CITY OF KARRATHA LOCAL BIODIVERSITY STRATEGY
FIELD SURVEY RESULTS

AUGUST 2019

Prepared for the City of Karratha

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vla

Abbreviation	Definition
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BOM	Bureau of Meteorology
°C	Degrees Celsius
DAFWA	Department of Agriculture and Food Western Australia
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation
DoEE	Department of the Environment and Energy
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
GDA94	Geocentric Datum of Australia 1994
GPS	Global Positioning System
ha	hectares
HTW	High Threat Weeds
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometers
m^2	Meters squared
mm	Millimeters
Main Roads	Main Roads Western Australia
MGA50	Map Grid of Australia
MNES	Matters of National Significance
NRM	Natural Resource Management
Parks and Wildlife	Department of Parks and Wildlife
P	Priority
PEC	Priority Ecological Community
sp.	Species (singular)
subsp.	Subspecies
T	Threatened
TEC	Threatened Ecological Community
TPFL	Threatened and Priority Flora Database (administered by DBCA)
TP List	Threatened and Priority Flora List (administered by DBCA)
WA Herb	Western Australian Herbarium
WC Act	*Wildlife Conservation Act 1950*
WMP	Weed Management Plan
WoNS	Weeds of National Significance

EXECUTIVE SUMMARY

Vicki Long and Associates (VLA) was engaged by the City of Karratha to undertake a field survey to validate and define assessments of biodiversity significance of key natural areas identified from the Local Biodiversity Strategy desktop study and community consultation process undertaken in 2017 (VLA 2017). Due to the vast extent of the City of Karratha lands, survey efforts were concentrated on the areas ranked as having a "high" need for survey.

The surveys were conducted after two years of well below average rainfall in the area. This limited the number and range of flora species available for identification and, consequently, the capacity to conduct a complete assessment.

A total of 426 vascular species from sixty-six families were recorded, within the survey areas sampled.

Ten Priority flora species were recorded, with a further eight species considered likely to occur following rainfall or having the potential to occur in the wider unsurveyed area.

Twenty four locally significant species which were recorded in the survey area add biodiversity value on both a local and regional level.

Three PECs were identified within the survey area and a potential fourth PEC requires verification following decent rainfall. One remnant PEC is considered worthy of restoration. Two communities, *Sporobolus virginicus* matted tussock grassland and ephemeral coastal wetland have been nominated as PECs and await assessment from the DBCA Special Communities branch.

Very little information is available regarding the impact of fire, particularly repeated fire, on individual Pilbara native flora, especially in the local area. It is known that rockpile PECs harbour fire sensitive species that have been reduced in the surrounding landscape, where rock protection from fire is not available. The City of Karratha should acknowledge the presence of these species in its Fire Management Plan and aim to reduce the frequency of burns in areas where populations of these fire sensitive species occur.

Despite the dry conditions, and given the survey was only undertaken at a reconnaissance level, a high number of flora species and vegetation types were recorded within the limited survey area during the dry season. This can be attributed to the diverse landforms and micro-niches present, which result in diverse vegetation types. It is an indicator of the significant biodiversity that occurs within the surrounds of the five town site areas, within the City of Karratha. As such, the City of Karratha should consider managing them at a minimum for weeds, and potentially for conservation.

A Weed Management Plan (WMP) needs to be developed and implemented by the City of Karratha to ensure weeds are controlled in a feasible, cost efficient and effective way. The WMP should prioritize areas for control, based on areas of high conservation value and be site specific for each area. The WMP should be designed to be undertaken for a minimum of five years.

Eighteen plants of significance to Aboriginal people have been identified through various ethno-botanic surveys conducted by the author in the area and through the consultation process for the desktop study. Any areas to be cleared, burnt or impacted within the City of Karratha, should consider the presence of these culturally significant plants and if possible, nearby areas containing these species be kept for conservation and the growing Indigenous tourism industry.

One hundred and eleven bird species were opportunistically recorded for the study area but this list is not comprehensive.

The landforms within the study area will support a diverse range of fauna (small mammals, marsupials and reptiles) of which we have no knowledge. The lack of knowledge about not only our Threatened and Priority fauna, but fauna in general is a significant knowledge gap in the understanding of biodiversity, which should be addressed by the City.

The information obtained from this survey can be used to develop a strategy for the City of Karratha which can be used to minimise impacts to these threatened areas. Further field surveys will need to be undertaken under more suitable conditions (ie following rain), to confirm the presence/absence of flora and vegetation of conservation significance.

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1. INTRODUCTION

1.1 Project Purpose and Statement

The purpose of the field surveys was to validate and further define assessments of biodiversity significance in key natural areas (within 5km of townships) identified from the City of Karratha's Local Biodiversity Strategy Desktop Study (Biodiversity Desktop Study) (VLA 2017).

The results from the field surveys include details of flora and vegetation of high biodiversity and conservation significance, evidence of fauna habitat and significant landform type. The on-ground threats to the integrity of areas of significant biodiversity, including weeds, tracks, litter and changed landform, have also been discussed.

The results have been presented in a concise manner and will help to guide the development of the City of Karratha's Local Biodiversity Strategy.

Two things must be noted:

1. funding only allowed for a very brief survey of each area (equivalent to a Reconnaissance level survey as described in the EPA Technical Guidance 2016)
2. the survey had to be conducted in a period of "dry" – following two years of below average rainfall. This will have impacted the results significantly.

For these two reasons, the results presented in this report are not sufficiently comprehensive to be used for any future planning approvals or clearing of land.

1.2 Background

The City of Karratha has been successful in securing a Natural Resource Management (NRM) grant to support the preparation of a Local Biodiversity Strategy for the City.

The Vision of the Strategy is:
"To develop a comprehensive strategy that identifies areas of biodiversity value within the Karratha LGA, qualifies and prioritizes areas of biodiversity according to ecological criteria and determines preservation and rehabilitation strategies for long term conservation. The strategy is to be at a landscape-scale (ie. landscapes and associated species, not just threatened species) and will aim to represent the region's stakeholders, with a particular focus on a collaborative management approach with Traditional Owners" (Heydenrych and Parsons 2018).

The purpose of the Strategy is to:
"*Identify areas of priority biodiversity assets and determine appropriate conservation measures for the long-term preservation of these assets"* (Heydenrych and Parsons. 2018).

The strategy should ensure diversity of species, together with protection of a range of representative ecological communities, threatened species, wetland, riverine and coastal vegetation and should enable the maintenance of basic ecological processes within the Project Area".

The initial phase of developing the Strategy includes:

- Conducting public consultation to support the desktop study
- Undertaking a desktop study with the aim of determining where on-ground surveys are necessary, to address knowledge gaps in local biodiversity

- Conduct on-ground surveys as recommended in the desktop study.

The public consultation process was conducted in conjunction with preparation of the Biodiversity Desktop Study; both were completed in 2017. Initially the on-ground surveys were to be conducted after the wet season in 2018, but due to low summer rainfall that year (<70 mm) and for the year generally (145 mm) it was decided to delay the survey until 2019. Mean summer (January, February, March) rainfall for the Karratha region is 170mm (Karratha Aero Station 004083). Summer rainfall in 2019 was below average with 71 mm being recorded in March at Karratha Aero (Station 004083). However, due to funding access, the survey could not be further delayed and was undertaken in May and June / July 2019.

2. PROJECT AREA

2.1 City of Karratha

The City of Karratha occupies a land mass of some 15,000 square kilometres on the central Pilbara coastline and is situated within one of Australia's top fifteen biodiversity hotspots (DEE 2017a). Known as the Hamersley-Pilbara hotspot, it provides habitat for a number of threatened, endemic and fire sensitive species and communities. Habitats and the flora and fauna they house, are diverse and are present from the Hamersley Ranges to the coastline, including the offshore islands. Some of the oldest rock formations in the world (over 2 billion years old) are within the City's boundaries. The coastal islands, within the City of Karratha, are refuges for vulnerable species and are breeding sites for turtles and seabirds. The Burrup Peninsula and Dampier Archipelago Islands house one of the largest, globally recognised rock art galleries in the world. The coastal plains include three Priority Ecological Communities (PECs), the Burrup Peninsula (Murujuga) a further two PECs and coastal dunes potentially another one PEC. A further PEC has been nominated for ephemeral wetland areas behind the remnant dunes surrounding Nickol Bay. Whilst a proportion of the inland mountainous habitat is protected by Karijini National Park and Chichester National Park, there are vast areas, particularly on the coastal plain and coastline, within which the City of Karratha is situated, which have no protection. These areas, being favourable for the establishment of townships, industry and associated infrastructure, are under increasing pressure from impacts caused by development and human activity and to date, there has been no strategy in place to quantify or qualify biodiversity values or to minimise impact on high conservation value areas. The desktop evaluation (VLA 2017) helped determine potential areas of conservation status; the field surveys were conducted with the aim of confirming these.

2.2 Constraints

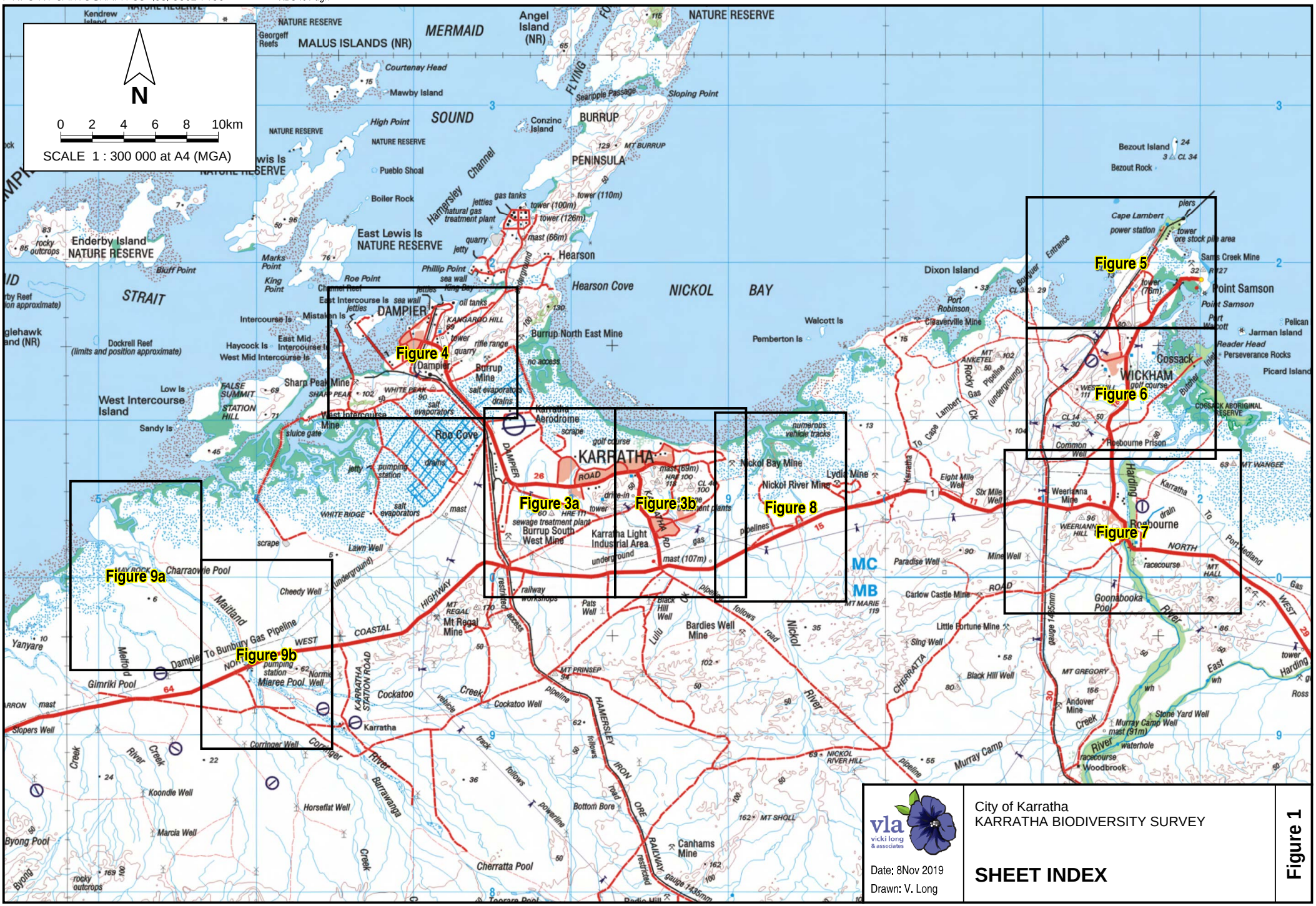
The vast extent of the City of Karratha (the City) lands, restrictions relating to the different forms of tenure that apply, the diversity of flora, fauna, landforms and the ecological communities housed within it, as well as the need to ensure the Strategy is manageable and effective, precluded a study of the entire area.

2.3 Revised Project Area

Considering the constraints described above, the Project Area for the biodiversity assessment has been limited to areas determined to have potential high conservation value (VLA 2017) within:

- Parcels of land directly under the control and influence of the City (i.e. reserves vested with the City and unallocated crown land);
- Coastal and riverine vegetation;
- Areas significantly impacted by the current population, i.e. areas within a 5 km radius from the edges of each townsite within the City of Karratha, as well as those foreshore reserves and waterways (Maitland and Nickol Rivers) most visited by people.

The Project Area is shown in Figure 1.


N
0 2 4 6 8 10km
SCALE 1 : 300 000 at A4 (MGA)
Figure 3a
Figure 3b
Figure 4
Figure 5
Figure 6
Figure 7
Figure 8
Figure 9a
Figure 9b
MALUS ISLANDS (NR)
MERMAID SOUND
BURRUP PENINSULA
NICKOL BAY
STRAIT
East Lewis Is NATURE RESERVE
Enderby Island NATURE RESERVE
DAMPIER
KARRATHA
Hearson Cove
Roe Cove
West Intercourse Island
Dixon Island
Point Samson
WICKHAM
Cossack
Roebourne
Burrup North East Mine
Burrup South West Mine
Karratha Light Industrial Area
Karratha Aerodrome
Nickol Bay Mine
Nickol River Mine
Mt Regal Mine
Bardies Well Mine
Carlow Castle Mine
Little Fortune Mine
Andover Mine
Canhams Mine
Sharp Peak Mine
West Intercourse Mine
Burrup Mine
Weeriana Mine
Goonabooka Pool
Gimriki Pool
Miaree Pool
Cherratta Pool
Byong Pool
Yanyare
Slopers Well
Koondle Well
Marcia Well
Horseflat Well
Cockatoo Well
Woodbrook
Murray Camp
Dampier To Bunbury Gas Pipeline
HIGHWAY
COASTAL ROAD
KARRATHA STATION ROAD
HAMERSLEY IRON ORE RAILWAY
Maitland River
Nickol River
Harding River
Cherratta River
Barrawanga Creek
Cockatoo Creek
Murray Camp Creek
Lawn Well
Cheedy Well
Corringer Well
Paradise Well
Sing Well
Black Hill Well
Stone Yard Well
Murray Camp Well
Common Well
Eight Mile Well
Six Mile Well
Mine Well
Pats Well
Lulu Well
Port Robinson
Cleaverville Mine
Walcott Is
Pemberton Is
Bezout Island
Bezout Rock
Cape Lambert
Sams Creek Mine
Jarman Island
Reader Head
Perseverance Rocks
Picard Island
Pelican Island
Roebourne Prison
COSSACK ABORIGINAL RESERVE
Hearson
Angel Island (NR)
Conzinc Island
Courtenay Head
Mawby Island
Sloping Point
Searipple Passage
Pueblo Shoal
Boiler Rock
High Point
Bluff Point
Marks Point
King Point
Roe Point
Dockrell Reef
Haycock Is
Intercourse Is
Mistaken Is
Sandy Is
Low Is
Georgeff Reefs
Kendrew Island
Hamersley Channel
Flying Fish Channel
Dampier To Bunbury Gas Pipeline
MC
MB
vla
vicki long & associates
Date: 8Nov 2019
Drawn: V. Long
City of Karratha
KARRATHA BIODIVERSITY SURVEY
SHEET INDEX
Figure 1

3. STATE AND COMMONWEALTH LEGISLATION

The legislative protection of flora and fauna within Western Australia is governed by three Acts:

- The *Biodiversity Conservation Act, 2016* (BC Act)
- The *Environmental Protection Act 1986* (EP Act)
- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This legislation and its governance of flora, vegetation and fauna is detailed in the Biodiversity Desktop Study (VLA 2017). This legislation relates to threatened and priority flora, clearing of native vegetation, threatened and priority fauna, conservation significant fauna, and threatened and priority ecological communities. The results of the field surveys comply with the relevant legislation and are also assessed against criteria in addition to statutory listings by State and Federal Government for classification of local and regional significance (Biodiversity Desktop Study Section 3.1.3).

The EPA (2016) also itemises an environmental objective for landform as being "*to maintain the variety and integrity of distinctive physical landforms so that environmental values are protected"* and details a list of criteria to be considered when assessing landform. (VLA 2017).

Declared (Plant) pest organisms and significant weed species are identified both at State and National level, the former under the *Biosecurity and Agriculture Management Act* 2007 (BAM Act) and the latter by the Australian Weeds Strategy (Invasive Plants and Animals Committee 2016) which identifies "Weeds of National Significance" (WoNS).

4. METHODOLOGY

4.1 Brief outline of Desktop relevant to the Field Surveys

A desktop study undertaken in 2017 assisted in identifying the ecological significance and conservation assets of the Project Area and the gaps in that knowledge. This process helped determine where on ground surveys needed to be conducted.

The Biodiversity Desktop Study (VLA 2017) included the review of maps, aerial photography, land tenure maps, regional flora and fauna species databases and literature relevant to the broader Pilbara region and more specifically, where possible, to the Project Area. Local knowledge and Traditional Owner knowledge were recorded by way of local community consultation workshops and meetings with Aboriginal Corporations. This information along with the likelihood of occurrence of Priority species (flora and fauna), Priority Ecological Communities, known areas of significant vegetation, significant landform and the known threats to these values, were then applied at a regional landscape scale to categorise the "Need for Survey" priority as High, Medium or Low.

4.2 Database Searches

Requests for database searches were submitted in 2017 to DPaW to ascertain whether any potential conservation significant flora and ecological communities have been recorded within the Project Area or surrounds. Conservation Codes for the Priority flora and PECs are given in Appendix 1.

Results were again verified prior to the 2019 surveys to check for changes. This information was used to guide search effort, especially in habitats known to house those species/communities. Database

searches were made within a 20 km radius of each of the townsites, which included foreshore reserves, and along the two waterways, Nickol River and Maitland River. Searches utilised are presented in Table 1.

Full details of the Methods for the Biodiversity Desktop Study are presented in section 4 of that report (VLA 2017).

Table 1: Database Searches Undertaken for this Study

Database	Focus of Search	Search Area
Threatened and Priority Flora Database (TPFL) (Department of Biodiversity, Conservation and Attractions 2017a)	Listed threatened and priority flora	20 km radial search around the town of Dampier at point 20°39'46"S 116°42'46" E
Department of the Environment and Energy Protected Matters Search Tool (Department of the Environment and Energy 2017a)	MNES, Flora and Fauna	20 km radial search around the town of Karratha at point 20° 44'33"S 116 ° 49'44" E
NatureMap (Department of Biodiversity, Conservation, and Attractions 2017b)	Flora and Fauna of Conservation Significance	
Threatened and Priority Ecological Communities Database (Department of Biodiversity, Conservation and Attractions 2017c)	Listed threatened and priority ecological communities	20 km radial search around the town of Roebourne at point 20° 46'11"S 117 ° 08'46" E
Western Australian Herbarium Flora (WAHerb) Database (Department of Biodiversity and Attractions 2017d)	Listed threatened and priority flora	20 km radial search around the towns of Wickham and Point Samson at point 20° 40'26"S 117°08'18" E
Threatened and Priority Fauna Database (Department of Biodiversity and Attractions 2017e)	Threatened and Priority Fauna	

4.3 Field Survey

The total area covered by the desktop study was vast, hence, it was only possible in the time available, to survey areas in the field which had been identified as High priority from the desktop assessment.

The field surveys were conducted by VLA's Principal Botanist Vicki Long with Laurinda Timmins, Sustainability Officer, City of Karratha, assisting for much of the field work. Potential grassland and chenopod PEC investigations in the vicinity of Roebourne were conducted between the 16 and 17 May 2019, in an endeavour to capture grasses essential to the identification of those PECs, prior to them drying off. The remaining surveys were conducted over 8 (non-consecutive) days between the 17 June and 6 July 2019.

4.3.1 Weather

Daily weather observations recorded from the Bureau of Meteorology Karratha Aero weather station (004083) were used to describe local rainfall and temperatures in the 6 months preceding the survey (Bureau of Meteorology 2019). In the 6 months preceding the survey, 88 mm of rainfall was recorded, 142 mm below the long term average. The last significant rainfall (71 mm) was recorded in March 2019, 33.4 mm of which was associated with Cyclone Veronica. Another 6 mm only was received in

April leading up to the field surveys in May and July. The average maximum temperature during the survey was 26°C (Bureau of Meteorology 2019).

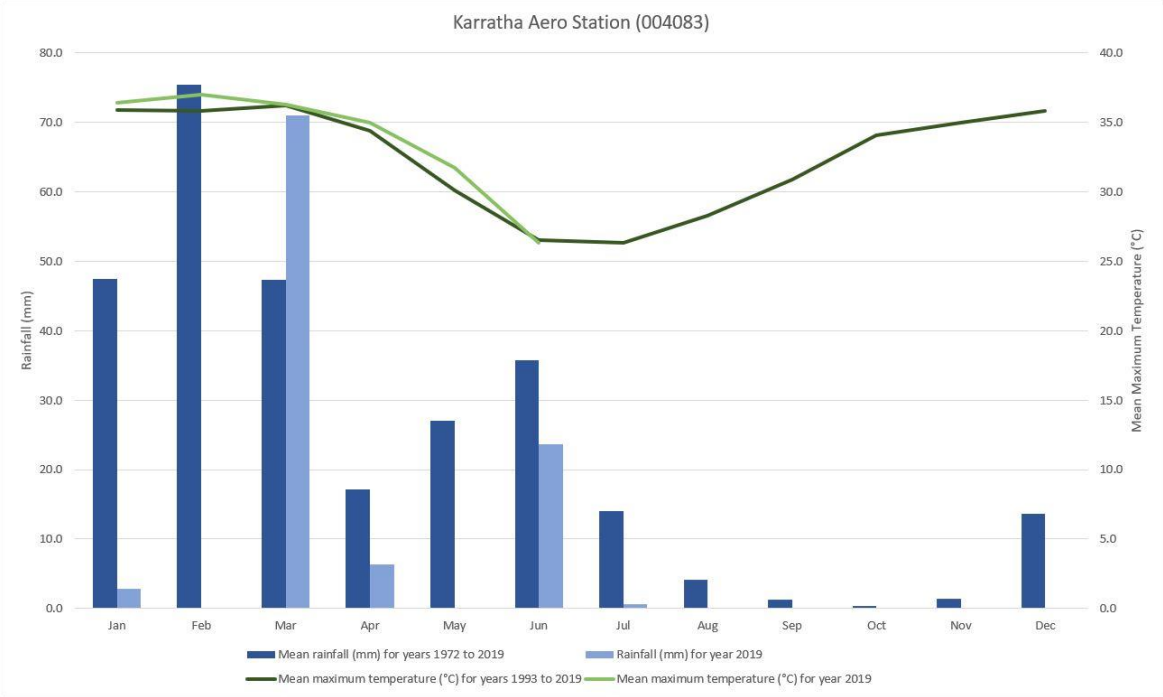


Figure 2. Mean and actual monthly rainfall and temperature data for Karratha Aero weather station (004083)

4.3.2 Survey Methodology

The methods adopted for the flora and vegetation survey were formulated, (as far as practicable, given the vast amount of high priority area to be surveyed), in accordance with the Reconnaissance Survey level described within the EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority 2016). In addition, the Bradley Method of Bush Regeneration (Bradley, 1988), as requested in the original Request for Quotation 36-16/17 was used to determine the restoration suitability of the site.

Vegetation was described according to the National Vegetation Information System (NVIS) (ESCAVI 2003) which is the nationally adopted classification system used for vegetation description for EIA in Western Australia.

Broadly, the vegetation classification system uses vegetation structure and dominant species to describe differences between vegetation units. Structural vegetation classification provides information on height of strata, foliar cover and dominant species.

At each location surveyed, the following information was recorded:

- Survey area name, site number, date.
- Approximate size of area.
- Location – coordinates taken using a handheld GPS (MGA50, GDA94).
- Dominant and other currently live species present, including weed species.
- Foliar cover – the estimated percentage cover for each species.

- Vegetation condition – assessed according to the vegetation condition scale adapted from Trudgen (1988) in The Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).
- Habitat - a broad description of the surrounding landscape based on landform, topography and soil.
- Fauna – visible or evidence of.
- Disturbance - records of any obvious disturbances such as fire (and estimated fire age), tracks, weed infestation, or grazing.
- Consideration as to whether the area
    - is suitable for restoration?
    - is an Aboriginal Heritage site
    - is part of poorly represented vegetation
    - is large or regular area
    - contains unusual, rarely recorded or significant plant/vegetation
    - Occurrence of PEC, Priority/significant flora, fauna or likely
    - Requires weed management
- Landform as refugia for isolated ecosystems
- Photographs - a photograph was taken of each survey area.

The field data sheet utilised is presented in Appendix 2.

4.3.3 Limitations of Field Survey

A complete assessment of the data collected from the field surveys was considered limited by the following:

- **Scope:** Although only areas of potential high conservation value were targeted, the total survey area was extensive, which limited the amount of search time spent at each sample site. Time to complete the survey was considered a limitation and results must therefore be treated with caution. The Scope could be completed to an indicative level only.

- **Timing:** Due to funding access, the survey was unable to be further delayed and was undertaken at a time where summer rainfall had been well below average for two years prior (Figure 2). However, some of the rockier areas (Burrup, Karratha hills, Wickham hills) housed many annuals which had not been expected, given the limited rainfall. Ephemerals, annuals and short-lived grasses were generally dead, but sometimes still identifiable. Although 20 mm of rain was received on 21 June 2019, this was insufficient for potential PEC grasslands to recover. Additionally, these grasslands respond reproductively to summer, not winter rainfall. Timing was not considered appropriate for survey of the Roebourne Plains grassland, nor for identification of the probable PECs which occur there. Grasses were either dead or had died back to rootstock. Identification of the Roebourne grassland PECs relies on sound identification of the variety of grass species that comprise the PEC, which was not possible during this survey.

- **Representation:** Due to the survey being undertaken in below average rainfall conditions, it is considered that grass, annual and ephemeral species may not be well represented. This includes Priority species, and the ability to identify PEC grasslands. The dry conditions are considered to have limited the number of fauna likely to have been present.

The following were not considered limitations and supported the survey:

- **Available information:** Sources of information and availability of contextual information were available at both a broad regional scale and for individual projects at a local level.
- **Mapping reliability:** Colour aerial photography at a scale of 1:5,000 was used to locate the survey areas and to assist in navigation and delineation of vegetation boundaries. The aerial photography was of good resolution and, in general, accurately represented ground conditions. As such, mapping reliability was not considered a limiting factor.
- **Access:** Access to the survey areas was possible from both well-established roads and lesser tracks and was not seen as a limitation.
- **Experience:** The botanist responsible for undertaking the field survey has considerable experience (34 years) in conducting vegetation, flora and level 1 fauna surveys in the local Karratha area and the City's representative has 6 years' experience in botany and ecology in the Pilbara. The identification of specimens brought back from the field was conducted either by the lead field botanist or by botanists at the WA Herbarium. Personnel experience was not considered a limiting factor.

5. RESULTS OF FIELD SURVEY

The results presented in this report pertain to the field surveys only. Results of the desktop study are provided in the Biodiversity Desktop Study (VLA 2017). The Biodiversity Desktop Study results were compared with those obtained from the field survey to formulate conclusions on the conservation significance of each area surveyed.

5.1 Survey Effort

Survey effort was generally kept within areas defined as High Priority from the Biodiversity Desktop Survey (VLA 2017), with a few Medium and Low priority areas which had significant features, also surveyed.

A total of 60 sites were surveyed from the six key study areas, these being:

- Dampier including the southern section of the Burrup Peninsula (Murujuga) – 12 sites
- Karratha East – 8 sites and Karratha West- 14 sites – 22 sites
- Roebourne (including Harding River) – 10 sites
- Wickham, Point Samson and Cossack – 11 sites
- Maitland River – 2 sites
- Nickol River – 3 sites

Areas surveyed are indicated on Figures 3a to 9b.

5.2 Interpretation of Field Data Results

In order to comply with the Vision of the City's Local Biodiversity Strategy, areas of significant biodiversity within the Karratha LGA were identified in the Biodiversity Desktop Study (VLA 2017). The

field survey, supported by the Bradley Method, endeavoured to verify the desktop results and then make recommendations for areas of preservation and /or rehabilitation.

Field results for each of the six key areas were assessed:

- at a regional landscape level (landscape and associated species),
- for presence of priority flora (and likelihood in a good season),
- for evidence of threatened or priority fauna,
- for presence of PECs or significant vegetation types (and likelihood in a good season),
- for any culturally significant sites or species and
- for significance of landform

The "Need for Survey based on Likelihood of Occurrence and Threats" tables (Tables 10-14 Biodiversity Desktop Study (VLA 2017)) were updated with results from the field surveys, forming the basis of conservation priority assessments.

Weed species recorded are also tabulated, however once again, it is envisaged that many weeds were present due to the dry conditions and those that were present were, for the majority, dormant. Estimates of weed cover over any one area could not reliably be assessed.

Recommendations for restoration and / or conservation of areas have been made using results from both the Biodiversity Desktop Study (including community consultation) and the field survey. Restoration according to the Bradley method involves removal of all weed species, allowing natural recruitment from surrounding landscape. Weed control of only Declared Pests, WoNS and High Threat Weeds (HTW) is not considered to be restoration.

5.3 Flora Species Recorded

A total of 426 vascular species from sixty-six families were recorded, within the survey areas sampled (areas classified as high priority from the desktop survey, together with four other sample areas given lower priority rankings, but having specific conservation significance) (Appendix 3). It should be noted that due to the dry conditions, this is not a comprehensive flora list due to the lack of grasses, annuals and ephemerals. Priority and Significant species may also be absent due to the dry conditions.

Species were recorded during searches at the sixty vegetation sample sites and opportunistically between sample sites. The number of species recorded is significantly high, given the limited area sampled and the dry survey conditions. A total of 759 flora species have been recorded for the total City of Karratha, which covers an area of some 5,026 km^2 (DBCA 2017b).

The high number of species recorded is probably related to the diverse landform, as evidenced through the vegetation types surveyed, but is also an indication of the significant biodiversity that occurs within a limited area around the five town site areas in the City of Karratha.

The flora species recorded include:

- 10 Priority Species (Table 2) Photos presented in Table 3.
- 24 Significant species (Table 4)

- 23+ “chenopods” Fire sensitive species (Table 5) However, this needs to be treated with caution. There is currently little knowledge about fire sensitive species in the Pilbara. What is listed in Table 5 is taken from available literature and from the author’s fire monitoring data of PEC species on the Burrup Peninsula post fire.
- 47 Weed species (including four WoNs species and six Declared Pests) (Table 6)
- Eighteen culturally important plants (Table 7). A significant number of the flora recorded are used by the local Aboriginal people for medicine, food, artefacts and culture. The plants presented in Table 7 are **only** those within a very close distance from the town sites (generally within walking distance) that are considered very important and are currently utilised by Aboriginal people living in the towns. Richard Walker, Ngarluma representative accompanied the botanists for a day of survey and further anecdotal information was received from other Aboriginal people from Roebourne and Karratha, known to the author.

5.3.1 Priority Flora

Of the 30 Priority species listed for the survey area (Table 2), ten were recorded during the survey and it is considered that a further four species would be likely to be found following rainfall.

Pentalepis trichodesmoides subsp. *hispida* was not found at any of the sites during this recent survey, however, it has been found previously at Cleaverville Beach during a survey undertaken for the City of Karratha (VLA 2018) and would be likely to occur at other sites within the survey area, following rainfall.

Table 3 shows photographs of the Priority species recorded during the survey.

Table 2: Priority Species recorded within a 20km radius of the Project Area and the likelihood of occurrence within the Project Area pre and post 2019 field surveys

Species	Conservation Code	Likelihood of Occurrence in Project Area	Likelihood of Occurrence after Field Survey	Comment
Helichrysum oligochaetum	1	Potential	Potential following rainfall	Annual species only emerging late in the year after rainfall
Bonamia brevifolia	1	Unlikely	Unlikely	
Rothia indica subsp. *australis*	1	Unlikely	Unlikely	
Tephrosia rosea var. Port Hedland	1	Likely	Recorded during survey	Very rare and only recorded on dunes near Point Samson / Sam's Creek
Goodenia pallida	1	Unlikely	Unlikely	
Abutilon sp. Pritzelianum	1	Potential	Potential following rainfall	
Gomphrena pusilla	2	Unlikely	Unlikely	
Pentalepis trichodesmoides subsp. *hispida*	2	Likely	Recorded during survey	Recorded on rocky hedland Cleaverville – likely to occur in other areas following rainfall
Euphorbia inappendiculata var. *inappendiculata*	2	Potential	Potential following rainfall	Annual herb requiring rainfall.
Stylidium weeliwolli	2	Unlikely	Unlikely	
Gomphrena cucullata	3	Likely	Likely following rainfall	
Gomphrena leptophylla	3	Likely	Likely following rainfall	
Gymnanthera cunninghamii	3	Likely	Recorded during survey	Recorded near Karratha LIA, Dampierand Burrup Peninsula
Stackhousia clementii	3	Likely	Sterile- Recorded during survey	Recorded near Hearson Cove Road
Atriplex lindleyi subsp. *conduplicata*	3	Likely	Recorded during survey	Two *A. lindlleyi* subsp were recorded, one with fruits (not a Priority species) the second without fruit and likely to be the P3 species.
Terminalia supranitifolia	3	Likely	Recorded during survey	

Species	Conservation Code	Likelihood of Occurrence in Project Area	Likelihood of Occurrence after Field Survey	Comment
Schoenus punctatus	3	Potential	Potential	Rarely occurring sedge found once on the Burrup Peninsula – requires rainfall.
Acacia glaucocaesia	3	Likely	Potential	Known to occur in the wider C of K area but not found during the field survey.
Glycine falcata	3	Unlikely	Unlikely	
Vigna triodiophila	3	Likely	Recorded during survey	Rare on the Burrup but potentially more abundant following rain
Corchorus congener	3	Unlikely	Unlikely	
Owenia acidula	3	Potential	Unlikely	Potential in the wider CofK area but not in the study area.
Eragrostis crateriformis	3	Unlikely.	Unlikely	
Eragrostis lanicaulis	3	Potential	Likely following rainfall	Annual, potential to occur following rain
Eragrostis surreyana	3	Likely	Potential	Has been recorded on Burrup Peninsula by author but requires rainfall.
Eriochloa fatmensis	3	Not identified in Desktop	Recorded during survey	Rare occurrence in Karratha area
Themeda sp. Hamersley Station	3	Potential	Recorded during survey	One small population remaining immediately west of Jingarri.
Oldenlandia sp. Hamersley Station	3	Unlikely	Potential	Potential to occur after rainfall
Solanum albostellatum	3	Unlikely	Unlikely	
Rhynchosia bungarensis	4	Likely	Recorded during survey	
Goodenia nuda	4	Potential	Likely following rainfall	

Table 3. Photos of Priority Species recorded during the survey

Plate 1: *Vigna triodiophylla* foliage

Plate 2: *Vigna triodiophylla* flower

Plate 3: *Terminalia supranitifolia*

Plate 4: *Terminalia supranitifolia* seed

Plate 5: *Rhynchosia bungarensis* vine

Plate 6: *Rhynchosia bungarensis* flower

Plate 7: *Gymnanthera cunninghamii*

Plate 8: *Gymnanthera cunninghamii* flower

Plate 9: *Tephrosia* sp Port Hedland foliage and flower

Plate 10 : *Tephrosia* sp Port Hedland shrub

Plate 11: *Eriochloa fatmensis*
Source: en.wikipedia.org

Plate 12: *Atriplex lindleyi* subsp. *conduplicata*
Source: species.wikimedia.org

Plate 13: *Stackhousia clementii*
Source: en.wikipedia.org

Plate 14: *Pentalepis trichodesmoides* subsp. *hispida*
Source: species.wikimedia.org

Plate 15: *Themeda* sp. Hamersley Station

Plate 16: *Themeda* sp. Hamersley Station seed

5.3.2 Locally Significant Flora Species

Locally significant flora species are defined as:

- not previously or rarely recorded in the survey area (Western Australian Herbarium 2019),
- at the end of their known range (Western Australian Herbarium 2019),
- that form a disjunct small population from the main population of occurrence.

Locally significant species recorded in the survey area are listed in Table 4.

Table 4: Locally Significant Flora Species recorded in the Survey Areas.

Significant Species	Location	Reason for local significance
Acacia sabulosa	Wickham	One record only in study area – limited red sand plain habitat.
Atriplex bunburyana	Roebourne area	Northern end of its range – became rare early century due to sheep grazing. Beard (1975) says "Roebourne Plains grasslands may originally have carried *Atriplex bunburyana*". Extensive revegetation by Dept of Agriculture has resulted in its presence in the area again (A. Mitchell pers comm) Fire sensitive.
Bonamia alatisemina	Wickham	Not previously collected in study area – (limited red sand plain habitat) - range begins near Port Hedland.
Cheilanthes contigua	Karratha Hills	Fern species -rarely found only in sheltered crevices of rockpiles, Karratha hills and Burrup.
Clerodendrum floribundum	Behind Wickham	Found inland Pilbara, only one record known from Pilbara coastal area.
Coynotheca pungens	Point Samson dunes	Not recorded in survey area at all, nearest records are north, Port Hedland and south near Exmouth
Dicliptera armata	Burrup Peninsula	Burrup and near vicinity to Karratha is the only location of this species in the Pilbara. Occurs very far north Kimberley (potentially a different sub-species) – remnant Kimberley species.
Dodonaea coriaceae	Wickham Rocky hills	Occurs in wider Pilbara but only one record for survey area.
Dolichandrone occidentalis	West of Jingarri	Rarely occurring around survey area and southern end of range.
Eucalyptus xerothermica	Burrup Peninsula	Only population in the study area is on the Burrup – one population on Barrow Island and common inland but not coastal Pilbara.
Ficus virens subsp *virens*	Dampier/ Burrup	Few coastal Pilbara records – Kimberley species
Heliotropium transforme	Wickham	Not previously recorded in study area.
Polygala aff *insingii*	Wickham	*Polygala* aff. *insingii* is very poorly recorded for the entire Pilbara region and not in the study area at all. One specimen of *Polygala* aff *insingii* has been recorded from the area though. Rare and very inconspicuous in the landscape.
Melaleuca argentea	Harding and Maitland Rivers, Dampier rock gully	Not recorded on FloraBase as being present in survey area but known to the author to occur here.
Melaleuca lasiandra	Harding River	Not previously recorded in study area and behind Wickham Back beach.

Significant Species	Location	Reason for local significance
Osbornia octodonta	Cossack	Only representation of this species in study area – southern-most extent of range, rarely recorded anywhere on Pilbara coastline.
Pittosporum phillyreoides	Burrup and "gum trees" behind Nickol Bay remnant dune	At the far northern most extent of its range past Cape Range and typically very coastal not rockpiles (Burrup) and wetlands (Karratha West)
Ptilotus divaricatus	West of Jingarri	Rarely recorded in survey – only one small population known from this area. North of range.
Samolus sp Millstream	Nickol River	Not previously recorded in survey area and poorly recorded in Pilbara
Scaevola cunninghamii	Karratha Back Beach and Point Samson dunes	Northern extent of its range.
Scaevala sericophylla	Point Samson dunes	Rarely recorded in survey area and northern extent of range
Senna glutinosa sups *chatelainiana*	Alluvial flats south of Karratha hills	One previous record in survey area only
Trigonella suavissima	Ephemeral wetland "gum trees" behind Nickol Bay remnant dune	Poorly recorded species, rare occurrences inland Pilbara
Triodia schinzii	Red sand plains	One record only from study area (limited red sand plain habitat)

5.3.3 Fire Sensitive Flora Species

Fire sensitive species in the Pilbara have been poorly studied. Latz (1995) reported on fire sensitive species in Central Australia, many of which apply to the survey area. There are scholarly papers on a small number of Pilbara species. VLA is currently conducting monitoring of fire impacted areas (both control burn and wildfire) for DBCA. Information for this report has been gleaned from these sources.

A summary of known fire sensitive species within the survey area are listed in Table 5.

Table 5: Known fire sensitive species (Latz 1995) and those recorded in Burrup Peninsula fire monitoring quadrats (VLA 2019) found within the survey area which need fire protection.

Species Intolerant to Fire*		
Acacia coriacea	*Acacia tenuissima*	*Alectryon oleifolius*
Amyema sp (mistletoe)	*Atriplex bunburyana*	*Brachychiton acuminatus*
*Capparis spinosa (*variable)	*Carissa lanceolata*	*Cynanchum viminale* subsp *australe*
Dichrostachys spicata	*Dodonea coriacea*	*Ehretia saligna*
Enchylaeana tomentosa	*Eragrostis eriopoda*	*Erythrina vespertilio*
Ficus brachypoda	*Flueggea virosa*	*Gymnanthera cunninghamii*
Pittosporum phillyreoides	*Ptilotus obovatus*	*Rhagodia eremaea*
Rhagodia preissii subsp *obovata*	*Terminalia supranitifolia*	Many Chenopod species (Atriplex / Scleroleana/Tecticornia.)

5.3.4 Weed Species

Forty seven introduced species were found during the field surveys (Table 6). Six of these are of serious consequence, being listed either as Declared Pests on the *West Australian Organism List*

(WAOL) under the *Biosecurity and Agriculture Management Act (2007) (*BAM), as species likely to have significant impact under the EPBC Act or as Weeds of National Significance (WONS). The survey areas in which these weeds have been found are shown on the individual area figures. The vine **Passiflora foetida* (Stinking passionflower) is considered one of the most significant threats to Northern Australia (Webber *et al* 2014).

Table 6: Weed species and their status recorded during the 2019 field surveys

Species	Common name	WoNS/Declared Pest
Aerva javanica	Kapok	
Albizia lebbeck	Rain tree	
Aloe vera	Aloe	
Bidens bipinnata	Bipinnate beggartick	
Calotropis procera	Calotropis	Declared Pest
Cenchrus ciliaris	Buffel grass	
Cenchrus setiger	Birdwood grass	
Chloris barbata		
Chloris virgata	Feathertop Rhodes grass	
Clitorea ternatea	Butterfly pea	
Conocarpus erectus	White button mangrove	
Cucumis melo	Wild melon	
Cynodon dactylon	Couch grass	
Distimake dissectus	Noon flower	
Echinochloa colona	Awnless barnyard grass	
Eurphorbia hirta	Strawberry weed	
Flaveria trinervia	Speedyweed	
Indigofera oblongifolia		
Indigofera sessiliflora		
Jatropha gossypiifolia	Belly ache bush	Declared Pest
Khaya senegalensis	African Mahoghany	Planted for shade
Lantana camara	Lantana	WoNS, Declared Pest
Leucaena leucocephala	Lead tree / coffee bush	
Macroptillium atropurpureum	Sirato	
Malvastrum americanum	Spiked malvastrum	
Melochia pyramidata	Pyramid flower	
Parkinsonia aculeata	Parkinsonia / Jerusalem thorn	WoNS, Declared Pest
Passiflora foetida	Stinking passionflower	High threat weed (HTW) (CSIRO)
Phoenix dactylifera	Date palm	
Portulaca pilosa	Pigface	
Prosopis glandulosa x velutina	Mesquite	WoNS, Declared Pest
Rumex vesicarius	Ruby dock	
Schinus terebinthifolia	Brazilian pepper	
Setaria verticillata	Whorlied pigeon grass	
Solanum nigrum	Nightshade	
Sonchus oleraceus	Sow thistle	
Stylosanthes hamata	Caribbean stylo	
Tamarindus indica	Tamarind	Heritage site – planted for shade
Tamarix aphylla	Tamarisk/ Athel pine	WoNS, Declared Pest
Tecoma stans	Tecoma	
Trianthema portulacastrum	Giant pigweed	

Species	Common name	WoNS/Declared Pest
Tribulus terrestris	Caltrop	
Tridax procumbens	Tridax	
Typha sp	Bullrush	
Vachellia farnesiana	Mimosa wattle	
Vitex trifolia	Vitex	
Washingtonia filifera	Californian Fan Palm	

It should be noted that the presence and abundance of weeds was limited by the dry conditions.

5.3.5 Plants Currently Utilised by Aboriginal People

Many plants in the Project Area have value to the local Aboriginal people. These plants are utilised by them in their daily lives, primarily for medicines, but also for traditional food. These plants may not have scientific significance (ie. they are not Priority or high conservation species) but should be recognised within the City as plants significant to the Traditional Owners. Consultation with the local Aboriginal Corporations (NAC, MAC) generally indicated the significance of these species, but personal communications with members of the broader local Aboriginal community strongly reinforced the concept of protecting the plants which they continue to utilise today. The plants listed in Table 7 only represent those that are considered to be significant, because they continue to be used in the lives of Aboriginals in the City today. These plants should be identified and protected as much as possible from clearing and the impacts of traffic, whilst Traditional Owners should be allowed to take these plants for traditional purposes under the *Native Title Act 1993*. Preservation of these plants is also important to the Indigenous cultural tourism industry.

Table 7 Plants CURRENTLY utilised by and considered important to Aboriginal people living in towns within the City of Karratha.

Species*	Common / Ngarluma name [1]	Use
Acacia coriacea	Wirewood/ Bardawurru	Bark – ash and tobacco chewed as a stimulant
Acacia inaequilatera	Camel bush Garrany	Medicine tree
Acacia pyrifolia	Kanji bush, Ganyji	Food (seed and gum)
Acacia xiphophylla	Snakewood, Marruwa	Best wood for cooking
Corymbia hamersleyana	Hamersley bloodwood Barlgarringu	Very important medicine currently and widely used. Also galls supply bush tucker.
Cyperus bulbosus	Wild onion Ngarlgu	Favorite food
Capparis spinosa	Capper bush Bajirla	Fruit
Eucalyptus camaldulensis	River red gum Wirrangkura	Wild honey
Eucalyptus victrix	Smooth barked coolabah Yamarrara	Bark prized – best one for mixing with chewing tobacco for stimulant. Also valued for lerp (energy food)
Grevillea pyramidalis	Northern grevillea Jiingu	Medicine plant and important woman's plant
Hakea lorea	Honey hakea Garrayin	Energy food (nectar)

Species*	Common / Ngarluma name [1]	Use
Ipomoea costata	Yam Mada	Food - source of carbohydrates
Lepidium platypetalum	Mustard plant "wild mustard"	Food (when other is scarce) but sought after for mustard flavoring of the flowers and buds
Melaleuca argentea	River paperbark Tharlgu	Wild honey (and previously water) and for serving bush food
Santalum lanceolatum	Northern sandalwood Wild plum Burdardu	Fruits – bush plum
Solanum diversiflorum	Bush tomato Garlumbu	Fruits – sought after food
Stemodia grossa	Vicks plant Minyjagarra	Important medicine plant
Triodia epactia	Gummy spinifex Mina	Resin still used to burn off evil spirits and as glue

*Only plants specifically singled out of the many used for medicine, food and culture have been listed here

[1] . From Wanggalil – Juluwarlu Aboriginal Corporation

5.4 Priority Ecological Communities (PECs)

Three PECs were recorded during the survey (Table 8) with a potential fourth being present, but not identifiable until after rainfall (Table 9). A fifth remnant PEC was recorded (Table 8) which is now degraded by weed species, but has the potential to be restored.

Table 8 Priority Ecological Communities recorded during field surveys 2019

Priority Ecological Communities (PECs) recorded during field survey	Priority Ranking	Area and Map Location	
Burrup Peninsula rock pile communities Pockets of vegetation in rock piles, rock pockets and outcrops. Comprise a mixture of Pilbara and Kimberley species, communities are different from those of the Hamersley and Chichester Ranges. Short-range endemic land snails. **Threats:** industrial development dust emissions, weeds. See note below.	Priority 1	Burrup Peninsula Dampier Map Karratha Maps	 **Plate 1: Burrup Rockpile PEC (P1)**
Stony Chenopod association of the Roebourne Plains area The community is dominated by *Eragrostis xerophila* and chenopods growing in saline clay soils with dense surface strew of pebbles and cobbles. The association appears to be uncommon and is likely to be linked with the Cheerawarra land system (Unit 3 - Saline clay plains). Only one occurrence has been located to date (Roebourne Airport), however it is likely some other small areas remain. **Threats:** grazing, clearing, and weeds especially buffel grass.	Priority 1	Roebourne Map Karratha West Map	 **Plate 2: Stony Chenopod association of the Roebourne Plains area (P1)**

Horseflat land system of the Roebourne Plains (Does not include priority ecological communities 'Roebourne Plains gilgai grasslands' and the 'Chenopod association of the Roebourne Plains area') The Horseflat Land System of the Roebourne Plains are extensive, weakly gilgaied clay plains dominated by tussock grasslands on mostly alluvial non-gilgaied, red clay loams or heavy clay loams. Perennial tussock grasses include *Eragrostis xerophila* (Roebourne Plains grass) and other *Eragrostis* spp., *Eriachne* spp. and *Dichanthium* spp. The community also supports a suite of annual grasses including *Sorghum* spp. and rare *Astrebela* spp. The community extends from Cape Preston to Balla Balla surrounding the towns of Karratha and Roebourne. This community incorporates Unit 3 (Gilgai plains), Unit 5 (Alluvial Plains) with some Unit 7 (Drainage Depressions) as described in Van Vreeswyk et al. 2004. **Threats:** grazing, weed invasion, fragmentation.	Priority 3(iii)	Roebourne Map Karratha Maps	 **Plate 3: Horseflat land system of the Roebourne Plains (P3**

Note : Burrup Rockpile PECs are listed as Priority 1 for protection: these are nominated as PECs because they are comprised of remnant Kimberley species, Pilbara inland species, coastal species, southern species and fire sensitive species – differing from communities of vegetation found in the inland ranges. Rockpile vegetation with the requisite type of vegetation to be a Rockpile PEC was found during the survey on rock ridges and rockpiles in other near coastal areas in the City of Karratha apart from the Burrup. (Awaiting confirmation of status as "Burrup" Rockpile PECs from DBCA Species and Communities Branch).

Table 9: Potential PEC not identifiable until after rainfall

Priority Ecological Communities (PECs) recorded during field survey	Priority Ranking	Area and Map Location	
Roebourne Plains coastal grasslands with gilgai microrelief on deep cracking clays (Roebourne Plains gilgai grasslands) The Roebourne Plains coastal grasslands with gilgai micro-relief occur on deep cracking clays that are self-mulching and emerge on depositional surfaces. The Roebourne Plains gilgai grasslands occur on microrelief of deep cracking clays, surrounded by clay plains/flats and sandy coastal and alluvial plains. The gilgai depressions supports ephemeral and perennial tussock grasslands dominated by *Sorghum* sp. and *Eragrostis xerophila* (Roebourne Plains grass) along with other native species including *Astrebla pectinata* (barley mitchell grass), *Eriachne benthamii* (swamp wanderrie grass), *Chrysopogon fallax* (golden beard grass) and *Panicum decompositum* (native millet). Restricted to the Karratha area, this community differs from the surrounding clay flats of the Horseflat land system which are dominated by *Eragrostis xerophila* and other perennial tussock grass species (*Eragrostis* mostly). **Threats:** Grazing, clearing for mining and infrastructure and urban development, weed invasion, basic raw material extraction.	Priority 1	Karratha West Map	 **Plate 4: Potential P1 PEC Roebourne Plains gilgai grasslands in dry condition. To be confirmed following rainfall (P1).**

Table 10: Remnant PEC which could be restored.

Priority Ecological Communities (PECs) recorded during field survey	Priority Ranking	Area and Map Location	
Coastal dune native tussock grassland dominated by *Whiteochloa airoides* Tussock grassland of *Whiteochloa airoides* occurs on the landward side of foredunes, hind dunes or remnant dunes with white or pinkish white medium sands with marine fragments. There may be occasional *Spinifex longifolius* tussock or *Triodia epactia* hummock grasses and scattered low shrubs of *Olearia dampierii* subsp. *dampierii, Scaevola spinescens, S. cunninghamii, Trianthema turgidifolia* and *Corchorus* species (*C. walcottii*, *C. laniflorus*). Occurs on Barrow Island and possibly some unaffected littoral areas in west Pilbara. **Threats:** weed invasion especially buffel grass and kapok, basic raw material extraction.	Priority 3	Karratha East Map	 **Plate 5: Remnant *Whiteochloa airoides* PEC which could be restored (Karratha Searipple dune) to original condition**

Two communities have been nominated for PEC status within the survey area. One of these is "Mat *Sporobolus virginicus* tussock grassland" which generally occurs along the edges of undisturbed tidal inlets, and occasionally along river banks. The defining criteria for this PEC is that it must be pure (no weeds) and dense, ie matted, where the grass grows upon itself.

The second potential PEC occurs in the Karratha area, north of Nickol, where an ephemeral wetland occurs behind the remnant dunes around Nickol Bay. Following rains, the area houses an extremely diverse range of flora including herbs, grasses and at least four different sedges. Additionally, the occurrence of the wetland bordered by coastal dunes to the north and gilgai grassland plains to the south, is highly unusual. The area is currently being degraded by off road vehicles, bikes and litter dumping. The second occurrence of this ephemeral wetland type occurs on the southern edge of the golf course in Bulgarra. However, this area is very degraded with weeds and could not qualify to become a PEC.

Plate 6: Potential *Sporobolus virginicus* matted grassland PEC being assessed by DBCA Special Communities Branch

Plate 7: Potential ephemeral coastal wetland PEC being assessed by DBCA Special Communities Branch

Both these communities have been nominated as PECs and are being assessed by the DBCA Special Communities Branch.

5.5 Vegetation Condition

Vegetation condition over the sites sampled varied from Excellent to Poor. The most common impacts causing degradation of vegetation condition were weeds, off road trails and tracks and too frequent fire. It should be noted, that sites that were classified as Degraded were not included in the survey as field survey time was limited and it was considered these added no biodiversity value.

Any future development projects within the Karratha LGA will need to have vegetation condition assessments undertaken, as the ratings given in this survey were generally site specific and cannot be extrapolated for the wider landform type.

Vegetation condition throughout the surveyed area is summarised in Table 11.

Table 11. Vegetation condition for landform types sampled within the Survey Area.

Condition rating and number of sites throughout the areas surveyed						
Area	Excellent	Very Good to Excellent	Very Good	Good to Very Good	Good	Poor
Karratha West	1	2	2			
Karratha East	1		1		1	2
Dampier/Burrup		2	1	1	1	2
Point Samson/Wickham Cossack	4	1	3	1	2	
Roebourne	2		1	2	2	
Nickol River				1	1	
Maitland River					1	
Total	**8**	**5**	**8**	**5**	**8**	**4**

In some cases, a number of sites were sampled in one habitat/landform and condition varied across those sites. These were scored within a range as shown in Table 11.

5.6 Fauna

Searches of the WA Threatened Fauna database, NatureMap and the EPBC Act Protected Matters database were undertaken for the Project Area during the desktop study.

A total of 783 fauna species were recorded for the Project Area from the desktop study. These fauna are known to occur in nine broad scale fauna habitats as identified from the literature and database searches. These are:

- Beach Dunes
- Mangal
- Saline Flats and Marshes
- Plains of Grasses and or Shrubs
- Hill Ranges and Slopes
- Rockpiles and Rock Ridges
- Rocky Gorges and Gullies
- Rivers, Drainage Lines and Waterholes
- Wetlands

The field survey confirmed the presence of these fauna habitats within the seven key areas surveyed, although due to dry conditions, wetlands and waterholes were not active. Although no trapping was conducted, a bird list was compiled (Appendix 4). One hundred and eleven bird species were identified from the field survey and other related surveys within the area. In addition, Priority fauna, namely *Liasis olivaceus barroni,* (Pilbara Olive Python listed as Vulnerable under the EPBC Act 1999) and *Dasyurus hallucatus* (Northern quoll listed as Endangered under the EPBC Act 1999) are known from records to occur on the Burrup Peninsula with the potential to occur in similar habitats in the Karratha hills (Karratha East and West), Dampier (anecdotal records indicate residents find them in their back yards), Roebourne, Point Samson and Wickham and along both the Maitland and Nickol rivers. The listed Critically Endangered *Lerista nervinae* (Nevins slider) is well documented to occur only on the

fragmented dunes around Cape Lambert. Several disused Pebble Mound Mouse (*Pseudomys chapmani)* mounds were found on the Burrup Peninsula. It is not expected that active mounds would be present, given the feral cats and foxes on the Burrup Peninsula, but it is worth noting these small native rodents were once located here.

5.7 Landform

5.7.1 Landforms and Biogeographic Units

The nine broad landforms identified from the desktop study as occurring within the Project Area (VLA 2017) and shown in Table 12, were recorded in the seven key areas during the field survey. The locations of these landforms are summarised for each area in Appendix 5.

Table 12: Landform types and Biogeographic Units found within the Project Area.

Broad Landform/Habitat	Biogeographic Unit
Beach Dunes	• Beach • Foredune Seaward Face • Foredune Crest • Foredune landward side • Secondary Dune • Remnant Dune
Mangal	• Fringing coast • Inter Tidal Creek
Saline Flats and Marshes	• Tidal Creek • Intratidal Flats • Land locked flats • Bare saline flats
Plains of Grasses and/ or Shrubs	• Tussock Grassland ▪ Roebourne Plains ▪ Roebourne Plains PEC ▪ Buffel • Hummock Grassland ▪ *Triodia epactia* ▪ *Triodia longiceps* ▪ *Triodia angusta* ▪ *Triodia wiseana* • Mosaic hummock and tussock grassland • Shrubland over Hummock Grassland • Chenopod Shrubland over open Tussock grassland
Hill Ranges and Slopes	• Stony Hill slopes • Rocky hill ranges • Upper stony slopes • Lower stony slopes
Rockpiles and Rock Ridges	• Rockpiles • Rock ridges
Rocky Gorges and gullies	• Deep rocky gullies • Shallow broad rocky gullies • Rocky gorges
Rivers, Drainage lines, Waterholes	• Broad major rivers • Minor creeks • Wide drainage lines with incised tracts • Narrow drainage lines

Broad Landform/Habitat	Biogeographic Unit
	• Perennial Water Hole • Ephemeral Water hole
Wetlands	• Ephemeral wetland • Permanent wetland

5.7.2 Significant Landforms

The landforms (Nickol Bay saline flats and associated remnant dune, Karratha Hills and Harding River) which were identified from the desktop study as meeting one or more of the criteria for being significant (VLA 2017), were confirmed from the field survey as occurring within the areas surveyed as well as having significant features which should be protected.

The EPA's environmental objective for landform is "*to maintain the variety and integrity of distinctive physical landforms, so that environmental values are protected".*

The EPA focusses assessment of landform on the significance of removal, or alteration of the landform and any direct impacts to the flora, vegetation or fauna associated with that landform. EPA considerations include:

- Variety : the landform is a particularly good or important example of its type; is not well represented over the local, regional or national scale or differs from other examples at these scales.
- Integrity: the landform is intact, being largely complete or whole and in good condition.
- Ecological importance: The landform has a distinctive or exclusive role in maintaining existing ecological and physical processes; for example, by providing a unique microclimate, source of water flow or shade. The landform supports endemic or highly restricted plants or animals.
- Scientific Importance: The landform provides evidence of past ecological processes or is an important geomorphological or geological site. The landform is of recognised scientific interest as a reference site or an example of where important natural processes are operating.
- Rarity: The landform is rare or relatively rare, being one of the few of its type at a national, regional or local scale.
- Social Importance: The landform supports significant amenity, cultural and heritage values.

5.8 Assessments of High Priority Areas

Assessments and results for the High Priority survey areas identified from the desktop study (Dampier (including Burrup Peninsula), Karratha East, Karratha West, Roebourne, Wickham and Cossack, the Nickol River and the Maitland River) are tabulated in Appendix 5. A summary of the findings is presented in Table 13.

Table 13: Summary of Key Results for Survey areas

Environmental Attribute	Dampier (incl. Burrup)	Karratha East	Karratha West	Roebourne	Point Samson Wickham Cossack	Nickol River	Maitland River
Landforms surveyed / (No of sites)	8 (12)	6 (8)	6 (14)	6 (10)	11 (13)	2(3)	1(2)
Number of Priority Flora species identified (as listed by DBCA)	6	2	3	2	2	0	0
Number of Locally Significant Flora species identified (as listed by DBCA)	5 + *Tecticornia* species	4	2	2	3	1	1
Number of Culturally Significant Flora species identified	10	9	10	12	9	4	6
Likely habitat for Priority Fauna	Yes	Potential	Potential	Potential	Yes - 1 known	Potential	Potential
Number of Priority Ecological Communities identified (as listed by DBCA)	2	1 1 remnant PEC	3 1 nominated PEC	2 1 nominated PEC	1	0	0
Number of Locally Significant Vegetation/Community identified (as per EPA 2016 criteria)	Entire Burrup	2	4	1	3	1	1
Number of Vegetation Communities with fire sensitive species	8	3	4	2	1	1	1
Aboriginal Heritage Sites as recorded during survey (Not surveyed by TOs or Archaeologist)	3	2	3	2	1	0	1
Number of Declared Pests/WONs Species identified	0	3	4	3	1	0	1

Environmental Attribute	Dampier (incl. Burrup)	Karratha East	Karratha West	Roebourne	Point Samson Wickham Cossack	Nickol River	Maitland River
Number of sites suitable for restoration (weed control, Bradley Method)	2	4	3	1	2	0	1

6 CONCLUSIONS

Landform areas of ecological significance and conservation value within the City of Karratha were identified and ranked according to criteria as detailed in the Biodiversity Desktop Study (VLA 2017). These areas were classified as having either a High, Medium or Low need for survey.

The field surveys were completed between May and July 2019 and concentrated on areas ranked as having a High need for survey, although a few Medium and Low areas, considered to have significant features, were also surveyed.

The limited field time available meant that the searches of sample sites were at a reconnaissance level only and although duplicate samples within each landform area were usually achieved, it is considered that the information collected is limited in terms of being able to fully assess all environmental factors for that landform. (For example, fauna habitat could be recorded as present but no provision in the funding was available for trapping or night-time searches for actual species).

Three PECs were identified and a potential fourth PEC requires verification following decent rainfall. One remnant PEC is considered worthy of restoration. Two communities, *Sporobolus virginicus* matted tussock grassland and ephemeral coastal wetland have been nominated as PECs and await assessment from the DBCA Special Communities branch. Despite the sampling limitations, the results of the field survey identify landform areas with high biodiversity value and conservation significance. As such, the City of Karratha should consider managing them at a minimum for weeds, and potentially for conservation.

The surveys were conducted after two years of well below average rainfall in the area. Ten Priority flora species were recorded, with a further eight species considered likely to occur following rainfall or have the potential to occur in the wider unsurveyed area.

The 24 locally significant flora species recorded, add biodiversity value on both a local and regional level.

Although the local field botanists were able to identify many dormant flora species, the dry conditions limited the number and range of flora species available for identification and, consequently, the capacity to conduct a complete assessment. Despite this, and given the survey was only undertaken at a reconnaissance level, a high number of flora species and vegetation types were recorded within the limited survey area during the dry season. This can be attributed to the diverse landforms and micro-niches present, which result in diverse vegetation types. It is an indicator of the significant biodiversity that occurs within the surrounds of the five town site areas, within the City of Karratha.

There is a paucity of documentation available with regard to the impact of fire, particularly repeated fire, on individual Pilbara native flora, especially in the local area (studies have been done on Mulga occurring inland). It is known for example, that rockpile PECs harbour fire sensitive species that have been reduced in the landscape where rock protection from fire is not available. Latz (1995) has studied fire response in northern Australian plants, many of which occur in the Pilbara. These species, along with those currently being documented by VLA for DBCA (2019 in progress), highlight species which are threatened by fire, and in particular, repeated fire. The City of Karratha should acknowledge the presence of these species in its Fire Management Plan and aim to reduce the frequency of burns in areas where populations of these fire sensitive species occur. Area assessment tables in Appendix 5

indicate the fire sensitive species recorded, and therefore those most likely to occur on a wider scale, in landforms surveyed.

Weed management needs to be considered on a case by case basis depending on feasibility of success, land use, current infestation levels and time/cost effectiveness. Legislation requires that Weeds of National Significance (WoNS) and Declared Pests be removed from land which falls within the City of Karratha. In terms of protecting the high biodiversity that is evident in the area, WoNS, Declared Pests and High Threat Weeds (HTW) should be removed as a matter of best environmental practice. A Weed Management Plan (WMP) needs to be developed and implemented by the City of Karratha to ensure weeds are controlled in a feasible, cost efficient and effective way. The WMP should prioritize areas for control, based on areas of high conservation value (Appendix 5) and be site specific for each area. The WMP should be designed to be undertaken for a minimum of five years.

Science recognises Threatened and Priority flora based on a number of qualifying scientific criteria, however there is no formal recognition of plants that are considered significant by the Aboriginal people. Although the use of plants by Aboriginal people, particularly for food, has diminished in the past 100 years, medicinal plants continue to be widely, commonly and currently utilised. For Aboriginals living in towns within the City of Karratha, significance is given to plants that they continue to utilise in their everyday lives, and which are within easy access (often walking distance) from those towns. Eighteen plants of significance to Aboriginal people have been identified through various ethno-botanic surveys conducted by the author in the area and through the consultation process for the desktop study. Any areas to be cleared, burnt or impacted within the City of Karratha, should consider the presence of these culturally significant plants and if possible, nearby areas containing these species be kept for conservation and the growing Indigenous tourism industry. Additionally, an orchard type park/garden could be established where plants can be both displayed as an educational tool and harvested by the local people.

An assessment of Priority and/or Threatened fauna could only be based on habitat type, with most habitats surveyed having the potential to support conservation significant species. Very little fauna field survey work has been conducted in the study area, apart from that undertaken in proximity to the resource areas (Burrup, Cape Lambert). The landforms within the study area will support a diverse range of fauna (small mammals, marsupials and reptiles) of which we have no knowledge.

Our coastline within the study area is known for its protected migratory, wading birds but dedicated field surveys have not been conducted to verify and quantify species usage and numbers. The lack of knowledge about not only our Threatened and Priority fauna, but fauna in general is a significant knowledge gap in the understanding of biodiversity, which should be addressed by the City.

The information presented in the assessment tables in Appendix 5, indicates that the local City of Karratha area does qualify for its inclusion as one of Australia's 15 Biodiversity Hotspots. The development of the City of Karratha's Local Biodiversity Strategy at landscape scale will ensure biodiversity is maintained over the long term.

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FIGURES

PINPOINT CARTOGRAPHICS (08) 9562 7136 KBS-f03a.dgn

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

7 710 000mN

7 707 500mN

7 705 000mN

477 500mE

480 000mE

482 500mE

5 PEC

10

12a

Nominated PEC

12b

6

7

15 PEC

13

5

13

PEC

1&3

PEC 5

PEC

6

Legend

- Study Area Boundary
- Cadastral Boundary
- Easement Boundary
- Quarry Site with WONS
- Area Surveyed

Area

1	Rockpiles and Rocky Ranges
2	Quartz rock ridges
3	Rocky hill slopes - low hills
4	Flats - Hummock grassland with scattered to open shrubs.
5	Flats - Tussock grassland
6	Flats - Mosaic grassland with scattered shrubs
7	Coastal north of City centre
8	Flats - coastal East of Nickol River
9	Mangrove coastline
10	Samphire and tidal flats
11	Beachs and Coastal Dunes (mostly covered in Karratha Foreshore Management Plan)
12a	Remnant Dunes around Nickol Flats
12b	Wetland at Nickol Flats
13	Drainage Lines and Gullies
14	Remnant Vegetation in Karratha
15	Mosaic vegetation and grassland containing two PECs (P1 and P3)

Need for Survey (Desktop Study - VLA, 2017)

- High Priority
- Medium Priority
- Low Priority

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2017.

vla vicki long & associates

Date: 22 Nov 2019
Drawn: V. Long

City of Karratha
KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019) IN THE PROJECT AREA - KARRATHA WEST

FIGURE 3a

PINPOINT CARTOGRAPHICS (08) 9562 7136 KBS-f03b.dgn

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

7 710 000mN

7 707 500mN

7 705 000mN

7 702 500mN

7 700 000mN

485 000mE

487 500mE

Remnant PEC for Restoration

11

14a

14b

7

1&3

PEC

PEC

PEC

8

8

13

6

2

Legend

Study Area Boundary

Cadastral Boundary

Easement Boundary

Area Surveyed

Area

1 Rockpiles and Rocky Ranges
2 Quartz rock ridges
3 Rocky hill slopes - low hills
4 Flats - Hummock grassland with scattered to open shrubs.
5 Flats - Tussock grassland
6 Flats - Mosaic grassland with scattered shrubs
7 Coastal north of City centre
8 Flats - coastal East of Nickol River
9 Mangrove coastline
10 Samphire and tidal flats
11 Beachs and Coastal Dunes (mostly covered in Karratha Foreshore Management Plan)
12 Remnant Dunes around Nickol Flats
13 Drainage Lines and Gullies
14a&b Remnant Vegetation in Karratha

Need for Survey (Desktop Study - VLA, 2017)

High Priority

Medium Priority

Low Priority

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2017.

vla vicki long & associates

Date: 22 Nov 2019

Drawn: V. Long

City of Karratha
KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019) IN THE PROJECT AREA - KARRATHA EAST

FIGURE 3b

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

7 717 500mN

7 715 000mN

465 000mE

467 500mE

470 000mE

472 500mE

Legend

- Study Area Boundary
- Cadastral Boundary
- Easement Boundary
- Area Surveyed

Area

1	Rockpiles and Rocky Ranges
2	Rockpiles and Rocky Ranges
3	Rockpiles and Rocky Ranges
4	Rocky hill slopes
5	Mangrove coastline
6	Mangrove coastline
7	Samphire and tidal flats
8	Beachs and Coastal Dunes (outside Dampier)
9	Drainage Lines and Gullies
10a	Hillslope
10b	Gully
10c	Drainage Zone

Need for Survey (Desktop Study - VLA, 2017)

- High Priority
- Medium Priority
- Low Priority

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2017.

vla vicki long & associates

Date: 22 Nov 2019

Drawn: V. Long

City of Karratha

KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019) IN THE PROJECT AREA - DAMPIER & BURRUP

FIGURE 4

KBS-f04.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

City of Karratha
KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019) IN THE PROJECT AREA - POINT SAMSON

FIGURE 5

Date: 10 Nov 2019
Drawn: V. Long

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2017.

Legend

- Study Area Boundary
- Cadastral Boundary
- Easement Boundary
- Area Surveyed

Area

1	Rockpiles and high rocky ridges
2	Stony hills and slopes
3	Flats - Hummock grassland with scattered to open shrubs
4	Samphire Flats
5	Cheniers
6a	Coastal Dunes
6b	Remnant Coastal Dune
7a	Point Samson
7b	Cossack
8	Drainage Lines and Gullies
9	Coastal Headland
10	Low Stony Island

Need for Survey (Desktop Study - VLA, 2017)

- High Priority
- Medium Priority
- Low Priority

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

7 722 500mN
7 720 000mN
7 717 500mN

510 000mE
512 500mE
515 000mE
517 500mE
520 000mE

KBS-105.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

510 000mE
512 500mE
515 000mE
517 500mE
520 000mE
7 715 000mN
7 712 500mN

PEC 1&2b

8
9
3
8
3
5
5
4
4
4
5
7b
8
8

Legend

- Study Area Boundary
- Cadastral Boundary
- Easement Boundary
- Area Surveyed

Area

1	Rockpiles and high rocky ridges
2	Stony hills and slopes
3	Flats - Hummock grassland with scattered to open shrubs
4	Samphire Flats
5	Cheniers
6a	Coastal Dunes
6b	Remnant Coastal Dune
7a	Point Samson
7b	Cossack
8	Drainage Lines and Gullies
9	Coastal Headland
10	Low Stony Island
11	Pindan Sand Plain

Need for Survey (Desktop Study - VLA, 2017)

- High Priority
- Medium Priority
- Low Priority

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2017.

vla vicki long & associates

Date: 22 Nov 2019
Drawn: V. Long

City of Karratha
KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019)IN THE PROJECT AREA - WICKHAM AND COSSACK

FIGURE 6

PINPOINT CARTOGRAPHICS (08) 9562 7136 KBS-f06.dgn

N

0 250 500 750 1000m

SCALE 1 : 37 500 at A3 (MGA)

510 000mE

515 000mE

520 000mE

7 705 000mN

7 700 000mN

9 8 10 10 PEC 7 10 7 PEC 5 PEC 5 PEC 5 7 5 PEC 3 1&3 4 9 5 9 1 Nominated PEC

Legend

- Study Area Boundary
- Cadastral Boundary
- Easement Boundary
- Area Surveyed

Area

1	Rockpiles on low hills
2	Quartz rock ridges
3	Low stony hills and slopes
4	Flats - Hummock grassland with scattered to open shrubs
5	Flats - *Eragrostis xerophila* tussock grassland (PEC - P3)
6	Flats - Mosaic tussock and hummock grassland with scattered shrubs
7	Flats - Chenopod saline with stony mantle (PEC - P1)
8	Flats - Riverine
9	River
10	Minor drainage lines and drainage zones

Need for Survey

- High Priority
- Medium Priority
- Low Priority

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2017.

KBS-107.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

vla vicki long & associates

Date: 22 Nov 2019

Drawn: V. Long

City of Karratha

KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019) IN THE PROJECT AREA - ROEBOURNE

FIGURE 7

PINPOINT CARTOGRAPHICS (08) 9562 7136 KBS-f08.dgn

7 710 000mN
7 707 500mN
7 705 000mN
7 702 500mN
492 500mE
495 000mE

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

Legend

- Study Area Boundary
- Cadastral Boundary
- Easement Boundary
- Area Surveyed

Area

1 River bed and banks
2 Low cheniers associated with mouth of river and flats
3 Samphire and Tidal
4 Mangroves
5 Remnant low shale hillocks

Need for Survey (Desktop Study - VLA, 2017)

- High Priority
- Medium Priority
- Low Priority

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2017.

vla vicki long & associates

Date: 22 Nov 2019
Drawn: V. Long

City of Karratha
KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019) IN THE PROJECT AREA - NICKOL RIVER

FIGURE 8

PINPOINT CARTOGRAPHICS (08) 9562 7136 KBS-f09b.dgn

457 500mE

460 000mE

462 500mE

7 700 000mN

7 697 500mN

7 695 000mN

7 692 500mN

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

1

Legend

- Study Area Boundary
- Cadastral Boundary
- Easement Boundary
- Area Surveyed

Area

1 River bed and banks
2 Low cheniers associated with mouth of river and flats
3 Samphire and Tidal
4 Mangroves

Need for Survey (Desktop Study - VLA, 2017)

- High Priority
- Medium Priority
- Low Priority

CADASTRAL SOURCE: Landgate, August 2017.
AERIAL PHOTOGRAPH SOURCE: Microsoft Virtual Earth, flown December 2010.

vla vicki long & associates

Date: 8 Nov 2019
Drawn: V. Long

City of Karratha
KARRATHA BIODIVERSITY SURVEY

AREAS SURVEYED (2019) IN THE PROJECT AREA - MAITLAND RIVER

FIGURE 9b

APPENDIX 1

DEFINITIONS OF CONSERVATION CATEGORIES FOR PRIORITY FLORA AND PRIORITY ECOLOGICAL COMMUNITIES

Table 1.1: Conservation codes for Threatened and Priority Flora in Western Australia (DBCA 2019)

Conservation Code	Description and rating	
THREATENED FLORA		
T (Threatened Flora)	Specially protected under the WC Act, listed under Schedules 1, 2 and 3 of the Wildlife Conservation (Rare Flora) Notice (which may also be referred to as Declared Rare Flora). Taxa which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such The assessment of the conservation status of these species is based on their national extent.	
	CR - Schedule 1	taxa that are extant and considered likely to become extinct or rare, as critically endangered flora, and therefore in need of special protection.
	EN -·Schedule 2	taxa that are extant and considered likely to become extinct or rare, as endangered flora, and therefore in need of special protection.
	VU - Schedule 3	taxa that are extant and considered likely to become extinct or rare, as vulnerable flora, and therefore in need of special protection.
EX (Presumed Extinct Flora)	Specially protected under the WC Act, listed under Schedule 4 of the Wildlife Conservation (Rare Flora) Notice (which may also be referred to as Declared Rare Flora). Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died and have been gazetted as such. Threatened flora are ranked according to their level of threat using IUCN Red List categories and criteria. For example, *Acacia splendens* is specially protected as Declared Rare Flora under the WC Act and is a threatened species with a ranking of Critically Endangered	
	EX - Schedule 4	taxa that are presumed to be extinct in the wild and therefore in need of special protection.
PRIORITY FLORA		
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 and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations, but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.	
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 locations, but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.	

Conservation Code	Description and rating
P3 (Priority Three): Poorly known species	Species that are known from several locations, and the species do not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations, but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
	(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Table 1.2: Conservation codes for Priority Ecological Communities in Western Australia (Department of Parks and Wildlife 2017).

P1: Priority One – Poorly-known ecological communities
Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2: Priority Two – Poorly-known ecological communities
Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3: 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 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.
P4: 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 during the past five years.
P5: 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.

APPENDIX 2

FIELD DATA SHEET EXAMPLE

City of Karratha Local Biodiversity Field Sample Sheet: **Rec By:**

Survey Area	**Site No** **Date**
Photo Nos	
GPS (UTM) Points within area: **GPS of any targeted sample sites:**	**Approximate Sample Size – entire area:** **Sample area size if targeted**
Habitat (Landform, topography, rock and soils):	
Fauna: **Evidence (Tracks/scats)** **Visible (mammals, birds, reptiles etc):** **Feral Evidence (dog/cat tracks/scats)**	
Seasonal Conditions:	
Disturbances **Type and Estimation of Abundance (Tracks, erosion, mining, rubbish, pipelines etc, soil removal/dumping, taking vegetation for fire, repeated fire)** **1.** **2.** **3.** **4. Is habitat significantly fragmented ? What protection will mitigate this – or not possible?**	
Is Area suitable for restoration: (ie are tracks able to be closed; is weed management possible; is the area important to community etc	
Estimated Fire Age	
Weeds, Abundance, Location	**Collection No:**

Survey Area:	**Site No:**	**Rec By:**	**Date:**

Vegetation Description :

Vegetation Condition (as per Trudgen) :

Landform as refugia for isolated ecosystems	Aboriginal Heritage Site	Part of poorly represented vegetation	Large (greater than 10 ha)	Regular shape (little edge effects)	Contains unusual, rarely recorded or significant plant/veg	Occurrence of PEC, Priority /significant flora, fauna or likely	Area has (or with modest managmnt <5% weed cover	Priority (High Medium Low)

Site	Species	Height	Cover	Species			Notes/Coll No.

APPENDIX 3

VASCULAR FLORA LIST FROM SITES SAMPLED WITHIN THE SURVEY AREA

Table 2.1. Vascular Flora Species for City of Karratha Biodiversity Study – recorded from releves and opportunistically

NOTE: Not complete for the area – more species would be available following a good rainfall season

Family	Name	Weed	Conservation Status
Acanthaceae	*Avicennia marina* subsp *marina*		
	Dicliptera armata		
Aizoaceae	*Trianthema pilosum*		
	Trianthema portulacastrum	*	
	Trianthema triquetrum		
	Trianthema turgidifolia		
Amaranthaceae	*Achyranthes aspera*		
	Aerva javanica	*	
	Alternanthera nana		
	Alternanthera nodiflora		
	Amaranthus undulatus		
	Gomphrena affinis		
	Gomphrena cunninghamii		
	Gomphrena sordida		
	Ptilotus aervoides		
	Ptilotus axillaris		
	Ptilotus astrolasius		
	Ptilotus auriculifolius		
	Ptilotus calostachyus		
	Ptilotus clementii		
	Ptilotus divaricatus		
	Ptilotus exaltus		
	Ptilotus fusiformis		
	Ptilotus helipteroides		
	Ptilotus murrayi		
	Ptilotus obovatus		
	Ptilotus polystachys		
	Surreya diandra		
Anacardiaceae	*Schinus terebinthifolia*	*	
Apocynaceae	*Calotropis procera*	*Declared	
	Carissa lanceolata		
	Cynanchum floribundum		
	Cynanchum viminale		
	Gymnanthera cunninghamii		P3
Araliaceae	*Trachymene oleraceae*		
Areaceae	*Washingtonia filifera*	*	
Arecaceae	*Phoenix dactylifera*	*	
Asphodelaceae	*Aloe vera*	*	
Asteraceae	*Bidens bipinnata*	*	
	Centipeda minima		

Family	Name	Weed	Conservation Status
Asteraceae	*Flaveria trinervia*	*	
	Ixiochlamys cuneifolia		
	Minuria integerrima		
	Pentalepis trichodesmoides subsp. *hispida*		P2
	Peripleura virgata		
	Pluchea dentex		
	Pluchea ferdinandi-muelleri		
	Pluchea longiseta (was Pluchea sp B Kimberley Flora)		
	Pluchea rubelliflora		
	Pluchea tetranthera		
	Pterocaulon sphacelatum		
	Pterocaulon sphaeranthoides		
	Rhodanthe floribunda		
	Rhodanthe humboldtiana		
	Rhodanthe margarethae		
	Sonchus oleraceus	*	
	Streptoglossa adscendens		
	Streptoglossa bubakii		
	Streptoglossa deccurens		
	Streptoglossa sp (sterile)		
	Tridax procumbens	+	
Bignoniaceae	*Dolichandrone occidentalis*		
	Tecoma stans	*	
Boraginaceae	*Ehretia saligna* var *saligna*		
	Heliotropium crispatum		
	Heliotropium cunninghamii		
	Heliotropium curassavicum		
	Heliotropium heteranthum		
	Heliotropium ovalifolium		
	Heliotropium transforme		
	Heliotropium tenuifolium		
	Heliotropium sp (sterile)		
	Trichodesma zeylanicum var *zeylanicum*		
Brassicaceae	*Lepidium pedicellosum*		
	Lepidium platypetalum		
	Lepidium pholidogynum		
Capparaceae	*Capparis spinosa*		
Campanulaceae	*Wahlenbergia tumidifructa*		
Caryophyllaceae	*Polycarpaea longiflora* (White form, M13-7)		
	Polycarpaea longiflora (Purple form)		
Celastraceae	*Stackhousia ? intermedia* (sterile)		
	Stackhousia clementii (sterile)		P3

Family	Name	Weed	Conservation Status
Chenopodiaceae	*Atriplex bunburyana*		
	Atriplex codonocarpa		
	Atriplex ? lindleyi subsp *conduplicata* sterile		P3
	Atriplex lindleyi subsp *inflata*		
	Dysphania plantaginella		
	Dysphania rhadinostachya subsp *rhadinostachya*		
	Enchylaena tomentosa var *tomentosa*		
	Neobassia astrocarpa		
	Maireana georgei		
	Maireana tomentosa		
	Rhagodia eremea		
	Rhagodia preissii subsp *obovata*		
	Salsola australis		
	Sclerolaena bicornis		
	Sclerolaena costata		
	Sclerolaena cuneata		
	Sclerolaena diacantha		
	Sclerolaena glabra		
	Sclerolaean hostilis		
	Sclerolaena uniflora		
	Tecticornia halocnemoides subsp *tenuis*		
	Tecticornia indica subsp leiostachya		
	Tecticornia sp sterile? *pergranulala* subsp *elongata*		
Cleomaceae	*Cleome viscosa*		
Combretaceae	*Conocarpus erectus*	*	
	Terminalia circumalata		
	Terminalia supranitifolia		
Commelinaceae	*Commelina ensifolia*		
Convolvulaceae	*Bonamia alatisemina*		
	Bonamia erecta		
	Bonamia media		
	Bonamia pannosa		
	Bonamia rosea		
	Distimake dissectus (was *Merremia)*	*	
	Evolvulus alsinoides var *decumbens*		
	Evolvulus alsinoides var. *villosicalyx*		
	Ipomoea coptica		
	Ipomoea costata		
	Ipomoea lonchophylla		
	Ipomoea muelleri		
	Ipomoea pes-caprae		
	Ipomoea polymorpha		
	Operculina aequisepala		

Family	Name	Weed	Conservation Status
	Polymeria ambigua		
	Polymeria calycina		
Cucurbitaceae	*Cucumis argenteus*		
	Cucumis maderaspatanus		
	Cucumis melo	*	
	Cucumis sp sterile		
	Trichosanthes cucumerina		
Cyperaceae	*Bulbostylis barbata*		
	Cyperus cunninghamii subsp *cunninghamii*		
	Cyperus bifax		
	Cyperus bulbosus		
	Cyperus iria		
	Cyperus squarrosus		
	Cyperus vaginatus		
	Eleocharis ?dulcis (dead and sterile)		
	Eleocharis geniculata		
	Fimbristylis depauperata		
	Fimbristylis dichotoma		
	Fimbristylis sp (sterile, dead)		
	Schoenoplectus sabulatus		
Elatinaceae	*Bergia perennis*		
Euphorbiaceae	*Adriana tomentosa*		
	Euphorbia australis		
	Euphorbia biconvexa		
	Euphorbia careyi		
	Euphorbia coghlanii		
	Euphorbia drummondii		
	Euphorbia hirta	*	
	Euphorbia myrtoides		
	Euphorbia tannensis subsp *eremophila*		
	Euphorbia vaccaria		
	Euphorbia sp (dead)		
	Jatropha gossypiifolia	*Declared	
Fabaceae	*Acacia ancistrocarpa*		
	Acacia ampliceps		
	Acacia bivenosa		
	Acacia colei Var *colei*		
	Acacia coriacea subsp *coriacea*		
	Acacia coriaceae subsp *pendens*		
	Acacia elachanthra		
	Acacia inaequilatera		
	Acacia maitlandii		
	Acacia orthocarpa		

Family	Name	Weed	Conservation Status
Fabaceae	*Acacia pyrifolia* var *morrisonii*		
	Acacia pyrifolia var *pyrifolia*		
	Acacia sabulosa		
	Acacia sclerosperma		
	Acacia sphaerostachya		
	Acacia stellaticeps		
	Acacia synchronicia		
	Acacia tenuissima		
	Acacia trachycarpa		
	Acacia tumida		
	Acacia xiphophylla		
	Alysicarpus muelleri		
	Cajanus cinereus		
	Clitorea ternata	+	
	Crotalaria cunninghamii		
	Crotalaria medicaginea		
	Crotalaria novae-hollandiae		
	Cullen cinereum		
	Cullen lachnostachys		
	Cullen leucochaites		
	Cullen pogonocarpum		
	Desmodium filiforme		
	Desmodium muelleri		
	Dichrostachys spicata		
	Erythrina vespertilio		
	Indigofera colutea		
	Indigofera linifolia		
	Indigofera linnaei		
	Indigofera monophylla		
	Indigofera oblongifolia	*	
	Indigofera sessiliflora	*	
	Indigofera trita		
	Isotropis atropurpurea		
	Lotus australis		
	Lotus cruentus		
	Leucaena leucocephala	+	
	Macroptillium atropurpureum	*	
	Neptunia dimorphantha		
	Parkinsonia aculeata	WoNS	
	Petalostylis labicheoides		
	Prosopis glandulosa x velutina	WoNS	
	Rhynchosia bungarensis		P4
	Rhynchosia minima		

Family	Name	Weed	Conservation Status
Fabaceae	*Senna artemisioides* subsp *helmsii*		
	Senna artemisioides subsp. *oligophylla*		
	Senna artemisioides subsp *chalelainiana*		
	Senna glutinosa subsp. *glutinosa*		
	Senna glutinosa subsp. *pruinosa*		
	Senna hamersleyensis		
	Senna notabilis		
	Senna venusta		
	Sesbania formosa	*	
	Sesbania cannabina		
	Stylosanthes hamata	*	
	Swainsona formosa		
	Swainsona kingii		
	Swainsona pterostylis		
	Tamarindus indica	*	
	Tephrosia clementii		
	Tephrosia leptoclada		
	Tephrosia rosea var. *clementii*		
	Tephrosia rosea var. Port Hedland (A.S.George 1114)		P1
	Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)		
	Tephrosia sp. Fortescue (A.A. Mitchell 606)		
	Tephrosia sp NW Eremaean (S.van Leeuwen et al PBS 0356)		
	Tephrosia. *supina*		
	Trigonella suavissima		
	Vachellia farnesiana	*	
	Vigna lanceolata		
	Vigna sp Hamerlsey Clay (AA Mitchell PRP113)		
	Vigna triodiophila		P3
Frankeniaceae	*Frankenia ambita*		
	Frankenia pauciflora		
Goodeniaceae	*Goodenia forrestii*		
	Goodenia lamprosperma		
	Goodenia microptera		
	Goodenia stobbsiana		
	Goodenia sp (sterile)		
	Scaevola cunninghamii		
	Scaevola sericophylla		
	Scaevola spinescens (narrow form)		
	Scaevola spinescens (broad form)		
Hemerocallidaceae	*Corynotheca pungens*		
Laminaceae	*Clerodendrum floribundum*		

Family	Name	Weed	Conservation Status
	Clerodendrum tomentosum var *lanceolatum*		
	Vitex trifolia	+	
Lauraceae	*Casssytha capillaris*		
	Cassytha filiformis		
Loranthaceae	*Amyema sanguinea*		
Malvaceae	*Abutilon cunninghamii*		
	Abutilon fraseri		
	Abutilon indicum subsp *australiense*		
	Abutilon lepidum		
	Abutilon sp. (dormant)		
	Brachychiton acuminatus		
	Corchorus ?incanus (sterile)		
	Corchorus parviflorus		
	Corchorus tridens		
	Corchorus walcottii		
	Gossypium australe		
	Gossypium robinsonii		
	Hibiscus austrinus		
	Hibiscus brachysiphonius		
	Hibiscus coatesii		
	Hibiscus sturtii var. *campylochlamys*		
	Hibiscus sturtii var. *platychlamys*		
	Lawrencia viridigrisea		
	Malvastrum americanum	*	
	Melhania obolongifolia		
	Melochia pyramidata	*	
	Sida arsiniata		
	Sida clementii		
	Sida echinocarpa		
	Sida fibulifera		
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)		
	Sida sp (sterile)		
	Triumfetta appendiculata		
	Triumfetta clementii		
	Triumfetta maconochieana		
	Malvaceae 1 (too dried to id)		
	Malvaceae 2 (too dried to id)		
	Waltheria indica		
Marsileaceae	*Marsilea hirsuta*		
Meliaceae	*Khaya senegalensis*[1]	*	
	Owenia reticulata		
Menispemaceae	*Tinospora smilacina*		
Molluginaceae	*Trigastrotheca molluginea*		

Family	Name	Weed	Conservation Status
Moraceae	*Ficus aculeata var indecora*		
	Ficus brachypoda		
	Ficus virens var *virens*		
Myrtaceae	*Corymbia hamersleyana*		
	Eucalyptus camaldulensis		
	Eucalyptus victrix		
	Eucalyptus xerothermica		
	Melaleuca argentea		
	Melaleuca glomerata		
	Melaleuca lasiandra		
	Melaleuca linophylla		
	Osbornia octodonta		
Nyctaginaceae	*Boerhavia ? burbidgeana* (too dormant to id)		
	Boerhavia coccinea		
	Boerhavia gardneri		
	Boerhavia sp		
	Commicarpus australis		
Oleaceae	*Jasminum didymium* subsp *lineare*		
Passifloraceae	*Passiflora foetida*	*HTW	
Phrymaceae	*Mimulus gracilis*		
Phyllanthaceae	*Flueggea virosa* subsp *melanthesoides*		
	Notoleptopus decaisnei		
	Phyllanthus baccatus		
	Phyllanthus erwinii		
	Phyllanthus maderaspatensis		
Pittosporaceae	*Pittosporum phillyrsoides*		
Plantaginaceae	*Stemodia grossa*		
Plumbaginaceae	*Aegialitis annulata*		
	Muellerolimon salicorniaceum		
	Plumbago zeylanica		
Poaceae	*Aristida contorta*		
	Aristida ? hygrometrica (dormant)		
	Aristida inaequiglumis		
	Aristida sp (sterile)		
	Cenchrus ciliaris	*	
	Cenchrus setiger	*	
	Chrysopogon fallax (dormant)		
	Chloris barbata	*	
	Chloris ? pumilio (dormant / sterile)		
	Chloris ? virgata (dormant / sterile)	*	
	Cymbopogon ambiguus		
	Cymbopogon obtectus		
	Cynodon dactylon	*	

Family	Name	Weed	Conservation Status
	Dactyloctenium radulans		
	Dichanthium sericeum subsp. ? humilius (died off)		
	Echinochloa colona	*	
	Enneapogon caerulescens		
	Enneapogon lindleyanus		
	Enneapogon polyphyllud		
	Enteropogon ramosus		
	Eragrostis cumingii		
	Eragrostis dielsii		
	Eragrostis eriopoda		
	Eragrostis falcata		
	Eragrostis setifolia		
	Eragrostis xerophila		
	Eriachne aristidea		
	Eriachne benthamii		
	Eriachne ciliata		
	Eriachne flaccida		
	Eriachne mucronata		
	Eriachne obtusa		
	Eriachne pulchella (died off)		
	Eriachne tenuiculmis		
	Eriachne sp "tall" (sterile)		
	Eriochloa fatmensis		P3
	Eulalia aurea		
	Iseilema ? dolichotrichum (died off)		
	Iseilema ? eremaeum (died off)		
	Iseilema ? vaginiflorum (died off)		
	Panicum decompositum		
	Paraneurachne muelleri		
	Paspalidium clementii		
	Paspalidium tabulatum		
	Setaria verticillata	*	
	Sorghum plumosum		
	Spinifex longifolius		
	Sporobolus australasicus		
	Sporobolus virginicus		
	Themeda sp Hamersley Station (M.E.Trudgen 11431)		P3
	Themeda triandra		
	Triodia angusta		
	Triodia epactia		
	Triodia longiceps		
	Triodia wiseana		

Family	Name	Weed	Conservation Status
	Whiteochloa airoides		
	*Xerochloa ? barbata (*dead)		
	Xerochloa ? laniflora (dead)		
Polygalaceae	*Polygala* aff *isingii* (S Van Leeuwin 999)		
Polygonaceae	*Rumex vesicarius*	*	
Portulacaceae	*Portulaca conspicua*		
	Portulaca intraterranea		
	Portulaca oleracea		
	Portulaca pilosa	*	
Primulaceae	*Aegiceras corniculatum*		
	Samolus sp Millstream		
Proteaceae	*Grevillea pyramidalis* subsp *pyramidalis*		
	Grevillea wickhamii		
	Hakea lorea subsp. *lorea*		
Pteridaceae	*Cheilanthes contigua*		
Rhizophoraceae	*Bruguiera exaristata*		
	Ceriops australis		
	Rhizophora stylosa		
Rubiaceae	*Olenlandia crouchiana*		
	Synaptantha tillaeacea		
Santalaceae	*Santalum lanceolatum*		
Sapindaceae	*Alectryon oleifolius* subsp *oleifolius*		
	Diplopeltis eriocarpa		
	Dodonaea coriacea		
Scrophulariaceae	*Eremophila longifolia*		
	Myoporum montanum		
Solanaceae	*Nicotiana benthamiana*		
	Nicotiana heterantha		
	Nicotiana occidentalis subsp *occidentalis*		
	Solanum cleistogamum		
	Solanum diversiflorum		
	Solanum horridum		
	Solanum lasiophyllum		
	Solanum nigrum	*	
	Solanum phlomoides		
Surinaceae	*Santalum lanceolatum*		
Tamaricaceae	*Tamarix aphylla*	+WoNS	
Thymelaeaceae	*Pimelea ammocharis*		
Typhaceae	*Typha ?domingensis* (sterile)	+	
Verbenaceae	*Lantana camara*	+WoNS	
Violaceae	*Hybanthus aurantiacus*		
Zygophyllaceae	*Tribulus hirsutus*		
	Tribulus occidentalis		

Family	Name	Weed	Conservation Status
	Tribulus platypterus		
	Tribulus suberosus		
	Tribulua terrestris	*	

[1] Planted at the pony club as a shade tree

APPENDIX 4

OPPORTUNISTIC BIRD SIGHTINGS FROM FIELDWORK AND OTHER RELATED SURVEYS

Genus/species Scientific name	Common name	Naturalised	Conservation Status	Comments
Accipiter sp.	Goshawk Sp.			
Acrocephalus australis	Australian Reed-Warbler			
Acticus hypoleucos	Common Sandpiper		IA	^
Amytornis striatus	Striated Grasswren			
Anas gracilis	Grey Teal			
Anas superciliosa	Pacific Black Duck			
Anhinga novaehollandiae	Australasian Darter			
Anthus australis	Australasian Pipit			^
Aquila audax	Wedge-tailed Eagle			
Ardea garzetta	Little Egret			
Ardea modesta	Great Egret			
Ardea novaehollandiea	White-faced Heron			
Ardea pacifica	White-necked Heron			^
Ardeotis australis	Bustard Australian			Carcass only
Arenaria interpres	Ruddy Turnstone		IA	^
Artamus cinereus	Black-faced Woodswallow			
Artamus leucorynchus	White-breasted Woodswallow			
Burhinus grallarius	Bush Stone-curlew			Identification by night calls
Cacatua roseicapilla	Galah			
Cacatus sanguinea	Little Corella			
Cacomantis pallidus	Pallid Cuckoo			
Calidris acuminata	Sharp-tailed Sandpiper		IA	^
Calidris alba	Sanderling		IA	^
Calidris canutus	Red Knot			^
Calidris ferruginea	Curlew Sandpiper		T	^
Calidris ruficollis	Red-necked Stint		IA	^
Calidris tenuiostris	Great Knot		T	^
Centropus phasianinus	Pheasant Coucal			^
Charadrius leschenaultii	Greater Sand Plover		T	^
Charadrius reuficapillus	Red-capped Plover			^
Chrysococcys basalis	Bronze-Cuckoo Horsefield's			Identification by calls only
Colluricincia megarhyncha	Grey Shrike-Thrush			
Coracina novaehollandiae	Black-faced Cuckoo-shrike			
Corvus sp. (bennetti or orru)	Crow (?Little or Torresian)			
Coturnix ypsilophora	Brown Quail			
Cracticus nigrogularis	Pied Butcherbird			
Cracticus torquatus	Grey Butcherbird			
Cygnus atratus	Black Swan			
Dacelo leachii	Kookaburra Blue-winged			
Elanus caeruleus	Black-shouldered Kite			
Elseyornis melanops	Black-fronted Dotterel			^
Emblema pictum	Painted Finch			
Eopsaltria pulverulenta	Mangrove Robin			
Ephippiorhynchus asiaticus	Black-necked stork			^
Eremiornis carteri	Spinifex Bird			
Falco berigora	Brown Falcon			
Falco cenchroides	Nankeen Kestrel			
Fulica atra	Eurasian Coot			

Genus/species Scientific name	Common name	Naturalised	Conservation Status	Comments
Gavicalis virescens	Singing Honeyeater			
Geopelia cuneata	Diamond Dove			
Geopelia striata subsp. Placida	Peaceful Dove			
Geophaps plumifera	Spinifex Pigeon			
Gerygone fusca	Western Gerygone			^
Gerygone tenebrosa	Dusky Gerygone			
Glareola maldivarum	Oriental Pratincole		IA	Near LIA in February
Grallina cyanoleuca	Magpie-lark			
Haematropus longirostris	Pied Oystercatcher			
Haliaeetus leucogaster	White-bellied Sea-Eagle			
Haliastur indus	Brahminy Kite			
Haliastur sphenurus	Whistling Kite			
Hamirostra melanosternon	Black -breasted Buzzard			
Hieraaetus morphnoides	Little Eagle			
Himantopus himantopus	Black-winged Stilt			^
Hirundo sp. ? neoxena	Swallow (?Welcome)			
Hydroprogne caspia	Caspian Tern		IA	^
Laris novaehollandiae	Silver Gull			
Lichenostomus penicillatus	White-plumed Honeyeater			
Lichmera indistincta	Brown Honeyeater			
Limosa lapponica	Bar-tailed Godwit		IA	^
Limosa limosa	Black-tailed Godwit		IA	^
Malacorhynchus membranaceaus	Pink-eared Duck			
Malurus lamerti	Variagated Fairy-wren			
Manorina flavigula	Yellow-throated Miner			
Melopsittacus undulatus	Budgerigar			
Merops ornatus	Rainbow Bee-eater			
Milvus migrans	Black Kite			
Neochmia ruficauda	Star Finch			
Numenius madagascariensis	Eastern Curlew		T	^
Numenius phaeopus	Whimbrel		IA	^
Nymphicus hollandicus	Cockatiel			
Ocyphaps lophotes	Crested Pigeon			
Oreoica gutturalis	Crested Bellbird			
Pachycephala melanura	Golden Mangrove Whistler			
Pachycephala rufiventris	Rufus Whistler			
Pandion cristatus	Eastern Osprey		IA	
Pelecanus conspicillatus	Australian Pelican			
Petrochelidon sp.	Martin (?Fairy or Tree)			
Phalacrocorax varius	Pied Cormorant			
Phalacrocoraz sulcirostris	Little Black Cormorant			
Platalea flavipes	Spoonbill Yellow-billed			
Pluvialis fulva	Pacific Golden Plover			^
Poliocephalus poliocephalus	Hoary-headed Grebe			
Pomatostomus temporalis	Grey-crowned Babbler			
Porphyrio porphyrio	Swamphen Purple			
Ptilonorhynchus maculatus subsp. Guttatus	Western Bowerbird			

Genus/species Scientific name	Common name	Naturalised	Conservation Status	Comments
Rhipidura leucophrys	Willie Wagtail			
Smicrornis brevirostris	Weebill			
Sterna hirundo	Common Term		IA	
Streptopelia chinensis	Spotted Turtle-Dove	*		
Taeniopygia guttata	Zebra Finch			
Thalasseus bergii	Crested Tern		IA	^
Threskiornis spinicollis	Ibis Straw-necked			
Todiramphus chloris	Kingfisher Collared			
Todiramphys pyrrhopygius	Kingfisher Red-backed			
Todiramphys sanctus	Kingfisher Sacred			
Tringa brevipes	Grey-tailed Tattler		P4	^
Tringa glareola	Wood Sandpiper		IA	^
Tringa nebularia	Common Greenshank		IA	^
Tringa stagnatilis	Marsh Sandpiper		IA	^
Xenus cinerus	Terek Sandpiper		IA	^
Zosterops luteus	Yellow White-eye			

APPENDIX 5

AREA DATA ASSESSMENT SHEETS

KARRATHA WEST Figure 3a Sheet 1a

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method) / Management
Rockpiles and Rocky Ranges including Karratha Hills **Figure 3a Sheet 1a** **Area 1/3**	*Rhynchosia bungarensis* (P4)	*Cheilanthes contigua* (Pilbara rock fern)	*Acacia coriacea* *Acacia inaequilatera* *Acacia pyrifolia* *Capparis spinosa* *Corymbia hamersleyana* *Eucalyptus victrix* *Grevillea pyramidalis* *Hakea lorea* *Stemodia grossa* *Triodia epactia*	Yes	Burrup Peninsula rock pile communities (see NOTE below)	Karratha Hills. <5% weeds, example of pristine rock range vegetation; contains PEC and fire sensitive species. Significant landform type 3.2 billion years old making it one of the oldest in the world and older than the Burrup Peninsula (2.7 bill) and contrasting with the surrounding flats which are very recent 20 000 yrs old. Refugia for isolated ecosystems. Refer to Desktop report (VLA 2018) for details of Significance.	Rockpile vegetation (*Erythrina vespertilo* *Acacia coriacea* *FIcus brachypoda* *Ehretia saligna* *Rhagodia eremea* *Capparis spinosa*) Drainage line vegetation	Rock art Grinding patches Midden sites	*****Calotropis procera* (Declared Pest) *****Lantana camara* (WoNS) in rocky gully	Yes – restoration achievable by +Bradley Method +weed control (weeds <5%) and removal of Declared Pest plants +weed, bike and walk trail management plan.
Vegetation Description and Condition	*Grevillea pyramidalis, Acacia inaequilatera* tall open or scattered shrubland over *Triodia epactia* hummock grassland with pocket vegetation of *Brachychiton acuminatus, Terminalia circumalata, Erythrina vespertilio, Acacia coriiacea, Ehretia saligna, Ficus aculeata indecora* low woodland over *Rhagodia eremaea, Jasminum didymum lineare* with scattered *Cymbopogon ambiguous* tussocks. *Terminalia circumalata/Acacia coriacea* in high rocky drainage lines, with *Corymbia hamersleyana* in lower drainage lines. Vegetation Condition: Very Good to Excellent. Buffel grass <1% along edges of tracks and trails and WONS / Declared species 1 off individuals.									
Threats	• Weeds; (loss flora diversity, degraded environment, fire hazard); • Unmanaged walk and mountain bike trails (impact on Aboriginal heritage sites; introduction and spread of weeds; erosion, loss of fauna); • Frequent fire (loss of biodiversity – fire sensitive species, encouragement of fire encouraged weeds and increased fuel load; loss of culturally utilized flora); • Future urban/industrial development (loss of local biodiversity and specific "environmental sense of place")									
Recommendations	• City to develop Weed, Mountain Bike and Walk Trail Management Plans and take responsibility for management of the Karratha Hills • Conduct comprehensive vegetation, flora, fauna and heritage surveys to understand priority and level for management. Biological surveys should also inform the fire management plan for the hills. • Removal of existing weeds as soon as possible, particularly **Calotropis procera* (Calotropis). Calotropis is generally found along floodplains (De Grey and Strelly River plains): Rocky hill slopes are not its usual habitat.									
NOTE	• Burrup Rockpile PECs are considered significant and worthy of protection because they represent remnant Kimberley species, inland Pilbara species, coastal species , southern species and fire sensitive species due to the particular microclimate afforded by the Burrup. Karratha hills are similar in many aspects and the survey confirmed that small pockets of rockpile PECS containing the requisite species types are present in the hills. (To be confirmed with Special Comm Branch)									
Flats – Tussock grassland **Figure 3a Sheet 1a** **Area 5**	Grasslands too dry to assess for this flora	Grasslands too dry to assess for this flora	Not known	Potential	Horseflat land system of the Roebourne Plains (P3) Potentially (too dry to assess) Roebourne Plains coastal grasslands with gilgai microrelief on deep cracking clays (Roebourne Plains gilgai grasslands**)** (P1)	The Priority 1 PEC is poorly represented and has been fragmented and largely removed from the survey area with the clearing for the Gap Ridge LIA development. Refugia for isolated ecosystems.	Fire sensitivity not known	Not present during survey	*****Tamarix aphylla* Tamarisk (WoNS and Declared Pest)	Restoration : N/A Management of development in this area should address rehabilitation and protection of any remaining PEC
Vegetation Description and Condition	Dry season assessment: *Eragrostis xerophila* tussock grassland with ? *Sorghum plumosum, Aristida* sp (both dormant) with patches of *Eriachne benthamii* in depressions. Annual senesced herbland. Vegetation Condition: Excellent – occasional long established tracks.									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method) / Management
Threats	• Destruction for Industrial / Resource development (loss of Priority Ecological Community therefore loss of biodiversity) • Unmanaged tracks (loss of flora, potential introduction of weeds to this currently weed free vegetation, erosion) • Litter									
Recommendations	• Survey tussock grassland areas following adequate rainfall to verify occurrence and extent of the Priority 1 PEC grassland. • Avoid Priority 1 PEC if it does occur there, but if industrial development must occur, survey beyond the area to ensure this PEC is elsewhere represented within the City area • Create formal roads avoiding PECs and manage weeds along these roads.									
Flats – Mosaic tussock grassland and hummock grassland with snakewood shrubs **Figure 3a Sheet 1a** **Area 6**		*Senna glutinosa subsp chatelainiana* *Dolichandrone occidentalis*	*Acacia xiphophylla* (snakewood) *Acacia pyrifolia* (kanji bush) *Hakea lorea* (cork hakea)	Potential		Contains frequent snakewood trees which are old, fire sensitive and utilized by Aboriginal people in town	Chenopod communities *Acacia xiphophylla* (snakewood) *Rhagodia eremaea* *Cynanchum viminale* subsp *australe*	Not present during survey but high potential for artefact scatters	Not present	Restoration : N/A Management of area needs to address threats discussed
Vegetation Description and Condition	Mosaic vegetation of *Acacia xiphophylla* scattered or open low shrubland over *Eragrostis xiphophylla* tussock grassland on clays and *Triodia wiseana / T. epactia* hummock grassland on patches of stony silts. Vegetation Condition: Very Good to Excellent <2% buffel grass but increasing new dirt bike tracks.									
Threats	• Increased off- road vehicle and trail bike tracks (loss of flora, fauna habitat, biodiversity; spread of weeds; erosion). • Litter dumping (potential to introduce disease to flora and fauna; fire hazard) • Degradation of adjacent residential estate (degradation of environment abutting residential areas reduces perceived value of properties there; creates dust and noise and has an overall negative impact) • Future residential development. • Fire management regime which is not understanding of fire sensitivity of the snakewood and chenopod shrubland – both fire intolerant.									
Recommendations	• Management of off-road vehicle tracks and dumping of litter (increase education and environmental awareness) • Review any fire management considering the fire sensitivity to species present.									
Remnant Dune **Figure 3a Sheet 1a Area 12a**	Not present	Not present	N/A	Potential	Remnant	Vegetation on remnant dune habitat fringing Nickol Bay ensures stability of this protective landform during cyclonic surge and extreme events. High tide mark during past cyclones can be observed close to the top of the dune. <10% weeds, closed *Triodia epactia, Eragrostis eriopoda, Whitechloa airoides* grassland fringing chenopods and mangroves. Unusual for coastal grassland to be relatively weed free. Refugia for isolated ecosystems. Refer to Desktop report (VLA 2017) for details of significance.	Fringing chenopod community with *Tecticornia* and *Frankenia* species (fire intolerant) Fringing mangroves *Eragrostis eriopoda*	Midden site Artefact scatter	Not present	Yes: Restoration is achievable. At a minimum management should apply see Recommendations
Vegetation Description and Condition	*Triodia epactia* closed hummock grassland with some *Whiteochloa airoides*. Patchy **Aerva javanica* along tracks. Fringing *Avicennia marina* subsp *marina* low trees with *Tecticornia* species with *Frankenia pauciflora, Lawrencia viridigrisea, Surreya diandra* and *Eragrostis falcata.* Vegetation Condition: Very Good - currently but being impacted by tracks and weeds.									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method) / Management
Threats	• Off-road vehicle and trail bike tracks (loss of flora, fauna habitat, biodiversity; spread of weeds; erosion). Tracks have increased substantially in the past 10 years • Potential for sand mining • Increased erosion caused by off-road vehicles – will compromise the stability of the dune and its protective value • Spread of weeds – currently weeds primarily occur along edges of tracks but are gradually encroaching into the dune proper, degrading this unusual near pristine vegetation. • Litter dumping (potential to introduce disease to flora and fauna; fire hazard)									
Recommendations	• Management of off-road vehicle tracks and dumping of litter (increase education and environmental awareness) • Control existing weeds – this can be easily and cost effectively achieved by spraying from a vehicle mounted spray unit. Implement 5 year Weed Management Plan • Consider fencing off area (include associated Ephemeral Wetland listed below)									
Remnant Wetland **Figure 3a Sheet 1a** **Area 12b**		*Trigonella suavissima* *Pittosoporum phillyreoides* *Cyperus sp* not identified	*Acacia coriacea* *Eucalyptus victrix* *Cyperus bulbosus* *Stemodia grossa*	Potential	Currently nominated and being assessed by Special Communities Branch (DBCA)	Rare remnant ephemeral wetland habitat and vegetation, unusual and diverse range of wetland species present after rain. Linked to Karratha East wetland which is now weed degraded. Unusual ecosystem. Refugia for isolated ecosystems (flora and fauna) Refer to Desktop report (VLA 2017) for details of significance.	*Pittosoporum phillyreoides* *Acacia coriacea* *Ehretia saligna* other wetland species not known.	Artefact scatter Midden on fringes	HTW *Passiflora foetida*	Yes: Restoration +close tracks into wetland and restore using Bradley Method +control weeds with a 5 year Weed Management Plan
Vegetation Description and Condition	*Eucalyptus victrix* low woodland with *Ehretia saligna, Pittosporum phillyreioides, Acacia coriacea,* over *Eulalia aurea, Eriachne flaccida, Eriachne benthamii* tussock grassland with annual sedgeland of *Cyperus sp, Cyperus bulbosus, Cyperus ? hesperius* (too dry to id) over annual herbland of *Goodenia lamperosperma, Trigonella suavissima* and aquatic herb *Marsilea hirsuta.* Vegetation Condition: Very good – currently but there are increasing tracks and dumped litter through the wetland.									
Threats	• Increasing off-road vehicle and bike tracks through this area (loss of unusual wetland ecology and flora diversity, loss of fauna habitat) • Introduction and spread of weeds degrading this unusual vegetation • Increased litter dumping – risk of introducing pests and diseases • Increased use for cutting timber – loss of component flora • Impacts caused by potential sand mining of abutting remnant dune • Anti-social behavior (evidence of drug kits)									
Recommendations:	• Raise public awareness of the biodiversity value of this vegetation • Restore using Bradley Method • Implement 5 year Weed Management Plan. (HTW stinking passionflower is still able to be eradicated at this stage) • Monitor for anti-social and destructive vegetation behavior • Close tracks during and following periods of rainfall. • Regularly check for dumped litter and abandoned vehicles and collect • Consider fencing off the area.									

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Drainage lines and Gullies **Figure 3a Sheet 1a** **Area 13**	*Themeda* sp Hamersley Station (ME Trudgen 11431) (Ally's Creek west of Jingarry only)	*Dolichandrone occidentalis*	*Acacia coriacea* *Acacia inaequilatera* *Acacia pyrifolia* *Capparis spinosa* *Corymbia hamersleyana* *Eucalyptus victrix* *Grevillea pyramidalis* *Santalum lanceolatum* *Stemodia grossa* *Triodia epactia*	Potential	Not Present	Dense woodland along creek banks provides refugia for birds and other fauna. *Santalum lanceolatum* and *Stemodia grossa* in minor drainage line (Allys Creek west of Jingarri) are both significant for Karratha Aboriginal people as can be easily accessed from town Ephemeral pools provide breeding ground for short lived aquatic flora, fauna (fish) and amphibians.	*Acacia coriacea* *Alectryon oleifolius* *Dichrostachys spicata* *Capparis spinosa* Chenopod species	7 Mile Creek as verbalized by Traditional Owners	Mesquite (Horse yard) Tamarisk (Horse yard) 10 other weed species recorded in vicinity of 7 Mile bridge including known threatening species Stinking passionflower Lead tree (100s of seedings and approximately 30 mature trees) Butterly pea vine Tridax and others	Restoration: N/A Management – remove WoNS and Declared Pests and limit spread of all weeds past current boundaries.
Vegetation Description and Condition	• **7 Mile Creek – major drainage line inland** : *Eucalyptus victrix* open woodland over *Acacia coriacea* tall shrubland with *Acacia ampliceps* over *Triodia epactia, *Cenchrus ciliaris, Eulalia aurea* mixed open grassland. There are areas of dense **Passiflora foetida, *Clitoria terneata* vines. Vegetation Condition: Poor to Good depending on weed cover. • **7 Mile Creek – draining into tidal flats area**: *Acacia ampliceps* open tall shrubland with occasional *Avicennia marina* subsp *marina* over *Tecticornia halocnemoides* subsp *tenuis, Frankenia pauciflora* low open shrubland over *Sporobolus virginicus* tussock to closed tussock grassland. Vegetation Condition: Excellent • **Minor drainage channel "Allys Creek" west of Jingarri** : *Acacia coriacea, Santalum lanceolatum, Alectryon oleifolius* tall shrubland over *Stemodia grossa* open herbland over **Cenchrus ciliaris* grassland with patches of *Themeda sp* Hamersley Station (ME Trudgen 11431). There are scattered *Eucalyptus victrix* and *Dolichandrone occidentalis* Vegetation Condition: Very Good – buffel grass dominates grass cover but upper strata vegetation in-tact.									
Threats	• Increased dominance of the many and profuse weeds in 7 Mile creek. Wild passionflower and butterfly pea vine are abundant from 7 Mile Bridge to Madigan Road. Lead tree has 1000s of seedlings and approximately. 30 adult mature trees near 7 Mile bridge and again at Madigan Rd. Mesquite and tamarisk potential to spread further down 7 Mile Creek – legal obligation to remove these. • Increased spread of WoNs and other significant weeds along creek beyond current boundaries, impacting a wider area within the City and reducing natural biodiversity. • Increased "garden escape" weeds in drainage lines in the vicinity of Karratha (includes a variety of palm trees (*Washingtonia filifera, Phoenix dactylifera*, cotton, (*Gossyipium hirsutm,* white button mangrove (*Conocarpus erectus)* and groves of tamarisk (*Tamix aphylla*) • Weeds out-competing native flora leading to loss if diversity. • Introduction of diseases which may harm native flora and fauna.									
Recommendations	• Eradicate WoNS and Declared Pest species and other garden escapes (see Threats) • Ensure other threatening weed species : stinking passionflower, lead tree, butterfly vine, tridax – do not extend beyond current boundaries. Control in areas include borrow pit (Area 6) and from around old sewerage plant (shown on Figure 3a, Sheet 1a)									
Flats – Mosaic tussock grassland with chenopod and hummock grassland with snakewood shrubs **Figure 3a Sheet 1a** **Area 15**	*Atriplex lindleyi* subsp *conduplicata*[1]	*Ptilotus divaricatus* *Senna glutinosa subsp chatelainiana* *Dolichandrone occidentalis*	*Acacia xiphophylla* (snakewood) *Acacia pyrifolia* (kanji bush) *Hakea lorea* (cork hakea)	Potential	Stony Chenopod association of the Roebourne Plains (P1) Horseflat land system of the Roebourne Plains (P3)	Contains 2x PECs as a fine scale mosaic and unusual example of extensive *Triodia longiceps* vegetation. Contains frequent snakewood trees which are old, fire sensitive and utilized by Aboriginal people in town	Chenopod communities *Acacia xiphophylla* (snakewood) *Rhagodia eremaea* *Cynanchum viminale* subsp *australe*	Not present during survey but high potential for artefact scatters	Not present	Restoration : N/A Management of area needs to address threats discussed below ie removal of WoNS species from adjoining borrow pit to protect this area.
Vegetation Description and Condition	Mosaic vegetation of *Acacia xiphophylla* over *Eragrostis xiphophylla* open tussock grassland and / or *Triodia wiseana / T. epactia* open hummock grassland with *Sclerolaena hostilis, S. bicornis, Trianthema turgidifolia* low chenopods over patchy *Eragrostis xerophila* (Chenopod PEC – P1) and areas of *Eragrostis xerophila* closed tussock grassland (Horseflat PEC -P3). Vegetation Condition: Excellent									

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Threats	• Increased off- road vehicle and trail bike tracks (loss of flora, fauna habitat, biodiversity; spread of weeds; erosion). Crab-hole terrain of PECs does help restrict these. • Spread of WoNS species from adjacent old City borrow pit. This old borrow pit has a large population of tamarisk trees and saplings – tamarisk is a WoNS species and must legally be dealt with. There is a risk of this highly invasive species infesting adjacent mosaic grassland flats and 7 Mile Creek which it would quickly choke. • Litter dumping (potential to introduce disease to flora and fauna; fire hazard) • Degradation of adjacent residential estate (degradation of environment abutting residential areas reduces perceived value of properties there; creates dust and noise and has an overall negative impact) • Future residential development. • Fire management regime which is not understanding of fire sensitivity of the snakewood and chenopod shrubland – both fire intolerant.									
Recommendations	• Eradicate tamarisk from old borrow pit (indicated on Figure 3a Sheet 1a) adjacent to this area as per legal requirements as soon as possible • Management of off-road vehicle tracks and dumping of litter (increase education and environmental awareness) • Review any fire management considering the fire sensitivity to species present. • Conduct vegetation mapping after sufficient rainfall to verify occurrence, condition and extent of PECs									

1.Specimen sterile but nominally identified as this species

KARRATHA EAST Figure 3b Sheet 1b

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat / Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Rockpiles and Rocky Ranges including Karratha Hills – includes rocky drainage gully, rock gorge and rockpiles **Figure 3b Sheet 1b Area 1 / 3**	*Rhynchosia bungarensis* (P4)	*Cheilanthes contigua* (Pilbara rock fern) *Dicliptera armata*	*Acacia coriacea* *Acacia inaequilatera* *Acacia pyrifolia* *Capparis spinosa* *Corymbia hamersleyana* *Eucalyptus victrix* *Grevillea pyramidalis* *Hakea lorea* *Stemodia grossa* *Triodia epactia*	Yes	Burrup Peninsula rock pile communities (see comment below)	Karratha Hills. <5% weeds, example of pristine rock range vegetation; contains PEC and fire sensitive species. Significant landform type 3.2 billion years old making it one of the oldest in the world and older than the Burrup Peninsula (2.7 bill) and contrasting with the surrounding flats which are very recent 20 000 yrs old. Isolated refugia for fauna. Refugia for isolated ecosystem Important to Karratha Aboriginal people for many of the plants they currently utilize.	Rockpile vegetation *Brachychiton acuminatus, Erythrina vespertilio, Acacia coriacea, , Brachypoda brachypoda Rhagodia eremea, Jasminum didymum Ptilotus obovatus* Drainage and deep rock gully vegetation Grove large old fire protected *Acacia coriacea.*	Rock Art Midden Site Stone flake artefact site	Not present on Eastern portion surveyed	Yes – restoration achievable by: +Bradley Method +weed control program over 5 years (weeds <5%) +weed control to restore some potential rockpile PECs +close vehicle tracks +remove litter
Vegetation Description and Condition	• *Triodia epactia* hummock grassland with patchy *T. wiseana* and scattered *Acacia bivenosa, A. inaequilatera, A. pyrifolia, Grevillea pyramidalis* on slopes. • *Brachychiton acuminatus, Erythrina vespertilio, Acacia coriacea, Terminalia circumalata, Brachypoda brachypoda* isolated low trees, sometimes in vegetation pocket over *Rhagodia eremea, Ptilotus obovatus, Jasminum didymum linea*re and scattered *Themeda triandra, Cymbopogon ambiguus, *Cenchrus cilaris* on rockpiles and outcrops and on edges of deep rocky gully. • *Stemodia grossa, Corchorus parviflorus* open low shrubland over *Eriachne tenuiculmis* open tussock grassland with patchy *Triodia epactia* and **Cenchrus ciliaris/C. setiger* (2-15%). There are scattered low trees *Erythrina vespertilio, Acacia coriacea* (on areas not burnt) on broad shallow rocky drainage line Vegetation Condition: Very Good – buffel grass varies, some areas are pristine but where there are tracks, trails and disturbance, 2-15% cover recorded. One area of dumped rubbish									
Threats	• Weeds; (loss flora diversity, degraded environment, fire hazard); • Unmanaged walk and mountain bike trails (impact on Aboriginal heritage sites; introduction and spread of weeds; erosion, loss of fauna). • Too frequent fire (loss of biodiversity – fire sensitive species, encouragement of fire encouraged weeds and increased fuel load; loss of culturally utilized flora); • Litter – one lower slope / drainage line area at the base of the hills has been used as a dumping ground for litter. • Future urban/industrial development (loss of local biodiversity and specific “environmental sense of place”) • Loss of very high diversity of species recorded in this area.									
Recommendations	• Have this section of the hills designated as a Nature Reserve to be managed by the City. • Remove litter from lower slopes and incorporate into Nature Reserve • Develop Nature Reserve Management plan (to include weed management, access to rock art and gully site access, promotion of biodiversity value) • Ensure fire management plan allows for fire sensitive species and for full recovery of species between burns.									
NOTE	Burrup Rockpile PECs are considered significant and worthy of protection because they represent remnant Kimberley species, inland Pilbara species, coastal species , southern species and fire sensitive species due to the particular microclimate afforded by the Burrup. Karratha hills are similar in many aspects and the survey confirmed that small pockets of rockpile PECS containing the requisite species types are present in the hills. (To be confirmed with Special Comm Branch)									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat / Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Quartz Rock Ridges **Figure 3b Sheet 1b Area 2**	Not present	Not present	*Acacia coriacea* *Acacia inaequilatera* *Acacia pyrifolia* *Capparis spinosa* *Grevillea pyramidalis* *Hakea lorea* *Triodia epactia*	Potential	Not Present	Isolated and relatively infrequent quartz ridges intrude into the landscape of the survey area. Refugia for isolated ecosystems. Vegetation on the ridge surveyed was not considered significant but one near Cheedatha, was reported to have an "an unusual vegetation type". See Area 2 Roebourne map.	*Ficus brachypoda* (rock fig) *Acacia coriacea* (dogwood) *Enchylaena tomentosa* (ruby salt bush) *Dichrostachys spicata* (pied piper bush)	Scatter site and baler shell	Not present	N/A
Vegetation Description and Condition	• *Grevillea pyramidalis,* with *Acacia inaequilatera, Ehretia saligna* low open woodland with scattered *Ficus brachypoda,* over mixed open low shrubland of *Indigofera monophylla, Acacia maitlandii, Senna glutinosa, Triumfetta appendiculata,* over *Triodia wiseana* open hummock grassland with some *Triodia angusta* and patchy *Eriachne mucronotoa.*tussock grasss on rocky quartz ridge. • *Acacia inaequilatera* tall shrubland over *Triodia wiseana* hummock grassland on hill slope. Vegetation Condition: Excellent <2% buffel grass, no trails or tracks.									
Threats	• Weeds (currently < 2 %) • Unmanaged 4WD tracks									
Recommendations	• Monitor for increased occurrence of threats									
Flats – Mosaic Grassland with scattered shrubs **Figure 3b Sheet 1b Area 6 (marked on original map as 4)**	*Atriplex lindleyi* subsp *conduplicata*[1]	*Senna glutinosa* subsp *chatelainiana*	*Acacia xiphophylla* *Acacia pyrifolia* *Hakea lorea*	Potential	Potential – potential mosaic Chenopod PEC (P1) and Horseflat Roebourne Plains PEC mosaic (timing – dry and time available limited proper evaluation of this area).	Contains frequent snakewood trees which are old, fire sensitive and utilized by Aboriginal people. Relatively widespread.	Chenopod communities *Acacia xiphophylla* (snakewood) *Rhagodia eremea* *Cynanchum viminale* subsp *australe*	Not present during brief survey but highly likely	Not present	N/A – restoration Management of increasing tracks.
Vegetation Description and Condition	*Scleroleana hostilis, S. bicornis* low shrubland or open low shrubland over *Eragrostis xerophila* tussock grass with patches of *Eriachne benthamii* on drainage areas with senesced herbland. Vegetation Condition: Excellent									
Threats	• Increased off-road vehicle and trail bike tracks (loss of flora, fauna habitat, biodiversity; spread of weeds; erosion). Crab-hole terrain of PECs does help restrict these. • Litter dumping (potential to introduce disease to flora and fauna; fire hazard) • Future development (industrial or residential) • Fire management regime which is not understanding of fire sensitivity of the snakewood and chenopod shrubland. Both fire intolerant.									
Recommendations	• Management of off-road vehicle tracks and dumping of litter (increase education and environmental awareness). • Review any fire management considering the fire sensitivity of species present.									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat / Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Drainage Lines and Gullies **Figure 3b Sheet 1b Area 13**	Not present	Not present	*Acacia coriacea* *Eucalyptus victrix* *Capparis spinosa* *Stemodia grossa* *Acacia xiphophylla* **NOTE:** *Lepidium platypetalum* (mustard plant) was recorded further to the west of the drainage line – protection for this small population was requested by Traditional Owners as it is the only source easily accessed in the area.	Potential	Not present	Dense woodland/shrubland providing refugia for abundant birds (recorded), mammals and reptiles. High diversity of species occurring here.	*Acacia coriacea* *Acacia xiphophylla* *Ehretia saligna* *Capparis spinosa*	Not present	**Calotropis procera* (Declared Pest) **Passiflora foetida* (High Threat Weed)	N/A: Implement 5 year weed management plan for Declared and High Threat and other more serious weeds.
Vegetation Description	*Eucalyptus victrix, Corymbia hamersleyana* low woodland over *Acacia coriacea, A. ampliceps, A. trachycarpa* **Calotropis procera* and **Vachellia farnesiana* open tall shrubland over *Myoporum montanum, Scaevola spinescens Capparis spinosa* open low shrubland over **Cenchrus setiger, *C. ciliaris* tussock grassland, **Passilflora foetida* vineland and open herbland including **Malvastrum americanum.* Vegetation Condition: Poor in this creekline surveyed (due to its proximity to the Karratha Light Industrial Area (LIA))									
Threats	• Increased cover and spread of weeds particularly Declared Pest **Calotropis procera* and high threat weed **Passiflora foetida* leading to loss of native flora and decreased diversity. • Weeds spreading beyond creekline (this has already occurred, and dense stinking passionflower was recorded beyond the creek) • Introduction of diseases which may harm native flora and fauna.									
Recommendations	• Remove Declared Pest (**Calotropis procera*) and High Threat weed (**Passiflora foetida*) from creekline and adjacent infested areas. • Monitor for significant increase in other weeds. • Protect area of mustard plant – signage or protective barrier to prevent vehicle impact, litter dumping etc,									
Remnant Vegetation **Figure 3b Sheet 1b Area 14a and 14b**	Not present	Too dry at time of survey	*Acacia coriacea* *Eucalyptus victrix* *Cyperus bulbosus* *Stemodia grossa*	Potential	Not present	14a. Similar to remnant wetland – Karratha west but this area adjacent to the golf club is now very degraded with weeds and its PEC significance lost. IHighlights need to protect Karratha West population) 14b. Extends into Bulgarra and less weed infested vegetation is found between Nairn St and Viveash Way.	*Acacia coriacea* (dogwood) *Ehretia saligna*	Not present during survey	**Calotropis procera* (calotropis) **Jatropha gossypiifolia* (bellyache bush) *Passiflora foetida* vines	14a: N/A Wetland adjacent to golf course – weeds too prolific but Declared, WoNS and HTW should be removed. 14b : Yes - Wetland in Bulgara restore using Bradley Method.
Vegetation Description and Condition	• 14a. *Eucalyptus victrix* open low woodland over closed mixed tussock grassland of *Eriachne flaccida, Eriachne benthamii, Eulalia aurea, Sporobolus virginicus* with **Cenchrus ciliaris (*on track edges). There is a herbland with abundant and diverse weeds – **Trianthema portulacastrum, *Jatropha gossypiifolia, *Tridax procumbens, *Stylosanthes hamata, *Malvastrum americanum, *Aerva javanica* and vines **Passiflora foetida and *Clitoria terneata* on remnant drainage zone adjacent golf club greens. Vegetation Condition: Poor – high diversity of weeds due to proximity to golf course. • 14b. *Eucalyptus victrix* low woodland over tussock grassland of *Eriachne flaccida, Eriachne benthamii, Eulalia aurea, Sporobolus virginicus, Sorghum plumosum.* There is some (<2%) *Cenchrus ciliaris* along edge of path. Vegetation Condition: Excellent.									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat / Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Threats	• Increased number of weeds, increased spread of weeds due to run off from watering and fertilizing golf greens • Spread of weeds, particularly Declared pests and high threat weeds (passiflora) into surrounding vegetation. • Vehicle damage to vegetation and increased risk of weed spread by vehicles driving in to place mosquito baits. • Disease and infestations due to high number and cover of weed species.									
Recommendations	• Control all weeds adjacent to the golf course and remove Declared Pests and high-risk weeds. • Walk mosquito baits to their location rather than access with quad bikes • Control weeds in Bulgarra area and maintain as a conservation area.									
Beaches and Coastal Dunes **Figure 3b Sheet 1b Area 11**	Not present	*Scaevola cunninghamii*	*Capparis spinosa* *Cyperus bulvosus* *Triodia epactia*	Potential	Remnant PEC : Coastal dune native tussock grassland dominated by *Whiteochloa airoides* (only known from Barrow Island but this area of dune could be restored to become the only mainland occurrence)	Dune habitat plays a significant role in protecting Bulgarra from tidal and cyclonic surge events. Remnant PEC which could be restored as one of the only mainland PECs of this type known (to date).	Dune vegetation once burnt is subject to rapid weed invasion.	Not present during survey	Not present	Yes – Bradley method and planting of *Whiteochloa airoedes* and *Scaevola cunnunghamii* undertake in conjunction with a 5 year Weed Management Plan to eradicate weeds.
Vegetation Description and Condition	*Triodia epactia, Whiteochloa airoides* hummock grassland with patchy **Cenchrus ciliaris* and scattered low *Scaevola cunninghamii, S. spinescens* and **Aerva javanica* (10-15%). Vegetation Condition: Good – able to be restored with long term weed control program.									
Threats	• Persisting 4WD tracks (leading to loss of vegetation, spread of weeds, erosion and loss of dune stability) • Dune erosion • Further take over of native species by weed species									
Recommendations	• Continue and extend work that has already been done to formalize protection of this dune • Implement a 5 year Weed Management Plan • Concurrent to the weed eradication program conduct planting program of *Whiteochloa airoides / Scaevola cunninghamii*. • Close off (fence along) base of dune to prevent persistent 4WD tracks over dune. • Consider establishing dune as a conservation area. This would also increase the value of existing look out and walk way along dune as a tourist feature.									

1. Specimen sterile but nominally identified as this species

DAMPIER and BURRUP Figure 4 Sheet 2

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
DAMPIER Remnant rocky lower hill slope **Figure 4 Sheet 2 Area 10a**	*Rhynchosia bungarensis* (P4)	*Pittosporum phillyreoides* *Ficus virens* subsp *virens*	*Acacia coriacea* *Acacia pyrifolia* *Solanum diversiflorum* *Ipomoea costata* *Grevillea pyramidalis* *Hakeo lorea* *Triodia epactia*	Potential	Not present	Refugia for wildlife in town – 15 euros counted utilizing the area and potential for other small marsupial mammals and reptiles. Fragmented habitat providing a small, but complete, natural rocky ecosystem in town.	*Ficus brachypoda* *Acacia coriacea* *Flueggea virosa* *Dichrostachys spicata* *Brachychiton acuminatus*	Not recorded but likely	Not present	Yes suitable for restoration – implement 5 year weed program and Bradley Method.
Vegetation Description and Condition	*Grevillea pyramidalis, Ipomoea costata* tall shrubland over *Indigofera monophyla, Cajanus cinereus, Solanum* spp open low shrubland over *Trioidia epactia* hummock grassland (*Triodia angusta* at the base of the hill slope). There are isolated *Brachychiton acuminatus, Ipomoea costata* on small rockpiles. <5% buffel grass. Vegetation Condition: Very Good – minimum disturbance or weeds									
Threats	• Infestation of weeds found in adjacent remnant stony drainage gully (see below) – loss of native species and biodiversity. Currently this rocky slope is <5% buffel grass and kapok.									
Recommendations	• Buffel grass and kapok on the hill slope are <5% and can still be managed. Implement 5 year weed plan to remove. • Remove high risk weeds from adjacent drainage gully (see below) to prevent infestation of hill slope • Road signs to alert drivers euros are present and may cross to the beach.									
DAMPIER Remnant rocky gully **Figure 4 Sheet 2 Area 10b**	*Rhynchosia bungarensis* (P4)	*Melaleuca argentea*	*Eucalyptus victrix* *Acacia coriacea* *Acacia pyrifolia* *Stemodia grossa* *Ipomoea costata*	Likely	Not present	Refugia for wildlife in town providing shade and moisture – 15 euros counted utilizing the area and potential for other small marsupial mammals, birds and reptiles. High flora species diversity (but also high weed diversity and cover) Fragmented habitat providing a small,l but complete, natural rocky drainage gully ecosystem in town	*Flueggea virosa* *Rhagodia eremaea* *Enchylaena tomentosa* *FIcus brachypoda* *Acacia coriacea*	Not recorded but likely	No Declared / WONS but High Threat weeds present (see Threats)	Can be restored with removal of weeds.
Vegetation Description And Condition	*Terminalia circumalata, Eucalyptus victrix* low open woodland over *Acacia* species mixed tall open shrubland over mixed *Triodia epactia* open hummock and **Cenchrus cilaris, Cymbopogon ambiguus* mixed open tussock grassland and *Cyperus vaginatus* open sedgeland. Vegetation Condition: Poor – many invasive weeds but still retains native vegetation structure.									
Threats	• Increased loss of native species and biodiversity through competition by weeds, particularly high threat weeds : stinking passionflower , California and date palms, tecoma and pepper tree. Weeds are abundant particularly palms and it may not be cost effective at this stage to treat.									
Recommendations	• Weeds in the gully are dense. If resources are available, remove high threat weeds.									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
DAMPIER Remnant drainage zone Figure 4 Sheet 2 Area 10C	*Gymnanthera cunninghamii* (P3) *Rhynchosia bungarensis* (P4)	Not present	*Eucalyptus victrix* *Stemodia grossa* *Ipomoea costata*	Unlikely	Not present	Isolated and unusual ecosystem – now disturbed. Potential to be species rich after rains.	*Gymnanthera cunninghamii* *Acacia coriacea*	Not present	Not present but High Threat weed present	Yes can be restored – weed control and Bradley method
Vegetation Description and Condition	*Eucalyptus victrix* low woodland over *Gymnanthera cunninghamii* (P3) open low open shrubland over open annual (currently dead) annual grassland with **Cenchrus ciiliaris* with scattered *Triodia longiceps* and open, mostly senesced herbs. Vegetation Condition: Poor. Weed species present (total 10-15%) but retains native vegetation structure.									
Threats	• Increased tracks • Illegal camping • Litter • Spread of weeds									
Recommendations	• Five year weed control program to remove stinking passionflower • Close off all tracks into area • Remove litter • Restore using Bradley Method • Unusual vegetation community with population of Priority species that could be developed as a natural, shady picnic / information area.									
DAMPIER Semi Disturbed Drainage line Figure 4 Sheet 2 Area 9	Assessed for weeds only	Assessed for weeds only	Assessed for weeds only	Potential	Not present		Assessed for weeds only	Not present	Tamarisk (WoNS) at pony club area with other exotics	N/A
Threats	• Drainage line south of the “pony club” area is weed free. This section is upstream from the weeds but there is always a risk of spread.									
Recommendations	• Remove WoNS from area.									
BURRUP Rocky Ridge and outcrop high in landscape – Figure 4 Sheet 2 Area 3	*Terminalia supranitifolia* (P3) *Vigna triodiophylla* (P3)	*FIcus virens* subsp *virens* *Pittosporum phillyreoides* *Dicliptera armata* *Eucalyptus xerothermica* *Triodia epactia*	*Acacia coriacea* *Corymbia hamersleyana* *Capparis spinosa* *Ipomoea costata* *Grevillea pyramidalis*	Likely	Burrup Rockpile PEC	Unique and Significant Vegetation (Trudgen 2001) and habitat – much of which is protected by Murujuga National Park	*Acacia coriacea* *Terminalia supranitifolia* *Brachychiton acuminatus* *Pittosporum phullyreoides* *Enchylaena tomentosa* *Ehretia saligna* *Flueggea virosa* *Dichrostachys spicata* *Rhagodia eremaea* *Ptilotus obovatus* *Alectryon oleifolius*	Rock art Middens Scatters	Not present	N/A
Vegetation Description and Condition	Pocket vegetation of *Brachychiton acuminatus, Flueggea virosa, Pittosporum phillyreoides, Acacia coriacea* (sometimes *Erythrina vespertilio)* low woodland with low *Terminalia supranitifolia, Rhagodia eremaea Enchylaena tomentosa, Jasmimum didymum* subsp.*lineare* with scattered *Cymbopogn ambiguous, Triodia epactia.* There can be some **Cenchrus ciliaris* on rockpiles nearer to disturbance. Similar species occur at the base of rocky ridges along with *Corymbia hamersleyana* and in rare instances *Eucalyptus xerothermica* Vegetation Condition: Very Good to Excellent – pockets vary, some have up to 1% buffel grass, others are pristine.									
Threats	• Weeds degrading PECs and replacing high diversity of native species • Future industrial / resource development • Feral cats taking Priority fauna									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Recommendations	• Support Murujuga Aboriginal Corporation with some skill training for managing weeds and vegetation generally and feral cat trapping • Support Murujga to develop areas with tourist potential									
BURRUP **Coastal sand flats** **Figure 4 Sheet 2** **Area 8**	*Gymnanthera cunninghamii* (P3)	*Pittosporum phillyreoides*	*Acacia coriacea* *Ipomoea costata*	Potential	Not present	Coastal sands degraded by buffel grass. *Erythrina vespertilio* (batwing) trees not common and not a common dune vegetation type.	*Acacia coriacea* *Gymnanthera cunninghamii* *Flueggea virosa* *Pittosporum phillyreodies* *Alectryon oleifolius*	Not present during survey but likely	Not Present but HTW **Passiflora foetida* present.	N/A
Vegetation Description and Condition	*Erythrina vespertilio* low open woodland with *Ehretia saligna, Acacia coriacea* over *Phyllanthus baccatus, Ficus aculeata indecora,* shrubland over **Cenchrus cilaris* tussock grassland. Vegetation Condition: Good- it does have buffel grass (60%), stinking passionfruit (HTW) and a track but upper story is in-tact.									
Threats	• Further weed degradation – spread of high threat weed stinking passionflower. Threat of buffel grass totally replacing native ground cover species. • Tracks causing dune erosion and spreading weeds									
Recommendations	• Not on City lease but City could notify RioTinto that this in an unusual coastal vegetation type not replicated elsewhere on the coastline within the study area and that management of weeds, particularly passiflora and tracks should be undertaken **Note:** this Landform protected under objectives of WAPC Statement of Planning Policy No 2.6 (2006) – as such, impacts should be managed.									
BURRUP **Stony hill slopes** **Figure 3 Sheet 2** **Area 4**	*Terminalia supranitifolia* (P3) *Rhynchosia bungarensis* (P4)	*FIcus virens* subsp *virens*	*Acacia coriacea* *Corymbia hamersleyana* *Capparis spinosa* *Ipomoea costata* *Grevillea pyramidalis* *Hakea lorea*	Yes – Disused Pebble Mound Mouse Mounds	Small rockpiles contain Burrup Rockpile PEC and Priority Species vegetation	Unique and Significant Vegetation (Trudgen 2001) and habitat – much of which is protected by Murujuga National Park	*Acacia coriacea* *Terminalia supranitifolia* *Brachychiton acuminatus* *Ehretia saligna* *Flueggea virosa* *Dichrostachys spicata* *Rhagodia eremaea* *FIcus aculeata* var *indecora* *Alectryon oleifolius*	Not present during survey but likely	Not present	N/A
Vegetation Description	*Grevilla pryamidalis* scattered to open tall shrubland, sometimes with scattered *Hakea lorea* subsp *lorea, Ipomoea costata, Acacia inaequilatera* over *Triodia epactia* hummock grassland, sometimes patchy *T. angusta.* There can be open low *Indigofera monophylla* shrubland. There are scattered *Brachychiton acuminatus, Terminalia supranitifolia, Dichrostachys spicata* on small rock outcrops. Vegetation Condition: Very Good to Excellent – only a small percentage of buffel grass long immediate road/track verges.									
Threats	• Spread of weeds into this largely weed free vegetation. • Weeds (buffel and kapok) abundant along gas pipeline and power line corridors – gradually creeping onto hill slopes – will degrade PECs • Unmanaged 4WD tracks.									
Recommendations	• Support Murujuga Aboriginal Corporation with some skill training for managing weeds and vegetation generally and feral cat trapping • Support Murujga to develop areas with tourist potential									
BURRUP **Tidal flats** **Figure 3 Sheet 2** **Area NEW (not shown on map – along City managed Hearson Cove Road)**	*Stackhousia clementii* (only record for this area)	*Tecticornia species*	Not present	Yes – Protected Migratory birds	Not Present	King Bay Tidal inlet is the only one of its kind on the Burrup Peninsula. It contains *Tecticornia* species that have not yet been formally identified at subspecies level.	*Tecticornia* species, *Frankenia ambita* *Lawrencia viridigrisea*	Midden and artefact scatters	Not present	Monitor

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Vegetation Description	*Tecticornia* species dwarf shrubland with fringing **Cenchrus ciliaris, Whiteochloa airoides* tussock and *Triodia epactia* hummock grassland. Vegetation Condition: Good To Very Good – buffel infestation varies.									
Threats	• Future widening or changes to road alignment can impact the Priority species and very poorly represented *Stackhousia clementii* the small population of which (<15 plants) is very close to the road. • Future widening or alignment changes can further spread weeds. • Future widening or alignment changes can impact significant *Tecticornia* species									
Recommendations	• Any future widening or changes to alignment of Hearson Cove road should be pre-empted by a flora survey to ensure rarely occurring Priority and Significant species are not impacted.									

WICKHAM, POINT SAMSON, COSSACK Figures 5 and 6, Sheets 3a and 3b

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ (EPA) Refugia for Isolated ecosystems	Fire Sensitive Vegetation (currently known)	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Coastal Dunes – Point Samson, Wickham **Figure 5 Sheet 3a Area 6a**	None recorded	*Scaevola sericophylla* *Scaevola cunninghamii* *Corynotheca pungens* *Melaleuca lasiandra* (hind dune drainage area)	*Acacia coriacea* *Cyperus bulbosus* *Capparis spinosa* *Santalum lanceolatum*	Yes *Lerista nevinae* only occurs on dunes in this immediate area	Not present	Refugia for Priority Fauna Dunes now fragmented due to development so have become refugia for isolated ecosystems. Particularly dense stands of *Acacia coriacea* on beach north of Point Samson - <5% kapok. *Melaleuca lasiandra /Acacia coriacea* tall shrubland in drainage line behind Wickham back beach dune is a very unusual vegetation type for this habitat.	*Acacia coriacea* *Rhagodia eremea* *Rhagodia preissii* subsp *obovata* *Capparis spinosa* *Cynanchum floribundum*	Midden sites	None recorded	Yes – Point Samson beach dune north of townsite – remove kapok and restore using Bradley Method.
Vegetation Description with Condition	*Acacia coriacea* subsp *coriacea* shrubland to closed shrubland over *Rhagodia preissii* subsp *obovata, Scaevola sericophylla, Scaevola cunninghamii* open low shrubland over mixed *Whiteochloa airoides, Spinifex longifolius, *Cenchrus ciliaris* (<10% - 35%) tussock and *Triodia epactia* hummock open grassland. There is patchy **Aerva javanica* <20% There is a drainage line behind the Wickham back beach dune with *Melaleuca lasiandra/Acacia coriacea* tall shrubland over mixed *Triodia epacia* hummock and **Cenchrus ciliaris* tussock grassland. Vegetation Condition: Good – generally moderately dense weed cover and tracks (excluding beach north of Point Samson - <5% weeds)									
Threats	• Tracks over dunes – (weed spread, new weed introduction, damage vegetation, erosion and loss of Priority fauna *Lerista nevinae* habitat) • Camping, weeds, rubbish and toilet usage on Wickham back beach – degrades habitat and is a health risk • Fire – destroying fire sensitive stands of dense *Acacia coriacea* on dunes. • Future residential / industrial development – further loss of the already fragmented *Lerista nevinae* habitat. • Sand mining • Rubbish and use as toilet – rubbish into the ocean, unsanitary and unhealthy environment.									
Recommendations	• Restore section of beach north of Point Samson by controlling kapok (5 year weed plan) and using Bradley Method • Close off unnecessary tracks • Any fire management regime must carefully consider the known fire sensitive plant species and the fact this is very restricted P1 fauna habitat. • City is undertaking some dune restoration at Wickham boat ramp beach – revegetation and closing of tracks – monitor • Implement 5 year weed management plan on these protected dunes and use Bradley Method once weed seed load is diminished. Help process by planting *Whiteochloa airoides / Spinifex longifolus/ Eulalia aurea* • Monitor other dunes for increased tracks. • Raise public awareness about rubbish (plastics / ocean; toilet and toilet paper / unhygienic etc) Note: this Landform protected under objectives of WAPC Statement of Planning Policy No 2.6 (2006)									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ (EPA) Refugia for Isolated ecosystems	Fire Sensitive Vegetation (currently known)	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Remnant Dune – Point Samson **Figure 5 Sheet 3a** **Area 6b**	*Tephrosia rosea* var Port Hedland (A.S George 1114) (P1)	*Scaevola sericophylla* *Scaevola cunninghamii*	*Acacia coriacea* *Santalum lanceolatum* (relatively abundant and a known source of bush plum for local Ngarluma ladies) *Triodia epactia*	Potentially *Lerista nevinae* habitat	Not Present	Potential isolated habitat for Priority Fauna Isolated remnant dune habitat. *Santalum lanceolatum* is harvested here by Roebourne Aboriginal people.	*Acacia coriacea* *Rhagodia eremea* *Rhagodia preissii* subsp *obovata*	None recorded but likely	None recorded	Potential to restore – formalizing tracks and controlling kapok and buffel grass over a 5 year plan. Indicated as look out point for mangal in City Structure Plan (2015)
Vegetation Description and Condition	*Acacia coriacea* subsp *coriacea* tall shrubland over *Scaevola spinescens, Scaevola sericophylla, Santalum lanceolatum* open shrubland over mixed **Cenchrus ciliaris* (50%), *Whiteochloa airoides* tussock and *Triodia epactia* hummock grassland. There is patchy **Aerva javanica* (5%). Vegetation Condition: Good – it has relatively dense buffel grass but upper storey does not contain weeds. Tracks are well established and no new tracks evident.									
Threats	• Increase in tracks (further spread of weeds, erosion) • Weeds outcompeting the native species that currently remain there including Priority 1 *Tephrosia rosea* var Port Hedland. Kapok in particular being in the same vegetation strata as the Priority species is a threat. **Note**: this Landform protected under objectives of WAPC Statement of Planning Policy No 2.6 (2006)									
Recommendations	• Formalise existing tracks • Initiate viewing point over mangroves • Initiate 5 year weed control as a minimum for kapok and Bradley method restoration.									
Mangal – Point Samson **Figure 5 Sheet 3a** **Area 7a**	None present	None recorded during brief survey but may be present	N/A	Migrant and protected waders	Not Present	Very dense mangal system with 4 and potentially 6 species present (too dense to enter). Protected by EPA Guidance Statement 2001	Potentially all mangrove species	N/A	None Present	N/A
Vegetation Description and Condition	*Avicennia marina* subsp marina / *Rhizophora stylosa* dense mangrove forest with some *Ceriops australis.* Potentially other species – mangal not searched. Vegetation Condition: Excellent									
Threats	• Insufficient knowledge relating to mangrove ecosystem here – (no dedicated field survey for mangrove species and fauna have been undertaken at Point Samson, desktop only). Without knowledge of this mangrove system it is difficult to predict any potential negative biodiversity impacts if any development (marina) occurs in future.									
Recommendations	• Field surveys if area is to be impacted at all in the future. Note: Protected by Guidance Statement for Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline EPA 2001									
Mangal - Cossack **Figure 6 Sheet 3b** **Area 7b**	None present	*Osbornia octodonta* (Myrtle Mangrove	None recorded	Potential – sea birds and waders	None Present	This population of mangroves is referenced as significant because it is one of the only Pilbara populations to contain 7 mangrove species.	Potentially all mangrove species	None recorded	None recorded	N/A
Vegetation Description and Condition	*Avicennia marina* var *marina, Rhizophora stylosa, Aegialitis annualta, Ceriops australis* with occasional *Bruguiera exaristata, Aegiceras corniculatum* and *Osbornia octodonta*. Vegetation Condition: Excellent									
Threats	• Impacts / spills / run off from any changed landform with development of Cossack									
Recommendations	• Any re-development of Cossack must carefully address landform changes which may indirectly impact the mangal here.									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ (EPA) Refugia for Isolated ecosystems	Fire Sensitive Vegetation (currently known)	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Coastal – Headland and associated remnant dune Point Samson Figure 5 Sheet 3a Area -9	*Tephrosia rosea* var Port Hedland (A.S George 1114) (P1)	*Corynotheca pungens* *Scaevola cunninghamii* *Scaevola sericophylla*	*Santalum lanceolatum* *Acacia pyrifolia* *Acacia coriacea* *Grevillea pyramidalis*	Probably *Lerista nervinae* on remnant dune	Not Present	Refugia for Priority *Lerista nervinae* and sea birds. Priority 1 species and small dense populations of *Corynotheca pungens* which is a significant species being a new record for the survey area make this a significant vegetation type.	*Rhagodia preissii* *Acacia coriacea* *Cynanchum viminale*	Not recorded but possible.	None Present	Yes – limit tracks, 5 year weed plan and restore using Bradley Method.
Vegetation Description and Condition	*Acacia stellaticeps* with *Scaevola spinescens* (broad from) and *Goodenia stobsianna* low shrubland, sometimes with dense populations of *Corynotheca pungens* over *Triodia epactia* and *Triodia* sp hummock grassland over mixed. Vegetation Condition: Very Good – low buffel cover, only occurs along tracks but too many tracks.									
Threats	• Mining – already occurs on the red sands at neck of the hedland (Sams Creek side) • Further spread of weeds – weeds are not present on the rocky part of the hedland. They do occur along the edges of the track on the remnant dune and have a small percent cover in the sand vegetation. • Unmanaged tracks – there are many tracks over the hedland, which could be reduced to prevent weed spread and erosion									
Recommendations	• Close sand mine if possible – and / or ensure it does not extend further. • Formalize two access tracks to end of hedland and close off the others. • Initiate a 5 year weed management plan. • Restore sand area with *Tephrosia rosea* var Port Hedland (A.S George 1114) (P1) and *Corynotheca pungens*									
Remnant low stony hill "island" surrounded by tidal flat Figure 5 Sheet 3a Area -10	None Present	None present	*Triodia epactia*	No	Not Present	Isolated ecosystem of Hard spinifex grassland (*T. wiseana/ T. longiceps*) with open herbland – not highly diverse.	*Trianthema turgidifolia*	Midden site	None Present	N/A
Vegetation Description and Condition	*Triodia wiseana, T.? longiceps (*sterile) hummock grassland with patchy *Triodia epactia* over open mixed herbland. Vegetation Condition: Very Good – old mining pits evident but regrown									
Threats	• Mining – old test pits present • Introduction of weeds (none currently present)									
Recommendations	• No immediate action – monitor for degradation.									
Rock ridges, high rock outcrops and stony slopes (volcanic, quartz, shale, siltstone) Figure 6 Sheet 3b Area 1/2a	None recorded	*Dodonaea coriacea* *Polygala* aff *insingii*	*Acacia inaequillatera* *Corymbia hamersleyana* *Hakea lorea* *Grevillea pyramidalis*	High potential for Quolls and Bats	Not Present	Locally represented in area	*Dodonaea coriacea* *Ptilotus obovatus*	None recorded	*Passilora foetida* was recorded at the mouth of a cave -High threat weed	N/A
Vegetation Description and Condition	*Triodia epactia* hummock grassland with patchy *Triodia wiseana.* There are scattered *Acacia bivenosa Acacia orthocarpa, Senna glutinosa* shrubs and *Corymbia hamersleyana* low trees. On rock outcrops: Scattered or individual *Ficus brachypoda, FIcus aculeata* var *indecora, Ehretia saligna, Grevillea pyramidalis* with scattered *Cymbopogon obtectus, Triodia epactia* hummocks. Vegetation Condition: Excellent									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ (EPA) Refugia for Isolated ecosystems	Fire Sensitive Vegetation (currently known)	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Threats	• Weeds along base of hill where there is current old disused infrastructure, tracks and buildings – can spread up hill slope which is currently almost entirely weed free • 1 x stinking passionflower vine at mouth of cave high in landscape – will spread. • Future mining and development									
Recommendations	• Address ownership of old infrastructure and buildings, remove, close off area. • Monitor for degradation • Survey for quoll presence and threatened bats									
Rock ridges, high rock outcrops and stony slopes (basalt and dolerite) **Figure 6 Sheet 3b** **Area 1/2b**	*Rhynchosia bungarensis* (P4)		*Acacia coriacea* *Capparis spinosa*	Potential	"Burrup" Rockple PEC (geology of this ridge system matches the Burrup) Species composition equates to Burrup Rockpile PEC. Minor degradation with buffel grass.	Pocket rockpile vegetation provides refugia for fire sensitive species and fauna.	*Ficus brachypoda* *Acacia coriacea* *Rhagodia eremaea* *Ptilotus obovatus*	None recorded	None Present	N/A
Vegetation Description and Condition	Rock pocket vegetation of :*FIcus brachypoda, F. aculeata, Ehretia saligna, Clerodendrum tomentosa, Acacia coraicea, Rhagodia eremaea, Capparis spinosa* with *Jasminum didymium lineare and Ptilotus obovatus.* Scattered *Cymbopogon* spp and **Cenchrus ciliaris* tussocks Vegetation Condition: Excellent to Very Good – when buffel present it is <2%									
Threats	• Weeds from area surrounding hills (degradation and loss of native species and PECS0 • Mining, development									
Recommendations	• No immediate action - Monitor for degradation									
Drainage Lines and Gullies **Figure 6 Sheet 3b** **Area 8**	None recorded	*Clerodendrum floribundum*	*Solanum diversiflorum* *Corymbia hamersleyana* *Acacia coriacea* *Acacia inaequilatera* *Capparis spinosa* *Triodia epactia*	Potential	None present	Drainage line vegetation provides refugia for all fauna and for diverse range of species. Drainage lines have varied dominant species due to fire..	*Acacia tenuissima* *Acacia coriacea* *Capparis spinosa*	None recorded by likely	None present	N/A
Vegetation Description and Condition	• *Gossypium robinsonii* shrubland over *Indigofera monophylly / Corchorus parviflorus* low shrubland over *Triodia epactia* hummock grassland. • *Corymbia hamersleyana* open or scattered low woodland over *Acacia tumida/Acacia ancistrocarpa* tall shrubland over *Scaevola spinescens* (broad form), *Indigofera monophyla, Corchorus parviflorus* low shrubland to open low shrubland over *Triodia epactia* hummock grassland with patchy to moderate **Cenchrus ciliaris.* (2-35%) • *Acacia inaequilatera/A. ancistrocarpa* open tall shrubland over *Acacia stellaticeps* how shrubland over *Triodia epactia* and *Triodia schinzii* hummock grassland and herbs. Vegetation Condition: Very Good to Good, depending on frequency of fire impacting shrub structure and density of buffel grass.									
Threats	• Numerous tracks through the area intercepting drainage line and gullies (weed spread, erosion) • Litter – rubbish dumping • Too frequent fire.									
Recommendations	• No immediate action – Monitor for degradation. • Conduct public awareness campaign to highlight negative impacts of rubbish dumping. (See NSW "Don't be a Tosser" campaign)									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ (EPA) Refugia for Isolated ecosystems	Fire Sensitive Vegetation (currently known)	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Sand Plain **Figure 6 Sheet 3b** **Area 11**	None recorded	*Polygala* aff *insingii* *Bonamia alatesimina* *Clerodendrum floribundum* *Heliotropium transforme* *Triodia schinzii* *Acacia sabulosa* *Dolichandrone occidentalis*	*Acacia inaequilatera* *Corymbia hamersleyana* *Triodia epactia* *Grevillea pyramidalis* *Hakea lorea*	Potential (reptile)	None present	Poorly represented landform in City area. This sand plain is part of the Uraroo Land system and is very limited in its occurrence in the study area. This means the vegetation represented on it is also limited and therefore locally significant.	*Eragrostis eriopoda* *Carissa lanceolata* (frequent fire has depleted fire sensitive species expected in this habitat).	None recorded but likely	None recorded	Monitor – and consider one area for restoration.
Vegetation Description and Condition	*Triodia schinzii* and *Triodia epactia* hummock grassland. There are scattered *Acacia ancistrocarpa, Senna oligophylla, Acacia sabulosa, Acacia stellaticeps, Corymbia hamersleyana.* Vegetation Condition: Excellent									
Threats	• Unmanaged tracks • Rubbish dumping • Too frequent fire – fire encouraged natives dominate vegetation									
Recommendations	• Poorly represented landform – monitor for degradation • Any fire management should carefully consider a full inventory of fire sensitive species (now very poorly represented) and consequent loss of biodiversity with dominance of a few fire encouraged plants.									
Sand Cheniers **Figure 6 Sheet 3b** **Area 5**	None Recorded	None recorded	None recorded	Potential	None present	Restricted vegetation type of dense mixed *Triodia epactia* hummock and *Eriachne obtusa* tussock grass with low shrubland of *Swainsona pterostylis* and *Ptilotus polystachys* with other herbs and mixed sedgeland. High species diversity. Locally significant	*Eragrostis eriopoda* other species not known but presence of *Acacia stellaticeps* would mean that after a fire the herbland would be largely replaced with this shrub.	Potential but not recorded	None recorded	N/A
Vegetation Description and Condition	Mixed *Triodia epactia* hummock and *Eriachne obtusa* tussock grassland over mixed herbland with low annual shrubland of *Swainsona pterostylis, Ptilotus polystachys* and annual sedges *Bulbostylis barbata, Cyperus bulbosus.* Both **Cenchrus ciliaris* and **C. setiger* are present but low percent cover (10%) due to the density of the other grass and herb species. Vegetation Condition: Very Good									
Threats	• Protected by tidal flats but increased tracks is a potential threat • Buffel and birdwood grass are present in low numbers – any disturbance would encourage spread. • Sand mining									
Recommendations	• No immediate action – monitor for any degradation.									

ROEBOURNE Figure 7 Sheet 4

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat / Refugia for Isolated ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Semi Saline flats with patchy stone mantle Chenopods and open Tussock grassland **Figure 7 Sheet 4 Area 7**	Not present	*Atriplex bunburyana*	Not present	Potential	Stony Chenopod association of the Roebourne Plains area (P1)	Stoney Chenopod PEC (P1) saline clay plains with pebbles and cobbles – isolated ecosystem	*Atriplex bunburyana* Chenopod species generally	Scatter and Midden	Not present	Monitor
Vegetation Description and Condition	*Sclerolaena hostilis, Sclerolaena* sp (sterile), *Atriplex bunburyana* scattered shrubs or low open shrubland over *Eragrostis xerophila* open tussock grassland. Vegetation Condition: Very Good – tracks through area									
Threats	• Weeds occur where past disturbance has occurred and along the track leading to the old Roebourne airport and associated infrastructure. There is a risk these can spread into this PEC and degrade it. • Scalds due to disturbance in the past (and probably sheep grazing) dominate the area. These will increase if species decrease due to new disturbances and tracks. • New tracks and clearing for new developments									
Recommendations	• Monitor for increased spread of weeds into the PEC. • Close off unused tracks to the airport.									
Weakly gilgaied flats with scattered stones **Figure 7 Sheet 4 Area 5**	Not present	*Atriplex bunburyana*	Not present	Potential	Potential Horseflat land system of the Roebourne Plains P3 Ecological Community (confirm following rain)	Significant because this vegetation community had become rare by the late 1970s due to sheep grazing. Revegetation by Dept of Agriculture and a lack of sheep grazing has now restored the vegetation again. No weeds were recorded in this vegetation giving it high conservation value. Diverse herbland.	*Atriplex bunburyana* Chenopod species generally	Not recorded	Not present	N/A
Vegetation Description and Condition	*Atriplex bunburyana* scattered shrubs or low shrubland over *Eragrostis xerophila* tussock grassland to closed tussock grassland over open herbland. Vegetation Condition: Very Good, tracks through area, <2% buffel grass									
Threats	• New tracks leading to scalds and erosion									
Recommendations	• Monitor for any degradation									
Drainage Zones/ Depressions over cracking and non cracking red clays. **Figure 7 Sheet 4 Area 10**	*Eriochloa fatmensis*	Not present	Not present	Potential	Horseflat land system of the Roebourne Plains (Horseflat U7) P3 when buffel grass is not dense.	Isolated drainage depressions on flats - Refugia for isolated ecosystems with dense tussock and sedgeland.	Not known	Not present	Mesquite (WoNS and Declared Pest) in one depression.	Monitor

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat / Refugia for Isolated ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Vegetation Description and Condition	*Eriachne benthamii, Chrysopogon fallax, Eragrostis xerophila* tussock grassland or closed tussock grassland, can have patchy **Cenchrus cliaris* over open sedge and herbland. Vegetation Condition: Very Good to Good – some areas have more dense buffel and one area had mesquite (WONS species)									
Threats	• Some buffel grass invasion in some areas. One area where *Prosopis sp. (mesquite) was found. Weed invasion of uninfested areas may occur. • Future development in area may remove this PEC.									
Recommendations	• Remove mesquite and monitor for persistence.									
Harding River **Figure 7 Sheet 4 Area 9**	Not present	*Melaleuca argentea* *Melaleuca lasiandra*	*Melaleuca argentea* *Melaleuca lasiandra* *Acacia coriacea* *Capparis spinosa* *Eucalyptus victrix* *Eucalyptus camaldulensis* *Stemodia grossa* *Triodia epactia*	Potential	Not present but the very dense mat-like *Sporobolus virginicus* grassland present is currently being assessed as a PEC.	Locally significant vegetation – tall, dense woodland in an arid environment provides refugia for fauna and for isolated ecosystem.	*Acacia coriacea* *Acacia tenuissima* *Amyema* sp *Dichrostachys spicata* *Ehretia saligna*	The river itself is an Aboriginal sacred.site	**Parkinsona aculeata* (WoNS and Declared Pest) *Phoenix dactylifera* (date palm – of concern to TOs see Threats)	Restoration – section of river in Roebourne townsite – remove all weeds. Beyond town site control WoNS and High Threat weeds (stinking passionflower) and weed rarely found in area – * *Melochia pyramidata* goats head burr.
Vegetation Description and Condition	• *Eucalyptus victrix, E. camaldulensis, Melaleuca argentea* low woodland over mixed *Acacia trachycarpa, A. ampliceps, Melaleuca glomerata* (**Parkinsonia aculeata* – treated) tall open shrubland over mixed *Chrysopogon fallax, Eulalia aurea, Aristida* sp **Cenchrus ciliaris* tussock and *Triodia angusta* hummock grassland / closed grassland over open herbland *Goodenia lamprosperma, Streptoglossa ssp.*. Open vines of **Passiflora foetida*. (south of Roebourne) Vegetation Condition: Good - high diversity of weed species but retains in-tact upper and mid-level vegetation. (WONS Parkinsonia is treated) • *Eucalyptus victrix* low open woodland over *Melaleuca glomerata* shrubland over *Eriachne flaccida* and **Cenchrus ciliaris* open tussock grass and open *Cyperus vaginatus, Schoenoplectus sabulatus* sedgeland. Can be dense patches of *Tecticornia indica* subsp ? *leiostachya* (no seeds) (in town) Vegetation Condition: Good – depending on weed density - does have buffel grassland with other species but upper and mid-level strata are in tact.									
Threats	• High number of weeds – will spread down river and into adjacent low areas – loss of native flora and diversity. There is a particular concern regarding the *Phoenix dactylifera* (date palm) which is rapidly spreading both north and south along the river system. This species replaces larger native trees along the river and concern has been raised about its presence several times by Roebourne TOs (Bigali Hanlon, Pansy Hicks) • Spread of diseases through weed abundance • Litter, glass and other rubbish – safety hazard where river is used for swimming									
Recommendations	• Control WoNS and High Threat weeds • Control **Melochia pyramidata (*goats head burr) • Monitor spread of WoNS and High Threat weeds beyond known populations • Remove rubbish from swimming areas and raise public awareness about litter dumping.									
River Flats **Figure 6 Sheet 4 Area 8**	Not present	Not present	*Triodia epactia*	Potential	Not present	Good example, <10% buffel grass, of mixed tussock (*Chrysopogon fallax)* and hummock *(Triodia epactia*) grass and herbland on red loamy earths.	Not known	River banks are considered part of the river sacred site. Broken baler shells found.	Not present	N/A
Vegetation Description and Condition	*Triodia epactia* hummock and *Chrysopogon fallax* tussock mixed grassland over mixed annual herbland. Vegetation Condition: Excellent									

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat / Refugia for Isolated ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Threats	• Tracks • Litter									
Recommendations	• Monitor condition									
Low Hills **Figure 7 Sheet 4** **Area 1/3**	Not present	Not present	*Acacia inaequilatera* *Hakea lorea* *Triodia epactia*	Potential	Not present	Good example of weed free hill slope vegetation	Not present	Not recorded	Not present	N/A
Vegetation Description and Condition	*Triodia wiseana* hummock grassland. Scattered shrubs, *Acacia inaequilatera, A. orthocarpa, Hakea lorea, Grevillea wickhamii.* Patchy *Triodia epactia.* Vegetation Condition: Excellent									
Threats	• Various tracks through the area may introduce weeds from nearby infested areas • Occasional rubbish dumps • Unlicensed prospectors									
Recommendations	• Monitor for degradation									

NICKOL RIVER Figure 8 Sheet 5

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat/ Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Riparian Zone - banks and stony bed of Nickol River **Figure 8 Sheet 5** **Area 1**	Not present	*Samolus* sp Millstream	*Stemodia grossa* *Eucalyptus victrix* *Acacia coriacea*	Potential	Not present	Isolated wooded ecosystem surrounded by treeless plains – refugia for fauna and flora. Significant record of *Samolus* sp Millstream being very poorly represented in the Pilbara generally and not previously in the study area.	*Capparis spinosa* *Acacia coriacea*	Not present in area surveyed but likely along this river	HTW **Passiflora foetida* See Threats	N/A
Vegetation Description and Condition	Open low woodland of *Eucalyptus victrix* over tall, sometimes closed shrubland of *Melaleuca glomerata, Melaleuca linophylla* over open mixed tussock grassland and sedgeland. Areas of dense **Clitoria terneata* weed vines. Vegetation Condition: Good to Very Good – condition varies, deteriorating near bridge where there is rubbish and weeds.									
Threats	• Weeds – there are some serious weeds in the Nickol River at the bridge (NWCH) including butterfly pea, typha (here classified as a weed because of its weedy tendencies) and sirato. The latter, sirato has not been recorded outside drainage lines in Karratha in this area previously. There is a risk that these weeds will spread further along or beyond the river especially with a flood event. Weeds could outcompete the *Samolus* sp Millstream which is considered a significant species due to its rarity in the Pilbara. • Tracks through the river at the bridge – spread of weeds • Litter dumping									
Recommendations	• Weed control program over 5 years to eradicate stinking passionflower, butterfly pea, typha and sirato.									
Remnant very low shale quarts/chert hillocks surrounded by river and tidal flats **Figure 8 Sheet 5** **Area 5**	Not present	Not present	*Grevillea pyramidalis* *Acacia coriacea*	Unlikely	Not Present	Hillocks had been partially burnt but normally provide an isolated refugia for both flora and fauna ecosystem and represent old eroding landform.	*Acacia coriacea* *Enchylaena tomentosa* *Ptilotus obovatus* *Ficus brachypoda* *Rhagodia eremaea* (These species were found on unburnt rocks but not on burnt slope)	Not present in survey area but there were large ,dense midden sites on the surrounding tussock grassland areas.	Not present	N/A
Vegetation Description and Condition	Fire regenerating open *Triodia epactia* over open mixed herbland with pockets of *Ficus brachypoda, Acacia coriacea, Eremophila longiflora, Clerodendrum tomentosum, Rhagoda eremaea* on unburnt rockpiles. Vegetation Condition: Regenerating after fire but appears Very Good									
Threats	• Tracks • Mining • Fire • Increase in weeds due to frequent fire (currently<2% weeds)									
Recommendations	• Monitor for further degradation									

MAITLAND RIVER (Miaree Pool) Figure 9b Sheet 6b*

Landform / Map Ref	Priority Flora (DBCA)	Locally Significant Flora (Florabase DBCA)	Culturally Significant Flora	Habitat for Priority or Threatened Fauna	Priority Ecological Community	Locally significant Vegetation/ Habitat /Refugia for Isolated Ecosystems (EPA)	Fire Sensitive Vegetation	Aboriginal Heritage Sites recorded on survey	Declared Pests/WONS	Suitable for Restoration (Bradley Method)
Riparian Zone – banks of Maitland River at Miaree Pool south of NWC Highway **Figure 9b Sheet 6b** **Area 1**	Not present during survey but likely to be present after rain.	*Melaleuca argentea*	*Stemodia grossa* *Capparis spinosa* *Melaleuca argentea* *Eucalyptus victrix* *Acacia pyrifolia* *Acacia coriaceae*	Likely	Not Present	The tall, dense, diverse, riparian vegetation of the Maitland river creates significant habitat and particularly so, due to the permanent water at Miaree Pool. This creates refugia for an observed high diversity of bird species and no doubt for other fauna and reptiles.	*Amyema sanguinea* *Acacia coriacea* *Capparis spinosa* *Ehretia saligna*	The river itself is a Sacred Site.	**Parkinsonia aculeata* (WoNS) (appeared to be treated – monitor) **Passiflora foetida* (HTW) (see Threats for Stylo and *Indigofera oblongifolia)*)	Yes 5 Year weed management plan, close off tracks and Bradley Method
Vegetation Description and Condition	Low open forest of *Eucalyptus camaldulensis, Melaleuca argentea, Sesbania formosa* over tall shrubland of *Acacia ampliceps A. trachycarpa,* (**Parkinsonia aculeata* - treated) over mixed low tussock grassland of **Cenchrus ciliaris, *C. setiger, Sporobolus virginicus* with occasional patches of **Cynodon dactylon* (couch) with sedges at the waterline *Cyperus vaginatus, Schoenoplectus sabulatus, Typha* sp. Vegetation Condition: Good – erosion and tracks, weed cover varies but basic vegetation structure is in-tact.									
Threats	• Numerous tracks to edge of water have been created leading to deep erosion of river bank, loss of native flora particularly along the river bank and spread of weeds • Dense weeds on west-north-west side of river – loss of native vegetation and further spread by vehicles and cattle. Particularly of concern is the stylo and *Indigofera oblongifolia* which should be controlled along with the Declared and WoNs weeds. • Litter and scattered camp fire places • Spread of WoNS and HTW species via vehicles to other City areas beyond the river especially with a flood event. • Increase in density of typha (bulrush) which is thought to be native but designated as a “weedy native”. This species is increasing rapidly and choking pools throughout the Pilbara. • Cattle disturbing soils (erosion) and eutrophication of soils and waterway (leads to algae and subsequent mortality of native aquatic weeds) • Continued use of river bank as a toilet despite City providing long-drop toilets – hygiene risk.									
Recommendations	• Develop Five Year Management Plan for weed and erosion control. There is a high diversity of weeds in the vicinity of Miaree Pool. Of note are **Stylosanthes hamata* (stylo) and *Indigofera oblongifolia* which have the ability to outcompete and totally replace native ground cover and shrub species. The latter destroys pastoral land. Kapok is very dense on the WNW side of the river – needs to be controlled to prevent total loss of native vegetation which is currently sparse. Research safest methods to cull typha. • The HTW, stinking passionflower and the stylo and *Indigofera monophyla* weed should be controlled. Parkinsonia appeared to have been treated but this will need to be followed up with repeated control efforts over 5 years before eradication is achieved. • Tracks leading down to the edge of the water should be closed. These tracks are causing erosion of the river banks themselves and dust bowls along the river edge due to loss of grassy bank area which families should be able enjoy without vehicles. • Fencing – this especially applies to the northern side of the river where it was obvious that cattle were significantly damaging the public space on the river bank and also that the public were entering the pastoral lease to access further along the river. • Raise awareness about the health issues of using the river bank for a toilet instead of toilets provided.									

*Due to access issues areas delineated on Figure 9a Sheet 6a could not be surveyed.