



Yara Pilbara Fertilisers Pty Ltd

Renewable Hydrogen Project Flora and Fauna Survey

June 2020

Executive summary

Yara Pilbara Fertilisers Pty Ltd (YPF) and Engie are proposing to develop a renewable hydrogen plant to provide a feed source for their existing ammonia plant on the Burrup Peninsula near Dampier. The renewable hydrogen plant would consist of an electrolyser and its balance of plant, a dedicated solar photovoltaic (PV) farm and supporting infrastructure, including roads (the Project).

YPF commissioned GHD Pty Ltd (GHD) to undertake a detailed flora and vegetation survey and level 2 fauna survey for the project. The survey area is located adjacent to the existing YPF Plant on the Burrup Peninsula and covers approximately 96.16 hectares.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions and qualifications contained throughout this report.

Key findings

Flora and Vegetation

Seven vegetation types were identified and described for the survey area, as well as cleared areas and seasonally inundated/open water. The vegetation within the survey area north of the existing YPF Plant primarily consists of hummock grasslands of *Triodia epactia* and *T. wiseana* with scattered to open shrublands dominated by *Acacia*, *Hakea* and *Grevillea* species on rocky hills. The vegetation south of the ammonia plant was generally dominated by samphire shrublands and *Triodia angusta* low hummock grasslands on saline tidal flats and **Cenchrus ciliaris* (Buffel grass) grasslands on coastal sands.

One Priority 1 Priority Ecological Community (PEC) was identified within the survey area. *Terminalia* scattered low trees (VT02) is considered to be representative of the Burrup Peninsula Rock Pile Communities PEC. There is approximately 2.09 ha of this PEC occurring within the survey area of which all is in Excellent condition. The *Tecticornia* isolated shrubs to open low shrubland (VT05) corresponds with vegetation units mapped by M.E. Trudgen & Associates (2002) designated Sm and described as Saline Inlet and Supra-tidal Flats. This vegetation was considered of conservation significance as it occurs in the tidal inlet between Hearson Cove and King Bay.

The survey recorded a total of 141 flora taxa (including subspecies and varieties) representing 40 families and 99 genera within the survey area. This total comprised of 138 native taxa and three introduced taxa, **Cenchrus ciliaris* (Buffel grass), **Aerva javanica* (Kapok bush) and **Vachellia farnesiana* (Mimosa bush).

Three Priority species listed by the DBCA was recorded within the survey area, *Terminalia supranitifolia* (Priority 3), *Vigna triodiophila* (Priority 3) and *Rhynchosia bungarensis* (Priority 4). These three species were largely restricted to the northern part of the survey area and grew in association with three vegetation types. An additional Priority flora species is considered likely to occur within the survey area. *Stackhousia clementii* (Priority 3) has previously been recorded within the survey area in the King Bay – Hearson Cove tidal inlet, just south of the existing ammonia plant. The area was systematically searched during the survey however no individuals were observed.

Fauna

Six broad habitat types (excluding disturbed/cleared areas) were recorded from the survey area. These habitat types closely align with the vegetation types and landforms within the survey area and consist of Rocky Outcropping, Foothills, Sand Plain, Minor Creek lines, Drainage area/

Floodplain and Water body. The most significant fauna habitats with the survey area are the Rocky Outcropping, Drainage area/ Floodplain and water body due to the conservation significant fauna that were recorded there.

The wet season (Level 2) 2020 fauna surveys recorded 113 vertebrate fauna species utilising the survey area, including 19 mammals, 57 birds, 36 reptiles and one amphibians. Of these four were introduced species and included Dog, Cat, Fox and Black Rat.

Eight conservation significant fauna species were recorded within the survey area during the field survey. This included:

- Pilbara Olive Python (*Liasis olivaceus barroni*) – Listed as Vulnerable under the BC Act and the EPBC Act
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Listed as Priority 4 by DBCA
- North-western Free-tail Bat (*Mormopetrus ozimops cobourgianus*) – Listed as Priority 1 by DBCA
- Caspian Tern (*Hydroprogne caspia*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Gull-billed Tern (*Gelochelidon nilotica*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Common Sandpiper (*Actitis hypoleucos*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Common Greenshank (*Tringa nebularia*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Red-necked Stint (*Calidris ruficollis*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act.

Of these species the terns and migratory shorebirds are considered vagrant and would seasonally utilise the waterbody and opportunistically utilise Drainage area/ Floodplain areas around high tide events. The Pilbara Olive Python is resident to the Rocky Outcropping and this would be considered core habitat for this species. The foothills and water body would be seasonally utilised for feeding and disbursal purposes. Old Western Pebble-mound Mouse mounds were recorded in the Foothills with the species considered no longer present on the Burrup Peninsula. The North-western Free-tail Bat was recorded via echolocation. This species core habitat is mangroves to which there is none within the survey area. Mangroves are present in King Bay and Hearson Cove therefore activity within the survey area is for foraging only.

An additional 23 other conservation significant species are likely to occur in the survey area. Most of these species are considered likely due to the floodplain and water body habitat provided in the survey at the time of the survey. This habitat incorporates a large water body and associated vegetation suitable habitat for numerous migratory shore bird species. The remaining habitat of the survey area are not considered to be utilised by these species. The Peregrine Falcon is likely to utilise all habitat types for foraging however no breeding habitat (cliffs, gorges, large trees) is present in the survey area.

Table of contents

1.	Introduction	1
1.1	Background	1
1.2	Purpose of this report	1
1.3	Project location	1
1.4	Scope of works	1
1.5	Relevant legislation, conservation codes and background information	2
1.6	Report limitations and assumptions	2
2.	Methodology	4
2.1	Desktop assessment	4
2.2	Field survey	4
2.3	Limitations	13
3.	Desktop assessment	16
3.1	Regional biogeography	16
3.2	Landforms and soils	16
3.3	Land systems	16
3.4	Hydrology	16
3.5	Land use	17
3.6	Vegetation and flora	17
3.7	Fauna	19
3.8	Previous studies	19
4.	Field survey results	22
4.1	Flora and vegetation	22
4.2	Fauna	31
5.	Discussion	51
5.1	Flora and vegetation	51
5.2	Fauna	51
6.	Conclusions	52
6.1	Key findings	52
7.	References	54

Table index

Table 1	Data collected during the field	5
Table 2	Fauna references	7
Table 3	Camera trap locations	9
Table 4	Bat acoustic recorder locations	10
Table 5	Survey effort	12

Table 6	Survey limitations	14
Table 7	Pre-European vegetation extents (GoWA 2019)	17
Table 8	PECs identified in the desktop searches	18
Table 9	Previous flora and fauna surveys undertaken on the Burrup Peninsula and surrounds relevant to the survey area.....	20
Table 10	Vegetation types identified within the survey area	23
Table 11	Extent of vegetation condition ratings mapped within the survey area	28
Table 12	Broad habitat types within the survey area.....	34
Table 13	Mammal families recorded during the field surveys	39
Table 14	Bird families recorded during the field surveys	40
Table 15	Reptile families recorded during the field surveys.....	40
Table 16	Location and comment on Pilbara Olive Python recorded	43
Table 17	Location and comments on Western Pebble-mound Mouse Mounds.....	44
Table 18	Location and comments on tern species recorded	46
Table 19	Location and comments on migratory waders recorded	47
Table 20	Summary of likelihood of occurrence assessment for conservation significant fauna species deemed likely to occur	48

Appendices

Appendix A – Figures

Appendix B – Relevant legislation, conservation codes and background information

Appendix C – Database searches

Appendix D – Flora survey results

Appendix E – Fauna survey results

Appendix F – Bat Call Analysis

1. Introduction

1.1 Background

Yara Pilbara Fertilisers Pty Ltd (YPF) and Engie are proposing to develop a renewable hydrogen plant to provide a feed source for their existing ammonia plant on the Burrup Peninsula near Dampier. The renewable hydrogen plant would consist of an electrolyser and its balance of plant, a dedicated solar photovoltaic (PV) farm and supporting infrastructure (the Project).

1.2 Purpose of this report

GHD Pty Ltd (GHD) was commissioned by YPF to undertake a detailed flora and vegetation survey and level 2 fauna survey for the project. The purpose of the surveys are to delineate key flora, vegetation and fauna values within the survey area. The outcome of the surveys and information supplied in the report will be used to inform the environmental assessment and approvals process.

1.3 Project location

1.3.1 Survey area

The survey area is located adjacent to the existing YPF Plant on the Burrup Peninsula, City of Karratha, in the Pilbara region of Western Australia (WA). The survey area consists of two areas totalling 96.16 hectares (ha).

The location of the survey area is shown on Figure 1, Appendix A.

1.3.2 Study area

A study area was defined for the desktop based searches of the assessment and includes a 10 kilometre (km) buffer of the survey area. A 10 km buffer is considered sufficient for the purpose of flora and fauna database searches for the Burrup Peninsula.

1.4 Scope of works

The scope of works was to undertake a desktop assessment and biological survey of the survey area. The following actions were completed to fulfil the scope:

- A desktop assessment of the survey area prior to the field survey to identify biological features and constraints, which may be in, or near the survey area
- A detailed flora and vegetation survey of the survey area to identify and map:
 - Vegetation types present, including any Threatened or Priority Ecological Communities (TECs and PECs) or other significant vegetation
 - Vegetation condition including the location of any Weeds of National Significance (WONS) or Declared Weeds
 - Flora species present including introduced species
 - The presence or likelihood of any Threatened or Priority flora
- A level 2 terrestrial fauna survey of the survey area to identify and map:
 - Fauna habitat types
 - Fauna species present including introduced species

- The presence or likelihood of any Threatened or Priority fauna
- Preparation of a biological survey report (this document) that:
 - Documents the results of the desktop assessment and field survey, including mapping
 - Identifies and discusses potentially occurring significant flora, vegetation and fauna species and their habitat
- Provision of spatial files in GIS format.

1.5 Relevant legislation, conservation codes and background information

In Western Australia (WA) significant communities, and flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory bodies also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this project is provided in Appendix B.

1.6 Report limitations and assumptions

This report has been prepared by GHD for Yara Pilbara Fertilisers Pty Ltd and may only be used and relied on by Yara Pilbara Fertilisers Pty Ltd for the purpose agreed between GHD and the Yara Pilbara Fertilisers Pty Ltd as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Yara Pilbara Fertilisers Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Yara Pilbara Fertilisers Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of access tracks, operational works, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of the field survey. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and fauna within the survey area. Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to the study area and to assist in survey design. The desktop assessment involved a review of:

- Previous reports relevant to the study area
- The Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the study area (DAWE 2020a) (Appendix C)
- The Department of Biodiversity, Conservation and Attractions (DBCA) TEC and PEC database to determine the potential for TECs or PECs to be present within the study area
- The *NatureMap* database for flora and fauna species previously recorded within the study area (DBCA 2007–) (Appendix C)
- The DBCA Threatened (Declared Rare) and Priority Flora database (TPFL), Threatened and Priority Fauna database, and the WA Herbarium database (WAHERB) and for Threatened and Priority flora species listed under the *Biodiversity Conservation Act 2016* (BC Act) and listed as priority by DBCA, previously recorded within the study area
- Existing datasets including previous vegetation mapping of the survey area, aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora and fauna species.

2.2 Field survey

2.2.1 Flora and vegetation

Field survey details and timing

The detailed flora and vegetation field survey was carried out by GHD ecologist Erin Lynch (flora licence no. SL012374) over six days from the 3 to 8 March 2020. The field survey was undertaken to identify and describe the dominant vegetation units, assess vegetation condition, and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant or other significant ecological communities and flora taxa were also undertaken during the field survey.

The survey methodology employed by GHD was undertaken with reference to the Environmental Protection Authority (EPA) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a).

Data collection

The survey methods involved a combination of sampling quadrats, relevés and photographic reference points located in identified vegetation units and walking traverses. Fifteen quadrats and six relevés were described throughout the survey area. Quadrat and relevé locations are shown on Figure 3, Appendix A and the data is provided in Appendix D.

Quadrats (measuring 50 m x 50 m – area of 2500 m²) were located within each identified vegetation unit. A minimum of three quadrats were located within each identified vegetation unit, except where the total area of the vegetation type was too small or could not be accessed. Relevés (unmarked search area) were completed to supplement quadrat data and to represent vegetation types of an irregular distribution (such as gullies, riparian areas and rock piles). Relevés were undertaken retaining a 2,500 m² search area where possible. Field data at each quadrat and relevé was recorded on a pro-forma data sheet and included the parameters detailed in Table 1.

Table 1 Data collected during the field

Aspect	Measurement
Collection attributes	Site code, personnel/recorder, date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, slope, landform, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum using a hand-held GPS tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale adapted by EPA (2016a) for the Eremaean and Northern Botanical Province.
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, clearing).
Flora	List of dominant flora from each structural layer, list of all species within the quadrat including average height and cover (using NVIS).

A flora inventory was compiled from taxa listed in described quadrats and relevés and from opportunistic floristic records throughout the survey area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations. Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat and relevé data and field observations. Vegetation unit descriptions follow NVIS and are consistent with NVIS Level V (Association). At Level V up to three taxa per stratum are used to describe the association (NVIS Technical Working Group 2017).

Statistical analyses

PRIMER v6 (Clarke and Gorley 2006) was used to examine the similarity between sites using collected data. A presence/absence matrix was created of all taxa (including perennials and annuals) present in GHD quadrats. The dissimilarity between quadrats was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A Cluster analysis (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. The outputs of the PRIMER analysis were used to inform decisions on vegetation units.

Vegetation condition

The vegetation condition was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Province of Western Australia (IBRA) (devised by Keighery (1994) and adapted by EPA (2016a)). The scale recognises the intactness of vegetation and consists of seven rating levels. The vegetation condition rating scale is located in Appendix B.

Surveys for conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. previous surveys, aerial photography, geology, soils and topography data, EPBC Act PMST (DAWE 2020a), TPFL, *NatureMap* and the WAHERB databases search results) were reviewed to determine conservation significant flora taxa potentially present within the study area. Additionally, ecological information (e.g. habitat, associated flora taxa and phenology) was sourced from FloraBase (WA Herbarium 1998–) to provide further details.

Potential habitats and locations of previous records were searched by walking traverses spaced approximately 20 metres (m) apart across the survey area. Locations within the survey area with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

Flora identification and nomenclature

Species well known to the survey botanist were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Species were identified by the use of taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–) and the EPBC Act Threatened species database provided by DAWE (2020b). Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 1998–).

2.2.2 Fauna survey

Field survey details and timing

The fauna field survey comprised a ten day single season Level 2 survey from 3 to 12 March 2020. The field survey was led by senior zoologist Glen Gaikhorst with assistance from GHD ecologists Madi Roberts and Brad Maryan, and environmental scientist Karina Potts. The survey was undertaken to identify and describe the dominant fauna habitat types present, assess habitats for conservation significant fauna, assess habitat connectivity, and identify and record fauna species through a trapping program and opportunistically. An assessment of the likelihood of occurrence of conservation significant fauna was also undertaken based on the database searches and previous local studies in consideration of fauna habitats occurring within the survey area.

Guiding documents

The survey methodology and data collection that GHD employed was consistent with:

- EPA Technical Guidance –Terrestrial Fauna Surveys, Perth, Environmental Protection Authority (EPA 2016a)
- EPA Technical Guidance – Sampling methods for terrestrial vertebrate fauna, Perth, Environmental Protection Authority (EPA 2016b)
- Survey Guidelines for Australia's Threatened Bats (Department of the Environment, Water, Heritage and the Arts 2010a)
- Survey Guidelines for Australia's Threatened Mammals (Department of the Environment, Water, Heritage and the Arts 2010b)
- Survey Guidelines for Australia's Threatened Reptiles (Department of the Environment, Water, Heritage and the Arts 2010c).

Permits and ethics

A Regulation 17 Licence to Take Fauna for Scientific Purposes was obtained from DBCA prior to undertaking the fauna survey (Licence Number: BA27000218). This permit also allows vouchering a limited number of non-conservation significant specimens for lodgement with the WAM. However in general, only specimens of particular scientific interest or taxonomic significance are collected for the WAM. The fauna survey (specifically trapping and animal handling) was undertaken in accordance with Standard Operating Procedures (SOPs) which were required to be followed under the conditions of GHD's fauna trapping permit. At the time of survey, compliance with these SOPs was accepted by DBCA as evidence of ethical treatment of animals.

Habitat assessment

Habitat assessment was conducted while undertaking the fauna trapping program. Field data was collected using Collector for ArcGIS for all systematic fauna sampling sites (section 0), at significant species record sites and other locations as required to enable delineation and mapping of major fauna habitat types throughout the survey area.

Broad habitat types within the survey area were identified, mapped and described based on the following:

- Geomorphology and substrate
- Photos of representative habitat types
- Vegetation dominant structure
- Values to associated fauna including significant species (e.g. refugee, foraging, shelter)
- Ecological processes of importance
- Disturbances (weeds, fire, ground disturbance)
- Wider extent and connectivity of habitat type based on previous mapping
- Comparison between broad habitat types
- Evaluation of the likelihood of occurrence of conservation significant fauna within the environments present (based on presence of suitable habitats and species recorded).

Fauna identification and nomenclature

Fauna were identified in the field using reference books and field guides and electronic guides (Table 2). Where identification was not possible, photographs of specimens were collected to be later identified. Nomenclature used in this report follows that used by WAM as reported on *NatureMap*. This nomenclature is deemed the most up-to-date species information for WA fauna.

Table 2 Fauna references

Fauna group	Field guide
Mammals	Menkhorst and Knight (2010), Van Dyck and Strahan (2008)
Bats	Churchill (2008), Menkhorst and Knight (2010)
Birds	Morcombe (2004)
Reptiles	Wilson and Swan (2017), Storr et al. (1999), Storr et. al. (2002)
Amphibians	Tyler and Doughty (2009)

Systematic trapping program

Systematic trapping programs are designed for recording general inventory species and significant species in a standardised approach where trapping and other survey effort is equal

and quantifiable across all trapping quadrats. This allows comparison of species abundance and richness between sampling sites and habitat types, and provides a robust and reproducible approach for analysing species accumulation data.

Trapping for terrestrial vertebrate fauna was undertaken using a series of standardised systematic trapping quadrat sites comprising pit-fall traps, Elliott box traps, cage traps and funnel traps. Traps were checked and cleared as per licence conditions within specified times each morning, middle of the day and evening, with fauna identified and released in situ. For each quadrat timed bird survey and active searching was also carried out.

A total of five quadrats were established within the representative habitat types in the survey area. Each quadrat was surveyed (trapped) for seven to eight nights. Checking of traps was carried out in accordance with the DBCA fauna trapping licence stipulating daily requirements for clearing traps. The trap method used are described below.

Fauna survey locations are shown on Figure 3, Appendix A. Fauna survey effort is described below and summarised in Table 5.

Pit-trap with drift fence

Six pit-fall traps consisting of buckets were installed in a linear formation at approximately 25 meter interval within each of the five quadrats. Where ground substrates were not conducive to digging the bucket was replaced with a funnel trap. This gave a total of 23 pit-fall traps across the survey area. Buckets were 20 litre plastic buckets (25 cm diameter by 40 cm deep). Each pit-fall trap was set with a 6-8 meters (m) long flywire drift fence (30 cm high) bisecting the pits to direct fauna into them. Soil, leaf litter and egg crate was placed within each pit to provide shade and protection to trapped fauna. Due to the time of year additional shelter for the bucket was provided via cardboard gazebo.

Funnel traps

Two funnel traps were set on each drift fence and positioned with one funnel at each end, giving a total of 12 funnels set at each trapping quadrat. Where buckets could not be installed additional funnels were utilised. Funnel traps were placed such that animals were directed into them from the drift fence. Funnel traps were covered with insulating and highly reflective materials or cardboard to maximise shade, and minimise heat and cold exposure to animals. In total 56 funnels were utilised.

Elliott box traps

Six Elliott box traps were used at each quadrat site. However at site 4 due to the rocky habitat (and potential for additional saxicoline species) an additional six Elliott traps were established. Traps were placed approximately 20 m apart and within 10 m from each respective pit-fall trap, and baited with universal bait (a mixture of peanut butter, rolled oats and sardines). Elliott traps were located within shady areas or covered with vegetation to minimise exposure to captured animals. Due to the hot conditions all Elliott traps were closed during the middle of the day. A total of 38 Elliott box traps were set.

Cage traps

One cage trap was located at each quadrat site, located in shady environments. Cage traps were baited with universal bait and each was covered with a hessian sack. Additionally to compliment the cage trap a remote camera was also positioned at each quadrat to capture any small to mid sized species. Cameras were also baited using sardines. In total five cages and five remote cameras were positioned at each quadrat.

Avifauna

Avifauna surveys were undertaken within each of the quadrat sites. Each survey comprised of a 20 minute census of birds within an unbounded 2 ha area. This approach is the standard method used by Birds Australia for the Bird Atlas project. Birds detected visually (using binoculars) and/or aurally over a 20 minute period were recorded. Numbers of each species observed were also recorded. All systematic bird surveys were undertaken within four hours of dawn or two hours of dusk, as these are the times of day when birds are most active. In addition to systematic surveys, observations of birds were also made opportunistically.

Active searches

Each quadrat site was actively searched by hand and using cultivator rakes for amphibians, reptiles, and mammals. Searches comprised overturning logs and looking underneath/in bark, rocks and leaf litter and low vegetation, and other ground debris to search for inactive fauna. All fauna both inactive and active including abundance was recorded. Species presence was also determined via secondary evidence, in the form of scats, tracks, feathers, skeletal remains and burrows. A minimum of one hour was spent at each quadrat and the general area around it.

Remote Fauna recording devices

Motion Cameras

Motion sensor cameras (Reconyx-Hyperfire) were deployed for a maximum of nine nights. Cameras were used for target significant fauna species detection and for general species inventory recording medium to large mammals, birds and reptiles. Cameras were set in areas where species might potentially be recorded e.g. rocky potential forage or den sites, at suspected active burrows, or along potential fauna movement corridors such as vehicle access tracks. Cameras were baited with sardines to attract fauna species within the survey area. For each camera location the time, date deployed, date recovered and the GPS coordinates were recorded (Table 3).

Data from the cameras were and analysed for the presence of animals following the field survey.

Table 3 Camera trap locations

Camera No.	Habitat type	Micro habitat	Location		Nights deployed
			Latitude	Longitude	
166	Floodplain/ Drainage line	Chenopod	-20.628289	116.788240	8
158	Floodplain/ Drainage line	Chenopod	-20.629643	116.784205	8
28	Sandplain	Tussock grasses	-20.629718	116.786110	8
14	Sandplain	Tussock grasses	-20.627226	116.791945	8
24	Floodplain/ Drainage line	Chenopod	-20.628651	116.789166	9
19	Rocky Outcrops	Rocky hills	-20.621616	116.779277	9
2	Rocky Outcrops	Rocky hills	-20.621619	116.780535	9
12	Rocky Outcrops	Rocky hills	-20.622378	116.781884	9
3	Foothills	Shrubland	-20.624626	116.779099	9
ghdB	Foothills	Shrubland	-20.624254	116.782015	8
Total					85 nights

Bat acoustic recorders

Bat Detectors (SM4 Songmeters) were deployed targeting a range of micro bats, but focussing on Ghost Bat and Pilbara Leaf-nosed Bat (PLNB). Detectors were set for up to two nights at selected locations. Bat detectors were positioned in areas where bat species were likely to be present i.e. water bodies, fly-ways such as rocky gullies, and set at potential roost caves. Bat detectors were programmed to record from 25 minutes pre-dusk to 25 minutes post-dawn. For each detector the time, date deployed, date recovered and the GPS coordinates were recorded (Table 4).

Data from the bat detectors were downloaded and analysed for the presence of animals following the field survey. Data from the detectors was analysed by Craig Grabham to determine species based using Kaleidoscope ® bat analysis software and a series of graphical reference comparison calls.

Table 4 Bat acoustic recorder locations

Site ID	Detector	Habitat type	Location		Nights deployed
			Latitude	Longitude	
Site 1	SM4-1	Hillcrest/Hillslope	-20.622327	116.778731	2
Site 2	SM4-6	Hillcrest/Hillslope	-20.628417	116.785029	3
Site 3	SM2-2	Hillcrest/Hillslope	-20.627087	116.789081	3
Total					7 nights

Non-systematic fauna survey

Non-systematic survey methods augment systematic trapping are aimed at detecting conservation significant species, and boosting inventory species records. These methods detect fauna by opportunistic observation and selectively searching particular habitat types and landform features in consideration of target species habitat preferences, optimal seasonal and diurnal timing to record active fauna or opportunistic secondary evidence. Non-systematic methods described below, particularly opportunistic observations generally account for a high proportion of the total fauna inventory and significant fauna recorded during surveys.

Nocturnal searching

Spot lighting was undertaken to locate nocturnal species such as nocturnal reptiles, mammals and birds that may otherwise remain undetected using other survey techniques. Hand held or head mounted spotlights were used for a minimum of one hour by two personnel in selected areas based on habitat suitability and site access in consideration of HSE requirements. In this survey only one nocturnal searching assessment was undertaken.

Opportunistic observations

Opportunistic observations involve the recording of fauna taxa (physical presence and/or signs of presence) spatially throughout the survey area. Opportunistic observations include physical observations (sighting or hearing fauna), and indirect evidence (scats, tracks, diggings, nests, feathers, skeletal remains, pellets) which indicate the current or recent activity of a species. Wherever possible, numbers of individuals, microhabitat use and other relevant information was recorded. Opportunistic observations were recorded outside of the diurnal, nocturnal or general trap site surveys (for example when driving, traversing the survey area, and during habitat assessment).

Cave searches

Cave searches were undertaken to identify potentially suitable structures for PLNB or Ghost Bat. Searches were undertaken on foot and included traversing outcrops considered to potentially contain caves. No caves were identified within the survey area.

Survey effort

Survey effort is described as the amount and type of survey that is undertaken during an assessment. Table 5 provides detail on the type and amount of survey time undertaken during the Level 2 fauna survey. Each of the five trapping sites were sampled for 7/8 consecutive trap-nights including bucket, cage, funnel, remote cameras and Elliott traps. Additionally 2-3 nights were sampled for bat acoustics, 135 to 160 minutes of night searches, 90 to 120 minutes of active searches and 90 to 120 minutes of bird assessments were undertaken at each quadrat (trap) site. The total trapping effort included 982 trap-nights (total trap effort), 550 minutes of bird assessments, 530 minutes of active searches, 810 minutes of night searches, seven nights of Bat detection and 85 camera nights.

Table 5 Survey effort

Trap site	Latitude	Longitude	Open	Pit-fail traps		Elliot traps		Cage traps		Funnel traps		Bats	Night search	Bird search	Active search
				(nights)	Per site	Trap nights	Per site	Trap nights	Per site	Trap nights	Per site				
1	-20.629211	116.790904	8	6	48	6	48	1	8	12	96	3	135	120	120
2	-20.628531	116.791432	8	6	48	6	48	1	8	12	96	3	135	100	100
3	-20.624299	116.779233	8	6	48	6	48	1	8	12	96	-	160	120	100
4	-20.622802	116.778389	8	1	8	12	96	1	8	12	96	2	160	120	120
5	-20.622584	116.781463	7	4	28	6	42	1	8	12	96	-	160	90	90
Total			-	23	180	36	282	5	40	60	480	7	810	550	530

Data analysis

Dendrogram

PRIMER v6 (Clarke and Gorley 2006) was used to examine the similarity between trapping sites using collected data. A matrix was created of all species (based on abundance) recorded at each trap site. The dissimilarity between sites was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A dendrogram (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. A factor was added to the output to define trap sites by habitat type.

Species accumulation

The number and type of species trapped each day was recorded and a species accumulation curve was created for the survey area using PRIMER v6 (Clarke and Gorley 2006). The species accumulation curve represents the successfulness of the trapping program for its duration. Typically, the longer the trapping program the more complete the representation of species sampled per trapping location or habitat type. Accumulation curves should show “levelling” of the groups species counts prior to the completion of the survey. Many limitations can influence the results of a curve and should be observed as a guide to the project’s success.

The data was run through PRIMER v6 against 8 existing models, these models are:

- Sobs – Curve of observed species counts
- Chao 1 – Chao's estimator based on number of rare species
- Chao 2 – Chao's estimator using just presence-absence data
- Jackknife 1 – Jackknife estimator based on species that only occur in one sample
- Jackknife 2 – Second order jackknife estimator
- Bootstrap – Bootstrap estimator based on proportion of quadrats containing each species
- MM (Michaelis-Menton) – Curve fitted to observed Sobs curve
- UGE – Calculated species accumulation curve based on (Ugland et al 2003).

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DBCA searches of Threatened flora and fauna provide more accurate information for the general area and local occurrence. However, some collections, sighting or trapping records cannot be dated and often misrepresent the current range of Threatened species.

2.3.2 Field survey limitations

The EPA (2016a, b) states that fauna and flora survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with the flora and fauna field survey are discussed in Table 6.

Table 6 Survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information	Nil	Adequate information is available for the survey area including: <ul style="list-style-type: none"> • Broad scale (1:250,000) mapping by Beard (1975) and digitised by Shepherd et al. (2002) • Regional biogeography (Van Vreeswyk et al. 2004) • A vegetation and floristic survey of the Burrup Peninsula and adjacent island Trudgen (2002).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not surveyed.
Proportion of flora collected and identified	Minor	The detailed flora and vegetation survey was undertaken at an optimal time (March). The recommended timing for flora surveys in the Northern Botanical Province region is during the wet season (January-March) (EPA 2016a). All taxonomic groups were considered to be represented. The portion of flora collected and identified was considered moderate to high. However it is likely the survey may have under-recorded some annuals and herbs due to a number of herbs being at an early stage of growth.
Flora determination	Minor	Flora determination was undertaken by GHD botanist/ecologist in the field and at the WA Herbarium. Species that could not be identified in the field were identified by the experienced taxonomic botanist Frank Obbens. Nine taxa could be identified to genus level only, and seven taxa could be tentatively identified to species level, due to lack of flowering and/or fruiting material required for identification. None of these species were considered to be potential conservation significant flora. The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time of report development.
Proportion of fauna identified, recorded and/or collected	Nil	All fauna was identified and released on site. The survey was undertaken during the end of the wet season for the Pilbara. This is considered the optimal period for fauna surveys As most fauna groups are active (EPA 2016b). Additionally the region had received excellent rainfall approximately two weeks prior to the survey filling water bodies.
Survey effort and extent (e.g. was the relevant area fully surveyed)	Nil	The survey sampling and intensity was considered adequate. The number of flora samples (e.g. quadrats and relevés) were considered adequate for the vegetation types described and the size of the survey area. Similarly, the survey effort for the fauna survey was considered sufficient for the size of the survey area and scope of the survey. In areas where pit trapping was unable to be completed (e.g. rock areas), pit traps were substituted with funnels and remote cameras.
Survey timing, rainfall, season of survey	Minor	The field survey was conducted during Autumn (3 March -12 March 2020). In the three months prior to the survey (December-February), the Karratha airport weather recording station (No. 003003, Bureau of Meteorology (BoM) 2020) recorded a total of 311.6 mm of rainfall. This is well above the recorded long-term average for the same period (December-February; 140.3 mm) (BoM 2020). The weather conditions recorded during the survey were generally dry, warm/hot and high humidity with moderate winds. A summary of the climatic conditions included:

Aspect	Constraint	Comment
		<ul style="list-style-type: none"> Daily maximum temperature: 32-40 °C Daily minimum temperature: 22-29 °C Daily rainfall: 13.6 mm on 4 March, remaining days 0 mm. <p>The timing of the survey is considered the most optimal time to complete surveys in the Karratha region.</p>
Disturbances that may have affected the results of the survey (e.g. fire, flood, accidental human intervention)	Minor	It was evident that the recent cyclone (Cyclone Damien) which hit Karratha on 8 February 2020 had caused some damage to the vegetation within the survey area and in the Burrup area. The cyclone caused torrential rain and wind gusts of up to 194 kph over Karratha. Most noticeable within the survey area was dead <i>Acacia</i> shrubs in the low floodplain area fringing the samphire shrubland. This may have been a result of flooding and strong winds. In recent aerial photography it appears that the upper shrub layer is alive in this area. Parts of the tidal flats contained water, which is likely to be a result of the recent cyclone.
Mapping reliability	Nil	High-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard 1975) and field data were used for mapping. Data were recorded in the field using hand-held GPS tools (e.g. Samsung tablet and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ± 5 metres on average. Therefore the data points consisting of coordinates recorded from the GPS may contain minor inaccuracies.
Resources	Nil	Adequate resources were employed during the field survey. Six person days were spent undertaking the flora and vegetation survey using a dedicated botanist. A total of 33 person days were spent undertaking the fauna survey.
Access restrictions	Minor	The majority of the survey area was accessible by foot and by vehicle. Two small areas could not be accessed as they were surrounded by open water and fencing (property boundary). However both areas could be viewed and assessed from the fence line.
Experience levels	Nil	The zoologists and ecologists who executed the flora and vegetation survey and fauna survey were practitioners suitably qualified in their respective fields all with experience in the Pilbara Region. Erin Lynch is a Senior Ecologist (botanist) with 12 years' experience in undertaking ecological surveys. Glen Gaikhorst is Senior Zoologist with over 20 years' experience in undertaking zoological surveys. Brad Maryan is a Zoologist with over 20 years' experience in undertaking zoological surveys. Madison Roberts is an Ecologist with three years' experience in undertaking fauna surveys. Karina Potts is an Environmental Scientist with over 15 years' experience in the environmental field.

3. Desktop assessment

3.1 Regional biogeography

The survey area is located in the Pilbara bioregion and Roebourne sub-region as described by Interim Biogeographic Regionalisation of Australia (IBRA).

The Roebourne sub-region is characterised by Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three (Kendrick and Stanley 2001).

3.2 Landforms and soils

The survey area is located within the Karratha Coast Zone of the Fortescue Province. This zone is characterised by coastal mudflats (with sandy coastal plains and some hills) on marine deposits (and some sedimentary and volcanic rocks of the Pilbara Craton). Soils include tidal soils with some calcareous loamy earths, salt lake soils and red/brown non-cracking clays (Tille 2006).

3.3 Land systems

Land system mapping of the Pilbara has been prepared by the Department of Agriculture and Food Western Australia (DAFWA) (van Vreeswyk et al. 2004). The purpose of the rangelands survey was to provide a comprehensive description and map of the biophysical resources of the region, together with an evaluation of the condition of the soils and vegetation throughout. Lands within the Pilbara area have been described and mapped into 20 broad land types comprised of 102 land systems according to a combination of landforms, soils, vegetation and drainage patterns (van Vreeswyk et al. 2004).

The mapping indicates two land system are present within the survey area:

- Granitic Land System – Rugged granitic hills supporting shrubby hard and soft spinifex grasslands (located within the northern section of the survey area)
- Littoral Land System – Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches (located within the southern and eastern section of the survey area).

3.4 Hydrology

There are no watercourses or wetlands within or immediately adjacent to the survey area. There are broad, ephemeral drainage lines within the northern part of survey area which drain water from the rocky outcrops in the north towards the low-lying tidal flats in the south during major rainfall events (usually associated with thunderstorms and cyclones). The southern and eastern parts of the survey area intersect a low-lying expanse of supratidal mud flats and coastal sand plain which link King Bay and Hearson Cove (supra-tidal flats). This area is known to be periodically inundated after extreme tides or extended heavy rainfall.

3.5 Land use

3.5.1 Conservation reserves and estates

The eastern part of the survey area intersects Murujuga National Park, which extends both north and south of the survey area. Murujuga is vested with the Murujuga Aboriginal Corporation (MAC), and land is leased back to the WA State Government as national park, where is jointly managed by the representatives of MAC and DBCA.

One other DBCA managed conservation area occurs within the study area, an un-named reserve (R 36915, Class A) located 8.8 km north of survey area.

3.5.2 Environmentally Sensitive Areas

No Environmentally Sensitive Areas (ESAs) occur within the survey area. The closest is ESA is located approximately 8 km north of the survey area.

3.6 Vegetation and flora

3.6.1 Pre-European vegetation associations and extent

Broad scale (1:1,000,000) pre-European vegetation mapping of the Pilbara area was complete at an association level (Beard 1975). The mapping indicates that one vegetation association occurs within the survey area, association 117, described as Hummock grasslands, grass steppe; soft spinifex.

The pre-European mapping has been adapted and digitised by Shepherd et al. (2002). The extent of vegetation associations have been determined by the state-wide vegetation remaining extent calculations maintained by DBCA (latest update March 2019 – GoWA 2019). The current extents of vegetation associations remaining are greater than 99 per cent of the pre-European extent at all scales (e.g. State, IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA) (Table 7).

Table 7 Pre-European vegetation extents (GoWA 2019)

Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DBCA managed land (proportion of Pre-European extent)
State: Western Australia	919,517.05	886,005.79	96.36	14.25
IBRA Bioregion: Pilbara	82,705.78	78,096.64	94.43	21.28
IBRA Subregion: Roebourne	50,962.94	46,901.57	92.03	34.54
LGA: City of Karratha	41,173.74	31,921.58	77.53	44.99

3.6.2 Conservation significant ecological communities

A search of the EPBC Act PMST database did not identify any TECs within the study area. A search of the DBCA TEC and PEC database identified four State-listed PECs within the study area. Details on these communities are provided in Table 8.

Table 8 PECs identified in the desktop searches

Community and status	Description (from DBCA 2019)	Location
Burrup Peninsula rock pile communities PEC DBCA: Priority 1	Pockets of vegetation in rock piles, rock pockets and outcrops. Comprise a mixture of Pilbara and Kimberley species, communities are different from those of the Hamersley and Chichester Ranges. Short-range endemic land snails.	62 occurrences within the study area, the closest approximately 1 km west of the survey area.
Burrup Peninsula rock pool communities PEC DBCA: Priority 1	Calcareous tufa deposits. Interesting aquatic snails.	Three occurrences within the study area, the closest approximately 350 m south of the survey area.
Horseflat Land System of the Roeburne Plains PEC DBCA: Priority 3	The Horseflat Land System of the Roebourne Plains are extensive, weakly gilgaied clay plains dominated by tussock grasslands on mostly alluvial non-gilgaied, red clay loams or heavy clay loams. Perennial tussock grasses include <i>Eragrostis xerophila</i> and other <i>Eragrostis</i> spp., <i>Eriachne</i> spp. and <i>Dichanthium</i> spp. The community also supports a suite of annual grasses including <i>Sorghum</i> spp. and rare <i>Astrebla</i> spp. The community extends from Cape Preston to Balla Balla surrounding the towns of Karratha and Roebourne.	Three occurrences within the study area, the closest approximately 9.7 km south of the survey area
Roebourne Plains gilgai grasslands PEC DBCA" Priority 1	The Roebourne Plains coastal grasslands with gilgai micro-relief occur on deep cracking clays that are self mulching and emerge on depositional surfaces. The community occurs on microrelief of deep cracking clays, surrounded by clay plains/flats and sandy coastal and alluvial plains. The gilgai depressions supports ephemeral and perennial tussock grasslands dominated by <i>Sorghum</i> sp. and <i>Eragrostis xerophila</i> along with other native species including <i>Astrebla pectinata</i> , <i>Eriachne benthamii</i> , <i>Chrysopogon fallax</i> and <i>Panicum decompositum</i> . Restricted to the Karratha area.	Four occurrences within the study area, the closest approximately 7.2 km south of the survey area

3.6.3 Flora diversity

The *NatureMap* database identified 281 flora species previously recorded within the study area. This total comprised 257 native taxa and 24 naturalised (introduced) taxa. Dominant families recorded included Fabaceae (48 taxa), Poaceae (33 taxa) and Malvaceae (20 taxa). The *NatureMap* database search is provided in Appendix C.

3.6.4 Conservation significant flora

Searches of the EPBC Act PMST, *NatureMap* database and DBCA TPFL and WAHERB databases identified the presence/potential presence of six conservation significance flora taxa within the study area. The desktop searches recorded:

- Five Priority 3 taxa

- One Priority 4 taxon.

One Priority taxon, *Stackhousia clementii* (Priority 3) has previously been recorded from two locations in the southern part of the survey area.

The locations of conservation significant flora registered on the DBCA databases are mapped in Figure 2, Appendix A.

3.7 Fauna

3.7.1 Fauna diversity

The *NatureMap* database identified 407 vertebrate fauna taxa previously recorded within the study area. This total included presence/potential presence of 110 birds, 71 reptiles, 30 mammals, 4 amphibian, 133 invertebrates and 59 fish. Of the 407 fauna species previously recorded 398 native and 9 naturalised (introduced) species. *NatureMap* database search is provided in Appendix C.

3.7.2 Conservation significant fauna

The EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 53 conservation significance fauna within the survey area. This total does not include those species that are exclusively marine as no marine habitat is present within the project area or indirectly impacted by the project.

The locations of conservation significant fauna registered on the DBCA databases are mapped in Figure 2, Appendix A.

3.8 Previous studies

A number of flora and fauna studies have been previously undertaken within or adjacent to the survey area. These studies have been completed by various environmental consultants and commissioned by the Department of Environment and Conservation (DEC). A summary of the key findings from recent studies relevant to the project is provided in Table 9.

Table 9 Previous flora and fauna surveys undertaken on the Burrup Peninsula and surrounds relevant to the survey area

Report Title and citation	Survey type and location	Key results
Perdaman Urea Project Pre-wet season biological survey. Animal Plant Mineral Pty Ltd (2018)	Pre-wet season flora, vegetation and terrestrial vertebrate fauna survey (level 1) Area assessed located adjacent to the YPF Plant on the west side.	<ul style="list-style-type: none"> • Thirty five vegetation associations were mapped over the study area. Seven vegetation associations were classified in the assessment to be synonymous with vegetation associations listed by M.E. Trudgen & Associates (2002) as being of conservation significance because they have less than 10 occurrences across the Burrup Peninsula and Angel, Gidley and Dolphin Islands. • Fifteen rocky outcrops were identified that constitute the P1 PEC – Rockpiles of the Burrup Peninsula. • Two flora species of conservation significance were identified inside the Project Area. One individual of <i>Terminalia supranitifolia</i> (P3) occurred on a rockpile in the north eastern extent of the Project Area which is also classified as the P1 PEC – Rockpiles of the Burrup Peninsula. One specimen of <i>Rhynchosia bungarensis</i> (P4) was collected from near the eastern Project Area boundary in a shallow drainage area. • Four broad fauna habitats were identified, two of which represent suitable habitat for a range of conservation significant species. Rocky outcrops, which may be occupied by the Northern Quoll and the Pilbara Olive Python, and the samphire shrublands and saltplains, which may provide foraging habitat for a range of migratory waders during king tides. • In total, nine conservation significant bird species were recorded during the survey, including the Red-necked Stint. No mammals or reptiles of conservation significance were recorded during the survey.
Technical Ammonium Nitrate Production Facility, Public Environmental Review for Burrup Nitrates Pty Ltd Fauna survey - Environmental Resources Management (2009) Flora survey - Outback Ecology (2009)	Level 1 flora and fauna surveys (reconnaissance) Area assessed located adjacent to the YPF Plant on the east side.	<ul style="list-style-type: none"> • Five broad vegetation types were identified during the flora survey. The vegetation types identified correspond to those vegetation assemblages previously identified and mapped as occurring within the area by Trudgen (2002). No declared rare or priority flora species were recorded within the site. • While no threatened or priority ecological communities known on the Burrup Peninsula, Trudgen (2002) assessed the regional significance of vegetation on the Burrup Peninsula, based on the minimum area necessary for the protection of an ecosystem. Vegetation associations were considered to be significant when the association is represented by less than 10 populations within the Burrup Peninsula or when less than 30% of the association occurs within the proposed Burrup Peninsula Conservation Reserve. Based on analysis of the Trudgen (2002), mapping undertaken by Woodside (2006), identified that the community mapped as Sm and described as Saline Inlet and Supra-tidal Flats was considered to represent a significant vegetation association. Outback Ecology (2009) further noted that approximately 56% of this community's extent is represented within the proposed Burrup Peninsula Conservation Reserve.

Report Title and citation	Survey type and location	Key results
		<ul style="list-style-type: none"> The fauna investigations identified 20 bird species and one mammal species as occurring within the site. No fauna of conservation significance were identified during the survey. Five species listed as migratory were recorded foraging within the supra-tidal flats.
Dampier Nitrogen Pty Ltd Detailed Wet Season Survey Astron Environmental (2005 and Addendum 2009)	Site C within the King Bay/Hearson Cove Industrial Area	<ul style="list-style-type: none"> The 2005 field survey recorded 143 flora taxa from 44 families. Twenty-three <i>Terminalia supranitifolia</i> (P3) and two <i>Rhynchosia bungarensis</i> (P4) individuals were identified from the site. Two rockpile communities were considered to be of particular conservation significance. The mapping of the samphire vegetation in the Hearson Cove – King Bay Valley by Astron Environmental (2005) was considered to be comprehensive.
Flora and Vegetation Survey of the Proposed Ammonia Plant Astron Environmental (2001a)	Level 2 flora and vegetation survey Area assessed includes the current survey area adjacent to the YFP Plant	<ul style="list-style-type: none"> Seven broad vegetation types and 15 vegetation assemblages were found to occur within the project lease, none of which were listed as being of conservation significance. A total of 131 vascular species (100 – dry season, 117 – wet season) were recorded within the Project Area. However, as the rainfall for the wet and dry season was low, this may not be representative of the full total. No Declared Rare Flora occurred within the project lease, but one Priority flora species, <i>Terminalia supranitifolia</i>, was found on the site during the vegetation surveys. A total of 38 <i>T. supranitifolia</i> individuals were located on or around the base of scree slopes and small rocky outcrops.
Fauna of the Burrup Peninsula and the Proposed Ammonia Plant. Astron Environmental (2001b)	Level 1 Area assessed includes the current survey area adjacent to the YFP Plant	<ul style="list-style-type: none"> A variety of habitats were identified including saline tidal and supratidal flats, grassland Steppes and rocky outcrops. No threatened species were identified during the surveys however potential habitat was considered to be present for the following species; Northern Quoll, Pilbara leaf-nosed Bat, Olive Python, Western pebble mound mouse and Water rat.
Vegetation of the Burrup Peninsula, Dolphin, Angel and Gidley Islands and Inland Ranges M.E. Trudgen & Associates (2002) and Trudgen & Griffin (2001).	Detailed survey Area assessed includes the current survey area	<ul style="list-style-type: none"> The study identified 240 vegetation associations (each with a small area of occurrence), a rich flora for its size (383 native vascular plant species from 54 families), and a high number of geographically restricted or uncommon species. Trudgen & Associates (2002) identified 33 native plant species on the Burrup Peninsula that were neither rare or priority flora, but that are of conservation interest. A significant geographic based pattern for the distribution of floristic units on the peninsula, in accordance with landscape groups (i.e. rock piles, drainage lines, etc.), was also identified. The vegetation of the Burrup Peninsula was found to be generally in very good or excellent condition, except in areas of coastal sand. It was outside of the terms of reference to map the Samphire flats in detail. The mapping and vegetation association descriptions detailed in the two volumes are the most comprehensive treatment of the regional flora available.

4. Field survey results

4.1 Flora and vegetation

4.1.1 Vegetation types

Seven vegetation types were identified and described for the survey area, as well as cleared areas (29.41 ha) and seasonally inundated/open water (5.45 ha). The vegetation within the survey area north of the existing YPF Plant primarily comprised hummock grasslands of *Triodia epactia* and *T. wiseana* with scattered to open shrublands dominated by *Acacia*, *Hakea* and *Grevillea* species on rocky hills. The vegetation south of the ammonia plant was generally dominated by samphire shrublands and *Triodia angusta* low hummock grasslands on saline tidal flats and **Cenchrus ciliaris* (Buffel grass) grasslands on coastal sands.

The vegetation types identified within the survey area are described in Table 10 and mapped on Figure 3, Appendix A.

Statistical analysis

The similarity between the GHD quadrats and relevés were examined using PRIMER. Analysis was run using two scenarios, all species and no singles (i.e. species that occur only once removed from the dataset). The cluster analysis and resulting dendrograms showed similar results with general groupings of quadrats for all vegetation types. The vegetation types that most closely grouped included ArrTdHc, AtEgCd, AeFsEd, AtSePd and AbCaPd. Vegetation types AuEeBs APoEc also largely grouped, however several quadrats/quadrat groupings representative of these types occurred across multiple clades. A two dimensional MDS scatter plot was also produced and largely reflected the dendrogram. The stress value (0.1) was the same for both scenarios and indicates a reasonable representation.

The outputs from the statistical analysis are presented in Appendix D.

Table 10 Vegetation types identified within the survey area

Vegetation type	Description	Extent (ha)	Landform, sample locations and notes	Representative photograph
VT01 <i>Grevillea</i> / <i>Acacia</i> open shrubland	<i>Grevillea pyramidalis</i> subsp. <i>pyramidalis</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Acacia inaequilatera</i> open tall shrubland over <i>Triodia epactia</i> and <i>Triodia wiseana</i> hummock grassland. Associated species: <i>Acacia bivenosa</i> , <i>Indigofera monophylla</i> , <i>Triumfetta clementii</i> , <i>Triumfetta appendiculata</i> , <i>Rhynchosia minima</i> , <i>Scaevola spinescens</i> , <i>Solanum lasiophyllum</i> and <i>Euphorbia coghlanii</i> .	Excellent: 8.06 Very Good: 0.99 Good: 0.34 <u>Total: 9.38</u>	Rocky sandy-loam lower slopes and broad drainage lines Q6, Q8, Q9, R3	
VT02 <i>Terminalia</i> isolated low trees Priority 1 PEC Burrup Peninsula rock pile communities	<i>Terminalia supranitifolia</i> , <i>Brachychiton acuminatus</i> and <i>Flueggea virosa</i> subsp. <i>melanthesoides</i> isolated low trees over <i>Acacia coriacea</i> subsp. <i>coriacea</i> , <i>Scaevola spinescens</i> and * <i>Vachellia farnesiana</i> sparse shrubland over <i>Triodia epactia</i> , <i>Cymbopogon ambiguus</i> , <i>Themeda triandra</i> and * <i>Cenchrus ciliaris</i> open hummock tussock grassland over <i>Cleome viscosa</i> , <i>Rhynchosia bungarensis</i> and <i>Boerhavia schomburgkiana</i> forbland. Associated species: <i>Ficus brachypoda</i> , <i>Paspalidium tabulatum</i> , <i>Rhynchosia minima</i> , <i>Trichodesma</i>	Excellent: 2.09 <u>Total: 2.09</u>	Rock piles and broad gully formations R1, R2, R4	

Vegetation type	Description	Extent (ha)	Landform, sample locations and notes	Representative photograph
	<i>zeylanicum</i> , <i>Rhagodia eremaea</i> , <i>Ehretia saligna</i> , <i>Abutilon fraseri</i> , <i>Ptilotus obovatus</i> , <i>Tinospora smilacina</i> and <i>Ipomoea costata</i> .			
VT03 <i>Triodia</i> hummock grassland	<p><i>Grevillea pyramidalis</i> subsp. <i>pyramidalis</i>, <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Acacia bivenosa</i> isolated shrubs over <i>Triodia epactia</i> hummock grassland over <i>Rhynchosia minima</i>, <i>Cleome viscosa</i> and <i>Cassytha capillaris</i> scattered forbland.</p> <p>Associated species: <i>Acacia inaequilatera</i>, <i>Scaevola spinescens</i>, <i>Indigofera colutea</i>, <i>Euphorbia coghlanii</i>, <i>Indigofera monophylla</i>, *<i>Cenchrus ciliaris</i>, <i>Bonamia media</i> and <i>Solanum lasiophyllum</i>.</p>	<p>Excellent: 12.15 Excellent-Very Good: 3.0 Very Good: 0.51 Good: 0.01 Poor: 0.37 Degraded: 0.13</p> <p><u>Total: 16.17</u></p>	<p>Upper to mid rocky slopes with some outcropping.</p> <p>Q2, Q3, Q4, Q5, Q7, Q15</p>	

Vegetation type	Description	Extent (ha)	Landform, sample locations and notes	Representative photograph
VT04 <i>Triodia</i> closed hummock grassland	<p><i>Triodia angusta</i> closed hummock grassland.</p> <p>Associated species: *<i>Cenchrus ciliaris</i>, <i>Aerva javanica</i>, <i>Indigofera colutea</i>, <i>Cyperus bulbosus</i>, <i>Eriachne obtusa</i>, <i>Neobassia astrocarpa</i>, <i>Threlkeldia diffusa</i>, <i>Dactyloctenium radulans</i> and <i>Trianthema turgidifolia</i>.</p>	<p>Very Good: 0.30 Good: 0.94</p> <p><u>Total: 1.24</u></p>	<p>Low-lying plains along the edges of the samphire tidal flats.</p> <p>R5</p>	
VT05 <i>Tecticornia</i> isolated shrubs to open low shrubland	<p><i>Tecticornia pterygosperma</i>, <i>Tecticornia indica</i> subsp. <i>bidens</i>, <i>Neobassia astrocarpa</i> and <i>Frankenia pauciflora</i> isolated shrubs to open low shrubland over *<i>Cenchrus ciliaris</i>, <i>Sporobolus virginicus</i> and <i>Eragrostis</i> spp. isolated grasses over <i>Cyperus bulbosus</i>, <i>Dysphania plantaginella</i> and <i>Cleome viscosa</i> sparse sedgeland and forbland.</p> <p>Associated species: <i>Surreya diandra</i>, <i>Eragrostis falcata</i>, <i>Eragrostis setifolia</i>, <i>Dactyloctenium radulans</i>, <i>Lawrencia viridigrisea</i>, <i>Triodia angusta</i>, <i>Indigofera linifolia</i>, <i>Heliotropium cunninghamii</i> and <i>Trianthema turgidifolia</i>.</p>	<p>Very Good: 13.40 Very Good-Good: 1.48 Good: 3.42</p> <p><u>Total: 18.3</u></p>	<p>Saline tidal flats / bare open ground. Irregularly inundated. Coral rubble.</p> <p>Q1, Q10, Q13</p>	

Vegetation type	Description	Extent (ha)	Landform, sample locations and notes	Representative photograph
VT06 * <i>Cenchrus</i> tussock grassland	<p><i>Acacia</i> sp. isolated shrubs (dead) over *<i>Cenchrus ciliaris</i> tussock grassland.</p> <p>Associated species: *<i>Aerva javanica</i>, <i>Cyperus bulbosus</i>, <i>Indigofera monophylla</i>, <i>Indigofera linifolia</i>, <i>Triodia epactia</i> and <i>Heliotropium cunninghamii</i>.</p>	<p>Completely Degraded: 12.14</p> <p><u>Total: 12.14</u></p>	<p>Coastal sands with some coral rubble.</p> <p>Q11, Q12, Q14</p>	
VT07 <i>Acacia</i> high shrubland	<p><i>Acacia ampliceps</i>, <i>Acacia bivenosa</i> and <i>Scaevola spinescens</i> tall shrubland over *<i>Aerva javanica</i>, <i>Trianthema turgidifolia</i> and <i>Neobassia astrocarpa</i> open low shrubland over <i>Triodia epactia</i>, <i>Triodia angusta</i> and *<i>Cenchrus ciliaris</i> open grassland over <i>Cleome viscosa</i>, <i>Cassytha capillaris</i> and <i>Cyperus bulbosus</i> isolated sedges and forbs.</p> <p>Associated species: <i>Trichodesma zeylanicum</i>, <i>Solanum lasiophyllum</i>, <i>Dactyloctenium radulans</i>, <i>Enchylaena tomentosa</i> and <i>Pterocaulon sphaeranthoides</i>.</p>	<p>Good: 0.48 Poor: 1.48</p> <p><u>Total: 1.96</u></p>	<p>Stoney, brown silty soil on low-lying plains near the tidal flats.</p> <p>R6</p>	

4.1.2 Threatened and Priority ecological communities

No TECs were identified within the survey area. The field survey identified one Priority 1 PEC within the survey area, the Burrup Peninsula Rock Pile Communities.

The 'Burrup Peninsula rock pile communities' are pockets of vegetation in the rock piles and outcrops. Comprise a mixture of Pilbara and Kimberley species, communities are different from those of the Hamersley and Chichester Ranges. The rock piles are important for providing fire and revolutionary refuge for flora (Kendrick and Stanley 2001). The rock pocket communities vary from open *Cymbopogon ambiguus* assemblages with *Ptilotus obovatus* and few small forbs and grasses on otherwise bare calcrete, through to *Triodia* sub shrub communities, to dense shrub/tree communities with *Flueggea virosa* subsp. *melanthesoides*, *Phyllanthus ciccoides*, small spreading trees of *Ficus brachypoda*, *Brachychiton acuminatus*, *Pittosporum phylliraeoides* and *Terminalia supranitifolia* often as large trees and sometimes in numbers.

Terminalia scattered low trees (VT02) is considered to be representative of the Burrup Peninsula rock pile communities PEC. This vegetation type includes scattered low trees of *Brachychiton acuminatus*, *Terminalia supranitifolia*, *Ficus brachypoda*, *Acacia coriacea* subsp. *coriacea* and *Flueggea virosa* subsp. *melanthesoides*, scattered patches of *Cymbopogon ambiguus* tussock grasses and *Triodia epactia* hummock grasses, *Tinospora smilacina*, *Rhynchosia bungarensis* and *Ipomoea costata* vines/herbs on rock piles. There is approximately 2.09 ha of this PEC occurring within the survey area of which all is in Excellent condition.

4.1.3 Other significant vegetation

M. E. Trudgen & Associates (2002) identified the tidal inlet between Hearson Cove and King Bay as being of conservation significance. The basic vegetation units mapped by M.E. Trudgen & Associates (2002) in the tidal inlet were designated Sm and described as Saline Inlet and Supra-tidal Flats. The *Tecticornia* isolated shrubs to open low shrubland (VT05) corresponds with this vegetation type and based on the EPA (2016a) is considered significant vegetation due to its restricted distribution and a degree of historical impact from threatening processes (clearing and weeds).

It was noted by Outback Ecology (2009) that there is approximately 56% of the Sm extent represented within the Burrup Peninsula Conservation Reserve (now the Murujuga National Park), above the 30% threshold proposed by M. E. Trudgen & Associates (2002).

4.1.4 Vegetation condition

The vegetation condition throughout the survey area ranged from Excellent to Completely Degraded, with the majority of the vegetation in the survey area considered to be in Excellent to Very Good condition (40.5 ha / 66%). The vegetation structure across the survey area in areas identified as Excellent to Very Good condition showed no to slight signs of damage with nil to minimal weeds recorded.

The coastal sands fringing the tidal mudflats is dominated by **Cenchrus ciliaris* (Buffel Grass) and is considered to be Completely Degraded. The vegetation in this area has suffered severe disturbances by the invasion by Buffel grass (**Cenchrus ciliaris*) and from vehicle tracks. The Buffel grass has almost totally displaced the native vegetation, creating a tussock grassland with very few native herbs and shrubs remaining. Buffel grass can reduce soil fertility, increases soil erosion and releases chemicals which are toxic to other flora. Kapok bush (**Aerva javanica*) is another disturbance response weed species that was common within the **Cenchrus* tussock grasslands and in areas of disturbance.

It appeared the recent cyclone may have had an impact on some of the vegetation within the survey area, most noticeable was the deaths of the tall shrubs (likely to be *Acacia* species) scattered throughout the **Cenchrus* tussock grassland.

The extents of vegetation condition mapped within the survey area is provided in Table 11 and mapped in Figure 4, Appendix A.

Table 11 Extent of vegetation condition ratings mapped within the survey area

Vegetation Condition (EPA 2016a)	Extent mapped (ha)
Excellent	22.31
Excellent-Very Good	3
Very Good	15.2
Very Good-Good	1.48
Good	5.19
Poor	1.85
Degraded	0.13
Completely Degraded	12.14
No condition (cleared/ openwater)	34.86
Total	96.16

4.1.5 Flora diversity

The survey recorded a total of 141 flora taxa (including subspecies and varieties) representing 40 families and 99 genera within the survey area. This total comprised of 138 native taxa and 3 introduced taxa. Dominant families within the survey area included Fabaceae (28 taxa), Poaceae (19 taxa) and Malvaceae (17 taxa).

The list of flora recorded within the survey area is provided in Appendix D.

A species accumulation curve was generated using PRIMER to assess adequacy of sampling effort within the survey area. The species accumulation curve for the survey area, based on flora recorded within quadrats, is approaching an asymptote, which suggests that the current survey effort is sufficient (Plate 1). Furthermore, the bootstrap estimate of species richness generated from this data indicates that 131 species could be expected from the survey area based on the diversity recorded within quadrats. The total species recorded from the survey area was 141 flora species, which is slightly more than the predicted species diversity estimate. The survey area is considered representative of the floristic diversity in the area.

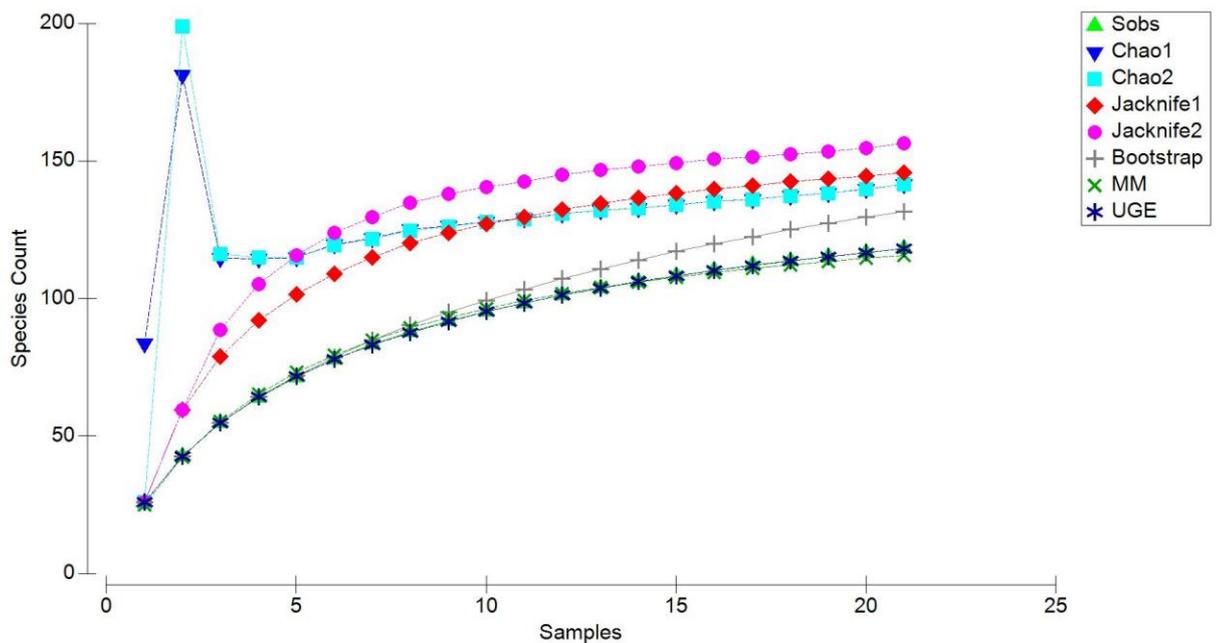


Plate 1 Species accumulation curve

4.1.6 Introduced flora

Three introduced taxa were recorded from the survey area, **Cenchrus ciliaris* (Buffel grass), **Aerva javanica* (Kapok bush) and **Vachellia farnesiana* (Mimosa bush). None of these species are WONS or listed as Declared pests. Buffel grass and Kapok bush have been rated as having 'high' potential ecological impact under the invasive plant prioritisation process. Buffel and Kapok are generally most common in previously disturbed area, vehicle tracks and along drainage lines. Mimosa bush was recorded in the rocky hills/broad gullies, and occasionally scattered on the low-lying plains.

4.1.7 Conservation significant flora

No Threatened flora species listed under the EPBC Act and/or BC Act was recorded within the survey area. Three Priority species listed by the DBCA were recorded within the survey area, including *Terminalia supranitifolia* (Priority 3), *Vigna triodiophila* (Priority 3) and *Rhynchosia bungarensis* (Priority 4).

The locations of Priority flora recorded within the survey area is provided in Appendix D and mapped on Figure 5, Appendix A.

Terminalia supranitifolia

Terminalia supranitifolia (Plate 2) is listed Priority 3. It is a spreading, tangled shrub or tree, 1.5-3 m tall that occurs on rockpiles, rock outcrops and in rocky gullies on the Burrup Peninsula. The tree is a remnant Kimberley species (Blackwell 1979), however it is not known to occur in the Kimberley. According to NatureMap there are 58 records of this species occurring in the Pilbara region, with a large number of records concentrated on the Burrup Peninsula.



Plate 2 *Terminalia supranitifolia* in situ

Within the survey area, *Terminalia supranitifolia*, occurs on the rockpile capped hills (VT02), on smaller hillslope rockpiles and along the broad drainage lines mid-slope of the rocky hills (VT01 and VT03). A total of 33 individuals from 30 locations were identified within the survey area.

Vigna triodiophila

Vigna triodiophila (Plate 3) is listed as Priority 3. It is a slender climbing herb with yellow flowers that occurs in *Triodia* hummocks and amongst rocks near the coast. According to NatureMap there are only 12 records of this species occurring in the Pilbara region, with the majority of records occurring on the Burrup Peninsula.



Plate 3 *Vigna triodiophila* in situ

A total of six plants from two locations were recorded within the survey area. The specimens recorded within the survey area occurred amongst *Triodia epactia* at the base of rock piles (VT02).

Rhynchosia bungarensis

Rhynchosia bungarensis (Plate 4) is listed Priority 4 and is a compact, prostrate shrub, to 0.5 m high with yellow flowers. It is known to occur on pebbly, shingly coarse sand amongst boulders and banks of flow lines in the mouth of a gully wall (WA Herbarium 1998–). According to NatureMap there are 110 records of this species in the Pilbara region, with a large number of records concentrated on the Burrup Peninsula.



Plate 4 *Rhynchosia bungarensis* in situ

A total of approximately 431 plants from 117 locations were recorded in the survey area. This species was recorded growing in skeletal sand along the bases of the bare rockpiles (VT02). Some estimates were made of population size within the survey area due to the high concentration of this species occurring along the rockpiles.

Likelihood of occurrence

A likelihood of occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment based on the desktop searches (provided in Appendix C). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of the species (Appendix D).

The likelihood of occurrence assessment post-field survey concluded that three taxa are present (*Terminalia supranitifolia*, *Vigna triodiophila* and *Rhynchosia bungarensis*) and an additional Priority flora species is likely to occur within the survey area. *Stackhousia clementii* (Priority 3) has previously been recorded within the survey area in the King Bay – Hearson Cove tidal inlet, just south of the existing ammonia plant. There are records of this species flowering in all months. The area was systematically searched during the survey however no individuals were observed. The tidal inlet is very rarely inundated, however the flooding from the recent cyclone (cyclone Damian in February) may have affected the presence of this species.

4.2 Fauna

4.2.1 Fauna habitats

Six broad habitat types (excluding disturbed/cleared areas) were recorded from the survey area. These habitat types closely align with the vegetation types and landforms within the survey area. The habitat types recorded in the survey area are described in Table 12 and mapped in Figure 7, Appendix A. The six broad fauna habitat types are:

- Rocky Outcropping
- Foothills
- Sand Plain
- Minor Drainage lines
- Floodplain
- Water.

Disturbed areas also formed portions of the survey area and although not always considered as fauna habitat areas these areas may be utilised by fauna.

The topography of the survey area varied from rocky hills (Rocky outcropping), foothills, sandy plains to minor drainage lines, Floodplain/drainage lines and water body. Minor drainage systems occur within the survey area which drain from the surrounding hills to the coast or across plains. Flow varies in direction through the survey area however always drains to the coast. A waterbody was present within the Floodplain/ drainage lines as a series of pools at the time of the survey (one main pool and several small pools trapped behind roads and pipelines). Soils varied greatly over the survey area and included red-brown stony or sandy loams, clays, with areas of rocky foothills and exposed boulder piles on hills.

4.2.2 Habitat linkages

The fauna habitats of the survey area are part of a contiguous largely intact area of remnant vegetation within leased land primarily used for industrial, national park and recreation. The fauna habitats of the survey area are part of a much larger area of similar habitats within the local area and greater Burrup Peninsular. The ephemeral Floodplain/ drainage lines within the survey area drain towards the coast and on the plain provide corridors linking the coast to the surrounding hills. Overall, the habitats within the survey area are largely contiguous through the local area and mostly well connected with habitats through the study area.

Disturbance

Some of the habitats within the survey area have been impacted by past disturbances including land clearing for infrastructure, linear corridors, land management (rock fall barriers etc.). There is also evidence of recreational use and weed incursion within the survey area.

Habitat value

The survey area provides low to high habitat value within the environment. This is due to the disturbances present in some habitats and the diversity of fauna in other areas which maintains its significance as well as the conservation significance fauna that are present or likely to be present in the survey area. For a breakdown of the significance of each habit see Table 12.

4.2.3 Habitat dendrogram

The similarity between sites based on the GHD trapping data versus habitat was examined using PRIMER. The cluster analysis and resulting dendrogram (Plate 5) shows that according to the species recorded that all four habitat where trapping was undertaken demonstrate uniqueness (could be more or less different species) in the species recorded and demonstrate isolating or clustering. The Floodplain/drainage line species had similarities with the sand plain sites and therefore are loosely clumped and relatively similar.

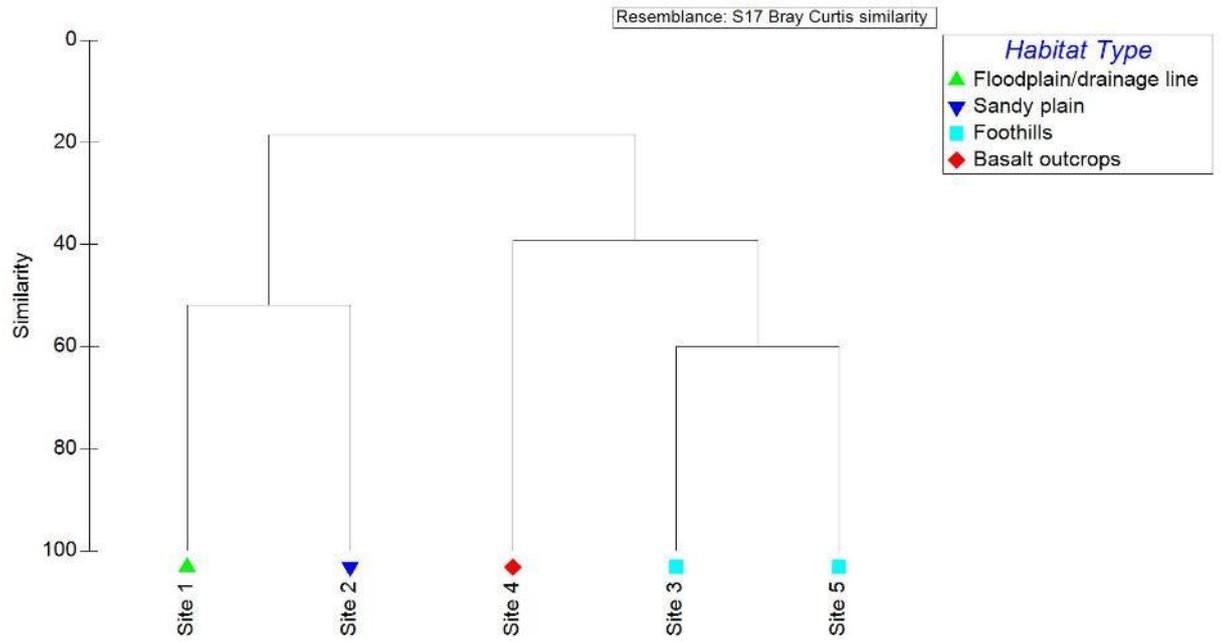


Plate 5 Dendrogram of habitat by species recorded

Table 12 Broad habitat types within the survey area

Description	Extent in the survey area	Representative Images
<p>Rocky Outcropping Hummock grassland of <i>Triodia</i> sp. with scattered <i>Terminalia supranitifolia</i>, <i>Brachychiton acuminatus</i> and <i>Flueggea virosa</i>.</p> <p>Rocky hills occur in the northern portion of the survey area. This habitat type is mostly dominated by a <i>Triodia</i> hummock grassland, however it does support tussock grasses and scattered <i>Acacia</i> shrubs. The boulder rock piles are typically devoid of ground cover. The crests of hills contain extensive rock outcropping or boulder piles and support scattered <i>Terminalia supranitifolia</i> and <i>Brachychiton acuminatus</i>. The scattered trees and shrubs provided litter and scattered woody debris, and the boulder piles provide extensive cover via crevices, small caves and cavities. No evidence of recent fire was recorded in the survey area. Evidence of old fire scars were present and determined based on the age of the vegetation.</p> <p>The rocky habitats are known to support a range of saxicoline (rock inhabiting) fauna species including Rothchild’s Rock Wallaby (<i>Petrogale rothchildi</i>) and Stimson’s Python (<i>Antaresia stimsonii</i>).</p> <p>Habitat value for fauna species of conservation significance</p> <p>A small area of habitat that joins to or is part of a contiguous remnant environment extending beyond the survey area on the Burrup Peninsula. This habitat provides resources for the Pilbara Olive Python (<i>Lialis olivaceus barroni</i>) that was recorded in this habitat type during the survey. This habitat is considered core habitat for this species. This habitat would also provide potential hunting and foraging opportunities for the Peregrine Falcon. No large cliffs were present in the survey area for Peregrine Falcon to utilise for breeding, however it looked to be present outside of the survey area particularly along the coastal cliffs and larger boulder piles surrounding the survey area. A bat detector at this location recorded the North-western Free-tail Bat (<i>Mormopterus (Ozimops) cobourgianus</i>). Due to the habitat present this species would have been foraging only.</p> <p>High value</p> <p>Core habitat for Pilbara Olive Python, foraging habitat for the Peregrine Falcon and North-western Free-tail Bat</p>	<p>3.74 ha</p>	

Description	Extent in the survey area	Representative Images
<p>Foothills</p> <p>Hummock grassland of <i>Triodia</i> sp. with scattered <i>Acacia</i> sp.</p> <p>The foothills habitat occur over much of the Burrup Peninsula, often adjacent to rocky hills or below boulder piles. This habitat type is mostly dominated by a <i>Triodia</i> hummock grassland however does support tussock grasses and scattered <i>Acacia</i> shrubs. The crests of the low hills contain rocky substrates but lacks the extensive boulder piles in the surrounding taller hills. Limited litter and woody debris is present and no logs, branches or hollows are available. Typically this habitat is very open with a heavy rocky substrate, providing limited hiding ability for fauna. Few fauna species were recorded in this habitat however the sun loving Ringtail Dragon (<i>Ctenophorus caudicinctus caudicinctus</i>) and Rock Ctenotus (<i>Ctenotus saxatilis</i>) were observed.</p> <p>Habitat value for fauna species of conservation significance</p> <p>This habitat would support foraging and the disbursal of the Pilbara Olive Python particularly in area close to or in between boulder piles and minor drainage lines. This environment may provide foraging habitat for the Peregrine Falcon. The Western Pebble-mound Mouse would have utilised this habitat based on the old mounds recorded, but the species appears to be now extinct on the Burrup Peninsula.</p> <p>Moderate to High value</p> <p>Supportive habitat for species foraging and disbursal particularly the Pilbara Olive Python.</p>	23.38 ha	
<p>Minor Creek line</p> <p>Shrublands of Mixed <i>Acacia</i> with <i>Hakea lorea</i>, <i>Cymbopogon ambiguus</i> over <i>Triodia</i> sp. on heavy loam/clay soils</p> <p>This habitat type is limited to the linear drainage systems which flow amongst the hills or on the foothills. They primarily consist of a thin, linear corridor of denser vegetation which drain into the intertidal mudflats and coastline. This habitat type is mostly dominated by <i>Acacia</i> species. Understorey includes <i>Triodia</i> hummock grassland and Buffel Grass (<i>Cenchrus</i> spp.) and mixed small shrub species. Litter, woody debris and logs were present along drainage line edges or were water flow created build up. No recent fire scaring was present in the survey area but minor historical evidence was obvious via the age of vegetation present. This habitat, particularly on the foothills provides a habitat corridor from the coastal tidal zone.</p> <p>Fauna species favouring riparian vegetation were also recorded including Singing Honeyeater (<i>Lichenostomus virescens</i>), Euro (<i>Macropus robustus</i>) and Long-snouted Water Dragon (<i>Gowidon longirostris</i>).</p>	9.38 ha	

Description	Extent in the survey area	Representative Images
<p>Habitat value for fauna species of conservation significance</p> <p>Patchy and typically linear in the landscape but part of a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat was present within the northern portion of the survey area and provides potential hunting and foraging opportunities for the Peregrine Falcon. Pilbara Olive Python have also been recorded in drainage lines particularly in association to rocky hills on the Burrup Peninsula.</p> <p>High value</p> <p>Linear corridor of habitat utilised by Pilbara Olive Python and Peregrine Falcon (in rocky environments) A fauna corridor for all other species on the foothills.</p>		
<p>Sand Plain</p> <p>Mixed shrubland to open plain over <i>Triodia</i> sp. and Buffel on sandy soils</p> <p>Sandy Plain is present between the rocky hills between Hearson Cove and Yara facilities. This area comprises mixed shrublands over <i>Triodia</i> sp. and Buffel on sand plain, but comprises a mix of fine coastal sands, shell and loam. The vegetation comprises shrubs of Acacia, Hakea and Grevillia over Triodia hummock and Buffel tussock grasses. Litter, woody debris and branches were present in areas where shrubs were present, but mostly the area was sparse of ground covers. No logs or hollows were observed due to the vegetation structure present. No recent fire scaring was present in the survey area, however a vast number of shrubs were dead with little recruitment suggesting changes to hydrology or another environmental factor. This habitat currently supports a range of small fauna species including Seventy's Skink (<i>Ctenotus seventyii</i>), Western Toe-toed Slider (<i>Lerista bipes</i>) and the Central Military Dragon (<i>Ctenophorus isolepis</i>). Triodia species on sandy soils are known to have high fauna diversity particularly in small mammals and skinks.</p> <p>Habitat value for fauna species of conservation significance</p> <p>A modified area of patchy habitat situated between rocky hills and Floodplain and drainage line areas. This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon.</p> <p>Low to Moderate value</p> <p>Habitat that typically supports high diversity of small vertebrate fauna and provides foraging habitat to Peregrine Falcon. However this habitat is Buffel dominated and appears to be impacted by environmental processes.</p>	4.98 ha	

Description	Extent in the survey area	Representative Images
<p>Water Body</p> <p>The waterbodies lie on the southern side of the YPF and YPN. The water bodies are present due to the modification of existing floodplain and drainage lines associated to Hearson Cove and King Bay. The water bodies are seasonal and were filled by the recent cyclone approximately three weeks previous to the survey. The water bodies were flanked by Chenopod species and had small vegetated islands present that were highly utilised by wetland and migratory bird species. Several bird species were recorded breeding in this area including the Black-winged Stilt (<i>Himantopus himantopus</i>), Red-capped Plover (<i>Charadrius ruficapillus</i>) and Grey Teal (<i>Anus gracilis</i>). Fish were also present in the water bodies and although not formally assessed the species observed were juvenile Silver Scat (<i>Selenotoca multifasciata</i>), Mullet species, Crescent Grunter (<i>Terapon jarbua</i>) and Milkfish (<i>Chanos chanos</i>). Fish were likely trapped in the water body during storm surge associated to the recent cyclone. Due to the fish species present predatory species such as the Jabiru (<i>Ephippiorhynchus asiaticus</i>), Little Egret (<i>Egretta garzetta</i>), terns and Pelican (<i>Pelecanus conspicillatus</i>).</p> <p>Habitat value for fauna species of conservation significance</p> <p>Five conservation significant species were recorded in this habitat type and include Caspian Tern (<i>Hydroprogne caspia</i>), Gull-billed Tern (<i>Gelochelidon nilotica</i>), Common Sandpiper (<i>Actitis hypoleucos</i>), Red-necked Stint (<i>Calidris ruficollis</i>) and Common Greenshank (<i>Tringa nebularia</i>). The terns appeared to be following the drainage line to the water body looking for food while the waders were recorded on the mudflat or in vegetation foraging. All birds when disturbed fly west into Hearson's Cove. The habitat within the survey area is likely linking habitats from King Bay to Hearson's Cove. Other migratory species may also utilise the habitat opportunistically. Due to the amount of bird activity it is also possible Pilbara Olive Pythons is search of food may forage and reside in the rock wall on the northern side of the water body. This species is very resourceful and adapts quickly to changes in high resource areas. A bat detector at this location recorded the North-western Free-tail Bat (<i>Mormopterus (Ozimops) cobourgianus</i>). Due to the habitat present this species would have been foraging only. The Peregrine Falcon (<i>Falco peregrinus</i>) may also utilise the area for foraging only.</p> <p>High value</p>	<p>9.69 ha</p>	

Description	Extent in the survey area	Representative Images
<p>Drainage areas/ Flood Plain</p> <p>Linking King Bay and Hearson Cove is a series of tidal drainage lines and floodplain. Portions of this area was tidally inundated during the survey and also supports a large waterbody as described above. When the high tide retracts to several small pools and a minor drainage line during the low period. Vegetation was generally sparse and scattered however in areas clustered to form low samphire shrublands. Buffel and other grasses occurred in small areas. Few areas of debris build up was present however dead branched and some logs were present around the water body. Scattered large rocks and shell were recorded. The samphire habitat was considered suitable for terrestrial migratory birds however no specimens were recorded during the survey despite bird assessments undertaken in this area. No fire evidence was recorded in this area.</p> <p>This habitat type recorded species associated with open environments or shrublands including the Delicate Mouse (<i>Pseudomys delicatus</i>), Horsefield's Bushlark (<i>Mirafra javanica</i>), Sand plain Gecko (<i>Lucacasium stenodactylum</i>) and Ornate Snake-eyed Skink (<i>Notoscincus ornatus</i>).</p> <p>Habitat value for fauna species of conservation significance</p> <p>Five conservation significant species were recorded in and adjacent to this habitat type and include Caspian Tern (<i>Hydroprogne caspia</i>), Gull-billed Tern (<i>Gelochelidon nilotica</i>), Common Sandpiper (<i>Actitis hypoleucos</i>), Red-necked Stint (<i>Calidris ruficollis</i>) and Common Greenshank (<i>Tringa nebularia</i>). All these species would use this habitat especially in areas that inundate during high and low tides. However use is opportunistic. A bat detector at this location recorded the North-western Free-tail Bat (Mormopterus (Ozimops) cobourgianus). Due to the habitat present this species would have been foraging only.</p> <p>Medium to High Value</p> <p>Foraging habitat for migratory birds, North-western Free-tail Bat and Peregrine Falcon</p>	<p>14.75 ha</p>	

4.2.4 Fauna diversity

The wet season (Level 2) 2020 fauna surveys recorded 113 vertebrate fauna species utilising the survey area, including 19 mammals, 57 birds, 36 reptiles and one amphibians. A breakdown of the fauna assemblages for the survey results is provided below.

Mammals

The surveys recorded 19 mammal species within the survey area, including four introduced and 15 native mammals. The composition of species includes 8 bats, 2 native rodents, two macropod, two small dasyurid, one Echidna and four introduced mammals. The most specious family was the microchiropteran Molossid bats (4 species), Vespertilion bats (3 species), Murid rodents (3 species) with Canids and Macropod each having two species. The remaining families were all singular. Fifty nine individual mammals (excluding bats as the actual number cannot be determined from call data) were recorded over the trapping program between six species (the remainder of the species were from evidence only ie scats), with the most abundant being the Euro and Delicate Mouse. Forty three Euro and 10 Delicate Mouse were recorded (73% and 17% respectively of total native mammal recordings).

Bats were only recorded via echolocation (apart from one sighting of a White-striped Free-tailed Bat) therefore only presence or absence information could be collected. Some species overlap in call identification and therefore may represent multiple species (such as in the *Nyctophilus* group). A breakdown of mammal families recorded during the surveys is provided in Table 13.

Table 13 Mammal families recorded during the field surveys

Mammal Family	No. of species
Canidae (Dingo)	2
Dasyuridae (Dunnarts)	2
Emballonuridae (Sheath tailed Bats)	1
Felidae (Cat)	1
Molossidae (Freetail Bats)	4
Macropodidae (Kangaroos)	2
Muridae (Rodents)	3
Tachyglossidae (Echidna)	1
Vespertilionidae (Bats)	3
Total	19

Birds

The bird surveys (from the Level 2) identified 57 bird species from 32 families. The most specious families were the Meliphagidae (4 species), Columbidae (4 species), Accipitridae (4 species), Falconidae (3 species), Artamidae (3 species), Laridae (3 species) and Scolopacidae (3 species). Five hundred and twenty eight individual birds were recorded over the trapping program. The most abundant species were the Black-winged Stilt with 72 records (14% of total bird recordings), Red-capped Plover with 53 records (10% of total bird recordings), Red-necked Stint with 38 records (7% of total bird recordings) and Silvergull with 28 records (5% of total bird records). A breakdown of bird families recorded during the survey is provided in Table 14.

The most abundant birds recorded above all were recorded in the eastern part of the survey area and associated with the water bodies and tidal creek which incorporate part of the survey area. Outside of this area bird numbers decrease. Water bodies often incur greater number of species and numbers due to resources present.

Table 14 Bird families recorded during the field surveys

Bird Family	No. of species
Accipitridae (Diurnal birds of prey)	4
Alaudidae (Bushlark)	1
Anatidae (Ducks)	2
Artamidae (Magpie group)	3
Ardeidae (Egret)	2
Cacatuidae (Cockatoo group)	2
Campephagidae (Cuckoo-shrikes)	2
Charadriidae (Plover)	1
Ciconiidae (Stork)	1
Cisticolidae (Cisticola)	1
Columbidae (Doves)	4
Corvidae (Crow)	1
Cuculidae (Cuckoos)	2
Estrildidae (Finch)	2
Eurostopodidae (Nightjar)	1
Falconidae (Falcons)	3
Halcyonidae (Kingfishers)	2
Hirundinidae (Martins)	1
Laridae (Gulls)	3
Maluridae (Wrens)	1
Megaluridae (Grassbirds)	1
Meliphagidae (Honeyeaters)	4
Monarchidae (Lark)	1
Motacillidae (Pipit)	1
Pelecanidae (Pelican)	1
Phasianidae (Quail)	1
Psittacidae (Parrots)	2
Ptilonorhynchidae (Bowerbird)	1
Recurvirostridae (Stilt)	1
Scolopacidae (Waders)	3
Strigidae (Owl)	1
Turnicidae (Button-quail)	1
Total	57

Reptiles

A total of 36 reptile species were recorded during the field survey from nine families. The most specious families were the Scincids (11 species), Diplodactylids (4 species), Agamids (4 species), Gekkonids (4 species) and Elapids (4 species). Four hundred and eighty five reptiles were recorded in the survey area over the trapping program. The most abundant species were Burrup rock Gecko with 88 records (18% of total reptile recordings), Spotted Rock Gecko with 86 records (18% of total reptile recordings) and Western Two-toed Slider with 80 records (16.5% of total reptile recordings each). A breakdown of reptile families recorded during the survey is provided in Table 15.

Table 15 Reptile families recorded during the field surveys

Reptile Family	No. of species
Agamidae (Dragons)	4
Diplodactylidae (Geckos)	4

Reptile Family	No. of species
Elapidae (Snakes)	4
Gekkonidae (Geckos)	4
Pygopodidae (Legless Lizards)	2
Pythonidae (Pythons)	3
Scincidae (Skinks)	11
Typhlopidae (Blindsnake)	1
Varanidae (Monitors)	3
Total	36

Amphibians

One amphibian species the Sheep Frog (*Cyclorana maini*) was recorded across the survey area from the family, hylidae. Due to climatic conditions few were active however the species was opportunistically recorded via metamorph frogs in pits and associated to one small pool of water with in a minor drainage line in the northern portion of the survey area.

Introduced species

Mammals comprised the only group in which introduced fauna were recorded. In total four species were observed and included;

- Black Rat (*Rattus rattus*)
- Dog (*Canus lupis*)
- Cat (*Felis catus*)
- Fox (*Vulpes vulpes*).

The Dog were likely pets animals roaming while walking at Hearson Cove. During bird census surveys two persons were also recorded walking dogs in the early morning.

Species accumulation curve

Accumulation curves were run for the data collected during the field survey within 8 models in PRIMER V6. Analysis of the terrestrial vertebrate trapping data produced a SAC, tending towards, but not yet reaching, asymptote (Plate 6). The bootstrap estimator of approximately 49 species, suggests around 95% of the total terrestrial vertebrate fauna was recorded given a total of 47 species recorded during the field survey. Overall, it is considered that terrestrial vertebrate fauna was adequately sampled and that survey effort was adequate to provide a true representation of the fauna assemblage present in the survey area at the time of the survey.

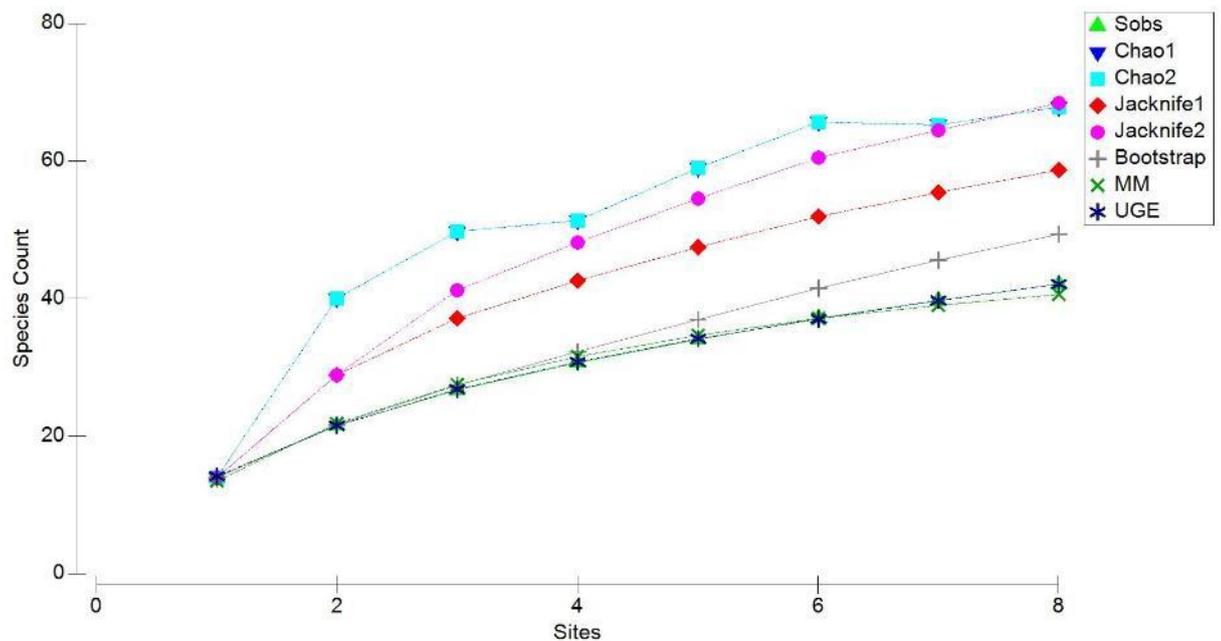


Plate 6 Species Accumulation Curve by trap sites for 8 models run.

4.2.5 Conservation significant fauna

Eight conservation significant fauna species were recorded within (or close to within) the survey area during the field survey. This included:

- Pilbara Olive Python (*Liasis olivaceus barroni*) – Listed as Vulnerable under the BC Act and the EPBC Act
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Listed as Priority 4 by DBCA
- North-western Free-tail Bat (*Mormopetrus ozimops cobourgianus*) - Listed as Priority 1 by DBCA
- Caspian Tern (*Hydroprogne caspia*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Gull-billed Tern (*Gelochelidon nilotica*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Common Sandpiper (*Actitis hypoleucos*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Common Greenshank (*Tringa nebularia*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Red-necked Stint (*Calidris ruficollis*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act.

Fauna species recorded in the survey area

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python (*Liasis olivaceus barroni*) is listed as Vulnerable under the EPBC Act and the BC Act.

The Pilbara Olive Python's range is restricted to the Pilbara region, north Western Australia, and including the Dampier Archipelago (Tutt et al 2002). Habitat consists of rocky escarpments, gorges and waterholes. The preferred microhabitats for this species are under rock piles, on top of rocks, and under spinifex as well as in man-made features such as overburden heaps,

railway embankments and sewerage treatment ponds. The species breeding season occurs from June to August, with males moving long distances in search of breeding females (Wilson and Swan 2017).

During the field survey two Pilbara Olive Python were recorded however one of these was a road kill just outside of the eastern part of the survey area. The other individual was found in the outcrops on the western side of the survey area (Plates 7 and 8). The location of where this specimen was recorded also includes a small rock water seep and is likely this individuals hunting (birds and mammals seeking a drink) location. The rocky ridgeline and outcropping habitat and drainage lines (and associated riparian vegetation) in the area around and within the survey area are core habitat for this species. The location and details of both individuals is presented below in Table 16 and Figure 7, Appendix A.

Table 16 Location and comment on Pilbara Olive Python recorded

Species	Landform	Longitude	Latitude	Comment
Pilbara Olive Python	Outcrops	116.792148	-20.631833	Juvenile dead on road at base of Rocks near D2
Pilbara Olive Python	Outcrops	116.778682	-20.622356	large adult (about 3 m) in main survey area



Plate 7 Pilbara Olive Python recorded in the survey area



Plate 8 Close up of the specimen

Western Pebble-mound Mouse (*Pseudomys chapmani*)

The Western Pebble-mound Mouse is listed Priority 4 under DBCA Priority fauna listing.

The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the species can be found on stony hills or hillsides with hummock grasslands. It constructs large mounds of pebbles on stony hills which cover an area of 0.5-9.0 square metres (Start 1996). ‘Active’ mounds are characterized by volcano-like cones capped by ‘craters’ that mark occluded entrances to subterranean burrow systems in which the mice live, often gregariously (Van Dyck and Strahan, 2008). Additionally an active mound has pebbles that do not or are not settled, meaning that the mound is being worked and pebbles continuously manipulated.

Evidence of the species was recorded via five disused mounds all within a local locations within the survey area (as shown below in Table 17 and in Figure 7, Appendix A). All were inactive mounds and were recorded on the Foothills habitat of the survey area. Plate 9 is an example of one of the mounds.

Table 17 Location and comments on Western Pebble-mound Mouse Mounds

Species	Landform	Longitude	Latitude	Comment
Western Pebble-mound Mouse	Foothills	116.780859	-20.624803	old mound 2 years
Western Pebble-mound Mouse	Foothills	116.780010	-20.623753	recently abandoned mound, about 6 months
Western Pebble-mound Mouse	Foothills	116.780085	-20.623488	old mound 2 year
Western Pebble-mound Mouse	Foothills	116.780256	-20.623358	very old mound
Western Pebble-mound Mouse	Foothills	116.780203	-20.623653	very old mound



Plate 9 Disused Western Pebble-mound Mouse mound

North-western Free-tail Bat (*Mormopetrus ozimops cobourgianus*)

The North-western Free-tail Bat is listed as P1 under DBCA priority listed fauna. The North-western Free-tail Bat is known from 12 locations in Western Australia (DBCA 2007–) and four in the Northern Territory. The species appears to be restricted in distribution to a few localised habitats. The species can appear to be locally common because it aggregates, however over a landscape is localised and restricted. In Western Australia, this species inhabits mangrove stands, and has been recorded roosting in hollows and or crevices in mangroves (van Dyck et al. 2008).

The North-western Free-tail Bat was recorded in the survey area (at all three bat detector sites) from calls over five nights of eleven recorded. Given the lack of mangrove within the survey area, it is likely this species opportunistically forages in the survey area and roosts in the mangroves to the west (in King Bay) or to the east in the northern portion of Hearson's Cove. There is only a small amount of habitat within the survey area for these species to utilise and any impacts are likely to be negligible. The bat call assessment is provided in Appendix F.

Terns (Caspian Tern, *Hydroprogne caspia* and Gull-billed Tern, *Gelochelidon nilotica*)

The terns recorded are listed as migratory under the EPBC Act and International Agreement under the BC Act.

Two migratory tern species were observed flying through and around the survey area, these being the Gull-billed Tern and Caspian Tern (Plate 10). These species were observed flying to and from King Bay and Hearson Cove into the floodplain/ drainage line and water body portion of the survey area. Additionally one species was recorded (Caspian Tern) on numerous occasions at the water body both resting and feeding on fish. This area is likely a regular in fly over location for these species moving between King Bay and Hearson's Cove. There is only a small amount of habitat within the survey area for these species to utilise and any impacts are likely to be negligible. All species are considered relatively common and to opportunistically use

the area. The location and comments on the species is presented below in Table 18 and Figure 7, Appendix A.

Table 18 Location and comments on tern species recorded

Species	Landform	Longitude	Latitude	Comment
Caspian Tern	Water Body	116.784260	-20.628001	2 to 4 birds feeding and loafing on water body
Gull-Billed Tern	Water Body	116.783490	-20.628671	2 birds feeding at water body



Plate 10 Two Caspian Terns loafing at the Water Body

Migratory Waders (Common Sandpiper, *Actitis hypoleucos*, Red-necked Stint, *Calidris ruficollis* and Common Greenshank, *Tringa nebularia*)

Three migratory waders listed as migratory under the EPBC Act and International Agreement under the BC Act were recorded in the survey area.

These species are often found on the intertidal mudflats, harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, non-vegetated mudflats. Also found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms and using saline or brackish lakes near coastal areas. These species also use saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and salt fields (Higgins & Davies 1996).

The three species recorded are the most common and widespread of all of the migratory species that visit Australia. Additionally they can also utilise a wide range of habitats. Numerous individuals of Common Greenshank (Plate 11) and Red-necked Stint (Plate 12) were recorded foraging in the water body and drainage line within the survey area. These individuals once disturbed flew towards Hearson’s Cove on the eastern side of the Burrup Peninsula. Only one Common Sandpiper was recorded foraging along the water body but this is not uncommon as this species is solitary. There is only a small amount of habitat within the survey area for these species to utilise and any impacts are likely to be negligible. There is additional habitat (tidal

mudflats) available in King Bay and within Hearson’s Cove, which is of much larger for wading species to utilise in the region. The location and comments on the species is presented below in Table 19 and Figure 7, Appendix A.

Table 19 Location and comments on migratory waders recorded

Species	Landform	Longitude	Latitude	Comment
Common Sandpiper	Water Body	116.786030	-20.627625	1 bird feeding and loafing
Common Greenshank	Water Body	116.784153	-20.628123	7 birds feeding and loafing
Common Greenshank	Water Body	116.784264	-20.628011	13 birds loafing
Red-necked Stint	Water Body	116.784250	-20.628017	Several birds feeding
Red-necked Stint	Water Body	116.784206	-20.628021	Several birds feeding



Plate 11 Group of Common Greenshank loafing on a mud spit



Plate 12 Group of Red-necked Stint and Red-caped Plover feeding in water

Likelihood of occurrence assessment

In addition to the field survey results, an assessment on the likelihood of conservation significant species occurring in the survey area was undertaken. This assessment is based on species' biology, habitat requirements, the quality and availability of suitable habitat as determined during the field survey and records of the species in the survey area and locality. Species-specific searches of the DBCA NatureMap database with a buffer of 10 km were also conducted in order to gather information about the broader regional occurrence of species to further inform the likelihood of occurrence assessment. Some species identified in the Protected Matters Search tool are not realistically considered to occur in the survey area or are not terrestrial vertebrate species and have been excluded from the assessment.

Excluding those recorded above an additional 23 other species are likely to occur in the survey area. Table 20 summarises the species of conservation significance that are considered likely to occur in the survey area. Most of these species listed below are considered likely due to the floodplain and water body habitat provided in the survey at the time of the survey. This habitat incorporates a large water body and associated vegetation suitable habitat for numerous migratory shore bird species. The remaining habitat of the survey area are not considered to be utilised by these species. The Peregrine Falcon is likely to utilise all habitat types for foraging however no breeding habitat (cliffs, gorges, large trees) is present in the survey area.

A brief description of these species and their associated habitat types within the survey area are described below. The parameters of assessment for this likelihood of occurrence assessment and the full likelihood of occurrence assessment are provided in Appendix E.

Table 20 Summary of likelihood of occurrence assessment for conservation significant fauna species deemed likely to occur

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Birds			
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Red Knot (<i>Calidris canutus</i>)	Ma, Mi, En	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Curlew Sandpiper (<i>Calidris ferruginea</i>)	Ma, Mi, Cr	Cr	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Pectoral Sandpiper (<i>Calidris melanotos</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Long-toed Stint (<i>Calidris subminuta</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Greater Knot (<i>Calidris tenuirostris</i>)	Ma, Mi, Cr	Cr	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Oriental Plover (<i>Charadrius veredus</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Peregrine Falcon (<i>Falco peregrinus</i>)	-	OS	Likely. The species is known from the region, however use would be opportunistic for all habitats and utilised for foraging purposes only. No breeding habitat present.
Oriental Pratincole (<i>Glareola maldivarum</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Broad-billed Sandpiper (<i>Limicola falcinellus</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Bar-tailed Godwit (<i>Limosa lapponica</i>) both sub species	Ma, Mi, Vu or Cr	Vu or Cr	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Black-tailed Godwit (<i>Limosa limosa</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Eastern Curlew (<i>Numenius madagascariensis</i>)	Ma, Mi, Cr	Vu	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Little Curlew (<i>Numenius minutus</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Whimbrel (<i>Numenius phaeopus</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Osprey (<i>Pandion cristatus</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Pacific Golden Plover (<i>Pluvialis fulva</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Grey Plover (<i>Pluvialis squatarola</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Australian Painted Snipe (<i>Rostratula australis</i>)	Ma, Mi, En	En	Likely. Available core chenopod over water habitat, however use would be opportunistic to floodplain and drainage lines.
Crested Tern (<i>Thalasseus bergii</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Grey-tailed Tattler (<i>Tringa brevipes</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.
Marsh Sandpiper (<i>Tringa stagnatilis</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Terek Sandpiper (<i>Xenus cinereus</i>)	Ma, Mi	IA	Likely. The species is known from the region, however use would be opportunistic to floodplain and drainage lines and utilised for foraging purposes only.

Key – (OS) = Other Special Protection under BC Act, (Vu) = Vulnerable under the EPBC Act and/ or BC Act, (En) = Endangered under the EPBC Act and/ or BC Act, (Cr) = Critically Endangered under the EPBC Act and/ or BC Act, (Ma, Mi) = under the EPBC Act, (IA) = under the BC Act, (P4) = Priority 4 under DBCA. For breakdown of code meaning see Appendix B.

5. Discussion

5.1 Flora and vegetation

The vegetation types identified and described within the survey area align with those previously described for in the area as described by Beard (1975), Astron (2001a) and Trudgen (2002). A total of 392 native species of flowering plants and one native fern have been recorded from the Burrup Peninsula (Trudgen 2002). The survey recorded a total of 141 flora taxa representing 40 families and 99 genera within the survey area. Given the size of the survey area the flora diversity is considered to be moderately diverse which would be a reflection of the variation in landforms including mudflats, coastal sands, rocky hills and rockpiles.

One Priority 1 Priority Ecological Community (PEC) was identified within the survey area. *Terminalia* scattered low trees (VT02) is considered to be representative of the Burrup Peninsula rock pile communities PEC. The locations of this PEC occurring within the survey area are not presently listed on the DBCA database. There is approximately 2.09 ha of this PEC occurring within the survey area of which all is in Excellent condition. Trudgen (2002) concluded that the vegetation of the Burrup Peninsula is atypical of the vegetation of both the Fortescue Botanical District and the Abydos Plain and has relatively little in common with it. Much of the vegetation is distinct in a regional sense, resulting from a combination of coastal climatic influences with the unusual geomorphology and relative isolation of the Burrup Peninsula. Therefore, at the subregional level, the Burrup Peninsula has a very high value for the conservation of vegetation, and adds to the conservation value of the area at a regional level.

The *Tecticornia* isolated shrubs to open low shrubland (VT05) vegetation type identified in the survey area corresponds with vegetation units mapped by M.E. Trudgen & Associates (2002) designated Sm and described as Saline Inlet and Supra-tidal Flats. This vegetation type is found within the King Bay – Hearsons Cove Valley. The EPA (2001) noted that vegetation in the King Bay – Hearsons Cove Valley has high conservation value and that part of the floristic variation appears to be uncommon elsewhere on the Peninsula (Trudgen et al. 2001).

Three Priority flora species listed by the DBCA was recorded within the survey area, *Terminalia supranitifolia* (Priority 3), *Vigna triodiophila* (Priority 3) and *Rhynchosia bungarensis* (Priority 4). These three species were recorded in the northern parts of the survey area and are strongly associated with the rockpile vegetation community which is classified as a Priority 1 PEC. Some *Terminalia supranitifolia* trees were also recorded on the lower hill slopes. *Terminalia supranitifolia* is typically found on rockpiles on the Burrup Peninsula but is also known from scattered populations in the Chichester Ranges (DBCA 2007–). *Rhynchosia bungarensis* is reasonably widespread throughout the Burrup Peninsula and is frequently found along the more sheltered bases of rockpiles. Outside the Burrup Peninsula, this species occurs as scattered populations within the Pilbara region. *Vigna triodiophila* is mostly restricted to the Burrup Peninsula with a small number of records in other areas of the Pilbara (DBCA 2007–).

5.2 Fauna

All the fauna habitat identified during the survey area are found throughout the region (greater Karratha/Dampier area) however on the Burrup Peninsular the sandy plain and drainage line/floodplain is restricted due to the rocky nature of the remainder of the Burrup Peninsular. This is shown in the species list by the presence of the Military Dragon and Serventy's Skink on the sand plain which although are common Pilbara species is the only known locality of the species on the Burrup Peninsular. The Rocky Outcropping is also a significant fauna habitat. The expensive crevices the outcrops provide enable saxicoline species to persist. Additionally it is core habitat for the Pilbara Olive Python.

6. Conclusions

6.1 Key findings

6.1.1 Flora and Vegetation

Seven vegetation types were identified and described for the survey area, as well as cleared areas and seasonally inundated/open water. The vegetation within the survey area north of the existing YPF Plant primarily consists of hummock grasslands of *Triodia epactia* and *T. wiseana* with scattered to open shrublands dominated by *Acacia*, *Hakea* and *Grevillea* species on rocky hills. The vegetation south of the ammonia plant was generally dominated by samphire shrublands and *Triodia angusta* low hummock grasslands on saline tidal flats and **Cenchrus ciliaris* (Buffel grass) grasslands on coastal sands.

One Priority 1 Priority Ecological Community (PEC) was identified within the survey area. *Terminalia* scattered low trees (VT02) is considered to be representative of the Burrup Peninsula rock pile communities PEC. There is approximately 2.09 ha of this PEC occurring within the survey area of which all is in Excellent condition. The *Tecticornia* isolated shrubs to open low shrubland (VT05) corresponds with vegetation units mapped by M.E. Trudgen & Associates (2002) designated Sm and described as Saline Inlet and Supra-tidal Flats. This vegetation was considered of conservation significance as it occurs in the tidal inlet between Hearson Cove and King Bay.

The survey recorded a total of 141 flora taxa (including subspecies and varieties) representing 40 families and 99 genera within the survey area. This total comprised of 138 native taxa and three introduced taxa, **Cenchrus ciliaris* (Buffel grass), **Aerva javanica* (Kapok bush) and **Vachellia farnesiana* (Mimosa bush).

Three Priority species listed by the DBCA was recorded within the survey area, *Terminalia supranitifolia* (Priority 3), *Vigna triodiophila* (Priority 3) and *Rhynchosia bungarensis* (Priority 4). These three species were restricted to the northern part of the survey area and largely grew in association with rock piles vegetation type (VT02). An additional Priority flora species is considered likely to occur within the survey area. *Stackhousia clementii* (Priority 3) has previously been recorded within the survey area in the King Bay – Hearson Cove tidal inlet, just south of the existing ammonia plant. The area was systematically searched during the survey however no individuals were observed.

6.1.2 Fauna

Six broad habitat types (excluding disturbed/cleared areas) were recorded from the survey area. These habitat types closely align with the vegetation types and landforms within the survey area and consist of Rocky Outcropping, Foothills, Sand Plain, Minor Drainage lines, Drainage area/ Floodplain and Water body. The most significant fauna habitats with the survey area are the Rocky Outcropping, Drainage area/ Floodplain and water body due to the conservation significant fauna that were recorded there.

The wet season (Level 2) 2020 fauna surveys recorded 113 vertebrate fauna species utilising the survey area, including 19 mammals, 57 birds, 36 reptiles and one amphibians. Of these four were introduced species and included Dog, Cat, Fox and Black Rat.

Eight conservation significant fauna species were recorded within the survey area during the field survey. This included:

- Pilbara Olive Python (*Liasis olivaceus barroni*) – Listed as Vulnerable under the BC Act and the EPBC Act.

- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Listed as Priority 4 by DBCA
- North-western Free-tail Bat (*Mormopetrus ozimops cobourgiensis*) – Listed as Priority 1 by DBCA
- Caspian Tern (*Hydroprogne caspia*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Gull-billed Tern (*Gelochelidon nilotica*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Common Sandpiper (*Actitis hypoleucos*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Common Greenshank (*Tringa nebularia*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act
- Red-necked Stint (*Calidris ruficollis*) – Listed Marine and Migratory (International Agreements) under the BC Act and the EPBC Act.

Of these species the terns and migratory shorebirds are considered vagrant and would seasonally utilise the waterbody and opportunistically utilise Drainage area/ Floodplain areas around high tide events. The Pilbara Olive Python is resident to the Rocky Outcropping and this would be considered core habitat for this species. The foothills and water body would be seasonally utilised for feeding and dispersal purposes. Old Western Pebble-mound Mouse mounds were recorded in the Foothills with the species considered no longer present on the Burrup Peninsular. The North-western Free-tail Bat was recorded via echolocation. This species core habitat is mangroves to which there is none within the survey area. Mangroves are present in King Bay and Hearson Cove therefore activity within the survey area is for foraging only.

An additional 23 other conservation significant species are likely to occur in the survey area. Most of these species are considered likely due to the floodplain and water body habitat provided in the survey at the time of the survey. This habitat incorporates a large water body and associated vegetation suitable habitat for numerous migratory shore bird species. The remaining habitat of the survey area are not considered to be utilised by these species. The Peregrine Falcon is likely to utilise all habitat types for foraging however no breeding habitat (cliffs, gorges, large trees) is present in the survey area.

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Appendices

Appendix A – Figures

Figure 1 Project locality

Figure 2 Constraints

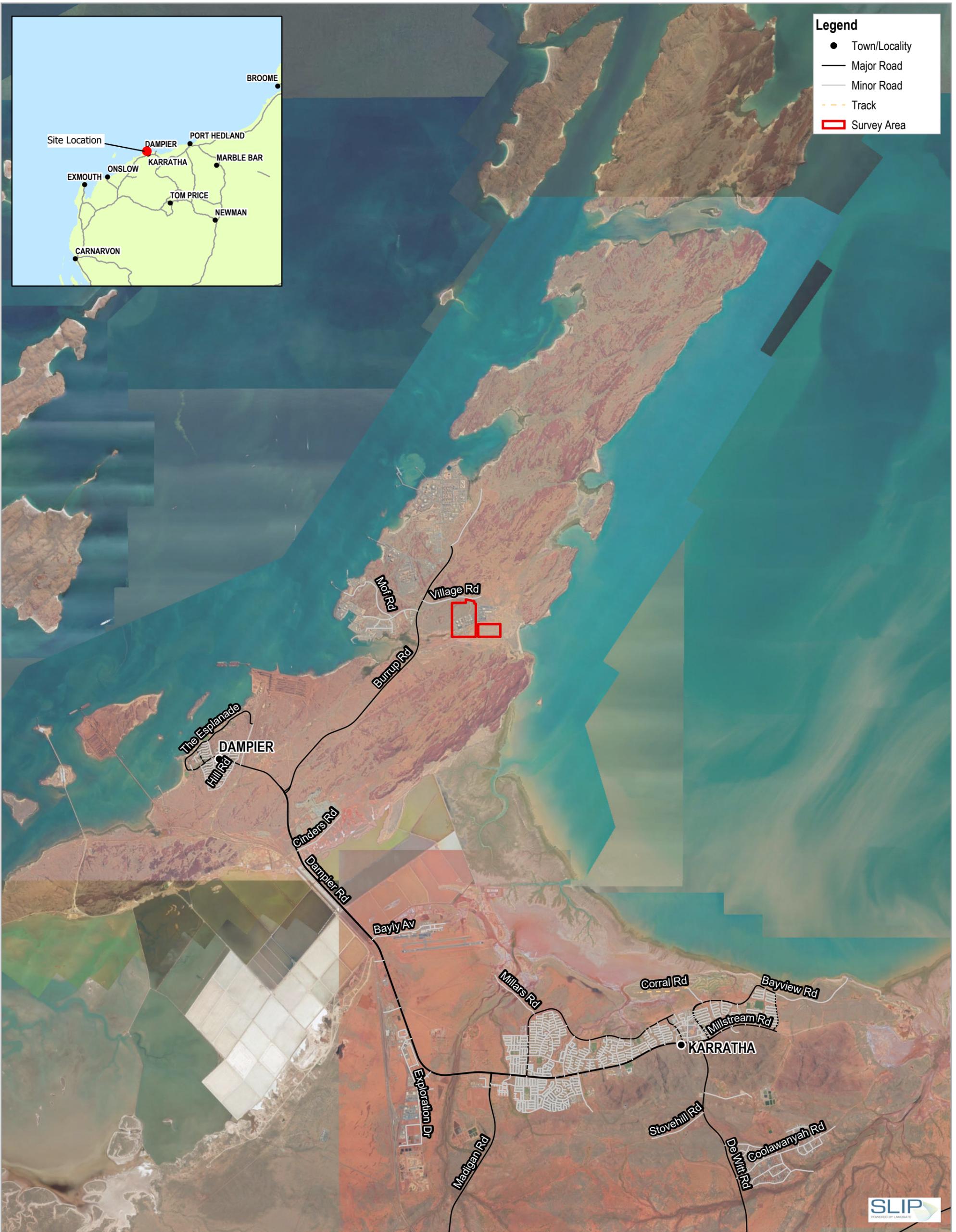
Figure 3 Fauna survey methods

Figure 4 Vegetation types

Figure 5 Vegetation condition

Figure 6 Significant vegetation and flora

Figure 7 Fauna survey results



Paper Size ISO A3
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 Kilometres



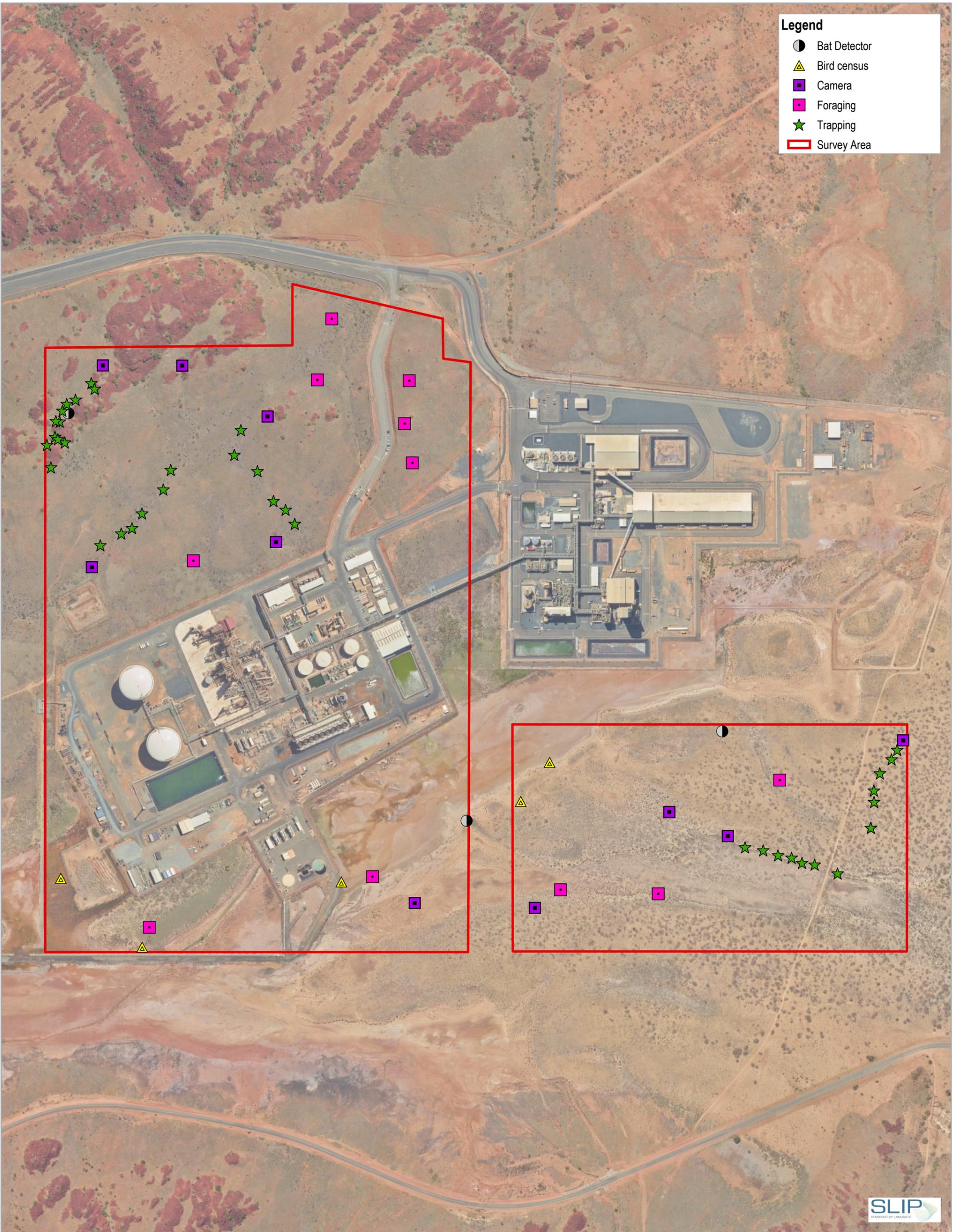
Map Projection: Transverse Mercator
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 Grid: GDA 1994 MGA Zone 50

Yara Pilbara Fertilisers Pty Ltd
 Renewable Hydrogen Project

Project No. 12520684
 Revision No. 0
 Date 6/06/2020

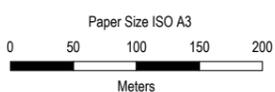
Locality Map

FIGURE 1



Legend

-  Bat Detector
-  Bird census
-  Camera
-  Foraging
-  Trapping
-  Survey Area



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 50



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Fauna survey methods

Project No. 12520684
 Revision No. 0
 Date 6/06/2020

FIGURE 2

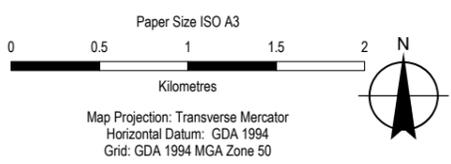
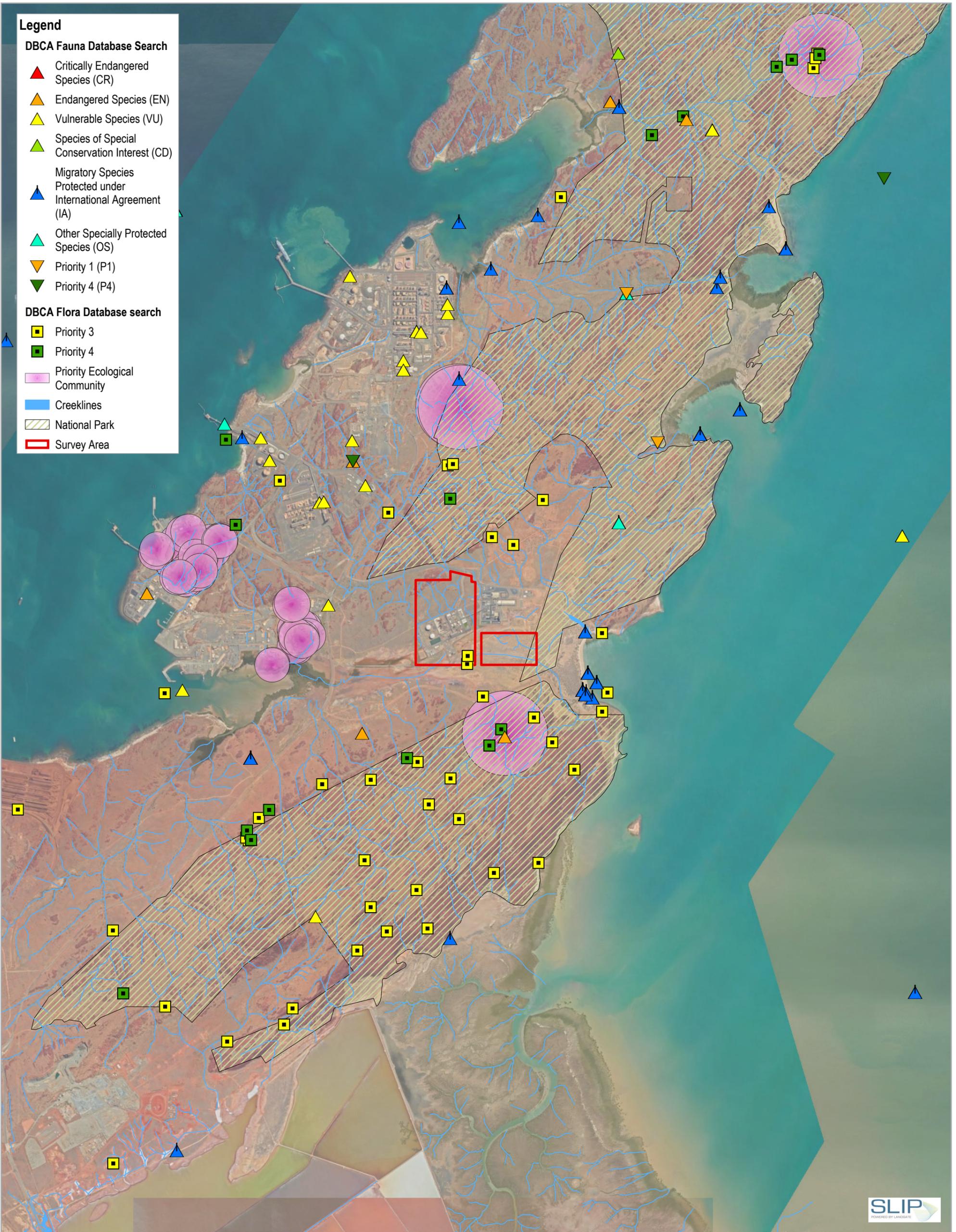
Legend

DBCFA Fauna Database Search

- ▲ Critically Endangered Species (CR)
- ▲ Endangered Species (EN)
- ▲ Vulnerable Species (VU)
- ▲ Species of Special Conservation Interest (CD)
- Migratory Species Protected under International Agreement (IA)
- ▲
- ▲ Other Specially Protected Species (OS)
- ▼ Priority 1 (P1)
- ▼ Priority 4 (P4)

DBCFA Flora Database search

- Priority 3
- Priority 4
- Priority Ecological Community
- Creeklines
- National Park
- Survey Area

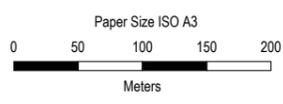
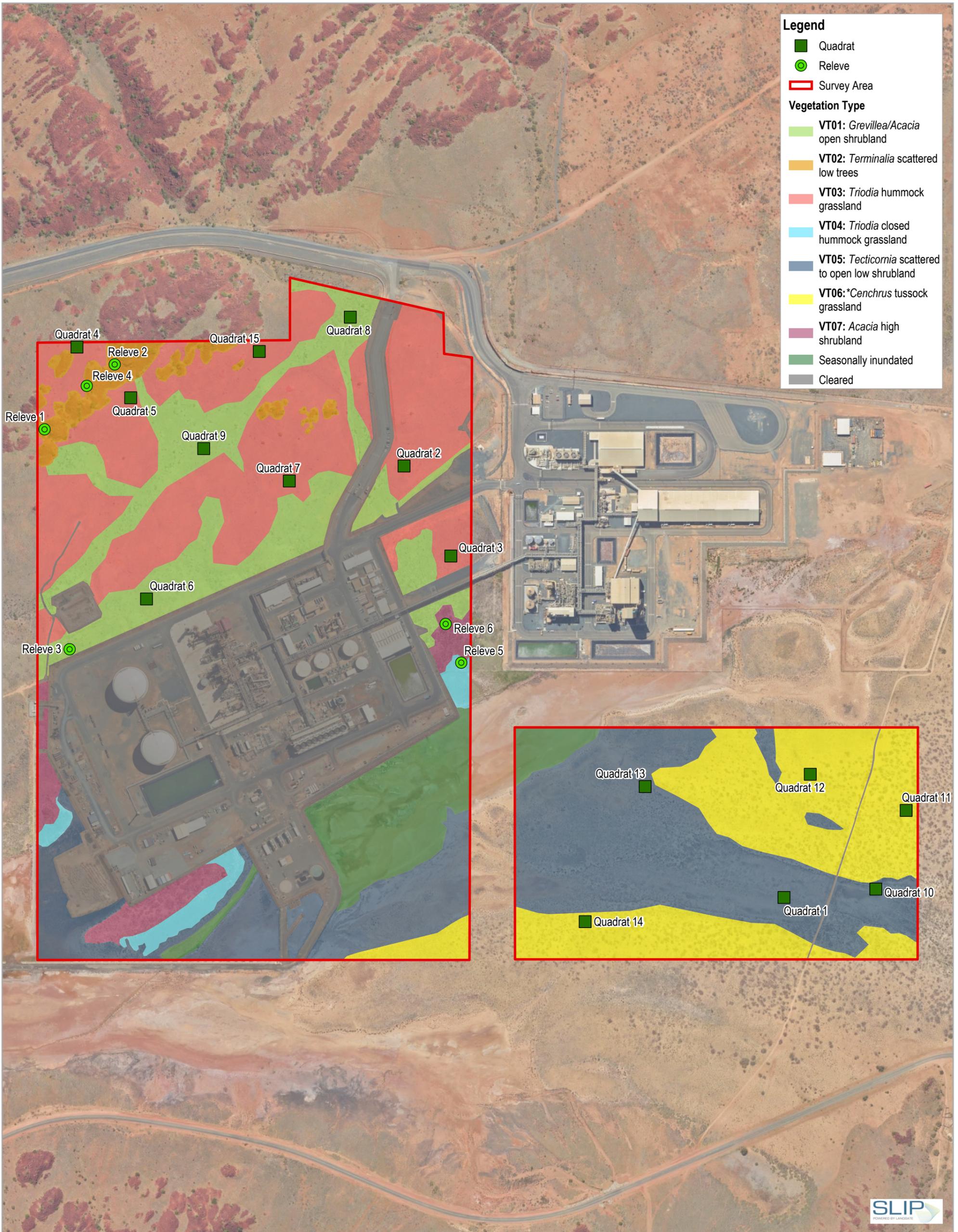


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Environmental Constraints

Project No. 12520684
Revision No. 0
Date 6/06/2020

FIGURE 3

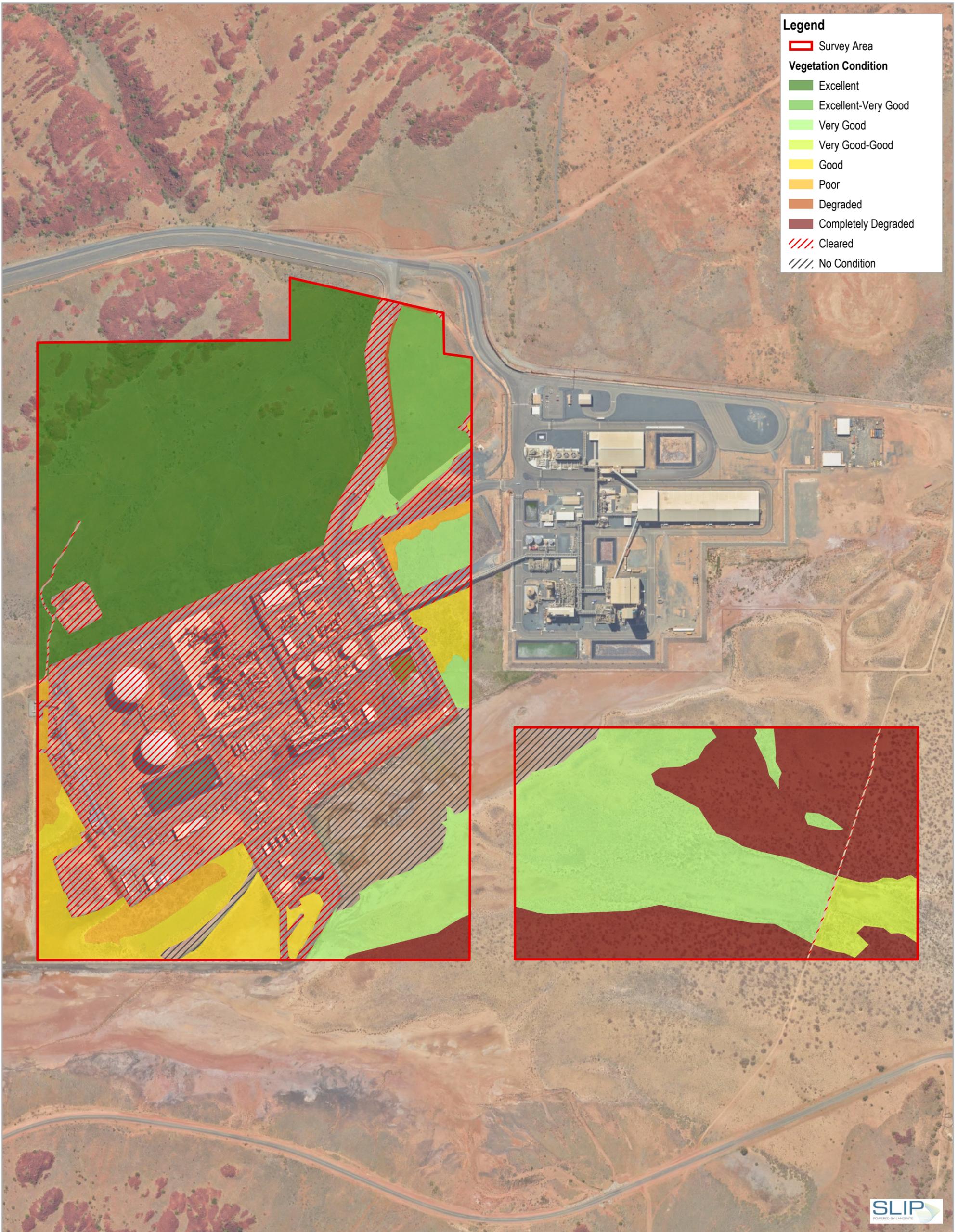


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Project No. 12520684
Revision No. 0
Date 6/06/2020

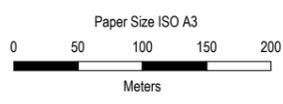
Vegetation Types

FIGURE 4



Legend

- Survey Area
- Excellent
- Excellent-Very Good
- Very Good
- Very Good-Good
- Good
- Poor
- Degraded
- Completely Degraded
- Cleared
- No Condition



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 50



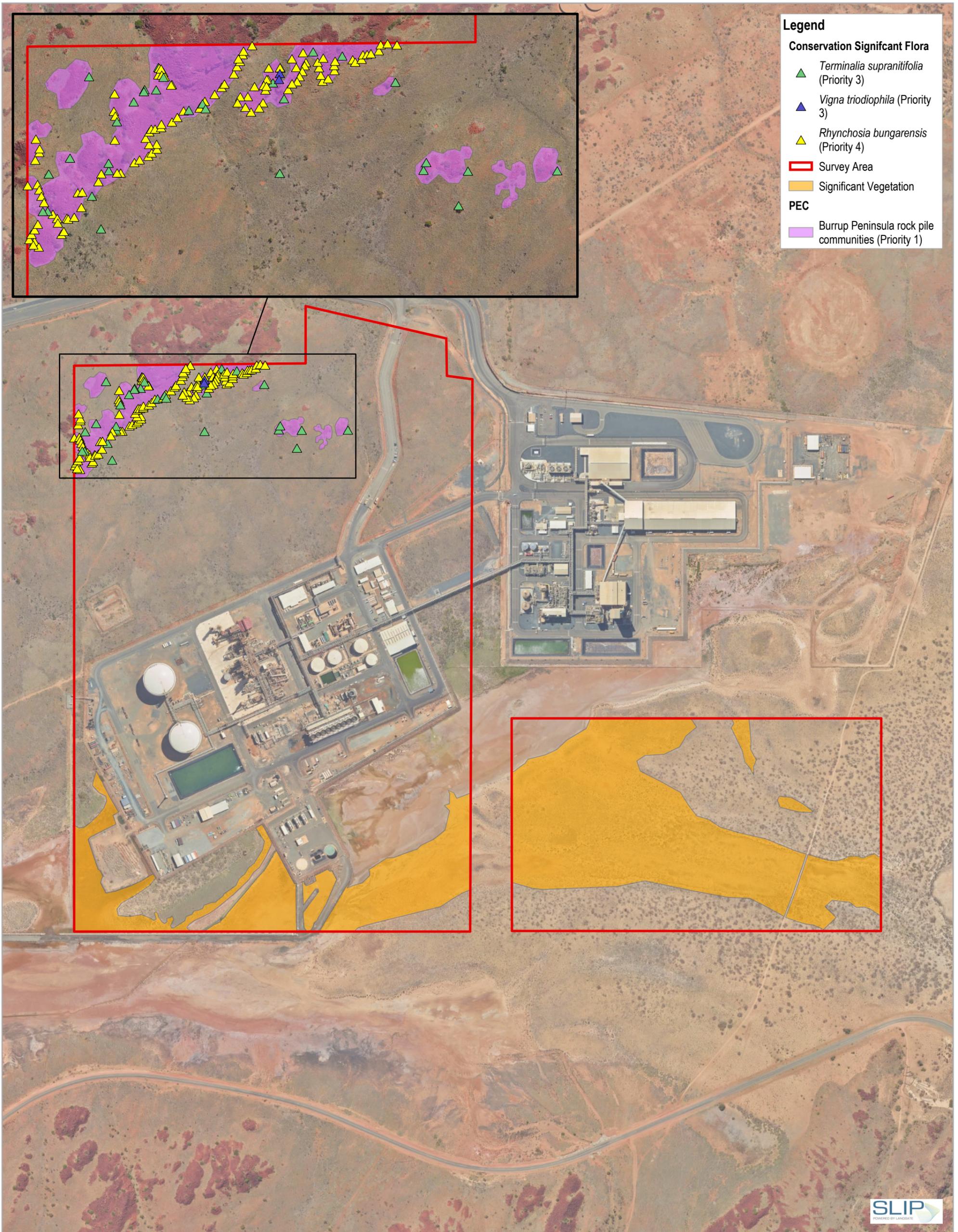
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Vegetation Condition

Project No. 12520684
 Revision No. 0
 Date 6/06/2020



FIGURE 5



Legend

Conservation Significant Flora

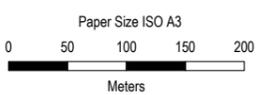
- ▲ *Terminalia supranitifolia* (Priority 3)
- ▲ *Vigna triodiophila* (Priority 3)
- ▲ *Rhynchosia bungarensis* (Priority 4)

Survey Area

- Survey Area
- Significant Vegetation

PEC

- Burrup Peninsula rock pile communities (Priority 1)



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 50

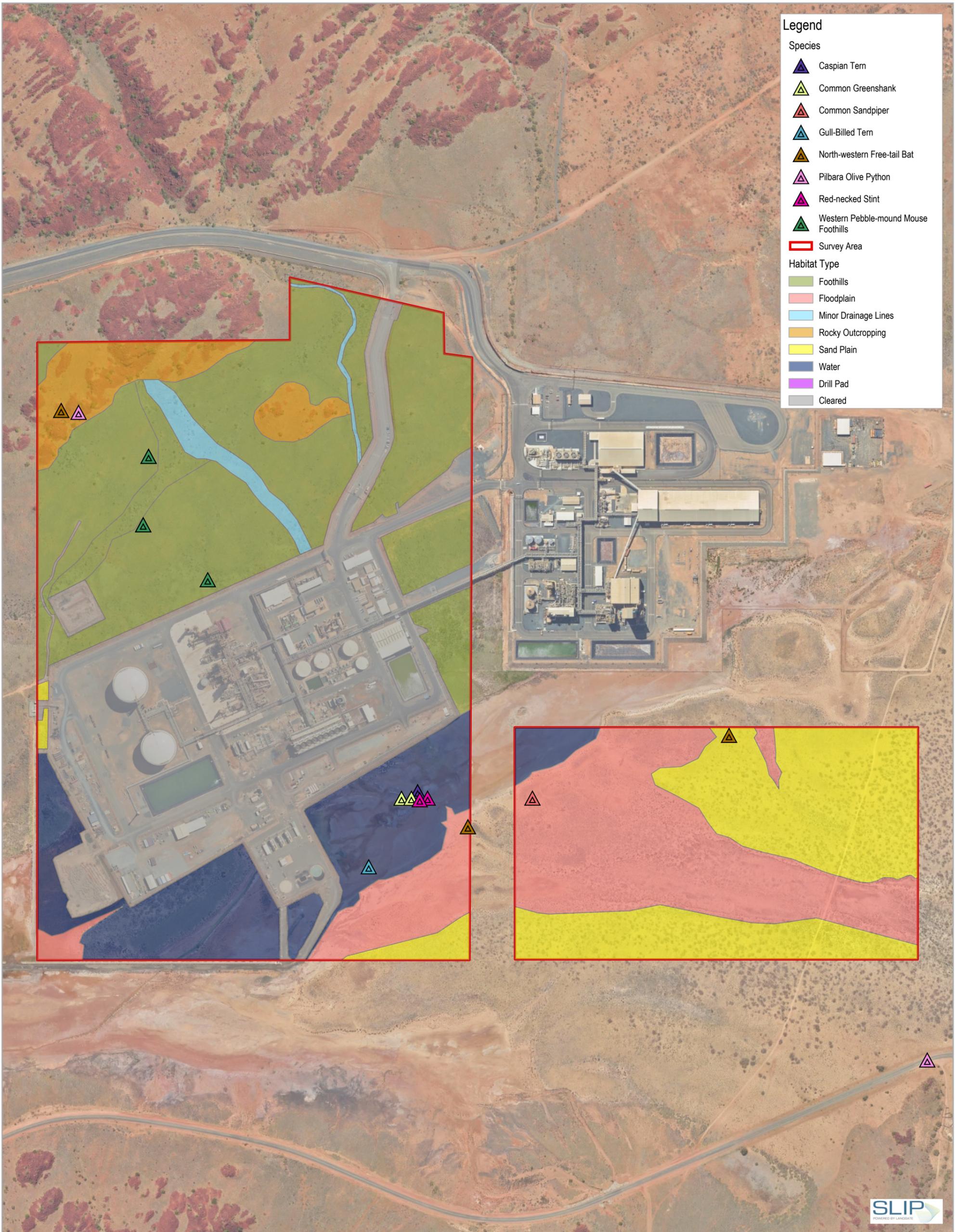


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Project No. 12520684
 Revision No. 0
 Date 6/06/2020

Significant vegetation and flora

FIGURE 6



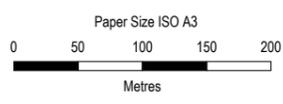
Legend

Species

- Caspian Tern
- Common Greenshank
- Common Sandpiper
- Gull-Billed Tern
- North-western Free-tail Bat
- Pilbara Olive Python
- Red-necked Stint
- Western Pebble-mound Mouse

Habitat Type

- Foothills
- Floodplain
- Minor Drainage Lines
- Rocky Outcropping
- Sand Plain
- Water
- Drill Pad
- Cleared



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 50



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 Renewable Hydrogen Project

Fauna Habitats

Project No. 12520684
 Revision No. 0
 Date 6/06/2020

FIGURE 7

Appendix B – Relevant legislation, conservation codes and background information

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of Agriculture, Water and the Environment (DAWE).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

- a) Native vegetation should not be cleared if it comprises a high level of biodiversity.
- b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
- c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
- d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
- e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
- f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
- g) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
- h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

- i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.
- j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State Biodiversity and Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biodiversity and ecological integrity should be a fundamental consideration in decision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State Biosecurity and Agriculture Management Act 2007

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976*. The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the <i>Australian Heritage Commission Act 1975</i> of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in “Bush Forever” Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the <i>Environmental Protection (Gnangara Mound Crown Land) Policy 1992</i> .
The areas covered by the <i>Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002</i> .
The areas covered by the lakes to which the <i>Environmental Protection (Swan Coastal Plain Lakes) Policy 1992</i> (EPP Lakes) applies.
Protected wetlands as defined in the <i>Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998</i> .

Reserves and conservation areas

Department of Biodiversity, Conservation and Attractions managed lands and waters

DBCA manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DBCA managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DBCA managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DBCA managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DBCA managed lands will generally be referred to DBCA throughout the assessment process.

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the

threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia’s Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2018), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated at least every two years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (EPA 2016a). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale for the Eremaean and Northern Botanical Provinces

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

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State BC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The BC Act provides for the Minister to list an ecological community as a TEC (section 27), or as a collapsed ecological community (section 31) statutory listing of State TECs by the Minister. The legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

Possible TECs that do not meet survey criteria are added to the DBCA Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Conservation codes and definitions for TECs listed under the EPBC Act and/ or BC Act

Categories	Definition
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Endangered (EN)	An ecological community if, at that time: A) is not critically endangered; and B) is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Vulnerable (VU)	An ecological community if, at that time: A) is not critically endangered or endangered; and B) is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Western Australia Conservation Categories (BC Act)	
<u>Threatened Ecological Communities</u>	

Categories	Definition
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Collapsed ecological communities

An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time –

- (a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed); or
- (b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover –
 - (i) its species composition or structure; or
 - (ii) its species composition and structure.

Section 33 of the BC Act provides for a collapsed ecological community to be regarded as a threatened ecological community if it is discovered in a state that no longer makes it eligible for listing as a collapsed ecological community.

Conservation categories and definitions for PECS as listed by the DBCA

Category	Description
Priority 1	<p>Poorly known ecological communities.</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
Priority 2	<p>Poorly known ecological communities.</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>

Category	Description
Priority 3	<p>Poorly known ecological communities.</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
Priority 4	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
Priority 5	<p>Conservation Dependent ecological communities.</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016b) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in 'pristine' condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range)
- Being poorly reserved.

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Flora and fauna

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the BC Act can warrant referral to the DEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for flora and fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of flora and fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act flora and fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet 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 or Extinct species under the BC Act cannot also be listed as Specially Protected species.

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 flora or fauna.

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.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act and BC Act listed flora and fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	<p>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”.</p> <p>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.</p>
Endangered (EN)	<p>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”.</p> <p>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</p>
Vulnerable (VU)	<p>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”.</p> <p>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.</p>
Extinct species	
Extinct (EX)	Species where “there is no reasonable doubt that the last member of the species has died”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (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).
Specially protected species	
Migratory (MI)	<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>

Conservation category	Definition
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Conservation codes for DBCA listed Priority flora and fauna

Priority category	Definition
Priority 1	<p>Poorly-known taxa</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	<p>Poorly-known taxa</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	<p>Poorly-known taxa</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	<p>Rare, Near Threatened and other taxa in need of monitoring</p> <p>A. Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.</p> <p>B. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>C. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.</p>

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016b) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
- Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems)
- Being poorly reserved

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007*.

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

References

- ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.
- Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.
- English, V and Blyth, J 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, Perth, Department of Conservation and Land Management.
- EPA 2010, *Technical Guide – Terrestrial Fauna Surveys*, EPA, Perth, WA.
- EPA 2016a, *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment*, EPA, Perth, WA.
- EPA 2016b, *Environmental Factor Guideline - Flora and Vegetation*, EPA, Perth, WA.
- GoWA 2018, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report)*, Current as of December 2017, Perth Western Australia, Department of Environment and Conservation, from <https://www2.landgate.wa.gov.au/web/guest/downloader>.
- Shepherd, DP, Beeston, GR & Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status*, Resource Management Technical Report 249, Perth, Department of Agriculture.

Appendix C – Database searches

EPBC Act PMST Report (20 km buffer)

NatureMap Flora and Fauna Report (20 km buffer)



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 19/02/20 16:57:39

[Summary](#)

[Details](#)

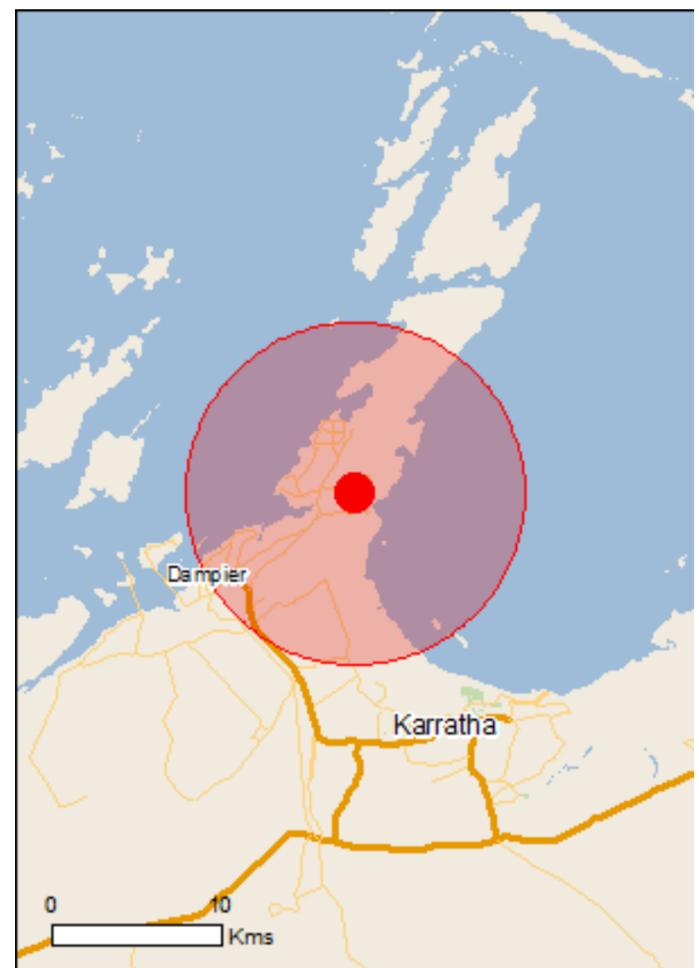
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	29
Listed Migratory Species:	58

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	98
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area

Name	Status	Type of Presence
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Rhinonictoris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding likely to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		

Name	Threatened	Type of Presence
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding likely to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species

Name	Threatened	Type of Presence
Tringa totanus Common Redshank, Redshank [835]		habitat known to occur within area Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis czeb lukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowellii null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area
Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within

Name	Status	Type of Presence area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Murujuga	WA
Unnamed WA36915	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
<i>Columba livia</i> Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
<i>Passer domesticus</i> House Sparrow [405]		Species or species habitat likely to occur within area
<i>Passer montanus</i> Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-20.62459 116.78823

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

NatureMap Species Report_Flora 10km

Created By Guest user on 19/02/2020

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Line'
Vertices 20° 37' 11" S, 116° 46' 51" E 20° 37' 49" S, 116° 46' 51" E
Group By Family

Family	Species	Records
Acanthaceae	3	7
Aizoaceae	2	3
Amaranthaceae	13	31
Apocynaceae	1	3
Araliaceae	2	7
Asteraceae	14	27
Boodleaceae	1	1
Boraginaceae	3	11
Brassicaceae	2	4
Capparaceae	2	2
Caryophyllaceae	1	1
Caulerpaceae	6	9
Celastraceae	1	3
Ceramiaceae	1	2
Chenopodiaceae	14	22
Cleomaceae	1	8
Codiaceae	1	2
Combretaceae	2	43
Commelinaceae	1	1
Convolvulaceae	6	12
Coralliaceae	1	1
Cucurbitaceae	2	3
Cymodoceaceae	1	3
Cyperaceae	10	18
Dasycladaceae	2	2
Euphorbiaceae	13	39
Fabaceae	48	167
Frankeniaceae	1	1
Gentianaceae	1	1
Goodeniaceae	7	16
Gyrostemonaceae	1	1
Halimedeaceae	1	1
Halymeniaceae	1	2
Hydrocharitaceae	5	9
Lamiaceae	2	2
Lauraceae	1	2
Lythraceae	2	4
Malvaceae	20	106
Menispermaceae	1	1
Molluginaceae	1	1
Moraceae	3	5
Mychodeaceae	1	1
Myrtaceae	4	11
Nyctaginaceae	3	7
Oleaceae	1	3
Passifloraceae	1	4
Phrymaceae	1	1
Phyllanthaceae	3	5
Pittosporaceae	1	4
Plantaginaceae	2	4
Plumbaginaceae	2	3
Poaceae	33	95
Polyphysaceae	1	2
Portulacaceae	1	1
Primulaceae	1	1
Proteaceae	3	5
Pteridaceae	1	2
Rhizophoraceae	3	4
Rhodomelaceae	2	2
Rubiaceae	1	1
Sapindaceae	2	2
Scrophulariaceae	2	4
Siphonocladaceae	1	2
Solanaceae	5	12
Stylidiaceae	1	3
Udoteaceae	1	2
Violaceae	1	1
Zygophyllaceae	2	3
TOTAL	281	769

Name ID Species Name

NatureMap is a collaborative project of the Department of Biodiversity, Conservation and Attractions and the Western Australian Museum.

Naturalised Conservation Code ¹Endemic To Query



Department of Biodiversity,
Conservation and Attractions



Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Acanthaceae				
1.	6828 <i>Avicennia marina</i> (White Mangrove)			
2.	14555 <i>Avicennia marina</i> subsp. <i>marina</i>			
3.	7166 <i>Dicliptera armata</i>			
Aizoaceae				
4.	2830 <i>Trianthema portulacastrum</i> (Giant Pigweed)	Y		
5.	44360 <i>Trianthema turgidifolium</i>			
Amaranthaceae				
6.	2646 <i>Aerva javanica</i> (Kopok Bush)	Y		
7.	2651 <i>Alternanthera nana</i> (Hairy Joyweed)			
8.	20018 <i>Amaranthus undulatus</i>			
9.	2680 <i>Gomphrena cunninghamii</i>			
10.	18367 <i>Gomphrena kanisii</i>			
11.	2696 <i>Ptilotus astrolasius</i>			
12.	2698 <i>Ptilotus auriculifolius</i>			
13.	2721 <i>Ptilotus exaltatus</i> (Tall Mulla Mulla)			
14.	2728 <i>Ptilotus gomphrenoides</i>			
15.	2746 <i>Ptilotus nobilis</i> (Tall Mulla Mulla)			
16.	2747 <i>Ptilotus obovatus</i> (Cotton Bush)			
17.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
18.	2766 <i>Ptilotus villosiflorus</i>			
Apocynaceae				
19.	6584 <i>Cynanchum floribundum</i> (Dumara Bush, Tjipa)			
Araliaceae				
20.	6278 <i>Trachymene oleracea</i>			
21.	19043 <i>Trachymene oleracea</i> subsp. <i>oleracea</i>			
Asteraceae				
22.	7832 <i>Angianthus milnei</i> (Cone-spike Angianthus)			
23.	7854 <i>Bidens bipinnata</i> (Bipinnate Beggartick)	Y		
24.	7939 <i>Conyza bonariensis</i> (Flaxleaf Fleabane)	Y		
25.	35558 <i>Flaveria trinervia</i> (Speedy Weed)	Y		
26.	8167 <i>Pluchea dentex</i>			
27.	43944 <i>Pluchea longiseta</i>			
28.	8168 <i>Pluchea rubelliflora</i>			
29.	8192 <i>Pterocaulon sphacelatum</i> (Apple Bush, Fruit Salad Plant)			
30.	8193 <i>Pterocaulon sphaeranthoides</i>			
31.	13310 <i>Rhodanthe margarethae</i>			
32.	8231 <i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
33.	8237 <i>Streptoglossa decurrens</i>			
34.	8238 <i>Streptoglossa liatroides</i>			
35.	8252 <i>Tridax procumbens</i> (Tridax, Tridax Daisy)	Y		
Boodleaceae				
36.	26508 <i>Boodlea composita</i>			
Boraginaceae				
37.	14301 <i>Ehretia saligna</i> var. <i>saligna</i>			
38.	6718 <i>Heliotropium tenuifolium</i> (Mamukata)			
39.	6727 <i>Trichodesma zeylanicum</i> (Camel Bush, Kumbalin)			
Brassicaceae				
40.	3035 <i>Lepidium pedicellosum</i>			
41.	3038 <i>Lepidium pholidogynum</i>			
Capparaceae				
42.	2981 <i>Capparis spinosa</i>			
43.	48291 <i>Capparis spinosa</i> subsp. <i>nummularia</i>			
Caryophyllaceae				
44.	2903 <i>Polycarpea longiflora</i>			
Caulerpaceae				
45.	42620 <i>Caulerpa chemnitzia</i>			
46.	44547 <i>Caulerpa lamourouxii</i>			
47.	26568 <i>Caulerpa lentillifera</i>			
48.	26573 <i>Caulerpa racemosa</i>			
49.	26576 <i>Caulerpa serrulata</i>			
50.	26577 <i>Caulerpa sertularioides</i>			
Celastraceae				

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
51.	4729 <i>Stackhousia clementii</i>		P3	
Ceramiaceae				
52.	27310 <i>Spyridia filamentosa</i>			
Chenopodiaceae				
53.	2504 <i>Dysphania plantaginella</i>			
54.	11890 <i>Dysphania rhadinostachya</i> subsp. <i>rhadinostachya</i>			
55.	2511 <i>Enchylaena tomentosa</i> (Barrier Saltbush)			
56.	2573 <i>Neobassia astrocarpa</i>			
57.	2582 <i>Rhagodia eremaea</i> (Thorny Saltbush)			
58.	11240 <i>Rhagodia preissii</i> subsp. <i>obovata</i>			
59.	30434 <i>Salsola australis</i>			
60.	2633 <i>Sclerolaena uniflora</i> (Two-spined Saltbush)			
61.	33236 <i>Tecticornia halocnemoides</i> (Shrubby Samphire)			
62.	33240 <i>Tecticornia halocnemoides</i> subsp. <i>longispicata</i>			
63.	33356 <i>Tecticornia indica</i> subsp. <i>indica</i>			
64.	33318 <i>Tecticornia indica</i> subsp. <i>leiostachya</i> (Samphire)			
65.	33220 <i>Tecticornia pterygosperma</i> subsp. <i>denticulata</i>			
66.	2644 <i>Threlkeldia diffusa</i> (Coast Bonefruit)			
Cleomaceae				
67.	2988 <i>Cleome viscosa</i> (Tickweed, Tjinduwadhu)			
Codiaceae				
68.	<i>Codium platyclados</i>			Y
Combretaceae				
69.	45698 <i>Terminalia circumalata</i>			
70.	5313 <i>Terminalia supranitifolia</i>		P3	
Commelinaceae				
71.	1165 <i>Commelina ensifolia</i> (Wandering Jew, Buargu)			
Convolvulaceae				
72.	44782 <i>Bonamia pilbarensis</i>			
73.	11200 <i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>			
74.	6624 <i>Ipomoea costata</i> (Rock Morning Glory, Kanti)			
75.	6633 <i>Ipomoea muelleri</i> (Poison Morning Glory, Yumbu)			
76.	6635 <i>Ipomoea pes-caprae</i>			
77.	11312 <i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>			
Corallinaceae				
78.	26462 <i>Amphiroa fragilissima</i>			
Cucurbitaceae				
79.	41720 <i>Cucumis argenteus</i>			
80.	41721 <i>Cucumis variabilis</i>			
Cymodoceaceae				
81.	131 <i>Halodule uninervis</i>			
Cyperaceae				
82.	774 <i>Cyperus bifax</i> (Downs Nutgrass)			
83.	12801 <i>Cyperus blakeanus</i>			
84.	777 <i>Cyperus bulbosus</i> (Bush Onion, Tjanmata)			
85.	12811 <i>Cyperus cunninghamii</i> subsp. <i>cunninghamii</i>			
86.	814 <i>Cyperus squarrosus</i>			
87.	818 <i>Cyperus vaginatus</i> (Stiffleaf Sedge)			
88.	827 <i>Eleocharis geniculata</i>			
89.	851 <i>Fimbristylis dichotoma</i> (Eight Day Grass)			
90.	16257 <i>Schoenoplectus subulatus</i>			
91.	1010 <i>Schoenus punctatus</i>		P3	
Dasycladaceae				
92.	26510 <i>Bornetella sphaerica</i>			
93.	44548 <i>Neomeris bilimbata</i>			
Euphorbiaceae				
94.	4583 <i>Adriana tomentosa</i>			
95.	17422 <i>Adriana tomentosa</i> var. <i>tomentosa</i>			
96.	4617 <i>Euphorbia australis</i> (Namana)			
97.	35307 <i>Euphorbia australis</i> var. <i>australis</i>			
98.	35303 <i>Euphorbia australis</i> var. <i>subtomentosa</i>			
99.	4619 <i>Euphorbia biconvexa</i>			
100.	9048 <i>Euphorbia careyi</i>			
101.	4623 <i>Euphorbia coghlanii</i> (Namana)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
102.	4629 <i>Euphorbia hirta</i> (Asthma Plant)	Y		
103.	4635 <i>Euphorbia myrtilloides</i>			
104.	12097 <i>Euphorbia tannensis</i> subsp. <i>eremophila</i> (Desert Spurge)			
105.	42879 <i>Euphorbia trigonosperma</i>			
106.	13281 <i>Euphorbia vaccaria</i>			

Fabaceae

107.	3209 <i>Acacia ampliceps</i>			
108.	3214 <i>Acacia ancistrocarpa</i> (Fitzroy Wattle)			
109.	3223 <i>Acacia arida</i>			
110.	3241 <i>Acacia bivenosa</i>			
111.	44588 <i>Acacia bivenosa</i> x <i>sclerosperma</i> subsp. <i>sclerosperma</i>			
112.	17013 <i>Acacia coleii</i> var. <i>colei</i>			
113.	3270 <i>Acacia coriacea</i> (Wirewood)			
114.	13500 <i>Acacia coriacea</i> subsp. <i>coriacea</i>			
115.	13502 <i>Acacia coriacea</i> subsp. <i>pendens</i>			
116.	12673 <i>Acacia glaucocaesia</i>			
117.	3356 <i>Acacia gregorii</i> (Gregory's Wattle)			
118.	3377 <i>Acacia inaequilatera</i> (Baderi)			
119.	3471 <i>Acacia orthocarpa</i> (Needleleaf Wattle)			
120.	29016 <i>Acacia pyriformis</i> var. <i>morisonii</i>			
121.	29015 <i>Acacia pyriformis</i> var. <i>pyriformis</i>			
122.	3551 <i>Acacia sphaerostachya</i>			
123.	3579 <i>Acacia trachycarpa</i> (Minni Ritchi, Balgali)			
124.	3606 <i>Acacia xiphophylla</i>			
125.	11055 <i>Cajanus cinereus</i>			
126.	11150 <i>Cajanus pubescens</i>			
127.	3749 <i>Canavalia rosea</i> (Wild Jack Bean)			
128.	3769 <i>Clitoria ternatea</i>	Y		
129.	3774 <i>Crotalaria cunninghamii</i> (Green Birdflower, Bilbun)			
130.	3785 <i>Crotalaria novae-hollandiae</i> (New Holland Rattlepod)			
131.	11231 <i>Crotalaria novae-hollandiae</i> subsp. <i>novae-hollandiae</i>			
132.	3612 <i>Dichrostachys spicata</i> (Pied Piper Bush)			
133.	3973 <i>Indigofera colutea</i> (Sticky Indigo)			
134.	3980 <i>Indigofera linifolia</i>			
135.	3982 <i>Indigofera monophylla</i>			
136.	3613 <i>Leucaena leucocephala</i> (Leucaena)	Y		
137.	4190 <i>Rhynchosia australis</i> (Rhynchosia)			
138.	20862 <i>Rhynchosia bungarensis</i>		P4	
139.	4191 <i>Rhynchosia minima</i> (Rhynchosia)			
140.	12280 <i>Senna artemisioides</i> subsp. <i>oligophylla</i>			
141.	12308 <i>Senna glutinosa</i> subsp. <i>x luerssenii</i>			
142.	12312 <i>Senna notabilis</i>			
143.	4196 <i>Sesbania cannabina</i> (Sesbania Pea)			
144.	12353 <i>Stylosanthes hamata</i> (Verano Stylo)	Y		
145.	12356 <i>Swainsona formosa</i>			
146.	4242 <i>Swainsona pterostylis</i>			
147.	4263 <i>Tephrosia clementii</i>			
148.	49016 <i>Tephrosia densa</i>			
149.	4272 <i>Tephrosia leptoclada</i>			
150.	4280 <i>Tephrosia rosea</i> (Flinders River Poison, Bungoo'dah)			
151.	19531 <i>Tephrosia rosea</i> var. <i>clementii</i>			
152.	15947 <i>Tephrosia</i> sp. <i>B Kimberley Flora</i> (C.A. Gardner 7300)			
153.	4285 <i>Tephrosia supina</i>			
154.	46577 <i>Vigna triodiophila</i>		P3	

Frankeniaceae

155. 5188 *Frankenia ambita*

Gentianaceae

156. 6539 *Centaurium erythraea* (Common Centaury)

Goodeniaceae

157. 7521 *Goodenia lamprosperma*

158. 7526 *Goodenia microptera*

159. 7556 *Goodenia tenuiloba*

160. 12578 *Scaevola acacioides*

161. 7606 *Scaevola crassifolia* (Thick-leaved Fan-flower)

162. 7608 *Scaevola cunninghamii*

163. 7644 *Scaevola spinescens* (Currant Bush, Maroon)

Gyrostemonaceae

164. 2778 *Codonocarpus cotinifolius* (Native Poplar, Kundurangu)

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Halimedaceae				
165.	26892 <i>Halimeda discoidea</i>			
Halymeniaceae				
166.	37642 <i>Halymenia durvillei</i>			
Hydrocharitaceae				
167.	162 <i>Halophila decipiens</i>			
168.	163 <i>Halophila minor</i>			
169.	164 <i>Halophila ovalis</i> (Sea Wrack)			
170.	165 <i>Halophila spinulosa</i>			
171.	139 <i>Najas tenuifolia</i> (Water Nymph)			
Lamiaceae				
172.	6732 <i>Clerodendrum tomentosum</i>			
173.	13689 <i>Clerodendrum tomentosum</i> var. <i>lanceolatum</i>			
Lauraceae				
174.	2949 <i>Cassytha capillaris</i>			
Lythraceae				
175.	5277 <i>Ammannia baccifera</i>			
176.	<i>Lawsonia inermis</i>			
Malvaceae				
177.	4891 <i>Abutilon fraseri</i> (Lantern Bush)			
178.	4895 <i>Abutilon lepidum</i>			
179.	12716 <i>Brachychiton acuminatus</i>			
180.	4857 <i>Corchorus elachocarpus</i>			
181.	25847 <i>Corchorus incanus</i> subsp. <i>incanus</i>			
182.	13659 <i>Corchorus laniflorus</i>			
183.	4865 <i>Corchorus tridens</i>			
184.	13467 <i>Corchorus trilocularis</i>			
185.	4867 <i>Corchorus walcottii</i> (Woolly Corchorus)			
186.	4910 <i>Gossypium australe</i> (Native Cotton)			
187.	4913 <i>Gossypium hirsutum</i> (Upland Cotton)	Y		
188.	29316 <i>Hibiscus austrinus</i>			
189.	4942 <i>Hibiscus sturtii</i> (Sturt's Hibiscus)			
190.	4960 <i>Lawrencia viridigrisea</i>			
191.	4962 <i>Malvastrum americanum</i> (Spiked Malvastrum)	Y		
192.	4971 <i>Sida cardiophylla</i>			
193.	4977 <i>Sida fibulifera</i> (Silver Sida)			
194.	33698 <i>Sida</i> sp. <i>Pilbara</i> (A.A. Mitchell PRP 1543)			
195.	4873 <i>Triumfetta appendiculata</i>			
196.	14694 <i>Triumfetta clementii</i>			
Menispermaceae				
197.	2942 <i>Tinospora smilacina</i> (Snakevine, Oondala)			
Molluginaceae				
198.	48201 <i>Trigastrotheca molluginea</i>			
Moraceae				
199.	31578 <i>Ficus aculeata</i> var. <i>indecora</i> (Ranji)			
200.	19648 <i>Ficus brachypoda</i>			
201.	1759 <i>Ficus virens</i> (Albayi)			
Mychodeaceae				
202.	27079 <i>Mychodea carmosa</i>			
Myrtaceae				
203.	17093 <i>Corymbia hamersleyana</i>			
204.	17092 <i>Corymbia opaca</i>			
205.	5752 <i>Eucalyptus prominens</i>			
206.	14548 <i>Eucalyptus victrix</i>			
Nyctaginaceae				
207.	2770 <i>Boerhavia coccinea</i> (Tar Vine, Wituka)			
208.	2772 <i>Boerhavia gardneri</i>			
209.	2776 <i>Commicarpus australis</i> (Perennial Tar Vine)			
Oleaceae				
210.	12059 <i>Jasminum didymum</i> subsp. <i>lineare</i> (Desert Jasmine)			
Passifloraceae				
211.	5226 <i>Passiflora foetida</i> (Stinking Passion Flower)	Y		

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Phrymaceae				
212.	18462 <i>Peplidium</i> sp. <i>E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)</i>			
Phyllanthaceae				
213.	4603 <i>Bridelia tomentosa</i>			
214.	12013 <i>Flueggea virosa</i> subsp. <i>melanthesoides</i> (<i>Dogwood, Guwal</i>)			
215.	4680 <i>Phyllanthus maderaspatensis</i>			
Pittosporaceae				
216.	41300 <i>Pittosporum phillyreoides</i> (<i>Weeping Pittosporum, Yaliti</i>)			
Plantaginaceae				
217.	7098 <i>Stemodia grossa</i> (<i>Marsh Stemodia, Mindjaara</i>)			
218.	7099 <i>Stemodia kingii</i>			
Plumbaginaceae				
219.	6486 <i>Aegialitis annulata</i> (<i>Club Mangrove</i>)			
220.	6490 <i>Muellerolimon salicorniaceum</i>			
Poaceae				
221.	207 <i>Aristida contorta</i> (<i>Bunched Kerosene Grass</i>)			
222.	215 <i>Aristida latifolia</i> (<i>Feathertop Wiregrass</i>)			
223.	226 <i>Arundo donax</i> (<i>Giant Reed</i>)	Y		
224.	258 <i>Cenchrus ciliaris</i> (<i>Buffel Grass</i>)	Y		
225.	41568 <i>Cenchrus setaceus</i> (<i>Fountain Grass</i>)	Y		
226.	29721 <i>Cenchrus setiger</i> (<i>Birdwood Grass</i>)	Y		
227.	266 <i>Chloris barbata</i> (<i>Purpletop Chloris</i>)	Y		
228.	269 <i>Chloris pectinata</i> (<i>Comb Chloris</i>)			
229.	273 <i>Chrysopogon fallax</i> (<i>Golden Beard Grass</i>)			
230.	279 <i>Cymbopogon ambiguus</i> (<i>Scentgrass</i>)			
231.	290 <i>Dactyloctenium radulans</i> (<i>Button Grass</i>)			
232.	313 <i>Digitaria ctenantha</i> (<i>Comb Finger Grass</i>)			
233.	357 <i>Enneapogon caeruleus</i> (<i>Limestone Grass</i>)			
234.	360 <i>Enneapogon lindleyanus</i> (<i>Wiry Nineawn, Purple-head Nineawn</i>)			
235.	381 <i>Eragrostis falcata</i> (<i>Sickle Lovegrass</i>)			
236.	38505 <i>Eragrostis surreyana</i>		P3	
237.	414 <i>Eriachne obtusa</i> (<i>Northern Wandrarrie Grass</i>)			
238.	421 <i>Eriachne tenuiculmis</i>			
239.	11011 <i>Eulalia aurea</i>			
240.	503 <i>Panicum decompositum</i> (<i>Native Millet, Kaltu-kaltu</i>)			
241.	518 <i>Paspalidium clementii</i> (<i>Clements Paspalidium</i>)			
242.	525 <i>Paspalidium tabulatum</i>			
243.	613 <i>Setaria verticillata</i> (<i>Whorled Pigeon Grass</i>)	Y		
244.	625 <i>Spinifex longifolius</i> (<i>Beach Spinifex</i>)			
245.	629 <i>Sporobolus australasicus</i> (<i>Fairy Grass</i>)			
246.	635 <i>Sporobolus virginicus</i> (<i>Marine Couch</i>)			
247.	17819 <i>Themeda</i> sp. <i>Mt Barricade (M.E. Trudgen 2471)</i>			
248.	673 <i>Themeda triandra</i>			
249.	679 <i>Triodia angusta</i>			
250.	13131 <i>Triodia epactia</i>			
251.	704 <i>Triodia wiseana</i> (<i>Limestone Spinifex</i>)			
252.	725 <i>Whiteochloa airoides</i>			
253.	728 <i>Whiteochloa cymbiformis</i>			
Polyphysaceae				
254.	48409 <i>Acetabularia caliculus</i>			
Portulacaceae				
255.	2878 <i>Portulaca conspicua</i>			
Primulaceae				
256.	6478 <i>Aegiceras corniculatum</i> (<i>River Mangrove</i>)			
Proteaceae				
257.	19570 <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i>			
258.	15975 <i>Grevillea pyramidalis</i> subsp. <i>pyramidalis</i>			
259.	19137 <i>Hakea lorea</i> subsp. <i>lorea</i>			
Pteridaceae				
260.	33 <i>Cheilanthes contigua</i>			
Rhizophoraceae				
261.	5291 <i>Bruguiera exaristata</i> (<i>Ribbed Mangrove</i>)			
262.	39680 <i>Ceriops australis</i>			
263.	5295 <i>Rhizophora stylosa</i> (<i>Spotted-leaved Red Mangrove</i>)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Rhodomelaceae				
264.	26441 <i>Acanthophora spicifera</i>			
265.	26782 <i>Digenea simplex</i>			
Rubiaceae				
266.	7318 <i>Dentella minutissima</i>			
Sapindaceae				
267.	4739 <i>Alectryon oleifolius</i>			
268.	11487 <i>Alectryon oleifolius</i> subsp. <i>oleifolius</i>			
Scrophulariaceae				
269.	7234 <i>Eremophila longifolia</i> (Berrigan, Tulypurpa)			
270.	17158 <i>Myoporum montanum</i> (Native Myrtle)			
Siphonocladaceae				
271.	26769 <i>Dictyosphaeria cavernosa</i>			
Solanaceae				
272.	20652 <i>Physalis angulata</i>	Y		
273.	7014 <i>Solanum horridum</i>			
274.	7018 <i>Solanum lasiophyllum</i> (Flannel Bush, Mindjulu)			
275.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
276.	7029 <i>Solanum phlomoides</i>			
Stylidiaceae				
277.	7729 <i>Stylidium fluminense</i>			
Udoteaceae				
278.	35302 <i>Udotea glaucescens</i>			
Violaceae				
279.	5215 <i>Hybanthus aurantiacus</i>			
Zygophyllaceae				
280.	4380 <i>Tribulus occidentalis</i> (Perennial Caltrop)			
281.	4383 <i>Tribulus terrestris</i> (Caltrop)	Y		

Conservation Codes

T - Rare or likely to become extinct
 X - Presumed extinct
 IA - Protected under international agreement
 S - Other specially protected fauna
 1 - Priority 1
 2 - Priority 2
 3 - Priority 3
 4 - Priority 4
 5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap Species Report_Fauna 10km

Created By Guest user on 19/02/2020

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Line'
Vertices 20° 37' 11" S, 116° 46' 51" E 20° 37' 49" S, 116° 46' 51" E
Group By Species Group

Species Group	Species	Records
Amphibian	4	50
Bird	122	797
Fish	59	65
Invertebrate	133	235
Mammal	31	218
Reptile	81	717
TOTAL	430	2082

Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
Amphibian				
1.	25371 <i>Cyclorana australis</i> (Giant Frog)			
2.	25375 <i>Cyclorana maini</i> (Sheep Frog)			
3.	25392 <i>Litoria rubella</i> (Little Red Tree Frog)			
4.	25430 <i>Notaden nichollsi</i> (Desert Spadefoot)			
Bird				
5.	41323 <i>Actitis hypoleucos</i> (Common Sandpiper)		IA	
6.	25544 <i>Aegotheles cristatus</i> (Australian Owlet-nightjar)			
7.	47414 <i>Anhinga novaehollandiae</i> (Australasian Darter)			
8.	24505 <i>Anous stolidus</i> subsp. <i>pileatus</i> (Common Noddy)		IA	
9.	25670 <i>Anthus australis</i> (Australian Pipit)			
10.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
11.	41324 <i>Ardea modesta</i> (great egret, white egret)			
12.	25736 <i>Arenaria interpres</i> (Ruddy Turnstone)		IA	
13.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
14.	25567 <i>Artamus leucorhynchus</i> (White-breasted Woodswallow)			
15.	24354 <i>Artamus leucorhynchus</i> subsp. <i>leucopygialis</i> (White-breasted Woodswallow)			
16.	24355 <i>Artamus minor</i> (Little Woodswallow)			
17.	<i>Barnardius zonarius</i>			
18.	24359 <i>Burhinus grallarius</i> (Bush Stone-curlew)			
19.	47897 <i>Butorides striata</i> (Striated Heron, Mangrove Heron)			
20.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
21.	42307 <i>Cacomantis pallidus</i> (Pallid Cuckoo)			
22.	24784 <i>Calidris ferruginea</i> (Curlew Sandpiper)		T	
23.	24788 <i>Calidris ruficollis</i> (Red-necked Stint)		IA	
24.	24790 <i>Calidris tenuirostris</i> (Great Knot)		T	
25.	25600 <i>Centropus phasianinus</i> (Pheasant Coucal)			
26.	25575 <i>Charadrius leschenaultii</i> (Greater Sand Plover)		T	
27.	25576 <i>Charadrius mongolus</i> (Lesser Sand Plover)		T	
28.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
29.	<i>Chroicocephalus novaehollandiae</i>			
30.	24289 <i>Circus assimilis</i> (Spotted Harrier)			
31.	24399 <i>Columba livia</i> (Domestic Pigeon)	Y		
32.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
33.	24416 <i>Corvus bennetti</i> (Little Crow)			
34.	25593 <i>Corvus orru</i> (Torresian Crow)			
35.	24420 <i>Cracticus nigrogularis</i> (Pied Butcherbird)			
36.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
37.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
38.	<i>Elanus axillaris</i>			
39.	47937 <i>Euseyonis melanops</i> (Black-fronted Dotterel)			
40.	24631 <i>Emblema pictum</i> (Painted Finch)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
41.	<i>Eolophus roseicapillus</i>			
42.	24653 <i>Eopsaltria pulverulenta</i> (Mangrove Robin)			
43.	25578 <i>Ephippiorhynchus asiaticus</i> (Black-necked Stork)			
44.	24570 <i>Epthianura tricolor</i> (Crimson Chat)			
45.	47938 <i>Esacus magnirostris</i> (Beach Stone-curlew, Beach Thick-knee)			
46.	25621 <i>Falco berigora</i> (Brown Falcon)			
47.	25622 <i>Falco cenchroides</i> (Australian Kestrel, Nankeen Kestrel)			
48.	25623 <i>Falco longipennis</i> (Australian Hobby)			
49.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
50.	24478 <i>Fregata ariel</i> (Lesser Frigatebird)		IA	
51.	24765 <i>Gallirallus philippensis</i> subsp. <i>mellori</i> (Buff-banded Rail)			
52.	47954 <i>Gelochelidon nilotica</i> (Gull-billed Tern)		IA	
53.	24401 <i>Geopelia cuneata</i> (Diamond Dove)			
54.	24402 <i>Geopelia humeralis</i> (Bar-shouldered Dove)			
55.	25585 <i>Geopelia striata</i> (Zebra Dove)			
56.	24404 <i>Geophaps plumifera</i> (Spinifex Pigeon)			
57.	24276 <i>Gerygone tenebrosa</i> (Dusky Gerygone)			
58.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
59.	24484 <i>Grus rubicunda</i> (Brolga)			
60.	25627 <i>Haematopus fuliginosus</i> (Sooty Oystercatcher)			
61.	24487 <i>Haematopus longirostris</i> (Pied Oystercatcher)			
62.	<i>Haematopus ostralegus</i>			Y
63.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)			
64.	25541 <i>Haliastur indus</i> (Brahminy Kite)			
65.	24294 <i>Haliastur indus</i> subsp. <i>girrenera</i> (Brahminy Kite)			
66.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
67.	47965 <i>Hieraaetus morphnoides</i> (Little Eagle)			
68.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
69.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
70.	48587 <i>Hydroprogne caspia</i> (Caspian Tern)		IA	
71.	25637 <i>Larus novaehollandiae</i> (Silver Gull)			
72.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
73.	30932 <i>Limosa lapponica</i> (Bar-tailed Godwit)		IA	
74.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
75.	24736 <i>Melopsittacus undulatus</i> (Budgerigar)			
76.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)			
77.	25542 <i>Milvus migrans</i> (Black Kite)			
78.	25685 <i>Neochmia ruficauda</i> (Star Finch)			
79.	<i>Neopsephotus bourkii</i>			
80.	24798 <i>Numenius madagascariensis</i> (Eastern Curlew)		T	
81.	24799 <i>Numenius minutus</i> (Little Curlew, Little Whimbrel)		IA	
82.	25742 <i>Numenius phaeopus</i> (Whimbrel)		IA	
83.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
84.	24742 <i>Nymphicus hollandicus</i> (Cockatiel)			
85.	24497 <i>Oceanites oceanicus</i> (Wilson's Storm-petrel)		IA	
86.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
87.	24620 <i>Pachycephala lanioides</i> (White-breasted Whistler)			
88.	24621 <i>Pachycephala melanura</i> subsp. <i>melanura</i> (Mangrove Golden Whistler)			
89.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
90.	48591 <i>Pandion cristatus</i> (Osprey, Eastern Osprey)		IA	
91.	48053 <i>Pardalotus rubricatus</i> subsp. <i>rubricatus</i> (Red-browed Pardalote)			Y
92.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
93.	25687 <i>Passer domesticus</i> (House Sparrow)	Y		
94.	24642 <i>Passer montanus</i> (Eurasian Tree Sparrow)	Y		
95.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
96.	48060 <i>Petrochelidon ariel</i> (Fairy Martin)			
97.	48061 <i>Petrochelidon nigricans</i> (Tree Martin)			
98.	25698 <i>Phalacrocorax melanoleucos</i> (Little Pied Cormorant)			
99.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
100.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
101.	24677 <i>Pitta moluccensis</i> (Blue-winged Pitta)			
102.	24382 <i>Pluvialis fulva</i> (Pacific Golden Plover)		IA	
103.	24383 <i>Pluvialis squatarola</i> (Grey Plover)		IA	
104.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
105.	24679 <i>Podargus strigoides</i> subsp. <i>brachypterus</i> (Tawny Frogmouth)			
106.	<i>Ptilonorhynchus guttatus</i>			
107.	24716 <i>Puffinus pacificus</i> (Wedge-tailed Shearwater)		IA	
108.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
109.	24457 <i>Rhipidura phasiana</i> (Mangrove Grey Fantail)			
110.	30948 <i>Smicrornis brevirostris</i> (Weebill)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
111.	24521 <i>Sterna bengalensis</i> (Lesser Crested Tern)			
112.	48594 <i>Sternula nereis</i> (Fairy Tern)			
113.	30870 <i>Taeniopygia guttata</i> (Zebra Finch)			
114.	<i>Thalasseus bengalensis</i>			
115.	48597 <i>Thalasseus bergii</i> (Crested Tern)		IA	
116.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
117.	25548 <i>Todiramphus chloris</i> (Collared Kingfisher)			
118.	24306 <i>Todiramphus chloris</i> subsp. <i>pilbara</i> (Pilbara Collared Kingfisher)			
119.	42351 <i>Todiramphus pyrrhopygius</i> (Red-backed Kingfisher)			
120.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
121.	24803 <i>Tringa brevipes</i> (Grey-tailed Tattler)		P4	
122.	24808 <i>Tringa nebularia</i> (Common Greenshank, greenshank)		IA	
123.	24851 <i>Turnix velox</i> (Little Button-quail)			
124.	24386 <i>Vanellus tricolor</i> (Banded Lapwing)			
125.	41351 <i>Xenus cinereus</i> (Terek Sandpiper)		IA	
126.	24857 <i>Zosterops luteus</i> (Yellow White-eye)			

Fish

127.	? ?			
128.	<i>Acentrogobius</i> sp.			
129.	<i>Alepes apercna</i>			
130.	<i>Alepes mate</i>			Y
131.	<i>Amblyeleotris gymnocephala</i>			
132.	<i>Amniataba caudavittata</i>			
133.	<i>Arius leptaspis</i>			Y
134.	<i>Callionymus japonicus</i>			Y
135.	<i>Carangoides</i> sp.			
136.	<i>Caranx bucculentus</i>			
137.	<i>Carcharhinus brachyurus</i>			
138.	<i>Cephalopholis boenak</i>			
139.	<i>Chelmon marginalis</i>			
140.	<i>Chelmon muelleri</i>			
141.	<i>Coris</i> sp.			
142.	<i>Ctenotrypauchen microcephalus</i>			
143.	<i>Drombus</i> sp.			
144.	<i>Elops hawaiiensis</i>			
145.	<i>Enneapterygius</i> sp.			
146.	<i>Epinephelus coioides</i>			
147.	<i>Epinephelus malabaricus</i>			
148.	<i>Eviota queenslandica</i>			
149.	<i>Gerres subfasciatus</i>			
150.	<i>Gobiodon rivulatus</i>			
151.	<i>Halieutaea brevicaudata?</i>			
152.	<i>Leiognathus</i> sp.			
153.	<i>Lepidotrigla</i> sp.			
154.	<i>Liza subviridis</i>			
155.	<i>Lophiocharon trisignatus</i>			
156.	<i>Lutjanus argentimaculatus</i>			
157.	<i>Lutjanus malabaricus</i>			
158.	<i>Lutjanus russellii</i>			
159.	<i>Metavelifer multiradiatus</i>			
160.	<i>Monacanthus chinensis</i>			
161.	<i>Monodactylus argenteus</i>			
162.	<i>Mugil cephalus</i>			
163.	<i>Nemipterus celebicus</i>			
164.	<i>Netuma proxima</i>			
165.	<i>Omobranchus punctatus</i>			
166.	<i>Paramonacanthus choirocephalus</i>			
167.	<i>Pentapodus</i> sp.			
168.	<i>Platycephalus</i> sp.			
169.	<i>Pleurosicya</i> sp.			
170.	<i>Polydactylus multiradiatus</i>			
171.	<i>Pomadasys maculatus</i>			
172.	<i>Priacanthus hamrur</i>			
173.	<i>Rastrelliger kanagurta</i>			
174.	<i>Scatophagus argus</i>			
175.	<i>Scolopsis taenioptera</i>			
176.	<i>Secutor insidiator</i>			
177.	<i>Sillago burrus</i>			
178.	<i>Sillago lutea</i>			
179.	<i>Sorsogona tuberculata</i>			

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180.	<i>Sphyraena barracuda</i>			
181.	<i>Terapon jarbua</i>			
182.	<i>Triacanthus</i> sp.			
183.	<i>Tylosurus crocodilus</i>			
184.	<i>Valamugil seheli</i>			
185.	<i>Yirrkala</i> sp.			
Invertebrate				
186.	<i>Actacarus pacificus</i>			
187.	<i>Agauopsis arborea</i>			Y
188.	<i>Agauopsis dasyderma</i>			Y
189.	<i>Agauopsis moorea</i>			Y
190.	<i>Agauopsis obtusa</i>			Y
191.	<i>Agraptocorixa parvipunctata</i>			
192.	<i>Allodessus bistrigatus</i>			
193.	<i>Alluaudomyia</i> sp.			
194.	<i>Alona</i> cf. <i>verrucosa</i>			
195.	<i>Alona rigidicaudis</i>			
196.	<i>Amblyomma triguttatum</i>			
197.	<i>Aname mainae</i>			
198.	<i>Anax papuensis</i>			
199.	<i>Anisops canaliculatus</i>			
200.	<i>Anisops hackeri</i>			
201.	<i>Anisops nasutus</i>			
202.	<i>Anisops</i> sp.			
203.	<i>Anomalohalacarus dampierensis</i>			Y
204.	<i>Anopheles annulipes</i> s.l.			
205.	<i>Austrostrophus stictopygus</i>			
206.	<i>Bdelloidea</i> sp. 2:2			
207.	<i>Berosus pulchellus</i>			
208.	<i>Ceriodaphnia cornuta</i>			
209.	<i>Ceriodaphnia</i> n. sp. a (Berner sp.#3) (SAP)			
210.	<i>Ceriodaphnia</i> n. sp. c (Berner sp.#1) (SAP)			
211.	<i>Cheumatopsyche wellsae</i>			
212.	<i>Chironomus</i> aff. <i>alternans</i> (V24) (CB)			
213.	<i>Cloeon</i> sp.			
214.	<i>Copidognathus lutarius</i>			Y
215.	<i>Copidognathus meridianus</i>			
216.	<i>Copidognathus piger</i>			Y
217.	<i>Cryptochironomus griseidorsum</i>			
218.	<i>Culex crinicauda</i>			
219.	<i>Culex palpalis</i>			
220.	<i>Cybister tripunctatus</i>			
221.	<i>Cyprretta</i> sp PSW074			
222.	<i>Cypricercus</i> sp. 422 (CB)			
223.	<i>Dasyheleinae</i> sp. P2 (PSW)			
224.	<i>Dicrotendipes</i> P5 (=balciunas?) (PSW)			
225.	<i>Diffugia</i> sp. P1			
226.	<i>Dineutus australis</i>			
227.	<i>Diplacodes bipunctata</i>			
228.	<i>Diplacodes haematodes</i>			
229.	<i>Ecnomus pilbarensis</i>			
230.	<i>Encentridophorus sarasini</i>			
231.	<i>Enchytraeidae</i> sp.			
232.	<i>Enochrus deserticola</i>			
233.	<i>Ephemeroporus barroisi</i> s.l.			
234.	<i>Ephydriidae</i> sp. 12 (PSW)			
235.	<i>Eretes australis</i>			
236.	<i>Euchlanis lyra</i>			
237.	<i>Euglypha</i> sp.			
238.	<i>Glyptophysa</i> sp			
239.	<i>Hellyethira</i> sp.			
240.	<i>Hemicordulia</i> sp.			
241.	<i>Heterocypris tatei</i>			
242.	<i>Hydraena</i> sp.			
243.	<i>Hydrochus obscuroaeus</i>			
244.	<i>Hydroglyphus grammopterus</i> (=trilineatus)			
245.	<i>Hydroglyphus leai</i>			
246.	<i>Hydroglyphus orthogrammus</i>			
247.	<i>Hyphydrus elegans</i>			
248.	<i>Hyphydrus lyratus</i>			

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249.	<i>Ilyocypris australiensis</i>			
250.	<i>Ilyodromus</i> sp BOS25			
251.	<i>Indolpium</i> sp.			
252.	<i>Ischnura aurora aurora</i>			
253.	<i>Isidorella egraria</i>			
254.	<i>Isobactrus australiensis</i>			Y
255.	<i>Isobactrus obesus</i>			Y
256.	<i>Keratella procurva</i>			
257.	<i>Laccophilus sharpi</i>			
258.	<i>Larsia albiceps</i>			
259.	<i>Latonopsis australis</i>			
260.	<i>Latrodectus geometricus</i>			
261.	<i>Leberis</i> cf. <i>diaphanus</i>			
262.	<i>Lecane bulla</i>			
263.	<i>Lecane luna</i>			
264.	<i>Lecane punctata</i>			
265.	<i>Lecane thalera</i>			
266.	<i>Lecane unguata</i>			
267.	<i>Lepadella patella</i>			
268.	<i>Limbodessus compactus</i>			
269.	<i>Limnadopsis "pilbarensis" (ex P2)(PSW)</i>			Y
270.	<i>Limnocythere dorsosicula</i>			
271.	<i>Litarachna bartschae</i>			Y
272.	<i>Macrochaetus</i> sp.			
273.	<i>Mesovelgia hungerfordi</i>			
274.	<i>Metacyclops</i> sp. P2 (PSW)			
275.	<i>Micronecta</i> n. sp. P3 (PSW)			
276.	<i>Microvelia (Austromicrovelia) peramoena</i>			
277.	<i>Monommata</i> sp.			
278.	<i>Muscidae</i> sp. P1			
279.	<i>Naididae (ex Tubificidae)</i>			
280.	<i>Nematoda</i> sp. P2/P4 (PSW)			
281.	<i>Nephila edulis</i>			
282.	<i>Opisthopora</i> sp.			
283.	<i>Orthetrum caledonicum</i>			
284.	<i>Pantala flavescens</i>			
285.	<i>Paracymus pygmaeus</i>			
286.	<i>Paracymus spenceri</i>			
287.	<i>Paratanytarsus</i> sp. P2 (PSW)			
288.	<i>Pilbarophreatoicus platyarthicus</i>			
289.	<i>Polypedilum nubifer</i>			
290.	<i>Pontarachne australis</i>			Y
291.	<i>Procladius paludicola</i>			
292.	<i>Quistrachia legendrei</i>			
293.	<i>Regimbartia attenuata</i>			
294.	<i>Rhagada angulata</i>			
295.	<i>Rhagada minima</i>			
296.	<i>Rheotanytarsus trivittatus</i>			
297.	<i>Rhombognathus dispar</i>			Y
298.	<i>Rhombognathus ocellaris</i>			Y
299.	<i>Rhombognathus scutulatus</i>			
300.	<i>Scaptognathides hawaiiensis</i>			Y
301.	<i>Scaptognathides ornatus</i>			Y
302.	<i>Scirtidae</i> sp.			
303.	<i>Scolopendra morsitans</i>			
304.	<i>Simaetha tenuior</i>			
305.	<i>Simognathus platyaspis</i>			Y
306.	<i>Simognathus salebrosus</i>			Y
307.	<i>Simognathus tener</i>			Y
308.	<i>Simulium ornatipes</i>			
309.	<i>Sternolophus australis</i>			
310.	<i>Stratiomyidae</i> sp.			
311.	<i>Tabanidae</i> sp.			
312.	<i>Tanytarsus</i> sp. D (SAP)			
313.	<i>Tasmanocoenis arcuata</i>			
314.	<i>Testudinella patina</i>			
315.	<i>Tramea stenoloba</i>			
316.	<i>Urodacus armatus</i>			
317.	<i>Venatrix arenaris</i>			
318.	<i>Zonocyprretta kalimna</i>			

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Mammal				
319.	48920 <i>Canis familiaris</i> (Dog, Dingo)	Y		
320.	24091 <i>Dasykaluta rosamondae</i> (Little Red Kaluta)			
321.	24093 <i>Dasyurus hallucatus</i> (Northern Quoll)		T	
322.	24084 <i>Dugong dugon</i> (Dugong)		S	
323.	24041 <i>Felis catus</i> (Cat)	Y		
324.	24215 <i>Hydromys chrysogaster</i> (Water-rat, Rakali)		P4	
325.	24180 <i>Macroderma gigas</i> (Ghost Bat)		T	
326.	25489 <i>Macropus robustus</i> (Euro, Biggada)			
327.	24135 <i>Macropus robustus subsp. erubescens</i> (Euro, Biggada)			
328.	24136 <i>Macropus rufus</i> (Red Kangaroo, Marlu)			
329.	24051 <i>Megaptera novaeangliae</i> (Humpback Whale)		S	
330.	<i>Mormopterus</i> (<i>Ozimops</i>) <i>cobourgianus</i>			
331.	24223 <i>Mus musculus</i> (House Mouse)	Y		
332.	24095 <i>Ningaiu timealeyi</i> (Pilbara Ningaiu)			
333.	<i>Nyctophilus geoffroyi subsp. pallescens</i>			
334.	48034 <i>Osphranter robustus</i> (Euro, Biggada)			
335.	24144 <i>Petrogale rothschildi</i> (Rothschild's Rock-wallaby)			
336.	<i>Planigale sp. nov.</i>			
337.	24105 <i>Pseudantechinus roryi</i> (Rory's Pseudantechinus)			
338.	24106 <i>Pseudantechinus woolleyae</i> (Woolley's Pseudantechinus)			
339.	24233 <i>Pseudomys chapmani</i> (Western Pebble-mound Mouse, Ngadji)		P4	
340.	24234 <i>Pseudomys delicatulus</i> (Delicate Mouse)			
341.	24235 <i>Pseudomys desertor</i> (Desert Mouse)			
342.	24237 <i>Pseudomys hermannsburgensis</i> (Sandy Inland Mouse)			
343.	24173 <i>Pteropus scapulatus</i> (Little Red Flying-fox)			
344.	24245 <i>Rattus rattus</i> (Black Rat)	Y		
345.	24207 <i>Tachyglossus aculeatus</i> (Short-beaked Echidna)			
346.	24175 <i>Taphozous georgianus</i> (Common Sheath-tailed Bat)			
347.	24205 <i>Vespadelus finlaysoni</i> (Finlayson's Cave Bat)			
348.	24040 <i>Vulpes vulpes</i> (Red Fox)	Y		
349.	24248 <i>Zyomys argurus</i> (Common Rock-rat)			
Reptile				
350.	<i>Acanthophis wellsei</i>			
351.	25332 <i>Acanthophis wellsi</i> (Pilbara Death Adder)			
352.	44628 <i>Anilios ammodytes</i>			
353.	44635 <i>Anilios grypus</i>			
354.	25318 <i>Antaresia perthensis</i> (Pygmy Python)			
355.	25448 <i>Antaresia stimsoni</i> (Stimson's Python)			
356.	25241 <i>Antaresia stimsoni subsp. stimsoni</i> (Stimson's Python)			
357.	25320 <i>Aspidites melanocephalus</i> (Black-headed Python)			
358.	25015 <i>Carlia munda</i> (Shaded-litter Rainbow Skink)			
359.	25017 <i>Carlia triacantha</i> (Desert Rainbow Skink)			
360.	25336 <i>Chelonia mydas</i> (Green Turtle)		T	
361.	24919 <i>Crenadactylus ocellatus subsp. horni</i> (Clawless Gecko)			
362.	30893 <i>Cryptoblepharus buchananii</i>			
363.	25020 <i>Cryptoblepharus plagiocephalus</i>			
364.	30892 <i>Cryptoblepharus ustulatus</i>			
365.	25458 <i>Ctenophorus caudicinctus</i> (Ring-tailed Dragon)			
366.	24865 <i>Ctenophorus caudicinctus subsp. caudicinctus</i> (Ring-tailed Dragon)			
367.	25459 <i>Ctenophorus isolepis</i> (Crested Dragon, Military Dragon)			
368.	24876 <i>Ctenophorus isolepis subsp. isolepis</i> (Crested Dragon, Military Dragon)			
369.	25043 <i>Ctenotus grandis subsp. titan</i>			
370.	25052 <i>Ctenotus leonhardii</i>			
371.	25064 <i>Ctenotus pantherinus subsp. ocellifer</i> (Leopard Ctenotus)			
372.	25072 <i>Ctenotus rubicundus</i>			
373.	25073 <i>Ctenotus saxatilis</i> (Rock Ctenotus)			
374.	25077 <i>Ctenotus serventyi</i>			
375.	25466 <i>Cyclodomorphus melanops</i> (Slender Blue-tongue)			
376.	25090 <i>Cyclodomorphus melanops subsp. melanops</i> (Slender Blue-tongue)			
377.	24996 <i>Delma borea</i>			
378.	25002 <i>Delma pax</i>			
379.	25004 <i>Delma tincta</i>			
380.	25468 <i>Demansia psammophis</i> (Yellow-faced Whipsnake)			
381.	25295 <i>Demansia psammophis subsp. cupreiceps</i> (Yellow-faced Whipsnake)			
382.	25297 <i>Demansia rufescens</i> (Rufous Whipsnake)			
383.	24926 <i>Diplodactylus conspicillatus</i> (Fat-tailed Gecko)			
384.	41404 <i>Diplodactylus galaxias</i> (Northern Pilbara Beak-faced Gecko)			
385.	24944 <i>Diplodactylus savagei</i> (Southern Pilbara Beak-faced Gecko)			

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386.	25092 <i>Egernia depressa</i> (Southern Pygmy Spiny-tailed Skink)			
387.	25101 <i>Egernia pilbarensis</i> (Pilbara Skink)			
388.	25362 <i>Ephalophis greyae</i>			
389.	42404 <i>Eremiascincus isolepis</i>			
390.	25342 <i>Eretmochelys imbricata</i> subsp. <i>bissa</i> (Hawksbill Turtle)		T	
391.	25327 <i>Fordonia leucobalia</i> (White-bellied Mangrove Snake)			
392.	25301 <i>Furina ornata</i> (Moon Snake)			
393.	24956 <i>Gehyra pilbara</i>			
394.	24958 <i>Gehyra punctata</i>			
395.	24959 <i>Gehyra variegata</i>			
396.	25232 <i>Hemidactylus frenatus</i> (Asian House Gecko)	Y		
397.	24961 <i>Heteronotia binoei</i> (Bynoe's Gecko)			
398.	25125 <i>Lerista bipes</i>			
399.	30928 <i>Lerista clara</i>			
400.	30929 <i>Lerista jacksoni</i>			
401.	25155 <i>Lerista muelleri</i>			
402.	25005 <i>Lialis burtonis</i>			
403.	25238 <i>Liasis olivaceus</i> subsp. <i>barroni</i> (Pilbara Olive Python)		T	
404.	25239 <i>Liasis olivaceus</i> subsp. <i>olivaceus</i> (Olive Python)			
405.	30933 <i>Lucasium stenodactylum</i>			
406.	25184 <i>Menetia greyii</i>			
407.	25491 <i>Menetia surda</i>			
408.	25187 <i>Menetia surda</i> subsp. <i>surda</i>			
409.	25193 <i>Morethia ruficauda</i> subsp. <i>exquisita</i>			
410.	25344 <i>Natator depressus</i> (Flatback Turtle)		T	
411.	25197 <i>Notoscincus ornatus</i> subsp. <i>ornatus</i>			
412.	24976 <i>Oedura marmorata</i> (Marbled Velvet Gecko)			
413.	24907 <i>Pogona minor</i> subsp. <i>minor</i> (Dwarf Bearded Dragon)			
414.	25261 <i>Pseudechis australis</i> (Mulga Snake)			
415.	42416 <i>Pseudonaja mengdeni</i> (Western Brown Snake)			
416.	25264 <i>Pseudonaja nuchalis</i> (Gwardar, Northern Brown Snake)			
417.	24924 <i>Strophurus ciliaris</i> subsp. <i>aberrans</i>			
418.	24927 <i>Strophurus elderi</i>			
419.	24949 <i>Strophurus wellingtonae</i>			
420.	25307 <i>Suta punctata</i> (Spotted Snake)			
421.	25202 <i>Tiliqua multifasciata</i> (Central Blue-tongue)			
422.	25209 <i>Varanus acanthurus</i> (Spiny-tailed Monitor)			
423.	25212 <i>Varanus eremius</i> (Pygmy Desert Monitor)			
424.	25216 <i>Varanus giganteus</i> (Perentie)			
425.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
426.	25524 <i>Varanus panoptes</i> (Yellow-spotted Monitor)			
427.	25223 <i>Varanus panoptes</i> subsp. <i>rubidus</i>			
428.	25224 <i>Varanus pilbarensis</i> (Pilbara Rock Monitor, Northern Pilbara Rock Goanna)			
429.	25526 <i>Varanus tristis</i> (Racehorse Monitor)			
430.	25227 <i>Varanus tristis</i> subsp. <i>tristis</i> (Racehorse Monitor)			

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Flora survey results

Statistical outputs

Flora species list

Quadrat Data

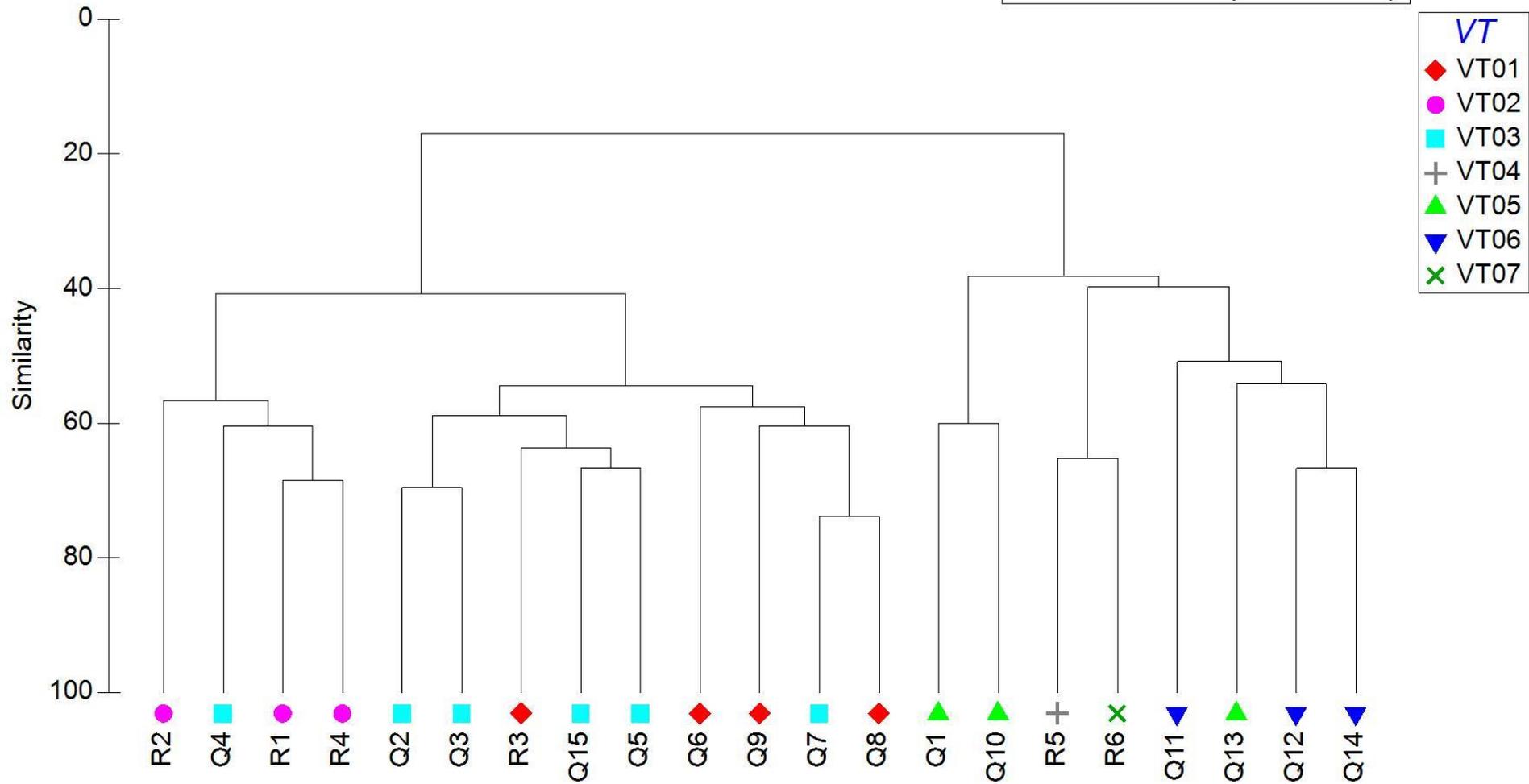
Conservation significant flora records

Flora likelihood of occurrence assessment guidelines

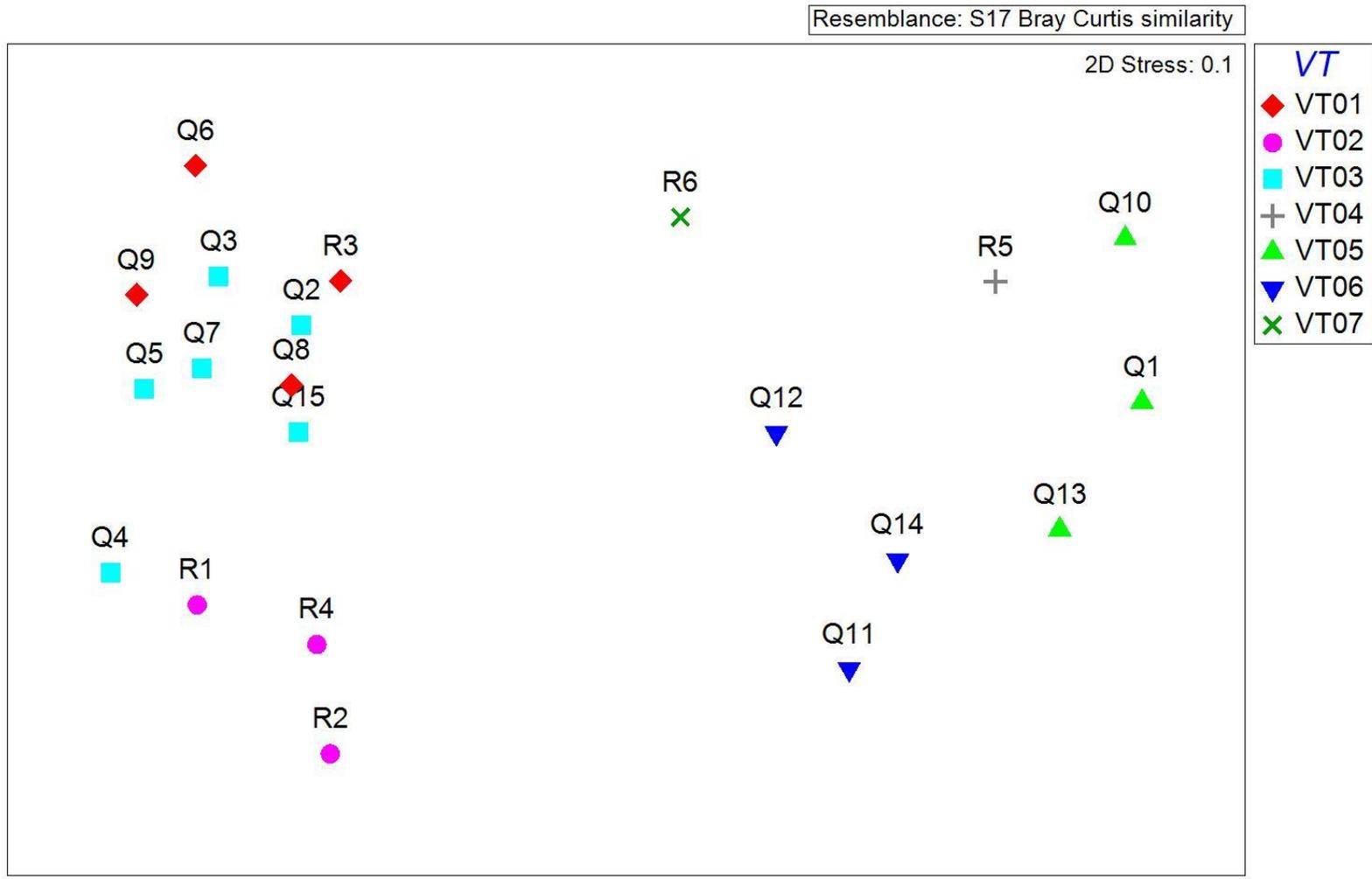
Flora likelihood of occurrence assessment

GHD Quadrats and Relevés

Resemblance: S17 Bray Curtis similarity



Dendrogram – GHD Quadrats and Relevés (no singles)



MDS - GHD Quadrats and Relevés (no single taxa)

Flora taxon recorded within the survey area by vegetation type

Family	Taxon	Status	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Acanthaceae	<i>Avicennia marina</i>						X		
Acanthaceae	<i>Dicladanthera forrestii</i>			X					
Aizoaceae	<i>Trianthera triquetrum</i>								X
Aizoaceae	<i>Trianthera turgidifolia</i>					X	X	X	X
Amaranthaceae	<i>Aerva javanica</i>	*	X	X	X	X	X	X	X
Amaranthaceae	<i>Amaranthus undulatus</i>			X	X		X		
Amaranthaceae	<i>Gomphrena cunninghamii</i>			X	X				
Amaranthaceae	<i>Ptilotus axillaris</i>								X
Amaranthaceae	<i>Ptilotus exaltatus</i>				X				
Amaranthaceae	<i>Ptilotus fusiformis</i>		X						
Amaranthaceae	<i>Ptilotus obovatus</i>			X					
Amaranthaceae	<i>Surreya diandra</i>						X	X	
Apocynaceae	<i>Cynanchum floribundum</i>			X	X				
Araliaceae	<i>Trachymene oleracea</i>			X	X				
Asteraceae	<i>Pentalepis trichodesmoides</i> ssp. <i>Trichodesmoides</i>		X						
Asteraceae	<i>Pterocaulon sphaeranthoides</i>		X			X			X
Boraginaceae	<i>Ehretia saligna</i>		X	X	X				
Boraginaceae	<i>Heliotropium cunninghamii</i>		X			X	X	X	
Boraginaceae	<i>Trichodesma zeylanicum</i>		X	X	X				X
Caryophyllaceae	<i>Polycarpaea longiflora</i>			X					
Chenopodiaceae	<i>Atriplex</i> sp.								X
Chenopodiaceae	<i>Dysphania plantaginella</i>						X	X	
Chenopodiaceae	<i>Enchylaena tomentosa</i>		X	X	X			X	X
Chenopodiaceae	<i>Neobassia astrocarpa</i>					X	X	X	X
Chenopodiaceae	<i>Rhagodia eremaea</i>		X	X	X				X
Chenopodiaceae	<i>Tecticornia ?pterygosperma</i>					X	X	X	

Family	Taxon	Status	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Chenopodiaceae	<i>Tecticornia indica</i> ?ssp. <i>bidens</i>					x	x		
Chenopodiaceae	<i>Tecticornia pterygosperma</i>						x		
Chenopodiaceae	<i>Threlkeldia diffusa</i>					x			x
Cleomaceae	<i>Cleome viscosa</i>		x	x	x	x	x	x	x
Combretaceae	<i>Terminalia supranitifolia</i>	P3	x	x	x				
Commelinaceae	<i>Commelina ensifolia</i>			x	x				
Convolvulaceae	<i>Bonamia media</i>		x		x				
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>		x	x	x				
Convolvulaceae	<i>Ipomoea costata</i>		x	x	x				
Convolvulaceae	<i>Ipomoea polymorpha</i>			x	x				
Convolvulaceae	<i>Operculina aequisejala</i>				x				
Convolvulaceae	<i>Polymeria ambigua</i>				x				
Cucurbitaceae	<i>Cucumis variabilis</i>		x	x	x				x
Cucurbitaceae	<i>Trichosanthes cucumerina</i>			x	x				
Cyperaceae	<i>Cyperus bulbosus</i>					x	x	x	x
Cyperaceae	<i>Fimbristylis dichotoma</i>		x						
Euphorbiaceae	<i>Euphorbia australis</i> var. <i>australis</i>						x		
Euphorbiaceae	<i>Euphorbia coghlanii</i>		x	x	x		x		x
Euphorbiaceae	<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>			x	x				
Fabaceae	<i>Acacia ampliceps</i>					x			x
Fabaceae	<i>Acacia bivenosa</i>		x	x	x			x	x
Fabaceae	<i>Acacia coleii</i> var. <i>coleii</i>		x		x				x
Fabaceae	<i>Acacia coriacea</i> subsp. <i>coriacea</i>		x	x	x			x	
Fabaceae	<i>Acacia inaequilatera</i>		x		x				
Fabaceae	<i>Acacia ?sericophylla</i>		x		x				
Fabaceae	<i>Alysicarpus muelleri</i>		x		x				
Fabaceae	<i>Crotalaria medicaginea</i> var. <i>neglecta</i>		x	x	x				

Family	Taxon	Status	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Fabaceae	<i>Crotalaria</i> sp.				x				
Fabaceae	<i>Crotalaria novaehollandiae</i> subsp. <i>novaehollandiae</i>		x		x				
Fabaceae	<i>Cullen ?stipulaceum</i>		x		x				
Fabaceae	<i>Desmodium filiforme</i>		x	x	x				
Fabaceae	<i>Dichrostachys spicata</i>		x	x					
Fabaceae	<i>Erythrina vespertilio</i>			x					
Fabaceae	<i>Indigofera colutea</i>		x		x	x			x
Fabaceae	<i>Indigofera linifolia</i>		x		x		x	x	
Fabaceae	<i>Indigofera monophylla</i>		x	x	x			x	
Fabaceae	<i>Indigofera trita</i>			x	x				
Fabaceae	<i>Rhynchosia bungarensis</i>	P4		x					
Fabaceae	<i>Rhynchosia minima</i>		x	x	x			x	
Fabaceae	<i>Senna glutinosa</i> subsp. <i>glutinosa</i>		x	x					
Fabaceae	<i>Senna notabilis</i>								x
Fabaceae	<i>Senna</i> sp.		x						
Fabaceae	<i>Tephrosia rosea</i> var. <i>clementii</i>		x						
Fabaceae	<i>Tephrosia supina</i>		x	x	x				
Fabaceae	<i>Vachellia farnesiana</i>	*	x	x	x			x	
Fabaceae	<i>Vigna triodiophila</i>	P3		x					
Fabaceae	<i>Zornia muelleriana</i>				x				
Frankeniaceae	<i>Frankenia ?pauciflora</i>						x		x
Goodeniaceae	<i>Goodenia microptera</i>		x		x				
Goodeniaceae	<i>Scaevola spinescens</i>		x	x	x			x	x
Lamiaceae	<i>Clerodendrum tomentosum</i> ?var. <i>tomentosum</i>			x					
Lamiaceae	<i>Clerodendrum tomentosum</i> var. <i>lanceolatum</i>			x					
Lauraceae	<i>Cassytha capillaris</i>		x		x				x

Family	Taxon	Status	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Malvaceae	<i>Abutilon</i> aff. <i>lepidum</i>				x				
Malvaceae	<i>Abutilon fraseri</i>			x	x				
Malvaceae	<i>Abutilon lepidum</i>		x		x				x
Malvaceae	<i>Abutilon</i> sp.		x						
Malvaceae	<i>Brachychiton acuminatus</i>			x	x				
Malvaceae	<i>Corchorus</i> sp.			x	x				
Malvaceae	<i>Corchorus tridens</i>				x				
Malvaceae	<i>Corchorus walcottii</i>		x	x	x				
Malvaceae	<i>Gossypium australe</i>		x	x	x				x
Malvaceae	<i>Hibiscus</i> sp.		x						
Malvaceae	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>			x	x				
Malvaceae	<i>Lawrenzia viridigrisea</i>						x		
Malvaceae	<i>Melhania oblongifolia</i>				x				
Malvaceae	<i>Sida fibulifera</i>				x	x			x
Malvaceae	<i>Sida</i> sp.		x	x	x			x	
Malvaceae	<i>Triumfetta appendiculata</i>		x	x	x				
Malvaceae	<i>Triumfetta clementii</i>		x	x	x				
Menispermaceae	<i>Tinospora smilacina</i>		x	x	x				
Molluginaceae	<i>Trigastrotheca molluginea</i>		x						
Moraceae	<i>Ficus brachypoda</i>			x					
Myrtaceae	<i>Corymbia</i> sp.		x						
Nyctaginaceae	<i>Boerhavia coccinea</i>		x	x	x				
Nyctaginaceae	<i>Boerhavia schomburgkiana</i>			x	x				
Nyctaginaceae	<i>Commicarpus australis</i>			x	x				
Oleaceae	<i>Jasminum didymum</i> subsp. <i>lineare</i>			x					
Phyllanthaceae	<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>			x					
Phyllanthaceae	<i>Notoleptopus decaisnei</i>			x					

Family	Taxon	Status	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>		x	x	x				
Pittosporaceae	<i>Pittosporum angustifolium</i>			x					
Plantaginaceae	<i>Stemodia grossa</i>		x						x
Poaceae	<i>Cenchrus ciliaris</i>	*	x	x	x	x	x	x	x
Poaceae	<i>Chrysopogon fallax</i>		x						
Poaceae	<i>Cymbopogon ambiguus</i>		x	x	x				
Poaceae	<i>Dactyloctenium radulans</i>			x		x	x	x	x
Poaceae	<i>Digitaria ctenantha</i>		x						
Poaceae	<i>Eragrostis falcata</i>						x		
Poaceae	<i>Eragrostis setifolia</i>						x	x	
Poaceae	<i>Eragrostis ?tenellula</i>						x		
Poaceae	<i>Eriachne obtusa</i>					x			
Poaceae	<i>Panicum decompositum</i>				x				
Poaceae	<i>Paspalidium basicladum</i>					x			x
Poaceae	<i>Paspalidium tabulatum</i>		x	x	x	x			x
Poaceae	<i>Sporobolus virginicus</i>					x	x		x
Poaceae	<i>Themeda triandra</i>			x	x				
Poaceae	<i>Triodia angusta</i>					x	x		x
Poaceae	<i>Triodia epactia</i>		x	x	x			x	x
Poaceae	<i>Triodia wiseana</i>		x		x				
Poaceae	<i>Whiteochloa airoides</i>								x
Poaceae	<i>Yakirra australiensis</i>		x						
Portulacaceae	<i>Portulaca oleracea</i>				x				
Portulacaceae	<i>Portulaca</i> sp.			x	x				
Primulaceae	<i>Samolus repens</i> sens lat.					x	x		x
Proteaceae	<i>Grevillea pyramidalis</i> subsp. <i>pyramidalis</i>		x	x	x				
Proteaceae	<i>Hakea lorea</i> subsp. <i>lorea</i>		x		x				

Family	Taxon	Status	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Sapindaceae	<i>Alectryon oleifolius</i> subsp. <i>oleifolius</i>		x						
Scrophulariaceae	<i>Myoporum montanum</i>								x
Solanaceae	<i>Solanum diversiflorum</i>				x				
Solanaceae	<i>Solanum horridum</i>		x		x				
Solanaceae	<i>Solanum lasiophyllum</i>		x		x				x
Violaceae	<i>Hybanthus aurantiacus</i>		x	x	x				x
Zygophyllaceae	<i>Tribulus hirsutus</i>				x				
Zygophyllaceae	<i>Tribulus occidentalis</i>		x						

* Introduced (weed) species

P3 DBCA Priority 3 species

P4 DBCA Priority 4 species

QUADRAT DATA

Quadrat 1

Q1	VT:	VT05
Type:	Quadrat	Size: 50 x 50 m
Date:	5/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7899293	-20.62946883
Landform and slope:	Saline tidal flats Gentle	
Drainage:	Seasonal wet	
Aspect	Flat	
Soil colour & type:	Clay Light brown	
Surface Component	5% small rocks and shelly material	
Vegetation condition:	Very good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	Buffel grass, tracks, shrub death	
Leaf litter:	2-10%	
Bare ground	11-30%	



Family	Taxon	Status	Cover (%)	Height (m)
Chenopodiaceae	<i>Tecticornia pterygosperma</i>		30-70	0.2
Cyperaceae	<i>Cyperus bulbosus</i>		<10	0.25
Poaceae	<i>Cenchrus ciliaris</i>	*	<10	0.3

Family	Taxon	Status	Cover (%)	Height (m)
Chenopodiaceae	<i>Tecticornia indica subsp. bidens</i>		<10	0.2
Chenopodiaceae	<i>Dysphania plantaginella</i>		<2	0.1
Poaceae	<i>Eragrostis tenellula</i>		<2	0.15
Cleomaceae	<i>Cleome viscosa</i>		<2	0.2
Chenopodiaceae	<i>Neobassia astrocarpa</i>		<2	0.35

Quadrat 2

Q2	VT:	VT03
Type:	Quadrat	Size: 50 x 50 m
Date:	6/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7840462	-20.62315872
Landform and slope:	Stony Plain Gentle	
Drainage:	Good	
Aspect	South	
Soil colour & type:	Sandy loam Red	
Surface Component	99% stony rocks	
Vegetation condition:	Very good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	Weeds, fencing	
Leaf litter:	2-10%	
Bare ground	11-30%	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia epactia</i>		70-100	0.6
Convolvulaceae	<i>Bonamia media</i>		<2	0.1
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.05
Fabaceae	<i>Indigofera linifolia</i>		<2	0.15
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2	0.15
Fabaceae	<i>Zornia muelleriana</i>		<2	0.1

Family	Taxon	Status	Cover (%)	Height (m)
Proteaceae	<i>Grevillea pyramidalis</i> <i>subsp. pyramidalis</i>		<10	1.5
Malvaceae	<i>Corchorus sp.</i>		<2	0.05
Fabaceae	<i>Crotalaria sp.</i>		<2	0.05
Solanaceae	<i>Solanum lasiophyllum</i>		<2	0.3
Malvaceae	<i>Gossypium australe</i>		<10	0.6
Cleomaceae	<i>Cleome viscosa</i>		<10	0.3
Fabaceae	<i>Indigofera monophylla</i>		<2	0.2
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	creeper
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.3
Phyllanthaceae	<i>Phyllanthus</i> <i>maderaspatensis</i>		<2	0.3
Amaranthaceae	<i>Aerva javanica</i>	*	<2	0.9
Portulacaceae	<i>Portulaca oleracea</i>		<2	0.05
Poaceae	<i>Cenchrus ciliaris</i>	*	<2	0.5
Convolvulaceae	<i>Ipomoea costata</i>		<2	2.1
Boraginaceae	<i>Ehretia saligna</i>		<2	2.4
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.4
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.3
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2	0.3
Goodeniaceae	<i>Scaevola spinescens</i>		<2	0.8
Malvaceae	<i>Triumfetta clementii</i>		<2	0.3
Fabaceae	<i>Tephrosia supina</i>		<2	0.1
Fabaceae	<i>Acacia bivenosa</i>		<2	1.6
Fabaceae	<i>Acacia inaequilatera</i>		<2	2
Proteaceae	<i>Hakea lorea subsp. lorea</i>		<2	1.4
Malvaceae	<i>Abutilon lepidum</i>		<2	0.3
Solanaceae	<i>Solanum diversiflorum</i>		<2	0.1
Goodeniaceae	<i>Goodenia microptera</i>		<2	0.1

Quadrat 3

Q3	VT:	VT03
Type:	Quadrat	Size: 50 x 50 m
Date:	6/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7847701	-20.62447475
Landform and slope:	Stony Plain Gentle	
Drainage:	Good	
Aspect	South	
Soil colour & type:	Sandy loam Red/brown	
Surface Component	80% rock	
Vegetation condition:	Good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds, previous clearing, tracks, infrastructure	
Leaf litter:	2-10%	
Bare ground	2-10%	

Photo 0091



Family	Taxon	Status	Cover (%)	Height (m)
Proteaceae	<i>Grevillea pyramidalis</i> <i>subsp. pyramidalis</i>		10-30	2.3
Poaceae	<i>Triodia epactia</i>		30-70	1
Euphorbiaceae	<i>Euphorbia tannensis</i> <i>subsp. eremophila</i>		<10	0.5
Solanaceae	<i>Solanum lasiophyllum</i>		<10	0.4

Family	Taxon	Status	Cover (%)	Height (m)
Amaranthaceae	<i>Ptilotus exaltatus</i>		<2	0.1
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2N	0.25
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>		<2	0.2
Solanaceae	<i>Solanum diversiflorum</i>		<2	0.1
Malvaceae	<i>Gossypium australe</i>		<2	0.3
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2	0.3
Cleomaceae	<i>Cleome viscosa</i>		<10	0.2
Poaceae	<i>Cenchrus ciliaris</i>	*	<10	0.3
Fabaceae	<i>Indigofera monophylla</i>		<2	0.3
Fabaceae	<i>Tephrosia supina</i>		<2	0.2
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.3
Malvaceae	<i>Abutilon lepidum</i>		<10	0.3
Lauraceae	<i>Cassytha capillaris</i>		<10	creeper
Malvaceae	<i>Triumfetta clementii</i>		<2	0.2
Goodeniaceae	<i>Scaevola spinescens</i>		<10	0.4
Fabaceae	<i>Indigofera colutea</i>		<2N	0.1
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.6
Convolvulaceae	<i>Bonamia media</i>		<2N	0.1
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.1
Portulacaceae	<i>Portulaca oleracea</i>		<2	0.05
Zygophyllaceae	<i>Tribulus hirsutus</i>		<2	0.2
Fabaceae	<i>Acacia bivenosa</i>		<2	1.2
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.1
Malvaceae	<i>Melhania oblongifolia</i>		<2	0.25
Apocynaceae	<i>Cynanchum floribundum</i>		<2	creeper
Fabaceae	<i>Indigofera trita</i>		<2	0.2
Poaceae	<i>Panicum decompositum</i>		<2	0.6
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	creeper
Fabaceae	<i>Tephrosia supina</i>		<10	0.4
Malvaceae	<i>Corchorus tridens</i>		<2	0.1
Goodeniaceae	<i>Goodenia microptera</i>		<2	0.1
Poaceae	<i>Cymbopogon ambiguus</i>		<2	1

Quadrat 4

Q4	VT:	VT03
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7789766	-20.62141525
Landform and slope:	Hillcrest/ Upper Hillslope Moderate	
Drainage:	Good	
Aspect	South/West	
Soil colour & type:	Sandy loam Red	
Surface Component	99% rocky, outcropping	
Vegetation condition:	Pristine	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	2-10%	
Bare ground	2-10%	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia epactia</i>		70-100	1
Fabaceae	<i>Rhynchosia minima</i>		<10	0.1
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.2
Araliaceae	<i>Trachymene oleracea</i>		<2N	0.1
Cleomaceae	<i>Cleome viscosa</i>		<10	0.8
Commelinaceae	<i>Commelina ensifolia</i>		<2	0.1

Family	Taxon	Status	Cover (%)	Height (m)
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2N	0.2
Amaranthaceae	<i>Gomphrena cunninghamii</i>		<2	0.1
Malvaceae	<i>Sida sp.</i>		<2	0.05
Fabaceae	<i>Desmodium filiforme</i>		<2	0.2
Fabaceae	<i>Tephrosia supina</i>		<2	0.1
Convolvulaceae	<i>Evolvulus alsinoides var. villosicalyx</i>		<2	0.05
Convolvulaceae	<i>Ipomoea costata</i>		<2	2
Malvaceae	<i>Brachychiton acuminatus</i>		<2	2.1
Malvaceae	<i>Abutilon fraseri</i>		<2	0.3
Amaranthaceae	<i>Amaranthus undulatus</i>		<2	0.4
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Poaceae	<i>Paspalidium tabulatum</i>		<2	0.4
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>		<2	0.4
Poaceae	<i>Cymbopogon ambiguus</i>		<2	1.2
Fabaceae	<i>Alysicarpus muelleri</i>		<2	0.4
Convolvulaceae	<i>Bonamia media</i>		<2	0.01
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.4
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.2
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.3
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	creeper
Nyctaginaceae	<i>Boerhavia schomburgkiana</i>		<2	0.4
Poaceae	<i>Themeda triandra</i>		<2	0.4
Portulacaceae	<i>Portulaca oleracea</i>		<2	0.05
Fabaceae	<i>Cullen ?stipulaceum</i>		<2	0.8
Fabaceae	<i>Crotalaria sp.</i>		<2	0.2
Malvaceae	<i>Triumfetta clementii</i>		<2	0.1
Euphorbiaceae	<i>Euphorbia tannensis subsp. eremophila</i>		<10	0.2

Quadrat 5

Q5	VT:	VT03
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7798089	-20.62215679
Landform and slope:	Hillslope Moderate	
Drainage:	Good	
Aspect	South/East	
Soil colour & type:	Sandy loam Red	
Surface Component	99% rocky	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	11-30%	
Bare ground	<2%	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia epactia</i>		70-100	1
Cleomaceae	<i>Cleome viscosa</i>		<10	0.6
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.3
Fabaceae	<i>Indigofera monophylla</i>		<10	0.5
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.2
Malvaceae	<i>Sida sp.</i>		<2	0.1

Family	Taxon	Status	Cover (%)	Height (m)
Malvaceae	<i>Abutilon lepidum</i>		<2	0.2
Malvaceae	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>		<2	
Malvaceae	<i>Triumfetta clementii</i>		<2N	0.2
Araliaceae	<i>Trachymene oleracea</i>		<2N	0.1
Fabaceae	<i>Indigofera colutea</i>		<2	0.2
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.4
Amaranthaceae	<i>Gomphrena cunninghamii</i>		<2	0.1
Fabaceae	<i>Acacia bivenosa</i>		<2	1.5
Fabaceae	<i>Crotalaria medicaginea</i> var. <i>neglecta</i>		<2	0.2
Fabaceae	<i>Tephrosia supina</i>		<2	0.2
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.2
Convolvulaceae	<i>Bonamia media</i>		<2	0.1
Proteaceae	<i>Hakea lorea</i> subsp. <i>lorea</i>		<2	1.5
Goodeniaceae	<i>Scaevola spinescens</i>		<2	1.2
Proteaceae	<i>Grevillea pyramidalis</i> subsp. <i>pyramidalis</i>		<2	1.1
Fabaceae	<i>Cullen stipulaceum</i>		<2	0.7
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	
Poaceae	<i>Cymbopogon ambiguus</i>		<2	1.2
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.5

Quadrat 6

Q6	VT:	VT01
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7800501	-20.62509628
Landform and slope:	Foothlope Gentle	
Drainage:	Good	
Aspect	South	
Soil colour & type:	Loam Red	
Surface Component	Rocky 85%	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	recent cyclone plant damage, scattered rubbish	
Leaf litter:	11-30%	
Bare ground	2-10%	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia epactia</i>		70-100	0.9
Fabaceae	<i>Acacia bivenosa</i>		<10	2.6
Fabaceae	<i>Acacia inaequilatera</i>		<10	2
Proteaceae	<i>Hakea lorea subsp. lorea</i>		<2	1.9
Proteaceae	<i>Grevillea pyramidalis subsp. pyramidalis</i>		10-30	2

Family	Taxon	Status	Cover (%)	Height (m)
Violaceae	<i>Hybanthus aurantiacus</i>		<2N	0.4
Fabaceae	<i>Rhynchosia minima</i>		<10	-
Fabaceae	<i>Indigofera monophylla</i>		<10	0.4
Malvaceae	<i>Sida sp.</i>		<2N	0.8
Solanaceae	<i>Solanum horridum</i>		<2	0.25
Malvaceae	<i>Triumfetta clementii</i>		<2	0.3
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Fabaceae	<i>Senna sp.</i>		<2	0.1
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.2
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2N	0.3
Convolvulaceae	<i>Evolvulus alsinoides var. villosicalyx</i>		<2	0.1
Boraginaceae	<i>Heliotropium cunninghamii</i>		<2N	0.2
Poaceae	<i>Chrysopogon fallax</i>		<2	0.9
Lauraceae	<i>Cassytha capillaris</i>		<2	-
Goodeniaceae	<i>Goodenia microptera</i>		<2	0.2
Malvaceae	<i>Abutilon lepidum</i>		<10	0.3
Fabaceae	<i>Acacia colei var. colei</i>		<2	0.4
Goodeniaceae	<i>Scaevola spinescens</i>		<2	1
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Fabaceae	<i>Desmodium filiforme</i>		<10	0.3
Solanaceae	<i>Solanum lasiophyllum</i>		<2	0.3
Fabaceae	<i>Cullen ?stipulaceum</i>		<2	0.1
Fabaceae	<i>Indigofera linifolia</i>		<2N	0.2
Malvaceae	<i>Corchorus walcottii</i>		<2	0.4
Asteraceae	<i>Pterocaulon sphaeranthoides</i>		<2	0.1
Fabaceae	<i>Indigofera colutea</i>		<2	0.05
Poaceae	<i>Yakirra australiensis</i>		<10	0.2

Quadrat 7

Q7	VT:	VT03
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7822667	-20.62337553
Landform and slope:	Footslope Gentle	
Drainage:	Good	
Aspect	South/West	
Soil colour & type:	Skeletal Red/brown	
Surface Component	Rocky 98%	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds, cyclone	
Leaf litter:	2-10%	
Bare ground	11-30%	



Family	Taxon	Status	Cover (%)	Height (m)
Proteaceae	<i>Grevillea pyramidalis</i> <i>subsp. pyramidalis</i>		10-30	2
Fabaceae	<i>Acacia inaequilatera</i>		<10	1.9
Poaceae	<i>Triodia epactia</i>		70-100	0.9
Fabaceae	<i>Rhynchosia minima</i>		<10	-
Convolvulaceae	<i>Polymeria ambigua</i>		<2N	-

Family	Taxon	Status	Cover (%)	Height (m)
Fabaceae	<i>Indigofera linifolia</i>		<2N	0.2
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.2
Malvaceae	<i>Triumfetta clementii</i>		<2	0.4
Malvaceae	<i>Abutilon lepidum</i>		<10	0.4
Fabaceae	<i>Indigofera monophylla</i>		<10	0.3
Proteaceae	<i>Hakea lorea subsp. lorea</i>		<2	1.7
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.2
Cucurbitaceae	<i>Trichosanthes cucumerina</i>		<2	-
Fabaceae	<i>Crotalaria novaehollandiae subsp. novaehollandiae</i>		<2	0.2
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.3
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2	0.3
Fabaceae	<i>Acacia coriacea subsp. coriacea</i>		<2	1.4
Solanaceae	<i>Solanum lasiophyllum</i>		<10	0.4
Goodeniaceae	<i>Scaevola spinescens</i>		<2	0.6
Fabaceae	<i>Acacia colei var. colei</i>		<2	0.4
Solanaceae	<i>Solanum horridum</i>		<2N	0.4
Malvaceae	<i>Corchorus walcottii</i>		<2	0.3
Fabaceae	<i>Acacia bivenosa</i>		<2	2.8
Cleomaceae	<i>Cleome viscosa</i>		<2	0.1
Poaceae	<i>Paspalidium tabulatum</i>		<2	0.5
Fabaceae	<i>Vachellia farnesiana</i>	*	<2	0.4
Fabaceae	<i>Tephrosia supina</i>		<2	0.1
Poaceae	<i>Cymbopogon ambiguus</i>		<2	1.1
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>		<2	0.2
Amaranthaceae	<i>Ptilotus exaltatus</i>		<2	0.2
Chenopodiaceae	<i>Rhagodia eremaea</i>		<2	1.1
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	0.2
Lauraceae	<i>Cassytha capillaris</i>		<2	-
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.1

Quadrat 8

Q8:	VT:	VT01
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7832161	-20.62098392
Landform and slope:	Foothlope Gentle	
Drainage:	Good	
Aspect	East	
Soil colour & type:	Skeletal Red/brown	
Surface Component	98% stony rocks and outcropping	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	cyclone, drainage water, weeds	
Leaf litter:	11-30%	
Bare ground	11-30%	



Family	Taxon	Status	Cover (%)	Height (m)
Proteaceae	<i>Grevillea pyramidalis</i> <i>subsp. pyramidalis</i>		10-30	2.2
Fabaceae	<i>Acacia inaequilatera</i>		10-30	2.1
Goodeniaceae	<i>Scaevola spinescens</i>		10-30	1.2
Poaceae	<i>Triodia epactia</i>		70-100	0.8
Malvaceae	<i>Corchorus walcottii</i>		<2	0.2

Family	Taxon	Status	Cover (%)	Height (m)
Malvaceae	<i>Triumfetta appendiculata</i>		<10	0.3
Fabaceae	<i>Tephrosia supina</i>		<2N	0.1
Malvaceae	<i>Triumfetta clementii</i>		<2	0.2
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.4
Fabaceae	<i>Crotalaria medicaginea</i> <i>var. neglecta</i>		<2	0.1
Malvaceae	<i>Abutilon lepidum</i>		<2N	0.1
Poaceae	<i>Paspalidium tabulatum</i>		<10	0.4
Poaceae	<i>Cenchrus ciliaris</i>	*	<10	0.3
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2N	0.2
Fabaceae	<i>Vachellia farnesiana</i>	*	<10	0.8
Malvaceae	<i>Abutilon sp.</i>		<2	0.5
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.2
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	0.1
Fabaceae	<i>Indigofera linifolia</i>		<2N	0.2
Fabaceae	<i>Cullen ?stipulaceum</i>		<2	0.1
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.1
Solanaceae	<i>Solanum lasiophyllum</i>		<10	0.3
Fabaceae	<i>Indigofera monophylla</i>		<10	0.8
Convolvulaceae	<i>Bonamia media</i>		<2	0.1
Fabaceae	<i>Acacia coriacea subsp.</i> <i>coriacea</i>		<2	0.5
Solanaceae	<i>Solanum horridum</i>		<2	0.2
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.2
Phyllanthaceae	<i>Phyllanthus</i> <i>maderaspatensis</i>		<2	0.2
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Cleomaceae	<i>Cleome viscosa</i>		<2	0.3

Quadrat 9

Q9	VT:	VT01
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7809399	-20.62290047
Landform and slope:	Footslope Gentle	
Drainage:	Good	
Aspect	South/East	
Soil colour & type:	Skeletal Red/brown	
Surface Component	Rocky 99%	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	11-30%	
Bare ground	2-10%	

Photo 199



Family	Taxon	Status	Cover (%)	Height (m)
Fabaceae	<i>Acacia inaequilatera</i>		10-30	2
Proteaceae	<i>Hakea lorea subsp. lorea</i>		<10	1.5
Fabaceae	<i>Acacia bivenosa</i>		70-100	0.9
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>		<2	2.1

Family	Taxon	Status	Cover (%)	Height (m)
Goodeniaceae	<i>Goodenia microptera</i>		<2	0.2
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2	0.2
Fabaceae	<i>Indigofera linifolia</i>		<2N	0.2
Malvaceae	<i>Triumfetta clementii</i>		<10	0.1
Convolvulaceae	<i>Bonamia media</i>		<2N	0.1
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.1
Fabaceae	<i>Tephrosia supina</i>		<2	0.2
Malvaceae	<i>Corchorus walcottii</i>		<2	0.3
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.2
Malvaceae	<i>Sida sp.</i>		<2N	0.3
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.3
Fabaceae	<i>Indigofera monophylla</i>		<10	0.3
Asteraceae	<i>Pentalepis trichodesmoides subsp. trichodesmoides</i>		<2	0.6
Poaceae	<i>Yakirra australiensis</i>		<2N	0.1
Convolvulaceae	<i>Evolvulus alsinoides var. villosicalyx</i>		<2	0.1
Poaceae	<i>Paspalidium tabulatum</i>		<10	0.4
Cleomaceae	<i>Cleome viscosa</i>		<10	0.3
Fabaceae	<i>Crotalaria novaehollandiae subsp. novaehollandiae</i>		<2	0.2
Cyperaceae	<i>Fimbristylis dichotoma</i>		<2	0.2
Fabaceae	<i>Acacia ?sericophylla</i>		<10	2
Fabaceae	<i>Vachellia farnesiana</i>	*	<2	0.5
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Solanaceae	<i>Solanum lasiophyllum</i>		<2	0.3
Fabaceae	<i>Indigofera colutea</i>		<2	0.2
Goodeniaceae	<i>Scaevola spinescens</i>		<2	1.2
Poaceae	<i>Cymbopogon ambiguus</i>		<2	1.3
Malvaceae	<i>Abutilon sp.</i>		<2	0.2
Poaceae	<i>Digitaria ctenantha</i>		<2	0.3
Boraginaceae	<i>Ehretia saligna</i>		<2	4
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	0.2
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Malvaceae	<i>Hibiscus sp.</i>		<2	0.2
Fabaceae	<i>Alysicarpus muelleri</i>		<2	0.2

Quadrat 10

Q10	VT:	VT05
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7913531	-20.6293479
Landform and slope:	Claypan Gentle	
Drainage:	Seasonal wet	
Aspect	Flat	
Soil colour & type:	Saline clay/loam Light brown	
Surface Component	Small pebbles and shell material	
Vegetation condition:	Very good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds, tracks	
Leaf litter:	<2%	
Bare ground	11-30%	



Family	Taxon	Status	Cover (%)	Height (m)
Chenopodiaceae	<i>Tecticornia</i> <i>?pterygosperma</i>		10-30	0.2
Poaceae	<i>Cenchrus ciliaris</i>	*	<2	0.2
Cyperaceae	<i>Cyperus bulbosus</i>		<10	0.2
Chenopodiaceae	<i>Tecticornia indica</i> subsp. <i>?bidens</i>		<10	0.3
Chenopodiaceae	<i>Dysphania plantaginella</i>		<2N	0.02

Family	Taxon	Status	Cover (%)	Height (m)
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2	0.2
Frankeniaceae	<i>Frankenia ?pauciflora</i>		<10	0.3
Poaceae	<i>Sporobolus virginicus</i>		<10	0.2
Malvaceae	<i>Lawrenzia viridigrisea</i>		<2	0.25
Euphorbiaceae	<i>Euphorbia australis</i> var. <i>australis</i>		<2	0.1
Chenopodiaceae	<i>Neobassia astrocarpa</i>		<2	0.2
Fabaceae	<i>Indigofera linifolia</i>		<2	0.2

Quadrat 11

Q11	VT:	VT06
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7918257	-20.6281995
Landform and slope:	Other Negligible	
Drainage:	Good	
Aspect	Flat	
Soil colour & type:	Gritty sand Brown	
Surface Component	Some shelly material	
Vegetation condition:	Degraded	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weed invasion, tracks, cyclone	
Leaf litter:	<2%	
Bare ground	31-70%	

Photo 205



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Cenchrus ciliaris</i>	*	30-70	0.6
Fabaceae	<i>Acacia ?sericophylla</i>		<2	1.4
Fabaceae	<i>Indigofera linifolia</i>		<2N	0.1
Amaranthaceae	<i>Aerva javanica</i>	*	<10	0.9
Poaceae	<i>Triodia epactia</i>		<2	0.4

Family	Taxon	Status	Cover (%)	Height (m)
Cleomaceae	<i>Cleome viscosa</i>		<2	0.3
Cyperaceae	<i>Cyperus bulbosus</i>		<2	0.2
Fabaceae	<i>Acacia bivenosa</i>		<2	2.9
Poaceae	<i>Eragrostis setifolia</i>		<2	0.4

Quadrat 12

Q12	VT:	VT06
Type:	Quadrat	Size: 50 x 50 m
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7903397	-20.62766968
Landform and slope:	Low-lying plain	
Drainage:	Good	
Aspect	Flat	
Soil colour & type:	Brown sand	
Surface Component	Some shelly material	
Vegetation condition:	Degraded	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds, track	
Leaf litter:	<2%	
Bare ground	31-70%	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Cenchrus ciliaris</i>	*	70-100	0.8
Fabaceae	<i>Indigofera monophylla</i>		<10	0.2
Fabaceae	<i>Indigofera linifolia</i>		<2N	0.1
Fabaceae	<i>Rhynchosia minima</i>		<2	0.01
Malvaceae	<i>Sida sp.</i>		<2	0.2
Cleomaceae	<i>Cleome viscosa</i>		<2	0.4
Cyperaceae	<i>Cyperus bulbosus</i>		<10	0.2

Family	Taxon	Status	Cover (%)	Height (m)
Aizoaceae	<i>Trianthema turgidifolia</i>		<2	0.2
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	0.3
Chenopodiaceae	<i>Neobassia astrocarpa</i>		<2	0.2
Chenopodiaceae	<i>Tecticornia</i> <i>?pterygosperma</i>		<2	0.4
Amaranthaceae	<i>Aerva javanica</i>	*	<2	0.4
Poaceae	<i>Triodia epactia</i>		<2	0.4
Boraginaceae	<i>Heliotropium</i> <i>cunninghamii</i>		<2	0.2
Poaceae	<i>Dactyloctenium radulans</i>		<2	0.1
Goodeniaceae	<i>Scaevola spinescens</i>		<2	0.8

Quadrat 13

Q13	VT:	VT05
Type:	Quadrat	Size: 50 x 50 m
Date:	8/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7877786	-20.62784615
Landform and slope:	Claypan / tidal flats	
Drainage:	Seasonal wet	
Aspect	Flat	
Soil colour & type:	Light brown clay/loam saline	
Surface Component	Pebbly rock and shelly material	
Vegetation condition:	Good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds, track	
Leaf litter:	<2%	
Bare ground	31-70%	



Family	Taxon	Status	Cover (%)	Height (m)
Chenopodiaceae	<i>Tecticornia</i> <i>?pterygosperma</i>		10-30	0.4
Cyperaceae	<i>Cyperus bulbosus</i>		10-30	0.2
Poaceae	<i>Eragrostis falcata</i>		10-30	0.1
Malvaceae	<i>Lawrenzia viridigrisea</i>		<2	0.2
Chenopodiaceae	<i>Neobassia astrocarpa</i>		10-30	0.2
Cleomaceae	<i>Cleome viscosa</i>		<2	0.3

Family	Taxon	Status	Cover (%)	Height (m)
Frankeniaceae	<i>Frankenia ?pauciflora</i>		<10	0.3
Amaranthaceae	<i>Surreya diandra</i>		10-30	0.4
Chenopodiaceae	<i>Dysphania plantaginella</i>		<2N	0.05
Poaceae	<i>Cenchrus ciliaris</i>	*	<10	0.3
Poaceae	<i>Triodia angusta</i>		<10	0.5
Amaranthaceae	<i>Aerva javanica</i>	*	<2	0.4
Aizoaceae	<i>Trianthema turgidifolia</i>		<2	0.3
Poaceae	<i>Dactyloctenium radulans</i>		<2	0.1
Poaceae	<i>Eragrostis setifolia</i>		<2	0.3
Chenopodiaceae	<i>Tecticornia ?pterygosperma</i>		<10	0.2
Fabaceae	<i>Indigofera linifolia</i>		<2	0.1
Amaranthaceae	<i>Amaranthus undulatus</i>		<2	0.1

Quadrat 14

Q14	VT:	VT06
Type:	Quadrat	Size: 50 x 50 m
Date:	8/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7868457	-20.62981815
Landform and slope:	Other Negligible	
Drainage:	Good	
Aspect	Flat	
Soil colour & type:	Gritty sand Light brown	
Surface Component	Shells	
Vegetation condition:	Completely degraded	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds, track	
Leaf litter:	<2%	
Bare ground	31-70%	
Comments	Dead upper shrub layer ?Acacia	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Cenchrus ciliaris</i>	*	30-70	0.9
Fabaceae	<i>Indigofera linifolia</i>		<10	0.2
Poaceae	<i>Triodia epactia</i>		<2	0.4
Amaranthaceae	<i>Aerva javanica</i>	*	<10	0.5
Cleomaceae	<i>Cleome viscosa</i>		<2	0.4

Family	Taxon	Status	Cover (%)	Height (m)
Aizoaceae	<i>Trianthema turgidifolia</i>		<2	0.4
Cyperaceae	<i>Cyperus bulbosus</i>		<2N	0.2
Chenopodiaceae	<i>Tecticornia</i> <i>?pterygosperma</i>		<2	0.4
Amaranthaceae	<i>Surreya diandra</i>		<2	0.2
Boraginaceae	<i>Heliotropium</i> <i>cunninghamii</i>		<2	0.2
Fabaceae	<i>Vachellia farnesiana</i>	*	<2	1

Quadrat 15

Q15	VT:	VT03
Type:	Quadrat	Size: 50 x 50 m
Date:	8/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7818033	-20.62148308
Landform and slope:	Hillslope Moderate	
Drainage:	Good	
Aspect	South/East	
Soil colour & type:	Skeletal Red brown	
Surface Component	99% rocky, outcropping	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	11-30%	
Bare ground	<2%	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia epactia</i>		70-100	1
Cleomaceae	<i>Cleome viscosa</i>		<10	0.3
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.2
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.5
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.2
Malvaceae	<i>Sida fibulifera</i>		<2N	0.1

Family	Taxon	Status	Cover (%)	Height (m)
Fabaceae	<i>Indigofera linifolia</i>		<2N	0.2
Malvaceae	<i>Triumfetta clementii</i>		<2	0.3
Amaranthaceae	<i>Gomphrena cunninghamii</i>		<2	0.1
Malvaceae	<i>Abutilon lepidum</i>		<2N	0.2
Araliaceae	<i>Trachymene oleraceae</i>		<2	0.1
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Poaceae	<i>Themeda triandra</i>		<2N	0.3
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.3
Proteaceae	<i>Hakea lorea subsp. lorea</i>		<10	1.6
Fabaceae	<i>Acacia ?sericophylla</i>		<2	1.7
Fabaceae	<i>Acacia inaequilatera</i>		<2	2.1
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2N	0.2
Poaceae	<i>Cenchrus ciliaris</i>	*	<2	0.1
Portulacaceae	<i>Portulaca sp.</i>		<2	0.05
Fabaceae	<i>Crotalaria medicaginea</i> <i>var. neglecta</i>		<2N	0.1
Convolvulaceae	<i>Bonamia media</i>		<2	0.1
Fabaceae	<i>Acacia bivenosa</i>		<2	2.1
Lauraceae	<i>Cassytha capillaris</i>		<2	-
Solanaceae	<i>Solanum horridum</i>		<2	0.3
Poaceae	<i>Cymbopogon ambiguus</i>		<2	1.1
Chenopodiaceae	<i>Rhagodia eremaea</i>		<2	1.2
Fabaceae	<i>Indigofera monophylla</i>		<10	0.4
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.3

Releve 1

R1	VT:	VT02
Type:	Releve	
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7784724	-20.62261597
Landform and slope:	Boulders/ Rockpiles Steep	
Drainage:	Good	
Aspect	n/a	
Soil colour & type:	Sandy loam Red/brown	
Surface Component	100% rock	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	2-10%	
Bare ground	31-70%	
Comments	Area around edge of rockpiles	



Family	Taxon	Status	Cover (%)	Height (m)
Malvaceae	<i>Brachychiton acuminatus</i>		<2	4
Combretaceae	<i>Terminalia supranitifolia</i>	P4	<2	2
Cucurbitaceae	<i>Trichosanthes cucumerina</i>		<2	-
Poaceae	<i>Cenchrus ciliaris</i>	*	<10	0.8

Family	Taxon	Status	Cover (%)	Height (m)
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Malvaceae	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>		<2	0.1
Cleomaceae	<i>Cleome viscosa</i>		10-30	1
Nyctaginaceae	<i>Boerhavia schomburgkiana</i>		<10	0.4
Commelinaceae	<i>Commelina ensifolia</i>		<2	0.2
Poaceae	<i>Paspalidium tabulatum</i>		<10	0.6
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	1
Malvaceae	<i>Abutilon fraseri</i>		<2	0.2
Fabaceae	<i>Rhynchosia bungarensis</i>	P4	<2N	-
Phyllanthaceae	<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>		<10	3
Goodeniaceae	<i>Scaevola spinescens</i>		<2	1
Chenopodiaceae	<i>Rhagodia eremaea</i>		<2	0.5
Pittosporaceae	<i>Pittosporum angustifolium</i>		<2	1.5
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>		<2	0.2
Malvaceae	<i>Triumfetta clementii</i>		<2N	0.2
Fabaceae	<i>Indigofera trita</i>		<2	0.2
Poaceae	<i>Cymbopogon ambiguus</i>		<10	1.5
Poaceae	<i>Themeda triandra</i>		<2	0.7
Amaranthaceae	<i>Amaranthus undulatus</i>		<2	0.8
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.2
Fabaceae	<i>Rhynchosia minima</i>		<2	0.1
Poaceae	<i>Triodia epactia</i>		10-30	0.8
Fabaceae	<i>Tephrosia supina</i>		<2	0.2
Fabaceae	<i>Vachellia farnesiana</i>	*	<2	1.5
Convolvulaceae	<i>Ipomoea costata</i>		<10	2
Fabaceae	<i>Indigofera monophylla</i>		<2	0.3
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.2
Amaranthaceae	<i>Gomphrena cunninghamii</i>		<2	0.2
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.5
Malvaceae	<i>Corchorus walcottii</i>		<2	0.3
Portulacaceae	<i>Portulaca</i> sp.		<2	0.1
Amaranthaceae	<i>Ptilotus obovatus</i>		<2	1
Proteaceae	<i>Grevillea pyramidalis</i> subsp. <i>pyramidalis</i>		<2	2.6
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Araliaceae	<i>Trachymene oleraceae</i>		<2	0.2

Releve 2

R2	VT:	VT02
Type:	Releve	
Date:	7/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7795613	-20.62166938
Landform and slope:	Boulders/ Rockpiles Steep	
Drainage:	Good	
Aspect	South	
Soil colour & type:	Sandy loam Red	
Surface Component	Rock 100%	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	2-10%	
Bare ground	31-70%	



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia epactia</i>		10-30	0.8
Phyllanthaceae	<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>		<10	1.8
Fabaceae	<i>Acacia coriacea</i> subsp. <i>coriacea</i>		<2	1.7
Poaceae	<i>Cymbopogon ambiguus</i>		<2	0.8
Cleomaceae	<i>Cleome viscosa</i>		10-30	0.9

Family	Taxon	Status	Cover (%)	Height (m)
Amaranthaceae	<i>Amaranthus undulatus</i>		<2N	0.4
Poaceae	<i>Cenchrus ciliaris</i>	*	<10	0.5
Poaceae	<i>Paspalidium tabulatum</i>		<10	0.5
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.3
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.2
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	0.4
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>		<2	0.1
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Malvaceae	<i>Abutilon fraseri</i>		<10	0.3
Poaceae	<i>Themeda triandra</i>		<2	0.4
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2	0.3
Euphorbiaceae	<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>		<2	0.3
Fabaceae	<i>Desmodium filiforme</i>		<2	0.4
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Sapindaceae	<i>Alectryon oleifolius</i> subsp. <i>oleifolius</i>		<2	0.4
Oleaceae	<i>Jasminum didymum</i> subsp. <i>lineare</i>		<2	0.6
Nyctaginaceae	<i>Boerhavia schomburgkiana</i>		<2	0.4
Fabaceae	<i>Acacia bivenosa</i>		<2	2
Amaranthaceae	<i>Aerva javanica</i>	*	<2	1
Malvaceae	<i>Brachychiton acuminatus</i>		<10	2
Proteaceae	<i>Grevillea pyramidalis</i> subsp. <i>pyramidalis</i>		<2	1
Malvaceae	<i>Gossypium australe</i>		<2	0.3
Pittosporaceae	<i>Pittosporum angustifolium</i>		<2	1.8
Fabaceae	<i>Senna glutinosa</i> subsp. <i>glutinosa</i>		<2	1.6
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Cucurbitaceae	<i>Trichosanthes cucumerina</i>		<2	-
Lamiaceae	<i>Clerodendrum tomentosum</i> var. <i>lanceolatum</i>		<2	5
Fabaceae	<i>Vachellia farnesiana</i>	*	<2	1.6

Releve 3

R3	VT:	VT01
Type:	Releve	
Date:	8/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7788564	-20.62582913
Landform and slope:	Boulders/ Rockpiles Steep	
Drainage:	Good	
Aspect	South	
Soil colour & type:	Sandy loam Red/brown/some clay	
Surface Component	Stony rocks 95%	
Vegetation condition:	Very good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	2-10%	
Bare ground	2-10%	



Family	Taxon	Status	Cover (%)	Height (m)
Fabaceae	<i>Acacia bivenosa</i>		10-30	3
Proteaceae	<i>Grevillea pyramidalis</i> <i>subsp. pyramidalis</i>		<10	1.6
Fabaceae	<i>Acacia coriacea</i> <i>subsp.</i> <i>coriacea</i>		<10	1.5
Proteaceae	<i>Hakea lorea</i> <i>subsp. lorea</i>		<10	1.5

Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia wiseana</i>		30-70	0.9
Boraginaceae	<i>Heliotropium cunninghamii</i>		<2N	0.2
Malvaceae	<i>Abutilon lepidum</i>		<2	0.3
Solanaceae	<i>Solanum horridum</i>		<2	0.15
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.2
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.3
Cleomaceae	<i>Cleome viscosa</i>		<10	0.6
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.5
Malvaceae	<i>Triumfetta clementii</i>		<2N	0.4
Fabaceae	<i>Indigofera monophylla</i>		<10	0.4
Amaranthaceae	<i>Aerva javanica</i>	*	<2	0.6
Fabaceae	<i>Acacia colei</i> var. <i>colei</i>		<2	2.6
Fabaceae	<i>Indigofera colutea</i>		<2N	0.1
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Poaceae	<i>Cenchrus ciliaris</i>	*	<10	0.7
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.3
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2N	0.2
Chenopodiaceae	<i>Rhagodia eremaea</i>		<2	1.6
Violaceae	<i>Hybanthus aurantiacus</i>		<2	0.4
Goodeniaceae	<i>Scaevola spinescens</i>		<2	1.2
Convolvulaceae	<i>Bonamia media</i>		<2N	-
Molluginaceae	<i>Trigastrotheca molluginea</i>		<2	0.3
Goodeniaceae	<i>Goodenia microptera</i>		<2	0.3
Poaceae	<i>Triodia epactia</i>		30-70	0.8

Releve 4

R4	VT:	VT02
Type:	Releve	
Date:	8/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7791279	-20.6219821
Landform and slope:	Boulders/ Rockpiles Steep	
Drainage:	Good	
Aspect	South	
Soil colour & type:	Skeletal Red/brown	
Surface Component	Rocky 100%	
Vegetation condition:	Excellent	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	2-10%	
Bare ground	2-10%	
Comments	hill top down gully	



Family	Taxon	Status	Cover (%)	Height (m)
Combretaceae	<i>Terminalia supranitifolia</i>	P4	<2	2.2
Fabaceae	<i>Acacia coriacea</i> subsp. <i>coriacea</i>		<10	2.3
Poaceae	<i>Cymbopogon ambiguus</i>		10-30	1.4
Amaranthaceae	<i>Aerva javanica</i>	*	<10	1

Family	Taxon	Status	Cover (%)	Height (m)
Cleomaceae	<i>Cleome viscosa</i>		10-30	0.8
Fabaceae	<i>Vachellia farnesiana</i>	*	<2	1.2
Poaceae	<i>Triodia epactia</i>		30-70	0.8
Boraginaceae	<i>Trichodesma zeylanicum</i>		<10	0.2
Amaranthaceae	<i>Amaranthus undulatus</i>		<2	0.3
Cucurbitaceae	<i>Trichosanthes cucumerina</i>		<2	-
Phyllanthaceae	<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>		<10	1.6
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	0.6
Poaceae	<i>Paspalidium tabulatum</i>		<10	0.4
Commelinaceae	<i>Commelina ensifolia</i>		<2	0.3
Malvaceae	<i>Abutilon fraseri</i>		<2	0.2
Goodeniaceae	<i>Scaevola spinescens</i>		<2	1.3
Malvaceae	<i>Brachychiton acuminatus</i>		<10	6
Menispermaceae	<i>Tinospora smilacina</i>		<2	-
Fabaceae	<i>Rhynchosia minima</i>		<2N	0.1
Araliaceae	<i>Trachymene oleraceae</i>		<2N	0.1
Amaranthaceae	<i>Gomphrena cunninghamii</i>		<2	0.2
Malvaceae	<i>Sida</i> sp.		<2	0.2
Cucurbitaceae	<i>Cucumis variabilis</i>		<2	-
Poaceae	<i>Themeda triandra</i>		<10	0.3
Caryophyllaceae	<i>Polycarpaea longiflora</i>		<2	0.3
Poaceae	<i>Dactyloctenium radulans</i>		<2	0.1
Malvaceae	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>		<2	0.5
Fabaceae	<i>Crotalaria medicaginea</i> var. <i>neglecta</i>		<2	0.1
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>		<2	0.3
Oleaceae	<i>Jasminum didymum</i> subsp. <i>lineare</i>		<2	1
Nyctaginaceae	<i>Boerhavia coccinea</i>		<2	0.4
Poaceae	<i>Cenchrus ciliaris</i>	*	<2	0.4
Malvaceae	<i>Triumfetta appendiculata</i>		<2	0.4
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2	0.2

Releve 5

R5	VT:	VT04
Type:	Releve	
Date:	8/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7849292	-20.62603232
Landform and slope:	Claypan	
Drainage:	Poor	
Aspect	Flat	
Soil colour & type:	Sandy loam Brown	
Surface Component		
Vegetation condition:	Good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds	
Leaf litter:	<2%	
Bare ground	11-30%	

Photo 111



Family	Taxon	Status	Cover (%)	Height (m)
Poaceae	<i>Triodia angusta</i>		70-100	0.3
Amaranthaceae	<i>Aerva javanica</i>	*	<10	0.6
Poaceae	<i>Cenchrus ciliaris</i>	*	10-30	0.4
Cleomaceae	<i>Cleome viscosa</i>		<2	0.3
Aizoaceae	<i>Trianthema turgidifolia</i>		<2	0.3
Poaceae	<i>Dactyloctenium radulans</i>		<2	0.1

Family	Taxon	Status	Cover (%)	Height (m)
Chenopodiaceae	<i>Neobassia astrocarpa</i>		<2	0.4
Fabaceae	<i>Indigofera colutea</i>		<2N	0.2
Asteraceae	<i>Pterocaulon sphaeranthoides</i>		<2	0.3
Chenopodiaceae	<i>Tecticornia</i> <i>?pterygosperma</i>		<2	0.4
Chenopodiaceae	<i>Tecticornia indica</i> subsp. <i>?bidens</i>		<2	0.4
Cyperaceae	<i>Cyperus bulbosus</i>		<10	0.3
Malvaceae	<i>Sida fibulifera</i>		<2	0.2
Fabaceae	<i>Acacia ampliceps</i>		<2	2
Chenopodiaceae	<i>Threlkeldia diffusa</i>		<2	0.4
Poaceae	<i>Sporobolus virginicus</i>		<2	0.1
Poaceae	<i>Paspalidium tabulatum</i>		<10	0.3

Releve 6

R6	VT:	VT07
Type:	Releve	
Date:	8/03/2020	Described by: Erin Lynch
Co-ordinates:	116.7846883	-20.62546682
Landform and slope:	Stony Plain Gentle	
Drainage:	Good	
Aspect	South	
Soil colour & type:	Sandy loam Brown	
Surface Component	Stony 40%	
Vegetation condition:	Good	
Fire age & intensity:	Old (6+ yr)	
Disturbances:	weeds, previous clearing	
Leaf litter:	<2%	
Bare ground	11-30%	

Photo 108



Family	Taxon	Status	Cover (%)	Height (m)
Fabaceae	<i>Acacia ampliceps</i>		10-30	2
Fabaceae	<i>Acacia bivenosa</i>		<10	2
Poaceae	<i>Triodia epactia</i>		10-30	0.8
Poaceae	<i>Triodia angusta</i>		<10	0.3
Goodeniaceae	<i>Scaevola spinescens</i>		<2	1.1

Family	Taxon	Status	Cover (%)	Height (m)
Chenopodiaceae	<i>Rhagodia eremaea</i>		<2	1
Chenopodiaceae	<i>Enchylaena tomentosa</i>		<2	0.6
Poaceae	<i>Dactyloctenium radulans</i>		<2	0.1
Poaceae	<i>Cenchrus ciliaris</i>	*	10-30	0.4
Euphorbiaceae	<i>Euphorbia coghlanii</i>		<2	0.3
Aizoaceae	<i>Trianthema turgidifolia</i>		<10	0.4
Malvaceae	<i>Abutilon lepidum</i>		<2	0.3
Cleomaceae	<i>Cleome viscosa</i>		<2N	0.3
Scrophulariaceae	<i>Myoporum montanum</i>		<2	1.5
Lauraceae	<i>Cassytha capillaris</i>		<10	-
Chenopodiaceae	<i>Neobassia astrocarpa</i>		<10	0.5
Cyperaceae	<i>Cyperus bulbosus</i>		<10	0.5
Malvaceae	<i>Sida fibulifera</i>		<2	0.3
Amaranthaceae	<i>Aerva javanica</i>	*	<10	0.6
Asteraceae	<i>Pterocaulon sphaeranthoides</i>		<2	0.3
Fabaceae	<i>Senna notabilis</i>		<2	0.2
Poaceae	<i>Paspalidium tabulatum</i>		<10	0.3
Frankeniaceae	<i>Frankenia ?pauciflora</i>		<2	0.4
Poaceae	<i>Sporobolus virginicus</i>		<2	0.2
Fabaceae	<i>Indigofera colutea</i>		<N	0.2
Aizoaceae	<i>Trianthema triquetrum</i>		<2	0.1
Chenopodiaceae	<i>Threlkeldia diffusa</i>		<10	0.4
Solanaceae	<i>Solanum lasiophyllum</i>		<2N	0.3
Boraginaceae	<i>Trichodesma zeylanicum</i>		<2N	0.4

Conservation significant flora records within the survey area

Taxon Name	WA Conservation Status	No. of plants	Latitude	Longitude
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7784	-20.6229
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7784	-20.6229
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7784	-20.6229
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7784	-20.6229
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7785	-20.6228
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7784	-20.6225
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7785	-20.6225
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7785	-20.6225
<i>Rhynchosia bungarensis</i>	Priority 4	8	116.7785	-20.6226
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7785	-20.6226
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7786	-20.6227
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7786	-20.6228
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7787	-20.6228
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7788	-20.6225
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7784	-20.6223
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7785	-20.6222
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7785	-20.6222
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7784	-20.6221
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7795	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7796	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7796	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7796	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7796	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7799	-20.6218
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7799	-20.6218
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7800	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7801	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7801	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7802	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7802	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7802	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	10	116.7802	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7803	-20.6213
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7806	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7805	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7804	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7804	-20.6218
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7804	-20.6219
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7803	-20.6219
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7803	-20.6218
<i>Rhynchosia bungarensis</i>	Priority 4	7	116.7803	-20.6218
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7803	-20.6217

Taxon Name	WA Conservation Status	No. of plants	Latitude	Longitude
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7802	-20.6218
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7802	-20.6218
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7785	-20.6230
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7784	-20.6230
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7787	-20.6229
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7787	-20.6229
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7786	-20.6228
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7787	-20.6228
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7788	-20.6227
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7788	-20.6227
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7788	-20.6225
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7795	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7795	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7795	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7791	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7791	-20.6219
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7791	-20.6219
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7791	-20.6221
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7793	-20.6223
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7793	-20.6223
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7794	-20.6222
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7794	-20.6222
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7795	-20.6222
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7795	-20.6222
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7794	-20.6222
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7794	-20.6221
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7794	-20.6220
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7794	-20.6220
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7795	-20.6220
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7795	-20.6220
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7795	-20.6220
<i>Rhynchosia bungarensis</i>	Priority 4	8	116.7796	-20.6220
<i>Rhynchosia bungarensis</i>	Priority 4	8	116.7797	-20.6219
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7797	-20.6219
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7799	-20.6219
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7802	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7803	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7808	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7807	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7806	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7805	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7805	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7804	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7805	-20.6217

Taxon Name	WA Conservation Status	No. of plants	Latitude	Longitude
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7806	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7807	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7808	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7808	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7808	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7807	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	7	116.7807	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7807	-20.6217
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7809	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	7	116.7809	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7809	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7809	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7809	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7810	-20.6216
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7810	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7810	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7811	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7812	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	1	116.7812	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	5	116.7813	-20.6215
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7813	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7813	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	7	116.7814	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7814	-20.6214
<i>Rhynchosia bungarensis</i>	Priority 4	6	116.7815	-20.6213
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7815	-20.6213
<i>Rhynchosia bungarensis</i>	Priority 4	3	116.7816	-20.6213
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7792	-20.6224
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7791	-20.6224
<i>Rhynchosia bungarensis</i>	Priority 4	2	116.7790	-20.6224
<i>Rhynchosia bungarensis</i>	Priority 4	4	116.7790	-20.6225
<i>Terminalia supranitifolia</i>	Priority 3	2	116.7789	-20.6226
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7785	-20.6224
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7787	-20.6223
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7789	-20.6216
<i>Terminalia supranitifolia</i>	Priority 3	2	116.7795	-20.6215
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7796	-20.6216
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7795	-20.6217
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7794	-20.6217
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7794	-20.6217
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7793	-20.6218
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7791	-20.6220
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7798	-20.6219
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7799	-20.6218

Taxon Name	WA Conservation Status	No. of plants	Latitude	Longitude
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7799	-20.6219
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7809	-20.6214
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7805	-20.6216
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7806	-20.6218
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7811	-20.6214
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7816	-20.6216
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7830	-20.6224
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7822	-20.6224
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7821	-20.6227
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7818	-20.6224
<i>Terminalia supranitifolia</i>	Priority 3	2	116.7806	-20.6224
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7791	-20.6224
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7791	-20.6223
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7790	-20.6228
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7785	-20.6227
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7785	-20.6227
<i>Terminalia supranitifolia</i>	Priority 3	1	116.7818	-20.6223
<i>Vigna triodiophila</i>	Priority 3	5	116.7806	-20.6216
<i>Vigna triodiophila</i>	Priority 3	1	116.7806	-20.6216

Flora likelihood of occurrence assessment guidelines

Likelihood of occurrence	Guideline
Known	Species recorded within survey area from field survey results.
Likely	Species previously recorded within 10 km and large areas of suitable habitat occur in the project area.
Possible	Species previously recorded within 10 km and areas of suitable habitat occur/may occur in the project area.
Unlikely	Species previously recorded within 10 km, but suitable habitat does not occur in the project area.
Highly unlikely	Species not previously recorded within 5 km, suitable habitat does not occur in the project area and/or the project area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Source information - desktop searches

PMST – DEE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area

TPFL and WAHERB – records of threatened flora from TPFL and WAHERB database searches within the study area

NM – DBCA *NatureMap* (accessed February 2020)

Flora likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within the study area

Family	Taxon	Status		Description (if available) (WA Herbarium 1998–, DEE 2018)	Likelihood of occurrence	Source
		EPBC Act	WC Act /DBCA			
Celastraceae	<i>Stackhousia clementii</i>		P3	Dense broom-like perennial, herb, to 0.45 m high. Flowers green/yellow/brown. Skeletal soils. Sandstone hills.	Likely There are two records from 2002 located within the survey area in the King Bay-Hearson's Cove tidal inlet. This area was systematically searched during the survey however no individuals were recorded.	NatureMap WAHerb
Combretaceae	<i>Terminalia supranitifolia</i>		P3	Spreading, tangled shrub or tree, 1.5-3 m high. Flowers green-yellow, May or July or December. Sand. Among rocks.	Present This species was recorded within the survey area growing in association with	NatureMap WAHerb

Family	Taxon	Status		Description (if available) (WA Herbarium 1998–, DEE 2018)	Likelihood of occurrence	Source
		EPBC Act	WC Act /DBCA			
					the rock piles on the rocky hills.	
Cyperaceae	<i>Schoenus punctatus</i>		P3	Shortly rhizomatous, tufted perennial, grass-like or herb (sedge), ca 0.6 m high. Flowers brown during August. Occurs along watercourses.	Unlikely There is no suitable habitat within the survey area. The closest known record is approximately 7.5 km north of the survey area.	NatureMap WAHerb
Fabaceae	<i>Rhynchosia bungarensis</i>		P4	Compact, prostrate shrub, to 0.5 m high. Fl. yellow. Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall.	Present This species was recorded multiple times within the survey area growing along the edges of the large rock piles along the rocky hills.	NatureMap WAHerb TPFL
Fabaceae	<i>Vigna triodiophila</i>		P3	Annual, climbing herb. Vine spreading 1 m through <i>Triodia angusta</i> . Flowers yellow.	Present This species was recorded within the <i>Triodia epactia</i> grasslands associated with the rocky hills.	NatureMap WAHerb TPFL
Poaceae	<i>Eragrostis surreyana</i>		P3	Tufted annual. Clumped herb to 2 cm high to 7 cm wide. Occurs in seepage/wetland areas on boulder/rocky areas. Stoney soil of red-brown sandy-clay. <i>Cyperus vaginatus</i> , <i>Schoenus falcatus</i> , <i>Fimbristylis rara</i> , <i>Schoenoplectus littoralis</i> , <i>Eragrostis</i> sp. Mt Montague, sedgeland – tussock grassland with <i>Stemodia grossa</i> , <i>Pluchea rubellifera</i> , <i>Styloidium fluminense</i> , <i>Peplidium</i> sp. E herbland.	Unlikely There is no suitable habitat within the survey area. The closest known record is approximately 7 km north of the survey area.	NatureMap WAHerb

Appendix E – Fauna survey results

Fauna species list

Trapping results

Likelihood of Occurrence Assessment

Species Recorded during the survey

Family	Species	Common Name	Status	Recorded
Birds				
Accipitridae	<i>Haliastur indus</i>	Brahminy Kite		X
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle		X
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite		X
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite		X
Alaudidae	<i>Mirafra javanica</i>	Horsefields Bushlark		X
Anatidae	<i>Anas gracilis</i>	Grey Teal		X
Anatidae	<i>Anas superciliosa</i>	Black Duck		X
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron		X
Ardeidae	<i>Egretta garzetta</i>	Little Egret		X
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow		X
Artamidae	<i>Artamus minor</i>	Little Woodswallow		X
Artamidae	<i>Artamus nigrogularis</i>	Pied Butcherbird		X
Cacatuidae	<i>Cacatua sanguinea</i>	Little Corella		X
Cacatuidae	<i>Eolophus roseicapilla</i>	Galah		X
Campephagidae	<i>Lalage sueurii</i>	White-winged Triller		X
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		X
Charadriidae	<i>Charadrius ruficapillus</i>	Red-capped Plover		X
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Jabiru		X
Cisticolidae	<i>Cisticola exilis</i>	Golden-headed Cisticola		X
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon		X
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing		X
Columbidae	<i>Geophaps plumifera</i>	Spinifex Pigeon		X
Columbidae	<i>Geopelia cuneata</i>	Diamond Dove		X
Corvidae	<i>Corvus orru</i>	Torresian Crow		X
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo		X
Cuculidae	<i>Centropus phasianinus</i>	Pheasant Coucal		X
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch		X
Estrildidae	<i>Emblema pictum</i>	Painted Finch		X
Eurostopodidae	<i>Eurostopodus argus</i>	Spotted Nightjar		X
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel		X
Falconidae	<i>Falco berigora</i>	Brown Falcon		X
Falconidae	<i>Falco longipennis</i>	Hobby Falcon		X
Halcyonidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher		X
Halcyonidae	<i>Todiramphus chloris</i>	Pilbara Collared Kingfisher		X
Hirundinidae	<i>Petrochelidon areil</i>	Fairy Martin		X
Laridae	<i>Larus novaehollandiae</i>	Silvergull		X
Laridae	<i>Hydroprogne caspia</i>	Caspian Tern	IA, Ma, Mi	X
Laridae	<i>Gelochelidon nilotica</i>	Gull-billed Tern	IA, Ma, Mi	X
Maluridae	<i>Malurus lamberti</i>	Variiegated Fairy-wren		X
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark		X

Family	Species	Common Name	Status	Recorded
Meliphagidae	<i>Manorina flavigula</i>	Yellow-throated Miners		X
Meliphagidae	<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater		X
Meliphagidae	<i>Lichenostomus virescens</i>	Singing Honeyeater		X
Meliphagidae	<i>Epthianura tricolor</i>	Crimson Chat		X
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark		X
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit		X
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican		X
Phasianidae	<i>Coturnix ypsilophora</i>	Brown Quail		X
Psittacidae	<i>Melopsittacus undulatus</i>	Budgerigar		X
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck		X
Ptilonorhynchidae	<i>Ptilonorhynchus guttatus</i>	Western Bowerbird		X
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt		X
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper	IA, Ma, Mi	X
Scolopacidae	<i>Calidris ruficollis</i>	Red-necked Stint	IA, Ma, Mi	X
Scolopacidae	<i>Tringa nebularia</i>	Common Greenshank	IA, Ma, Mi	X
Strigidae	<i>Ninox novaeseelandiae</i>	Southern Boobook		X
Turnicidae	<i>Turnix velox</i>	Little Button Quail		X
Reptiles				
Agamidae	<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon		X
Agamidae	<i>Ctenophorus isolepis</i>	Military Dragon		X
Agamidae	<i>Gowidon longirostris</i>	Long-snouted Water Dragon		X
Agamidae	<i>Pogona mitchelli</i>	Pilbara Bearded Dragon		X
Diplodactylidae	<i>Diplodactylus galaxias</i>	Northern Pilbara Beak-faced Gecko		X
Diplodactylidae	<i>Lucasium stenodactylum</i>	Sand Plain Gecko		X
Diplodactylidae	<i>Oedura fimbria</i>	Western Marbled Velvet Gecko		X
Diplodactylidae	<i>Strophurus elderi</i>	Jeweled Gecko		X
Elapidae	<i>Acanthophis wellsei</i>	Pilbara Death Adder		X
Elapidae	<i>Demansia p. cupriceps</i>	Yellow-faced Whip Snake		X
Elapidae	<i>Pseudechis australis</i>	Mulga snake		X
Elapidae	<i>Pseudonaja mengdeni</i>	Gwardar		X
Gekkonidae	<i>Gehyra crypta</i>	Cryptic Gecko		X
Gekkonidae	<i>Gehyra peninsularis</i>	Burrup Rock Gecko		X
Gekkonidae	<i>Gehyra punctata</i>	Spotted Rock Gecko		X
Gekkonidae	<i>Heteronotia binoei</i>	Bynoe's Gecko		X
Pygopodidae	<i>Delma pax</i>	Peace Delma		X
Pygopodidae	<i>Lialis burtonis</i>	Burtons Legless Lizard		X
Pythonidae	<i>Antaresia perthensis</i>	Pygmy Python		X
Pythonidae	<i>Antaresia stimpsoni</i>	Stimsons Python		X
Pythonidae	<i>Liasis olivaceus barroni</i>	Pilbara Olive python	Vu, Vu	X

Family	Species	Common Name	Status	Recorded
Scincidae	<i>Cryptoblepharus ustulatus</i>	Ruset Snake-eyed Skink		X
Scincidae	<i>Ctenotus pantherinus</i>	Leopard Skink		X
Scincidae	<i>Ctenotus serventyi</i>	Serventy's Ctenotus		X
Scincidae	<i>Ctenotus saxatilis</i>	Rock Skink		X
Scincidae	<i>Menetia greyii</i>	Common Dwarf Skink		X
Scincidae	<i>Menetia surda</i>	Western Dwarf Skink		X
Scincidae	<i>Morethia ruficauda</i>	Firetail Skink		X
Scincidae	<i>Lerista bipes</i>	Western Two-toed Slider		X
Scincidae	<i>Lerista jacksoni</i>	Jackson's Three-toed Slider		X
Scincidae	<i>Notoscincus ornatus</i>	Ornate Snake-eyed Skink		X
Scincidae	<i>Tiliqua multifasciata</i>	Central Blue Tongue		X
Typhlopidae	<i>Anilius grypus</i>	Northern Beaked Blind Snake		X
Varanidae	<i>Varanus acanthurus</i>	Ridge-tailed Monitor		X
Varanidae	<i>Varanus gouldii</i>	Goulds Monitor		X
Varanidae	<i>Varanus panopties</i>	Spotted Monitor		X
Amphibia				
Hylidae	<i>Cyclorana maini</i>	Sheep Frog		X
Mammals				X
Canidae	<i>Canis lupis</i>	Dog	int	X
Canidae	<i>Vulpes vulpes</i>	Fox	int	X
Dasyuridae	<i>Dasykaluta rosamondae</i>	Kaluta		X
Dasyuridae	<i>Pseudantechinus woolleyae</i>	Wooley's Antechinus		X
Emballonuridae	<i>Taphozous georgianus</i>	Common Sheathtail Bat		X
Felidae	<i>Felis catus</i>	Cat	int	X
Macropodidae	<i>Macropus robustus</i>	Euro		X
Macropodidae	<i>Petrogale rothschildi</i>	Rothchilds Rock wallaby		X
Molossidae	<i>Austronomus australis</i>	White-striped Free-tailed Bat		X
Molossidae	<i>Chaerephon jobensis</i>	Northern Free-tailed Bat		Pr
Molossidae	<i>Mormopetrus ozimops cobourgianus</i>	North-western Free-tail Bat	P1	X
Molossidae	<i>Mormopetrus ozimops lumsdenae</i>	Northern Freetail Bat		Pr
Muridae	<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse	P4	X
Muridae	<i>Pseudomys delicatus</i>	Delicate mouse		X
Muridae	<i>Rattus rattus</i>	Black Rat	int	X
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna		X
Vespertilionidae	<i>Chalinolobus gouldii</i>	Goulds Wattled-bat		X
Vespertilionidae	<i>Scotorepens greyii</i>	Little Broad-nosed Bat		X
Vespertilionidae	<i>Vespadelus finlaysoni</i>	Inland Cave Bat		X

Key – X, species recorded, Pr, Probably the species based on bat call analysis, int, introduced species to Western Australia, (Vu) = Vulnerable under the EPBC Act and/ or BC Act, (Ma, Mi) = under the EPBC Act, (IA) = under the BC Act, (P1 and 4) = Priority 1 and 4 under DBCA. For breakdown of code meaning see Appendix B.

Trapping Program nights 5 to 7

Date	Night 5 - 8/3/2020															Night 6 - 9/3/2020															Night 7 - 10/3/2020																				
Common name	Site 1			Site 2			Site 3			Site 4			Site 5			Site 1			Site 2			Site 3			Site 4			Site 5			Site 1			Site 2			Site 3			Site 4			Site 5								
Reptiles	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird			
Ring-tailed Dragon									1																																										
Military Dragon						1																																													
Long-snouted Water Dragon																																																			
Pilbara Bearded Dragon																																																			
Northern Beaked Blind Snake									1																																										
Pygmy Python																																																			
Stimsons Python						1																																													
Olive python																																																			
Pilbara Death Adder																																																			
Yellow-faced Whip Snake																																																			
Mulga snake																																																			
Gwardar																		1			1																														
Northern Pilbara Beak-faced Gecko																																																			
Cryptic Gecko																																																			
Burru Rock Gecko																																																			
Spotted Rock Gecko																																																			
Bynoe's Gecko																																																			
Sand Plain Gecko						1																																													
Western Marbled Velvet Gecko																																																			
Jeweled Gecko																																																			
Peace Delma																																																			
Burtons Legless Lizard																																																			
Ruset Snake-eyed Skink																																																			
Leopard Skink																																																			
Serventy's Ctenotus						1																																													
Rock Skink									6						4			1						9			2			1			1						5						6						
Common Dwarf Skink			1			4												1			1																		1												
Western Dwarf Skink															1									2						1																					
Firetail Skink															1																																				
Western Two-toed Slider			2			8												1			5									2			5																		
Jackson's Three-toed Slider									1												1									1															1						
Ornate Snake-eyed Skink																																																			
Central Blue Tongue																																																			
Ridge-tailed Monitor																																																			
Goulds Monitor																																																			
Spotted Monitor																																																			
Amphibia																																																			

Trapping Program Night 8, camera, opportunistic and species totals

Date	Night 8 - 11/3/2020																	
Common name	Site 1			Site 2			Site 3			Site 4			Site 5			Cameras	Opportunistic	Totals
Reptiles	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird	Trap	Act.	Bird			
Ring-tailed Dragon																	9	21
Military Dragon																	2	3
Long-snouted Water Dragon																	2	4
Pilbara Bearded Dragon																2		2
Northern Beaked Blind Snake																		2
Pygmy Python																	1	3
Stimsons Python																		3
Olive python																	1	2
Pilbara Death Adder																		1
Yellow-faced Whip Snake																		1
Mulga snake																		1
Gwardar																	1	6
Northern Pilbara Beak-faced Gecko																		2
Cryptic Gecko																		2
Burru Rock Gecko										3							34	88
Spotted Rock Gecko																	25	86
Bynoe's Gecko																		4
Sand Plain Gecko																	2	11
Western Marbled Velvet Gecko																		3
Jeweled Gecko																		1
Peace Delma																		1
Burtons Legless Lizard	1																	2
Ruset Snake-eyed Skink																	6	12
Leopard Skink																	1	2
Serventy's Ctenotus				2													2	8
Rock Skink	1						6			1			3				7	75
Common Dwarf Skink	2			4													2	30
Western Dwarf Skink																		11
Firetail Skink																	1	6
Western Two-toed Slider				6														80
Jackson's Three-toed Slider													1					6
Ornate Snake-eyed Skink																		1
Central Blue Tongue																	1	1
Ridge-tailed Monitor																		1
Goulds Monitor																	1	1
Spotted Monitor																2		2
Amphibia																		

Parameters of fauna likelihood of occurrence assessment

Assessment outcome	Description
Known	The species was recorded or has been recorded recently by reputable observers
Likely	Species are likely to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area. OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as unlikely include those species previously recorded within 5 km of the survey area however: <ul style="list-style-type: none"> - There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. - The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR Those species that have a known distribution overlapping with the survey area however: <ul style="list-style-type: none"> - There is limited habitat in the survey area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). - The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered highly unlikely to occur in the survey area include: <ul style="list-style-type: none"> - Those species that have no suitable habitat within the survey area. - Those species that have become locally extinct, or are not known to have ever been present in the region of the survey area.

Source information - desktop searches

PMST – DAWE PMST to identify fauna listed under the EPBC Act potentially occurring within the survey area

DBCA – DBCA 2020. WA Government, DBCA Threatened and Priority fauna rankings

NM – DBCA NatureMap (accessed February 2020)

Fauna likelihood of occurrence assessment

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
Birds						
<i>Actitis hypoleucos</i>	Common Sandpiper	IA	Ma, Mi	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. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering et al. 2007; Higgins & Davies 1996). 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. Birds sometimes venture into grassy areas adjoining wetlands (Higgins & Davies 1996).	Known	NM PMST
<i>Anous stolidus subsp. pileatus</i>	Common Noddy	IA	Ma, Mi	The Common Noddy is found in tropical and sub-tropical seas off the west, north and east coasts of Australia, from the Abrolhos Islands in WA to the islands of the Great Barrier Reef in Qld, as well as Norfolk and Lord Howe Islands. Some are seen almost annually in NSW as far south as Sydney. It also ranges across tropical parts of the Pacific, Indian and Atlantic Oceans (DAWE 2020).	Unlikely, Habitat not present for this species	NM PMST
<i>Arenaria interpres</i>	Ruddy Turnstone	IA	Ma, Mi	In Australasia, the Ruddy Turnstone is mainly found on coastal regions with exposed rock coast lines or coral reefs. It also lives near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can, however, be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats (Higgins & Davies 1996).	Unlikely, typically this species prefers coastal habitats. Species may opportunistically use the site	NM PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
<i>Calidris canutus</i>	Red Knot	IA, En	Ma, Mi, En	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. They rarely use inland lakes or swamps (Higgins & Davies 1996).	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	PMST
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	IA	Ma, Mi	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgeland and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands, and coastal areas with much beachcast seaweed. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996).	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	PMST
<i>Calidris alba</i>	Sanderling	IA	Ma, Mi	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. Rarely, they are recorded in near-coastal wetlands, such as lagoons, hypersaline lakes, salt ponds and	Unlikely, typically this species prefers coastal habitats. Species may opportunistically use the site	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				samphire flats. There are rare inland records from sandy shores of ephemeral brackish lakes and brackish river-pools (Higgins & Davies 1996). They roost on/behind: bare sand high on the beach, clumps of washed-up kelp, coastal dunes, rocky reefs and ledges (Higgins & Davies 1996). Breeding habitat is usually open ground, sometimes on raised hummocks or ridges, in the Arctic tundra of Greenland, Canada and Siberia (Cramp 1985; Pringle 1987).		
<i>Calidris melanotos</i>	Pectoral Sandpiper	IA	Ma, Mi	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. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands (Higgins & Davies 1996).	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	PMST
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	IA	Ma, Mi	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. They have also been recorded in creeks, swamps and lakes near the coast, particularly those with bare mudflats or sand exposed by receding water. They often favour mud among, or fringed by, mangroves, particularly on the seaward side and sometimes occur in estuaries edged by saltmarsh. They are rarely recorded inland. Foraging occurs on exposed flats of soft mud or wet sand at edges of coastal and near-coastal wetlands, often around channels on mudflats or in accumulated mud in swales between shell banks. In northern Australia, they forage in soft mud near mangroves, but may remain on same muddy section, even though fresher substrate may be exposed by the receding tide. They also forage in shallow water	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				on muddy edges of ponds. They roost on the banks of sheltered sandy, shelly or shingly beaches (Higgins & Davies 1996). They nest on the ground, frequently in the top of a tussock (Cramp 1985).		
<i>Tringa stagnatilis</i>	Marsh Sandpiper	IA	Ma, Mi	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 (Higgins & Davies 1996), although surveys in Kakadu National Park recorded more birds around shallow freshwater lakes than in areas influenced by tide (Bamford 1988). At the Top End they often use ephemeral pools on inundated freshwater and tidal floodplains (Higgins & Davies 1996).	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	PMST
<i>Tringa totanus</i>	Common Redshank	IA	Ma, Mi	The Common Redshank is found at sheltered coastal wetlands such as bays, river estuaries, lagoons, inlets and saltmarsh (with bare open flats and banks of mud or sand). They are also found around salt lakes, freshwater lagoons, artificial wetlands and saltworks and sewage farms (Higgins & Davies 1996). The Common Redshank has been observed feeding in shallow water, on wet bare mud or sand, or on algal deposits, round the edges of wetlands, near rocks or samphire (Higgins & Davies 1996). They have been recorded roosting on small elevated areas such as estuarine sandbars and muddy islets surrounded by water (Higgins & Davies 1996).	Unlikely, some habitat present however is rare and opportunistic visitor	PMST
<i>Calidris ferruginea</i>	Curlew Sandpiper	IA, Cr	Ma, Mi, Cr	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. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996)	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	NM PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
<i>Calidris ruficollis</i>	Red-necked Stint	IA	Ma, Mi	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. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats. They sometimes use flooded paddocks or damp grasslands. They have occasionally been recorded on dry gibber plains, with little or no perennial vegetation (Higgins & Davies 1996).	Known	NM PMST
<i>Calidris subminuta</i>	Long-toed Stint	IA	Ma, Mi	In Australia, 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. It has also been observed at open, less vegetated shores of larger lakes and ponds and is common on muddy fringes of drying ephemeral lakes and swamps. The Long-toed Stint also frequents permanent wetlands such as reservoirs and artificial lakes. They are uncommon, but not unknown, at tidal estuaries, saline lakes, saltponds and bore swamps (Higgins & Davies 1996). The Long-toed Stint forages on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around the edges of wetlands. They occasionally feed on open water, well away from the shore; this is more common in drying ephemeral wetlands. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water. It also roosts in small depressions in the mud (Higgins & Davies 1996).	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
<i>Calidris tenuirostris</i>	Great Knot	Cr	Ma, Mi, Cr	In Australasia, the species typically prefers sheltered coastal habitats, with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, saltlakes and non-tidal lagoons. The Great Knot rarely occurs on inland lakes and swamps (Higgins & Davies 1996). Typically, the Great Knot roosts in large groups in open areas, often at the waters edge or in shallow water close to feeding grounds (Higgins & Davies 1996; Rogers 2001). It is known that in hot conditions, waders prefer to roost where a damp substrate lowers the local temperature (Rogers 1999). A group of approximately 8610 birds have been recorded roosting at an inland claypan near Roebuck Bay in north-west Western Australia (Collins et al. 2001).	Likely, Habitat is present for the species, only in the floodplain, drainage line areas	NM PMST
<i>Charadrius leschenaultii</i>	Greater Sand Plover	IA, Vu	Ma, Mi, Vu	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 and inshore reefs, rock platforms, small rocky islands or sand cays on coral reefs. They are occasionally recorded on near-coastal saltworks and saltlakes, including marginal saltmarsh, and on brackish swamps (Stewart et al. 2007).	Unlikely, typically this species prefers coastal habitats. Species may opportunistically use the site	NM PMST
<i>Charadrius mongolus</i>	Lesser Sand Plover	IA, En	Ma, Mi, En	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. In north-western Australia, the species appears to use the Port Hedland saltworks in preference to nearby beaches. The species is seldom recorded away from the coast, at margins of lakes, soaks and swamps associated with artesian bores (Marchant & Higgins 1993).	Unlikely, typically this species prefers coastal habitats. Species may opportunistically use the site	NM PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
<i>Charadrius veredus</i>	Oriental Plover	IA	Ma, Mi	Immediately after arriving in non-breeding grounds in northern Australia, Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. Thereafter they usually 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 (Storr 1980).	Likely, some habitat is present for this species, only within the floodplain and drainage lines	PMST
<i>Glareola maldivarum</i>	Oriental Pratincole	IA	Ma, Mi	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 (Lloyd and Lloyd 1991).	Likely, some habitat is present for this species, only within the floodplain and drainage lines	PMST
<i>Falco peregrinus</i>	Peregrine Falcon	OS		The Peregrine Falcon is seen occasionally anywhere in the south-west of WA. It is found everywhere from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions. The species nests primarily on ledges of cliffs, shallow tree hollows, and ledges of building in cities. (Morcombe 2004).	Likely, Foraging habitat is present for the species throughout the survey area, however no breeding habitat is present.	NM
<i>Fregata ariel</i>	Lesser Frigatebird	IA	Ma, Mi	The Lesser Frigatebird is said to be the most common and widespread frigatebird in Australian seas (DAWE 2020). It is common in tropical seas, breeding on remote islands, including Christmas Island in the Indian Ocean in recent years. These birds are most likely to be seen from the mainland prior to the onset of a tropical cyclone, and once this abates they disappear again.	Unlikely, No habitat present for this species, is primarily an open sea species.	NM PMST
<i>Gelochelidon nilotica</i>	Gull-billed Tern	IA	Ma, Mi	The Gull-billed Tern is nomadic or migratory species in Australia. Gull-billed Terns are found in freshwater swamps, brackish and salt	Known	NM

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands, where resources are favorable. They are only rarely found over the ocean. The Gull-billed Tern. Although essentially an inland species, outside breeding season it shows a distinct preference for saltmarshes and lagoons near the coast. Movements are not fully understood but it is common and widespread in Australia (Morcombe 2004).		
<i>Hydroprogne caspia</i>	Caspian Tern	IA	Ma, Mi	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. In offshore areas the species prefers sheltered situations, particularly near islands, and is rarely seen beyond reefs (DAWE 2020).	Known	NM PMST
<i>Sterna dougallii</i>	Roseate Tern	IA	Ma, Mi	The Roseate Tern occurs in coastal and marine areas in subtropical and tropical seas. The species inhabits rocky and sandy beaches, coral reefs, sand cays and offshore islands. Birds rarely occur in inshore waters or near the mainland, usually venturing into these areas only accidentally, when nesting islands are nearby. In WA, the subspecies is regularly recorded north from Mandurah to around Eighty Mile Beach. Around the Kimberley coastline, the subspecies occurs at scattered sites, north to the Bonaparte Archipelago and possibly further. The subspecies used to be a sporadic visitor to the southwest, but occurs regularly at present. In addition, breeding colonies have been established on Lancelin Island and Second Rock (DAWE 2020).	Unlikely, typically marine exclusive, however use could be opportunistic, limited and irregular.	PMST
<i>Limosa limosa</i>	Black-tailed Godwit	IA	Ma, Mi	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	Likely, some habitat is present for this species, only within the floodplain and	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				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. There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows. They also use lagoons in sewage farms and saltworks (Higgins & Davies 1996).	drainage lines when water is present	
<i>Limosa lapponica</i> (all sub-species)	Bar-tailed Godwit	IA, Vu or Cr	Ma, Mi, Vu or Cr	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. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips, although it is commonly recorded in paddocks at some locations overseas (Marchant & Higgins 1993).	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	NM PMST
<i>Macronectes giganteus</i>	Southern Giant petrel	IA	MA, Mi, En	The Southern Giant Petrel is a marine bird and occurs over open seas and inshore waters in Antarctic and subtropical waters. In summer it occurs predominantly in sub-Antarctic to Antarctic waters, usually below 60° S in the South Pacific and southeast Indian Oceans. During winter most adults disperse widely and are rare in the southern waters of the Indian Ocean. The Southern Giant Petrel breeds on the Antarctic Continent, Peninsula and islands, and on sub-Antarctic islands and South America (Morcombe 2004).	Unlikely, No habitat present for this species, is primarily an open sea species.	PMST
<i>Numenius madagascariensis</i>	Eastern Curlew	IA, Cr	Ma, Mi, Cr	The Eastern Curlew is a large non-breeding migratory shorebird, found commonly along the north coast of Western Australia, but rarely south of Shark Bay. The species is found along the coastline from Barrow Island and Dampier Archipelago, through the Kimberley in WA to the NT. It is found in estuaries, bays, harbours, inlets and coastal lagoons, saltworks and sewerage farms, areas (e.g. intertidal mudflats or sandflats fringed by mangroves) often with beds of seagrass and occasionally on ocean beaches, coral reefs, rock platforms and rocky islets. The Eastern Curlew forages on soft, sheltered, intertidal sand- or mudflats, often near mangroves, on	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	NM PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				saltflats, saltmarshes, rock pools, coastal reefs and ocean beaches near the tideline. The species roosts in large flocks, separate from other waders on sandy spits and islets, dry beach sand near the high-water mark, among coastal vegetation (including low saltmarsh and mangroves) and occasionally on reef-flats, in the shallow water of lagoons, near-coastal wetlands, in trees and posts (Morcombe 2004).		
<i>Numenius minutus</i>	Little Curlew, Little Whimbrel	IA	Ma, Mi	When resting during the heat of day, the Little Curlew congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The species prefers pools with bare dry mud (including mudbanks in shallow water) and they do not use pools if they are totally dry, flooded or heavily vegetated (Higgins & Davies 1996). Birds may also rest in grassy, open woodlands and on bare blacksoil plains, or on dry or recently burnt grasslands on floodplains, which may be without vegetation for hundreds of metres, and occasionally on mudflats when nearby grasslands are unburnt, or around swamps. Resting has also been recorded under partly submerged vegetation. After freshwater pools dry up, roosting may occur in the shallows of reservoirs and the sea (Higgins & Davies 1996).	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	NM
<i>Numenius phaeopus</i>	Whimbrel	IA	Ma, Mi	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. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and salt fields (Higgins & Davies 1996). There are a small number of inland records from saline lakes and canegrass swamps (Jarman 1978). It has also been recorded in coastal dunes and on a football field (Smith & Chafer 1987).	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	NM PMST
<i>Phalaropus lobatus</i>	Red-necked Phalarope	IA	Ma, Mi	During the non-breeding period the Red-necked Phalarope occurs mainly at sea. It is commonly sighted in Australia from mid-October to	Unlikely, some habitat present	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				early-April, where it is recorded at both inland and coastal lakes/swamps, including highly saline waters and artificial wetlands notably saltworks. In WA the species has been seen on Rottneest Island, Pelican Point, the Swan River, Port Hedland Saltworks, the Eyre Bird Observatory and Hinds Lake Nature Reserve (DAWE 2020).	however is rare and opportunistic visitor	
<i>Oceanites oceanicus</i>	Wilson's Storm-petrel	IA	Ma, Mi	The Wilson's Storm-Petrel is a pelagic (marine) species distributed throughout most of the world's oceans. Its distribution stretches north through the mid-latitudes of the Northern Hemisphere and south through the oceans surrounding Australia and the Australian Antarctic Territory. A very small species that breeds in Antarctic waters (DAWE 2020)	Unlikely, No habitat present for this species, is primarily an open sea species.	NM
<i>Pandion cristatus</i>	Osprey, Eastern Osprey	IA	Ma, Mi	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging (Marchant & Higgins 1993). They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range, but may also occur on low sandy, muddy or rocky shores and over coral cays.	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	NM PMST
<i>Pezoporus occidentalis</i>	Night Parrot	En	En	The Night Parrot inhabits arid and semi-arid areas that are characterised by having dense, low vegetation. Based on accepted records, the habitat of the Night Parrot consists of Triodia grasslands in stony or sandy environments and of samphire and chenopod shrublands, including genera such as Atriplex, Bassia and Maireana, on floodplains and claypans, and on the margins of saltlakes, creeks or other sources of water (Parker 1980). It has also been observed to enter dense Muehlenbecki growth when flushed from a more typical habitat (Boles et al. 1994).	Highly Unlikely, the Burrup peninsular is not part of the species modelled distribution	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
<i>Pluvialis fulva</i>	Pacific Golden Plover	IA	Ma, Mi	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 <i>Sarcocornia</i> , 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. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass. Other terrestrial habitats inhabited include short (or, occasionally, long) grass in paddocks, crops or airstrips, or ploughed or recently burnt areas, and they are very occasionally recorded well away from water (Marchant & Higgins 1993).	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	NM PMST
<i>Pluvialis squatarola</i>	Grey Plover	IA	Ma, Mi	In non-breeding grounds in Australia, 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. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (Marchant & Higgins 1993).	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	NM PMST
<i>Ardenna pacificus</i>	Wedge-tailed Shearwater	IA	Ma, Mi	The wedge-tailed shearwater is a medium-large shearwater in the group referred to as a muttonbird. It is a pelagic, marine bird species known from tropical and subtropical waters of the Pacific and Indian Oceans. The species primarily breeds on Islands with one recorded site Rottneest Island (DAWE 2020).	Unlikely, No habitat present for this species, is primarily an open sea species.	NM PMST
<i>Calonectris leucomelas</i>	Streaked Shearwater	IA	Ma, Mi	The streaked shearwater is a large, pale-faced shearwater that breeds in on islands off the southern Russian Far East, Japan, east China, Korea and Taiwan and migrates in the non breeding season to the waters between Papua New Guinea and Australia. The species	Unlikely, No habitat present for this species, is primarily	NM PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				rarely ventures south past the Kimberley with scattered records along the Pilbara coast (ALA 2020)	an open sea species.	
<i>Rostratula australis</i>	Australian Painted Snipe	En	En	The Australian Painted Snipe is rarely seen as it is extremely secretive, keeping to dense vegetation of swamps, emerging only in subdued light of dawn and dusk. The preferred habitat of this species includes surrounds and shallows of wetlands that are well vegetated with dense low cover (Morcombe 2004).	Likely, some habitat is present for this species, only within the floodplain and drainage lines when water is present	PMST
<i>Sternula nereis nereis</i>	Australian Fairy Tern	Vu	Vu	The habitat of the fairy tern is essentially marine, including sheltered coasts, bays, inlets, estuaries, coastal lagoons, ocean beaches but rarely out to sea or out of sight of land. They also inhabit wetlands near the coast including salt ponds and lakes. This species favours sites with sand spits and small sand islets in river mouth channels (Morcombe 2004).	Unlikely, No habitat present for this species, is primarily an open sea species, opportunistic use only.	PMST
<i>Thalasseus bergii</i>	Crested Tern	IA	Ma, Mi	Crested Terns occur singularly or in flocks in coastal areas, estuaries, inlets, islands and occasionally on large inland lakes or rivers. They are often seen perching with gulls on beaches, sand spits or jetties. Crested Terns are widespread from the south coast of Africa north to Asia, south to Australia and east to Polynesia. They also occur on many islands in the Indian and Pacific Oceans (DAWE 2020).	Likely, habitat is present for this species when water is present within the floodplain and drainage line habitats	NM
<i>Tringa brevipes</i>	Grey-tailed Tattler	IA, P4	Ma, Mi	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. In Moreton Bay, Queensland, it is most abundant in areas with dense beds of seagrass. In Tasmania it is also abundant in areas with seagrass beds. It is less often on open flat sandy beaches or sandbanks, especially around accumulated seaweed or isolated clumps of dead coral. It is occasionally found around near-coastal	Likely, habitat is present for this species when water is present within the floodplain and drainage line habitats	NM PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				wetlands, such as lagoons and lakes and ponds in sewage farms and saltworks. Inland records for the species are rare with sightings on river banks and the edges of rock pools (Higgins & Davies 1996).		
<i>Tringa nebularia</i>	Common Greenshank	IA	MA, Mi	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. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees (Higgins & Davies 1996).	Known	NM PMST
<i>Xenus cinereus</i>	Terek Sandpiper	IA	MA, Mi	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 (<i>Halosarcia</i> spp.). Birds are seldom near the edge of water, however, birds may wade into the water (Marchant & Higgins 1993). Occasionally, on sandy beaches, among seaweed and other debris and in rocky areas, Terek Sandpipers will use the supralittoral or upper littoral zone, where a film of water covers the sand. However, on exposed rock platforms, the species forages in the lower littoral zone and not the supralittoral or upper littoral zones (Marchant & Higgins 1993).	Likely, habitat is present for this species when water is present within the floodplain and drainage line habitats	NM PMST
<i>Hirundo rustica</i>	Barn Swallow	IA	Ma, Mi	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,	Unlikely, this species is a rare vagrant to Australia	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland (DAWE 2020).	and any use is irregular and opportunistic	
<i>Motacilla cinerea</i>	Grey Wagtail	IA	Ma, Mi	A migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	Unlikely, this species is a rare vagrant to Australia and any use is irregular and opportunistic	PMST
<i>Motacilla flava</i>	Yellow Wagtail	IA	Ma, Mi	A migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	Unlikely, this species is a rare vagrant to Australia and any use is irregular and opportunistic	PMST
<i>Apus pacificus</i>	Fork-tailed Swift	IA	Ma, Mi	In WA there are sparsely scattered records along the south coast, ranging from the Eyre Bird Observatory and west to Denmark. They are widespread in coastal and sub-coastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. This species is almost exclusively aerial, flying less than 1 m to at least 300 m above ground. This species is considered rare in the south-west region (DAWE 2020).	Unlikely, this species is strictly aerial very rarely utilising a terrestrial habitat	PMST
Mammals						
<i>Dasyurus hallucatus</i>	Northern Quoll	En	En	The Northern Quoll once occurred across the majority of northern Australia but its range has significantly contracted. It occurs in the Pilbara region but in disjunct populations. The Northern Quoll inhabits a range of vegetation associations but is especially abundant on dissected rocky escarpment and eucalypt woodland within 200 km of the coast. It is known to den in rock crevices and rock piles and favours rocky areas. They are predominantly nocturnal but are occasionally active during the day, particularly during the mating	Unlikely, habitat is present for this species however recent searches for the species have not found the species to be persisting on the Burrup Peninsular.	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				season and are known to have a large home range (Van Dyck and Strahan 2008).		
<i>Hydromys chrysogaster</i>	Water rat, Rakali	P4		The Water Rat lives in the vicinity of permanent bodies of fresh or brackish water, from sub-alpine streams to lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. It can travel considerable distance overland and is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck and Strahan 2008).	Unlikely, water is present in the survey area but it is seasonal and temporary.	DBCA
<i>Macroderma gigas</i>	Ghost bat	Vu	Vu	The Ghost Bat occurs in a wide range of habitats, and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost. It is patchily distributed across Australia, and is sensitive to disturbance (Van Dyck and Strahan 2008).	Unlikely, No cave are present in or around the survey area. The species is known north and east of Karratha due to caves and mine adits present.	PMST
<i>Rhinonictoris aurantia (Pilbara form)</i>	Pilbara leaf nosed bat	Vu	Vu	The Pilbara Leaf-nosed Bat roosts in deep caves or mines in the wet season and forages nearby. This species occurs in the Pilbara region where its populations are scattered and localised. There are a few known populations of this species in the western Pilbara, roosting in caves formed in gorges that dissect massive siliceous sedimentary geology. It is most often observed in flight over waterholes in gorges (Van Dyck and Strahan 2008). Optimal roosts are thought to occur in caves that form between ascending rock layers, where humidity is maintained from seeping groundwater (Van Dyck and Strahan 2008)	Unlikely, No cave are present in or around the survey area. The species is known north and east of Karratha due to caves present.	PMST
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse, Ngadji	P4		The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the Western Pebble-mound Mouse can be found on stony hillsides with hummocky grasslands and little or no soil. It constructs large mounds of pebbles on stony slopes which cover an area of 0.5-9.0 square metres. 'Active' mounds are characterized by volcano-like cones capped by 'craters' that mark occluded entrances to subterranean	Known, although all the mounds located appear old	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the survey area	Source
		BC Act	EPBC Act			
				burrow systems in which the mice live, often gregariously (Van Dyck and Strahan 2008)		
Reptiles						
<i>Liasis olivaceus subsp. barroni</i>	Pilbara Olive Python	Vu	Vu	The Olive Python (Pilbara subspecies) is a dull olive-brown to pale fawn or rich-brown python with a white underside and pale finely dotted lips. This species reaches an average size of 2.5 m but can grow up to 4 m long. The Olive Python's range is restricted to the Pilbara region, north Western Australia, and the Dampier Archipelago. Habitat consists of rocky escarpments, gorges and waterholes within the Pilbara region. The preferred microhabitats for this species are under rock piles, on top of rocks, and under spinifex as well as in man-made features such as overburden heaps, railway embankments and sewerage treatment ponds. The species' breeding season occurs from June to August, with males moving long distances in search of breeding females (Wilson and Swan 2017).	Known	PMST

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Appendix F – Bat Call Analysis

Bat Call Analysis

Bat call analysis – Craig Grabham

Ultrasonic survey

Bat calls were recorded during field surveys using in situ (stationary) full spectrum Song Meter (SM4 bat) detectors (Wildlife Acoustics). A total of 7 consecutive survey nights at approximately 11 hours each night was completed.

Bat call analysis and limitations

Call identification was also assisted by consulting distribution information for potential species (Armstrong 2011 and McKenzie et al various dates; Churchill 2008; Van Dyck et al. 2013), historical surveys and records from NatureMap. No reference calls were collected during the survey.

Data was processed and analysed using a combination of manual review and automated processes using Kaleidoscope Pro (Wildlife Acoustic, version 5.1.9) using the following process:

Files were downloaded from the units and saved to a hard drive and external hard drive (back up copy) following the survey for later processing and analysis

For compressed WAV4 files (full spectrum) collected using the Song Meter units, files were converted to standard WAV using the conversion function in Kaleidoscope Pro

For each night data was manually reviewed using Kaleidoscope from the first bat call detected for a period of approximately 120 minutes following civil twilight for, Northern Coastal Free-tail Bat, Pilbara Leaf-nosed Bat and Ghost Bat calls. During the manual process calls were the analysed by visually comparing the spectrogram (time-frequency graph) and call characteristics (e.g. peak frequency, characteristic frequency, pulse duration and call shape) with species call descriptions from published guidelines (e.g. Armstrong and Cole 2007; McKenzie and Bullen 2009 and 2012)

Data was then batch processed using Wildlife Acoustic Kaleidoscope signal parameter process. Further manual data review was also completed for validation purposes to accurately identify species.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape with the exception of the Pilbara Leaf-nosed Bat where at least two clear pulses was acceptable. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but may be used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call will be assigned a confidence rating (see Mills et al. 1996 & Duffy et al. 2000) as summarised below.

Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap, particularly poor quality calls or mixed species calls making it difficult to distinguish between species e.g. <ul style="list-style-type: none">• Taphozous georianus/ Taphozous hilli• Chalinolobus gouldii /Mormopterus ozimops cobourgianus

- Nyctophilus sp. The calls of Nyctophilus geoffroyi / daedalus/ arnhemensis.

The semi-automated analysis process does not always capture all ‘softer’ Pilbara Leaf-nosed Bat (those calls with a lower amplitude) and Ghost Bat calls and sometimes calls with few pulses. Noting these limitations the manual review of all files during step 3 of the analysis process each night ensured no early or emergence calls were missed. Furthermore, random manual checking of whole night revealed that very few if any Pilbara Leaf-nosed Bat calls were missed for the majority of the nights. Having said that both the Pilbara Leaf-nosed Bat and Ghost Bat need to be in close proximity to the bat detector to be recorded. The Ghost Bat call in particular is of low intensity making it difficult to detect with a bat detector therefore ultrasonic surveys should not be the primary means of surveying for this species.

Summary of results and survey effort

Approximately 9101 full spectrum WAV files were analysed (all sites all nights combined) of which approximately 45% were identified as bat call of some description. Five species were positively (Definite) identified of the 13 or so species that are known to occur from the locality of the study area. As many as two other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

Mormopetrus ozimops cobourgianus (P1 species listed under the *Biodiversity Conservation Act 2016 BC Act*) was definitely identified for four of the 7 survey nights. This. No other threatened species listed under the BC Act and *Environment Protection and Biodiversity Conservation Act 1999* were recorded (Definite) as a result of call analysis.

Summary of bat call analysis

Species	Date						
	5/3	6/3	7/3	8/3	9/3	10/3	11/3
Chaerephon jobensis			PR		PR	PR	
Taphozous georgianus	D	D	D	D	D	D	D
Chalinolobus gouldii		PR	D	PR		PR	PR
Mormopetrus ozimops cobourgianus (*P1)		D	D	D	D	D	
Scotorepens greyii	D	D	D		D		
Vespadelus finlaysoni	D	D	D	D	D	D	D
Mormopetrus ozimops lumsdenae/ Taphozous georgianus	SG	SG	SG	SG	SG	SG	SG
Number of species per night	3	4	5	3	4	3	2
Survey effort	11	11	11	11	11	11	11

Table Notes:

Total number of species recorded for each night/site is based on definite (D) identification only. See confidence rating above for e.g. D or Pr

* - species listed under the *WA Biodiversity Conservation Act 2016*.

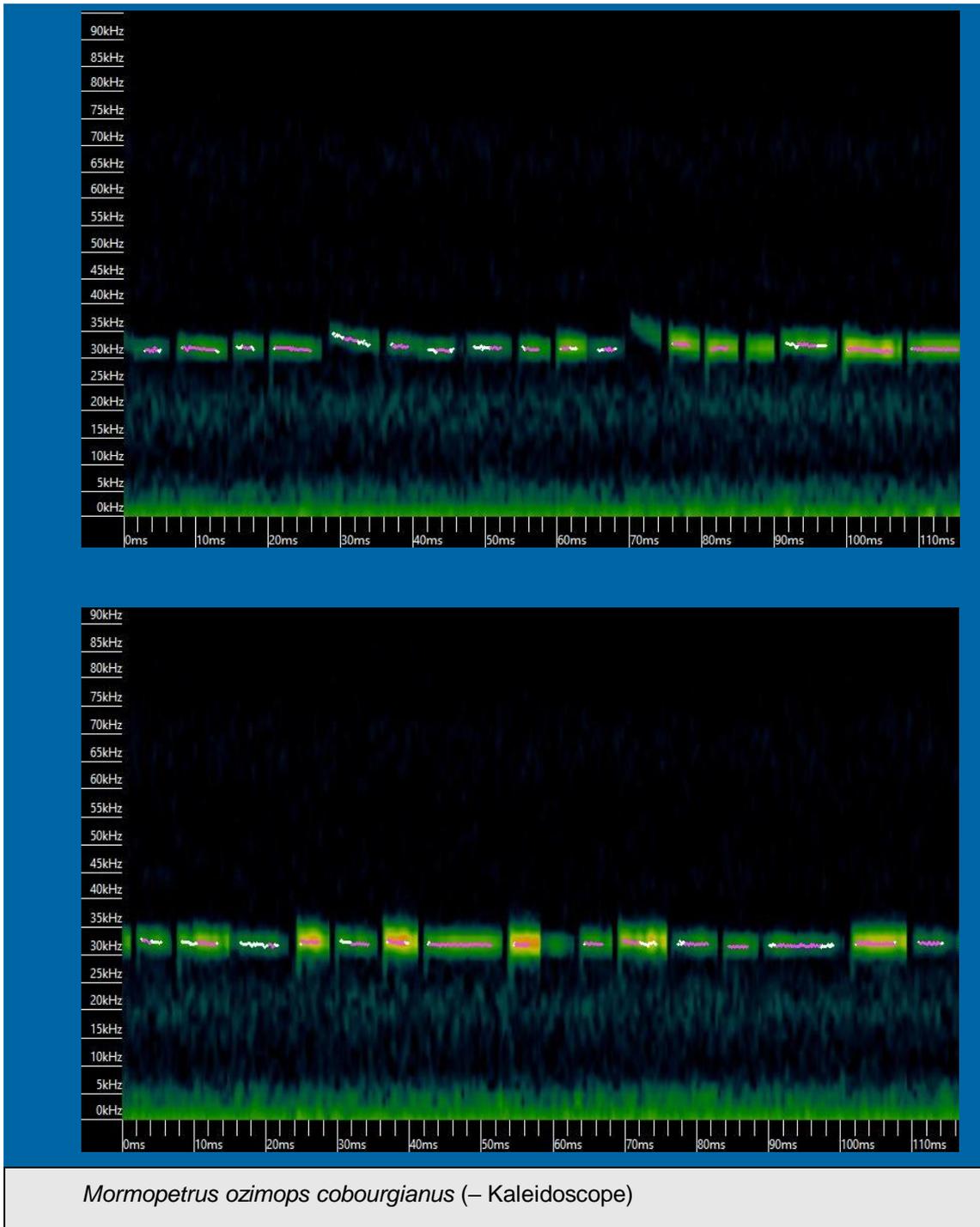
Survey effort: estimate of time between sunset and sunrise for a successful night of Anabat detection based on first and last files recorded.

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Appendix 1 - Example time-frequency graphs

Example time-frequency graph. Displayed in compressed mode



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**Yara Development Envelope
Archaeological Site Verifications,
Burrup Peninsula, WA – Report**

April 2020

Phil Czerwinski & Warren Fish

**Client:
Yara Pilbara
Attention: Luke Blackbourn
Manager – Public Affairs
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Spatial Data

Spatial data captured for any archaeological site in this report has been obtained by using a hand held GPS unit using the GDA94 coordinate system.

Acknowledgements

Land Access Solutions acknowledges and thanks the following individuals who assisted in this project:

- Todd Griffin (Griffin Spatial & Mapping)
- Peter Jeffries (MAC).

Abbreviations

Abbreviation	Definition
ACMC	Aboriginal Cultural Material Committee
AHIS	Aboriginal Heritage Inquiry System
DPLH	Department of Planning, Lands and Heritage
GPS	Global Positioning System
LAS	Land Access Solutions Pty Ltd
MAC	Murujuga Aboriginal Corporation

Executive Summary

This report documents an archaeological site verification program for the Yara Fertilisers development envelope, Burrup Peninsula, WA. The fieldwork involved archaeologists and an anthropologist from Land Access Solutions. Representatives from the Murujuga Aboriginal Corporation were also consulted during the project.

The objective of the fieldwork was to identify and record all archaeological sites within the Yara development envelope.

During the archaeological site verification program all nine previously recorded Aboriginal heritage places within the Yara development envelope were assessed. Eight of these places were relocated, and revised boundaries, site information and photographs taken. One place could not be relocated, even though the peg that marks the place was still visible.

This report makes the following recommendations.

- Yara avoid all of the nine Aboriginal heritage places if possible.
- Yara quarantine the hills in the north-western corner of the lease from development.
- Yara engage Aboriginal monitors for initial earthworks.
- MAC Rangers are involved in monitoring of the heritage places. This will enable knowledge transfer to occur and ensure the heritage values are protected for future generations.
- Yara continue to consult with MAC to ensure heritage values are managed.

Contents

Contents	4
List of Figures	6
List of Tables.....	7
1 Introduction	8
1.1 Area.....	8
1.2 Brief	8
1.3 Participation.....	8
2 Aboriginal Heritage Act 1972.....	10
3 Area.....	11
3.1 Environment	11
3.2 Aboriginal Heritage	11
3.2.1 DPLH Aboriginal Heritage Inquiry System.....	11
3.2.2 Previous Surveys	11
4 Methods.....	14
4.1 Aboriginal Consultation – Methods	14
4.1.1 Pre-Fieldwork Consultation	14
4.1.2 Post-Fieldwork Consultation	14
4.2 Archaeological Fieldwork - Methods.....	15
4.2.1 Aboriginal Sites - Definitions.....	15
4.2.2 Archaeological Sites – Significance	15
5 Results	16
5.1 Archaeological Fieldwork - Results	16
5.1.1 Discussion.....	16
5.1.2 Management	16
5.2 Aboriginal Consultation - Results	17
5.2.1 MAC Office	17
5.2.2 Community Visits.....	17
6 Summary & Recommendations.....	19
6.1 Summary	19
6.2 Recommendations	19
7 References	20
8 Appendix 1: Spatial Data	21
9 Appendix 2: Site Information	22
9.1 9838 (Artefact Scatter)	22

**Yara Development Envelope Archaeological Site
Verifications, Burrup Peninsula, WA – Report**

9.2	18612 (Engraving).....	24
9.3	18613 (Quarry)	26
9.4	20264 (Grinding Patch)	28
9.5	20265 (Engraving).....	30
9.6	20266 (Engraving).....	32
9.7	20894 (Engraving).....	34
9.8	20895 (Engraving).....	37
9.9	20897 (Quarry)	40

List of Figures

Figure 1: Yara development envelope – area & results.....	9
Figure 2: 20894 – engraving of a map / ‘scorpion’.....	18
Figure 3: 20895 – engraving of a cultural design / ‘boomerang’	18
Figure 4: 9838 – view of site	23
Figure 5: 9838 – artefacts.....	23
Figure 6: 18612 – view of site	25
Figure 7: 18612 – original site photo	25
Figure 8: 18613 – view of site	27
Figure 9: 18613 – artefacts	27
Figure 10: 20264 – view of site.....	29
Figure 11: 20264 – grinding patch	29
Figure 12: 20265 – view of site.....	31
Figure 13: 20265 – engraving.....	31
Figure 14: 20266 – view of site peg	33
Figure 15: 20894 – view of site.....	35
Figure 16: 20894 – engraving 1	35
Figure 17: 20894 – engraving 2	36
Figure 18: 20894 – engraving 3	36
Figure 19: 20895 – view of site.....	38
Figure 20: 20895 – original site photo	38
Figure 21: 20895 – engraving 1	39
Figure 22: 20895 – engraving 2	39
Figure 23: 20897 – view of site.....	41
Figure 24: 20897 – artefacts	41

List of Tables

Table 1: Yara development envelope - details.....	8
Table 2: Yara development envelope - DPLH sites	13
Table 3: Yara development envelope - archaeological sites.....	16
Table 4: Yara development envelope – spatial data	21
Table 5: 9838 – site details	22
Table 6: 18612 – site details	24
Table 7: 18613 – site details	26
Table 8: 20264 – site details	28
Table 9: 20265 – site details	30
Table 10: 20266 – site details.....	32
Table 11: 20894 – site details.....	34
Table 12: 20895 – site details.....	37
Table 13: 20897 – site details.....	40

1 Introduction

Land Access Solutions (LAS) has been engaged by Yara Fertilisers (Yara) to complete an archaeological site verification program for the Yara development envelope, Burrup Peninsula, WA (Figure 1).

1.1 Area

The Yara development envelope consists of two land parcels totalling approximately 14km east-north-west of Karratha. It and is 23.47 hectares in size.

1.2 Brief

LAS were engaged to fulfil the following brief.

- In consultation with representatives from the Murujuga Aboriginal Corporation (MAC), undertake an archaeological site verification program of the Yara development envelope.
- Record the location, and describe the archaeological sites, within the Yara development envelope.
- If satisfied the archaeological material meets criteria under Section 5 of the AHA, clearly determine the extent of the site, and complete a recording of archaeological features, using a systematic method of site recording.

1.3 Participation

The fieldwork was completed over one fieldtrip (Table 1).

CONSULTATION & FIELDWORK DETAILS	
Fieldwork Dates	23-25/3/2020
MAC Consultants*	Tootsie Daniels
	Vince Adams
	Terry Dale
	Keith Churnside
	Jimmy Horace
Yara Representatives	Mark Bradley
LAS Archaeologists	Phil Czerwinski
	Warren Fish

* Due to the coronavirus pandemic, consultation was restricted (see Section 4.1 for details)

Table 1: Yara development envelope - details

Yara Development Envelope Archaeological Site Verifications, Burrup Peninsula, WA – Report



Figure 1: Yara development envelope – area & results

2 Aboriginal Heritage Act 1972

All Aboriginal Sites within Western Australia are protected under the *Aboriginal Heritage Act 1972* (AHA). An Aboriginal site is defined under Section 5 of the AHA. For archaeological sites, Section 5(a) & 5(c) have the most relevance.

(a) Any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present.

(c) Any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State.

It is an offence under Section 17 of the AHA to excavate, destroy, damage, conceal or in any way alter any Aboriginal site without prior consent, under Section 18 of the AHA, from the Minister of Aboriginal Affairs. Penalties apply for breaches of the AHA.

For the administration of Section 18 of the AHA, the Aboriginal Cultural Materials Committee (ACMC) makes recommendations to the Minister of Aboriginal Affairs regarding whether a place meets criteria under Section 5 of the AHA and, where relevant, whether impacts to Aboriginal Sites should occur. The Minister of Aboriginal Affairs must be informed by these recommendations prior to granting or not granting consent to use the land where that use will impact Aboriginal Sites. Under Section 39(2&3) of the AHA, the ACMC use a set of standardised criteria in the evaluation of Aboriginal Sites.

For a full version of the AHA, refer to the following link: (http://www.austlii.edu.au/au/legis/wa/consol_act/aha1972164/).

3 Area

3.1 Environment

The Yara development envelope is located within the granophyre hills, hummocks and boulders of the Burrup Peninsula. The main vegetation in this area is spinifex grass, with occasional kurrajong trees growing amongst the granophyre outcrops. Creeks within the area are vegetated by numerous eucalyptus tree species and herbaceous plants.

3.2 Aboriginal Heritage

3.2.1 DPLH Aboriginal Heritage Inquiry System

A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System (AHIS) identified thirty-two previously recorded Aboriginal heritage places with boundaries overlapping the Yara development envelope (Table 2).

Of these thirty-two places, nine are Registered Sites (meaning the ACMC has assessed these as places to which the AHA applies), nineteen are Lodged (meaning the places are yet to be assessed by the ACMC), and three are Stored Data (meaning these places have been assessed as not being Aboriginal Sites under the AHA). One place (DPLH #23323) falls into none of these categories, and has the site status of "Contact DAA".

Desktop analysis of these previous site recordings identified eighteen of the thirty-two DPLH AHIS places have potential to be within the Yara development footprint. This is based on the fact that three of the places have been assessed as not Aboriginal Sites (#18611, #18614, & 18616), six of the places have been salvaged under a Section 18 consent under the AHA (#9635, #18611, #18614, #18616, #18617, & #21922), many of these places were recorded on other parts of the Burrup Peninsula (e.g. #23383, #23402, & 23763), and one covers the whole of the Burrup Peninsula (#23323) but has an unclear site status. Excluding the hills in the northwest of the Yara development envelope excludes a further nine DHPL AHIS places; leaving nine DPLH AHIS places to be verified during the current fieldwork.

3.2.2 Previous Surveys

Several archaeological and ethnographic surveys have been undertaken over the Yara development envelope. Two of these were broad scale regional archaeological studies of the Burrup Peninsula (DAS 1984, Vinnicombe 1997), while four reports are relevant to the Burrup (now Yara) Fertilisers plant (AIC 2001a, AIC 2001b, O'Connor 2001, Quartermaine 2003a, Quartermaine 2003b, and Quartermaine 2003c). The archaeological reports by Quartermaine relate to the salvage of six archaeological sites within the fertiliser plant and infrastructure corridor footprint.

**Yara Development Envelope Archaeological Site
Verifications, Burrup Peninsula, WA – Report**

DPLH SITE ID	SITE NAME	SITE STATUS	SITE TYPE	WITHIN YARA DEVELOPMENT ENVELOPE
9073	ROCK SHOT	Registered Site	Engraving, Other	NO
9215	HAUL ROAD SOUTH 06.	Registered Site	Artefacts / Scatter, Engraving, Grinding Patches / Grooves, Water Source, Other	NO
9635	FIRE QUARRY	Registered Site	Artefacts / Scatter	NO
9806	KING BAY EAST Q	Registered Site	Engraving, Man-Made Structure	NO
9807	KING BAY EAST R	Registered Site	Artefacts / Scatter, Engraving, Grinding Patches / Grooves, Man- Made Structure, Quarry	NO
9838	SMALL SITE	Lodged	Artefacts / Scatter	YES
18611	Burrup Fertiliser / Field Site 1	Stored Data	Artefacts / Scatter, Midden / Scatter	N/A
18612	DRD 130	Lodged	Engraving	YES
18613	DRD 134	Lodged	Artefacts / Scatter, Engraving, Quarry	YES
18614	DRD 135	Stored Data	Artefacts / Scatter	N/A
18616	DRD 138	Stored Data	Artefacts / Scatter	N/A
18617	BF/EFS 1 (relocated site)	Registered Site	Engraving	NO
19157	DRD 71	Lodged	Engraving, Other	NO
19230	DRD 131	Lodged	Engraving	NO
19232	DRD 133	Lodged	Engraving	NO
20264	Burrup Fertiliser Infrastructure Corridor 1	Lodged	Grinding Patches / Grooves	YES
20265	Burrup Fertiliser Infrastructure Corridor 2	Lodged	Engraving	YES
20266	Burrup Fertiliser Infrastructure Corridor 3	Lodged	Engraving	YES
20267	Burrup Fertiliser Infrastructure Corridor 4	Lodged	Engraving	NO

**Yara Development Envelope Archaeological Site
Verifications, Burrup Peninsula, WA – Report**

DPLH SITE ID	SITE NAME	SITE STATUS	SITE TYPE	WITHIN YARA DEVELOPMENT ENVELOPE
20269	Burrup Fertiliser Infrastructure Corridor 6	Lodged	Engraving	NO
20270	Burrup Fertiliser Infrastructure Corridor 7	Lodged	Engraving	NO
20271	Burrup Fertiliser Infrastructure Corridor 8	Lodged	Engraving	NO
20276	Burrup Fertiliser Infrastructure Corridor 13	Lodged	Grinding Patches / Grooves	NO
20894	BF / FS 03-1	Lodged	Engraving	YES
20895	BF / FS 03-2	Lodged	Engraving	YES
20896	BF / FS 03-3	Lodged	Engraving	NO
20897	BF / FS 03-4	Lodged	Quarry	YES
21922	BF/EFS 1 (Relocated 01/09/2003)	Lodged	Engraving	NO
23323	Burrup Peninsula, Murujuga	Contact DAA	Artefacts / Scatter, Ceremonial, Engraving, Fish Trap, Grinding Patches / Grooves, Historical, Man-Made Structure, Midden / Scatter, Modified Tree, Mythological, Quarry, Rockshelter, Skeletal Material / Burial, Arch Deposit, Camp, Hunting Place, Massacre	NO
23383	Woodside Pluto Area B 3	Registered Site	Man-Made Structure	NO
23402	Woodside Pluto Area B 22	Registered Site	Engraving	NO
23763	WGTO PB 138	Registered Site	Engraving	NO

Table 2: Yara development envelope - DPLH sites

4 Methods

4.1 Aboriginal Consultation – Methods

4.1.1 Pre-Fieldwork Consultation

Consultation about the site verification program was impacted by the Covid 19 pandemic, and the concern that the virus could be spread throughout the Aboriginal community by conducting consultations in a closed environment. This was a key determinant of MAC consultation methodology.

On 23 March 2018, MAC representatives Tootsie Daniels, Jimmy Horace, Vince Adams, Terry Dale, and Keith Churnside met with LAS archaeologists Warren Fish and Phil Czerwinski at the MAC office on the Burrup Peninsula. Concerns regarding potential virus transmission were raised and discussed, and it was agreed that requesting the Elders to conduct fieldwork under trying conditions was not ideal.

An overview of the site verification program was provided to the MAC representatives and it was decided that the LAS archaeologists would go in the field and verify all of the previously recorded sites. Pedestrian survey was seen to be redundant because the area had been surveyed numerous times in the past. The results of this fieldwork would then be brought back to the MAC representatives by way of a meeting once completed, and they would then have the opportunity to provide comment on the cultural aspects of the heritage sites, and present their views on the project in general. Individual sites could be visited if they presented particular issues or were of special significance.

4.1.2 Post-Fieldwork Consultation

During the archaeological fieldwork on 24 March 2020, a directive was given by Yara that no face to face meeting could be held between the relevant parties (these being MAC, Yara & LAS) due to social distancing measures. This meant that the planned post-fieldwork meeting was cancelled, and a work around was required to gain MAC representatives' views on the fieldwork results.

To overcome these obstacles, a strategy was developed where LAS would provide MAC with a presentation on the fieldwork results, and Vince Adams would then visit MAC representatives individually, present the material and record comment on the cultural aspects of the heritage sites. Mr Adams would then collate the viewpoints and provide feedback to Warren Fish.

The PowerPoint presentation to be circulated amongst MAC representatives was worked through with Vince Adams at the MAC office. Mark Bradley and Brian Howarth (Yara) were present. Mr Adams was comfortable with the information in the presentation and confirmed its adequacy in fulfilling the consultation process.

4.2 Archaeological Fieldwork - Methods

Prior to the fieldwork, the sites data was uploaded into handheld Garmin Global Positioning System (GPS) units for orientation in the field. Maps were printed to brief all participants. To verify the previously recorded sites, the previous site boundaries were uploaded into a handheld GPS unit for identification in the field. The DPLH site file for each site, and related survey reports, were reviewed to gain as much information about the place prior to the field inspection. Systematic coverage of the archaeological sites was then completed to ensure fulsome coverage within the site boundaries. Where the previous site boundary was spatially inaccurate, this was revised. Up to date site photos were then taken, and information about the intrasite components revised.

4.2.1 Aboriginal Sites - Definitions

For the purpose of this site verification program, and in keeping with legislative definitions and the LAS principals for recording Aboriginal Sites, an 'Aboriginal Site' is defined by LAS as follows.

A location with sufficient archaeological material, with adequate spatial context and environmental integrity, where it can unequivocally be demonstrated that techniques of Aboriginal hunter-gatherer subsistence technologies occurred at the location, and that the location is of "importance and significance" to further the knowledge of Aboriginal lifeways through archaeological investigation.

4.2.2 Archaeological Sites – Significance

Significance assessments are used to quantify whether an archaeological site has potential to provide information across a range of attributes accounting for scientific and/or social values. LAS assess archaeological significance as a spectrum of what attributes an archaeological site has that can contribute information to the understanding of past hunter-gatherer subsistence strategies, and also whether this significance has a contemporary context.

All archaeological sites recorded during the fieldwork are assigned a site significance based on the following considerations: Scientific Research Potential, Representativeness, Relatedness, Constituent Parts, Public Education Potential, Condition, Social Significance, and Aesthetic Value.

5 Results

5.1 Archaeological Fieldwork - Results

During the archaeological fieldwork all nine of the DPLH AHIS sites within the Yara development envelope were assessed (Table 3). Eight of these places were relocated, and revised boundaries, site information and photographs taken. One place could not be relocated, even though the peg that marks the place was still visible.

DPLH SITE ID	EASTING	NORTHING	SITE SIZE	SITE TYPE
9838	477399	7719635	42m x 16m	Artefact Scatter
18612	477211	7719383	9m x 8m	Engraving
18613	477107	7719414	25m x 20m	Quarry
20264	476912	7719418	10m x 9m	Grinding Patch
20265	476904	7719478	11m x 10m	Engraving
20266	476910	7719482	N/A	Engraving
20894	477504	7719620	33m x 8m	Engraving
20895	477498	7719723	14m x 7m	Engraving
20897	477430	7719675	33m x 17m	Quarry

Table 3: Yara development envelope - archaeological sites

5.1.1 Discussion

The archaeological sites within the Yara development envelope are all small and relatively modest based on known sites on the Burrup Peninsula (e.g. *Ngajarli* / Deep Gorge). The engraving sites contain a maximum of four motifs; none of which are outstanding examples of rock art when compared to other places with the same motifs. The artefact scatters and quarries are small, and do not have a wide variety of technological innovation for stone tool making.

5.1.2 Management

These archaeological sites should be managed in consultation with MAC. While the site boundaries of eight of the nine sites have been verified, there remains one site (#20266) that could not be located. This does not present a difficult management issue. 20266 is recorded as being on the same granophyre outcrop as #20265, and excising this outcrop from any development, along with having Aboriginal monitors present for earthworks, should protect any heritage values at this place.

Similarly, it is difficult to reconcile the exact locations of the reported three engravings recorded as being at #18613. Excising the granophyre outcrop the site is located on, plus having Aboriginal monitors on ground to monitor earthworks, should provide a way to ensure the heritage values of this place are managed.

5.2 Aboriginal Consultation - Results

As explained in Section 4.1, consultation with MAC was curtailed because of the COVID-19 pandemic. No site visits were held with MAC representatives; instead site information was provided to them as a presentation.

5.2.1 MAC Office

The PowerPoint presentation developed for this consultation was initially worked through with Vince Adams at the MAC office on 25 March 2020. Along with a general discussion about Aboriginal culture in the northwest WA, Adams provided some interesting insights into what the archaeology of the Yara development envelope means to him as an Aboriginal person. He was particularly articulate about the engravings, and how interpretation of individual motifs vary based on a person's world views. For example, the 'scorpion' recorded at site 20894 was a map (Figure 2), and how the 'boomerang' motifs are in fact related to designs painted on men's bodies during ceremonial activity (Figure 3).

Vince also viewed the spatial relationship of the archaeological sites as being a place where occupation was minimal, and that the area was not heavily used by Aboriginal people in the past, and was likely a place of temporary habitation where resources were gathered, and art made in an impromptu manner, as people travelled through the country to better watered and sheltered areas on Murujuga.

5.2.2 Community Visits

The post-fieldwork community consultation was completed by Vince Adams. Mr Adams travelled to the MAC representatives to meet them in person, and provided them with a copy of the PowerPoint presentation. The results of this consultation were unanimous and centred around the following:

- No rock art be relocated;
- Hills to the north-west of the lease not to be developed;
- Support for the project provided above two points taken into account; and
- Aboriginal monitors be present during ground disturbing activities.



Figure 2: 20894 – engraving of a map / 'scorpion'



Figure 3: 20895 – engraving of a cultural design / 'boomerang'

6 Summary & Recommendations

6.1 Summary

Desktop study of Aboriginal heritage survey reports has highlighted the Yara development envelope has previously been covered by numerous heritage surveys, both archaeological and ethnographic. Desktop analysis of the previously recorded DPLH Aboriginal heritage sites shows that, of potentially thirty-two sites, nine of these sites are located within the Yara development envelope. The site verification fieldwork relocated, remapped and updated site information for eight of these nine sites, with one site not being re-located. Consultation with MAC representatives acknowledged these sites as being of cultural importance, and should not be disturbed. Management options discussed with MAC representatives identified that excluding the sites from the development area, and having Aboriginal monitors engaged during initial earthworks provide the necessary tools to manage Aboriginal heritage values of the sites and the land.

6.2 Recommendations

This report makes the following recommendations.

- Yara avoid all of the nine Aboriginal heritage places if possible.
- Yara quarantine the hills in the north-western corner of the lease from development.
- Yara engage Aboriginal monitors for initial earthworks.
- MAC Rangers are involved in monitoring of the heritage places. This will enable knowledge transfer to occur and ensure the heritage values are protected for future generations.
- Yara continue to consult with MAC to ensure heritage values are managed.

7 References

Aboriginal Heritage Act 1972 Western Australia
(http://www.austlii.edu.au/au/legis/wa/consol_act/aha1972164/)

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Vinnicombe, P. 1997 *Maitland Heavy Industry Estate: Aboriginal Heritage Survey*. Report prepared for Department of Resources Development

8 Appendix 1: Spatial Data

All spatial data is provided electronically.

FILE NAME	DATA DESCRIPTION
YARA DE ARCHAEOLOGICAL SITE VERIFICATIONS	PowerPoint presentation provided to MAC for community consultation
YF__Artefact_location_mgazn50	Point data for Aboriginal site features
YF__Heritage_sites_mgazn50	Polygon data for Aboriginal site boundaries
YF__Peg_location_mgazn50	Point data for recorded location for #20266
YF__Potential_Dev_areas_mgazn50.shp	Polygon for Yara development envelope area

Table 4: Yara development envelope – spatial data

9 Appendix 2: Site Information

9.1 9838 (Artefact Scatter)

Site ID	Small Site
DPLH ID	9838
Site Type	Artefact Scatter
Easting (GDA94 – Zone 50)	477399
Northing (GDA94 – Zone 50)	7719635
Site Measurements	42m x 16m
Site Area	538m ²
Maximum Artefact Density	5/m ²
Estimated Artefact Count	~100
Site Significance	Scientific / Condition

Table 5: 9838 – site details

9.1.1.1 Site Environment

9838 is located on a flat rocky pavement on the eastern side of a granophyre knoll. The site is bounded to the west by this knoll, and to the east by a shallow creek line that runs in a north south direction. Vegetation is spinifex grass and sparse, small grevillea trees. Ground surface visibility at the time of recording was low at around 20%.

9.1.1.2 Site Description

9838 was originally recorded by DAS (1984) and described as a “*dispersed scatter of primary flakes and cores which extends over an area of approximately 20m long (N-S) and 1.5 – 3m wide*”. The site was subsequently verified by Quartermaine (2003b), who noted “*the site is registered as a small artefact scatter at the eastern end of a low hill near a small gully. The site was marked within an area of 25 by 5 metres*”.

9838 is an artefact scatter (Figures 4-5). It contains stone artefacts made from locally available coarse grained dolerite. Artefacts include flakes, cores and broken pieces. Artefacts are generally large in size, which is a reflection of the coarse grained nature of the rock the artefacts are made from. No tools were found at the site. The site represents a reduction area where Aboriginal people made stone flakes to be transported away for use elsewhere.

9.1.1.3 Site Significance

This place has archaeological significance relevant to scientific research merit and condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.



Figure 4: 9838 – view of site



Figure 5: 9838 – artefacts

9.2 18612 (Engraving)

Site ID	DRD 130
DPLH ID	18612
Site Type	Engraving
Easting (GDA94 – Zone 50)	477211
Northing (GDA94 – Zone 50)	7719383
Site Measurements	9m x 8m
Site Area	56m ²
Engraving Count	1
Site Significance	Condition

Table 6: 18612 – site details

9.2.1.1 Site Environment

18612 is located on single boulder amongst a series of granophyre boulders. A shallow creek line runs to the west in a north south direction. Vegetation is spinifex grass and sparse, small grevillea trees. Ground surface visibility at the time of recording was excellent at around 90%.

9.2.1.2 Site Description

18612 was originally recorded by Vinnicombe (1997) as a single engraving. Quartermaine (2003b) subsequently recorded that “*this site is an engraving site on a low hill with outcropping rock*”, and that the site #18618 is a duplicate recording of 18612. Quartermaine (2003b) provides a photograph of the recorded place for this site, which was used to relocate the engraved boulder during the current fieldwork. The boulder recorded as this site had been pegged. Neither of the two previous recordings detail what the engraving is of.

18612 is an engraving site (Figures 6-7). It is difficult to determine what the engraving is of, since it is either very faint or a series of random / non-descript peckings.

9.2.1.3 Site Significance

This place has archaeological significance relevant to condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.



Figure 6: 18612 – view of site



Figure 7: 18612 – original site photo

9.3 18613 (Quarry)

Site ID	DRD 134
DPLH ID	18613
Site Type	Quarry
Easting (GDA94 – Zone 50)	477107
Northing (GDA94 – Zone 50)	7719414
Site Measurements	25m x 20m
Site Area	410m ²
Maximum Artefact Density	8/m ²
Estimated Artefact Count	~50
Site Significance	Scientific / Condition

Table 7: 18613 – site details

9.3.1.1 Site Environment

18613 is located on a low granophyre outcrop. A shallow creek line runs to the west of this outcrop in a north south direction. Vegetation is spinifex grass and sparse, small grevillea trees. Ground surface visibility at the time of recording was excellent at around 90%.

9.3.1.2 Site Description

18613 was originally recorded by Vinnicombe (1997) as containing three engravings, a quarry site and associated artefact scatter. Quartermaine (2003b) subsequently recorded that *“this site is an archaeological site containing engravings, quarry and artefact scatter. It is situated on the rocky top of a low hill approximately 80m north-west of DIA id 18612. Site dimensions are 40 by 30 metres”*. Quartermaine (2003b) provides a photograph of the recorded place for this site, which was used to relocate the site during the current fieldwork. Neither of the two previous recordings detail what the engravings are of.

18613 is a quarry site (Figures 8-9). The three engravings reportedly at this site were extensively searched for, but no engravings could be located within the DPLH site boundary for this place. The quarry and associated artefact scatter consists of granophyre boulders that have been used as cores, and have had large flakes removed. Artefacts include cores, flakes and broken pieces. No tools were found at the site. Whether the large flakes struck off the boulder cores were subsequently used as cores to produce smaller, more useable flakes for tools is likely.

9.3.1.3 Site Significance

This place has archaeological significance relevant to scientific research merit and condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.
- Pilbara-wide core reduction sequences.



Figure 8: 18613 – view of site



Figure 9: 18613 – artefacts

9.4 20264 (Grinding Patch)

Site ID	Burrup Fertiliser Infrastructure Corridor 1
DPLH ID	20264
Site Type	Grinding Patch
Easting (GDA94 – Zone 50)	476912
Northing (GDA94 – Zone 50)	7719418
Site Measurements	10m x 9m
Site Area	66m ²
Grinding Patch Count	1
Site Significance	Scientific / Condition

Table 8: 20264 – site details

9.4.1.1 Site Environment

20264 is located on single boulder amongst a series of granophyre boulders. Vegetation is spinifex grass and sparse, small grevillea trees. Ground surface visibility at the time of recording was excellent at around 90%.

9.4.1.2 Site Description

20264 was originally recorded by Quartermaine (DPLH site file 20264) as “*grinding patches... [located on a]...massive boulder or bedrock*”. The DPLH site file for 20264 provides a photograph of the recorded place for this site, which was used to relocate the boulder during the current fieldwork. This boulder, and another boulder nearby, had been pegged. An examination of the purported grinding patch, detailed by the photograph in the site file, identified this is not a grinding patch (the reported ground surface still retains an undulating surface at the micro level, and if used as a grinding surface these higher areas would have been bevelled off). Therefore the other pegged boulder with characteristics of being used as a grinding surface was recorded as the site location. This boulder is also closer to the location recorded for the site based on the DPLH AHIS.

20264 is a single grinding patch (Figures 10-11). It consists of a small ground surface on a flat section of a granophyre boulder. The grinding patch shows low-moderate abrasion from rock on rock rubbing, and was likely used as an opportunistic surface to grind seed such as those from spinifex grass.

9.4.1.3 Site Significance

This place has archaeological significance relevant to scientific research merit and condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.



Figure 10: 20264 – view of site



Figure 11: 20264 – grinding patch

9.5 20265 (Engraving)

Site ID	Burrup Fertiliser Infrastructure Corridor 2
DPLH ID	20265
Site Type	Engraving
Easting (GDA94 – Zone 50)	476904
Northing (GDA94 – Zone 50)	7719478
Site Measurements	11m x 10m
Site Area	78m ²
Engraving Count	1
Site Significance	Scientific / Condition

Table 9: 20265 – site details

9.5.1.1 Site Environment

20265 is located on top of a moderate sized granophyre knoll. Vegetation is spinifex grass, a kurrajong tree growing out of the knoll, and sparse, small grevillea trees. Ground surface visibility at the time of recording was excellent at 100%.

9.5.1.2 Site Description

20265 was recorded by Quartermaine (DPLH site file 20265) as an “engraving: motif... [located on a]...small boulder”. The DPLH site file for 20265 provides a photograph of the recorded place for this site, which was used to relocate the boulder during the current fieldwork. The boulder recorded as this site had been pegged.

20265 is a single engraving (Figures 12-13). It is an irregular circle shape that has been deeply pecked into the boulder surface. There is a moderate level of re-patination over the engraving.

9.5.1.3 Site Significance

This place has archaeological significance relevant to scientific research merit and condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.
- Aboriginal views on, and interpretation of, rock art.



Figure 12: 20265 – view of site



Figure 13: 20265 – engraving

9.6 20266 (Engraving)

Site ID	Burrup Fertiliser Infrastructure Corridor 3
DPLH ID	20266
Site Type	Engraving
Easting (GDA94 – Zone 50)	476910
Northing (GDA94 – Zone 50)	7719482
Site Measurements	0m x 0m
Site Area	0m ²
Engraving Count	0
Site Significance	N/A

Table 10: 20266 – site details

9.6.1.1 Site Environment

20266 is located on top of a moderate sized granophyre knoll. Vegetation is spinifex grass, a kurrajong tree growing out of the knoll, and sparse, small grevillea trees. Ground surface visibility at the time of recording was excellent at 100%.

9.6.1.2 Site Description

20266 was recorded by Quartermaine (DPLH site file 20266) as an “engraving: boomerang... [located on a]...fractured piece...1.5m west of site FS-02”. The DPLH site file for 20266 does not provides a photograph of the recorded place for this site, and based on the original recording notes no photograph was taken then. The boulder recorded as this site had been pegged (Figure 14).

The engraving reportedly at this site was extensively searched for, but no engravings could be located within the DPLH site boundary for this place.

9.6.1.3 Site Significance

Based on the current fieldwork this place does not contain any archaeological material. Therefore the place has no archaeological significance.



Figure 14: 20266 – view of site peg

9.7 20894 (Engraving)

Site ID	BF / FS 03-1
DPLH ID	20894
Site Type	Engraving
Easting (GDA94 – Zone 50)	477504
Northing (GDA94 – Zone 50)	7719620
Site Measurements	33m x 8m
Site Area	219m ²
Engraving Count	3
Site Significance	Scientific / Condition

Table 11: 20894 – site details

9.7.1.1 Site Environment

20894 is located amongst numerous granophyre boulders outcropping on a hilltop. Vegetation is spinifex grass and sparse, small grevillea trees. Ground surface visibility at the time of recording was moderate at around 70%.

9.7.1.2 Site Description

20894 was originally recorded by Quartermaine (2003c) as follows: *“This site is an engraving site consisting of two individual motifs on separate but adjoining boulders. They located on a low hill with outcropping rocks. The motifs are a boomerangs and a scorpion shaped engraving”*. Quartermaine (2003c) provides photographs of the recorded boulders at this site, which were used to relocate the boulders during the current fieldwork. The boulders had been pegged.

20894 is an engraving site (Figures 15-18). It contains the two previously recorded engravings, plus a bird track engraving on the same granophyre outcrop (this engraving is on the western side of the outcrop, whereas the other two engraved boulders are on the eastern side). All engravings have been pecked, with the bird track being abraded as well. Part of the ‘boomerang’ motif has disappeared when the rock on which it was executed has shattered, with this occurring prior to the previous site recording.

9.7.1.3 Site Significance

This place has archaeological significance relevant to scientific research merit and condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.
- Aboriginal views on, and interpretation of, rock art.



Figure 15: 20894 – view of site



Figure 16: 20894 – engraving 1



Figure 17: 20894 – engraving 2



Figure 18: 20894 – engraving 3

9.8 20895 (Engraving)

Site ID	BF / FS 03-2
DPLH ID	20895
Site Type	Engraving
Easting (GDA94 – Zone 50)	477498
Northing (GDA94 – Zone 50)	7719723
Site Measurements	14m x 7m
Site Area	77m ²
Engraving Count	4
Site Significance	Scientific / Condition

Table 12: 20895 – site details

9.8.1.1 Site Environment

20895 is located amongst numerous granophyre boulders located on a hilltop. Vegetation is spinifex grass and sparse, small grevillea trees. Ground surface visibility at the time of recording was moderate at around 70%.

9.8.1.2 Site Description

20894 was originally recorded by Quartermaine (2003c) as follows: *“This site is an engraving site consisting of an individual motif on a granophyre boulder. It is located on a low hill with outcropping rocks. The motif is a boomerang shaped engraving”*. Quartermaine (2003c) provides a photograph of the recorded boulder at this site, which was used to relocate the boulder during the current fieldwork. The boulder had been pegged.

20894 is an engraving site (Figures 19-22). It contains the previously recorded ‘boomerang’ engraving, plus an engraved upright boulder containing three motifs: the top one appears to be a baby turtle, the middle one is a bird track, and the bottom engraving is an infilled circle. All engravings have been pecked.

9.8.1.3 Site Significance

This place has archaeological significance relevant to scientific research merit and condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.
- Aboriginal views on, and interpretation of, rock art.



Figure 19: 20895 – view of site



Figure 20: 20895 – original site photo



Figure 21: 20895 – engraving 1



Figure 22: 20895 – engraving 2

9.9 20897 (Quarry)

Site ID	BF / FS 03-4
DPLH ID	20897
Site Type	Quarry
Easting (GDA94 – Zone 50)	477430
Northing (GDA94 – Zone 50)	7719675
Site Measurements	33m x 17m
Site Area	455m ²
Maximum Artefact Density	6/m ²
Estimated Artefact Count	~100
Site Significance	Scientific / Condition

Table 13: 20897 – site details

9.9.1.1 Site Environment

20897 is located on a large granophyre outcrop. A shallow creek line runs to the west of this outcrop in a north south direction. Vegetation is spinifex grass, a kurrajong tree growing out of the outcrop, and small grevillea trees. Ground surface visibility at the time of recording was excellent at 100%.

9.9.1.2 Site Description

20897 was originally recorded by Quartermaine (2003c) as follows: *“This site is a quarry and is situated 40 metres south-west of the registered site area on the west side of the access corridor. It covers an area of ten by twenty metres on a low granophyre outcrop (Plate 9). It contains a number of large cores and boulders with negative flake scars (Plate 10). Smaller cores and flakes were also noted”*. Quartermaine (2003c) provides photographs of this site, which were used to relocate the quarry during the current fieldwork.

20897 is a quarry site (Figures 23-24). The quarry consists of granophyre boulders that have been used as cores, and have had large flakes removed. Artefacts include cores, flakes and broken pieces. No tools were found at the site. Whether the large flakes struck off the boulder cores were subsequently used as cores to produce smaller, more useable flakes for tools is likely.

9.9.1.3 Site Significance

This place has archaeological significance relevant to scientific research merit and condition. The research potential of this site relates to the following analysis.

- Pilbara-wide Aboriginal settlement patterns.
- Pilbara-wide core reduction sequences.



Figure 23: 20897 – view of site



Figure 24: 20897 – artefacts