Northern Quoll	EN	EN	DBCA 2020b, Naturemap, PMST	The Northern Quoll occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. Northern Quoll are also known to occupy non rocky lowland habitats such as beach scrub communities in central Queensland. Northern Quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Rocky habitats are usually of high relief, often rugged and dissected but can also include tor fields or caves in low lying areas such as in Western Australia. Eucalypt forest or woodland habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Source ¹	Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA					
<i>Rostratula australis</i>	Australian Painted Snipe	EN	EN	PMST	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum <i>Muehlenbeckia</i> or canegrass or sometimes tea-tree (<i>Melaleuca</i>).	Unlikely	No suitable habitat is present for this species within the Project Area	
<i>Macronectes giganteus</i>	Southern Giant-Petrel	EN, M	M	PMST	The Southern Giant-Petrel is marine bird that occurs in Antarctic to subtropical waters. In summer, it mainly occurs over Antarctic waters, and it is widespread south as far as the pack-ice and onto the Antarctic continent	Unlikely	No suitable habitat is present for this species within the Project Area	
<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU, M	VU, M	DBCAs 2020b, Naturemap, PMST	In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons.	Unlikely	No suitable habitat is present for this species within the Project Area	
<i>Falco hypoleucos</i>	Grey Falcon	VU	VU	DBCAs 2020b, Naturemap, PMST	The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter.	Unlikely	No suitable habitat is present for this species within the Project Area	

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Lagostrophus fasciatus</i> subsp. <i>fasciatus</i>	Banded Hare-wallaby	VU	VU	DBCA 2020b, Naturemap	<i>Lagostrophus fasciatus</i> usually lives in woodlands with thick, dense shrubs, which it uses for shelter during the day. Many of the shrubs are of the species <i>Acacia ligulata</i> . Additionally, banded hare-wallabies form runs under the shrubs. The islands on which they live are of a Mediterranean climate, warm with moderate rainfall and distinct wet and dry seasons. Banded hare wallabies mainly browse or occasionally graze on foliage and grasses. Individuals accumulate in areas with high densities of <i>Acacia ligulata</i> , <i>A. coriacea</i> , <i>Heterodendrum oleifolium</i> , and <i>Diplolaena dampieri</i> , using them as the main sources of food. They are also sometimes found grazing in <i>Triodia</i> grasslands.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Liasis olivaceus barroni</i>	Olive Python	VU	VU	PMST	The Pilbara Olive Python prefers escarpments, gorges and waterholes across the ranges within the Pilbara region. They are usually found in close proximity to water and rock outcrops, where they will find prey.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Macroderma gigas</i>	Ghost Bat	VU	VU	DBCA 2020b, PMST	<i>Macroderma gigas</i> roost in caves, old mine tunnels and in deep cracks in rocks. They usually roost in colonies but, because many of their roosting sites are being destroyed, it is rare to find large colonies. Ghost Bats are distributed widely but patchily across the northern half of Australia and are found in a variety of tropical habitats. Perhaps the species' most famous roosting and nesting sites, and largest colonies, are at Mount Etna caves, near Rockhampton in Queensland.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Macrotis lagotis</i>	Bilby	VU	VU	DBCAs 2020b, Naturemap, PMST	The bilby is now largely restricted to the Gibson, Little Sandy and Great Sandy Deserts, and parts of the Pilbara, Dampierland, Central Kimberley and Ord-Victoria Plains bioregions. The bilby continues to occupy a wide range of vegetation types, with the major vegetation types defined as open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland (spinifex) growing on sandplains and dunes, drainage systems, salt lake systems and other alluvial areas.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Rhinonicteris aurantia</i> (Pilbara form)	Pilbara Leaf-nosed Bat	VU	VU	DBCAs 2020b, PMST	The Pilbara Leaf-nosed Bat roosts during the day in caves and mine adits (horizontal tunnels) with stable, warm and humid microclimates because of its poor ability to maintain its heat and water balance. In terms of natural structures, roosting opportunity is limited to those geological formations that provide rocky outcrop, and that also have the propensity to erode into sufficiently deep underground structures.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Sternula nereis</i> subsp. <i>nereis</i>	Fairy tern	VU	VU	DBCAs 2020b	The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Limosa lapponica</i> subsp. <i>baueri</i>	Bar-tailed Godwit	M	VU	PMST	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status		Source ¹	Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA				
<i>Actitis hypoleucos</i>	Common Sandpiper	M	M	DBCAs 2020b, Naturemap, PMST	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Generally, the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Arenaria interpres</i>	Ruddy Turnstone	M	M	DBCAs 2020b, Naturemap, PMST	Saltwater lakes, coastal bays, inlets and intertidal shorelines.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	M	M	DBCAs 2020b, Naturemap, PMST	They forage at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water. Roosting occurs at the edges of wetlands, on wet open mud or sand, in shallow water, or in short sparse vegetation, such as grass or saltmarsh.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Calidris alba</i>	Sanderling	M	M	DBCAs 2020b, Naturemap, PMST	In Australia, the species is almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed. Sanderlings also occur on beaches that may contain wave-washed rocky outcrops. Less often the species occurs on more sheltered sandy shorelines of estuaries, inlets and harbours.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status		Source ¹	Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA				
<i>Calidris melanotos</i>	Pectoral Sandpiper	M	M	DBCAs 2020b, Naturemap, PMST	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Calidris ruficollis</i>	Red-necked Stint	M	M	DBCAs 2020b, Naturemap, PMST	In Australasia, the Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Calidris subminuta</i>	Long-toed Stint	M	M	DBCAs 2020b, Naturemap, PMST	The Long-toed Stint occurs in a variety of terrestrial wetlands. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Charadrius veredus</i>	Oriental Plover	M	M	DBCAs 2020b, Naturemap, PMST	Inhabit flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns and cattle camps, or open areas that have been recently burnt. At the onset of the Wet Season, some may move into lightly wooded grasslands.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Chlidonias leucopterus</i>	White-winged Black Tern	M	M	DBCA 2020b, Naturemap	In Australia, and elsewhere in their non-breeding range, the species mostly inhabits fresh, brackish or saline, and coastal or subcoastal wetlands. White-winged Black Terns frequent tidal wetlands, such as harbours, bays, estuaries and lagoons, and their associated tidal sandflats and mudflats. Terrestrial wetlands, including swamps, lakes, billabongs, rivers, floodplains, reservoirs, saltworks, sewage ponds and outfalls are also inhabited.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Fregata ariel</i>	Lesser Frigatebird	M	M	DBCA 2020b, Naturemap	The Lesser Frigatebird usually breeds on remote islands in small bushes and mangroves, generally in low vegetation and even on the ground. It is found in tropical and subtropical waters. It forages in the adjacent ocean.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Gallinago stenura</i>	Pin-tailed Snipe	M	M	DBCA 2020b, Naturemap	During non-breeding period the Pin-tailed Snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Gelochelidon nilotica</i>	Gull-billed Tern	M	M	DBCA 2020b, Naturemap	It breeds in a variety of locations with bare or sparsely vegetated islands, banks, flats, or spits of dry mud and sand including barrier beaches (shoals), dunes, saltmarshes, saltpans, freshwater lagoons, estuaries, deltas, inland lakes, rivers, marshes and swamps.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Glareola maldivarum</i>	Oriental Pratincole	M	M	DBCAs 2020b, Naturemap, PMST	In non-breeding grounds in Australia, the Oriental Pratincole usually inhabits open plains, floodplains or short grassland (including farmland or airstrips), often with extensive bare areas. They often occur near terrestrial wetlands, such as billabongs, lakes or creeks, and artificial wetlands such as reservoirs, saltworks and sewage farms, especially around the margins. The species also occurs along the coast, inhabiting beaches, mudflats and islands, or around coastal lagoons.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Hirundo rustica</i>	Barn Swallow	M	M	DBCAs 2020b, Naturemap, PMST	In Australia, the Barn Swallow is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires, and also in or over freshwater wetlands, paperbark <i>Melaleuca</i> woodland, mesophyll shrub thickets and tussock grassland.	Potential	Marginal suitable habitat occurs within the Project Area, records are located within 3km of the Project Area
<i>Hydroprogne caspia</i>	Caspian Tern	M	M	DBCAs 2020b, Naturemap	The Caspian Tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	M	M	DBCAs 2020b, Naturemap, PMST	The Broad-billed Sandpiper occurs in sheltered parts of the coast, favouring estuarine mudflats but also occasionally occur on saltmarshes, shallow freshwater lagoons, saltworks and sewage farms, and in areas with large soft intertidal mudflats, which may have shell or sandbanks nearby. Occasionally they occur on reefs or rocky platforms.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Limnodromus semipalmatus</i>	Asian Dowitcher	M	M	DBCAs 2020b, Naturemap	Sheltered coasts, intertidal mudflats, soft mud.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Limosa lapponica</i>	Bar-tailed Godwit	M	M	DBCA 2020b, Naturemap, PMST	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Limosa limosa</i>	Black-tailed Godwit	M	M	DBCA 2020b, Naturemap, PMST	In Australia the Black-tailed Godwit has a primarily coastal habitat environment. The species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets. The use of habitat often depends on the stage of the tide. It is also found in shallow and sparsely vegetated, near-coastal, wetlands; such as saltmarsh, saltflats, river pools, swamps, lagoons and floodplains.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Motacilla cinerea</i>	Grey Wagtail	M	M	PMST	This species 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, even canals, where there are artificial waterfalls, weirs, millraces or lock gates.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Motacilla flava</i>	Yellow wagtail	M	M	DBCA 2020b, Naturemap, PMST	This species occupies a 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.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Numenius minutus</i>	Little Curlew	M	M	DBCA 2020b, Naturemap, PMST	The Little Curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Numenius phaeopus</i>	Whimbrel	M	M	DBCA 2020b, Naturemap, PMST	The Whimbrel is often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes near coastal areas.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Oceanites oceanicus</i>	Wilson's Storm-petrel	M	M	DBCA 2020b, Naturemap	Wilson's Storm-Petrel spends much of its life at sea. In the non-breeding season, the birds are mainly seen in tropical and subtropical waters. Breeding habitat for the species is on the Antarctic Continent and Peninsula, and peri-Antarctic and Subantarctic islands. The birds are found in snow and ice-free areas utilising cliffs, scree slopes, moraines, rocky headlands, hills, and broken or boulder-strewn low-lying ground, fissures or crevices.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Onychoprion anaethetus</i>	Bridled Tern	M	M	DBCA 2020b, Naturemap	Bridled Terns occupy tropical and subtropical seas, breeding on islands, including vegetated coral cays, rocky continental islands and rock stacks.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Philomachus pugnax</i>	Ruff (reeve)	M	M	DBCA 2020b	In Australia the Ruff is found on generally fresh, brackish of saline wetlands with exposed mudflats at the edges. It is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands. They are occasionally seen on sheltered coasts, in harbours, estuaries, seashores and are known to visit sewage farms and saltworks.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Plegadis falcinellus</i>	Glossy Ibis	M	M	DBCA 2020b, Naturemap	The Glossy Ibis' preferred habitat for foraging and breeding are freshwater marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Pluvialis fulva</i>	Pacific Golden Plover	M	M	DBCA 2020b, Naturemap, PMST	In non-breeding grounds in Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as Sarcocornia, or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Pluvialis squatarola</i>	Grey Plover	M	M	DBCA 2020b, Naturemap, PMST	Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons.	Unlikely	No suitable habitat is present for this species within the Project Area

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Sterna hirundo</i>	Common Tern	M	M	DBCA 2020b, Naturemap	Common Terns are marine, pelagic and coastal. In Australia, they are recorded in all marine zones, but are commonly observed in near-coastal waters, both on ocean beaches, platforms and headlands and in sheltered waters, such as bays, harbours and estuaries with muddy, sandy or rocky shores.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Sternula albifrons</i>	Little Tern	M	M	DBCA 2020b, Naturemap	In Australia, Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Sula leucogaster</i>	Brown booby	M	M	DBCA 2020b	The Brown Booby uses both marine and terrestrial habitat. The species occurs in, but is not restricted to, tropical waters of all major oceans, often staying close to breeding islands. The Brown Booby utilises tropical islands, continental islands, sand cays and atolls for breeding. The Brown Booby nests on the ground in a variety of sites, from rugged rocky terrain (cliffs, steep slopes) on larger islands, to beaches, sand bards, coral rubble and guano flats on cays.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Thalasseus bergii</i>	Crested Tern	M	M	DBCA 2020b, Naturemap	Coastal bays and inlets, lakes and large rivers.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Tringa glareola</i>	Wood Sandpiper	M	M	DBCA 2020b, Naturemap, PMST	The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially <i>Melaleuca</i> and River Red Gums <i>Eucalyptus camaldulensis</i> and often with fallen timber.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.

Species	Common name	Conservation status		Source ¹	Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA				
<i>Tringa nebularia</i>	Common Greenshank	M	M	DBCA 2020b, Naturemap, PMST	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.
<i>Tringa stagnatilis</i>	Marsh Sandpiper	M	M	DBCA 2020b, Naturemap, PMST	The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In north Australia they prefer intertidal mudflats.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Xenus cinereus</i>	Terek Sandpiper	M	M	DBCA 2020b, Naturemap, PMST	Preferring to roost in or among mangroves. The Terek Sandpiper mostly forages in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons. The species has also been recorded on islets, mudbanks, sandbanks and spits, and near mangroves and occasionally in samphire.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Actitis hypoleucos</i>	Common Sandpiper	M	M	DBCA 2020b, Naturemap, PMST	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Generally, the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots.	Unlikely	Although previous records are located approximately 2.5km to the east of the Project Area, no suitable habitat is present for this species within the Project Area.

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Pandion cristatus</i>	Osprey	-	M	DBCA 2020b, Naturemap, PMST	Ospreys are found on the coast and in terrestrial wetlands of tropical and temperate Australia and offshore islands, occasionally ranging inland along rivers, though mainly in the north of the country.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Falco peregrinus</i>	Peregrine Falcon	-	OS	DBCA 2020b, Naturemap	The Peregrine Falcon is found in most habitats, from rainforests to the arid zone, and at most altitudes, from the coast to alpine areas. It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water, and may even be found nesting on high city buildings	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Mormopterus cobourgiensis</i>	North-western free-tailed bat	-	P1	DBCA 2020b	They are known to occupy tree hollows of the mangrove species <i>Avicennia marina</i> , but no other types of roost site are known.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Ctenopus angusticeps</i>	Airlie Island Ctenopus	-	P3	DBCA 2020b, Naturemap	The species occurs in coastal samphire flats, coastal Spinifex, tussock grassland and acacia shrubland.	Potential	Marginal suitable habitat occurs within the Project Area. Records of this species are located 10km north of the Project Area.
<i>Dasycercus blythi</i>	Brush-tailed Mulgara	-	P4	DBCA 2020b, Naturemap	Brush-tailed mulgaras occur in a range of vegetation types; however, the principal habitat is mature hummock grasslands of spinifex, especially <i>Triodia basedowii</i> and <i>T. pungens</i> .	Potential	Marginal suitable habitat is located within the Project Area. A record is located approximately 2.5 km to the east of the Project Area.
<i>Dasycercus cristicauda</i>	Crest-tailed Mulgara	-	P4	DBCA 2020b, Naturemap	The crest-tailed mulgara inhabits the inland sandy deserts of central Australia, primarily amongst Spinifex bush. It has also been found in dunes dominated by sandhill canegrass (<i>Zygochloa paradoxa</i>), nitre bush (<i>Nitraria billardierei</i>) grasslands, and sandhill canegrass flats near salt lakes.	Potential	A previous recent record is located within the Project Area. Marginal suitable habitat occurs within the Project Area.

Species	Common name	Conservation status			Habitat	Likelihood of occurrence	Justification
		EPBC Act	BC Act / DBCA	Source ¹			
<i>Dasyercus</i> sp.	Mulgara	-	P4	Naturemap	Mulgaras inhabit the arid, sandy regions of Australia. They lives in burrows that they dig on the flats between low sand-dunes or on the slopes of high dunes.	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Pseudomys chapmani</i>	Western pebble-mound mouse, ngadji	-	P4	DBCA 2020b	A mound, foreground centre, amongst <i>Triodia</i> hummocks in the Pilbara region. It is native to and found only in Western Australia, where it lives in pebbly soils in arid tussock grassland and acacia woodland. The vegetation at the preferred habitat, hummock grasslands, is <i>Triodia basedowii</i> , <i>Cassia. Acacia</i> and <i>Ptilotus</i> , and it is associated with eroding sands at natural features which expose small stones (pebbles).	Unlikely	No suitable habitat is present for this species within the Project Area
<i>Tringa brevipes</i>	Grey-tailed Tattler	-	P4	DBCA 2020b, Naturemap, PMST	The Grey-tailed Tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves.	Unlikely	No suitable habitat is present for this species within the Project Area

Appendix E Flora species list

Family	Confirmed Name
Aizoaceae	<i>Trianthema triquetrum</i>
Amaranthaceae	* <i>Aerva javanica</i>
Amaranthaceae	<i>Ptilotus astrolasius</i>
Amaranthaceae	<i>Ptilotus fusiformis</i>
Amaranthaceae	<i>Ptilotus obovatus</i>
Amaranthaceae	<i>Ptilotus polystachyus</i>
Apocynaceae	* <i>Calotropis procera</i>
Apocynaceae	<i>Carissa lanceolata</i>
Asteraceae	<i>Pluchea ferdinandi-muelleri</i>
Asteraceae	<i>Pluchea tetranthera</i>
Bignoniaceae	<i>Dolichandrone occidentalis</i>
Chenopodiaceae	<i>Salsola australis</i>
Convolvulaceae	<i>Bonamia erecta</i>
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>
Convolvulaceae	<i>Dodonaea coriacea</i>
Cucurbitaceae	<i>Cucumis variabilis</i>
Cyperaceae	<i>Fimbristylis dichotoma</i>
Fabaceae	<i>Acacia colei</i>
Fabaceae	<i>Acacia sericophylla</i>
Fabaceae	<i>Acacia stellaticeps</i>
Fabaceae	<i>Alternanthera angustifolia</i>
Fabaceae	<i>Bulbostylis barbata</i>
Fabaceae	<i>Calandrinia stagnensis</i>
Fabaceae	<i>Indigofera linifolia</i>
Fabaceae	<i>Indigofera monophylla</i>
Fabaceae	<i>Leptosema anomalum</i>
Fabaceae	<i>Senna notabilis</i>
Fabaceae	<i>Tephrosia rosea</i> var. <i>rosea</i>
Goodeniaceae	<i>Goodenia lamprosperma</i>
Gyrostemonaceae	<i>Codonocarpus cotinifolius</i>
Lauraceae	<i>Cassytha filiformis</i>
Malvaceae	<i>Corchorus walcottii</i>
Malvaceae	<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)
Malvaceae	<i>Triumfetta ramosa</i>
Malvaceae	<i>Waltheria indica</i>
Molluginaceae	<i>Trigastrotheca molluginea</i>
Plantaginaceae	<i>Stemodia viscosa</i>
Poaceae	<i>Aristida holathera</i>
Poaceae	<i>Corymbia candida</i> subsp. <i>lausifolia</i>
Poaceae	<i>Eragrostis eriopoda</i>
Poaceae	<i>Eriachne obtusa</i>
Poaceae	<i>Sorghum timorense</i>

Family	Confirmed Name
Poaceae	<i>Triodia epactia</i>
Poaceae	<i>Triodia schinzii</i>
Portulacaceae	<i>Portulaca oleracea</i>
Proteaceae	<i>Hakea lorea</i>
Thymelaeaceae	<i>Pimelea ammodoris</i>
Violaceae	<i>Hybanthus aurantiacus</i>
Zygophyllaceae	<i>Tribulus occidentalis</i>

Appendix F Flora species by quadrat matrix

Family	Scientific name	ELA A01	ELA A02	ELA A03	ELA A04	ELA A05
Amaranthaceae	<i>Ptilotus astrolasius</i>	0	0	1	1	1
Amaranthaceae	<i>Ptilotus fusiformis</i>	1	1	1	1	1
Amaranthaceae	<i>Ptilotus obovatus</i>	1	0	0	0	0
Amaranthaceae	<i>Ptilotus polystachyus</i>	0	0	0	0	1
Apocynaceae	<i>Carissa lanceolata</i>	0	0	1	0	0
Asteraceae	<i>Pluchea ferdinandi-muelleri</i>	1	1	1	1	1
Asteraceae	<i>Pluchea tetranthera</i>	1	1	0	1	1
Bignoniaceae	<i>Dolichandrone occidentalis</i>	0	0	0	1	1
Convolvulaceae	<i>Bonamia erecta</i>	0	0	1	0	1
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	1	1	1	1	1
Cucurbitaceae	<i>Cucumis variabilis</i>	1	0	0	0	1
Cyperaceae	<i>Fimbristylis dichotoma</i>	1	0	0	0	0
Fabaceae	<i>Acacia colei</i>	1	0	1	1	1
Fabaceae	<i>Acacia sericophylla</i>	0	0	1	1	1
Fabaceae	<i>Acacia stellaticeps</i>	1	1	1	1	1
Fabaceae	<i>Indigofera linifolia</i>	0	0	0	0	1
Fabaceae	<i>Indigofera monophylla</i>	1	0	0	1	1
Fabaceae	<i>Leptosema anomalum</i>	1	1	1	0	0
Fabaceae	<i>Senna notabilis</i>	1	0	0	1	1
Fabaceae	<i>Tephrosia rosea</i> var. <i>rosea</i>	0	0	0	1	0
Lauraceae	<i>Cassytha filiformis</i>	1	1	1	1	1
Malvaceae	<i>Corchorus walcottii</i>	1	0	1	1	1
Malvaceae	<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)	1	0	1	0	1
Malvaceae	<i>Triumfetta ramosa</i>	0	0	0	1	0
Malvaceae	<i>Waltheria indica</i>	1	0	0	0	1
Molluginaceae	<i>Trigastrotheca molluginea</i>	1	0	0	0	1

Family	Scientific name	ELA A01	ELA A02	ELA A03	ELA A04	ELA A05
Poaceae	<i>Aristida holathera</i>	1	1	1	1	1
Poaceae	<i>Eragrostis eriopoda</i>	0	0	0	1	1
Poaceae	<i>Eriachne obtusa</i>	1	1	1	1	0
Poaceae	<i>Sorghum timorense</i>	1	1	1	1	1
Poaceae	<i>Triodia epactia</i>	1	1	1	1	1
Poaceae	<i>Triodia schinzii</i>	1	1	1	1	1
Proteaceae	<i>Hakea lorea</i>	0	1	1	1	0
Thymelaeaceae	<i>Pimelea ammocharis</i>	0	0	0	1	0
Violaceae	<i>Hybanthus aurantiacus</i>	1	1	1	1	1

Appendix G Quadrat site data

Site Name and Number	Date	Site type	Observer
ELA A01	09/07/2020	50 x 50 m	JC & JM
Vegetation Condition	Disturbance Notes	Age since fire	Vegetation Type
Excellent	Nil	Young (1-10 years)	AcAsTe
Habitat description	Landform unit	Aspect	Slope %
Isolated <i>Acacia</i> over open <i>Triodia</i> hummock grassland	Flat	N/A	0
Soil colour	Soil texture	Soil type	Soil condition
Brown/Red	Medium	Sand	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Nil	0	0.2	25
Easting		Northing	
661071		7741101	



Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Acacia coleii</i>	0.1	120	U
<i>Acacia stellaticeps</i>	5	40	M
<i>Aristida holathera</i>	0.05	45	M
<i>Cassytha filiformis</i>	0.2	CL	G

Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Corchorus walcottii</i>	0.1	45	M
<i>Cucumis variabilis</i>	0.01	CL	G
<i>Eriachne obtusa</i>	0.5	40	M
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.01	15	G
<i>Fimbristylis dichotoma</i>	0.03	40	M
<i>Hybanthus aurantiacus</i>	0.02	30	M
<i>Indigofera monophylla</i>	0.1	30	M
<i>Leptosema anomalum</i>	0.05	30	M
<i>Pluchea ferdinandi-muelleri</i>	0.5	45	M
<i>Pluchea tetranthera</i>	0.05	30	M
<i>Ptilotus fusiformis</i>	0.01	30	G
<i>Ptilotus obovatus</i>	0.02	50	M
<i>Senna notabilis</i>	0.02	25	M
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)	0.02	60	M
<i>Sorghum timorense</i>	1	120	U
<i>Trigastrotheca molluginea</i>	0.02	20	G
<i>Triodia epactia</i>	10	80	U
<i>Triodia schinzii</i>	0.5	50	M
<i>Waltheria indica</i>	0.01	35	M

Site Name and Number	Date	Site type	Observer
ELA A02	10/07/2020	50 x 50 m	JC & JM
Vegetation Condition	Disturbance Notes	Age since fire	Vegetation Type
Excellent	Nil	Young (1-10 years)	AcAsTe
Habitat description	Landform unit	Aspect	Slope %
Open <i>Triodia</i> Hummock grassland	Flat	N/A	0
Soil colour	Soil texture	Soil type	Soil condition
Brown/Red	Medium	Sand	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Nil	0	0.2	40
Easting		Northing	
660772		7741266	



Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Acacia stellaticeps</i>	2	40	M
<i>Aristida holathera</i>	0.02	40	M
<i>Cassytha filiformis</i>	0.02	CL	G
<i>Eriachne obtusa</i>	0.05	35	M
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.01	15	G
<i>Hakea lorea</i>	0.2	100	U
<i>Hybanthus aurantiacus</i>	0.01	35	M

Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Leptosema anomalum</i>	0.5	30	M
<i>Pluchea ferdinandi-muelleri</i>	0.2	40	M
<i>Pluchea tetranthera</i>	0.1	30	M
<i>Ptilotus fusiformis</i>	0.01	30	M
<i>Sorghum timorense</i>	0.1	120	M
<i>Triodia epactia</i>	25	50	M

Site Name and Number	Date	Site type	Observer
ELA A03	10/07/2020	50 x 50 m	JC & JM
Vegetation Condition	Disturbance Notes	Age since fire	Vegetation Type
Excellent	Nil	Young (1-10 years)	AcAsTe
Habitat description	Landform unit	Aspect	Slope %
Sparse <i>Acacia</i> shrubland over <i>Senna</i> on stony plain	Flat	N/A	0
Soil colour	Soil texture	Soil type	Soil condition
Brown/Red	Medium	Sand	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Nil	0	0.2	10
Easting		Northing	
661015		7741409	



Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Acacia colei</i>	0.05	50	M
<i>Acacia sericophylla</i>	0.1	110	U
<i>Acacia stellaticeps</i>	20	40	M
<i>Aristida holathera</i>	0.01	40	M
<i>Bonamia erecta</i>	0.02	30	M
<i>Carissa lanceolata</i>	0.1	80	U
<i>Cassytha filiformis</i>	0.1	CL	G

Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Corchorus walcottii</i>	20	30	M
<i>Eriachne obtusa</i>	0.02	35	M
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.01	15	G
<i>Hakea lorea</i>	0.1	110	U
<i>Hybanthus aurantiacus</i>	0.01	30	M
<i>Leptosema anomalum</i>	1	30	M
<i>Pluchea ferdinandi-muelleri</i>	0.3	80	U
<i>Ptilotus astrolasius</i>	0.02	40	M
<i>Ptilotus fusiformis</i>	0.01	30	M
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)	0.05	50	M
<i>Sorghum timorense</i>	0.02	150	U
<i>Triodia epactia</i>	10	50	M
<i>Triodia schinzii</i>	2	100	U

Site Name and Number	Date	Site type	Observer
ELA A04	10/07/2020	50 x 50 m	JC & JM
Vegetation Condition	Disturbance Notes	Age since fire	Vegetation Type
Excellent	Nil	Young (1-10 years)	AcAsTe
Habitat description	Landform unit	Aspect	Slope %
Isolated <i>Acacia</i> over open <i>Triodia</i> hummock grassland	Flat	N/A	0
Soil colour	Soil texture	Soil type	Soil condition
Brown/Red	Medium	Sand	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Nil	0	1	15
Easting		Northing	
661191		7741588	



Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Acacia colei</i>	0.5	120	U
<i>Acacia sericophylla</i>	0.5	120	U
<i>Acacia stellaticeps</i>	20	40	M
<i>Aristida holathera</i>	0.02	40	M
<i>Cassytha filiformis</i>	0.1	CL	G
<i>Corchorus walcottii</i>	0.4	45	M
<i>Dolichandrone occidentalis</i>	0.2	80	U

Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Eragrostis eriopoda</i>	0.25	40	M
<i>Eriachne obtusa</i>	0.1	30	M
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.01	15	G
<i>Hakea lorea</i>	0.3	100	U
<i>Hybanthus aurantiacus</i>	0.1	40	M
<i>Indigofera monophylla</i>	0.2	35	M
<i>Pimelea ammocharis</i>	0.05	80	U
<i>Pluchea ferdinandi-muelleri</i>	0.2	60	M
<i>Pluchea tetranthera</i>	0.01	30	M
<i>Ptilotus astrolasius</i>	0.5	45	M
<i>Ptilotus fusiformis</i>	0.01	35	M
<i>Senna notabilis</i>	0.02	40	M
<i>Sorghum timorense</i>	0.2	100	U
<i>Tephrosia rosea</i> var. <i>rosea</i>	0.02	45	M
<i>Triodia epactia</i>	15	50	M
<i>Triodia schinzii</i>	5	85	U
<i>Triumfetta ramosa</i>	0.02	50	M

Site Name and Number	Date	Site type	Observer
ELA A05	10/07/2020	50 x 50 m	JC & JM
Vegetation Condition	Disturbance Notes	Age since fire	Vegetation Type
Very Good	Grazing, cattle tracks	Old (>20 years)	ApAkAc
Habitat description	Landform unit	Aspect	Slope %
Open <i>Acacia</i> shrubland on stony plain	Flat to open depression	N/A	0
Soil colour	Soil texture	Soil type	Soil condition
Orange	Fine	Light clay	Dry
Rock type	Outcropping %	Litter (%)	Bare ground (%)
Granite, ironstone and quartz	0	0.05	80
Easting		Northing	
424094		7336970	



Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Acacia colei</i>	0.2	150	U
<i>Acacia sericophylla</i>	0.2	120	U
<i>Acacia stellaticeps</i>	40	70	U
<i>Aristida holathera</i>	0.01	35	M
<i>Bonamia erecta</i>	0.02	40	M
<i>Cassytha filiformis</i>	0.02	CL	G
<i>Corchorus walcottii</i>	0.3	60	M

Species	Cover (%)	Height (cm)	Stratum (U=Upper, M=Middle, G=Ground)
<i>Cucumis variabilis</i>	0.03	CL	G
<i>Dolichandrone occidentalis</i>	0.1	80	U
<i>Eragrostis eriopoda</i>	0.2	40	M
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.01	20	M
<i>Hybanthus aurantiacus</i>	0.03	35	M
<i>Indigofera linifolia</i>	0.01	20	M
<i>Indigofera monophylla</i>	0.2	40	M
<i>Pluchea ferdinandi-muelleri</i>	0.05	45	M
<i>Pluchea tetranthera</i>	0.01	40	M
<i>Ptilotus astrolasius</i>	0.05	50	M
<i>Ptilotus fusiformis</i>	0.01	50	M
<i>Ptilotus polystachyus</i>	0.01	50	M
<i>Senna notabilis</i>	0.02	30	M
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)	0.02	60	M
<i>Sorghum timorense</i>	0.2	120	U
<i>Trigastrotheca molluginea</i>	0.01	15	G
<i>Triodia epactia</i>	20	50	M
<i>Triodia schinzii</i>	1	100	U
<i>Waltheria indica</i>	0.05	80	M

Appendix H Hierarchical clustering dendrogram

