Ningaloo Lighthouse Development
Environmental Surveys

Minderoo

ecoscape

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Draft rev0	Lyn Atkins	 Bruce Turner Senior Environmental Scientist	 David Kaesehagen, Managing Director	17/08/2018
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Direct all inquiries to:
Ecoscape (Australia) Pty Ltd
9 Stirling Highway • PO Box 50 NORTH FREMANTLE WA 6159
Ph: (08) 9430 8955 Fax: (08) 9430 8977

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We would also like to acknowledge Arvid Hogstrum, District Manager, Exmouth District Parks and Wildlife Service, Department of Biodiversity, Conservation and Attractions for facilitating the approval of a Regulation 4 permit to enable part of the Jurabi Coastal Park to be included in the assessment.

SUMMARY

Minderoo has recently acquired the Ningaloo Lighthouse Tourist Park and associated freehold lands, and appointed Ecoscape to conduct a baseline environmental assessment of its lands and adjacent areas to identify the flora, vegetation and fauna values of the site. The adjacent lands included Unallocated Crown Land and parts of Jurabi Coastal Park, for which a Department of Biodiversity, Conservation and Attractions Regulation 4 permit was granted to permit survey.

The desktop assessment conducted prior to the field survey identified that:

- the survey area corresponds with the mapping of the Cape Range Subterranean Waterways wetland, listed in the Directory of Important Wetlands of Australia
- the survey area is included in Environmentally Sensitive Area mapping, most likely due to its proximity to conservation lands (including Jurabi Coastal Park, a small portion of which is included in the survey area, and Ningaloo Marine Park) or the wetland above
- no terrestrial Threatened or Priority Ecological Communities are known from nearby
- no Threatened Flora or Threatened Fauna species are known from nearby, and therefore none are expected to be associated with the survey area
- 23 Priority Flora species have been previously recorded from within 50 km of the survey area including one previously recorded from within it
- 40 conservation significant fauna species have been previously recorded from within 20 km of the survey area; 27 of these are birds protected under international agreements but without other conservation significance.

The field survey was conducted over 5.5 days during July 2018.

The survey area was considered to be represented by seven vegetation types based on a combination of structural vegetation types as mapped in the field and floristic groups. The vegetation types corresponded with the three major habitat types within the survey area:

- coastal zone; **AcRp shrubland** (*Acacia coriacea* and *Rhagodia preissii* shrubland) on stable (hind) beach dunes, merging into vegetation type **TeSlWa grassland** (*Triodia epactia*, *Spinifex longifolius* and *Whiteochloa airoides* grassland) on the more stable of the foredunes (above the high water mark)
- limestone hills of Cape Range; **Mc shrubland** (*Melaleuca cardiophylla* shrubland) on the Cape Range limestone slopes and crests, **AbSaAt shrubland** (*Acacia bivenosa, Senna artemisioides* and *Acacia tetragonophylla* shrubland) in gorges, **Ab shrubland** (*Acacia bivenosa* shrubland) on scree slopes, and **AbFb shrubland** (*Acacia bivenosa* and *Ficus brachypoda* shrubland) in the interzone between the Cape Range and beach
- red Pindan dunes; **BaDp shrubland** (*Banksia ashbyi* and *Daviesia pleurophylla* shrubland).

None of the recorded vegetation types are of conservation significance, however, vegetation type **BaDp shrubland** is considered to be locally and possibly regionally significant due to it corresponding with a restricted landform, having unique floristic composition and that it provides habitat for *Daviesia pleurophylla* (P2).

The vegetation condition ranged from Degraded to Excellent with most of the survey area in Very Good or Excellent condition (62.78%). Weeds, primarily Buffel Grass (**Cenchrus ciliaris*), were the main reason for vegetation being included in the lesser condition ratings (Good or lesser).

A total of 169 vascular flora species were recorded from the survey area, 10 of which were not identified to species level due to lack of diagnostic reproductive material. Six were confirmed as being of conservation significance, with a seventh considered highly likely to be of conservation significance, however, reproductive material would be required to confirm this. The recorded Priority Flora species were:

- *Daviesia pleurophylla* (P2) which was a characteristic species on the red Pindan dunes in vegetation type **BaDp shrubland**
- *Tinospora esiangkara* (P2) with two plants recorded
- *Corchorus ?congener* (not confirmed but considered likely, P3) from coastal dunes

- *Eremophila forrestii* subsp. *capensis* (P3) occurring occasionally on limestone in vegetation type **Mc shrubland**
- *Grevillea calcicola* (P3), one plant recorded in vegetation type Mc shrubland close to a previous record for this species
- *Stackhousia umbellata* (P3) that was a characteristic but not dominant species in vegetation type **Mc shrubland**
- *Brachychiton obtusilobus* (P4) associated with or near minor gorges on limestone.

Eight introduced species (weeds) were recorded, most commonly Buffel Grass (**Cenchrus ciliaris*). One Declared Pest plant and WONS species was recorded: **Tamarix aphylla*, however there are no management requirements in relation to its presence.

Five fauna habitat types were recorded: dune crests and dune swales on the red Pindan dunes; rocky hills and slopes, and sheltered gullies and minor caves associated with Cape Range limestone, and coastal dunes.

Forty six vertebrate fauna species were recorded, including two of conservation significance *Pandion haliaetus* (Osprey, protected under international agreements) and *Lerista allochira* (Cape Range Slider, P3 from very close to the survey area), and three introduced species (Feral Cat, Rabbit and Sheep).

1 INTRODUCTION

Minderoo has recently acquired the Ningaloo Lighthouse Holiday Park and adjacent freehold lands, and has commissioned Ecoscape to conduct a flora, vegetation and fauna survey of its lands and adjacent areas to identify the flora, vegetation and fauna values of the site.

1.1 PROJECT PURPOSE

The project purpose is to identify the flora, vegetation and fauna attributes of the area associated with the Ningaloo Lighthouse Holiday Park ('Holiday Park') and adjacent lands, particularly to identify significant aspects.

There are currently no detailed plans that would identify any particular future development impact areas.

1.1.1 PROJECT SCOPE

The scope of works is to:

- describe and map the vegetation, including assessing vegetation condition
- detail the flora of the survey area and identify locations of significant flora
- identify any significant flora or vegetation features that may be of interest from a development and tourism point of view
- identify the terrestrial fauna of the survey area
- document any other significant features that may be of interest.

Adjacent areas have been included in the survey as well as freehold land held by Minderoo in order to give local context to the survey.

1.2 SURVEY AREA

The survey area, located approximately 13 km north of Exmouth, is within the Shire of Exmouth and consists of Lots 1, 2 and 6 Yardie Creek Road and some adjacent Unallocated Crown Land (UCL) and immediately adjacent parts of the Jurabi Coastal Park. The survey area incorporates the decommissioned Vlamingh Head Lighthouse, which is located on UCL excised from Lot 1.

Lot 2 is largely occupied by the Ningaloo Lighthouse Holiday Park ('Holiday Park') that includes caravan and camp sites, and various bungalows and chalets with supporting infrastructure including swimming pool, administration, works areas and café.

The survey area occupies 112.20 ha.

Minderoo also requested an assessment of an area on UCL around Department of Defence lands approximately 1.5 km south of the main survey area, known as the 'southern survey area' in this report.

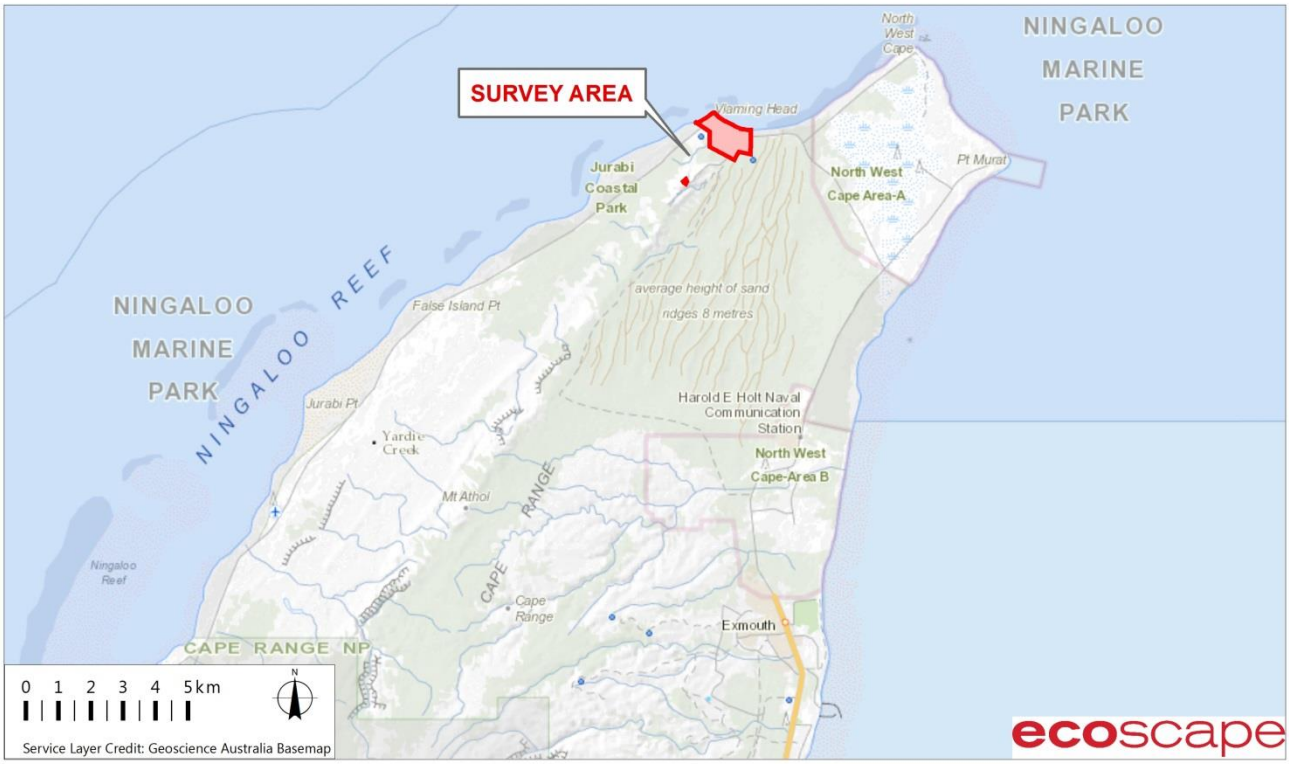

Figure 1: Survey area location

1.3 STATUTORY FRAMEWORK

This environmental assessment was conducted in accordance with Commonwealth and State legislation and guidelines:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Wildlife Conservation Act 1950* (WC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act, partly enacted)
- Department of Environment Water Heritage and the Arts (DEWHA 2009) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999.*

In addition, the Minister for the Environment has published lists of fauna and flora species in need of special protection because they are considered rare, likely to become extinct, or are presumed extinct. The current listings were published in the *Government Gazette* on 16 January 2018 (Government of Western Australia 2018b) and was taken into account.

As well as those listed above, the assessment complied with EPA requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2016c) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*, known as the *Flora and Vegetation Technical Guidance*
- EPA (2016d) *Technical Guidance - Terrestrial Fauna Surveys*, known as the *Fauna Technical Guidance*
- EPA (2016e) *Technical Guidance - Sampling Methods for Terrestrial Vertebrate Fauna*
- EPA (2016a) *Environmental Factor Guideline: Flora and Vegetation*
- EPA (2016b) *Environmental Factor Guideline: Terrestrial Fauna*.

1.3.1 WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia. It is anticipated to replace the WC Act in

2019, however, fully enacted most parts of the WC Act still apply. The parts of the BC Act currently in effect are listed on the Department of Biodiversity, Conservation and Attractions website (DBCA 2018, accessed 3 July 2018) and relate largely to definitions.

Threatened species (both flora and fauna) that meet the categories listed within the BC Act are highly protected and require authorisation by the Minister to take or disturb. These are known as Threatened Flora and Threatened Fauna. The conservation categories of critically endangered, endangered and vulnerable have been aligned with those detailed in the EPBC Act, as below.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the Act. These are known as specially protected species in the BC Act.

Threatened Ecological Communities are also protected under the BC Act and are categorised using the same criteria as threatened species.

At the time of writing this report, most provisions within the BC Act have not been yet been proclaimed, including those relating to species of conservation interest (Specially Protected Species) and Threatened Ecological Communities. As these are not included in the WC Act, there is currently no specific legal protection afforded to these within Western Australia beyond the usual protection of unlisted species and native vegetation under the *Native Vegetation Clearing Regulations* (Government of Western Australia 2004), unless they are protected under the Commonwealth EPBC Act. Threatened Flora and Threatened Fauna are protected under the provisions of the WC Act until the BC Act is fully enacted.

The DBCA is planning on publishing updated Biodiversity Conservation Regulations that underpin the licencing and management activities by mid-September 2018, with the Act coming into effect on 1 January 2019 (DBCA 2018, accessed 3 July 2018).

1.3.2 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

At a Commonwealth level, Threatened taxa are protected under the EPBC Act, which lists species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (detailed in **Table 11** in **Appendix One**).

The EPBC Act takes precedence over state legislation.

1.3.3 THREATENED AND PRIORITY FLORA

Conservation significant flora species are those that are listed as TF (Threatened Flora) and (within Western Australia) as PF (Priority Flora). TF species are listed as threatened by the Western Australian DBCA and protected under the provisions of the BC Act. Some State-listed TF are provided with additional protection as they are also listed under the Commonwealth EPBC Act.

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed in the BC Act, some may qualify as being of special conservation interest and these have a greater level of protection than unlisted species.

There are eight categories covering State-listed TF and PF species (DBCA 2017) which are outlined in **Table 12** in **Appendix One** (noting that the definitions for TF included in the BC Act have been aligned with those in the EPBC Act). PF for Western Australia are regularly reviewed by the DBCA whenever new information becomes available, with species status altered or removed from the list when data indicates that they no longer meet the requirements outlined in **Table 12**.

1.3.4 OTHER SIGNIFICANT FLORA

According to the *Flora and Vegetation Technical Guidance* (EPA 2016c) other than being listed as Threatened or Priority Flora, a species can be considered as significant if it is considered to be:

- locally endemic or association with a restricted habitat type (e.g. Groundwater Dependent Ecosystems, Sheet Flow Dependent Vegetation)
- a new species or has anomalous features that indicate a potential new species
- at the extremes of range, recently discovered range extensions (generally considered greater than 100 km or in a different bioregion), or isolated outliers of the main range
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

1.3.5 INTRODUCED FLORA

Introduced plant species, known as weeds, are plants that are not indigenous to an area and have been introduced either directly or indirectly (unintentionally) through human activity. Species are regarded as introduced if they are listed as 'alien' on *FloraBase* (Western Australian Herbarium [WAH] 1998-2018).

1.3.5.1 Weeds of National Significance (WONS)

At a national level there are thirty-two weed species listed as Weeds of National Significance (WONS) (Australian Government & DotEE 2018b; Weeds Australia 2012). The Commonwealth *National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* (2012) describes broad goals and objectives to manage these species.

1.3.5.2 Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Under the BAM Act, Declared Pests are listed as one of the three categories, or exempt:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility
- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage
- exempt (no category).

1.3.6 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

1.3.6.1 Nationally Listed Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (Government of Western Australia 2016b). At Commonwealth level, Threatened Ecological Communities (TECs) are protected under the Commonwealth EPBC Act. An ecological community may be categorised into one of the three sub-categories:

- Critically Endangered, if it is facing an extremely high risk of extinction in the wild in the immediate future
- Endangered, if it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
- Vulnerable, if it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

1.3.6.2 State Listed Threatened Ecological Communities

The Western Australian DBCA also maintains a list of TECs which are further categorised into three subcategories much like those of the EPBC Act. The full details of DBCA criteria are shown in **Table 13** in **Appendix One**.

1.3.6.3 State Listed Priority Ecological Communities

DBCA maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined.

1.3.7 THREATENED AND PRIORITY FAUNA

Certain fauna species are listed in conservation categories under the Commonwealth EPBC Act (outlined in **Table 11** in **Appendix One** and/or Western Australian BC Act. In addition to these statutory listings, DBCA maintains a list of 'Priority' species (P1-P5) that are also of conservation interest, outlined in **Table 12** in **Appendix One**. It is a requirement of fauna survey for environmental impact assessment that potential for presence of these species, and for impact due to the proposed action, are investigated using all appropriate sources of information.

Migratory species are matters of Commonwealth environmental significance under the EPBC Act and also listed for special protection under the Western Australian BC Act. Recognised migratory species include any native species identified in an international agreement approved by the Minister and those listed under:

- The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
- The China-Australia Migratory Bird Agreement (CAMBA)
- The Japan-Australia Migratory Bird Agreement (JAMBA)
- The Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

1.3.8 ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas around Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the Environmental Protection (Environmentally Sensitive Areas) Notice (Government of Western Australia 2005).

1.3.9 CONSERVATION ESTATE

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate and representative reserve system for Western Australia. The Conservation and Parks Commission is the vesting body for conservation lands, forest and marine reserves that are managed by DBCA (Government of Western Australia 2018a).

2 DESKTOP ASSESSMENT (EXISTING ENVIRONMENT)

2.1 PHYSICAL ENVIRONMENT

2.1.1 CLIMATE

The climate of the survey area is arid, semi-desert to subtropical with variable summer and winter rainfall. Cyclonic activity can be significant, and cyclonic systems may affect the coast and hinterland annually (Kendrick & Mau 2002).

According to the Köppen-Geiger climate classification, the survey area has a hot desert climate (Class BWh) (Peel *et al.* 2007). This classification includes arid regions where annual evaporation exceeds annual precipitation, and with a mean annual temperature ≥18°C.

Figure 2 outlines the rainfall and temperature data for the survey area. The closest Bureau of Meteorology (BoM) site recording rainfall is Exmouth town (station 5051, operating since 1964; BoM 2018a), approximately 13 km south of the survey area. The mean annual rainfall is 275.1 mm, 82% of which falls in the first 6 months of the year (summer-autumn) period. There was no significant rainfall in 2018 until June (34.8 mm during January-May, 141.8 mm in June) (BoM 2018a).

The nearest BoM station recording temperatures is Learmonth Airport (station 5007, operating since 1945), located approximately 25 km south of the survey area. January is the hottest month with a mean maximum temperature of 37.9°C and mean minimum of 23.0°C, and July is the coldest month with a mean maximum temperature of 24.8°C and mean minimum of 11.4°C (BoM 2018a).

Temperatures during the summer period immediately before the July 2018 survey were appreciably higher than the long-term mean (excluding February, which was cooler), with March 2018, on average, having a maximum temperature 2.6°C higher than the long-term mean and April 2018, on average, having a maximum temperature 3.9°C higher than the long-term mean (BoM 2018a).

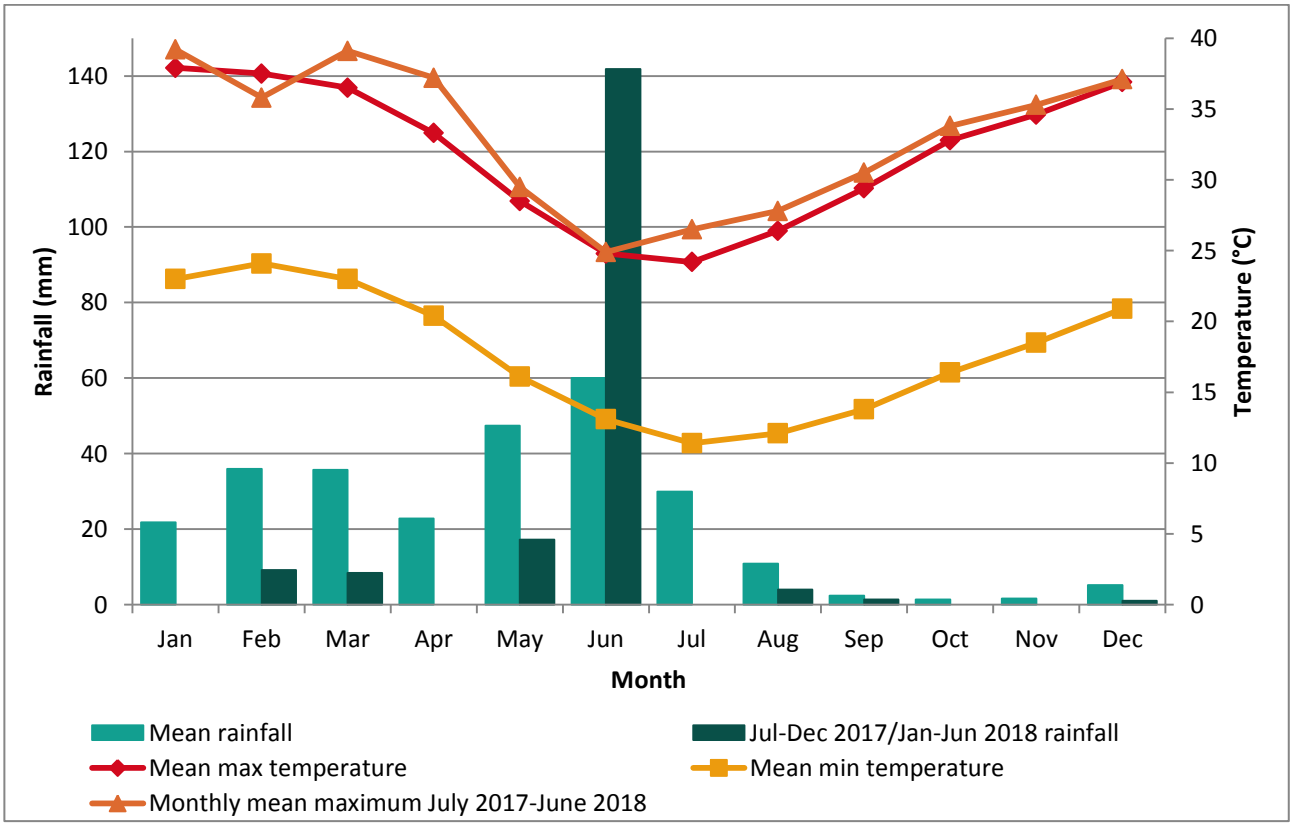

Figure 2: Rainfall (Exmouth) and temperature data (Learmonth Airport) (BoM 2018a)

2.1.2 WETLANDS AND DRAINAGE

There are no surface wetlands within the survey area.

However, the low-lying portions of survey area are included in mapping, which includes buffers, of the Directory of Important Wetlands of Australia. Part of the Cape Range Subterranean Waterways wetland is located approximately 2.5 km east of the survey area; other areas included in the wetland are scattered through Northwest Cape. These consist of waterways, sinkholes, general groundwater and artificial wells, with the main ecological feature being entirely endemic stygofauna (Australian Government & DotEE 2010, accessed 03 July 2018).

2.1.3 ENVIRONMENTALLY SENSITIVE AREAS

The survey area is included in an ESA. It is unlikely that the ESA refers to any aspects relevant to the flora and vegetation or terrestrial fauna of the survey area, and is more likely attributed due to its proximity to conservation lands (Jurabi Coastal Park and Ningaloo Marine Park, **Section 2.1.4**) or its proximity to the Cape Range Subterranean Waterways wetland (**Section 2.1.2**).

2.1.4 CONSERVATION LANDS

The survey area, in part, corresponds with Jurabi Coastal Park on the northern and western edges of the survey area and is immediately adjacent to the Ningaloo Marine Park.

Cape Range National Park is located approximately 17 km south of the survey area.

2.1.5 LAND USE HISTORY

Part of Lot 2 is occupied by tourist infrastructure (short-term accommodation and supporting infrastructure). Part of Lot 1 has been excised (as UCL) and includes the decommissioned Vlamingh Head Lighthouse and access road, which is a tourist attraction and viewing location. Lot 6 has an unsealed road dissecting its length.

All other parts are uncleared. The survey area is not within any pastoral leases, however, it is likely that the vegetation has been grazed by domestic (e.g. cattle, horses, sheep) and feral (e.g. goats) animals since the area was settled by Europeans in the early 1900s. However, the town of Exmouth itself was not established until 1967 when the United States constructed the Naval Communication Station.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (DotEE 2016).

The survey area is located within the Carnarvon IBRA region in the Cape Range CAR1 subregion, described as (Williams & Mitchell 2001):

> *The Carnarvon bioregion is composed of quaternary alluvial, aeolian and marine sediments overlying Cretaceous strata. A mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields. Limestone strata with* Acacia stuartii *or* A. bivenosa *shrubland outcrop in the north, where extensive tidal flats in sheltered embayments support mangal.*
>
> *Cape Range and Giralia dunefields form the northern part of Carnarvon Basin. Rugged tertiary limestone ranges and extensive areas of red aeolian dunefield, Quaternary coastal beach dunes and mud flats.* Acacia *shrublands over* Triodia *on limestone (*Acacia stuartii *or* A. bivenosa*) and red dunefields,* Triodia *hummock grasslands with sparse* Eucalyptus *trees and shrubs on the Cape Range. Extensive hummock grasslands (*Triodia*) on the Cape Range and eastern dune-fields. Tidal mudflats of sheltered embayments of Exmouth Gulf support extensive mangroves. Beach dunes with Spinifex communities. An extensive mosaic of saline alluvial plains with*

samphire and saltbush low shrublands along the eastern hinterland of Exmouth Gulf. Islands of the Muiron, Barrow, Lowendal and Montebello groups are limestone-based. Climate is arid, semi-desert to subtropical climate, with variable summer and winter rainfall. Cyclonic activity can be significant, and cyclonic systems may affect the coast and hinterland annually. Subregional area for CAR1 is 2, 547, 911 ha.

2.2.2 PRE-EUROPEAN VEGETATION

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia at a scale of 1:250 000 in the south-west and at a scale of 1:1 000 000 in less developed areas.

Beard's vegetation maps depict the native vegetation as it was presumed to be at the time of settlement, and is known as the pre-European vegetation type and extent and has since been developed in digital form by Shepherd *et al.* (2002) and updated by DAFWA (2012). Extents are updated annually by DBCA. This mapping indicates that the survey area includes areas mapped as:

- Association 662, described as hummock grassland; shrub steppe; mixed *Acacia* scrub & dwarf scrub with soft spinifex & *Triodia basedowii*
- Association 663, described as hummock grasslands, shrub steppe; waterwood (*Acacia coriacea*) over soft spinifex
- Association 664, described as hummock grasslands, sparse tree-steppe; scattered bloodwood over soft spinifex & *Triodia* sp. indet. aff. Angusta (*Triodia angusta*).

The pre-European vegetation association identified from the survey area (DAFWA 2012) and its pre-European and current extents are listed in **Table 1** (Government of Western Australia 2016a) and shown on **Map 1**.

Table 1: Pre-European vegetation association representation (Government of Western Australia 2016a)

Region	Vegetation association	Original extent (ha)	Current extent (ha)	% Remaining
Western Australia	662	284,795.92	282,125.59	99.06
	663	30,474.41	25,976.66	85.24
	664	83,774.94	82,154.14	98.07
IBRA biographic region (Carnarvon)	662	282,709.68	281,679.32	99.64
	663	29,068.26	25,866.32	88.98
	664	83,739.62	82,154.14	98.11
IBRA biographic sub-region (Ningaloo)	662	282,709.68	281,679.32	99.64
	663	29,068.26	25,866.32	88.98
	664	83,739.62	82,154.14	98.11
LGA (Shire of Exmouth)	662	194,410.67	193,595.74	99.58
	663	30,474.41	25,976.66	85.24
	664	83,774.94	82,154.14	98.07

2.2.3 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

A *Protected Matters Search Tool* (PMST, Australian Government & DotEE 2018a) search (*EPBC Act Protected Matters Report*, search reference PMST_2V6IIK) was conducted using a 10 km buffer from a central point of the survey area. The search did not identify any EPBC-listed TECs within the search area buffer.

The results of the DBCA communities database search are shown on **Map 2**.

2.2.4 THREATENED AND PRIORITY FLORA

The PMST search (Australian Government & DotEE 2018a) identified no EPBC-listed TF that may or are likely to occur within the 10 km search buffer area, or suitable habitat that may or is likely to occur.

The results of the DBCA and *NatureMap* (DPaW 2007-2018) conservation significant flora database search are included in **Table 17** in **Appendix Two** and shown on **Map 2**. The searches identified 23 conservation

significant species are known to occur within 50 km of the survey area or, for four species, were identified by a place name search ('Exmouth', 'Cape Range').

No TF species were identified by these database searches, therefore no TF species are known to occur within at least 50 km of the survey area.

Of the 23 species identified by the database searches, two are P1 species (both identified from place name searches), nine are P2 species, nine are P3 species and three are P4 species. One of these (*Grevillea calcicola*, P3) has been previously recorded from within the survey area, however, additional early (i.e. pre-1980s) conservation significant flora records with inaccurate GPS locations are also likely to have been recorded within or very close to the survey area (*Stackhousia umbellata*, P3 from 1965; *Daviesia pleurophylla*, P2 from 1978).

2.2.4.1 Threatened and Priority Flora Likelihood Assessment

Ecoscape conducted a likelihood assessment to identify conservation significant flora species that have potential to occur within the study area. The likelihood of a species occurring is based on the following attributes, as listed on *FloraBase* (WAH 1998-2018; 2018), tailored to local populations, and information from recent nearby surveys.

The attributes were:

- broad soil type usually associated with the species
- broad landform usually associated with the species
- usual vegetation (characteristic species) with which the species is usually associated
- species having previously been recorded from within approximately 20 km of the study area (considered as 'nearby').

The likelihood rating is assigned using the categories listed in **Table 2**.

Table 2: Categories for likelihood of occurrence of conservation significant flora

Likelihood	Categories
Recorded	Species recorded within the study area
Possible	May occur within the study area (but has not been recorded); broadly, 2-4 of the required attributes (but always including records from nearby or from within the overall range of the species) are present in the study area
Unlikely	Could occur but is not expected; 1-3 of the required attributes are present in the study area but: • it is not known from nearby, or • it is known from nearby but has no other required attributes, or • it is known from nearby but has at least one well-defined attribute that does not occur in the study area (e.g. it is associated with a specific landform or soil type that does not occur in the study area)
Highly Unlikely	The species characteristics include only one or none of the required attributes of soil, landform, associated vegetation and having previously been recorded nearby, or a critical element (often landform) is not within the study area and as such it almost certainly does not occur.

Based on the above, with the knowledge that the survey area includes areas of limestone hills, coastal dunes and red Pindan sand dunes, 11 conservation significant flora species are considered as having a 'possible' likelihood of occurrence and three are considered to have been previously recorded from within the survey area.

2.2.5 DECLARED PEST PLANTS AND WONS WEEDS

Forty five s22 Declared Pest species were identified by a WAOL search (Department of Primary Industries and Regional Development 2018) for the Shire of Exmouth and 'Whole of State' i.e. they are Declared Pest plants in the Shire of Exmouth (**Table 18** in **Appendix Two**). According to *NatureMap* (DPaW 2007-2018, accessed 3 July 2018), none have been collected from within 10 km of the survey area.

There are 32 WONS listed for Australia (Australian Government & DotEE 2018b). None have been collected within 10 km of the survey area (DPaW 2007-2018, accessed 3 July 2018). However, *Tamarix aphylla* (Athel Tree, Tamarix, Salt Cedar) that is listed as a WONS species (and Declared Pest plant) is frequently planted as a shade tree in arid and semi-arid areas including at the Ningaloo Lighthouse Holiday Park and is rarely reported as a weed. In most circumstances, including within the Holiday Park, the species is not invasive, however, is a significant weed in some places including Carnarvon (Department of Primary Industries and Regional Development 2017) and central Australia (National Heritage Trust 2003) where it can have a significant ecological impact. Under the BAM Act this species does not have any management requirements.

2.2.6 CONSERVATION SIGNIFICANT FAUNA SPECIES

A review of databases and previous survey reports in the proximity of the survey area was undertaken, including the following sources:

- PMST search (Australian Government & DotEE 2018a, search reference PMST_2V6IIK) using a 10 km buffer around a central point within the survey area
- *NatureMap* (DPaW 2007-2018), using a 10 km buffer of a point central within the survey area
- DBCA database search (search reference FAUNA#5758), using a 20 km buffer around a central point
- previous survey reports.

The database and literature searches identified conservation significant vertebrate fauna species that have been previously recorded at or near the survey area, or for the PMST, where the species or suitable habitat 'may' occur or is 'likely to occur'. The combined results are presented in **Table 19** in **Appendix Two**. The results of the DBCA database search are shown on **Map 3**.

The conservation significant species included in the database searches comprised:

- three mammals; two identified only via the PMST, both as 'species or habitat may occur'
- three reptiles
- 39 birds; 27 protected under international agreements without other conservation significance, and three identified only via the PMST as 'species or habitat may occur' or 'species or habitat likely to occur'.

2.2.6.1 Conservation Significant Fauna Likelihood Assessment

The likelihood of occurrence of the conservation significant fauna species identified by the database and literature searches as being known from nearby was assessed in a similar manner to flora, using the following criteria:

- suitability of habitats present within the survey area
- distance between previous record of conservation significant species and the survey area
- frequency and number of records in the region, and
- date of record of conservation significant species (recent or historical).

The sufficiency of information and behavioural and ecological characteristics, such as cryptic behaviours were also taken into account. Using the above criteria, the categories of likelihood of occurrence are shown in **Table 3**.

Table 3: Categories for likelihood of occurrence of conservation significant fauna

Likelihood	Categories
Recorded	Species recorded within the survey area within a reasonable timeframe (0-5 years)
High	Species recorded in close proximity to the survey area (<5 km) within the past 10 years; and suitable habitat occurs within the survey area
Medium	Species historically recorded in close proximity (<5 km) to the survey area, more than 10 years ago; and suitable habitat may exist within the survey area
Low	Species not recorded in the proximity of the survey area or rarely recorded within 10 km of the survey area; and suitable habitat unlikely to occur within the survey area
Very Low	Species not recorded by multiple surveys/databases within 20 km of the survey area and suitable habitat does not occur within the survey area, however species or suitable habitat is listed as potentially occurring in the wider region

Species with the highest likelihood of occurring in the survey area (i.e. 'recorded' and 'high', as defined in **Table 3**) are highlighted in **Table 20** in **Appendix Two**. These, and their habitats, formed the basis of searches during the field survey.

The mammal species identified by the database searches are considered highly unlikely (Very Low likelihood) to occur:

- *Dasyurus hallucatus* (Northern Quoll) has never been recorded on the North West Cape peninsula
- *Petrogale lateralis* (Black-flanked Rock-wallaby) may have previously occurred (prior to European settlement), however, there are no actual records from within 10 km of the survey area
- *Rhinonicteris aurantia* Pilbara form (Pilbara Leaf-nosed Bat) has only one record from the North West Cape peninsula, and few areas of suitable habitat occur within or close to the survey area.

All three of the Priority-listed reptile species (*Aprasia rostrata*, Ningaloo Worm-lizard; *Diplodactylus capensis*, Cape Range Stone Gecko; *Lerista allochira*, Cape Range Slider) have either a Medium or, for the Cape Range Slider, a recorded likelihood of occurring within the survey area. Suitable habitat for these species is abundant within the survey area, although two of these species have only a Medium likelihood of occurring, the low amount of known surveys in the area suggests underrepresentation in collections.

A total of 39 birds, 27 of which are protected under international agreements and without additional protection (and another six with additional statutory protection), were assessed for likelihood of occurring within the survey area. Three species have previously been recorded as occurring within or immediately adjacent to the survey area: Osprey (*Pandion haliaetus*), Crested Tern (*Sterna bergii*) and Common Sandpiper (*Tringa hypoleucos*), both protected under international agreements only. Another, listed as P4 (Grey-tailed Tattler, *Tringa brevipes*), was assessed as having a High likelihood of occurring.

2.3 LITERATURE REVIEW

The following documents have been reviewed for relevance to this project:

- 360 Environmental (2017), *Australian Bundle Site. Detailed Flora and Vegetation Assessment*, detailing the investigation of a 535 ha site 35 km south of Exmouth, approximately 50 km south of the survey area. The survey identified 74 vascular flora taxa including one of conservation significance (*Corchorus congener*, P3) that was considered to be widespread within the survey area and beyond, 10 natural vegetation types and the vegetation was in Very Good to Completely Degraded condition, with Buffel Grass (**Cenchrus ciliaris*) contributing significantly to the vegetation condition.
- ENV Australia Pty Ltd (2012), *Ashburton North Strategic Industrial Area Flora and Vegetation Assessment*, detailing the investigation of a 564 ha study area located near Onslow, approximately 90 km east of the survey area and across the Exmouth Gulf. The survey identified 131 vascular flora species including one P3 species and five vegetation associations in Excellent to Completely Degraded condition.
- Meissner (2010a), *Biodiversity values of basic raw material sites within Cape Range National Park*, reported on the assessment of biodiversity values of eight existing borrow pits and two sites on UCL, including one

near the survey area in red sandplain. This site was dominated by *Acacia bivenosa* and *Senna glutinosa* subsp. *pruinosa* over *Triodia epactia* and *Triodia basedowii*, with *Acanthocarpus humilis*, *Melaleuca cardiophylla* and *Acacia gregorii* on an adjacent limestone ridge. Two priority-listed flora species were recorded from the site; *Eremophila forrestii* subsp. *capensis* and *Corchorus congener*, both P3.

- Meissner (2010b), *Biodiversity values of Unallocated Crown Land on Cape Range peninsula, Western Australia*, reported on the natural values of UCL on Cape Range Peninsula including the survey area. The report notes three broad vegetation types; vegetation on limestone hills and ranges, coastal plain vegetation and vegetation of red sand dunes, the latter having no representation within the conservation estate.
- Astron Environmental Services (2009), *Exmouth Wastewater Treatment Plant Land Acquisition Flora, Vegetation and Fauna Survey.* The survey of approximately 200 ha adjacent to the town of Exmouth identified 16 vegetation types (none of conservation significance) of varying condition depending on weed density, 79 vascular flora species (two P3 species, *Corchorus congener* and *Gymnanthera cunninghamii*) and seven vertebrate fauna species.
- Ecoscape (2009), *Flora and vegetation survey, Market Street, Exmouth*, detailing the flora and vegetation survey of 3.5 ha within the town site of Exmouth. The survey identified a single vegetation type in Completely Degraded or Degraded condition and 35 vascular flora species.
- GHD (2008), *Passing lanes and materials pit Minilya Exmouth Road targeted flora survey*. The report documents a targeted flora survey of several small areas adjacent to the main road 10-28 km south of Exmouth. There were no significant findings during the field survey.
- Baynes & Jones (1993) *The mammals of Cape Range peninsula, north-western Australia* describes the mammal fauna of the area as it was known in 1993. Historically 49 mammal species were known from the peninsula, comprising 38 native ground mammals, five bats and six introduced species. Approximately half of these are now extinct. The mammal fauna have their origins in the arid zone and no species were identified as being endemic to the peninsula.
- Keighery & Gibson (1993), *Biogeography and composition of the flora of the Cape Range peninsula, Western Australia*. This document details the flora of the Cape Range peninsula, and identifies 630 species of vascular plants including 12 endemic taxa and 50 taxa that are at northern end of their range; these are mostly sandplain or coastal dune species.
- Kendrick (1993) *Biogeography of the vertebrates of the Cape Range peninsula*. At the time of writing, 30 mammals, 84 reptiles, five amphibians and approximately 200 birds were known from the peninsula. The mammal, bird and reptile faunas were considered largely typical of semi-arid and arid areas, although species were often geographically isolated from the main populations. Endemism was considered to be low.
- Pringle (1987), *The biogeography of plant communities on the western coastal plain of the Exmouth Peninsula* (Honours Thesis). The author considered that the flora had origins in both the eremaean region and south west, with the southwestern species becoming isolated from their ancestral populations with some having evolved to become endemic species. These were largely associated with red aeolian sand dunes. However, overall, the flora was considered representative of widely distributed arid environments.

3 METHODS

3.1 FLORA AND VEGETATION SURVEY

3.1.1 GUIDING PRINCIPLES

The flora and vegetation survey was conducted according to the *Flora and Vegetation Technical Guidance* (EPA 2016c) as a detailed survey. The EPA recommends a detailed survey to have:

- a comprehensive survey design paying particular attention to optimal survey timing, disturbance events and the potential requirement for supplementary surveys
- a minimum of three quadrats (in proportion to the extent of the vegetation unit), located throughout each preliminary vegetation types sampled throughout its geographic range, with additional quadrats and rescoring during supplementary surveys to clarify vegetation unit boundaries
- regional surveys if there is insufficient information available (identified during the desktop assessment) to provide local and regional context
- the survey may include a number of sampling techniques including quadrats, relevés, transects and traverses, as well as opportunistic observations
- the flora inventory should be comprised of data collected from quadrats and relevés, supplemented by opportunistic observations, systematic surveys and targeted inspections of various habitat areas
- it may be appropriate to increase survey effort in areas of unusual habitat
- sampling sites that are placed at representative locations throughout the survey area considering landform, geology, elevation, slope, aspect, surface or groundwater expression and soil type, as well as vegetation structure, composition and condition.

Targeted searches were also conducted in areas of habitat suitable for conservation significant flora identified during the desktop assessment as having potential to occur.

3.1.2 FLORA AND VEGETATION FIELD SURVEY

The survey area did not include the tourist park or its immediate vicinity.

The field survey was conducted as a single phase survey. At least three floristic quadrats were recorded in each vegetation type in areas of native vegetation where the vegetation was in Good or better condition, and at least one relevé in areas where access was unsafe (scree slope) or where survey time was restricted. Relevés are unmeasured areas, with less background information collected but with the same effort applied to collecting a flora inventory as for quadrats.

Opportunistic observations were conducted to contribute to a complete flora inventory.

Targeted searches were conducted for conservation significant flora in areas of suitable habitat.

On ground observations, supported by aerial photography, were used to describe the vegetation of the survey area. Extrapolated vegetation type extensions were approximated using a combination of aerial imagery interpretation and field observations.

3.1.2.1 Field Survey Timing

The field survey was conducted during 9-14 July 2018. The *Flora and Vegetation Technical Guidance* (EPA 2016c) identifies autumn as the appropriate season of survey for the Carnarvon IBRA region as this is considered to represent the season following rainfall.

However, Exmouth did not experience significant rainfall over the summer period (17.6 mm over January-April), and did experience significant rainfall in June (141.8 mm over two events). The survey timing in July 2018 is therefore optimal as the survey was conducted approximately 5 weeks after the first significant rainfall event (46.2 mm during 5-8 June), with supplementary follow-up rainfall (95.6 mm on 19 June). Additionally, the highest priority flora species (P2) identified as likely to occur based on the desktop assessment are described as having their flowering period corresponding with the survey period.

3.1.2.2 Floristic Quadrats and Relevés

Floristic quadrat ('quadrat') and relevé locations were selected using aerial photography, environmental values and field observations to represent the vegetation values existing at the site. The unmarked quadrats were 30 m x 30 m, or equivalent area in linear habitats. Relevés were unmeasured, however, approximately the same size area was assessed.

The following information was collected from within each quadrat sampled:

- observer
- date
- quadrat/site number
- GPS location (GDA94) of the northwest corner
- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the quadrat
- soil type and colour
- topography
- list of flora species recorded with the average height and total cover within the quadrat for each species
- vegetation description (as per below)
- vegetation condition.

3.1.2.3 Conservation Significant Flora Searches (Targeted Searches)

Accessible areas of potentially suitable habitat, as identified during the desktop study, were searched for conservation significant flora.

Grid surveys were not conducted, however, the area was extensively traversed with searches for likely species occurring during these traverses.

3.1.2.4 Range Extensions

Taxa recorded during the field survey that are outside of their known distribution were identified as range extensions. Known taxa records (WAH 1998-2018) were used as a guide to determine if each taxon recorded in the survey area was representative of a range extension (defined as greater than 100 km from nearest record) or outlier population.

3.1.2.5 Introduced Species

Introduced species (weeds) were recorded during the collection of the overall flora inventory.

The field survey included searches for WONS and Declared Pest plants. Their locations and numbers/extents were recorded where noted during the field survey, and each WONS or Declared Pest plant species photographed.

3.1.2.6 Vegetation Description and Classification

Vegetation was described from each of the quadrats using the height and estimated cover of dominant and characteristic species of each stratum based on the National Vegetation Information System, recorded at Level V (Executive Steering Committee for Australian Vegetation Information [ESCAVI] 2003) (**Table 14** and **Table 15** in **Appendix One**). Up to three species per stratum from each stratum (upper, mid and ground) were used to formulate vegetation descriptions for each quadrat and each vegetation type.

Vegetation type descriptions were created by combining quadrat descriptions and modifying, where necessary, based on the wider vegetation. Vegetation codes for these were formulated using the characteristic species of the tallest stratum and the vegetation structure e.g. **BaDp shrubland** refers to *Banksia ashbyi* subsp. *boreoscaia* and *Daviesia pleurophylla* tall sparse shrubland.

Vegetation mapping was conducted in the field by mapping units of similar vegetation (known as vegetation types) and hand drawing boundaries onto printed aerial imagery for later digitisation.

3.1.2.7 Vegetation Condition and Mapping

Vegetation condition was assessed continuously throughout the survey area and at each quadrat using the Vegetation Condition Scale for the Eremaean Botanical Provinces (EPA 2016c) (**Table 16** in **Appendix One**).

The main factor influencing vegetation is generally weed cover.

The spatial extent of the varying vegetation condition was mapped using GIS and vegetation condition maps are provided in this report.

3.1.3 STATISTICAL ANALYSIS

3.1.3.1 Survey Area Floristic Analysis

PATN© software (Belbin & Collins 2006) was used to undertake statistical analysis to generate floristic groups using the data collected from the quadrats and relevés, in order to better understand local significance of floristic units. PATN analysis has been used for several local floristic analyses including Gibson *et al.* (1994) for the Swan Coastal Plain.

PATN is a multivariate analysis tool that generates estimates of association (resemblance, affinity, distance) between sets of objects described by a suite of variables (attributes), and classifies the objects into groups and condenses the information and displays the patterns in the data graphically.

PATN offers a choice of data transformations prior to multivariate analysis.

Floristic groups, identified using a dendrogram output of the analysis, are used as a tool to inform vegetation type groups at various levels and scales.

For this analysis, the Kulczynski similarity coefficient was the appropriate association to use as it has proven to be a good estimation of association for ecological applications (Belbin & Collins 2006). This was followed by Flexible UPMGA (Un-weighted Pair Group Using Arithmetic Averaging) fusion to produce clusters of related objects (species); these are the floristic groups that are displayed as a dendrogram.

Interpretation of these purely floristic groups into recognisable and mappable on-ground units is a tool used to identify broad vegetation types. Generally, quadrats or relevés that are closely floristically related on the dendrogram form identifiable vegetation units, however, as presence-absence data is used in the analysis and there is no weighting given to dominant species, at times the floristic groups are not easily related to on-ground vegetation types. Vegetation types are therefore determined as a combination of floristic analysis and on-ground interpretation using dominant and characteristic species.

3.1.3.2 Adequacy of Sampling

In order to demonstrate adequacy of sampling, a species accumulation curve was generated by the software Species Diversity and Richness (Pisces Conservation Ltd 2010) using five random selections of sample order, and using quadrat data only.

A taxa by area plot was also created using quadrat and relevé data for the survey area and nearby. This plot gives an indication of relative species richness, and can also provide an indication of survey adequacy.

Adequacy of sampling is also assessed in terms of representation of various attributes, including vegetation types and representation of land systems.

3.2 FAUNA AND FAUNA HABITAT SURVEY

3.2.1 GUIDING PRINCIPLES

The following were taken into account when developing the survey methodology:

- EPA (2016d) *Fauna Technical Guidance*
- background information on the survey area (i.e. desktop assessment, aerial imagery and other data).

The *Fauna Technical Guidance* recommends the following for a Level 1 fauna survey:

- desktop assessment to gather contextual information on the survey area from previous surveys, literature, database searches and map-based information

- site visit to be conducted to verify the accuracy of the desktop study, delineate and characterise the fauna and faunal assemblages present in the survey area
- survey to include low intensity sampling of fauna and faunal assemblages.

3.2.2 FAUNA FIELD SURVEY

The fauna field assessment included identifying fauna habitat, with fauna species identified opportunistically based on sightings, calls, remains, diggings and other signs. Potential habitats for conservation significant species were identified and evaluated and their likelihood of occurrence assessed.

3.2.2.1 Timing of the Field Survey

The fauna survey was undertaken during 9-14 July 2018. The season was not optimal for survey, which according to the EPA (2016d) *Fauna Technical Guidance* is in spring (September to November) to ensure sampling during peak activity of reptiles, amphibians and birds. Survey timing for these fauna groups is dependent on warm temperatures and/or rainfall events, mammal activity is not dependent on weather and is therefore not constrained.

Despite the suboptimal season of survey according to the *Technical Guidance*, daytime temperatures were in the 25-28° range and where observed, reptiles were moving rapidly and therefore not torpid.

3.2.2.2 Fauna Habitat Mapping

Fauna habitat types were assessed continuously throughout the survey and at each observation of fauna, in particular when conservation significant species were recorded. Fauna habitats were described as an area which is distinguishable from its surrounding area by its land form, vegetation structure and composition, soil characteristics and fauna assemblage that occur in the area. In addition, the likelihood to harbour specialised fauna species which are not found in adjacent areas was taken into consideration. The spatial extent of each habitat type was mapped using GIS.

4 RESULTS

4.1 FLORA AND VEGETATION SURVEY

The flora and vegetation survey was conducted by Lyn Atkins (Associate Environmental Scientist, senior botanist, flora collecting permit SL012268) during 9-14 July 2018.

Extents detailed in the following sections are not inclusive of the southern survey area.

4.1.1 VEGETATION

Seven vegetation types, based on a combination of structural vegetation type as identified in the field and floristic grouping (see **Appendix Five**), were recorded from within the survey area (**Table 4**). The extents of the vegetation types and representative quadrat locations are shown on **Map 4**. Extent calculations do not include the southern survey area.

In summary the following vegetation types were identified from the survey area:

- coastal zone:
  - **AcRp shrubland** (*Acacia coriacea* and *Rhagodia preissii* shrubland) on stable (hind) beach dunes, merging into vegetation type **TeSlWa grassland**
  - **TeSlWa grassland** (*Triodia epactia*, *Spinifex longifolius* and *Whiteochloa airoides* grassland) on the more stable of the foredunes (above the high water mark)
- limestone hills of Cape Range:
  - **Mc shrubland** (*Melaleuca cardiophylla* shrubland) on the Cape Range limestone slopes and crests. This vegetation type was continuous between the main survey area around the Ningaloo Lighthouse Holiday Park and Vlamingh Head Lighthouse, and the southern survey area.
  - **AbSaAt shrubland** (*Acacia bivenosa, Senna artemisioides* and *Acacia tetragonophylla* shrubland) in gorges on the Cape Range limestone
  - **Ab shrubland** (*Acacia bivenosa* shrubland) on the north and west-facing scree slopes of the Cape Range, near Vlamingh Head Lighthouse
  - **AbFb shrubland** (*Acacia bivenosa* and *Ficus brachypoda* shrubland) in the interzone between the Cape Range and beach; the substrate is frequently beach sand between smooth limestone boulders, on the west-facing footslopes of the Cape Range
- red Pindan dunes:
  - **BaDp shrubland** (*Banksia ashbyi* and *Daviesia pleurophylla* shrubland) on the red Pindan sand dunes, associated with both crests and swales.

Table 4: Vegetation types

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Study Area
Beach: Stable (Hind) Dunes	**AcRp shrubland**	*Acacia coriacea* subsp. *coriacea* and *Rhagodia preissii* subsp. *obovata* mid sparse shrubland/chenopod shrubland over *Triodia epactia* and *Spinifex longifolius* low hummock grassland/tussock grassland **NVIS** M+ ^*Acacia coriacea* subsp. *coriacea*,^ *Rhagodia preissii* subsp. *obovata*\^shrub,chenopod shrub\3\r;G ^ *Triodia epactia,Spinifex longifolius*\^hummock grass,tussock grass\1\c	NL1811 NL1814 NL1815		**Cenchrus ciliaris* *Commicarpus australis* *Corchorus carnarvonensis* *Corynotheca flexuosissima* *Dampiera incana var. incana* *Indigofera boviperda subsp. boviperda* *Portulaca oleracea* *Scaevola sericophylla* *Solanum lasiophyllum* *Threlkeldia diffusa* *Thysanotus exfimbriatus* *Whiteochloa airoides*	14.88 ha 13.26%
Beach: Foredunes	**TeSlWa grassland**	*Triodia epactia, Spinifex longifolius* and *Whiteochloa airoides* low hummock grassland/tussock grassland **NVIS** G+ ^ *Triodia epactia*,^ *Spinifex longifolius,Whiteochloa airoides*\^hummock grass,tussock grass\1\c	NL1816		*Acanthocarpus preissii* *Angianthus cunninghamii* *Atriplex* sp. *Corynotheca flexuosissima* *Ipomoea pes-caprae* subsp. *brasiliensis* *Launaea sarmentosa* *Lotus australis* *Sporobolus virginicus* *Threlkeldia diffusa*	3.39 ha 3.02%

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Study Area
Cape Range: Limestone	**Mc shrubland**	*Melaleuca cardiophylla* mid open shrubland over *Triodia glabra, Triodia angusta* and *Acacia gregorii* mid hummock grassland/low shrubland **NVIS** M+ ^*Melaleuca cardiophylla*\^shrub\3\i;G ^*Triodia glabra,*^ *Triodia angusta,Acacia gregorii*\^hummock grass,shrub\2\c	NL1804 NL1805 NL1806 NL1808 NL1817		*Acacia bivenosa* *Acanthocarpus humilis* *Corchorus crozophorifolius* *Dampiera incana* var. *incana* *Eremophila forrestii* subsp. *capensis* (P3) *Eriachne mucronata* *Exocarpos aphyllus* *Grevillea variifolia* subsp. *variifolia* *Hakea stenophylla* subsp. *stenophylla* *Hannafordia quadrivalvis* subsp. *recurva* *Heliotropium glanduliferum* *Hibbertia spicata* subsp. *spicata* *Hybanthus aurantiacus* *Indigofera monophylla* *Labichea cassioides* *Leptosema macrocarpum* *Pterocaulon sphaeranthoides* *Ptilotus nobilis* subsp. *nobilis* *Solanum lasiophyllum* *Stackhousia umbellata* (P3) *Thysanotus exfimbriatus* *Tribulus suberosus* *Triodia epactia*	42.49 ha 37.87% (not including southern survey area)

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Study Area
Cape Range Gorges: Limestone	**AbSaAt shrubland**	*Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Acacia tetragonophylla* mid open shrubland over *Triodia angusta* and *Scaevola tomentosa* mid hummock grassland/low shrubland **NVIS** M+ ^^*Acacia bivenosa,Senna artemisioides* subsp. *oligophylla,Acacia tetragonophylla*\^shrub\3\i;G ^Triodia *angusta,*^ *Scaevola tomentosa*\^hummock grass,shrub\2\c	NL1807 NL1810		*Acacia coriacea* subsp. *coriacea* *Alectryon oleifolius* subsp. *oleifolius* **Bidens subalternans* var. *simulans* **Cenchrus ciliaris* *Commicarpus australis* *Corchorus carnarvonensis* *Cucumis variabilis* *Cymbopogon ambiguus* *Enchylaena tomentosa* *Erodium cygnorum* *Exocarpos aphyllus* *Ficus brachypoda* *Gossypium robinsonii* *Indigofera monophylla* *Ipomoea costata* *Jasminum* sp. Exmouth (G. Marsh 77) *Ptilotus obovatus* *Scaevola spinescens* *Solanum lasiophyllum* **Sonchus oleraceus* *Thysanotus exfimbriatus* *Tribulus suberosus* *Zygophyllum retivalve*	0.69 ha 0.61%

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Study Area
Cape Range Scree Slope: Limestone	**Ab shrubland**	*Acacia bivenosa* mid sparse shrubland over *Triodia angusta* mid hummock grassland **NVIS** M ^*Acacia bivenosa*\^shrub\3\r;G+ ^*Triodia angusta*\^hummock grass\2\c	NL1809R		*Abutilon fraseri* **Aerva javanica* **Bidens subalternans* var. *simulans* **Cenchrus ciliaris* *Commicarpus australis* *Corchorus carnarvonensis* *Cynanchum viminale* *Enchylaena tomentosa* *Eremophila longifolia* *Euphorbia sharkoensis* *Euphorbia tannensis* subsp. *eremophila* *Evolvulus alsinoides* var. *decumbens* *Heliotropium glanduliferum* *Hibiscus leptocladus* *Indigofera monophylla* *Melhania oblongifolia* *Ptilotus clementii* *Ptilotus nobilis* subsp. *nobilis* *Ptilotus obovatus* *Rhynchosia minima* *Salsola australis* *Solanum lasiophyllum* *Zygophyllum retivalve*	1.58 ha 1.41%

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Study Area
Cape Range/Beach Interzone: Limestone	**AbFb shrubland**	*Acacia bivenosa* and *Ficus brachypoda* mid sparse shrubland over *Triodia epactia*, *Triodia glabra* and *Triodia angusta* mid hummock grassland **NVIS** M+ ^*Acacia bivenosa*,*Ficus brachypoda*\^shrub\3\r;G ^*Triodia epactia*,*Triodia glabra*,*Triodia angusta*\^hummock grass\2\c	NL1818R NL1819R		**Cenchrus ciliaris* *Gossypium robinsonii* *Grevillea variifolia* subsp. *variifolia* *Indigofera monophylla* *Ptilotus nobilis* subsp. *nobilis* *Ptilotus obovatus* *Solanum lasiophyllum*	3.27 ha 2.92%

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Study Area
Pindan Dunes: red Sand	**BaDp shrubland**	*Banksia ashbyi* subsp. *boreoscaia* and *Daviesia pleurophylla* tall sparse shrubland over *Triodia glabra*, *Scaevola sericophylla* and *Acacia gregorii* mid hummock grassland/low shrubland **NVIS** M ^^ *Banksia ashbyi* subsp. *boreoscaia*,^ *Daviesia pleurophylla*\^shrub\4\r;G+ ^ *Triodia glabra*,^ *Scaevola sericophylla*,*Acacia gregorii*\^hummock grass,shrub\2\c	NL1801 NL1802 NL1803 NL1812 NL1813		*Acacia bivenosa* *Acacia coriacea subsp. coriacea* *Acacia gregorii* *Acacia sclerosperma subsp. sclerosperma* *Acacia spathulifolia* *Bulbostylis barbata* **Cenchrus ciliaris* *Commelina ensifolia* *Corchorus carnarvonensis* *Corymbia zygophylla* *Duboisia hopwoodii* *Dysphania plantaginella* *Euphorbia tannensis* subsp. *eremophila* *Grevillea stenobotrya* *Hannafordia quadrivalvis* subsp. *recurva* *Heliotropium glanduliferum* *Indigofera boviperda* subsp. *boviperda* *Quoya loxocarpa* *Scaevola ?pulchella* *Scaevola sericophylla* *Thysanotus exfimbriatus* *Trichodesma zeylanicum* var. *zeylanicum* *Triodia glabra*	22.21 ha 19.79%
Not vegetation						23.68 ha, 21.11%
Total						**112.20 ha**

4.1.1.1 Vegetation Significance

None of the existing vegetation has any formal conservation significance i.e. none is representative of any currently described TEC or PEC.

4.1.1.2 Vegetation Condition

The vegetation of the survey area ranged from Excellent condition to Degraded condition (**Table 5**), with the better condition vegetation (Very Good and Excellent) associated with the limestone soils of the Cape Range and the red Pindan dunes east and south of the Holiday Park. Areas close to the roads, Holiday Park, powerline, along the sewerage line from the Holiday Park to the settling ponds to the south, and on the coastal side of Yardie Creek Road were in lesser condition, generally rated as such due to the amount of Buffel Grass (**Cenchrus ciliaris*) in these areas. The immediate environs of the Holiday Park were not included in the survey, and the extents do not include the southern survey area.

Table 5: Vegetation condition extents

Vegetation condition	Extent (ha)	Extent (%)
Excellent	17.91	15.96
Very Good	52.53	46.82
Good	10.85	9.67
Poor	2.01	1.79
Degraded	5.21	4.64
Completely Degraded	-	-
Not vegetated (unvegetated coastal dunes, roads, tourist park etc.)	23.68	21.11

Vegetation condition extents are shown on **Map 5**.

4.1.2 FLORA

A total of 169 vascular flora species were recorded from within the survey area from floristic quadrats, relevés and opportunistic observations. Eight (4.76%) were introduced species. Ten could not be identified with certainty to species level and six were only identified to family level due to insufficient diagnostic reproductive (flowering/fruiting) material. The timing of the field survey, approximately 5 weeks following significant rainfall, was optimal for identifying shrub species, however, annual species were largely small and had not yet commenced flowering. Consequently, due to the low probability for accurate identification, they were not collected unless there was sufficient diagnostic material, thus there would be additional species present in the survey area.

The families with the highest number of taxa were Poaceae (23 taxa), Fabaceae (22), Malvaceae (14) and Asteraceae and Myrtaceae (seven each). The most commonly recorded genera were *Acacia* (nine taxa), *Triodia* (five taxa) and *Ptilotus* and *Scaevola* (four taxa each). The most commonly encountered species were *Solanum lasiophyllum*, recorded from 15 of 19 quadrats and relevés, and **Cenchrus ciliaris* (Buffel Grass), from 12 of 19 quadrats and relevés.

The flora inventory, presented as a site by species table, is in **Table 21** in **Appendix Three**.

4.1.2.1 Conservation Significant Flora

No EPBC Act-listed or WC Act-listed Threatened Flora were recorded in the survey area.

Six PF species were confirmed as occurring within the survey area, with a seventh species considered likely to have been collected although this could not be confirmed due to the lack of diagnostic material. The PF species recorded were:

- P2:
  - *Daviesia pleurophylla*
  - *Tinospora esiangkara*
- P3:
  - *Corchorus ?congener* (not confirmed but considered likely)
  - *Eremophila forrestii* subsp. *capensis*
  - *Grevillea calcicola*
  - *Stackhousia umbellata*

- P4:
  - *Brachychiton obtusilobus*.

Descriptions of each are provided in **Table 6** that follows.

Table 6: Priority Flora species recorded from the survey area

Daviesia pleurophylla				
	Description (WAH 2018; WAH & DBCA 2018)	**Habitat (WAH 2018; WAH & DBCA 2018)**	**Survey results**	**Photograph**
Priority 2	*Daviesia pleurophylla* is a divaricately branched, broom-like shrub with spinescent branches to 3 m high; yellow flowers with red/orange centres.	Occurs on sand dunes. In the survey area it was confined to the red Pindan dunes on the east and southeast of the survey area Associated vegetation from *FloraBase*: 'shrubland as dominant species', 'with *Myoporum montanum*, *Acacia coriacea* and *Grevillea stenobotrya*', 'with *Banksia*'. Distribution: Carnarvon IBRA region, Cape Range subregion.	**Records**: Recorded as being a continuous population and at times codominant species within vegetation type **BaDp shrubland**. Population within the survey area estimated at over 100 plants; total population would be in the thousands. **Populations**: one continuous population **Habitat**: Occurs in one vegetation type: • **BaDp shrubland** (*Banksia ashbyi* subsp. *boreoscaia* and *Daviesia pleurophylla* tall sparse shrubland)	
Tinospora esiangkara				
	Description (WAH 2018; WAH & DBCA 2018)	**Habitat (WAH 2018; WAH & DBCA 2018)**	**Survey results**	**Photograph**
Priority 2	*Tinospora esiangkara* is a climber to 2 m high.	Occurs primarily on limestone outcrops and ridges. Also on red clay and (within the survey area) red sand. Associated vegetation from *FloraBase*: *Acacia tetragonophylla*, *A. bivenosa*, A. *xiphophylla, Corymbia hamersleyana*, *Melaleuca cardiophylla*, *Triodia pungens*. Distribution: Carnarvon IBRA region, Cape Range subregion. Also in Northern Territory and Queensland.	**Records**: Recorded from two locations (estimated two plants). **Populations**: two **Habitat**: Occurs in two vegetation types: • **BaDp shrubland** (*Banksia ashbyi* subsp. *boreoscaia* and *Daviesia pleurophylla* tall sparse shrubland) • **Mc shrubland** (*Melaleuca cardiophylla* shrubland)	

Corchorus congener				
	Description (WAH 2018; WAH & DBCA 2018)	**Habitat (WAH 2018; WAH & DBCA 2018)**	**Survey results**	**Photograph from *FloraBase* (WAH 1998)**
Priority 3	*Corchorus congener* is a spreading shrub to 0.6 m high with yellow flowers. This species was not identified with certainty in the survey area due to lack of reproductive material (flowers/fruit), however, it is highly likely to be this species.	Occurs on sand and sand over limestone. Within the survey area the likely specimen occurred on coastal dunes. Associated vegetation from *FloraBase*: *Acacia coriacea*, *Triodia epactia*, **Cenchrus ciliaris*. Distribution: Carnarvon and Pilbara IBRA regions, Cape Range and Hamersley subregions (respectively).	**Records**: Recorded from one location (estimated two plants). **Populations**: one **Habitat**: Occurs in one vegetation type: • **AcRp shrubland** (*Acacia coriacea* and *Rhagodia preissii* shrubland)	 *Corchorus congener* Photos: J. English
Eremophila forrestii* subsp. *capensis				
	Description (Brown & Buirchell 2011; WAH 2018; WAH & DBCA 2018)	**Habitat (Brown & Buirchell 2011; WAH 2018; WAH & DBCA 2018)**	**Survey results**	**Photograph**
Priority 3	*Eremophila forrestii* subsp. *capensis* is an erect shrub to 2 m high with felted grey green to yellowish green leaves and pink, green cream or yellow flowers. Within the survey area plants were generally under 1 m in height with variable flower colour from pinkish (with or without spots) to (less commonly) maroon, as pictured.	Occurs on exposed limestone. Associated vegetation: largely undocumented in *FloraBase* records. Broad associated vegetation is described as 'low shrubland', 'amongst mallee over spinifex', 'Spinifex and Eucalypts'. Distribution: Carnarvon IBRA region, Cape Range subregion.	**Records**: Recorded from seven locations (estimated 20-30 plants). **Populations**: one **Habitat**: Occurs in one vegetation type: • **Mc shrubland** (*Melaleuca cardiophylla* shrubland)	

Grevillea calcicola				
	Description (WAH 2018; WAH & DBCA 2018)	**Habitat (WAH 2018; WAH & DBCA 2018)**	**Survey results**	**Photograph from Olde & Marriott(1995)**
Priority 3	*Grevillea calcicola* is a straggly tree or shrub to 4 m high with cream-white flowers.	Occurs on limestone hilltops. There are no descriptions of associated vegetation in *FloraBase*. Distribution: Carnarvon IBRA region, Cape Range subregion.	**Records**: Recorded from one location (estimated one plant). As this species was not flowering at the time of survey and the sterile plant is similar to other *Grevillea* species it is highly likely that additional individuals occur. **Populations**: 1 **Habitat**: Occurs in one vegetation type: • **Mc shrubland** (*Melaleuca cardiophylla* shrubland)	
Stackhousia umbellata				
	Description (WAH 2018; WAH & DBCA 2018)	**Habitat (WAH 2018; WAH & DBCA 2018)**	**Survey results**	**Photograph**
Priority 3	*Stackhousia umbellata* is a leafless, spreading perennial herb to 0.5 m high with yellow flowers. In the survey area this species was up to 0.7 m high and usually, but not always, emergent from *Triodia wiseana* hummocks.	Occurs in sandy soils on limestone. Within the survey area it occurred on limestone rocky areas with virtually no loose substrate. Associated vegetation from *FloraBase*: 'low shrubland over *Triodia* (Spinifex)', 'low trees over Spinifex', '*Triodia wiseana* and *Dampiera incana*, *Melaleuca cardiophylla* low open heath', '*Acacia bivenosa* and *A. pyrifolia*'. Distribution: Carnarvon IBRA region, Cape Range subregion.	**Records**: This species occurred as a continuous population in exposed limestone on the Cape Range (excluding scree or disturbed areas). In any given area in the relevant landform this species was at a density of 2-20 plants per 100 m^2, tending to lower densities on coastal, north or west-facing slopes. **Populations**: continuous on exposed limestone. **Habitat**: Occurs in one vegetation type: • **Mc shrubland** (*Melaleuca cardiophylla* shrubland)	

Brachychiton obtusilobus				
	Description (WAH 2018; WAH & DBCA 2018)	**Habitat (WAH 2018; WAH & DBCA 2018)**	**Survey results**	**Photograph**
Priority 4	*Brachychiton obtusilobus* is a small tree 3.5-6 m high when mature, with cream flowers and large star-shaped fruit. Within the survey area specimens ranged from approximately 1.5 m high to 3-4 m high.	Occurs on limestone ranges, in gorges and occasionally sandplains. Within the survey area the species was recorded from limestone ranges, within minor gorges and on exposed limestone ridges often above gorges. Associated vegetation: largely undocumented in *FloraBase* records. Broad associated vegetation includes 'low tree and shrub vegetation', 'open shrub – *Triodia* steppe', 'Spinifex and scrub'. Distribution: Carnarvon IBRA region, Cape Range subregion.	**Records**: Recorded from four locations (five plants). **Populations**: one (two subpopulations approximately 375 m apart, separated by a significant landscape feature) **Habitat**: Occurs in two vegetation types: • **Mc shrubland** (*Melaleuca cardiophylla* shrubland) • **AbSaAt shrubland** (*Acacia bivenosa*, *Senna artemisioides* and *Acacia tetragonophylla* shrubland)	

Threatened and Priority Flora Report Forms are included in **Appendix Four**.

4.1.2.2 Significant Flora

Recorded flora that are considered significant within the study area and according to the criteria outlined in the *Flora and Vegetation Technical Guidance* (EPA 2016c):

- *Banksia ashbyi* subsp. *boreoscaia*; range edge for the genus *Banksia* (except for tropical species) and for this species and subspecies
- *Hibbertia spicata* subsp. *spicata*; part of a known disjunct population, separated from the main southwest distribution by approximately 500 km
- *Olax aurantia*; part of a known disjunct population, separated from the main southwest distribution by approximately 500 km
- *Owenia reticulata*; range extension of over 100 km (according to the distribution illustrated on *NatureMap*, DPAW 2007-2018)
- *Paraneurachne muelleri*; range extension of over 100 km
- *Synostemon rhytidospermus*; range extension of over 100 km.

None of the above are of conservation significance.

4.1.2.3 Flora of Taxonomic Interest

No flora species collected from within the survey area are of any specific taxonomic interest.

Due to the survey area location many species are at the northern, southern or western extremity of their natural range and as such their physiological features are also at the extremity of their range (e.g. size and shape of features, degree of hairiness).

Only one taxon was considered as potentially of taxonomic interest. *Alyogyne* aff. *pinoniana*, as it is known in this report, exhibited only slightly lobed leaves, whereas most specimens of *Alyogyne pinoniana sensu stricto* housed in the Western Australian Herbarium exhibited more deeply divided, crenulate-margined leaves. One specimen in the Herbarium, also from Cape Range (J. English 204), was considered to match the specimens collected during this survey suggesting there may be variation within the species confined to this area.

4.1.2.4 Taxonomic Note

This report incorporates taxonomy as currently listed on *FloraBase* (Western Australian Herbarium 1998-August 2018). Accordingly, one of the *Triodia* species occurring within the survey area has been listed as *T. schinzii* within this report, however, according to the taxonomy in *SpiKey* (Barrett *et al.* 2018) is more accurately known as *T. avenoides*. *T. avenoides*, in *SpiKey*, is described as being endemic to sandy soils in the western Pilbara and Carnarvon bioregions.

There is no conservation significance accorded to either taxa.

4.1.2.5 Introduced Flora

The immediate environs of the Ningaloo Lighthouse Holiday Park was not included in the survey.

Eight introduced flora species (weeds), representing 4.76% of the total flora species, were recorded during the field survey. Buffel Grass (**Cenchrus ciliaris*) was the most commonly recorded introduced species occurring in 12 of 19 quadrats and relevés, and was a major contributor to vegetation condition assessment of Very Good being the highest (best) vegetation condition score recorded for all areas near the Holiday Park and near roads and other infrastructure.

One Declared Pest plant and WONS species was recorded; a single **Tamarix aphylla* clump (most likely a single, large plant, **Plate 1**) was recorded on the beach north of the Holiday Park. It is unknown if this was deliberately planted, however, given its position at the end of a minor creek draining from the nearby Holiday Park where this species is the most common planted shade tree and wind break, it is likely to have invaded the area. However, despite being listed as a Declared Pest and WONS weed, there are no management requirements.

None of the other recorded introduced species have any specific significance i.e. they are not Declared Pest plants or WONs species.

According to DPaW's (2016) Weed Prioritisation Process for (DBCA) Pilbara region, the introduced species recorded from the survey area have the following attributes:

- **Aerva javanica*: High ecological impact, Rapid invasiveness
- **Bidens subalternans* var. *simulans*: not listed. Other *Bidens* species are Unknown ecological impact, Rapid invasiveness.
- **Cenchrus ciliaris*: High ecological impact, Rapid invasiveness
- *Unidentified succulent: not able to determine similar species but unlikely to be significant for ecological impact or invasiveness (**Plate 2**)
- **Passiflora foetida*: High ecological impact, Rapid invasiveness
- **Phoenix dactylifera*: High ecological impact, Rapid invasiveness
- **Sonchus oleraceus*: Low ecological impact, Rapid invasiveness
- **Tamarix aphylla*: High ecological impact, Rapid invasiveness.

Plate 1: *Tamarix aphylla*

Plate 2: *Unidentified succulent

Weed locations are shown on **Map 5**.

4.1.3 BOTANICAL LIMITATIONS

Survey design: Single phase, quadrat-based flora and vegetation survey with extensive traverses through the survey area searching for conservation significant flora.

Survey type: Detailed flora and vegetation survey with extensive searches for conservation significant flora searches conducted over a single phase. Where possible (except for scree sites where it was unsafe to traverse and areas with only a small extent), at least three quadrats or detailed relevés were recorded per vegetation type.

Type of vegetation classification system: Vegetation classified at NVIS Level V (ESCAVI 2003) using largely structural vegetation types defined using dominant and characteristic species and vegetation structure as recorded during the field surveys. Floristic analysis was used to identify major floristic groups and outlier groups of floristic interest.

Table 7: Botanical limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Availability of contextual information at a regional and local scale	Moderate	There were few references to flora and vegetation surveys that have been conducted in the general vicinity, and to Ecoscape's knowledge none have been conducted in areas corresponding with the survey area.

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Competency/experience of the team conducting the survey, including experience in the bioregion surveyed	Negligible	The botanist conducting the field survey has over 30 years' experience conducting flora and vegetation surveys in Western Australian Wheatbelt, although has conducted only one previous survey in the Exmouth area.
Proportion of the flora recorded and/or collected, and any identification issues	Negligible	A total of 169 flora taxa were recorded during the field survey of which only 16 (9.5%) were not identifiable due to lack of reproductive material. Although this is a relatively high proportion of unidentified taxa, a significant number were annual grasses that had not yet flowered and at least two are likely to be uncommon forms of otherwise common species, but without reproductive material this could not be confirmed. None of the unidentified species are similar to any currently defined conservation significant species. The total of 169 taxa is a significant portion (approximately 50%) of all previous records from the survey area (196 vascular flora species are listed as having previously been recorded from within a 10 km search radius of the survey area using a *NatureMap* search; approximately 100 of these were recorded during this survey).
Was the appropriate area fully surveyed (effort and extent)	No	The survey area was covered sufficiently to develop a thorough understanding of the flora and vegetation. Three relevés were recorded rather than floristic quadrats due to safety considerations (one on scree slopes) and two due to time constraints; these areas also did not have three quadrats/relevés recorded within them, however, are unlikely to be developed thus is not considered a constraint. Additionally, one vegetation type that was only identified as unique following floristic analysis had only one quadrat recorded within it. This area will not be developed as it is immediately above the high water mark, thus is also not considered a constraint. However, the survey effort in these areas was sufficient to accurately detail the vegetation and floristic composition.
Access restrictions within the survey area	No	All remnants within the potential impact area were fully accessible.
Survey timing, rainfall, season of survey	Negligible	The field survey was conducted in July which is outside the season considered optimal for survey in the Carnarvon bioregion. However, there was little summer rainfall, but significant rain in the period leading up to the field survey (**Figure 3**), and most perennial species were flowering. Most annual species had not yet commenced flowering and are underrepresented in the flora inventory, however, none of the conservation significant species likely to occur, as identified by the database searches of previous records, are annuals thus constraints relating to this aspect are considered negligible.
Disturbance that may have affected the results of the survey e.g. fire, flood, clearing	No	There were no recent disturbances that could have affected the survey.

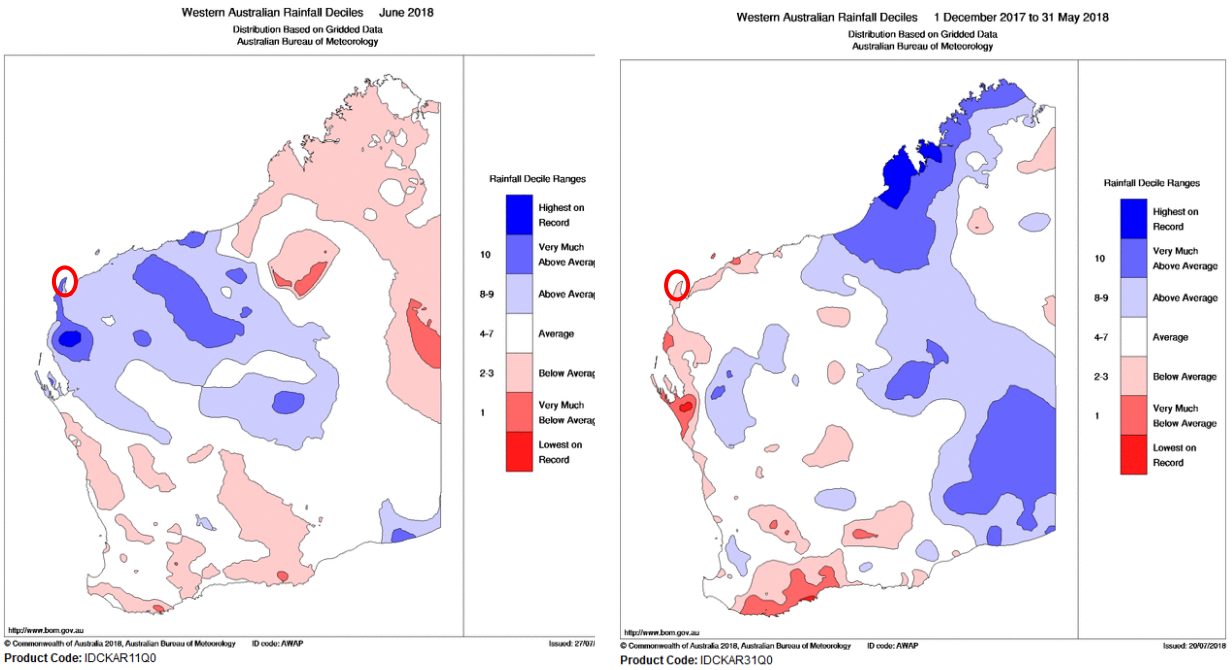

Figure 3: Rainfall deciles for the month prior to the field survey (left) and 6 months prior to June (BoM 2018b)

4.2 FAUNA SURVEY

4.2.1 FAUNA HABITAT

Five fauna habitat types were recorded from within the survey area, described in **Table 8**. None of the habitat types are confined to the survey area and all occur commonly in areas adjacent to the survey area. The most confined of these habitat types are those associated with the red Pindan dunes, that while occupying an estimated 3,500 ha in the local area (including approximately 22 ha within the survey area), are isolated by at least 40 km from the nearest similar habitat type.

Table 8: Fauna habitat type descriptions

Habitat type	Description	Photo
Dune crest	The eastern and south eastern portion of the survey area, east of the Cape Range, was occupied by red sand dunes, known as Pindan dunes, of aeolian origin. The dune crests formed roughly parallel north-south ridges and were vegetated with low shrubs and Spinifex (*Triodia*) hummock grasses with extensive bare areas. Except directly under more dense shrubs, and within the Spinifex hummocks, there is virtually no leaf litter, and due to the lack of trees, no logs are present. The dune crests formed significant habitat for some of the reptile assemblage, including *Aprasia rostrata* (Ningaloo Worm-lizard, P3) and birds, particularly when *Banksia ashbyi* is flowering. Extent: 3.61 ha	

Habitat type	Description	Photo
Dune swale	The red Pindan dune swales of the eastern and south eastern portion of the survey area were vegetated largely by Spinifex (*Triodia*) hummock grasses, with varying cover of low to medium (less than 2 m high) shrubs (and rarely mallees) and extensive bare soil areas. Except directly under more dense shrubs, and within the Spinifex hummocks, there is virtually no leaf litter. Low trees or mallees are only very sparsely present thus there are no logs in most areas, and only very small logs in the mallee patches. The dune swales formed significant habitat for some of the reptile assemblage including *Ctenophorus* species (Dragon Lizards) and *Aprasia rostrata* (Ningaloo Worm-lizard, P3). The occasional mallee provided habitat for the smaller bird species. Extent: 17.89 ha	
Rocky hills and slopes	The rocky hills and slopes of the Cape Range, with extensive areas of exposed limestone and loose limestone rocks, were vegetated largely by low shrubs and Spinifex (*Triodia*) hummock grasses. Leaf litter is almost entirely absent and there are no logs present in this habitat. The loose limestone rocks provide significant habitat for much of the reptile assemblage including *Diplodactylus capensis* (Cape Range Stone Gecko, P2). Extent: 47.14 ha	

Habitat type	Description	Photo
Sheltered gullies and minor caves	The rugged limestone Cape Range had a small number of sheltered gullies that included minor caves, providing shaded habitat for fauna species. Minor caves also occurred around the knoll with the Vlamingh Head Lighthouse. The vegetation within these gullies included taller shrubs and small trees (e.g. *Acacia tetragonophylla*, *Ficus brachypoda*), as well as low shrubs and Spinifex (*Triodia*) hummock grasses. Leaf litter was present in some of the more sheltered areas, not including the minor creeklines that formed these gullies. The sheltered gullies, and in particular the minor caves, provided habitat for reptiles including *Lerista allochira* (Cape Range Slider, P3) and *Diplodactylus capensis* (Cape Range Stone Gecko, P2), and small mammals including *Pseudantechinus roryi*. In areas more isolated from human contact, the gullies would provide habitat for *Petrogale lateralis* (Black-flanked Rock Wallaby, EN), however, the Wallaby was not present within the survey area. Extent: 1.19 ha	
Coastal dunes	The coastal dunes are largely stable and vegetated with hummock grasses (most frequently Soft Spinifex, *Triodia epactia*) with occasional Coastal Spinifex (*Spinifex longifolius*) and dense clumps of shrubs (*Acacia coriacea*, *Ficus brachypoda*, *Rhagodia preissii*). Bare areas of white beach sand, including exposed dune slopes, also occur commonly in the more windy areas, close to the beach and where human foot traffic has caused erosion. There is virtually no leaf litter present, except under the dense shrubs and within grass hummocks and tussocks. The coastal dunes provide habitat for a significant portion of the reptile assemblage including *Aprasia rostrata* (Ningaloo Worm-lizard, P3). Extent: 27.72 ha	

4.2.2 FAUNA ASSEMBLAGE

Forty six vertebrate fauna species, listed in **Table 9**, were recorded during the field survey from opportunistic observations, during targeted searches, motion camera records and secondary signs, consisting of six mammals (three introduced), 28 birds and 12 reptiles. Of these, two were of conservation significance:

- *Pandion haliaetus* (Osprey, protected under international agreements), observed flying over the lighthouse and perched on a pole at the Holiday Park
- *Lerista allochira* (Cape Range Slider, P3), observed close to the edge of the survey area on the western side of Cape Range.

Table 9: Recorded fauna species

Species	Common name	Cons. Code	Naturalised
Mammals			
Felis catus	Feral Cat		Y
Oryctolagus cuniculus	Rabbit		Y
Osphranter robustus	Euro		
Ovis aries	Sheep		Y
Pseudantechinus roryi			
Tachyglossus aculeatus	Short-beaked Echidna		
Reptiles			
Gehyra pilbara	Pilbara Dtella		
Lerista allochira	Cape Range Slider	P3	
Lerista bipes	North-western Sandslider		
Lerista elegans	Elegant Slider		
Lerista macropisthopus subsp. *fusciceps*	Unpatterned Robust Slider		
Lerista miopus	Northern Dotted-line Robust Slider		
Lerista planiventralis	Keeled Slider		
Menetia greyii	Common Dwarf Skink		
Morethia lineoocellata	West Coast Morethia Skink		
Morethia ruficauda subsp. *exquisita*	Lined Firetail Skink		
Notoscincus ornatus	Ornate Soil-crevice Skink		
Simoselaps bertholdi	Jan's Banded Snake		
Birds			
Aquila audax	Wedge-tailed Eagle		
Calamanthus campestris	Rufous Fieldwren		
Chroicocephalus novaehollandiae	Silver Gull		
Chrysococcyx basalis	Horsefield's Bronze-cuckoo		
Circus assimilis	Spotted Harrier		
Coracina novaehollandiae	Black-faced Cuckoo-shrike		
Corvus orru	Torresian Crow		
Cracticus nigrogularis	Pied Butcherbird		
Dromaius novaehollandiae	Emu		
Elanus axillaris	Black-shouldered Kite		
Emblema pictum	Painted Finch		
Falco berigora	Brown Falcon		
Falco cenchroides	Australian Kestrel		
Gavicalis virescens	Singing Honeyeater		
Haliastur sphenurus	Whistling Kite		
Lalage tricolor	White-winged Triller		
Lichmera indistincta	Brown Honeyeater		
Malurus leucopterus	White-winged Fairy-wren		
Manorina flavigula	Yellow-throated Miner		
Merops ornatus	Rainbow Bee-eater		
Pandion haliaetus	Eastern Osprey	IA	

Species	Common name	Cons. Code	Naturalised
Pardalotus rubricatus	Red-browed Pardalote		
Pardalotus striatus	Striated Pardalote		
Poodytes carteri	Spinifexbird		
Ptilonorhynchus guttatus	Western Bowerbird		
Rhipidura leucophrys	Willie Wagtail		
Stipiturus ruficeps	Rufous-crowned Emu-wren		
Taeniopygia guttata	Zebra Finch		

Fauna locations are included in **Table 22** in **Appendix Seven**.

4.2.3 FAUNA SURVEY LIMITATIONS

The limitations of the Level 1 fauna survey are summarised in **Table 10** below. There were no or negligible constraints in relation to survey adequacy.

Table 10: Fauna survey limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Competency/experience of the consultant conducting the survey	No	The fauna field surveyor was experienced with the fauna survey methods used and with the identification of fauna taxa.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	The survey was conducted as a Level 1 fauna assessment. Sufficient time was allocated to the fauna survey, which included active diurnal searches, a nocturnal search and motion cameras, to adequately describe the fauna assemblage present in the survey area.
Proportion of fauna identified, recorded and/or collected.	No	All fauna species opportunistically observed were identified in the field.
Sources of information (previously available information as distinct from new data).	Negligible	Few sources referencing field surveys in the vicinity were available. None to negligible constraints were associated with this lack of previous data.
The proportion of the task achieved and further work which might be needed.	No	The survey area was adequately searched.
Timing/weather/season/cycle.	Negligible	The timing of the field survey was within a period suitable to identify most components of the expected fauna assemblage, if they were present on site. A small number of expected species, including *Diplodactylus capensis* (Cape range Stone Gecko, P2) were not active as temperatures were not sufficiently high, however, this constraint is considered negligible. The seasonal conditions were suitable for fauna survey with warm daytime temperatures and fine weather during the survey period.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	Negligible	One motion camera was moved by human intervention. However, the camera's location in a position close to human use (lighthouse lookout) would have restricted the suite of fauna present, thus this constraint is negligible to none.
Intensity (in retrospect was the intensity adequate).	No	The survey was considered suitable to determine the presence or potential presence of conservation significant fauna.
Completeness (e.g. was relevant area fully surveyed), remoteness and/or access problems	No	The entire survey area was adequately searched and was entirely accessible.

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Resources (e.g. degree of expertise available in animal identification to taxon level).	No	Field staff has over 10 years' experience identifying fauna. All terrestrial vertebrate fauna were identified to species level.
Availability of contextual (e.g. biogeographic) information on the region).	Negligible	Few fauna surveys appear to have been conducted in the general region i.e. the Cape Range subregion of the Carnarvon IBRA region. However, there is 1990s literature available describing the suite of species present at that time, giving context to the discussion in this report.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	No	The survey was conducted as a Level 1 fauna assessment. All fauna species opportunistically observed were identified in the field. The survey did not include marine or subterranean species, nor invertebrates.

5 DISCUSSION

5.1 VEGETATION SIGNIFICANCE

Seven vegetation types were recorded as occurring within the survey area, corresponding with three major habitat types.

5.1.1 COASTAL ZONE VEGETATION

Two vegetation types were recorded from the white beach sands in the coastal zone. One occurred on the foredunes above the high water mark (**TeSlWa grassland**; *Triodia epactia*, *Spinifex longifolius* and *Whiteochloa airoides* grassland); the other occurred on the taller stable hind dunes (**AcRp shrubland**; *Acacia coriacea* and *Rhagodia preissii* shrubland). Both were observed to occur commonly on the northern and western shores of the North West Cape peninsula outside the survey area. Similar vegetation is considered to be widespread and has been reported from near Learmonth (360 Environmental 2017), adjacent to Exmouth (Astron Environmental Services 2009), to a degree, near the entrance to the Cape Range National Park (Pit One; Meissner 2010a), and along the coast to the west of Cape Range (Pringle 1987).

Neither of the recorded vegetation types have any conservation significance i.e. they are not representative of any currently described TEC or PEC, nor are they considered to have any regional or local significance. These vegetation types are represented within the conservation estate in Jurabi Coastal Park and Cape Range National Park.

5.1.2 VEGETATION OF THE LIMESTONE HILLS OF CAPE RANGE

Four vegetation types were recorded from the limestone hills of Cape Range. The most commonly occurring vegetation type is **Mc shrubland** (*Melaleuca cardiophylla* mid open shrubland) on the Cape Range limestone slopes and crests, including the southern survey area and between this and the main survey area. Similar vegetation is considered to be widespread and has been reported within the Cape Range (Meissner 2010a; 2010b).

Two vegetation types are restricted in extent due to their association with landforms that are restricted in extent.

Vegetation type **AbSaAt shrubland** (*Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Acacia tetragonophylla* shrubland) was recorded from minor gorges in the Cape Range limestone. The gorges within the survey area are small and offer only a limited amount of shelter. All characteristic species are common within the broader landform, and gorges of various significance are widespread within the Range (Meissner 2010b), and were observed as commonly occurring adjacent to the southern survey area (**Plate 3**).

Vegetation type **Ab shrubland** (*Acacia bivenosa* shrubland) occurs on the north and west-facing scree slopes near Vlamingh Head Lighthouse. Essentially this vegetation type is a somewhat species-poor version of **Mc shrubland** and, while of restricted extent, is considered widespread within Cape Range.

These vegetation types would be represented within the conservation estate in Cape Range National Park. The gorges have been reported as having diverse floristics (Pringle 1987), and herein are considered locally significant for that reason.

Vegetation type **AbFb shrubland** (*Acacia bivenosa* and *Ficus brachypoda* shrubland) occurs in the interzone between the Cape Range and beach, and is described as being in the Jurabi Terrace System by Pringle (1987). Pringle's dissertation made no further reference to vegetation of this landform having any floristic significance, and it is likely that this landform and therefore similar vegetation occurs along the western face of the Range into Cape Range National Park.

None of the recorded vegetation types have any formal conservation significance, and although endemic to the Cape Range, are considered to be widespread within and adjacent to the Range that extends for approximately 80 km to the south. These vegetation types are represented within the conservation estate in the Cape Range National Park.

Plate 3: Minor gorges from the southern survey area

5.1.3 VEGETATION OF THE RED PINDAN DUNES

A single vegetation type, recorded from the red Pindan dunes (**Plate 4**) on the east and southeast of the survey area, **BaDp shrubland** (*Banksia ashbyi* and *Daviesia pleurophylla* shrubland), is substantially similar to described vegetation from the same area in other documents (Keighery & Gibson 1993; Meissner 2010a; 2010b; Pringle 1987).

Although this vegetation type does not have any formal conservation significance, all previous surveys that have included this landform and the vegetation upon it have considered the vegetation to be of significance for various reasons including it being confined to a restricted landform (Meissner 2010a; 2010b), or having unique floristic composition (Keighery & Gibson 1993; Pringle 1987).

Red sand dunes occur to the south of survey area, however, Meissner (2010b) contends that these northern dunes have a different floristic composition to the southern dunes. She reports that the northern dunes are represented by a small (approximately 50 ha) area within the Jurabi Coastal Park but is otherwise not protected and corresponds with UCL.

Ecoscape concurs with these assessments of significance and consider this vegetation type to be at least locally and potentially regionally significant. It may also be significant as habitat for *Daviesia pleurophylla* (P2).

Plate 4: Red Pindan dunes

5.1.4 VEGETATION CONDITION

The vegetation ranged in condition from Degraded, in areas close to roads and the powerline, to Excellent with no obvious signs of disturbance.

Sandy soils tended to have the lesser vegetation condition ratings, with the best recorded condition being Very Good due to weed invasion. Buffel Grass (**Cenchrus ciliaris*) is the main cause of vegetation condition being recorded as Very Good or lesser condition.

The limestone hills and crests of the survey area, except where adjacent to areas of human disturbance, appeared to be more resistant to the invasion of Buffel Grass, except in localised areas including gorges that have areas of softer, sandy soil. Buffel Grass, **Bidens subalternans* var. *simulans*, Stinking Passion Flower **Passiflora foetida* and Common Sowthistle **Sonchus oleraceus* were recorded from gorges. There is a sewerage pipe from the Holiday Park to the nearby evaporation ponds; this localised area was also associated with weed invasion and was in lesser condition than the surrounding area. Kapok Weed (**Aerva javanica*), Buffel Grass and Common Sowthistle **Sonchus oleraceus* were recorded adjacent to the pipeline.

5.2 FLORA SIGNIFICANCE

A total of 169 vascular flora species were recorded from the survey area, including 10 that could not be identified with certainty due to lack of reproductive material. The species accumulation curve using quadrat and relevé data indicates that additional species would have been recorded with additional survey, however, the Bootstrap calculation indicates that, when taking opportunistic observations into account, most species would have been recorded. Ecoscape acknowledges that additional annual species would occur within the survey area, however, none of the species potentially occurring are likely to be of significance.

A *NatureMap* (DPAW 2007-2018) search of all flora species using a 10 km buffer around the survey area identified 210 flora species have been recorded from within the *NatureMap* search area. Of these, 11 are seaweeds and four are listed twice (*sens. lat.* and subtaxa), therefore 196 vascular flora species are known to occur (i.e. have been collected and vouchered with the Western Australia Herbarium) within the vicinity of the survey area. None are endemic to the search area.

Of Ecoscape's 169 vascular flora species, approximately 100 of these are represented in the *NatureMap* list and approximately 60 are new collections, indicating the adequacy of this brief survey in relation to previous surveys (noting that not all of these new collections will be submitted to the herbarium for vouchering as not all meet the required standards due to inadequate material or are common species adequately represented overall).

5.2.1 CONSERVATION SIGNIFICANT FLORA SPECIES

No TF species listed for protection under the Commonwealth EPBC Act or Western Australian WC Act were recorded from the survey area. No TF species were identified as being known to occur within 50 km of the survey area, therefore no TF species were likely to occur within the survey area.

Six PF species were identified with certainty from within the survey area, and a seventh highly likely but could not be confirmed due to lack of reproductive material:

- *Daviesia pleurophylla* (P2), which was a dominant and characteristic species on the red Pindan dunes; see below for discussion regarding this species.
- *Tinospora esiangkara* (P2), which was recorded from two locations (two plants), one on the red Pindan dunes and one on the western face of Vlamingh Head, in exposed limestone. See discussion below.
- *Corchorus ?congener* (P3, not confirmed but considered likely) was recorded from one location on coastal dunes. This species is represented by 140 records on *NatureMap* and has a southwest-northeast distribution of approximately 475 km.
- *Eremophila forrestii* subsp. *capensis* (P3) occurred occasionally, generally in small groups of 2-6 plants, on exposed limestone. This taxon is represented by eight records on *NatureMap*, all of them on the North West Cape, with a north-south distribution of approximately 50 km. Six of these records are located within the conservation estate.
- *Grevillea calcicola* (P3) was recorded from one quadrat on exposed limestone; this species was not flowering at the time of survey and additional plants are likely to occur in similar areas. *Grevillea calcicola* has a north-south distribution of approximately 70 km, and approximately half of the 15 *NatureMap* records are from within the conservation estate or lands that are of conservation interest and have potential to be added to the conservation estate in the future. It has been previously recorded from within the survey area.
- *Stackhousia umbellata* (P3) was a characteristic species from areas of exposed limestone and, in any given area within the habitat range, occurred at a density of 2-20 plants per 100 m^2. There are 15 records of this species listed on NatureMap, all except one from the North West Cape Peninsula within an approximate 110 km north-south range, with an outlier record from the Dampier Archipelago approximately 280 km to the northeast.
- *Brachychiton obtusilobus* (P4) occurred on limestone, generally close to or within minor gorges but in the more exposed parts. Thirteen records of this species are listed on *NatureMap*, all from within the North West Cape peninsula, within an approximate 60 km north-south range. Approximately half are located within conservation estate.

Of these, the two P2-listed species are considered the most significant and are discussed below.

Daviesia pleurophylla (P2)

Daviesia pleurophylla is known from seven records listed on *NatureMap* (DPAW 2007-2018), and has a north-south distribution of approximately 70 km. Five of these records are from within 8 km of the survey area. All records with collecting information confirm that this species occurs on red dunes.

According to Meissner (2010b) red dunes are largely not included in the conservation estate (although a small extent is apparently within the Jurabi Coastal Park) therefore species restricted to this landform are unlikely to be significantly represented within the conservation estate. One of the *NatureMap* records is located within conservation estate; a 1970 collection from near Yardie Creek (in an area that, on aerial imagery, appears to be red sand dunes although Meissner (2010b) contends that these dunes are floristically different). There is no record of how many plants were in the population and it is unknown if this plant/population is still extant.

However, the overall lack of records of this species implies that, as well as being poorly known and under-represented within the conservation estate, this species is likely to be geographically restricted and also of significance for that reason.

Tinospora esiangkara (P2)

Tinospora esiangkara is represented by nine records on *NatureMap* (DPAW 2007-2018), all within a 30 km north-south range on the North West Cape peninsula, although this record would extend this range by approximately 20 km. Only one of the *NatureMap* records is associated with the conservation estate.

Two plants of this species were recorded during this survey; one within a floristic quadrat on red Pindan sand and one during targeted searches (site traverses) on limestone, although it is possible that additional plants occur as the plant itself is not significant or showy, and is similar in structure to other climbing species within the survey area.

Of the vouchered specimens of *Tinospora esiangkara*, only two location records have plant numbers listed (one plant and three plants), suggesting that it is sparsely distributed where it occurs, as was observed during this survey. Meissner (2010a; 2010b) recorded this species in her surveys on the North West Cape peninsula and comments in her survey reports also suggest that this species is sparsely distributed where it occurs. However, no specimens from her surveys have been vouchered.

This species also occurs in the Northern Territory, in Kakadu National Park and Arnhem Land, and in Queensland from Cooktown and northwards, including on Torres Strait islands.

5.2.2 OTHER CONSERVATION SIGNIFICANT SPECIES

A number of other conservation significant flora species were considered to have a 'Possible' likelihood of occurring within the survey area based on their known distribution, habitat as described on *FloraBase* and in specimen records (WAH 1998-2018) and habitat available within the survey area (**Table 17** in **Appendix Two**), but were not recorded during the field survey. While it is possible that these occurred but were overlooked, most are not known to occur within 10 km of the survey area (*Acanthocarpus rupestris*, *Harnieria kempeana* subsp. *rhadinophylla*, *Tephrosia* sp. North West Cape (G. Marsh 81) (all P2), *Acacia alexandri* (P3)) thus, although possible are less likely to occur, or if they do, are more likely to occur only sparsely.

One species, *Phyllanthus fuernrohrii* (P3), has previously been recorded within 10 km of the study area and, based on the factors used for the likelihood assessment, has a higher probability of occurring. However, the records from close to the survey area are from the 1960s, thus this species has not been recently recorded from within the vicinity of the survey area. *NatureMap* (DPaW 2007-2018) shows an approximate 470 km north-south distribution from Dirk Hartog Island northwards to North West Cape and its absence from the survey area is unlikely to be of significance.

5.2.3 OTHER SIGNIFCANT FLORA SPECIES

The vascular flora of the area is known to have both southern, temperate and eremaean, arid and semi-arid, affinities (Keighery & Gibson 1993), and many species from either of these zones are at either the northern (for southern species) or southern (for eremaean species) end of their natural range. Geographically, all species are at the western extent of their distribution due to the survey area location. Physical characteristics of many species, including attributes such as leaf size and shape, and the amount of hairiness of some species, were also at the extremes of their recorded physiological ranges. Consequently many species were compared with a range of specimens within the Western Australian Herbarium to confirm their identity.

Notwithstanding the above, species that can be considered of greatest significance according to the EPA (2016c) *Flora and Vegetation Technical Guidance* are:

- *Alyogyne* aff. *pinoniana*, as it is known in this report, is of significance as it displays anomalous features in respect to its leaf shape. The only other record of this taxon *sensu. stricto*. in the Western Australian Herbarium from the vicinity also displays these anomalous features, thus it is possible that there may be sufficient taxonomic variation to suggest that it may be a new species or subtaxon.
- *Banksia ashbyi* subsp. *boreoscaia*; the genus *Banksia* consists largely of temperate species, with a few from the arid zone and tropical areas including eastern Australian rainforests, northern Australia and New Guinea (Australian National Botanic Gardens & Centre for Australian National Biodiversity Research 2015).

This taxon represents the most northern extent of the temperate Banksias in Western Australia (red arrow on **Figure 4**).

- *Hibbertia spicata* subsp. *spicata*; this species occurs as part of a known disjunct population, separated from the main southwest distribution by approximately 500 km. Within the survey area it was a widespread and characteristic species of the shrublands on limestone.
- *Olax aurantia*; the records from the North West Cape peninsula form a known disjunct population, separated from the main southwest distribution by approximately 500 km; this species was sparsely distributed on the red Pindan dunes
- *Owenia reticulata*, this is the first record from the peninsula and a range extension of over 100 km to the nearest record on *NatureMap* (DPaW 2007-2018). It was sparsely distributed on the red Pindan dunes.
- *Paraneurachne muelleri*; this is the first record of this wide-ranging species from the peninsula and a range extension of over 100 km. It was recorded from one quadrat on limestone.
- *Synostemon rhytidospermus*; range extension of over 100 km. It was observed occurring sparsely in cracks on limestone slopes, in shrubland vegetation.
- Only one taxon was considered as potentially of taxonomic interest. *Alyogyne* aff. *pinoniana*, as it is known in this report, exhibited only slightly lobed leaves, whereas most specimens of *Alyogyne pinoniana sensu stricto* housed in the Western Australian Herbarium exhibited more deeply divided, crenulate-margined leaves. One specimen in the Herbarium, also from Cape Range (J. English 204), was considered to match the specimens collected during this survey suggesting there may be variation within the species confined to this area.

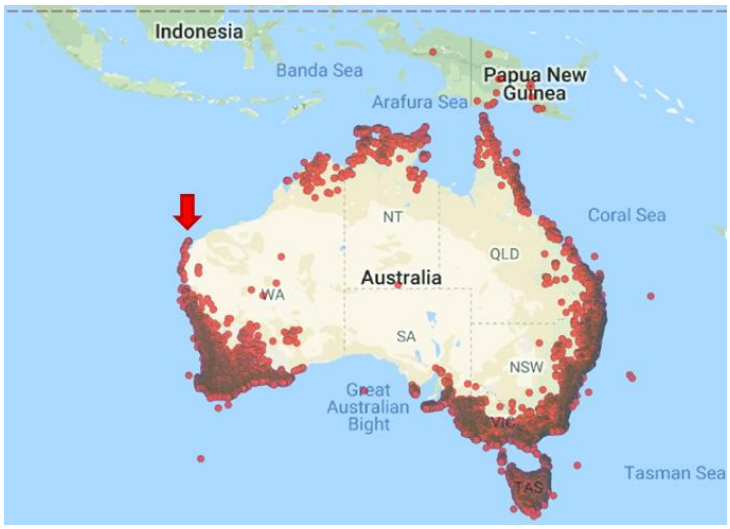

Figure 4: *Banksia* distribution (Atlas of Living Australia 2018)

5.3 FAUNA

5.3.1 FAUNA HABITAT SIGNIFICANCE

Five fauna habitat types were recorded from within the survey area, consisting of two types on the red Pindan dunes (dune crest and swale), two types on limestone (rocky hills and slopes, and sheltered gullies and minor caves), and coastal dunes.

Each of these habitat types suits various suites of reptiles, mammals and birds.

Beaches were not included in the survey area, nor shoreline rocks/reef areas. Many of the conservation significant species (birds) identified from the database searches as having been recorded within the vicinity of the survey area are listed as being protected under international agreements (**Table 20** in **Appendix Two**). These are unlikely to land within the survey area itself as most species are shorebirds, only landing on beaches, or would only overfly the area to get to the shoreline. None would be dependent on the survey area.

The exception is the Osprey (*Pandion haliaetus*) which was recorded as perching within the survey area during this survey. Despite this, this species would not be dependent on the survey area to provide food or as habitat, and no evidence of nesting activity was observed.

Coastal dune habitats are widespread along the coastline, and not restricted in extent. Only one conservation significant reptile species (*Aprasia rostrata*, Ningaloo Worm-lizard, P3) is known to occur on the coastal dunes, however, it also occurs in other sandy habitats (including the red Pindan dunes within the survey area), and is not dependent on the coastal dunes. This species was not recorded during the survey but is considered likely to occur.

On a regional basis, the red Pindan dunes and their two habitat types are the most restricted in extent. Fauna species, particularly reptiles, are likely to require the sandy soils of this habitat, however, none of the species likely to occur are dependent on this habitat type within the survey area. No species of conservation significance were recorded in the red Pindan dunes during the field survey, although *Aprasia rostrata* , (Ningaloo Worm-lizard, P3) is likely to occur.

The limestone Cape Range provides the most prominent habitat types within the survey area, and was present within the main survey area and the southern survey area, and in between these two areas. A number of conservation significant fauna species have been previously recorded from the limestone hills, and in particular the sheltered gorges and minor caves. Endangered *Petrogale lateralis* (Black-flanked Rock Wallaby) are dependent on the gorges and minor caves, however, were not recorded within the survey area and are unlikely to occur due to the amount of human activity in the area, the small areas of available gorge habitat and that the survey area is on the edge of the species' potential local range. It may occur close to the southern survey area but not observed, and is far more likely to occur further south where there are larger gorges. Two conservation significant lizards, *Lerista allochira* (Cape Range Slider, P3), which was recorded from close to the survey area during the field survey, and *Diplodactylus capensis* (Cape Range Stone Gecko, P2), are known from the limestone habitat types.

No fauna species inhabiting or likely to inhabit the survey area is dependent on the survey area.

The survey targeted terrestrial species, thus subterranean species were not included. Two subterranean species of conservation significance were identified as occurring close to the survey area although not within it; *Milyeringa veritas* (Cave Gudgeon, Blind Gudgeon) and *Ophisternon candidum* (Blind Cave Eel). Both are listed as Vulnerable under the Commonwealth EPBC Act. It is unknown if either would actually occur within the karst cave system under the survey area, or even if there are caves under the survey area as this was beyond the scope of this project.

5.3.2 FAUNA ASSEMBLAGE

Forty six vertebrate fauna species were recorded during the field survey.

Six mammals were recorded, none of which were of conservation significance and three of which were introduced (Cat, Rabbit, Sheep). The native species were Euro (*Osphranter robustus*) and Echidna (*Tachyglossus aculeatus*), both of which are common, frequently encountered, highly visible and wide-ranging and not requiring specific habitat types, and *Pseudantechinus roryi*, which was recorded on motion camera in a minor cave to the east of the Vlamingh Head Lighthouse. This small carnivorous marsupial is not of conservation significance and has a range extending from the North West Cape peninsula, which is a disjunct population, through the Pilbara, Great Sandy Desert, Little Sandy Desert, Gibson Desert and Great Victoria Desert bioregions (DPaW 2007-2018). Menkhorst & Knight (2011) consider that the Cape Range population may represent an undescribed taxon. For this reason this species may be considered as significant (EPA 2016d).

Twelve reptiles were recorded during the field survey, only one of which was of conservation significance; *Lerista allochira* (Cape Range Slider, P3). This species is known only from the North West Cape peninsula, inhabiting a known range of approximately 70 km north-south and 20 km east-west (DPaW 2007-2018). All habitat types provided suitable areas for various reptile species.

Ecoscape considers that the suite of reptiles, and the number of individuals observed during the field survey was low compared to what was expected given the weather conditions and season of survey. It is possible that the extremely hot and dry summer (see **Section 2.1.1**) may have affected reptile populations, and residual populations may have been lower than usual. Ecoscape considers that *Aprasia rostrata* (Ningaloo Worm-lizard, P3) should have been located during the field survey if it was present, however, *Diplodactylus capensis* (Cape Range Stone Gecko, P2) was not expected to be recorded as temperatures were not sufficiently high. Both species were considered to have a Medium likelihood of occurring.

Twenty eight bird species were recorded. Only one, Osprey (*Pandion haliaetus*), was of conservation significance as it is listed for protection under international agreements, however, this species is frequently recorded in mostly coastal areas all over Australia, and also in Sulawesi, Java, New Guinea and New Caledonia (Atlas of Living Australia 2018). No other species of conservation significance were recorded, and all recorded birds are considered as commonly occurring. All habitat types were utilised by various species.

5.4 ENVIRONMENTAL FEATURES OF INTEREST

'Environmental features' are not included in the environmental assessment of the site, and are purely observations made during the site assessment.

No environmental features of potential high interest were noted during the field surveys. Although interesting in its own right, the landscape is in general not particularly spectacular, especially when compared with the established tourist destinations and associated activities of Ningaloo Reef (swimming, snorkelling, diving), various gorges in the Cape Range (Yardie Creek, Charles Knife, Shothole Canyon, Mandu Mandu), various beaches, wildlife opportunities (turtles, mangroves, Yardie Creek wallabies, bird watching), fishing, boating, surfing, kayaking, reef walking and 'stairway to the moon' viewing. Vlamingh Head Lighthouse is an existing tourist destination with a spectacular view over the ocean and parking is at a premium at sunset, or if there are whales in the bay.

Features that are of interest within the survey area to some visitors are likely to include:

- *Banksia ashbyi*, which is attractive when flowering and a surprising occurrence to some
- attractive wildflowers in season, in both red Pindan dunes and on limestone
- exploring the minor gorges and caves between the Tourist Park and lighthouse, and around the base of Vlamingh Head, with possible minor track improvements to improve access up the hill required to improve safety
- the view from the southern survey area, known locally as 'Witches Hill', is spectacular although permission to access the Department of Defence Lands and track improvements to allow 2WD access would be required.

6 EIA CONSIDERATIONS

6.1 FLORA AND VEGETATION FACTOR CONSIDERATIONS

Considerations for EIA for the factor *Flora and Vegetation* (EPA 2016a) include, but are not necessarily limited to:

- application of the mitigation hierarchy to avoid and minimise impacts to flora and vegetation, where possible
- the flora and vegetation affected by the proposal
- the potential impacts and the activities that will cause them, including direct and indirect impacts
- the implications of cumulative impacts
- whether surveys and analyses have been undertaken to a standard consistent with guidance
- the scale at which impacts to flora and vegetation are considered
- the significance of the flora and vegetation, and the risk to the flora and vegetation
- the current state of knowledge of flora and vegetation and the level of confidence underpinning the predicted residual impacts
- whether proposed management and mitigation approaches are technically and practically feasible
- whether the proposal area will be revegetated in a manner that promotes biological diversity and ecological integrity.

Various issues are frequently of significance within the environmental impact assessment process. These issues, and the potential impact from the proposed works, are summarised below.

Ecoscape is not aware of any specific plans for development thus the following relates only to the baseline survey as was conducted.

Habitat Loss, Degradation and Fragmentation

The pre-European vegetation associations associated with the survey area all have more than 85% of their original extents remaining at state, bioregion, subregion and local government extents (**Table 1** in **Section 2.2.2**). Any clearing associated with future development is unlikely to have a significant impact on the remaining extents of these vegetation associations.

There are three main vegetation habitat types occurring in the survey area.

Coastal dunes are widespread and any clearing in these is unlikely to have any significant effect on the habitat type as a whole, however, local impacts may be significant due to the narrow extent and possibility that degradation may affect the wider area with windblown sand and the possibility of weed invasion exacerbated by soil disturbance.

The limestone hills and crest, and to a lesser extent the minor habitat types occurring within them (gorges and gullies, and scree slopes), are largely resistant to degradation due to the hard substrate that resists weed invasion and erosion in most forms, even when cleared. Sheltered gorges and gullies are more prone to weed invasion due to the more protected environment, and scree slopes more prone to wind and water erosion if vegetation is removed.

The red Pindan dunes are locally more restricted, and have a higher potential for degradation as clearing exposes the soil to wind erosion, and the sandy soils are more susceptible to weed invasion. These dunes are also almost the only habitat for *Daviesia pleurophylla* (P2) which, on a population scale, is almost entirely confined to this habitat type. Despite this, any small-scale clearing affecting this species and its habitat is unlikely to be significant in terms of the population as a whole.

No Threatened Flora species are known to occur within approximately 50 km of the survey area, thus any potential development will not affect such species.

Fragmentation is unlikely to be significant should any development occur within the survey area as the area, in general, forms contiguous habitat and this is unlikely to change in the future.

Invasive Species

Eight introduced species were recorded from the survey area; one is a Declared Pest plant and WONS species. **Tamarix aphylla* has been planted as a shade tree and windbreak within the Holiday Park, and a single individual was recorded within the survey area on the beach edge, at the head of a minor creek draining the Holiday Park. Although this species is potentially invasive, and the individual is unlikely to have been deliberately planted, invasion by this species does not overall appear to have occurred, however, may potentially occur in the future.

Buffel Grass (**Cenchrus ciliaris*), introduced as a pastoral species (Keighery 2010), is significantly affecting the vegetation condition in parts of the survey area, particularly on sandy soils and adjacent to human development including roads. Clearing, especially on sandy soils, potentially provides additional habitat for this species.

Kapok Bush (**Aerva javanica*) was observed along all road verges throughout the survey area, however the only uncleared areas where this species was recorded was adjacent to the sewerage pipe between the Holiday Park and the settling ponds to the south, and on the scree slopes between the Vlamingh Head Lighthouse and Yardie Creek Road. This species has the potential to invade any cleared area.

Stinking Passion Flower (**Passiflora foetida*) was observed in only one minor gorge within the survey area, although it has potential to invade other areas.

None of the other introduced species recorded from the survey area (**Bidens subalternans* var. *simulans*, unidentified succulent, Date Palm **Phoenix dactylifera*, or Common Sowthistle **Sonchus oleraceus*) are likely to have a significant impact should development within the survey area occur.

Fire Regimes

Fire occurs naturally in the landscape as a result of lightning strike and vegetation has evolved to recover rapidly. No evidence of recent fire was observed within the survey area.

Fire has also been used by Traditional Owners to flush game and generate new growth that attracts herbivores, and has been used by pastoralists to generate new growth that is more palatable to livestock.

Any potential development is unlikely to alter the frequency, intensity or extent of fires.

Changing Climate

Climate change in Western Australia is likely to increase in frequency and intensity of cyclones and be responsible for increases in temperature (Western Australian Government 2012).

Climate change impacts on native flora and vegetation may be of importance as a cumulative impact when taking all changing factors into account, however, of its own, climate change is unlikely to be to be a significant factor in the survey area. Given the small scale of potential clearing, any effects on the flora and vegetation cumulatively with climate change are unlikely to be significant.

The survey area was considered to extend to the high water mark, which, with anticipated sea-level rise (of approximately 0.12 m by 2030, CoastAdapt 2018) associated with a warming climate, may be affected by climate change. However, significant potential development within the coastal dunes is unlikely to be approved thus this aspect is not significant to the flora and vegetation values of the survey area.

State of Knowledge

Few botanical surveys are known to have been conducted in the local area, thus general knowledge pertaining to the flora and vegetation values of the survey area and surrounds is limited. Despite this, the flora species recorded from the survey area and others likely to occur are generally well understood, and the vegetation types are associated with simple landforms thus is uncomplicated. Lack of knowledge in this regard is unlikely to be a significant consideration for EIA.

It is considered the 'application of general ecological principles' are likely to be a reasonable guide to understanding the flora and vegetation of the survey area.

6.2 FAUNA FACTOR CONSIDERATIONS

Considerations for EIA for the factor *Terrestrial Fauna* (EPA 2016b) include, but are not necessarily limited to:

- application of the mitigation hierarchy to avoid and minimise impacts to terrestrial fauna, where possible
- the terrestrial fauna affected by the proposal
- the potential impacts and the activities that will cause them, including direct and indirect impacts
- the implications of cumulative impacts
- whether surveys and analyses have been undertaken to a standard consistent with EPA technical guidance
- the scale at which impacts terrestrial fauna are considered
- the significance of the terrestrial fauna and the risk to those fauna
- the current state of knowledge of the affected species/assemblages and the level of confidence underpinning the predicted residual impacts
- whether proposed management and mitigation approaches are technically and practically feasible.

Various issues are frequently of significance within the environmental impact assessment process. These issues, and the potential impact from the proposed works, are summarised below.

Habitat loss, degradation and fragmentation

No Threatened Fauna species are known to occur within or close to the survey area, therefore any potential development will not affect such species.

Due to the widespread broad nature of the fauna habitat types within the survey area, the scale of habitat loss and effects of degradation and fragmentation are unlikely to be significant for any proposed works on the tenements.

Fire Regimes

Altered fire regimes (more frequent or intense fires) may open up habitats and provide additional food resources for herbivores, however, may also decrease the amount of shelter available for some species including general cover and leaf litter. Increases in herbivores may also result in an increase in predators, including feral species (cats, foxes).

Fire regimes are unlikely to be altered as a result of any potential development of the survey area.

Invasive Species

Invasive species, including feral predators such as cats and scavengers such as rats and mice (that may also predate on smaller species; although these were not detected during the field survey they are likely to occur, especially in areas close to human habitation), are highly adaptable, can thrive in areas of human disturbance and can have a significant effect on species assemblages.

Invasive species may increase as a result of potential development of the survey area.

Changing Climate

Temperature and changes in rainfall may affect the distribution and diversity of fauna species. Temperatures are anticipated to rise in general, and cyclone frequency and intensity is likely to increase (Western Australian Government 2012). Information of the effects of climate change, particularly temperature, are largely unknown for most fauna species, although we consider that the above average summer/autumn temperatures experienced prior to the field survey may have reduced the population density of reptile species.

Climate change will not affect any potential development, however, the cumulative effects of climate change and disturbance may need to be taken into account. Sea-level rise is unlikely to have any significant effect on the fauna of the survey area.

State of Knowledge

Terrestrial vertebrate fauna are generally well understood. With the possible exception of *Pseudantechinus roryi* potentially being an undescribed species, there are no knowledge gaps that would affect the understanding of these fauna within the study areas.

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MAPS

LEGEND

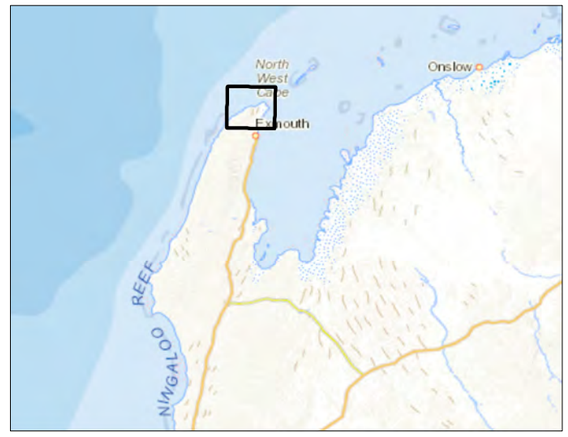
- Survey Area
- Populated Places
- Place Names
- Watercourses
- Minor Road

Pre European Vegetation (DAFWA 2012)

System Assocation: Description

- CAPE RANGE 117: Hummock grasslands, grass steppe; soft spinifex
- CAPE RANGE 662: Hummock grassland; shrub steppe; mixed acacia scrub and dwarf scrub with soft spinifex and *Triodia basedowii*
- CAPE RANGE 663: Hummock grasslands, shrub steppe; waterwood over soft spinifex
- CAPE RANGE 664: Hummock grasslands, sparse tree-steppe; scattered bloodwood over soft spinifex and *Triodia* sp. indet. aff. Angusta
- CAPE RANGE 676: Succulent steppe; samphire

DATASOURCES :
SOURCE DATA: ECOSCAPE SURVEY DATA
AERIAL: LANDGATE
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY



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PRE EUROPEAN VEGETATION ASSOCIATION

NINGALOO SURVEYS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

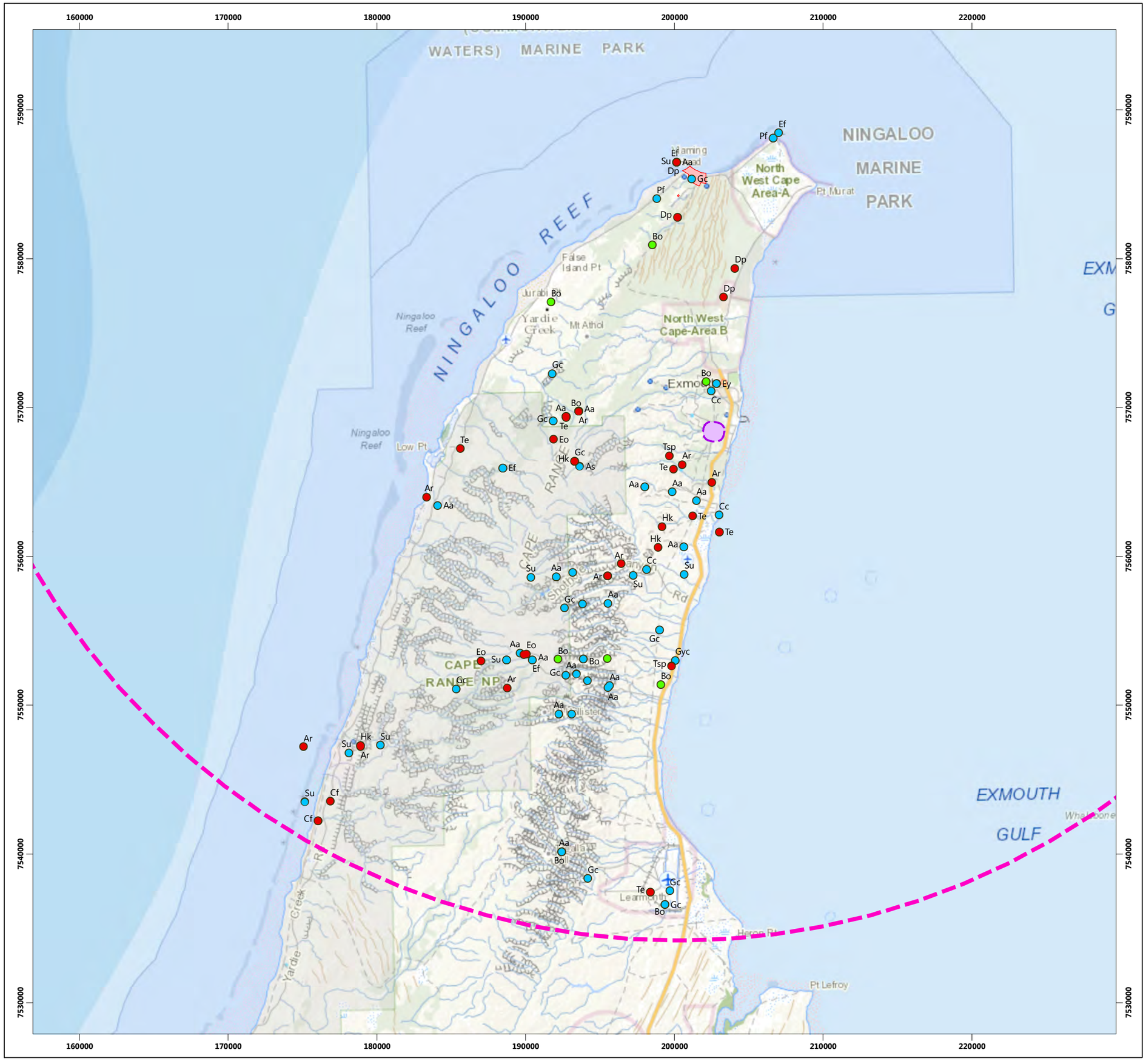
SCALE: 1:75,000 @ A3

0 1 2 3 km

PROJECT NO: 4216-18

REV	AUTHOR	APPROVED	DATE
01	AF	JN	16/08/2018

MAP 01



LEGEND

DBCA Flora Database

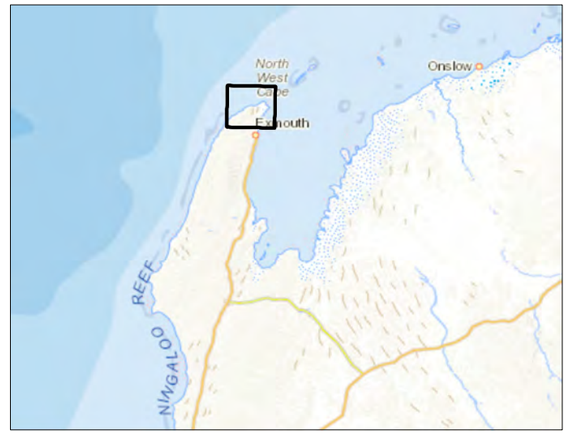
- Priority 2 (DBCA)
- Priority 3 (DBCA)
- Priority 4 (DBCA)
- DBCA Search Buffer (50km)

DBCA Ecological Communities Database

- Camerons Cave Troglobitic Community (Critically Endangered)
- Survey Area

Species Labels
Aa - *Acacia alexandri* - P3
Ar - *Acacia ryaniana* - P2
As - *Acacia startii* - P3
Ar - *Acanthocarpus rupestris* - P2
Bo - *Brachychiton obtusilobus* - P4
Cc - *Corchorus congener* - P3
Cf - *Crinum flaccidum* - P2
Dp - *Daviesia pleurophylla* - P2
Ef - *Eremophila forrestii* subsp. *capensis* - P3
Eo - *Eremophila occidens* - P2
Ey - *Eremophila youngii* subsp. *lepidota* - P4
Gc - *Grevillea calcicola* - P3
Gyc - *Gymnanthera cunninghamii* - P3
Hk - *Harnieria kempeana subsp. rhadinophylla* - P2
Pf - *Phyllanthus fuernrohrii* - P3
Su - *Stackhousia umbellata* - P3
Tsp - *Tephrosia* sp. North West Cape (G. Marsh 81) - P2
Te - *Tinospora esiangkara* - P2

DATASOURCES :
SOURCE DATA: ECOSCAPE SURVEY DATA
AERIAL: LANDGATE
SERVICE LAYERS: GEOCSCIENCE AUSTRALIA



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DATABASE SEARCH RESULTS
FLORA AND COMMUNITIES
NINGALOO SURVEYS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N
SCALE: 1:250,000 @ A3
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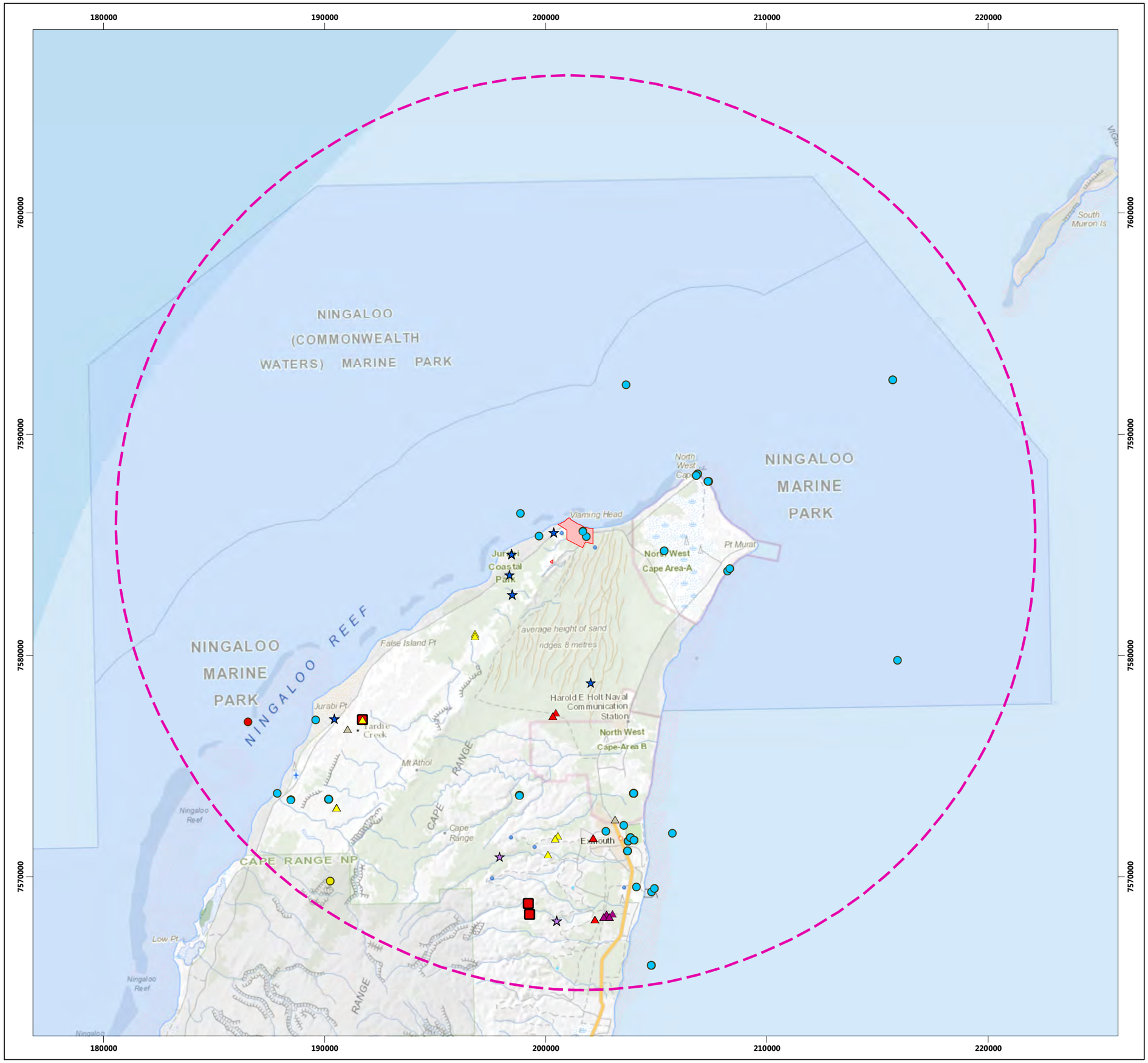
PROJECT NO: 4216-18

REV	AUTHOR	APPROVED	DATE
01	AF	JN	16/08/2018

MAP
02

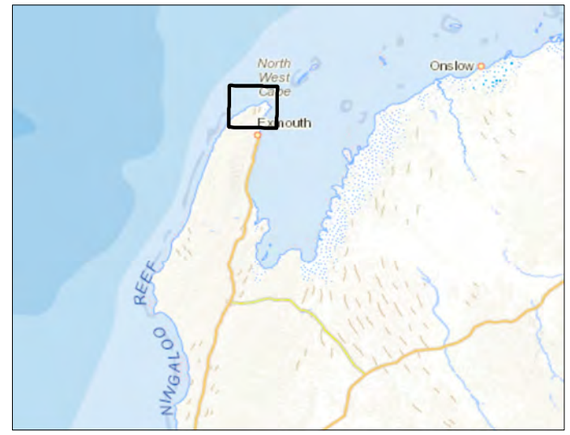


LEGEND

Priority Fauna Records (Marine Species Removed) DBCA

- Mammal, Endangered
- Bird, Endangered
- Bird, Endangered & International Agreement
- Bird, Vulnerable
- Bird, International Agreement (& VU at subsp. level)
- Bird, Vulnerable & International Agreement
- Bird, Other Specially Protected
- Bird, International Agreement
- Invertebrate, Critical
- Invertebrate, Endangered
- Invertebrate, Vulnerable
- Invertebrate, Priority 4
- Reptile, Priority 2
- Reptile, Priority 3
- Fauna Search Buffer 20km
- Survey Area

DATASOURCES :
SOURCE DATA: ECOSCAPE SURVEY DATA
AERIAL: LANDGATE
SERVICE LAYERS: GEOSCIENCE AUSTRALIA



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DATABASE SEARCH RESULTS
FAUNA

NINGALOO SURVEYS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:168,342 @ A3

0 1 2 3 4 5 Km

PROJECT NO: 4216-18

REV	AUTHOR	APPROVED	DATE
01	AF	JN	16/08/2018

MAP
03

200500 201000 201500 202000

7586000 7585500 7585000

NL1811 NL1818R NL1819R NL1810 NL1809 NL1814 NL1816 NL1815 NL1808 NL1807 NL1802 NL1801 NL1806 NL1805 NL1804 NL1803 NL1813 NL1812

AbFb Shrubland
AcRp Shrubland
Ab Shrubland
TeSlWa Grassland
Not Vegetation
AbSaAt Shrubland
BaDp Shrubland
Mc Shrubland

Inset A

Mc Shrubland (Inferred)
Not Vegetation
NL1817
0 100 200 m

LEGEND

- Quadrat Locations

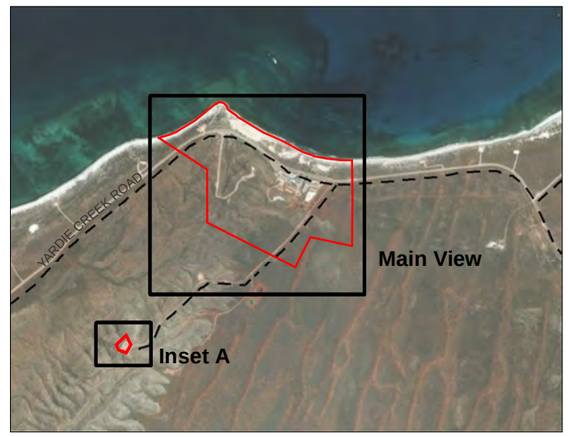
Conservation Significant Flora Locations

- Priority Two- *Daviesia pleurophylla* (occurs throughout BaDp veg type)
- Priority Two-*Tinospora esiangkara*
- Priority Three-*Corchorus ?congener*
- Priority Three-*Grevillea calcicola*
- Priority Three-*Eremophila forrestii* subsp. *capensis*
- Priority Three-*Stackhousia umbellata* (occurs throughout Mc veg type)
- Priority Four-*Brachychiton obtusilobus*
- Survey Area

Vegetation Type

- Ab Shrubland
- AbFb Shrubland
- AbSaAt Shrubland
- AcRp Shrubland
- BaDp Shrubland
- Mc Shrubland
- Mc Shrubland (Inferred)
- TeSlWa Grassland
- Not Vegetation

DATASOURCES :
SOURCE DATA: ECOSCAPE SURVEY DATA
AERIAL: LANDGATE
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY



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VEGETATION TYPE, QUADRAT LOCATION AND CONSERVATION SIGNIFICANT FLORA LOCATIONS

NINGALOO SURVEYS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:6,000 @ A3

0 100 200 m

PROJECT NO: 4216-18

REV	AUTHOR	APPROVED	DATE
01	AF	JN	16/08/2018

MAP 04

200500 201000 201500 202000

7586000 7585500 7585000

Inset A

0 100 200 m

LEGEND

Declared Pest Plant Locations

- *Tamarix aphylla*

Introduced Plant Locations

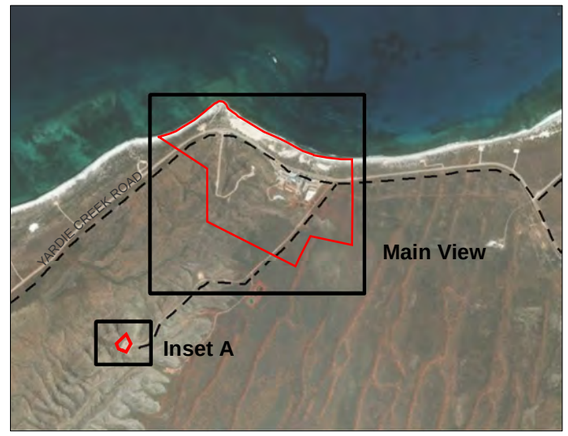
- Unidentified Succulent
- *Passiflora foetida* (Stinking Passion Flower)
- Survey Area
- *Aerva javanica* (Kapok) Extent

Vegetation Condition

Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded

DATASOURCES :
SOURCE DATA: ECOSCAPE SURVEY DATA
AERIAL: LANDGATE
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY



ecoscape

VEGETATION CONDITION AND INTRODUCED PLANT LOCATIONS

NINGALOO SURVEYS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:6,000 @ A3

0 100 200 m

PROJECT NO: 4216-18

REV	AUTHOR	APPROVED	DATE
01	AF	JN	16/08/2018

MAP 05

200500 201000 201500 202000

7586000 7585500 7585000

Coastal Dunes

Rocky Hills and Slopes

Sheltered Gullies and Minor Caves

Dune Swales

Dune Crests

Inset A

0 100 200 m

LEGEND

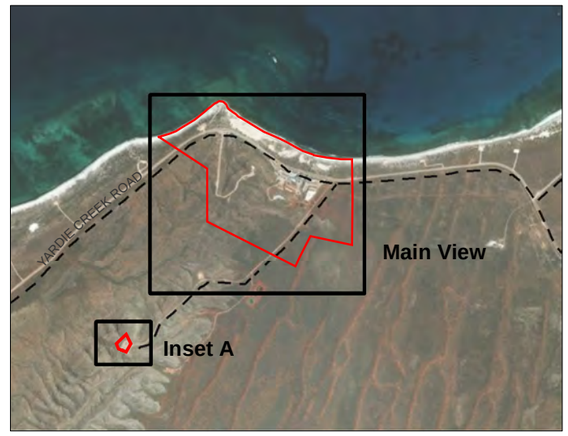
Conservation Significant Fauna Observations

- Priority 3, *Lerista allochira* (Cape Range Slider)
- International Agreement, *Pandion haliaetus* (Osprey)
- Survey Area

Fauna Habitat Type

- Coastal Dunes
- Dune Crests
- Dune Swales
- Rocky Hills and Slopes
- Sheltered Gullies and Minor Caves

DATASOURCES :
SOURCE DATA: ECOSCAPE SURVEY DATA
AERIAL: LANDGATE
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY



ecoscape

FAUNA HABITAT TYPES AND CONSERVATION SIGNIFICANT FAUNA OBSERVATIONS

NINGALOO SURVEYS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:6,000 @ A3

0 100 200 m

PROJECT NO: 4216-18

REV	AUTHOR	APPROVED	DATE
01	AF	JN	16/08/2018

MAP 06

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 11: EPBC Act categories for flora and fauna

EPBC ACT 1999 category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Table 12: Conservation codes for Western Australian flora and fauna (DPaW 2017)

Conservation Codes for Western Australian Flora and Fauna	
T	**Threatened species*** Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). • ***Threatened fauna*** is that subset of 'Specially Protected Fauna' declared to be ' likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. • ***Threatened flora*** is flora that has been declared to be 'likely to become extinct or is rare, or is otherwise in need of special protection' pursuant to section 23F(2) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically Endangered species** Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	**Endangered species** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	**Vulnerable species** Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	**Presumed extinct species** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
IA	**Migratory birds protected under an international agreement** 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 the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	**Conservation Dependent fauna** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice
OS	**Other specially protected fauna** Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice
P	**Priority 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 list 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.
P1	**Priority One: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road or 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 localities 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.
P2	**Priority Two: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more localities 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.
P3	**Priority Three: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread localities 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 localities 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.

Conservation Codes for Western Australian Flora and Fauna	
P4	**Priority Four: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).	

Table 13: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed
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. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
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. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being

Criteria	Definition
	substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
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. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority ecological communities	
Priority One	*Poorly known ecological communities* Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. 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.
Priority Two	*Poorly known ecological communities* Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and / or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	*Poorly known ecological communities* i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or; ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; iii. Communities made up of large, and/or widespread occurrences, that may or 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. 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.
Priority Four	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. 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. 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. iii. Ecological communities that have been removed from the list of threatened communities

Criteria	Definition
	during the past five years.
Priority Five	*Conservation Dependent Ecological Communities* Ecological Communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table 14: NVIS structural formation terminology, terrestrial vegetation (ESCAVI 2003)

	Cover characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 15: NVIS height classes (ESCAVI 2003)

Height		Growth form				
Height Class	**Height Range (m)**	**Tree, vine (M & U), palm (single-stemmed)**	**Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)**	**Tree mallee, mallee shrub**	**Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)**	**Bryophyte, lichen, seagrass, aquatic**
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low

Source: (based on Walker & Hopkins 1990)

Table 16: Vegetation Condition Scale for the Eremaean Botanical Province (EPA 2016c)

Condition rating	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.

APPENDIX TWO DESKTOP ASSESSMENT RESULTS

Table 17: Flora database search results (DBCA database search using 50 km buffer), likelihood and flora survey records

DBCA *	*Nature Map*	Species name	Habitat from *FloraBase* (WAH 1998-2018) or (for *Acacia* species) *World Wide Wattle* (Shire of Dalwallinu *et al.* 2010)	Flowers	Likelihood of occurrence	
					Desktop	Re-assessed
		DBCA Priority 1				
P	>50 km	*Abutilon* sp. Quobba (H. Demarz 3858)	Sandy or rocky sandy soil.	Jul-Oct	Highly unlikely	Highly unlikely
P	>50 km	*Cyperus victoriensis*	Creek	Jun-Aug	Highly unlikely	Highly unlikely
		DBCA Priority 2				
X	20-50 km	*Acacia ryaniana*	Red or white sand, sand over limestone, coastal dunes. *Spinifex longifolius*, *Triodia* spp.	Jun-Nov	Unlikely	Unlikely
X	10-20 km	*Acanthocarpus rupestris*	Red sand, limestone. *Triodia* -shrub steppe, sometimes by creek-lines.	May-Jun	Possible	Possible
X	>50 km	*Crinum flaccidum*	Between coastal dunes and limestone range	Most months	Unlikely	Unlikely
X	<10 km	*Daviesia pleurophylla*	Red sand dunes.	Jun-Oct	Recorded (probable)	Recorded
X	20-50 km	*Eremophila occidens*	Limestone ranges, dunes	Aug-Sep	Possible	Unlikely
X	10-20 km	*Harnieria kempeana* subsp. *rhadinophylla*	Calcareous loam. Amongst limestone rocks, creek banks.	May-Sep	Possible	Possible
X	10-20 km	*Tephrosia* sp. North West Cape (G. Marsh 81)	Limestone	May-Sep	Possible	Possible
X	10-20 km	*Tinospora esiangkara*	Pebbly orange-brown calcareous loam. Limestone outcrops or ridges, near creek bank.	Jul-Oct	Possible	Recorded
X	20-50 km	*Verticordia serotina*	Red sand, sand dunes.	Aug-Sep	Unlikely	Unlikely
		DBCA Priority 3				
X	10-20 km	*Acacia alexandri*	Limestone. Stony creeks, steep rocky slopes.	Jun-Sep	Possible	Possible
X	20-50 km	*Acacia startii*	Limestone hills, watercourses	Jul-Aug	Possible	Unlikely
P	>50 km	*Carpobrotus* sp. Thevenard Island (M. White 050)	Coarse white sand, limestone	Aug	Unlikely	Unlikely
X	10-20 km	*Corchorus congener*	Sand, red sandy loam with limestone. Sand dunes, plains.	Apr-Nov	Possible	Recorded (probable)
X	<10 km	*Eremophila forrestii* subsp. *capensis*	Brown rocky soils, limestone. Ridges.	Jun-Aug	Possible	Recorded
X	<10 km	*Grevillea calcicola*	Limestone hilltops.	May-Aug	Recorded (probable)	Recorded
X	20-50 km	*Gymnanthera cunninghamii*	Sand, alluvium	Jan-Dec	Unlikely	Unlikely
X	<10 km	*Phyllanthus fuernrohrii*	Limestone	Feb-Sep	Possible	Possible
X	<10 km	*Stackhousia umbellata*	Sandy soils on limestone. *Triodia*.	May-Sep	Recorded	Recorded
		DBCA Priority 4				
X	<10 km	*Brachychiton obtusilobus*	Skeletal soils. Rocky limestone ranges, gorges, occasionally sandplains.	Aug-Sep	Possible	Recorded
X	10-20 km	*Eremophila youngii* subsp. *lepidota*	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats.	Jan-Sep	Unlikely	Unlikely
P	>50 km	*Livistona alfredii*	Limestone, Pindan sand, alluvium. Pools.	Jul-Sep	Highly unlikely	Highly unlikely

* P = place name search result only i.e. not recorded within 50 km of the survey area

Table 18: Declared Pest plants listed for Exmouth (Department of Primary Industries and Regional Development 2018)

Scientific name	Common name(s)	Control categories	Keeping category	Declared areas
Alhagi maurorum Medik.	Camelthorn	C3 Management		Whole of State
Asparagus asparagoides (L.) Druce	Bridal creeper	No Control Category	Exempt	Whole of State
Austrocylindropuntia cylindrica (Juss. ex Lam.) Backeb.	Coral cactus, cane cactus	C3 Management	Restricted	Whole of State
Austrocylindropuntia subulata (Muehlenpf.) Backeb.	Eve's pin, Eve's needle	C3 Management	Restricted	Whole of State
Calotropis procera (Aiton) W.T.Aiton	Rubber bush, calotropis	No Control Category	Exempt	Whole of State
Chondrilla juncea L.	Skeleton weed, rush skeleton weed, naked weed, hogbite, gum succory	C2 Eradication		Includes Exmouth
Cryptostegia madagascariensis Bojer ex Decne.	Rubbervine, Madagascar rubbervine	No Control Category	Exempt	Whole of State
Cylindropuntia fulgida (Engelm.) F.M.Knuth	Coral cactus, boxing glove cactus	C3 Management	Restricted	Whole of State
Cylindropuntia imbricata (Haw.) F.M.Knuth	Rope pear, devil's rope	C3 Management	Restricted	Whole of State
Cylindropuntia kleiniae (DC.) F.M.Knuth	Candle cholla, Klein's pencil cactus, Klein's cholla	C3 Management	Restricted	Whole of State
Cylindropuntia pallida (Rose) F.M.Knuth	White-spined Hudson pear, Hudson pear (white-spined)	C3 Management	Restricted	Whole of State
Cylindropuntia tunicata (Lehm.) F.M.Knuth	Thistle cholla, brown-spined Hudson pear, Hudson pear (brown-spined)	C3 Management	Restricted	Whole of State
Echium plantagineum L.	Salvation Jane, Paterson's curse	No Control Category	Exempt	Whole of State
Hydrocotyle ranunculoides L. f.	Water pennywort, spaghetti weed, hydrocotyle, grote waternavel, floating marshpennywort	C3 Management		Whole of State
Jatropha gossypiifolia L.	Cotton-leaf physic-nut, bellyache bush	C3 Management		Whole of State
Lantana camara L.	Wild sage, white sage, red-flowered sage, largeleaf lantana, common lantana	C3 Management		Whole of State
Moraea flaccida (Sweet) Steud.	One-leaf cape tulip	No Control Category	Exempt	Whole of State
Moraea miniata Andrews	Two-leaf cape tulip	No Control Category	Exempt	Whole of State
Onopordum acaulon L.	Stemless thistle	No Control Category	Exempt	Whole of State
Opuntia elata Salm-Dyck	Riverina pear	C3 Management	Restricted	Whole of State
Opuntia elatior Mill.	Red-flower prickly pear	C3 Management	Restricted	Whole of State
Opuntia engelmannii Salm-Dyck ex Engelm.	Engelmann's prickly pear, Engelmann's pear	C3 Management	Restricted	Whole of State
Opuntia ficus-indica (L.) Mill.	Tuna cactus, sweet pricklypear, spiny pest pear, spineless cactus, prickly pear, mission pricklypear, grootdoringturksvy, Indian fig, Boereturksvy	C3 Management	Exempt	Whole of State
Opuntia microdasys (Lehm.) Pfeiff.	Teddy bear cactus, golden bristle cactus, bunny ears	C3 Management	Restricted	Whole of State
Opuntia monacantha Haw.	Drooping tree pear	C3 Management	Restricted	Whole of State
Opuntia polyacantha Haw.	Plains prickly pear	C3 Management	Restricted	Whole of State
Opuntia puberula Hort. Vindob. ex Pfeiff.	Nopal de tortuga, nopal de culebra	C3 Management	Restricted	Whole of State
Opuntia stricta (Haw.) Haw.	Erect prickly pear, common prickly pear	C3 Management	Restricted	Whole of State

Scientific name	Common name(s)	Control categories	Keeping category	Declared areas
Opuntia tomentosa Salm-Dyck	Velvet tree pear, velvet pear	C3 Management	Restricted	Whole of State
Parkinsonia aculeata L.	Parkinsonia		Exempt	Whole of State
Pistia stratiotes L.	Water lettuce	C2 Eradication		Whole of State
Prosopis glandulosa Torr. x Prosopis velutina Wooton	Mesquite	C2 Eradication	Prohibited	Includes Exmouth
Rubus ulmifolius Schott	Elmleaf blackberry, Thornfree, Loch Ness, Blacksatin	C3 Management	Exempt	Includes Exmouth
Sagittaria platyphylla (Engelm.) J.G.Sm.	Sagittaria, delta arrowhead	C3 Management		Whole of State
Senna alata (L.) Roxb.	Seven-golden-candlesticks, ringwormshrub, ringwormbush, ringworm senna, empress-candle-plant, emperor's candlesticks, candlestick senna, candle bush, Christmas-candle	No Control Category	Exempt	Whole of State
Senna obtusifolia (L.) H.S.Irwin & Barneby	Sicklepod senna, sicklepod, coffeeweed, Javabean, Chinese Senna	No Control Category	Exempt	Whole of State
Silybum marianum (L.) Gaertn.	Variegated thistle, milkthistle, blessed milkthistle	No Control Category		
Solanum elaeagnifolium Cav.	White horsenettle, silverleaf nightshade	No Control Category	Exempt	Whole of State
Solanum linnaeanum Hepper & P.-M.L.Jaeger	Apple of Sodom	No Control Category	Exempt	Whole of State
Tamarix aphylla (L.) H.Karst.	Tamarisk, flowering cypress, athel tree, athel tamarisk, athel pine, athel	No Control Category	Exempt	Whole of State
Ulex europaeus L.	Gorse, furze	C2 Eradication		Includes Exmouth
Xanthium spinosum L.	Thorny burweed, spiny cocklebur, spiny clotbur, prickly burweed, piikkisappiruoho, dagger weed, dagger cocklebur, burweed, boetebos, Bathurst burr	C2 Eradication		Includes Exmouth
Xanthium strumarium L.	Sheepbur, sea burdock ,rough cocklebur, kra chap, karheasappiruoho, kankerroos,hedgehog burweed, heartleaf cocklebur, ditchbur, common cocklebur, cocklebur, clotbur, buttonbur, burweed, abrojillo, Noogoora burr, Bathurst burr	C2 Eradication		Includes Exmouth
Zantedeschia aethiopica (L.) Spreng.	Calla lily, arum lily	No Control Category	Exempt	Whole of State
Ziziphus mauritiana Lam.	Saucunazi, macaniqueira, m'sau, Indian jujube, Chinese apple	C3 Management		Whole of State

Table 19: Fauna database search and survey results (vertebrates)

Database search results do not include entirely marine species e.g. whales, fish, turtles, or subterranean species.

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Mammals							
BOVIDAE							
Ovis aries	Sheep		Y				X
DASYURIDAE							
Dasyurus hallucatus	Northern Quoll	EN		X			
Pseudantechinus roryi							X
Sminthopsis macroura	Stripe-faced Dunnart				X		
EMBALLONURIDAE							
Taphozous georgianus	Common Sheath-tailed Bat				X		
FELIDAE							
Felis catus	Feral Cat		Y				X
LEPORIDAE							
Oryctolagus cuniculus	Rabbit		Y				X
MACROPODIDAE							
Osphranter robustus	Euro				X		X
Petrogale lateralis	Black-flanked Rock-wallaby	EN		X	X	X	
MURIDAE							
Mus musculus	House Mouse		Y		X		
Notomys alexis	Spinifex Hopping-mouse				X		
Pseudomys hermannsburgensis	Sandy Inland Mouse				X		
Rattus rattus	Black Rat		Y		X		
TACHYGLOSSIDAE							
Tachyglossus aculeatus	Short-beaked Echidna						X
VESPERTILIONIDAE							
Chalinolobus gouldii	Gould's Wattled Bat				X		
Vespadelus finlaysoni	Finlayson's Cave Bat				X		
YINPTEROCHIROPTERA							
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU		X			
Reptiles							
AGAMIDAE							
Amphibolurus gilberti	Ta-ta, Gilbert's Dragon				X		
Amphibolurus longirostris	Long-nosed Dragon				X		
Ctenophorus femoralis	Dune Dragon				X		
Ctenophorus isolepis	Military Dragon				X		
Ctenophorus nuchalis	Central Netted Dragon				X		
Ctenophorus parviceps	Northern Heath Dragon				X		
Ctenophorus reticulatus	Western Netted Dragon				X		
Diporiphora adductus	Carnarvon Dragon				X		
Pogona minor	Dwarf Bearded Dragon				X		
CARPHODACTYLIDAE							

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Nephrurus levis	Smooth Knob-tailed Gecko				X		
DIPLODACTYLIDAE							
Crenadactylus ocellatus subsp. *horni*	Clawless Gecko				X		
Diplodactylus capensis	Cape Range Stone Gecko	P2			X	X	
Diplodactylus bilybara	Fat-tailed Gecko				X		
Diplodactylus ornatus	Ornate Stone Gecko				X		
Lucasium stenodactylum	Sand-plain Gecko				X		
Strophurus ciliaris subsp. *aberrans*	Northern Spiny-tailed Gecko				X		
Strophurus jeanae	Southern Phasmid Gecko				X		
Strophurus rankini	Exmouth Spiny-tailed Gecko				X		
Strophurus strophurus	Western Spiny-tailed Gecko				X		
ELAPIDAE							
Acanthophis wellsi	Pilbara Death Adder				X		
Brachyurophis approximans	North-western Shovel-nosed Snake				X		
Demansia calodera	Black-necked Whipsnake				X		
Demansia psammophis subsp. *cupreiceps*	Yellow-faced Whipsnake				X		
Furina ornata	Moon Snake				X		
Pseudechis australis	Mulga Snake				X		
Pseudonaja mengdeni	Western Brown Snake				X		
Pseudonaja modesta	Ringed Brown Snake				X		
Simoselaps bertholdi	Jan's Banded Snake				X		X
Suta fasciata	Rosen's Snake				X		
GEKKONIDAE							
Gehyra australis	Northern Dtella				X		
Gehyra pilbara	Pilbara Dtella				X		X
Gehyra variegata	Tree Dtella				X		
Heteronotia binoei	Bynoe's Gecko				X		
PYGOPODIDAE							
Aprasia rostrata	Ningaloo Worm-lizard	P3			X	X	
Delma nasuta	Sharp-snouted Delma				X		
Delma tealei	Teale's Delma				X		
Delma tincta	Excitable Delma				X		
Lialis burtonis	Burton's Legless Lizard				X		
PYTHONIDAE							
Antaresia perthensis	Pygmy Python				X		
Antaresia stimsoni	Stimson's Python				X		
Aspidites melanocephalus	Black-headed Python				X		
SCINCIDAE							
Cryptoblepharus plagiocephalus	Snake-eyed Skink				X		
Ctenotus grandis subsp. titan	Grand Ctenotus				X		
Ctenotus hanloni	Nimble Ctenotus				X		

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Ctenotus iapetus	North West Cape Ctenotus				X		
Ctenotus pantherinus subsp. *ocellifer*	Leopard Ctenotus				X		
Ctenotus rufescens	Rufous Finesnout Ctenotus				X		
Ctenotus saxatilis	Rock Ctenotus				X		
Cyclodomorphus melanops	Slender Blue-tongue				X		
Eremiascincus isolepis	Northern Bar-lipped Skink				X		
Eremiascincus pallidus	Western Narrow-banded Skink				X		
Eremiascincus richardsonii	Broad-banded Sand Swimmer				X		
Lerista allochira	Cape Range Slider	P3			X	X	X
Lerista bipes	North-western Sandslider				X		X
Lerista clara	Sharp-blazed Three-toed Slider				X		
Lerista elegans	Elegant Slider				X		X
Lerista macropisthopus subsp. *fusciceps*	Unpatterned Robust Slider				X		X
Lerista miopus	Northern Dotted-line Robust Slider				X		X
Lerista planiventralis	Keeled Slider				X		X
Menetia greyii	Common Dwarf Skink				X		X
Menetia surda	Western Dwarf Skink				X		
Morethia lineoocellata	West Coast Morethia Skink				X		X
Morethia ruficauda subsp. *exquisita*	Lined Firetail Skink				X		X
Notoscincus ornatus	Ornate Soil-crevice Skink				X		X
VARANIDAE							
Varanus acanthurus	Spiny-tailed Monitor				X		
Varanus brevicauda	Short-tailed Pygmy Monitor				X		
Varanus eremius	Pygmy Desert Monitor				X		
Varanus giganteus	Perentie				X		
Varanus gouldii	Sand Monitor				X		
Varanus tristis	Racehorse Monitor				X		
Birds							
ACANTHIZIDAE							
Calamanthus campestris	Rufous Fieldwren				X		X
Gerygone fusca	Western Gerygone				X		
Smicrornis brevirostris	Weebill				X		
Pyrrholaemus brunneus	Redthroat				X		
ACCIPITRIDAE							
Accipiter cirrocephalus	Collared Sparrowhawk				X		
Accipiter fasciatus	Brown Goshawk				X		
Aquila audax	Wedge-tailed Eagle				X		X
Circus approximans	Swamp Harrier				X		
Circus assimilis	Spotted Harrier				X		X
Elanus axillaris	Black-shouldered Kite				X		X

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Haliaeetus leucogaster	White-bellied Sea-Eagle				X		
Haliastur indus	Brahminy Kite				X		
Haliastur sphenurus	Whistling Kite				X		X
Hieraaetus morphnoides	Little Eagle				X		
Milvus migrans	Black Kite				X		
AEGOTHELIDAE							
Aegotheles cristatus	Australian Owlet-nightjar				X		
ALAUDIDAE							
Mirafra javanica	Horsfield's Bushlark				X		
ALCEDINIDAE							
Todiramphus pyrrhopygius	Red-backed Kingfisher				X		
Todiramphus sanctus	Sacred Kingfisher				X		
ANATIDAE							
Anas gracilis	Grey Teal				X		
Anas platyrhynchos subsp. *domesticus*	Domestic Duck				X		
Anas superciliosa	Pacific Black Duck				X		
Cygnus atratus	Black Swan				X		
ANHINGIDAE							
Anhinga novaehollandiae	Australasian Darter				X		
ARDEIDAE							
Ardea modesta	Great Egret				X		
Ardea sacra	Eastern Reef Egret				X		
Butorides striata	Striated Heron				X		
Egretta garzetta	Little Egret				X		
Egretta novaehollandiae	White-faced Heron				X		
Nycticorax caledonicus	Nankeen Night Heron				X		
ARTAMIDAE							
Artamus cinereus	Black-faced Woodswallow				X		
Artamus leucorynchus	White-breasted Woodswallow				X		
Artamus minor	Little Woodswallow				X		
Artamus personatus	Masked Woodswallow				X		
BURHINIDAE							
Esacus magnirostris	Beach Stone-curlew				X		
CACATUIDAE							
Cacatua roseicapilla	Galah				X		
Cacatua sanguinea	Little Corella				X		
Nymphicus hollandicus	Cockatiel				X		
CAMPEPHAGIDAE							
Coracina novaehollandiae	Black-faced Cuckoo-shrike				X		X
Lalage tricolor	White-winged Triller						X
CHARADRIIDAE							

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Charadrius leschenaultii	Greater Sand Plover	IA (VU at subsp. level)			X	X	
Charadrius mongolus	Lesser Sand Plover	EN & IA			X	X	
Charadrius ruficapillus	Red-capped Plover				X		
Charadrius veredus	Oriental Plover	IA				X	
Elseyornis melanops	Black-fronted Dotterel				X		
Erythrogonys cinctus	Red-kneed Dotterel				X		
Pluvialis fulva	Pacific Golden Plover	IA				X	
Pluvialis squatarola	Grey Plover	IA			X	X	
Vanellus tricolor	Banded Lapwing				X		
COLUMBIDAE							
Columba livia	Domestic Pigeon	Y			X		
Geopelia cuneata	Diamond Dove				X		
Geopelia humeralis	Bar-shouldered Dove				X		
Geopelia striata	Zebra Dove				X		
Geophaps plumifera	Spinifex Pigeon				X		
Ocyphaps lophotes	Crested Pigeon				X		
CORVIDAE							
Corvus bennetti	Little Crow				X		
Corvus orru	Torresian Crow				X		X
CRACTICIDAE							
Cracticus nigrogularis	Pied Butcherbird				X		X
Cracticus tibicen	Australian Magpie				X		
Cracticus torquatus	Grey Butcherbird				X		
CUCULIDAE							
Cacomantis pallidus	Pallid Cuckoo				X		
Chrysococcyx basalis	Horsefield's Bronze-cuckoo						X
DICAEIDAE							
Dicaeum hirundinaceum	Mistletoebird				X		
DIOMEDEIDAE							
Thalassarche chlororhynchos	Atlantic Yellow-nosed Albatross	VU			X	X	
DROMAIIDAE							
Dromaius novaehollandiae	Emu				X		X
ESTRILDIDAE							
Emblema pictum	Painted Finch				X		X
Neochmia ruficauda	Star Finch				X		
Taeniopygia guttata	Zebra Finch				X		X
FALCONIDAE							
Falco berigora	Brown Falcon				X		X
Falco cenchroides	Australian Kestrel				X		X
Falco longipennis	Australian Hobby				X		
Falco peregrinus	Peregrine Falcon	OS				X	
GLAREOLIDAE							

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Glareola maldivarum	Oriental Pratincole	IA			X	X	
HAEMATOPODIDAE							
Haematopus fuliginosus	Sooty Oystercatcher				X		
Haematopus longirostris	Pied Oystercatcher				X		
HIRUNDINIDAE							
Hirundo neoxena	Welcome Swallow				X		
Petrochelidon ariel	Fairy Martin				X		
Petrochelidon nigricans	Tree Martin				X		
LARIDAE							
Larus novaehollandiae	Silver Gull				X		X
Sterna albifrons	Little Tern	IA			X		
Sterna bengalensis	Lesser Crested Tern				X		
Sterna bergii	Crested Tern	IA			X	X	
Sterna caspia	Caspian Tern	IA			X		
Sterna dougallii	Roseate Tern	IA			X	X	
Sterna hirundo	Common Tern	IA				X	
Sterna leucoptera	White-winged Black Tern	IA			X	X	
Sterna nereis	Fairy Tern			X	X		
LOCUSTELLIDAE							
Eremiornis carteri	Spinifexbird				X		X
MALURIDAE							
Malurus lamberti	Variegated Fairy-wren				X		
Malurus leucopterus	White-winged Fairy-wren				X		X
Stipiturus ruficeps	Rufous-crowned Emu-wren				X		X
MELIPHAGIDAE							
Gavicalis virescens	Singing Honeyeater				X		X
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				X		
Lichmera indistincta	Brown Honeyeater				X		X
Manorina flavigula	Yellow-throated Miner				X		X
Ptilotula keartlandi	Grey-headed Honeyeater				X		
Epthianura tricolor	Crimson Chat				X		
Certhionyx variegatus	Pied Honeyeater				X		
MEROPIDAE							
Merops ornatus	Rainbow Bee-eater				X		X
MONARCHIDAE							
Grallina cyanoleuca	Magpie-lark				X		
OCEANITIDAE							
Oceanites oceanicus	Wilson's Storm-petrel	IA			X		
OREOICIDAE							
Oreoica gutturalis	Crested Bellbird				X		
OTIDIDAE							
Ardeotis australis	Australian Bustard				X		
PACHYCEPHALIDAE							

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Colluricincla harmonica	Grey Shrike-thrush				X		
PANDIONIDAE							
Pandion haliaetus	Osprey	IA			X		X
PARDALOTIDAE							
Pardalotus striatus	Striated Pardalote				X		X
Pardalotus rubricatus	Red-browed Pardalote						X
PELECANIDAE							
Pelecanus conspicillatus	Australian Pelican				X		
PHAETHONTIDAE							
Phaethon lepturus	White-tailed Tropicbird	IA			X	X	
PHALACROCORACIDAE							
Phalacrocorax sulcirostris	Little Black Cormorant				X		
Phalacrocorax varius	Pied Cormorant				X		
PODARGIDAE							
Podargus strigoides	Tawny Frogmouth				X		
PODICIPEDIDAE							
Poliocephalus poliocephalus	Hoary-headed Grebe				X		
Tachybaptus novaehollandiae	Australasian Grebe				X		
POMATOSTOMIDAE							
Pomatostomus temporalis	Grey-crowned Babbler				X		
PROCELLARIIDAE							
Macronectes giganteus	Southern Giant Petrel	IA		X			
Puffinus huttoni	Hutton's Shearwater	EN			X	X	
PSITTACIDAE							
Platycercus zonarius	Australian Ringneck				X		
Melopsittacus undulatus	Budgerigar				X		
Pezoporus occidentalis	Night Parrot	EN		X			
PTILONORHYNCHIDAE							
Ptilonorhynchus guttatus	Western Bowerbird				X		X
RALLIDAE							
Fulica atra	Eurasian Coot				X		
Gallirallus philippensis	Buff-banded Rail				X		
RECURVIROSTRIDAE							
Himantopus himantopus	Black-winged Stilt				X		
RHIPIDURIDAE							
Rhipidura albiscapa	Grey Fantail				X		
Rhipidura leucophrys	Willie Wagtail				X		X
Rhipidura phasiana	Mangrove Grey Fantail				X		
SCOLOPACIDAE							
Arenaria interpres	Ruddy Turnstone	IA			X	X	
Calidris acuminata	Sharp-tailed Sandpiper	IA			X	X	
Calidris alba	Sanderling	IA			X	X	
Calidris canutus	Red Knot	IA (VU at subsp. level)		X		X	

Family and species	Common name	Cons. Code	Naturalised	PMST	*NatureMap*	DBCA database	Field Survey
Calidris ferruginea	Curlew Sandpiper	VU & IA		X		X	
Calidris ruficollis	Red-necked Stint	IA				X	
Calidris subminuta	Long-toed Stint	IA			X	X	
Limosa lapponica	Bar-tailed Godwit	IA (VU at subsp. level)		X		X	
Numenius madagascariensis	Eastern Curlew	EN		X			
Numenius minutus	Little Curlew	IA			X	X	
Numenius phaeopus	Whimbrel	IA			X	X	
Tringa brevipes	Grey-tailed Tattler	P4			X		
Tringa glareola	Wood Sandpiper	IA			X	X	
Tringa hypoleucos	Common Sandpiper	IA			X		
Tringa nebularia	Common Greenshank	IA			X	X	
Tringa stagnatilis	Marsh Sandpiper	IA			X	X	
STURNIDAE							
Gelochelidon nilotica	Gull-billed Tern	IA			X		
THRESKIORNITHIDAE							
Plegadis falcinellus	Glossy Ibis	IA				X	
Threskiornis spinicollis	Straw-necked Ibis				X		
TURNICIDAE							
Turnix velox	Little Button-quail				X		
ZOSTEROPIDAE							
Zosterops luteus	Yellow White-eye				X		
Amphibians							
HYLIDAE							
Cyclorana maini	Sheep Frog				X		
MYOBATRACHIDAE							
Neobatrachus aquilonius	Northern Burrowing Frog				X		
Neobatrachus fulvus	Tawny Trilling Frog				X		

Table 20: Conservation significant fauna likelihood assessment

Species with darker blue shading were recorded during the field survey.

Taxonomic Group	Species	Common name	Cons. Code	Desktop Likelihood
Mammals	*Dasyurus hallucatus*	Northern Quoll	EN	Very low
	Petrogale lateralis	Black-flanked Rock-wallaby	EN	Very low
	Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	Very low
Reptiles	*Aprasia rostrata*	Ningaloo Worm-lizard	P3	Medium
	Diplodactylus capensis	Cape Range Stone Gecko	P2	Medium
	Lerista allochira	Cape Range Slider	P3	Recorded
Birds	*Arenaria interpres*	Ruddy Turnstone	IA	Medium
	Calidris acuminata	Sharp-tailed Sandpiper	IA	Medium
	Calidris alba	Sanderling	IA	Medium
	Calidris canutus	Red Knot	IA (VU at subsp. level)	Medium
	Calidris ferruginea	Curlew Sandpiper	VU & IA	Low
	Calidris ruficollis	Red-necked Stint	IA	Low
	Calidris subminuta	Long-toed Stint	IA	Medium
	Charadrius leschenaultii	Greater Sand Plover	IA (VU at subsp. level)	Medium
	Charadrius mongolus	Lesser Sand Plover	EN & IA	Medium
	Charadrius veredus	Oriental Plover	IA	Low
	Falco peregrinus	Peregrine Falcon	OS	Low
	Gelochelidon nilotica	Gull-billed Tern	IA	Medium
	Glareola maldivarum	Oriental Pratincole	IA	Medium
	Limosa lapponica subsp. baueri	Bar-tailed Godwit	VU & IA	Low
	Macronectes giganteus	Southern Giant Petrel	IA	Very Low
	Numenius madagascariensis	Eastern Curlew	EN	Medium
	Numenius minutus	Little Curlew	IA	Medium
	Numenius phaeopus	Whimbrel	IA	Low
	Oceanites oceanicus	Wilson's Storm-petrel	IA	Medium
	Pandion haliaetus	Eastern Osprey	IA	Recorded
	Pezoporus occidentalis	Night Parrot	EN	Very Low
	Phaethon lepturus	White-tailed Tropicbird	IA	Medium
	Plegadis falcinellus	Glossy Ibis	IA	Low
	Pluvialis fulva	Pacific Golden Plover	IA	Low
	Pluvialis squatarola	Grey Plover	IA	Low
	Puffinus huttoni	Hutton's Shearwater	EN	Very low
	Sterna albifrons	Little Tern	IA	Medium
	Sterna bergii	Crested Tern	IA	Recorded
	Sterna caspia	Caspian Tern	IA	Medium
	Sterna dougallii	Roseate Tern	IA	Low
	Sterna hirundo	Common Tern	IA	Very low
	Sterna leucopterus	White-winged Black Tern	IA	Medium
	Sterna nereis	Fairy Tern	VU	Medium
	Thalassarche chlororhynchos	Atlantic Yellow-nosed Albatross	VU	Low
	Tringa brevipes	Grey-tailed Tattler	P4	High
	Tringa glareola	Wood Sandpiper	IA	Medium
	Tringa hypoleucos	Common Sandpiper	IA	Recorded
	Tringa nebularia	Common Greenshank	IA	Low
	Tringa stagnatilis	Marsh Sandpiper	IA	Medium

APPENDIX THREE FLORA FIELD SURVEY RESULTS

Table 21: Flora site x species

Family	Species	Naturalised	Cons. code	NL1801	NL1802	NL1803	NL1804	NL1805	NL1806	NL1807	NL1808	NL1809R	NL1810	NL1811	NL1812	NL1813	NL1814	NL1815	NL1816	NL1817	NL1818R	NL1819R	Opp
Acanthaceae	*Dipteracanthus australasicus* subsp. *australasicus*												X									X	
	Dipteracanthus australasicus subsp. *corynothecus*																			X			
Aizoaceae	*Trianthema pilosum*														X								
Amaranthaceae	*Aerva javanica*	*										X											X
	Amaranthus clementii																						X
	Amaranthus undulatus																						X
	Ptilotus axillaris				X																		
	Ptilotus clementii											X											X
	Ptilotus nobilis subsp. *nobilis*						X	X	X		X	X	X							X	X	X	
	Ptilotus obovatus									X		X	X								X	X	
Apocynaceae	*Cynanchum viminale*								X	X		X								X			X
Arecaceae	*Phoenix dactylifera*	*																					X
Asparagaceae	*Acanthocarpus humilis*						X	X	X														X
	Acanthocarpus preissii																		X				X
	Acanthocarpus verticillatus																						X
	Acanthocarpus ?verticillatus			X		X																	
	Thysanotus exfimbriatus				X		X	X	X	X			X		X	X	X	X					X
	Unidentified succulent	*																					X
Asteraceae	*Angianthus cunninghamii*																		X				X
	Asteraceae sp.																		X				
	Bidens subalternans var. *simulans*	*								X		X	X										X
	Launaea sarmentosa																		X				
	Olearia sp. Kennedy Range (G. Byrne 66)																X						
	Pterocaulon sphaeranthoides						X	X			X							X		X			X

Family	Species	Naturalised	Cons. code	NL1801	NL1802	NL1803	NL1804	NL1805	NL1806	NL1807	NL1808	NL1809R	NL1810	NL1811	NL1812	NL1813	NL1814	NL1815	NL1816	NL1817	NL1818R	NL1819R	Opp
	Sonchus oleraceus	*								X			X										X
Boraginaceae	*Heliotropium crispatum*																	X					X
	Heliotropium glanduliferum			X	X	X	X	X			X	X			X	X							
	Trichodesma zeylanicum var. zeylanicum			X	X	X			X	X													
Campanulaceae	*Wahlenbergia tumidifructa*																						X
Capparaceae	*Capparis spinosa* subsp. *nummularia*													X									X
Celastraceae	*Stackhousia umbellata*		P3				X	X	X	X	X									X			X
Chenopodiaceae	*Atriplex* sp.																		X				X
	Dysphania plantaginella			X	X	X		X	X														
	Enchylaena tomentosa									X		X	X										
	Rhagodia preissii subsp. *obovata*					X				X				X			X	X					
	Salsola australis											X		X									
	Threlkeldia diffusa													X			X	X	X				
Colchicaceae	*Wurmbea odorata*				X					X	X									X			
Commelinaceae	*Commelina ensifolia*			X	X	X										X							
Convolvulaceae	*Evolvulus alsinoides* var. *decumbens*				X		X					X								X		X	
	Ipomoea costata				X				X	X			X							X			X
	Ipomoea pes-caprae subsp. *brasiliensis*																		X				X
Cucurbitaceae	*Cucumis variabilis*				X		X			X			X										
Cyperaceae	*Bulbostylis barbata*			X		X									X	X							
Dilleniaceae	*Hibbertia spicata* subsp. *spicata*						X	X	X	X	X									X			
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*			X																			2
	Euphorbia sharkoensis									X		X											
	Euphorbia sp.																X				X		X
	Euphorbia tannensis subsp. *eremophila*			X	X	X						X	X		X	X							
Fabaceae	*Acacia arida*																			X	X		
	Acacia ?bivenosa																			X			

Family	Species	Naturalised	Cons. code	NL1801	NL1802	NL1803	NL1804	NL1805	NL1806	NL1807	NL1808	NL1809R	NL1810	NL1811	NL1812	NL1813	NL1814	NL1815	NL1816	NL1817	NL1818R	NL1819R	Opp
	Acacia bivenosa			X			X		X	X	X	X	X								X	X	
	Acacia coriacea subsp. *coriacea*			X			X			X			X	X	X	X	X	X			X		X
	Acacia gregorii				X	X	X	X			X				X	X				X			
	Acacia pyrifolia var. *pyrifolia*												X							X	X		X
	Acacia sclerosperma subsp. *sclerosperma*				X													X					
	Acacia spathulifolia			X		X			X						X								
	Acacia tetragonophylla									X			X							X			
	Crotalaria cunninghamii															X							X
	Daviesia pleurophylla		P2			X									X								X
	Indigofera boviperda subsp. *boviperda*			X	X	X									X	X	X	X			X		
	Indigofera monophylla						X	X	X	X	X	X	X							X	X	X	X
	Indigofera sp.				X																		
	Labichea cassioides							X	X	X													X
	Leptosema macrocarpum						X	X	X		X									X			
	Lotus australis																	X	X				X
	Rhynchosia minima				X							X	X			X							
	Senna artemisioides subsp. *oligophylla*									X			X							X		X	X
	Senna glutinosa subsp. *glutinosa*																						X
	Senna glutinosa subsp. *pruinosa*						X																X
	Tephrosia rosea var. *clementii*																					X	
Geraniaceae	*Erodium cygnorum*				X					X			X										
Goodeniaceae	*Dampiera incana* var. *incana*			X			X	X	X		X			X			X	X		X	X		
	Lechenaultia subcymosa																			X			
	Scaevola ?pulchella			X	X		X								X								
	Scaevola sericophylla			X	X	X			X	X					X	X	X	X					
	Scaevola spinescens									X			X										
	Scaevola tomentosa									X			X							X	X		X

Family	Species	Naturalised	Cons. code	NL1801	NL1802	NL1803	NL1804	NL1805	NL1806	NL1807	NL1808	NL1809R	NL1810	NL1811	NL1812	NL1813	NL1814	NL1815	NL1816	NL1817	NL1818R	NL1819R	Opp
Gyrostemonaceae	*Gyrostemon ramulosus*			X			X																
Hemerocallidaceae	*Corynotheca flexuosissima*													X			X	X	X				
	Tricoryne corynothecoides				X			X															
Lamiaceae	*Clerodendrum tomentosum* var. *tomentosum*									X						X							X
	Quoya loxocarpa			X	X											X							
Lauraceae	*Cassytha aurea* var. *aurea*							X	X	X													
	Cassytha capillaris				X			X															
Loganiaceae	*Logania litoralis*									X	X												X
Malvaceae	*Abutilon fraseri*									X		X											
	Abutilon sp.					X	X																
	Alyogyne pinoniana					X		X	X				X										
	Alyogyne aff. *pinoniana*					X				X					X					X		X	
	Brachychiton obtusilobus		P4							X													X
	Corchorus ?congener		P3															X					
	Corchorus carnarvonensis			X		X		X		X		X	X	X	X	X	X						
	Corchorus crozophorifolius										X									X		X	
	Gossypium robinsonii									X			X								X	X	
	Hannafordia quadrivalvis subsp. *recurva*			X		X	X	X	X		X					X					X		
	Hibiscus leptocladus										X	X											
	Melhania oblongifolia											X											
	Seringia hermanniifolia			X																			
	Sida rohlenae subsp. *rohlenae*			X																			
Meliaceae	*Owenia reticulata*			X																			X
Menispermaceae	*Tinospora esiangkara*		P2		X																		X
Montiaceae	*Calandrinia* sp.																						X
Moraceae	*Ficus brachypoda*									X			X								X	X	
Myrtaceae	*Calytrix truncatifolia*																						X

Family	Species	Naturalised	Cons. code	NL1801	NL1802	NL1803	NL1804	NL1805	NL1806	NL1807	NL1808	NL1809R	NL1810	NL1811	NL1812	NL1813	NL1814	NL1815	NL1816	NL1817	NL1818R	NL1819R	Opp
	Corymbia hamersleyana																			X			
	Corymbia zygophylla															X							X
	Eucalyptus xerothermica																						X
	Melaleuca cardiophylla						X	X	X		X		X							X			X
	Thryptomene baeckeacea									X													
	Verticordia forrestii			X																			
Nyctaginaceae	*Boerhavia coccinea*										X												
	Commicarpus australis					X				X		X	X	X	X		X	X					
Olacaceae	*Olax aurantia*			X																			
Oleaceae	*Jasminum* sp. Exmouth (G. Marsh 77)					X			X	X			X		X					X			X
Passifloraceae	*Passiflora foetida*	*																					X
Phyllanthaceae	*Phyllanthus hamelinii*								X														X
	Synostemon rhytidospermus																						X
Pittosporaceae	*Pittosporum phillyreoides*												X								X		
Plumbaginaceae	*Plumbago zeylanica*																						X
Poaceae	*Aristida holathera* var. *holathera*																						X
	Cenchrus ciliaris	*		X	X	X				X		X	X	X	X		X	X			X	X	
	Cymbopogon ambiguus						X		X	X			X									X	
	Enneapogon lindleyanus																			X			X
	Eragrostis eriopoda			X		X	X																
	Eriachne aristidea																						X
	Eriachne mucronata							X			X									X	X		
	Eulalia aurea										X												
	Paraneurachne muelleri								X														
	Paspalidium clementii								X														X
	Poaceae sp.1																						
	Poaceae sp.2									X	X												

Family	Species	Naturalised	Cons. code	NL1801	NL1802	NL1803	NL1804	NL1805	NL1806	NL1807	NL1808	NL1809R	NL1810	NL1811	NL1812	NL1813	NL1814	NL1815	NL1816	NL1817	NL1818R	NL1819R	Opp
	Poaceae sp.3																			X			
	Poaceae sp.4						X																
	Spinifex longifolius													X			X		X				
	Sporobolus virginicus																		X				X
	Themeda triandra										X												X
	Triodia angusta									X	X	X	X							X	X		
	Triodia epactia			X	X		X		X	X				X			X	X	X		X	X	X
	Triodia glabra			X	X	X	X	X	X						X	X						X	
	Triodia schinzii														X								
	Triodia wiseana						X																X
	Whiteochloa airoides													X			X	X	X				
Portulacaceae	*Portulaca oleracea*													X			X	X					
Proteaceae	*Banksia ashbyi* subsp. *boreoscaia*			X											X								
	Grevillea ?eriostachya														X								
	Grevillea calcicola		P3						X														
	Grevillea stenobotrya			X		X		X															
	Grevillea variifolia subsp. *variifolia*						X		X	X											X	X	
	Hakea stenophylla subsp. *stenophylla*					X	X	X							X								
Rubiaceae	*Oldenlandia crouchiana*																					X	
Santalaceae	*Exocarpos aphyllus*							X	X	X			X							X			X
	Exocarpos sparteus			X			X																
	Santalum sp.																						X
Sapindaceae	*Alectryon oleifolius* subsp. *oleifolius*					X				X			X										
	Diplopeltis eriocarpa																						X
Scrophulariaceae	*Eremophila forrestii* subsp. *capensis*		P3				X		X	X	X									X			X
	Eremophila longifolia											X	X										
Solanaceae	*Duboisia hopwoodii*			X											X								

Family	Species	Naturalised	Cons. code	NL1801	NL1802	NL1803	NL1804	NL1805	NL1806	NL1807	NL1808	NL1809R	NL1810	NL1811	NL1812	NL1813	NL1814	NL1815	NL1816	NL1817	NL1818R	NL1819R	Opp
	Solanum cleistogamum														X								
	Solanum diversiflorum						X		X							X							X
	Solanum lasiophyllum			X			X	X	X	X	X	X	X	X		X	X	X		X	X	X	
Tamaricaceae	*Tamarix aphylla*	*																					X
Thymelaeaceae	*Pimelea ammocharis*						X																X
Violaceae	*Hybanthus aurantiacus*						X	X	X		X												X
Zygophyllaceae	*Tribulus ?occidentalis*				X		X																X
	Tribulus suberosus									X	X		X							X			X
	Zygophyllum fruticulosum																X						
	Zygophyllum retivalve								X	X	X	X	X										

APPENDIX FOUR THREATENED AND PRIORITY FLORA REPORT FORMS

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at http://dpaw.wa.gov.au/ under *Standard Report Forms*

TAXON: Brachychiton obtusilobus **TPFL Pop. No:**

OBSERVATION DATE: 11/07/2018 **CONSERVATION STATUS:** P4 New population ☐

OBSERVER/S: Lyn Atkins **PHONE:** 9430 8955

ROLE: Associate Environmental Scientist **ORGANISATION:** Ecoscape

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

Approximately 200 m southeast of Vlamingh Head Lighthouse, North West Cape

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Exmouth Land manager present: ☐

DATUM:

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

COORDINATES: (If UTM coords provided, **Zone** is also required)

DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: 7585369.528

Long / Easting: 201286.342

ZONE: 50

METHOD USED:

GPS ☐ Differential GPS ☐ Map ☐

No. satellites: Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

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

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

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

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

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			
Dead				

Area of pop (m²): 1

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

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

Summary Quad. Totals: Alive				

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

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

COMMENT:

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

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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

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

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

HABITAT INFORMATION:

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

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

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

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

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

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

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

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

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

1. Melaleuca cardiophylla mid open shrubland
2. Triodia glabra, Triodia angusta and Acacia gregorii mid hummock grassland/low shrubland
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

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

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

COMMENT:

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

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

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

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

Recorded 5 plants within 350 m of Vlamingh Head Lighthouse

DRF PERMIT/ LICENCE No: SL012268 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☒ Regional Herb. ☐ District Herb. ☐ Other: _____

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

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

Submitter of Record: Lynette Atkins Role: Associate Environmental Scientist Signed: _____ Date: 17/08/2018

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

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TAXON: Daviesia pleurophylla **TPFL Pop. No:**

OBSERVATION DATE: 13/07/2018 **CONSERVATION STATUS:** P2 New population ☐

OBSERVER/S: Lyn Atkins **PHONE:** 9430 8955

ROLE: Associate Environmental Scientist **ORGANISATION:** Ecoscape

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

Approximately 750 m southeast of Vlamingh Head Lighthouse, North West Cape

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Exmouth Land manager present: ☐

DATUM:

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

COORDINATES: (If UTM coords provided, **Zone** is also required)

DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: 7584955.018

Long / Easting: 201681.26

ZONE: 50

METHOD USED:

GPS ☐ Differential GPS ☐ Map ☐

No. satellites: _____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

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

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

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m^2: _____

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

WHAT COUNTED: Plants ☐ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	100			
Dead				

Area of pop (m²): 20 ha

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

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

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☒ Flowerbud ☒ Flower ☒

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

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

COMMENT:

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

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

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

HABITAT INFORMATION:

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

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other:
Dunes and swales

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

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

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

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

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

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

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

1. Banksia ashbyi subsp. boreoscaia and Daviesia pleurophylla tall sparse shrubland
2. Triodia glabra, Scaevola sericophylla and Acacia gregorii mid hummock grassland/low shrubland
3.
4.

ASSOCIATED SPECIES:
Other (non-dominant) spp

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

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

COMMENT:

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

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

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

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

Specimen will be lodged in WA Herbarium

Specimen No. 4216-FL-19

Dominant and characteristic species within vegetation type (on red Pindan dunes and swales)

DRF PERMIT/ LICENCE No: SL012268 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☒ Regional Herb. ☐ District Herb. ☐ Other: _____

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

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

Submitter of Record: Lynette Atkins Role: Associate Environmental Scientist Signed: _____ Date: 17/08/2018

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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

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

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at http://dpaw.wa.gov.au/ under *Standard Report Forms*

TAXON: Eremophila forrestii subsp. capensis **TPFL Pop. No:**

OBSERVATION DATE: 11/07/2018 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Lyn Atkins **PHONE:** 9430 8955

ROLE: Associate Environmental Scientist **ORGANISATION:** Ecoscape

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

Approximately 150 m southeast of Vlamingh Head Lighthouse, North West Cape

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Exmouth Land manager present: ☐

DATUM:

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

COORDINATES: (If UTM coords provided, **Zone** is also required)

DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: 7585437.30

Long / Easting: 201305.73

ZONE: 50

METHOD USED:

GPS ☐ Differential GPS ☐ Map ☐

No. satellites: Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

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

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

EFFORT: Time spent surveying (minutes): No. of minutes spent / 100 m^2:

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

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	20-30			
Dead				

Area of pop (m²): 1

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

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

Summary Quad. Totals: Alive				

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

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

COMMENT:

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

Please return completed form to **Species And Communities Branch** DBCA,
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RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

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Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

HABITAT INFORMATION:

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

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

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

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

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

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

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

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

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

1. Melaleuca cardiophylla mid open shrubland
2. Triodia glabra, Triodia angusta and Acacia gregorii mid hummock grassland/low shrubland
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

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

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

COMMENT:

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

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

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

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

One specimen will be lodged in WA Herbarium

Occurs occasionally in small groups in the vegetation type, most frequently in exposed situations

DRF PERMIT/ LICENCE No: SL012268 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☒ Regional Herb. ☐ District Herb. ☐ Other: _____

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

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

Submitter of Record: Lynette Atkins Role: Associate Environmental Scientist Signed: _____ Date: 17/08/2018

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TAXON: Grevillea calcicola **TPFL Pop. No:**

OBSERVATION DATE: 11/07/2018 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Lyn Atkins **PHONE:** 9430 8955

ROLE: Associate Environmental Scientist **ORGANISATION:** Ecoscape

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

Approximately 300 m south of Vlamingh Head Lighthouse, North West Cape

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Exmouth Land manager present: ☐

DATUM:

GDA94 / MGA94 ☒

AGD84 / AMG84 ☐

WGS84 ☐

Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)

DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: 7585296.69

Long / Easting: 201202.226

ZONE: 50

METHOD USED:

GPS ☐ Differential GPS ☐ Map ☐

No. satellites: Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

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

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

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

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

EFFORT: Time spent surveying (minutes): No. of minutes spent / 100 m^2:

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒ Count method:

(Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			
Dead				

Area of pop (m²): 1

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

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

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☒ Flowerbud ☐ Flower ☐

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

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

COMMENT:

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

Please return completed form to **Species And Communities Branch** DBCA,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

HABITAT INFORMATION:

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

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

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

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

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

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

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

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

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

1. Melaleuca cardiophylla mid open shrubland
2. Triodia glabra, Triodia angusta and Acacia gregorii mid hummock grassland/low shrubland
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

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

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

COMMENT:

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

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

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

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

Vegetative specimen only

DRF PERMIT/ LICENCE No: SL012268 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☒ Regional Herb. ☐ District Herb. ☐ Other: _____

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

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

Submitter of Record: Lynette Atkins Role: Associate Environmental Scientist Signed: _____ Date: 17/08/2018

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

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Version 1.3 August 2017

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TAXON: Stackhousia umbellata **TPFL Pop. No:**

OBSERVATION DATE: 11/07/2018 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Lyn Atkins **PHONE:** 9430 8955

ROLE: Associate Environmental Scientist **ORGANISATION:** Ecoscape

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

Approximately 300 m south of Vlamingh Head Lighthouse, North West Cape

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Exmouth Land manager present: ☐

DATUM:

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

COORDINATES: (If UTM coords provided, **Zone** is also required)

DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: 7585201.094

Long / Easting: 201902.669

ZONE: 50

METHOD USED:

GPS ☐ Differential GPS ☐ Map ☐

No. satellites: Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

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

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

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

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

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1000s			
Dead				

Area of pop (m²): 1

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

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

Summary Quad. Totals: Alive				

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

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

COMMENT:

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

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GOVERNMENT OF WESTERN AUSTRALIA

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Version 1.3 August 2017

HABITAT INFORMATION:

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

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

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

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

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

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

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

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

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

1. Melaleuca cardiophylla mid open shrubland
2. Triodia glabra, Triodia angusta and Acacia gregorii mid hummock grassland/low shrubland
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

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

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

COMMENT:

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

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

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

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

Characteristic but not dominant species in entire vegetation type; density ranges from 2-20 per 100 m2 area

Mostly observed growing through Triodia clumps

DRF PERMIT/ LICENCE No: SL012268 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☒ Regional Herb. ☐ District Herb. ☐ Other: _____

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

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

Submitter of Record: Lynette Atkins Role: Associate Environmental Scientist Signed: _____ Date: 17/08/2018

Please return completed form to **Species And Communities Branch** DBCA,
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Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

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Version 1.3 August 2017

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TAXON: Tinospora esiangkara **TPFL Pop. No:**

OBSERVATION DATE: 10/07/2018 **CONSERVATION STATUS:** P2 New population ☐

OBSERVER/S: Lyn Atkins **PHONE:** 9430 8955

ROLE: Associate Environmental Scientist **ORGANISATION:** Ecoscape

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

Approximately 900 m east of Vlamingh Head Lighthouse, North West Cape

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Exmouth Land manager present: ☐

DATUM:

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

COORDINATES: (If UTM coords provided, **Zone** is also required)

DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: 7585391.765

Long / Easting: 202071.411

ZONE: 50

METHOD USED:

GPS ☐ Differential GPS ☐ Map ☐

No. satellites: Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

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

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☐ Area observed (m²): 900

EFFORT: Time spent surveying (minutes): 2 hrs No. of minutes spent / 100 m^2:

POP'N COUNT ACCURACY: Actual ☒ Extrapolation ☐ Estimate ☐ Count method:

(Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			
Dead				

Area of pop (m²): 1

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

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

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☒ Flowerbud ☒ Flower ☒

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

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

COMMENT:

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

Please return completed form to **Species And Communities Branch** DBCA,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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

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

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3 August 2017

HABITAT INFORMATION:

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

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: Dunes and swales

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

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

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

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

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

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

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

1. Banksia ashbyi subsp. boreoscaia and Daviesia pleurophylla tall sparse shrubland
2. Triodia glabra, Scaevola sericophylla and Acacia gregorii mid hummock grassland/low shrubland
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

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

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

COMMENT:

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

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

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

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

One specimen will be lodged in WA Herbarium

Specimen Nos. NL1802-14, 4216FL-25

Also recorded at 201021.053 E, 7585625.544 N (14/07/2018) in Melaleuca cardiophylla mid open shrubland over Triodia glabra, Triodia angusta and Acacia gregorii mid hummock grassland/low shrubland (1 plant)

DRF PERMIT/ LICENCE No: SL012268 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☒ Regional Herb. ☐ District Herb. ☐ Other: _____

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

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

Submitter of Record: Lynette Atkins Role: Associate Environmental Scientist Signed: _____ Date: 17/08/2018

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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

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

APPENDIX FIVE FLORA STATISTICAL ANALYSIS

FLORISTIC ANALYSIS

Floristic analysis was conducted using the quadrat and relevé data from the field survey (**Figure 5**). The analysis identified three broad floristic groups (supergroups) corresponding with the three major landform/habitat types present within the survey area: red Pindan sand dunes (five quadrats, determined to represent a single vegetation type, **BaDp**); coastal dunes (four quadrats, determined to represent two vegetation types: **AcRp** on stable hinddunes and **TeSlWa** on foredunes); and limestone (four vegetation types, as follows).

The latter landform/habitat type required a degree of interpretation, however, the major vegetation type of the wide-ranging slopes and crests (**Mc**) was clearly separate from the others. The two gorge quadrats, determined as being vegetation type **AbSaAt**, were separated on the floristic dendrogram from the remaining limestone vegetation types. However, it is of interest that these two quadrats from the somewhat more sheltered gorge areas (vegetation type **AbSaAt**) were floristically more similar to the vegetation type of the highly exposed scree slopes (vegetation type **Ab**) than the vegetation of the scree slopes was to the equally exposed western footslopes vegetation (**AbFb**).

Overall, the floristic vegetation types were a good match for the observed structural vegetation types of the survey area.

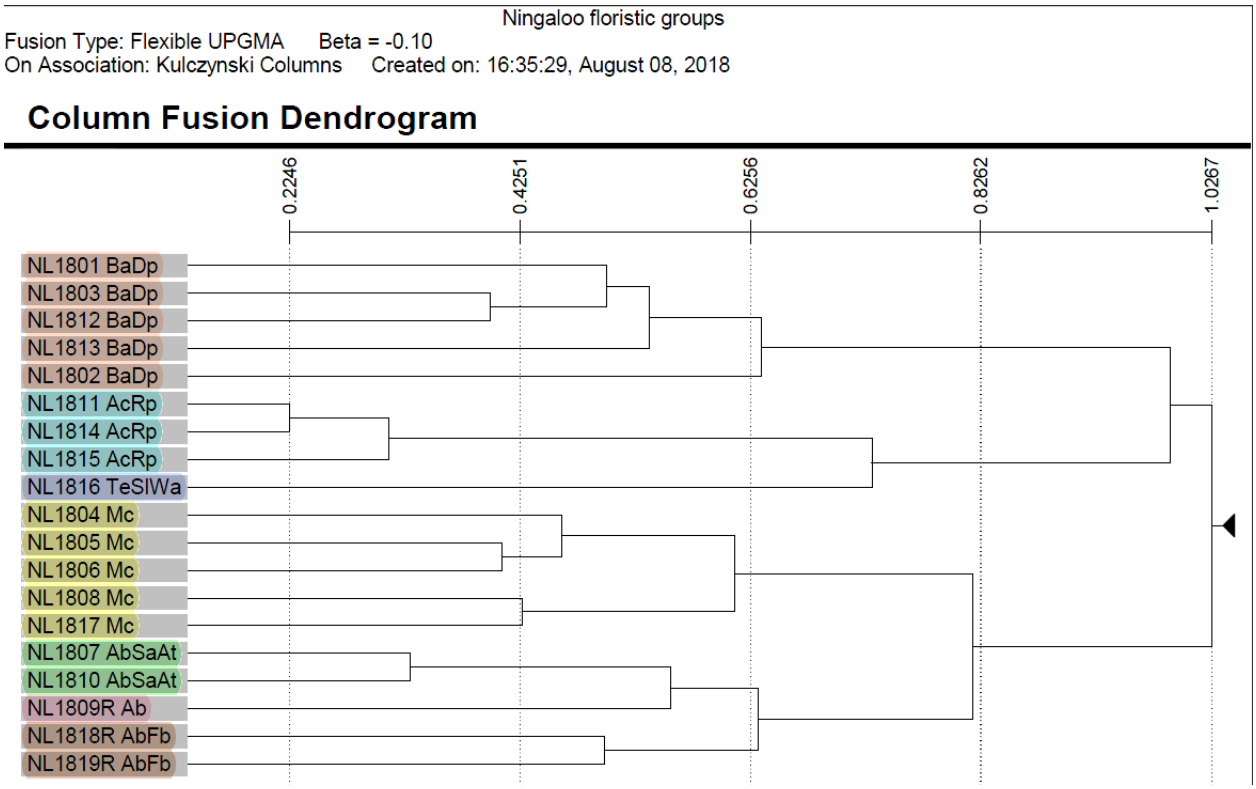


Figure 5: Floristic dendrogram

ADEQUACY OF SURVEY

Adequacy of survey can be demonstrated using a species accumulation curve; if the curve has reached (or almost reached) an asymptote it is considered that most species are likely to have been recorded from the survey area.

Species accumulation curves were generated using all data and separately for each survey area tenement using quadrat data (**Figure 6**). Opportunistic observations, which increase the number of species recorded, are not included in the analysis.

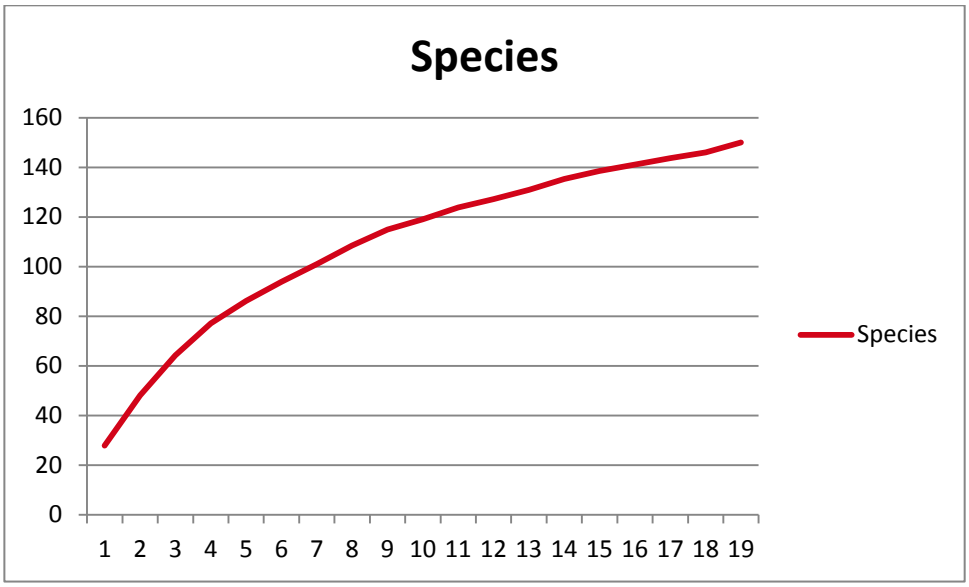


Figure 6: Species accumulation curve using quadrat data

The species accumulation curve suggests that additional survey would have recorded additional species. However, the Bootstrap estimate of species richness is 172.1 which, when taking opportunistic observations into account, is close to the number of species recorded (169). As annual species had largely not commenced flowering during the field survey, few such species were collected and are therefore included in the species total. Ecoscape considers that additional species that are present within the survey area would be largely annual herbs.

APPENDIX SIX FLORA QUADRAT DATA

Ningaloo

NL1801

Staff LJA **Date** 10/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201897 **mE** 7585357 **mN** **Lat.** -21.8105 **Long.** 114.1167

Habitat Lower-Slope

Aspect E **Slope** Gentle

Soil Type Red sand

Rock Type None

Loose Rock 0 % cover **Litter** 15 % cover ; <1 cm in depth

Bare ground **Weeds** <1 % cover

Vegetation M ^*Scaevola sericophylla,Acacia bivenosa,Duboisia hopwoodii*\^shrub\3\r;G+ ^*Triodia glabra*, ^*Acacia spathulifolia*\^hummock grass,shrub\2\c

Veg. Condition Very Good

Disturbance None evident

Fire Age No evidence

Notes Pindan dunes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		1.5	2	
Acacia coriacea subsp. *coriacea*		1.2	1	
Acacia spathulifolia		0.6	<1	
Acanthocarpus ?verticillatus		1.2	<1	
Adriana tomentosa var. *tomentosa*		0.7	<1	
Banksia ashbyi subsp. *boreoscaia*		1.5	1	

Ningaloo

Bulbostylis barbata	0.01	<1
**Cenchrus ciliaris*	0.3	<1
Commelina ensifolia	0.3	<1
Corchorus carnarvonensis	0.5	<1
Dampiera incana var. *incana*	0.4	<1
Duboisia hopwoodii	1.8	2
Dysphania plantaginella	0.03	<1
Eragrostis eriopoda	0.3	<1
Euphorbia tannensis subsp. *eremophila*	0.4	<1
Exocarpos sparteus	1.5	<1
Grevillea stenobotrya	1.5	1
Gyrostemon ramulosus	1.3	<1
Hannafordia quadrivalvis subsp. *recurva*	0.6	<1
Heliotropium glanduliferum	0.3	<1
Indigofera boviperda subsp. *boviperda*	0.4	<1
Olax aurantia	1.5	<1
Owenia reticulata	0.3	<1
Quoya loxocarpa	0.6	<1
Scaevola sericophylla	1.6	3
Scaevola sp.	0.3	<1
Seringia hermanniifolia	0.3	<1
Sida rohlenae subsp. *rohlenae*	0.2	<1
Solanum lasiophyllum	0.5	1
Trichodesma zeylanicum var. *zeylanicum*	0.1	<1
Triodia epactia	0.4	1
Triodia glabra	0.8	20
Verticordia forrestii	0.7	<1

Ningaloo

NL1802

Staff LJA **Date** 10/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 202071 **mE** 7585392 **mN** **Lat.** -21.8102 **Long.** 114.1184

Habitat Lower-Slope

Aspect NW **Slope** Very Gentle

Soil Type Red sand

Rock Type None

Loose Rock 0 % cover **Litter** 5 % cover ; <1 cm in depth

Bare ground 40 % cover **Weeds** 2 % cover

Vegetation M ^*Acacia sclerosperma* subsp. *sclerosperma*\^shrub\3\r;G+ ^*Triodia glabra*\^hummock grass\2\c

Veg. Condition Very Good

Disturbance None evident

Fire Age No evidence

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia gregorii		0.6	<1	
Acacia sclerosperma subsp. *sclerosperma*		1.4	2	
Cassytha capillaris		0,3	<1	
**Cenchrus ciliaris*		0.3	1	
Commelina ensifolia		0.4	<1	
Cucumis variabilis		1.5	<1	

Ningaloo

Dysphania plantaginella			<1
Erodium cygnorum		0.1	<1
Euphorbia tannensis subsp. *eremophila*		0.3	<1
Evolvulus alsinoides var. *decumbens*			<1
Heliotropium glanduliferum		1.0	<1
Indigofera boviperda subsp. *boviperda*		0.4	<1
Indigofera sp.		0,3	<1
Ipomoea costata			<1
Ptilotus axillaris		0.05	<1
Quoya loxocarpa		0.3	<1
Rhynchosia minima		0.9	<1
Scaevola sericophylla		0.8	2
Scaevola sp.			<1
Thysanotus exfimbriatus		0.6	<1
Tinospora esiangkara	P 2	1.2	<1
Tribulus ?occidentalis		0.1	<1
Trichodesma zeylanicum var. *zeylanicum*		0.1	<1
Tricoryne corynothecoides		0.4	<1
Triodia epactia		0.4	1
Triodia glabra		0.9	50
Wurmbea odorata		0.4	<1

Ningaloo

NL1803

Staff LJA **Date** 10/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 202012 **mE** 7585210 **mN** **Lat.** -21.8119 **Long.** 114.1178

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Red sand

Rock Type None

Loose Rock 0 % cover **Litter** 5 % cover ; <1 cm in depth

Bare ground 30 % cover **Weeds** <1 % cover

Vegetation M ^*Grevillea stenobotrya*,^*Daviesia pleurophylla*\^shrub\4\r;G+ ^*Triodia glabra*,^*Scaevola sericophylla*\^hummock grass,shrub\2\c

Veg. Condition Very Good

Disturbance None evident

Fire Age No evidence

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon sp.		0.5	<1	
Acacia gregorii		0.8	<1	
Acacia spathulifolia		1	<1	
Acanthocarpus ? *verticillatus*		0.6	<1	
Alectryon oleifolius subsp. *oleifolius*		1.2	<1	
Alyogyne aff. *pinoniana*		0.7	<1	

Alyogyne aff. *pinoniana*		0.6	<1
Bulbostylis barbata		0.02	<1
**Cenchrus ciliaris*		0.3	<1
Commelina ensifolia		0.4	<1
Commicarpus australis		0.7	<1
Corchorus carnarvonensis		0.3	<1
Daviesia pleurophylla	P 2	2.2	2
Dysphania plantaginella		0.05	<1
Eragrostis eriopoda		0.3	<1
Euphorbia tannensis subsp. *eremophila*		0.4	<1
Grevillea stenobotrya		2.0	2
Hakea stenophylla subsp. *stenophylla*		0.5	<1
Hannafordia quadrivalvis subsp. *recurva*		0.5	<1
Heliotropium glanduliferum		0.4	<1
Indigofera boviperda subsp. *boviperda*		0.4	<1
Jasminum sp. Exmouth (G. Marsh 77)		1.3	<1
Rhagodia preissii subsp. *obovata*		0.6	<1
Scaevola sericophylla		0.7	10
Trichodesma zeylanicum var. *zeylanicum*		0.1	<1
Triodia glabra		0.5	40

Ningaloo

NL1804

Staff LJA **Date** 11/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201903 **mE** 7585201 **mN** **Lat.** -21.8119 **Long.** 114.1167

Habitat Upper-Slope

Aspect SE **Slope** Gentle

Soil Type Red loamy sand

Rock Type Limestone

Loose Rock 10-20 % cover; 6-20 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 25 % cover **Weeds** <1 % cover

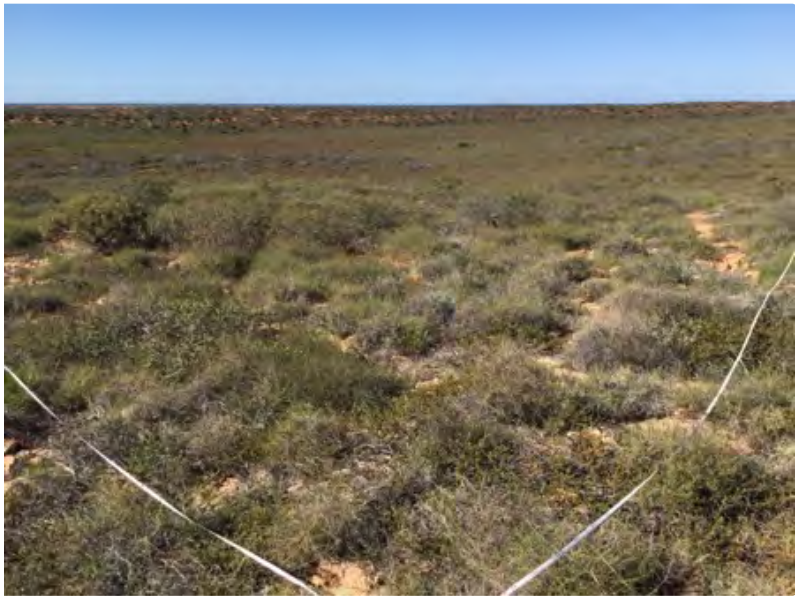
Vegetation G+ ^^ *Triodia glabra*,*Triodia wiseana*,*Melaleuca cardiophylla*\^hummock grass,shrub\2\d

Veg. Condition Excellent

Disturbance None

Fire Age No evidence

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon sp.		0.4	<1	
Acacia bivenosa		1	<1	
Acacia coriacea subsp. *coriacea*			<11	
Acacia gregorii		0.2	5	
Acanthocarpus humilis		0.3	<1	
Cucumis variabilis		1.2	<1	
Cymbopogon ambiguus		0.4	<1	

Dampiera incana var. *incana*		0.4	<1
Eragrostis eriopoda		0.3	<1
Eremophila forrestii subsp. *capensis*	P 3	0.8	<1
Evolvulus alsinoides var. *decumbens*		0.3	<1
Exocarpos sparteus		0.6	<1
Grevillea variifolia subsp. *variifolia*		1.3	1
Gyrostemon ramulosus		0.6	<1
Hakea stenophylla subsp. *stenophylla*		0.4	<1
Hannafordia quadrivalvis subsp. *recurva*		0.3	<1
Heliotropium glanduliferum		0.3	<1
Hibbertia spicata subsp. *spicata*		0.5	<1
Hybanthus aurantiacus		0.4	<1
Indigofera monophylla		0.4	<1
Leptosema macrocarpum		0.3	5
Melaleuca cardiophylla		1	5
Pimelea ammocharis		1	<1
Poaceae sp.		0.3	<1
Pterocaulon sphaeranthoides		0.2	<1
Ptilotus nobilis subsp. *nobilis*		0.4	<1
Scaevola sp.		0.2	<1
Senna glutinosa subsp. *pruinosa*		0.5	<1
Solanum diversiflorum		0.1	<1
Solanum lasiophyllum		0.3	<1
Stackhousia umbellata	P 3	1	1
Thysanotus exfimbriatus		0.3	<1
Tribulus ?occidentalis			<1
Triodia epactia		0.5	2
Triodia glabra		0.5	40
Triodia wiseana		0.6	20

Ningaloo

NL1805

Staff LJA **Date** 11/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201500 **mE** 7585263 **mN** **Lat.** -21.8113 **Long.** 114.1128

Habitat Crest

Aspect N/A **Slope** N/A

Soil Type Red loamy sand

Rock Type Limestone

Loose Rock 10-20 % cover; 20-60 mm in size **Litter** 20 % cover ; <1 cm in depth

Bare ground 30 % cover **Weeds** <1 % cover

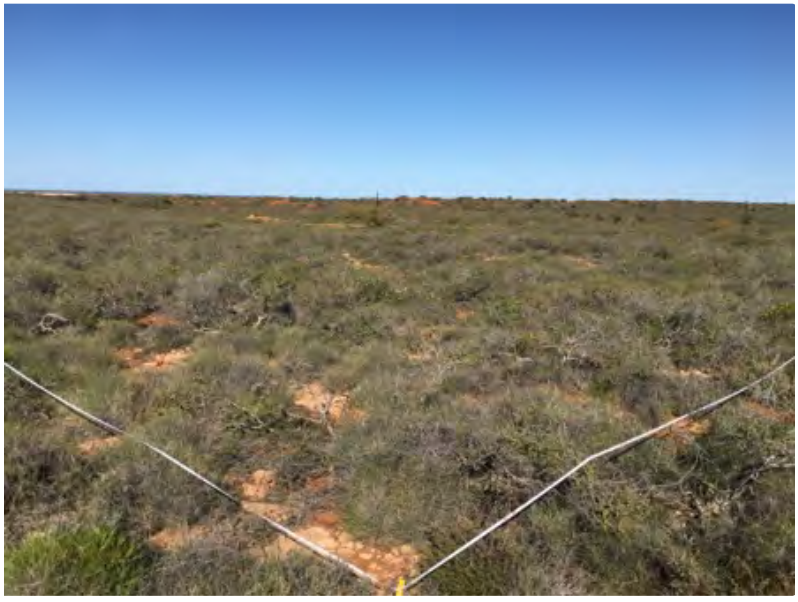
Vegetation G+ ^*Melaleuca cardiophylla*,^*Triodia glabra*,*Acacia gregorii*\^shrub,hummock grass\2\c

Veg. Condition Very Good

Disturbance Unknown; doesn't look 'pristine'

Fire Age No evidence

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia gregorii		0.3	3	
Acanthocarpus humilis		0.3	1	
Alyogyne aff. *pinoniana*		0.4	<1	
Cassytha aurea var. *aurea*		0.4	<1	
Cassytha capillaris		0.3	<1	
Corchorus carnarvonensis		0.3	<1	
Dampiera incana var. *incana*			0.4	

Ningaloo

Dysphania plantaginella		0.03	<1
Eriachne mucronata		0.3	<1
Exocarpos aphyllus		0.6	<1
Grevillea stenobotrya		0.4	<1
Hakea stenophylla subsp. *stenophylla*		0.6	2
Hannafordia quadrivalvis subsp. *recurva*		0.3	<1
Heliotropium glanduliferum		0.2	<1
Hibbertia spicata subsp. *spicata*		0.3	2
Hybanthus aurantiacus		0.3	<1
Indigofera monophylla		0,4	<1
Labichea cassioides		0.3	<1
Leptosema macrocarpum		0.4	1
Melaleuca cardiophylla		1	20
Pterocaulon sphaeranthoides		0.1	<1
Ptilotus nobilis subsp. *nobilis*		0.3	<1
Solanum lasiophyllum		0,3	<1
Stackhousia umbellata	P 3	0.3	<1
Thysanotus exfimbriatus		0.2	<1
Tricoryne corynothecoides		0.3	<1
Triodia glabra		0.5	25

Ningaloo

NL1806

Staff LJA **Date** 11/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201202 **mE** 7585297 **mN** **Lat.** -21.8109 **Long.** 114.1100

Habitat Crest

Aspect S **Slope** Very Gentle

Soil Type Red brown loamy sand

Rock Type Limestone

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 45 % cover **Weeds** <1 % cover

Vegetation M+ ^*Melaleuca cardiophylla*,^*Acacia spathulifolia,Exocarpos aphyllus*\^shrub\3\i;G ^*Triodia glabra*\^hummock grass\2\c

Veg. Condition Excellent

Disturbance None evident

Fire Age No evidence

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		1.2	1	
Acacia spathulifolia		1.8	2	
Acanthocarpus humilis		0.3	<1	
Alyogyne aff. *pinoniana*		0.3	<1	
Cassytha aurea var. *aurea*		0.6	<1	
Cymbopogon ambiguus		0.3	<1	

Cynanchum viminale		0.8	<1
Dampiera incana var. *incana*		0.4	<1
Dysphania plantaginella		0.05	<1
Eremophila forrestii subsp. *capensis*	P 3	1	<1
Exocarpos aphyllus		2	2
Grevillea calcicola	P 3	1.5	<1
Grevillea variifolia subsp. *variifolia*		1	<1
Hannafordia quadrivalvis subsp. *recurva*		0.5	<1
Hibbertia spicata subsp. *spicata*		0.3	<1
Hybanthus aurantiacus		0.2	<1
Indigofera monophylla		0.4	<1
Ipomoea costata			<1
Jasminum sp. Exmouth (G. Marsh 77)			<1
Labichea cassioides		0.7	2
Leptosema macrocarpum		0.3	<1
Melaleuca cardiophylla		1.8	15
Paraneurachne muelleri		0.05	<1
Paspalidium clementii		0.2	<1
Phyllanthus hamelinii		0.6	<1
Ptilotus nobilis subsp. *nobilis*		0.4	<1
Scaevola sericophylla		0.8	1
Solanum diversiflorum		0.2	<1
Solanum lasiophyllum		0.4	<1
Stackhousia umbellata	P 3	1	<1
Thysanotus exfimbriatus		0.2	<1
Trichodesma zeylanicum var. *zeylanicum*		0.2	<1
Triodia epactia		0.5	1
Triodia glabra		0.5	25
Zygophyllum retivalve		0.2	<1

Ningaloo

NL1807

Staff LJA **Date** 12/07/2018 **Season** E

Revisit

Type Q

Location Ningaloo

MGA Zone 50 201224 **mE** 7585411 **mN** **Lat.** -21.8099 **Long.** 114.1102

Habitat Gorge

Aspect E **Slope** Steep

Soil Type Brown sandy clay

Rock Type Limestone

Loose Rock 20-50 % cover; 60-200 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 30 % cover **Weeds** 2 % cover

Vegetation M+ ^^*Acacia tetragonophylla,Acacia bivenosa,Sarcostemma viminale*\^shrub\4\i;G ^ *Triodia angusta*,^ *Scaevola tomentosa,Erodium cygnorum*\^hummock grass,shrub,forb\2\c

Veg. Condition Very Good

Disturbance Dumped tin sheets otherwise minimal

Fire Age No evidence

Notes Gorge. Quadrant approx. 15 m wide for gorge extent.

Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon fraseri		0.1	<1	
Acacia bivenosa		1.2	2	
Acacia coriacea subsp. *coriacea*		1.2	1	
Acacia tetragonophylla		2	3	
Alectryon oleifolius subsp. *oleifolius*		0.5	<1	
Alyogyne aff. *pinoniana*		0.3	<1	

**Bidens subalternans* var. *simulans*		0.2	<1
Brachychiton obtusilobus	P 4	2.2	<1
Cassytha aurea var. *aurea*		2	<1
**Cenchrus ciliaris*		0.3	<1
Clerodendrum tomentosum var. *tomentosum*		2	<1
Commicarpus australis		0.8	<1
Corchorus carnarvonensis		0.7	<1
Cucumis variabilis		1.5	<1
Cymbopogon ambiguus		0.3	<1
Cynanchum viminale		1.2	2
Enchylaena tomentosa		0.3	<1
Eremophila forrestii subsp. *capensis*	P 3	1.2	<1
Erodium cygnorum		0.05	2
Euphorbia sharkoensis		0.2	<1
Exocarpos aphyllus		1.5	<1
Ficus brachypoda		2.5	<1
Gossypium robinsonii		1	<1
Grevillea variifolia subsp. *variifolia*		1	<1
Hibbertia spicata subsp. *spicata*		0.3	<1
Indigofera monophylla		0.2	<1
Ipomoea costata		3	<1
Jasminum sp. Exmouth (G. Marsh 77)		1	<1
Labichea cassioides		1	<1
Logania litoralis		2.5	2
Poaceae sp.		1	<1
Ptilotus obovatus		0.6	<1
Rhagodia preissii subsp. *obovata*		1	<1
Scaevola sericophylla		1	1
Scaevola spinescens		0.8	<1
Scaevola tomentosa		0.5	2
Senna artemisioides subsp. *oligophylla*		0,3	<1
Solanum lasiophyllum		0.3	<1
**Sonchus oleraceus*		0.2	<1
Stackhousia umbellata	P 3	0.4	<1
Thryptomene baeckeacea			<1
Thysanotus exfimbriatus		0.4	<1
Tribulus suberosus		0.8	<1
Trichodesma zeylanicum		0.5	<1
Triodia angusta		0.6	25

Ningaloo

Triodia epactia	0.4	<1
Wurmbea odorata	0.3	<1
Zygophyllum retivalve	0.1	<1

Ningaloo

NL1808

Staff LJA **Date** 12/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201396 **mE** 7585625 **mN** **Lat.** -21.8080 **Long.** 114.1119

Habitat Upper-Slope

Aspect N **Slope** Moderate

Soil Type Brown gritty clay

Rock Type Limestone

Loose Rock 50-90 % cover; 20-60 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 60 % cover **Weeds** <1 % cover

Vegetation G+ ^^ *Triodia angusta,Melaleuca cardiophylla,Acacia gregorii*\^hummock grass,shrub\1\c

Veg. Condition Very Good

Disturbance Minor human walking and Euro tracks

Fire Age No evidence

Notes Unmeasured due to slope

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		0.2	<1	
Acacia gregorii		0.2	2	
Boerhavia coccinea		0.05	<1	
Corchorus crozophorifolius		0.3	<1	
Dampiera incana var. *incana*		0.2	<1	
Eremophila forrestii subsp. *capensis*	P 3	0.3	<1	
Eriachne mucronata		0.2	<1	

Eulalia aurea		0.6	<1
Hannafordia quadrivalvis subsp. *recurva*		0.2	<1
Heliotropium glanduliferum		0.3	<1
Hibbertia spicata subsp. *spicata*		0.2	<1
Hibiscus leptocladus		0.3	<1
Hybanthus aurantiacus		0.3	<1
Indigofera monophylla		0.3	<1
Leptosema macrocarpum		0.2	<1
Logania litoralis		0.5	<1
Melaleuca cardiophylla		0.3	5
Poaceae sp.		0.3	<1
Pterocaulon sphaeranthoides		0.4	<1
Ptilotus nobilis subsp. *nobilis*		0.1	<1
Solanum lasiophyllum		0.3	<1
Stackhousia umbellata	P 3	0.3	<1
Themeda triandra		0.4	<1
Tribulus suberosus		0.5	<1
Triodia angusta		0.5	30
Wurmbea odorata		0.2	<1
Zygophyllum retivalve		0.1	<1

Ningaloo

NL1809R

Staff LJA **Date** 12/07/2018 **Season** E

Revisit

Type R 30 m x 30 m

Location Ningaloo

MGA Zone 50 201366 **mE** 7585767 **mN** **Lat.** -21.8067 **Long.** 114.1116

Habitat Lower-Slope

Aspect N **Slope** Steep

Soil Type Grey sand

Rock Type Limestone

Loose Rock >90 % cover; 60-200 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 40 % cover **Weeds** 5 % cover

Vegetation M ^*Acacia bivenosa*\^shrub\3\r;G+ ^*Triodia angusta*\^hummock grass\2\c

Veg. Condition Very Good

Disturbance No obvious signs of human disturbance

Fire Age No evidence

Notes Not extensively traversed or extent measured due to safety concerns (steep scree slope)

Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon fraseri		0.5	<1	
Acacia bivenosa		1.2	5	
**Aerva javanica*		0.5	<1	
**Bidens subalternans* var. *simulans*		0.1	<1	
**Cenchrus ciliaris*		0.3	5	
Commicarpus australis		0.8	<1	
Corchorus carnarvonensis		0.4	<1	

Ningaloo

Cynanchum viminale	1	<1
Enchylaena tomentosa	0.8	<1
Eremophila longifolia	0.4	<1
Euphorbia sharkoensis	0.1	<1
Euphorbia tannensis subsp. *eremophila*	0.1	<1
Evolvulus alsinoides var. *decumbens*	0.3	<1
Heliotropium glanduliferum	0.5	<1
Hibiscus leptocladus	0.3	<1
Indigofera monophylla	0.3	<1
Melhania oblongifolia	0.2	<1
Ptilotus clementii	0.4	<1
Ptilotus nobilis subsp. *nobilis*	0.2	<1
Ptilotus obovatus	0.6	<1
Rhynchosia minima	0.5	<1
Salsola australis	0.2	<1
Solanum lasiophyllum	0.5	<1
Triodia angusta	0.8	40
Zygophyllum retivalve	0.1	<1

Ningaloo

NL1810

Staff LJA **Date** 12/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201110 **mE** 7585788 **mN** **Lat.** -21.8065 **Long.** 114.1092

Habitat Gorge

Aspect N/A **Slope** Cliffed

Soil Type Brown sand

Rock Type Limestone

Loose Rock 20-50 % cover; 200 mm in size **Litter** 20 % cover ; 2-5 cm in depth

Bare ground 25 % cover **Weeds** 2 % cover

Vegetation U ^*Ficus brachypoda*\^tree\6\r;M+ ^^*Senna artemisioides* subsp. *oligophylla,Acacia coriacea* subsp. *coriacea,Scaevola tomentosa*\^shrub\3\i;G ^*Triodia angusta*\^hummock grass\2\c

Veg. Condition Very Good

Disturbance Minimal

Fire Age No evidence

Notes Narrow gorge. Quadrant not measured but approx 10 m wide within gorge

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		1.3	2	
Acacia coriacea subsp. *coriacea*		1.8	2	
Acacia pyrifolia var. *pyrifolia*		1.8	2	
Acacia tetragonophylla		1.5	<1	
Alectryon oleifolius subsp. *oleifolius*		1.5	<1	
Alyogyne aff. *pinoniana*		0.3	<1	

Ningaloo

**Bidens subalternans* var. *simulans*	0.1	<1
**Cenchrus ciliaris*	0.2	<1
Commicarpus australis	0.5	<1
Corchorus carnarvonensis	0.3	<1
Cucumis variabilis	1.0	<1
Cymbopogon ambiguus	0.3	<1
Dipteracanthus australasicus subsp. *australasicus*	0.2	<1
Enchylaena tomentosa	0.8	<1
Eremophila longifolia	2.0	2
Erodium cygnorum	0.2	<1
Euphorbia tannensis subsp. *eremophila*	0.3	<1
Exocarpos aphyllus	1.5	1
Ficus brachypoda	3.5	2
Gossypium robinsonii	1.8	<1
Indigofera monophylla	0.2	<1
Ipomoea costata		<1
Jasminum sp. Exmouth (G. Marsh 77)	1.0	<1
Melaleuca cardiophylla	1.6	2
Pittosporum phillyreoides	3.5	2
Ptilotus nobilis subsp. *nobilis*	0.2	<1
Ptilotus obovatus	0.6	<1
Rhynchosia minima	0.6	<1
Scaevola spinescens	1.3	<1
Scaevola tomentosa	.3	2
Senna artemisioides subsp. *oligophylla*	1.8	2
Solanum lasiophyllum		<1
**Sonchus oleraceus*	0.1	<1
Thysanotus exfimbriatus	1.0	<1
Tribulus suberosus		0.6
Triodia angusta	1.0	40
Zygophyllum retivalve	0.1	<1

Ningaloo

NL1811

Staff LJA **Date** 12/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201040 **mE** 7586097 **mN** **Lat.** -21.8037 **Long.** 114.1085

Habitat Dunes

Aspect N **Slope** Very Gentle

Soil Type White sand

Rock Type None

Loose Rock 0 % cover **Litter** 25 % cover ; <1 cm in depth

Bare ground 20 % cover **Weeds** 5 % cover

Vegetation M+ ^*Acacia coriacea* subsp. *coriacea*,^ *Rhagodia preissii* subsp. *obovata*\^shrub,chenopod shrub\3\i;G ^ *Triodia epactia*,^ *Cenchrus ciliaris*,*Spinifex longifolius*\^hummock grass,tussock grass\1\c

Veg. Condition Good

Disturbance Rabbits, rubbish

Fire Age No evidence

Notes Quadrant size estimated

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia coriacea subsp. *coriacea*		2.0	10	
Capparis spinosa subsp. *nummularia*		1.0	<1	
**Cenchrus ciliaris*		0.4	5	
Commicarpus australis		1.0	<1	
Corchorus carnarvonensis		0.3	<1	

Ningaloo

Corynotheca flexuosissima	0.4	<1
Dampiera incana var. *incana*	0.3	<1
Portulaca oleracea	0.2	<1
Rhagodia preissii subsp. *obovata*	1.5	10
Salsola australis	0.3	<1
Solanum lasiophyllum	2	<1
Spinifex longifolius	0.6	5
Threlkeldia diffusa	0.3	<1
Triodia epactia	0.5	50
Whiteochloa airoides	0.4	<1

Ningaloo

NL1812

Staff LJA **Date** 13/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201630 **mE** 7585022 **mN** **Lat.** -21.8135 **Long.** 114.1140

Habitat Swale

Aspect N/A **Slope** N/A

Soil Type Red sand

Rock Type None

Loose Rock 0 % cover **Litter** 5 % cover ; 1-5 cm in depth

Bare ground 45 % cover **Weeds** <1 % cover

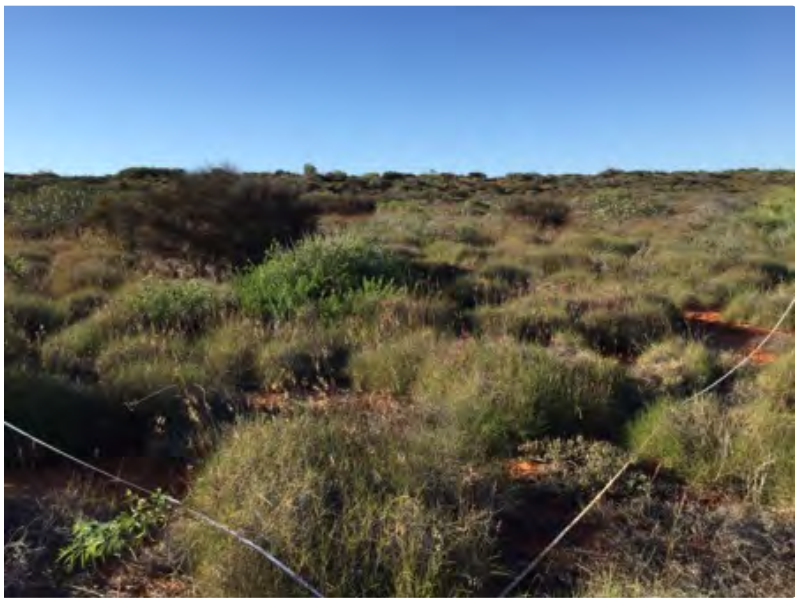
Vegetation M+ ^*Banksia ashbyi* subsp. *boreoscaia*,^*Daviesia pleurophylla*\^shrub\3\r;G ^*Triodia glabra*, ^*Scaevola sericophylla*\^hummock grass,shrub\2\c

Veg. Condition Very Good

Disturbance None obvious

Fire Age No evidence

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia coriacea subsp. *coriacea*		1.6	1	
Acacia gregorii		0.4		
Acacia spathulifolia		0.8	<1	
Alyogyne aff. *pinoniana*		0.2	<1	
Banksia ashbyi subsp. *boreoscaia*		2.0	3	
Bulbostylis barbata		0.02	<1	

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**Cenchrus ciliaris*		0.4	<1
Commicarpus australis		0.4	<1
Corchorus carnarvonensis		0.3	<1
Daviesia pleurophylla	P 2	1.5	2
Duboisia hopwoodii		2.0	<1
Euphorbia tannensis subsp. *eremophila*		0.3	<1
Grevillea ? eriostachya		0.5	<1
Hakea stenophylla subsp. *stenophylla*		0.6	<1
Heliotropium glanduliferum		0.3	<1
Indigofera boviperda subsp. *boviperda*		0.3	1
Jasminum sp. Exmouth (G. Marsh 77)		0.6	<1
Scaevola sericophylla		0.7	10
Scaevola sp.		0.3	<1
Solanum cleistogamum		0.4	<1
Thysanotus exfimbriatus		0.6	<1
Trianthema pilosum		0.2	<1
Triodia glabra		0.6	35
Triodia schinzii		0.5	<1

Ningaloo

NL1813

Staff LJA **Date** 13/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201494 **mE** 7585126 **mN** **Lat.** -21.8125 **Long.** 114.1128

Habitat Swale

Aspect N/A **Slope** N/A

Soil Type Red sand

Rock Type None

Loose Rock 0 % cover **Litter** 20 % cover ; 1-2 cm in depth

Bare ground 35 % cover **Weeds** <1 % cover

Vegetation M ^*Corymbia zygophylla*\^shrub\3\bi;G+ ^*Triodia glabra*,^*Scaevola sericophylla,Acacia gregorii*\^hummock grass,shrub\2\c

Veg. Condition Very Good

Disturbance Rabbits

Fire Age No evidence

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia coriacea subsp. *coriacea*		1.4	<1	
Acacia gregorii		0.5	2	
Bulbostylis barbata			<1	
Clerodendrum tomentosum var. *tomentosum*		1.0	1	
Commelina ensifolia		0.3	<1	
Corchorus carnarvonensis		0.3	<1	

Ningaloo

Corymbia zygophylla	2.0	1
Crotalaria cunninghamii	1.2	<1
Euphorbia tannensis subsp. *eremophila*	0.3	<1
Hannafordia quadrivalvis subsp. *recurva*	0.4	<1
Heliotropium glanduliferum	0.3	<1
Indigofera boviperda subsp. *boviperda*	0.3	<1
Quoya loxocarpa	0.4	<1
Rhynchosia minima	0.5	<1
Scaevola sericophylla	0.6	5
Solanum diversiflorum	0.2	<1
Solanum lasiophyllum	0.5	<1
Thysanotus exfimbriatus	0.3	<1
Triodia glabra	0.6	40

Ningaloo

NL1814

Staff LJA **Date** 13/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201648 **mE** 7585753 **mN** **Lat.** -21.8069 **Long.** 114.1144

Habitat Dunes

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type None

Loose Rock 0 % cover **Litter** 50 % cover ; 1-3 cm in depth

Bare ground 20 % cover **Weeds** 5 % cover

Vegetation M+ ^*Acacia coriacea* subsp. *coriacea*\^shrub\3\r;G ^*Triodia epactia*,^*Spinifex longifolius*, *Cenchrus ciliaris*\^hummock grass,tussock grass\1\c

Veg. Condition Good

Disturbance Human foot traffic

Fire Age No evidence

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia coriacea subsp. *coriacea*		2.0	5	
**Cenchrus ciliaris*		0.5	2	
Commicarpus australis		0.4	<1	
Corchorus carnarvonensis		0.3	<1	
Corynotheca flexuosissima		0.3	<1	
Dampiera incana var. *incana*			<1	

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Euphorbia sp.	0.1	<1
Indigofera boviperda subsp. *boviperda*	0.3	<1
Olearia sp. Kennedy Range (G. Byrne 66)	1.1	<1
Portulaca oleracea	0.1	<1
Rhagodia preissii subsp. *obovata*	1.2	<1
Scaevola sericophylla	0.5	<1
Solanum lasiophyllum	0.6	<1
Spinifex longifolius	0.8	5
Threlkeldia diffusa	0.5	<1
Thysanotus exfimbriatus	0.5	<1
Triodia epactia	0.5	50
Whiteochloa airoides	0.5	2
Zygophyllum fruticulosum	0.5	<1

Ningaloo

NL1815

Staff LJA **Date** 13/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 202075 **mE** 7585664 **mN** **Lat.** -21.8078 **Long.** 114.1185

Habitat Dunes

Aspect SE **Slope** Very Gentle

Soil Type White sand

Rock Type None

Loose Rock 0 % cover **Litter** 20 % cover ; 1-10 cm in depth

Bare ground 15 % cover **Weeds** 2 % cover

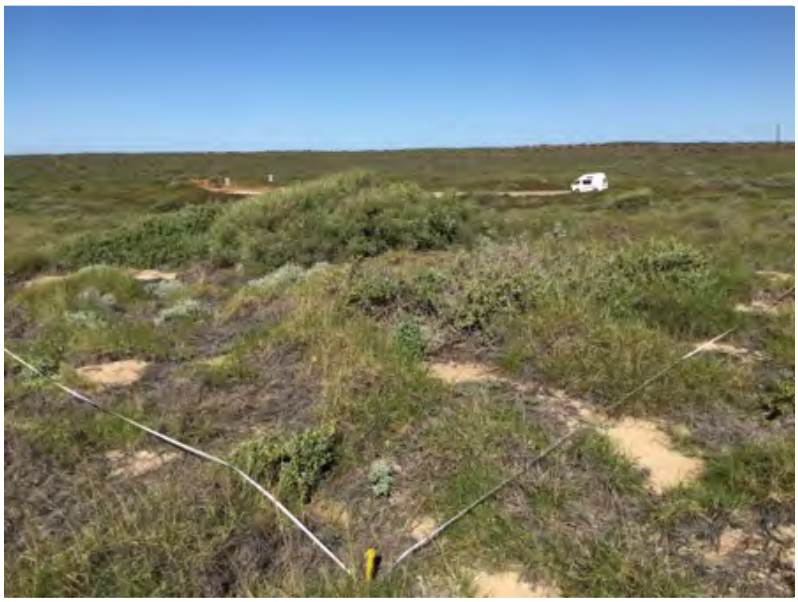
Vegetation M+ ^*Acacia coriacea* subsp. *coriacea*,^ *Rhagodia preissii* subsp. *obovata*\^shrub,chenopod shrub\3\r;G ^ *Triodia epactia*\^hummock grass\1\c

Veg. Condition Very Good

Disturbance Rabbits

Fire Age No evidence

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia coriacea subsp. *coriacea*		2.0	5	
Acacia sclerosperma subsp. *sclerosperma*		0.8	<1	
**Cenchrus ciliaris*		0.3	1	
Commicarpus australis		0.4	<1	
Corchorus ?congener	P 3	0.3	<1	
Corynotheca flexuosissima		0.3	<1	

Ningaloo

Dampiera incana var. *incana*	0.3	<1
Heliotropium crispatum	0.3	<1
Indigofera boviperda subsp. *boviperda*	0.2	<1
Lotus australis	0.1	<1
Portulaca oleracea	0.1	<1
Pterocaulon sphaeranthoides	0.1	<1
Rhagodia preissii subsp. *obovata*	1.2	5
Scaevola sericophylla	0.5	<1
Solanum lasiophyllum	0.4	<1
Threlkeldia diffusa	0.8	<1
Thysanotus exfimbriatus	0.3	<1
Triodia epactia	0.5	40
Whiteochloa airoides	0.4	1

Ningaloo

NL1816

Staff LJA **Date** 13/07/2018 **Season** E

Revisit

Type Q 30 m x 30 m

Location Ningaloo

MGA Zone 50 201958 **mE** 7585727 **mN** **Lat.** -21.8072 **Long.** 114.1173

Habitat Beach

Aspect N **Slope** Very Gentle

Soil Type White sand

Rock Type None

Loose Rock 0 % cover **Litter** 5 % cover ; 1 cm in depth

Bare ground 60 % cover **Weeds** <1 % cover

Vegetation G+ ^ *Triodia epactia*,^ *Spinifex longifolius*,*Whiteochloa airoides*\^hummock grass,tussock grass\1\c

Veg. Condition Very Good

Disturbance Human access to beach

Fire Age No fire

Notes Unmeasured quadrant on old dune blowout

Species	WA Cons.	Height (m)	Cover (%)	Count
Acanthocarpus preissii		0.3	<1	
Angianthus cunninghamii		0.3	<1	
Asteraceae sp.		0.3	<1	
Atriplex sp.		1	1	
Corynotheca flexuosissima		0.1	<1	
Ipomoea pes-caprae subsp. *brasiliensis*		0.2	<1	

Ningaloo

Launaea sarmentosa	0.1	<1
Lotus australis	0.3	<1
Spinifex longifolius	0.6	5
Sporobolus virginicus	0.1	<1
Threlkeldia diffusa	0.3	<1
Triodia epactia	0.4	25
Whiteochloa airoides	0.5	2

Ningaloo

NL1817

Staff LJA **Date** 14/07/2018 **Season** E

Revisit

Type Q 60 m x 15 m

Location Ningaloo

MGA Zone 50 200385 **mE** 7584162 **mN** **Lat.** -21.8211 **Long.** 114.1019

Habitat Crest

Aspect E **Slope** Gentle

Soil Type Brown loamy sand

Rock Type Limestone

Loose Rock 50-90 % cover; 20-60 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 30 % cover **Weeds** 0 % cover

Vegetation G+ ^ *Triodia angusta,Acacia gregorii*\^hummock grass,shrub\2\c

Veg. Condition Excellent

Disturbance None

Fire Age No evidence

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia ?bivenosa		0.6	<1	
Acacia arida		0.2	<1	
Acacia gregorii		0.2	5	
Acacia pyrifolia var. *pyrifolia*			<1	0.5
Acacia tetragonophylla		0.6	<1	
Alyogyne aff. *pinoniana*		0.5	<1	
Corchorus crozophorifolius		0.3	<1	

Corymbia hamersleyana		1.5	<1
Cynanchum viminale		0.3	<1
Dampiera incana var. *incana*		0.4	<1
Dipteracanthus australasicus subsp. *corynothecus*		0.2	<1
Enneapogon lindleyanus		0.	<1
Eremophila forrestii subsp. *capensis*	P 3	1.0	<1
Eriachne mucronata		0.4	<1
Evolvulus alsinoides var. *decumbens*		0.2	<1
Exocarpos aphyllus		1.0	<1
Hibbertia spicata subsp. *spicata*		0.3	<1
Indigofera monophylla		0.2	<1
Ipomoea costata		1.0	<1
Jasminum sp. Exmouth (G. Marsh 77)		0.8	<1
Lechenaultia subcymosa		0.3	<1
Leptosema macrocarpum		0.3	<1
Melaleuca cardiophylla		0.6	1
Poaceae sp.		0.2	<1
Pterocaulon sphaeranthoides		0.3	<1
Ptilotus nobilis subsp. *nobilis*		0.4	<1
Scaevola tomentosa		0.3	<1
Senna artemisioides subsp. *oligophylla*		0,4	<1
Solanum lasiophyllum		0.3	<1
Stackhousia umbellata	P 3	0.4	<1
Tribulus suberosus		0.5	<1
Triodia angusta		0.6	55
Wurmbea odorata		0.1	<1

Ningaloo

NL1818R

Staff LJA **Date** 14/07/2018 **Season** E

Revisit

Type R 30 m x 30 m

Location Ningaloo

MGA Zone 50 200994 **mE** 7585884 **mN** **Lat.** -21.8056 **Long.** 114.1081

Habitat Lower-Slope

Aspect W **Slope** Gentle

Soil Type Pink sand

Rock Type Limestone

Loose Rock 2-10 % cover; 20-60 mm in size **Litter** 5 % cover ; 1 cm in depth

Bare ground 60 % cover **Weeds** 1 % cover

Vegetation M+ ^*Acacia bivenosa*\^shrub\3\r;G ^*Triodia epactia*,^*Triodia angusta*\^hummock grass\2\c

Veg. Condition Very Good

Disturbance None obvious

Fire Age No evidence

Notes Transition between coastal and hill

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia arida		0.8	<1	
Acacia bivenosa		1.0	5	
Acacia coriacea subsp. *coriacea*		1.5	<1	
Acacia pyrifolia var. *pyrifolia*		1.2	<1	
**Cenchrus ciliaris*		0.4	1	
Dampiera incana var. *incana*		0.3	<1	
Eriachne mucronata		0.2	<1	

Euphorbia sp.	0.	<1
Ficus brachypoda	1.2	<1
Gossypium robinsonii	1.2	<1
Grevillea variifolia subsp. *variifolia*	1.2	<1
Hannafordia quadrivalvis subsp. *recurva*	0.8	<1
Indigofera boviperda subsp. *boviperda*	0.3	<1
Indigofera monophylla	0.2	<1
Pittosporum phillyreoides	2.0	<1
Ptilotus nobilis subsp. *nobilis*	0.3	<1
Ptilotus obovatus	0.3	<1
Scaevola tomentosa	0.3	<1
Solanum lasiophyllum	0.2	<1
Triodia angusta	0.8	10
Triodia epactia	0.5	25

Ningaloo

NL1819R

Staff LJA **Date** 14/07/2018 **Season** E

Revisit

Type R 30 m x 30 m

Location Ningaloo

MGA Zone 50 200810 **mE** 7585780 **mN** **Lat.** -21.8065 **Long.** 114.1063

Habitat Lower-Slope

Aspect W **Slope** Very Gentle

Soil Type Pink sand

Rock Type Limestone

Loose Rock 2-10 % cover; 20-60 mm in size **Litter** 5 % cover ; 1 cm in depth

Bare ground 70 % cover **Weeds** 1 % cover

Vegetation M+ ^*Ficus brachypoda*,^*Acacia bivenosa*\^shrub\3\r;G ^*Triodia glabra*,*Triodia epactia*\^hummock grass\2\i

Veg. Condition Very Good

Disturbance Rabbits

Fire Age No evidence

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		1.3	2	
Alyogyne aff. *pinoniana*		0.3	<1	
**Cenchrus ciliaris*		0.3	1	
Corchorus crozophorifolius		0.3	<1	
Cymbopogon ambiguus		0.4	<1	
Dipteracanthus australasicus subsp. *australasicus*		0.1	<1	

Ningaloo

Evolvulus alsinoides var. *decumbens*	0.2	<1
Ficus brachypoda	1.3	2
Gossypium robinsonii	0.5	<1
Grevillea variifolia subsp. *variifolia*	.0	<1
Indigofera monophylla	0.2	<1
Oldenlandia crouchiana	0.1	<1
Ptilotus nobilis subsp. *nobilis*	0.6	<1
Ptilotus obovatus	0.5	<1
Senna artemisioides subsp. *oligophylla*	0.3	<1
Solanum lasiophyllum	0.1	<1
Tephrosia rosea var. *clementii*	0.2	<1
Triodia epactia	0.4	2
Triodia glabra	0.3	20

APPENDIX SEVEN FAUNA FIELD SURVEY RESULTS

Table 22: Fauna sites (MGA 94 zone 50)

Species	Common Name	Easting	Northing
Felis catus	Feral Cat	202102.4	7585319
Gehyra pilbara	Pilbara Dtella	201125.8	7585707
Gehyra pilbara	Pilbara Dtella	201539.1	7585287
Lerista allochira (P3)	Cape Range Slider	200914.2	7585614
Lerista bipes	North-western Sandslider	202070.4	7585616
Lerista bipes	North-western Sandslider	200708.7	7585933
Lerista bipes	North-western Sandslider	201123.7	7585686
Lerista bipes	North-western Sandslider	201124.2	7585687
Lerista bipes	North-western Sandslider	201114.1	7585687
Lerista bipes	North-western Sandslider	201607.9	7585078
Lerista bipes	North-western Sandslider	201848.9	7585661
Lerista bipes	North-western Sandslider	202128.2	7585660
Lerista bipes	North-western Sandslider	201883.9	7585325
Lerista bipes	North-western Sandslider	201869.3	7585287
Lerista bipes	North-western Sandslider	201863.6	7585219
Lerista bipes	North-western Sandslider	201983.3	7585421
Lerista bipes	North-western Sandslider	202004	7585214
Lerista bipes	North-western Sandslider	202106.8	7585304
Lerista bipes	North-western Sandslider	202101.1	7585339
Lerista bipes	North-western Sandslider	202109.6	7585350
Lerista bipes	North-western Sandslider	201999.1	7585432
Lerista bipes	North-western Sandslider	201996.5	7585439
Lerista bipes	North-western Sandslider	201941.7	7585429
Lerista bipes	North-western Sandslider	201922.5	7585434
Lerista elegans	Elegant Slider	202061	7585606
Lerista elegans	Elegant Slider	202016.9	7585611
Lerista elegans	Elegant Slider	200711.7	7585935
Lerista elegans	Elegant Slider	202108.9	7585273
Lerista elegans	Elegant Slider	202108.6	7585363
Lerista elegans	Elegant Slider	201999.9	7585429
Lerista macropisthopus subsp. *fusciceps*	Unpatterned Robust Slider	201128.8	7585686
Lerista macropisthopus subsp. *fusciceps*	Unpatterned Robust Slider	201123.1	7585686
Lerista miopus	Northern Dotted-line Robust Slider	202018.2	7585611
Lerista miopus	Northern Dotted-line Robust Slider	202069.9	7585610
Lerista miopus	Northern Dotted-line Robust Slider	202127.7	7585651
Lerista miopus	Northern Dotted-line Robust Slider	201850.5	7585658
Lerista miopus	Northern Dotted-line Robust Slider	202133	7585661
Lerista miopus	Northern Dotted-line Robust Slider	201999.6	7585189
Lerista planiventralis	Keeled Slider	201117.8	7586058
Menetia greyii	Common Dwarf Skink	201550.2	7585275
Menetia greyii	Common Dwarf Skink	201675.1	7585213
Morethia lineooccelatus	West Coast Morethia Skink	201107.5	7586058

Species	Common Name	Easting	Northing
Morethia ruficauda subsp. *exquisita*	Lined Firetail Skink	200890.7	7585806
Morethia ruficauda subsp. *exquisita*	Lined Firetail Skink	201858.7	7585223
Morethia ruficauda subsp. *exquisita*	Lined Firetail Skink	201848	7585273
Notoscincus ornatus	Ornate Soil-crevice Skink	201548.7	7585274
Oryctolagus cuniculus	Rabbit	201546.7	7585349
Oryctolagus cuniculus (scat)	Rabbit	201925.9	7585696
Osphranter robustus	Euro	201219.4	7585636
Osphranter robustus	Euro	201694.5	7585002
Osphranter robustus	Euro	201314.1	7585893
Osphranter robustus	Euro	201458.5	7585301
Osphranter robustus	Euro	201874	7585168
Osphranter robustus	Euro	201214.2	7585632
Osphranter robustus	Euro	201299.6	7585716
Ovis aries	Sheep	201286.6	7585609
Ovis aries scat	Sheep	201158.3	7585532
Pseudantechinus roryi		201342.8	7585531
Simoselaps bertholdi	Jan's Banded Snake	202102.1	7585359
Tachyglossus aculeatus (track)	Echidna	201447	7585840