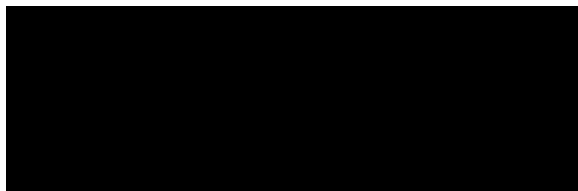
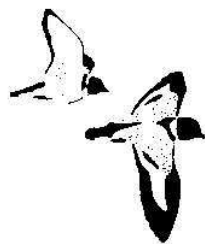
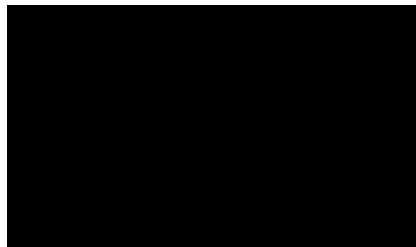


## **Fauna Assessment of the Broome Port Area**

Prepared for:



Prepared by:



22<sup>nd</sup> January 2010

## **EXECUTIVE SUMMARY**

The Broome Port Authority (BrPA) manages the Port of Broome, located approximately 2200 km north north-east of Perth and the largest port within the Kimberley Region. The port situated on the southern extremity of the Broome Peninsula on the south-west side of the township of Broome. The BrPA is proposing to expand existing laydown areas for off-shore maritime industry support. Approximately 54 ha (inclusive of roads) of native vegetation are proposed to be cleared by the BrPA as part of this project. An additional 8 ha may be cleared by the Yawuru Native Title Holders (RNTBC) Aboriginal Corporation or its nominated entity for related purposes.

As part of the environmental impact assessment for this expansion, Bamford Consulting Ecologists was commissioned by Coffey Natural Systems (Coffey) on behalf of the BrPA to conduct a literature review, desktop survey and site inspection to identify fauna and habitat values of the Broome Port area, and in particular the areas subject to the expansion plan. The aims of fauna assessments such as this include:

- review the list of fauna expected to occur on the site in the light of fauna habitats present, with a focus on investigating the likelihood of significant species being present;
- identify significant or fragile fauna habitats within the study area;
- identify any ecological processes in the study area upon which fauna may depend;
- identify general patterns of biodiversity within or adjacent to the study area, and
- identify potential impacts upon fauna and propose recommendations to minimise impacts.

The review of databases, literature and habitats present indicated that a total of 385 native vertebrate fauna species may occur on the Broome Peninsula or utilise a home range that includes the Broome Peninsula.

Based on available habitats, 15 conservation significant species are considered likely to utilise the Project Area. Of these, five are of high significance (Conservation Significance Level 1), being listed under legislation, three are of moderate conservation significance (Conservation Significance Level 2), being listed as priority species by the Department of Environment and Conservation, and seven are of local significance (Conservation Significance Level 3), because they have restricted distributions or occur as isolated populations on the edge of their range. An additional five species have the potential to be rare visitors to the Project Area. However these species are not expected to be dependent on habitat within the Project Area.

Impacts upon fauna due to the construction and operation of the Project are likely to include: some localised loss of habitat, fragmentation of habitats, impacts from roadkill, and changes in hydrology, the fire regime and the abundance of introduced predators. The significance of these impacts and recommendations for their minimisation are discussed.

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## 1. INTRODUCTION

### *1.1 Introduction*

The Broome Port Authority (BrPA) manages the Port of Broome (see Figure 1), located approximately 2200 km north north-east of Perth and the largest port within the Kimberley Region. The Port currently handles a wide range of imports into and exports from Broome and supports many industries, including pearling, offshore oil and gas supply vessels, livestock exports and cruise liners, as well as being the largest fuel and container port for the region. The total length of the Port of Broome jetty was extended to 331m in 2005, to allow a greater volume of imports and exports, and to allow for correct segregation of non-compatible industries (Port of Broome 2008).

The port situated on the southern extremity of the Broome Peninsula on the south-west side of the township of Broome. The BrPA is proposing to expand existing laydown areas for off-shore maritime industry support.

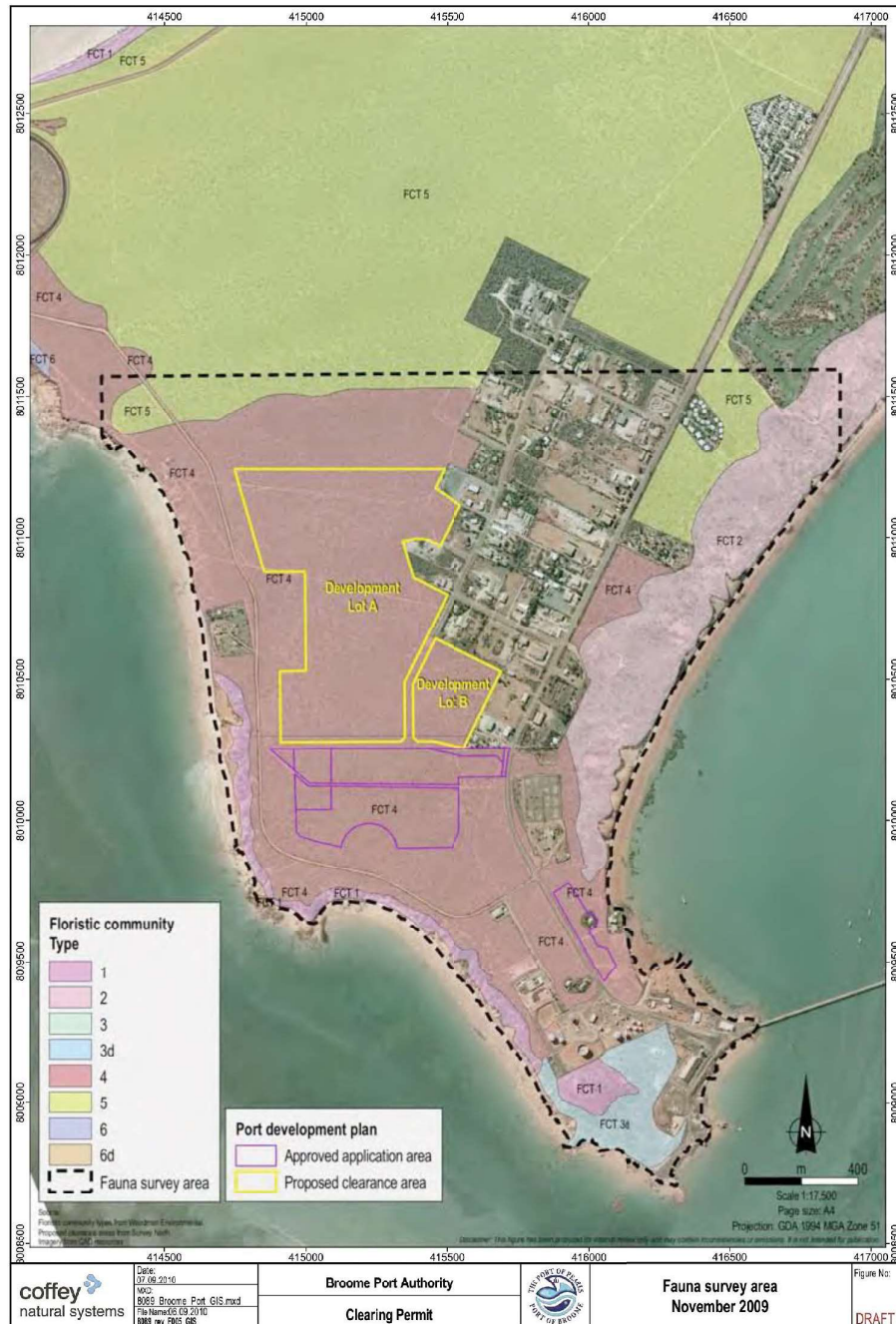
The BrPA is making an application to the Shire of Broome to re-zone approximately 70 ha of land located immediately to the north of BrPA lands between Port Rd and Kavite Rd as delineated in yellow on Figure 1.1. If the rezoning application is successful then the BrPA will seek a vegetation clearance permit for between 54 and 62 ha within this rezoning area. For the purposes of this report, the 70 ha rezoning area is referred to as the Project Area (i.e., the area in which vegetation clearing and direct impact may occur). The balance of the 70 ha which will not be cleared, and has been incorporated to accommodate a reasonable boundary and any heritage areas. This area will revert to reserve once the final boundaries of the area to be developed are determined.

As part of the environmental impact assessment for this expansion, Bamford Consulting Ecologists was commissioned by Coffey Natural Systems (Coffey) on behalf of the BrPA to conduct a literature review, desktop survey and site inspection to identify fauna and habitat values of the Broome Port area, and in particular the Project Area.

The BrPA has also indicated that a native vegetation corridor will be established on the western side of the Project Area to maintain the vegetation link to the rest of the peninsula. Approximately 44 ha of native vegetation on land currently vested in BrPA are proposed to be transferred into an environmental reserve. As part of the assessment the values of this area were compared with those of the Project Area.

Finally, it is understood that the outcomes from this report will be used by the BrPA to ensure clearing occurs in a manner that avoids or minimises impacts as far as practicable, i.e., not all the 'Project Area' will be cleared.

**Figure 1. Survey Area.** Note the Fauna survey area is delineated by the dashed black line while the Project Area is enclosed by the yellow border. The vegetation within the proposed Project Area is classified as FCT4, with FCT1, 2, 3 and 5 occurring nearby (see 2.2).



### *1.2 Study Objectives*

The objectives of fauna studies in the Environmental Impact Assessment (“EIA”) process are broadly to determine the fauna values of a site and the likely impacts of a proposed development. This provides government agencies with the information needed to assess the significance of impacts under state and government legislation. The key objectives of fauna studies are to:

- review the list of fauna expected to occur on the site in the light of fauna habitats present, with a focus on investigating the likelihood of significant species being present;
- investigate the likelihood of significant species being present in the study area;
- identify significant or fragile fauna habitats within the study area;
- identify any ecological processes in the study area upon which fauna may depend;
- identify general patterns of biodiversity within or adjacent to the study area, and
- identify potential impacts upon fauna and propose recommendations to minimise impacts.

## 2. BACKGROUND

### 2.1 Regional Description

The Project Area lies within the Pindanland subregion of the Dampierland Bioregion of the Interim Biogeographical Regionalisation for Australia (IBRA) classification system (EA 2000; McKenzie *et al.* 2003, See Figure 2). The Dampierland Bioregion falls within the Bioregion Group 3 classification of EPA (2004). This group is described as:

“Bioregions of the Northern Botanical Province, native vegetation is largely contiguous but is used for commercial grazing.”

The general features of this region are summarised by Graham (2001). The climate is dry hot tropical and semi-arid with summer rainfall (averaging between 450 – 700 mm). The Pindanland Subregion covers an area of 5 198 904 ha with four basic components:

1. Quaternary sandplain overlying Jurassic and Mesozoic sandstones with Pindan and hummock grasslands on hills.
2. Quaternary marine deposits on coastal plains, with mangal, samphire – *Sporobolus* spp. grasslands, *Melaleuca alsophila* low forests, and Spinifex spp. – *Crotalaria* spp. strand communities.
3. Quaternary alluvial plains associated with the Permian and Mesozoic sediments of Fitzroy Trough support tree savannahs of ribbon grass (*Chrysopogon* spp.)/ bluegrass (*Dichanthium* spp.) grasses with scattered Coolibah (*Eucalyptus microtheca*) and *Bauhinia cunninghamii*.
4. Riparian forests of river red gum (*Eucalyptus camaldulensis*) and Cadjeput (*Melaleuca* spp.) fringing drainages.

The vegetation of the Pindanland Subregion is described primarily as Pindan on sandplain. Beard (1979) describes the Pindan vegetation as an open layer of trees (typically *Eucalyptus tectifica* and *Corymbia dampieri*, 12-15 metres in height) over a dense layer of *Acacia* species and a sparse ground covering. The Pindan vegetation of the Peninsula represents a significant transition zone between the deserts to the south and the sub-tropics to the north.

Graham (2001) provides a detailed description of special values and features of the region with respect to fauna and environments, including endemism, refugia, significant species and important wetlands. Rainforest patches, mangroves, riparian zones and springs provide dry season refuges in the subregion.

Terrestrial fauna species of conservation significance found in the Pindanland Subregion include:

- Bilby (*Macrotis lagotis*)
- Gouldian Finch (*Erythrura gouldiae*)
- Red Goshawk (*Erythrotriorchis radiatus*)
- Freshwater Crocodile (*Crocodylus johnstoni*)
- Saltwater Crocodile (*Crocodylus porosus*)
- Flock Bronzewing (*Phaps histrionica*)

- Australian Bustard (*Ardeotis australis*)
- Pictorella Mannikin (*Heteromunia pectoralis*)
- Star Finch (*Neochmia ruficauda subclarescens*)
- Orange Leaf-nosed Bat (*Rhinonictus aurantius*)



**Figure 2 IBRA Subregions in Western Australia. Note the project lies in DL2: Pindanland.**

In addition, large numbers of migratory waterbirds have been recorded along the shoreline and mud flats of Roebuck Bay, an area recognised internationally as



significant for such species. These species are listed under the Japan – Australia Migratory Bird Agreement (JAMA), China- Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention of Migratory species have been recorded in the area, and therefore are migratory under the federal EPBC Act. These species are listed in Table 3.

## 2.2 Description of the Project Area

The Port of Broome is found on the western edge of the Dampierland Bioregion, on the northern tip of Roebuck Bay. The topography and soils of the region are composed of extensive riverine plains with grey and brown cracking clays, extensive sandplains on red earthy sands, low uplands of sandstone and limestone with shallow stony soils (Beard 1990). The area is underlain by a mixture of quaternary sandplain overlying jurassic sandstones; quaternary marine deposits on coastal plains, with devonian reef limestones and extensive alluvial river plains (Beard 1990).

Trudgen (1988) undertook a flora and vegetation survey of the Broome coastline. The vegetation was split into a number of categories including: vegetation of the Strand area, Dunal vegetation, Pindan vegetation, Vine Thicket and related vegetation (Gubinge Woodlands), and Melaleuca open forest.

A short description of vegetation communities within the Port Management Area (PMA) is given in URS (2004), as described below:

- Dunal vegetation varies with dune aspect, slope and shoreline proximity, with species such as *Spinifex longifolius*, *Canavalia rosea* and *Acacia bivenosa* colonising eroding seaward faces; whereas the seaward ridge and backslopes are colonised by species such as *Crotolaria cunninghamii*, *Marsdenia cinerascens*, *Santalum lanceolatum* and *Acacia bivenosa*.
- Discontinuous vine thickets occur in depressions and swales between dune ridges, with species such as *Gyrocarpus americanus*, *Abrus precatorius*, *Passiflora foetida*, *Tinospora smilacina* and *Capparis lasiantha* present.
- Eucalypt and Gubinge woodland over hummock grassland of *Plectrachne pungens* occur on inland dune ridge and slopes, with other species such as *Gardenia pyriformis* and *Clerodendrum tomentosum* also present. These woodlands merge with Pindan vegetation where the rearward dunes slope down onto the Pindan plain.
- Pindan vegetation present lying between Port Drive and the base of the dunes is typical of the area, and is comprised of mixed Acacia/Eucalypt woodland including *Acacia eriopoda*, *Eucalyptus dampieri* and *Terminalia petiolaris* with scattered shrubs and grasses including *Lysiphyllum cunninghamii*, *Hakea macrocarpa* and *Ventilago viminalis*.
- Mangrove communities in the PMA were noted by URS (2004) to be limited to minor patches along the Roebuck Bay shoreline.

The vegetation communities vary significantly on the Broome Peninsula moving northwards from the Port of Broome (Urbanplan 2006). This is due to the effect of the ocean on the climate at either end of the Broome Peninsula. Woodman (2008) describes two broad landscape types in the survey area – coastal dunes and pindan soils:

1. Open Woodlands and Shrublands over grasslands on pale brown to orange sands on foredunes, immediately behind foredunes and other dunal areas.
2. Open Woodlands over Shrublands over grasslands on orange to red pindan soils on lowerslopes to crests.

The broad landscape types are further broken into Floristic Community Types (FCTs, Woodman, 2008, see Figure 1). Five major vegetation types (FCTs) are described by Woodman (2008) for the Port of Broome area:

- FCT1. Shrubland dominated by *Acacia bivenosa* and *Crotalaria cunninghamii* subsp. *cunninghamii* with occasional *Bauhinia cunninghamii* and *Santalum lanceolatum* over grassland dominated by *Spinifex longifolius* on pale brown sand on foredunes and on leeward side of foredunes. This habitat occurs on the crests of foredunes or on the leeward side of the foredune, on the western coastline of the survey area, north of Gantheaume Point along Cable Beach.
- FCT2. Open Woodland of *Corymbia polycarpa* over open shrubland dominated by *Crotalaria cunninghamii* subsp. *cunninghamii* and *Tephrosia rosea* var. *rosea* over grassland dominated by *Triodia acutispicula* and *Poaceae* sp. 2 on orange sand on secondary dunes. This habitat occurs on the sheltered eastern side of the southern Broome Peninsula, on Roebuck Bay (see Figure 1).
- FCT3. Open Woodland of mixed species including *Bauhinia cunninghamii* and *Terminalia petiolaris* over occasional shrubland dominated by *Acacia bivenosa* over lower shrubland of mixed species including *Tephrosia rosea* var. *rosea*, *Euphorbia coghlanii* and *Abrus precatorius* subsp. *precatorius* on pale orange to brown sand on lowerslopes behind dunes, and secondary dunes. This habitat occurs on the western coast along Cable Beach. A small area of disturbed vegetation of this habitat type occurs at the very southern tip of the peninsula. Clearing and developmental activities have led to the quality of the vegetation in this area to decline. This habitat equates to Monsoon (vine) thickets on coastal sand dunes of Dampier Peninsula. Discontinuous vine thickets occur in depressions and swales between dune ridges (see Figure 1).
- FCT4. Pindan 1: Open Woodland of mixed *Corymbia* spp., *Hakea macrocarpa* and *Persoonia falcata* over Shrubland dominated by *Acacia colei* var. *colei* and other species such as *Ehretia saligna* var. *saligna* and *Waltheria indica* over grassland dominated by *Triodia pungens* and *Triodia acutispicula* on orange to red pindan soils on lower to upperslope positions. This habitat occurs on pindan soil on the southern half of the survey area (see Figure 1).
- FCT5. Pindan 2: Open Woodland of *Corymbia damperi* and *Corymbia zygophylla* over sparse Shrubland of *Acacia colei* var. *colei* and *Acacia eriopoda* over grassland dominated by *Triodia acutispicula*, *Triodia microstachya* or *Triodia pungens* on orange to red pindan soils on lower to upperslope positions. This habitat occurs on pindan soils north and east of Gantheaume Point (Figure 1).

The proposed area of disturbance is mapped by Woodman (2008) as FCT4.

### 2.3 Assessment of Conservation Significance

The conservation status of fauna species is assessed under Commonwealth and State Acts such as the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Wildlife Conservation Act 1950*. The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN) and reviewed by Mace and Stuart (1994). The Wildlife Conservation Act uses a set of Schedules but also classifies species using some of the IUCN categories. These categories and Schedules are described in Appendix One.

The EPBC Act also has lists of migratory species that are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals). In addition, the federal Department of Environment, Water, Heritage and the Arts (DEWHA, formerly Environment Australia) has supported the publication of reports on the conservation status of most vertebrate fauna species e.g. reptiles (Cogger *et al.* 1993), birds (Garnett and Crowley 2000), monotremes and marsupials (Maxwell *et al.* 1996), rodents (Lee 1995) and bats (Duncan *et al.* 1999); while the Threatened Species and Communities Section of Environment Australia has produced a list of Threatened Australian Fauna (Environment Australia 1999), although this list is effectively a precursor to the list produced under the EPBC Act. These publications also use the IUCN categories, although those used by Cogger *et al.* (1993) and Wager and Jackson (1993) differ in some respects as these reports pre-date Mace and Stuart's review (1994).

In Western Australia, the Department of Environment and Conservation (DEC) has produced a supplementary list of Priority Fauna, being species that are not considered Threatened under the *Wildlife Conservation Act* but for which the DEC feels there is cause for concern. Some Priority species, however, are also assigned to the IUCN Conservation Dependent category. Levels of Priority are described in Appendix One.

Fauna species included under conservation acts and/or agreements are formally recognised as of conservation significance under state or federal legislation. Species listed only as Priority by DEC, or that are included in publications such as Garnett and Crowley (2000) and Cogger *et al.* (1993) but not in State or Commonwealth Acts, are also of recognised conservation significance. In addition, species that are at the limit of their distribution, those that have a very restricted range and those that occur in breeding colonies, such as some waterbirds, can be considered of conservation significance, although this level of significance has no legislative or published recognition and is based on interpretation of distribution information. The WA Department of Environmental Protection (2000, now DEC) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Perth Bushplan.

On the basis of the above comments, three levels of conservation significance are recognised in this report:

1. **Conservation Significance (CS) 1:** Species listed under State or Commonwealth Acts.
2. **Conservation Significance (CS) 2:** Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by the DEC.
3. **Conservation Significance (CS) 3:** Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution. This level may have links to preserving biodiversity at the genetic level (EPA 2002). For example, if a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Species on the edge of their range, or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3.

In addition to these conservation levels, species that have been introduced (INT) are indicated.

### 3. METHODS

#### 3.1 Approach

This fauna assessment and report preparation were carried out with reference to guidance and position statements published by the WA Environmental Protection Authority (EPA) on fauna surveys and environmental protection, and Commonwealth biodiversity legislation (e.g. EPA 2002; EPA 2004). The level of fauna assessment required by the EPA is determined by the size and location of the proposed disturbance and the sensitivity of the surrounding environment in which the disturbance is planned.

The Project Area lies within Bioregion Group 3 as classified by the EPA (EPA 2004), described as bioregions of the Northern Botanical Province with native vegetation largely contiguous but used for commercial grazing. Due to the scale of the proposed disturbance Coffey commissioned Bamford Consulting Ecologists to undertake an extended Level 1 Fauna Assessment (a desktop study and reconnaissance survey).

A Level 1 Survey is described as a:

“Background research or ‘desktop’ study with the purpose to gather background information on the target area (usually at the locality scale). This involves a search of all sources for literature, data and map-based information (EPA, 2004).”

The purpose of a Reconnaissance Survey is to verify the accuracy of the background study; to further delineate and characterise the fauna and faunal assemblages present in the target area; and to identify potential impacts.

This involves:

“a target area visit by suitably qualified personnel to undertake selective, low intensity sampling of the fauna and faunal assemblages, and to provide habitat descriptions and habitat maps of the Project Area”.

The area proposed to be cleared by the BrPA was visited during October 2009 as well as adjacent areas. The survey area for this assessment is located on the Broome Peninsula. The Port of Broome lies at the northern end of Roebuck Bay, a wetland of international significance.

#### 3.2 Personnel

The Broome Port Fauna Assessment was undertaken from 30<sup>th</sup> October till 1<sup>st</sup> November 2009 by the following personnel:

- Jeff Turpin (B.Sc. Zoology)
- Carly Bishop (B. Sc. Hons Environmental Management)

The field survey was conducted under DEC Regulation 17 (Licence to take Fauna for Scientific Purposes) licence number SF007106. This fauna assessment document was prepared by Mr Jeff Turpin (B.Sc.) and Dr Mike Bamford (B.Sc. Hons. Ph.D).

### 3.3 Nomenclature and taxonomy

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based largely on the Western Australian Museum's *Checklist of the Vertebrates of Western Australia*. The authorities used for each vertebrate group are: amphibians and reptiles (Aplin and Smith 2001), birds (Christidis and Boles 1994; Johnstone 2001), and mammals (How *et al.* 2001).

### 3.4 Sources of Information for desktop assessment

Information for this fauna assessment was drawn primarily from the DEC's NatureMap ([www.naturemap.dec.wa.gov.au](http://www.naturemap.dec.wa.gov.au), 2009). Additional information was obtained from the Birds Australia Atlas Database, DEC Threatened Fauna Database and EPBC Protected Matters Search Tool, and all databases were interrogated in October 2009 (see below). This information was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were: freshwater fish (Allen *et al.* 2002), frogs (Tyler *et al.* 2000), reptiles (Storr *et al.* 1983, 1990, 1999 and 2002), birds (Blakers *et al.* 1984; Johnstone and Storr 1998; Johnstone and Storr, 2003; Storr, 1984), and mammals (Churchill 1998; Strahan 1995; Menkhorst and Knight 2001).

Database	Type of records held on database	Area searched
NatureMap (DEC and WA Museum)	Records on DEC Fauna database plus records of specimens held in the WA Museum. Includes historical data.	-16.5 S, 122.000 E and -18.5 S, 123.5 E
Birds Australia Atlas Database	Records of bird observations in Australia, 1998-2009.	Species list for the 1 degree grid cell containing -18.00341E, 122.21039S
DEC Threatened and Priority Fauna Database	Information and records on Threatened and Priority species in Western Australia	-17.88553E, 122.2717S with a 30 km buffer
EPBC Protected Matters Search Tool	Records on matters protected under the EPBC Act, including threatened species and conservation estate.	18.00341E, 122.21039S with a 30 km buffer

The desktop review generated a large species list that is likely to include vagrants to the region (such as some birds) and species that do occur in the region (and greater survey area), but for which there may or may not be suitable habitat within the Project Area (the proposed area of disturbance). With respect to conservation significant species identified from the desktop review, the precautionary approach is taken and all are discussed in this report.

### 3.5 Reconnaissance Survey.

During the Broome Port Fauna Assessment each major habitat type within the survey area was visited to develop an understanding of habitats present and to assess the

likelihood of conservation significant species present in the area. All fauna species observed during surveying were recorded.

Sixteen opportunistic fauna sites were selected, assessed for fauna habitat types and sampled opportunistically for fauna. At each Opportunistic Fauna Site a 20 minute, 2 ha Bird Survey was undertaken (following the standardised Birds Australia survey format), as well as searching for significant fauna, habitat assessments and microhabitat searching for smaller vertebrates and invertebrates. The locations of the Opportunistic Fauna Sites are detailed below.

Site	Eastings Zone	Northing 51K	Habitat	Comments
1	415038	8010737	Pindan, Eastern Fig thicket	Bird 1
2	414742	8011006	Pindan, North-West	Bird 2
3	415516	8010396	Pindan, South-east	Bird 3
4	414974	8010402	Pindan, South-west, Fig Thicket	Bird 4
5	415286	8011160	Pindan, North, FCT5	Bird 5
6	414816	8011388	Pindan, North, FCT5	Bird 6
7	415074	8010949	Pindan	Bird 7
8	415032	8010124	Pindan	Approved Clearance 1
9	415549	8010117	Pindan	Approved Clearance 2
10	414868	8009750	Coastal Shrubland	Reddel Beach Car park
11	415025	8009688	Monsoon Thicket	Reddel Beach Vine Thicket
12	416033	8009058	Monsoon Thicket	Port Monsoon Thicket
13	414811	8009819	Reddell Beach	Reddell Beach
14	416202	8009538	Intertidal zone	Intertidal Zone near Port
15	416144	8009583	Beach, Mangrove, mudflat	Port Beach
16	416647	8011153	Tall Secondary Dune	Tall Eastern Dune
17	416738	8011101	Beach, mudflat	Roebuck Bay

### 3.5.1 Fauna Sampling Techniques

The aim of the field survey was to develop an understanding of the fauna habitats of the site, and to search for evidence of conservation significant species. All habitats encountered were assessed as to the likelihood of supporting species of conservation significance known to occur in the region. These species include the Bilby (*Macrotis lagotis*), Peregrine Falcon (*Falco peregrinus*), Bush Stone-curlew (*Burhinus grallarius*) and a number of migratory birds listed under the EPBC Act. All fauna species observed during surveying were also recorded.

Sampling consisted of:

- Searching for evidence of significant fauna species
- Microhabitat searching for smaller vertebrate animals (e.g. reptiles and mammals) and invertebrates (specifically short-range endemic invertebrates such as land snails, millipedes and mygalomorph spiders);
- Bird censusing (Birds Australia 20 minute, 2 ha search)
- Habitat assessment
- Opportunistic observations
- Spotlighting

- Call playback
- Acoustic recordings of bats
- Motion-sensitive cameras

#### Searching for significant species

Significant species identified in the desktop assessment that may occur in the Project Area include several that can be found by searching for evidence of their activities. These include the Bilby (diggings and burrows), Bush Stone-curlew (call play-back) and other species (scats, tracks shelters etc.). Searching for evidence of significant fauna was therefore undertaken by walking through habitat considered suitable for such species.

#### Micro-habitat searching

Micro-habitat searching was carried at each opportunistic fauna survey site within the survey area. Searching involved raking through leaf-litter, breaking into dead trees, looking under bark, digging up burrows and turning over rocks, logs and dead Spinifex.

#### Bird Surveys

At each survey site a standardised bird census was undertaken. Each bird survey followed the standardised technique used by Birds Australia: a 20 minute, 2 Hectare search. Opportunistic bird surveys were conducted at least once in each habitat present within the Project Area. All opportunistic bird observations were also recorded.

#### Habitat Assessment

Each habitat visited was assessed as to the suitability of supporting threatened fauna. Habitat was assessed according to vegetation, landform, geology and soils.

#### Opportunistic surveys

At all times, observations of fauna were noted when they contributed to the accumulation of information on the fauna of the site. These included such casual observations as birds or reptiles seen while travelling through the site and also secondary evidence of fauna including tracks, scats, shelters and burrows.

#### Spotlighting

Spotlighting was conducted both on foot, using head-torches (referred to as head-torching), and from the vehicle using the vehicle headlights and a hand-held spotlight. Where necessary, animals were captured for identification and then released. Spotlighting was conducted on the nights of the 30<sup>th</sup> and 31<sup>st</sup> of October 2009.

#### Call playback

The broadcasting of bird vocalisations is an efficient and effective survey method to detect many species, particularly nocturnal species such as owls and the Bush Stone-curlew. Several bird species respond to species specific calls broadcast over a loud speaker system (using MP3 recordings broadcast through loud speakers).



The conservation significant Bush Stone-curlew and Barking Owl are known to respond to call playback (J. Turpin, pers. obs.). Call playback was conducted for both species at sites deemed suitable, including at:

- 415038N, 8010737E, in Pindan within the survey area
- 415574N, 8010390E, in Pindan within the survey area
- 415032N, 8010124E, in Pindan outside the survey area

#### Bat surveys

Bats were surveyed using electronic AnaBat bat call recorders (Titley Scientific, Brisbane). Ultrasonic echolocation calls of bats were recorded with an AnaBat II bat detector connected to an audio recorder, and later processed using AnalookW software. Identification of species was assisted by measuring the following echolocation call parameters:

- Fmax Maximum call frequency (kHz)
- Fmin Minimum call frequency (kHz)
- Fc Characteristic frequency (kHz)
- Fpeak Frequency with peak number of cycles (kHz)
- DUR Duration of call (ms)

The AnaBat detector was deployed overnight at two sites:

- 415038N, 8010737E, in Pindan within the survey area
- 415574N, 8010390E, in Pindan within the survey area

#### Motion-sensitive cameras

Two motion sensitive cameras were established within the survey area to record fauna. Motion cameras have been used successfully on fauna surveys to record mammals (such as Macropods, Possums, Bandicoots and Dasyurids) and birds (J. Turpin, pers. obs.) Two motion cameras were established at the base of Fig trees with large hollows and were baited with universal bait (sardines, peanut butter, rolled oats). Both motion cameras sampled over two nights (30<sup>th</sup> and 31<sup>st</sup> October 2009) and were installed at:

- 415103E, 8010755N, Fig Thicket in Pindan;
- 415588E, 8010433N, Fig Thicket in Pindan.

## 4. RESULTS

### 4.1 Fauna Habitats

The major fauna habitats occurring within the study area reflect the major vegetation types present (Floristic Community Types – FCTs, see Figure 1). Nine major fauna habitats were recorded from the greater survey area. These are:

1. **Pindan Vegetation. (FCT4)** Pindan 1 – mixed *Corymbia* spp., *Hakea macrocarpa* and *Persoonia falcata* over Shrubland dominated by *Acacia colei* var. *colei* over grassland dominated by *Triodia pungens* and *Triodia acutispicula* on orange to red pindan soils. This is the major habitat type within the Project Area (see Figure 1) .



2. **Thickets and large shrubs of *Ficus aculeata* var. *indecora*.** (within FCT4 and 5). This Fig species occurs in thickets or single shrubs and is scattered throughout the survey area. Large stands occur within the proposed Project Area, particularly in the eastern parts. This habitat is significant as large mature trees and shrubs contain hollows suitable for birds and arboreal mammals.



3. **Monsoon Thickets.** Monsoon Thickets occur on the inland side of coastal dunes along the Dampier Peninsula, and tend to become larger and have greater species diversity in the north of the region compared with the south. This habitat type is reflected by FCT 3 and elements of FCT 1 (see Figure 1). A large degraded area occurs on the southern tip of the Broome Peninsula, with smaller areas occurring near the Reddell Beach Car Park. Monsoon Thickets are also recognised as a Threatened Ecological Community (TEC).



4. **Pindan Vegetation.** (FCT5) Pindan 2: Open Woodland of *Corymbia damperi* and *Corymbia zygophylla* over sparse Shrubland of *Acacia colei* var. *colei* and *Acacia eriopoda* over grassland dominated by *Triodia acutispicula*, *Triodia microstachya* or *Triodia pungens* on orange to red pindan soils. This habitat occurs in the northern parts of the survey area.



5. **Tall Dunes on the eastern margin of the peninsula** (FCT2) – supporting Open Woodland of *Corymbia polycarpa* over open shrubland dominated by *Crotalaria cunninghamii* subsp. *cunninghamii* and *Tephrosia rosea* var. *rosea* over grassland dominated by *Triodia acutispicula* and *Poaceae* sp. 2 on orange sand on secondary dunes. This habitat occurs on the sheltered eastern side of the southern Broome Peninsula, on Roebuck Bay (see Figure 1).



6. **Coastal Shrubland on Primary Dunes** (FCT1, western side of the peninsula): dominated by *Acacia bivenosa* and *Crotalaria cunninghamii* subsp. *cunninghamii* with occasional *Bauhinia cunninghamii* and *Santalum lanceolatum* over grassland dominated by *Spinifex longifolius* on pale brown sand on foredunes and on leeward side of foredunes. This habitat type occurs mostly outside the Project Area however intergrades with the Pindan vegetation on the western margins of the project (see Figure 1).



7. **Mangrove communities.** This habitat is limited to patches along the Roebuck Bay shoreline (see Figure 1)..



8. **Beaches and mud flats.** Occur along the coastline with an extensive area of intertidal mudflats occurring the eastern shoreline of the Broome Peninsula, adjacent to and north of the Broome Port.



9. **Minor Rocky Headlands.** Rocky Headlands occur along the coastline.

Additionally, some disturbed areas occur within the Project Area, particularly around the Broome Port. Several tracks also cross the Project Area.

#### Project Area.

Within the Project Area four of the above fauna habitats were recognised. These were:

1. Pindan Vegetation: Pindan 1
2. Pindan Vegetation: Pindan 2.
3. Thickets and large shrubs of *Ficus aculeata* var. *indecora*
4. An intergrade of Pindan vegetation with coastal shrublands on the projects western margins.

#### 4.2 Vertebrate fauna

The desktop survey identified 385 fauna species potentially occurring in the Broome region and greater study area. This comprised 11 Frog, 82 Reptile, 255 Bird and 37 Mammal species (see Tables 1 - 4). These lists are based largely upon known species distributions and available habitats. Table 5 lists those species considered to be of conservation significance and details their respective conservation status. The faunal assemblage shows components of both the arid zone to the south and the tropical Kimberley to the north-east, reflecting the transition zone of climate in the area. As a result, most fauna species expected to occur in the Project Area are widespread but some are also restricted to the Dampier Peninsula. The fauna lists also include a number of migratory species, including waterbirds, waders and marine birds. These species may periodically occur within the vicinity of the Port of Broome and some may utilise the coastal mud flats, beaches and mangroves. A number of migratory waders were also observed flying over the Project Area.

Overall, the assemblage of vertebrate fauna expected in the Project Area is typical of the region. Most fauna species occurring or expected to occur in the Project Area are widespread but some species may have restricted or habitat limited distributions, and some fauna species expected have declined in the region. Conservation significant fauna species occurring or likely to occur in the Project Area are discussed below.

The vertebrate fauna expected to occur within the region have the following composition (see Tables 1, 2 and 3):

Taxon	Number of species expected in Survey Area	Significant fauna expected: Survey Area				Significant fauna expected: Project Area			
		CS1	CS2	CS3	INT	CS1	CS2	CS3	INT
Frogs	11	-	-	-	-	-	-	-	-
Reptiles	82	1	2	4	1	1	2	4	1
Birds	255	59	7	3	1	6	2	1	1
Mammals	33 (native) 4 (feral species)	2	4	3	3	1	-	3	3
<b>Total</b>	<b>385</b>	<b>62</b>	<b>13</b>	<b>10</b>	<b>5</b>	<b>8</b>	<b>4</b>	<b>8</b>	<b>5</b>

A total of 85 conservation significant vertebrate species are expected to occur in the Broome area based on database searches (62 CS1, 13 CS2, 10 CS3 species). However many species are expected to occur in habitats absent from the Project Area. For example large numbers of migratory waterbirds are expected to occur along the adjacent coastline however are not expected to occur within the Project Area. A total of 20 conservation significant species are expected at the project.

##### 4.2.1 Freshwater Fish

No species of freshwater fish are expected to occur in the study area. There are no freshwater habitats within the Project Area.

#### 4.2.2 Amphibians

A total of eleven frog species may occur in the Broome area (see Table 2). One frog species, *Litoria caerulea*, was recorded from the survey area.

There are three frog species of conservation significance in the Broome area:

<u>Conservation Significance Level 3</u>	
Derby Toadlet	<i>Uperoleia aspera</i>
Mjoberg's Toadlet	<i>Uperoleia mjobergi</i>
Mole Toadlet	<i>Uperoleia talpa</i>
<p>These species have restricted distributions and occur on floodplains and flooded areas in the vicinity of Broome. They are not expected to occur within the Pindan habitat and coastal dunes within the survey area and are therefore not expected within the Project Area.</p>	

#### 4.2.3 Reptiles

A total of 82 reptile species may occur in the Project Area (see Table 3). This includes 13 geckoes, two pygopods, 10 agamids, seven varanids, 26 skinks, three blind snakes, five pythons and 13 elapid snakes. This list includes the recently described *Cryptoblepharus metallicus*, *Cryptoblepharus rubber* and *Cryptoblepharus tythos* (Horner, 2007).

Ten reptile species were recorded during the 2009 field survey. These were:

<i>Gehyra australis</i>	Recorded from Pindan vegetation within the Project Area
<i>Hemidactylus frenatus</i>	Recorded within survey area.
<i>Amphibolurus gilberti</i>	Recorded from dense vegetation.
<i>Diporiphora pindan</i>	Recorded from tall coastal dune (eastern side of peninsula)
<i>Varanus gouldii</i>	Recorded from Pindan vegetation within the clearance area
<i>Varanus tristis tristis</i>	Recorded from Pindan vegetation within the clearance area
<i>Cryptoblepharus ruber</i>	Recorded from Ficus thicket within the clearance area
<i>Ctenotus inornatus</i>	Recorded from Pindan vegetation within the clearance area
<i>Glaphyromorphus isolepis</i>	Recorded from Pindan vegetation within the clearance area
<i>Tiliqua scincoides</i>	Recorded from Pindan vegetation within the clearance area

An additional seven reptile species have been recorded within the fauna survey area (from database searches and local records). This includes two conservation significant species:

- *Lerista separanda* (Priority 2) recorded from Triodia hummock
- *Simoselaps minimus* (Priority 2) recorded from Triodia hummock
- *Lialis burtonis* recorded from Pindan
- *Chlamydosaurus kingii* recorded from Pindan
- *Aspidites melanocephalus* recorded from Pindan
- *Furina ornata* recorded from Pindan
- *Pseudechis australis* recorded from Pindan



Seven conservation significant reptile species occur or are considered to have the potential to occur within the Project Area. They are discussed below.

Conservation Significance Level 1

Airlie Island Ctenotus

*Ctenotus angusticeps*

*Ctenotus angusticeps* is listed as Vulnerable under the EPBC act and Wildlife Conservation Act. This species occurs on Airlie Island, north-east of Onslow, the mainland adjacent to Airlie Island and has been recorded south of Broome at Roebuck Bay (DEWHA, 2008). At Roebuck Bay, lizards have been found on coastal mudflats vegetated with Spinifex (Wilson and Swan, 2003). On Airlie Island this species has been recorded in low *Acacia coriacea* shrubland with coastal Spinifex and limestone formations (Browne-Cooper and Maryan, 1990). This species has the potential to occur in the Project Area.

Conservation Significance Level 2

a skink  
a snake

*Lerista separanda*  
*Simoselaps minimus*

*Lerista separanda* is listed as Priority 2 by DEC. It has a restricted range within the Semiarid and arid southwest Kimberley. This species has been previously recorded from the survey area (on the Broome Peninsula) within leaf litter and under *Triodia* sp. (NatureMap, 2009). This record lies approximately 1km north-east of the proposed Project Area.

*Lerista separanda* has also been recorded at Kimbolton, Point Coulomb and Nita Downs (Storr *et al.*, 1999). Wilson and Swan (2008) suggest this species occurs in sandy areas along the south-west Kimberly coast. This species occurs near the Project Area and is likely to occur across the Project Area within the Pindan vegetation.

*Simoselaps minimus* is listed as Priority 2 by DEC. It is restricted range to the Dampier Peninsula. *Simoselaps minimus* has been recorded from the fauna survey area, within soil under a *Triodia* clump approximately 1km north-east of the proposed Project Area (DEC, 2009). Wilson and Swan (2008) suggest this species occurs in coastal dunes and sandy junction between dunes and adjacent acacia shrublands. This species is likely to occur within the Project Area.

Conservation Significance Level 3

a dragon  
a skink  
a skink  
a skink

*Diporiphora pindan*  
*Ctenotus colletti*  
*Lerista apoda*  
*Morethia storri*

*Diporiphora pindan* is restricted to Dampier Land and adjacent coast and hinterland. It occurs mainly in Pindan (a thicket mostly of *Acacia* species growing on light red

soils, Cogger, 2000). This species was recorded during the field survey and is likely to occur within the Project Area.

*Ctenotus colletti* is known only from the southwest Kimberley between Beagle Bay and Bidyadanga. It occurs in semiarid acacia scrub (Pindan) on red sandy soils (Storr *et al.*, 1999). This species is likely to occur within the Project Area.

*Lerista apoda* is confined to the Dampier Peninsula in the semi-arid southwest Kimberley (Storr *et al.*, 1999). Wilson and Swan (2008) suggest this species occurs in sandy areas (of Dampier Land) particularly along the transition zone between coastal dunes and red sands supporting Acacia thickets. This species may occur in the Project Area.

*Morethia storri* has a very restricted distribution in Western Australia. This species is confined to the semiarid areas of the northern Dampier Peninsula, and is also known from northern areas of the Northern Territory (Storr *et al.*, 1999). This species may occur in the Project Area within woodlands and shrublands.

One introduced gecko species, *Hemidactylus frenatus*, was recorded in the Project Area during the site visit.

#### 4.2.4 Birds

A total of at least 255 bird species may occur in the survey area (see Table 3). This list excludes species that may occur as vagrants but does include waterbirds that may fly over the project, including migratory wader species and marine seabirds. The nationally vulnerable Princess Parrot (*Polytelis alexandrae*) has been recorded from the Broome area, although this record may be of an aviary escapee (Broome Bird Observatory, 2007) and has not been included in this list. Forty three migratory and/or marine species may utilise habitat on the fringes of the study area, the coastal beaches, mud flats and coastal waters. These species are listed in Table A.

A total of 76 bird species were recorded from the fauna survey area during the 2009 survey. This includes 34 species recorded from the Project Area, with the additional species recorded in adjacent habitats – mangroves, mudflats, coastal dunes and beaches (Survey Area, see Table A).

Table A lists the bird species recorded from the Project Area and the greater survey area. This lists includes 21 species of conservation significance, all listed under the EPBC Act. Of the conservation significant species recorded, all migratory waders were on the intertidal mudflats of Roebuck Bay (approximately 500m from the Project Area), however two species were observed flying over the Project Area. The migratory marine species (Osprey, Lesser Frigatebird, White-bellied Sea-Eagle and Brown Booby) were recorded along the peninsula coastline. Small parties of the Barn Swallow were observed foraging along coastal dunes. One conservation significant bird, the Rainbow Bee-eater, was recorded from the project area.

**Table A.** Bird Species recorded during the 2009 Inspection.

Common Name	Species Name	Status	Project Area	Survey Area
Plumed Whistling-Duck	<i>Dendrocygna eytoni</i>			X
Wandering Whistling-Duck	<i>Dendrocygna arcuata</i>			X
Pacific Black Duck	<i>Anas superciliosa</i>			X
Grey Teal	<i>Anas gracilis</i>			X
Brown Booby	<i>Sula leucogaster</i>	EPBC MIG		X
Lesser Frigatebird	<i>Fregata ariel</i>	EPBC MIG		X
Eastern Reef Egret	<i>Egretta sacra</i>		X (fly over)	X
Striated Heron	<i>Butorides striatus</i>			X
Australian White Ibis	<i>Threskiornis moluca</i>			X
Eastern Osprey	<i>Pandion cristatus</i>	EPBC MIG		X
Black-shouldered Kite	<i>Elanus axillaris</i>		X	
Black (Fork-tailed) Kite	<i>Milvus migrans</i>			X
Whistling Kite	<i>Haliastur sphenurus</i>			X
Brahminy Kite	<i>Haliastur indus</i>			X
White bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	EPBC MIG		X
Brown Goshawk	<i>Accipiter fasciatus</i>		X	X
Nankeen Kestrel	<i>Falco cenchroides</i>			X
Black-tailed Godwit	<i>Limosa limosa</i>	EPBC MIG		X
Bar-tailed Godwit	<i>Limosa lapponica</i>	EPBC MIG		X
Whimbrel	<i>Numenius phaeopus</i>	EPBC MIG		X
Eastern Curlew	<i>Numenius madagascariensis</i>	EPBC MIG		X
Common Greenshank	<i>Tringa nebularia</i>	EPBC MIG		X
Terek Sandpiper	<i>Xenus cinereus</i>	EPBC MIG		X
Common Sandpiper	<i>Actitis hypoleucos</i>	EPBC MIG	X (fly over)	X
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	EPBC MIG		X
Ruddy Turnstone	<i>Arenaria interpres</i>	EPBC MIG		X

Common Name	Species Name	Status	Project Area	Survey Area
Great Knot	<i>Calidris tenuirostris</i>	EPBC MIG		X
Red-necked Stint	<i>Calidris ruficollis</i>	EPBC MIG		X
Curlew Sandpiper	<i>Calidris ferruginea</i>	EPBC MIG		X
Pied Oystercatcher	<i>Haematopus longirostris</i>			X
Black-winged Stilt	<i>Himantopus himantopus</i>			X
Pacific Golden Plover	<i>Pluvialis fulva</i>	EPBC MIG		X
Grey Plover	<i>Pluvialis squatarola</i>	EPBC MIG		X
Red-capped Plover	<i>Charadrius ruficapillus</i>			X
Greater Sand Plover	<i>Charadrius leschenaultii</i>	EPBC MIG		X
Masked Lapwing	<i>Vanellus miles</i>			X
Silver Gull	<i>Larus novaehollandiae</i>			X
Gull-billed Tern	<i>Sterna nilotica</i>			X
Crested Tern	<i>Sterna bergii</i>			X
Whiskered Tern	<i>Chlidonias hybridus</i>			X
Peaceful Dove	<i>Geopelia placida</i>		X	X
Bar-shouldered Dove	<i>Geopelia humeralis</i>		X	X
Crested Pigeon	<i>Ocyphaps lophotes</i>		X	X
Little Corella	<i>Cacatua sanguinea</i>			X
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>		X	X
Red-winged Parrot	<i>Aprosmictus erythropterus</i>		X	X
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>		X	X
Pheasant Coucal	<i>Centropus phasianinus</i>		X	X
Tawny Frogmouth	<i>Podargus strigoides</i>		X	X
Blue-winged Kookaburra	<i>Dacelo leachii</i>		X	X
Sacred Kingfisher	<i>Todiramphus sanctus</i>		X	
Rainbow Bee-eater	<i>Merops ornatus</i>	EPBC MIG	X	X
Dollarbird	<i>Eurystomus orientalis</i>			X
Variegated Fairy-wren	<i>Malurus lamberti</i>		X	X
Red backed Fairy-wren	<i>Malurus melanocephalus</i>		X	X
White throated Gerygone	<i>Gerygone olivacea</i>		X	X
Dusky Gerygone	<i>Gerygone tenebrosa</i>			X
Little Friarbird	<i>Philemon citreogularis</i>		X	X
Singing Honeyeater	<i>Lichenostomus virescens</i>		X	X
Yellow-tinted Honeyeater	<i>Lichenostomus flavescens</i>		X	X
Black-chinned Honeyeater	<i>Melithreptus gularis</i>		X	X
Brown Honeyeater	<i>Lichmera indistincta</i>		X	X
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>			X
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>		X	X
Rufous Whistler	<i>Pachycephala rufiventris</i>		X	X
Mangrove Golden Whistler	<i>Pachycephala melanura</i>			X
Grey Shrike-thrush	<i>Colluricincla harmonica</i>		X	X
Broad-billed Flycatcher	<i>Myiagra ruficollis</i>			X
Restless Flycatcher	<i>Myiagra inquieta</i>			X
Magpie-lark	<i>Grallina cyanoleuca</i>		X	X
Willie Wagtail	<i>Rhipidura leucophrys</i>		X	X
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		X	X
Black-faced Woodswallow	<i>Artamus cinereus</i>		X	
Pied Butcherbird	<i>Cracticus nigrogularis</i>		X	X
Torresian Crow	<i>Corvus orru</i>			X
Great Bowerbird	<i>Chlamydera nuchalis</i>		X	X
Zebra Finch	<i>Taeniopygia guttata</i>			X
Mistletoebird	<i>Dicaeum hirundinaceum</i>		X	X
Barn Swallow	<i>Hirundo rustica</i>	EPBC MIG		X
Tree Martin	<i>Hirundo nigricans</i>		X	X

Conservation significant bird species occurring in the Broome area are discussed below.

Conservation Significance Level 1

Magpie Goose	<i>Anseranas semipalmata</i>
Eastern Great Egret	<i>Ardea modesta (alba)</i>
Cattle Egret	<i>Ardea ibis</i>
Glossy Ibis	<i>Plegadis falcinellus</i>
Eastern Osprey	<i>Pandion cristatus</i>
White bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>
Oriental Pratincole	<i>Glareola maldivarum</i>
Oriental Cuckoo	<i>Cuculus saturatus</i>
Fork-tailed Swift	<i>Apus pacificus</i>
Rainbow Bee-eater	<i>Merops ornatus</i>
White throated Needletail	<i>Hirundapus caudacutus</i>
Barn Swallow	<i>Hirundo rustica</i>
Yellow Wagtail	<i>Motacilla flava</i>

These 13 bird species are listed as Migratory under the JAMBA, CAMBA and/or Bonn Convention, and as such are also protected under the EPBC Act. Those species covered under JAMBA are also protected under Schedule 3 of the Wildlife Conservation Act. The majority of these species occur seasonally in the Broome area.

The Oriental Pratincole inhabits wetlands, open plains, tidal flats and beaches and has been recorded from Entrance Point and beaches fringing the Broome Port (Birds Australia, 2009). The Barn Swallow inhabits open areas and has been recorded from the Port of Broome area (Birds Australia, 2009). This species was recorded during the fauna survey foraging along coastal dunes.

The Osprey and White-bellied Sea Eagle are coastal and marine species. Both species were recorded along the coastline surrounding the Port of Broome.

The Fork-tailed Swift and White-throated Needletail are aerial species largely independent of terrestrial habitat types, and are likely to be seasonal visitors to the Project Area. The Fork-tailed Swift has been recorded from the Port of Broome while the White-throated Needletail has been recorded from the Broome Bird Observatory (Birds Australia, 2009).

The Magpie Goose, Great Egret, Cattle Egret, Glossy Ibis and Yellow Wagtail generally are associated with wetlands. This habitat is absent from the Project Area.

The Oriental Cuckoo inhabits rainforest margins, monsoon forest, vine thicket, Paperbark swamps and mangroves. This species has been recorded from the Broome Bird Observatory (Birds Australia, 2009), but is probably only an occasional visitor in small numbers to the region.

The Rainbow Bee-eater occurs in the better watered parts of Western Australia, between the Kimberley and south-west, preferring lightly wooded, preferably sandy country near water (Johnstone and Storr, 1998). This species can occur as a resident, breeding visitor, postnuptial nomad, passage migrant or winter visitor. It nests in

burrows dug usually at a slight angle in flat ground, gently elevated slopes, sandy banks or cuttings, and often at the margins of roads or tracks. The Rainbow Bee-eater has been recorded from the Port of Broome area (Birds Australia, 2009) and was recorded from the Project Area during the 2009 survey.

The Oriental Pratincole, Great Egret, Osprey and White-bellied Sea-Eagle are likely to utilise habitat on the margins of the Project Area – the coastal beaches and inshore coastal waters. The Rainbow Bee-eater has been recorded within the Project Area and Oriental Cuckoo may occur within the vicinity of Project Area in dense vegetation such as vine thickets.

Red Goshawk *Erythroriorchus radiatus*

The Red Goshawk is listed as Vulnerable under the *EPBC Act* and *Wildlife Conservation Act*. This species is a rare inhabitant of undisturbed forest or woodland across northern Australia. There is only one recent record for the Red Goshawk within 30 km of Broome (in 1976). This species is unlikely to utilise habitat within the Project Area. It generally favours tall eucalypt and Melaleuca woodland (M. Bamford pers. obs., J. Turpin, pers. obs.).

Peregrine Falcon *Falco peregrinus*

The Peregrine Falcon is classified as Specially Protected Fauna under Schedule 4 of the *Wildlife Conservation Act*. This species is found in a variety of habitats, including rocky ledges, cliffs, watercourses, open woodland acacia shrublands and may occur in the study area. The Peregrine Falcon has been recorded near the study area with three recent records from within 10 km of Broome (Birds Australia, 2009). The species has been recorded within the fauna survey area on the eastern side of the Peninsula near Roebuck Bay (Birds Australia, 2009). The Project Area may be a small component of the foraging range of a pair of Peregrine Falcons. However, this species is unlikely to be dependent on habitat within the Project Area.

Gouldian Finch *Erythrura gouldiae*

The Gouldian Finch is listed as Endangered under the *EPBC Act* and *WA Wildlife Conservation Act*. The Gouldian Finch occurs in open tropical woodlands, riparian vegetation, and hummock grasslands across northern Australia. The Project Area lies outside the core distribution of this species and as such it is unlikely to occur in the area. On Dampier Peninsula the Gouldian Finch has been recorded from One Arm Point (Birds Australia, 2009).

#### EPBC Listed Migratory Species

A high number of migratory warden species listed under the *EPBC Act* have been previously recorded from the Survey Area (Birds Australia, 2009). These are listed in Table B.

Table B: Migratory bird species listed under the EPBC Act previously recorded from the Broome area (Birds Australia, 2009). The majority of species have been recorded from the eastern coastline of the Broome Peninsula (along Roebuck Bay) in the vicinity of the Port of Broome near Entrance Pt.

Common Name	Species Name	Records
Common Sandpiper	<i>Actitis hypoleucos</i>	Broome Port (many)
Ruddy Turnstone	<i>Arenaria interpres</i>	Broome Port (many)
Sanderling	<i>Calidris alba</i>	Broome Port
Red Knot	<i>Calidris canutus</i>	Broome Port
Curlew Sandpiper	<i>Calidris ferruginea</i>	Broome Port (many)
Red-necked Stint	<i>Calidris ruficollis</i>	Broome Port (many)
Great Knot	<i>Calidris tenuirostris</i>	Broome Port (many)
Greater Sand Plover	<i>Charadrius leschenaultia</i>	Broome Port (many)
Lesser Sand Plover	<i>Charadrius mongolus</i>	Broome Port
Oriental Plover	<i>Charadrius veredus</i>	Broome
Oriental Pratincole	<i>Glareola maldivarum</i>	Entrance Point (Port)
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	Broome Port (many)
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	Broome Port
Bar-tailed Godwit	<i>Limosa lapponica</i>	Broome Port (many)
Black-tailed Godwit	<i>Limosa limosa</i>	Broome Port (many)
Eastern Curlew	<i>Numenius madagascariensis</i>	Broome Port
Little Curlew	<i>Numenius minutus</i>	Broome Port (many)
Whimbrel	<i>Numenius phaeopus</i>	Broome Port (many)
Grey Plover	<i>Pluvialis squatarola</i>	Broome Port (many)
Painted Snipe	<i>Rostratula benghalensis</i>	Roebuck Plains
Common Greenshank	<i>Tringa nebularia</i>	Broome Port (many)
Terek Sandpiper	<i>Xenus cinereus</i>	Broome Port
Streaked Shearwater	<i>Calonectris leucomelas</i>	Cable Beach
Little Tern	<i>Sterna albifrons</i>	Broome Port (many)
Pin-tailed Snipe	<i>Gallinago stenura</i>	Broome
Swinhoe's Snipe	<i>Gallinago megala</i>	Broome
Common Redshank	<i>Tringa totanus</i>	Broome Bird Observatory
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Broome Port (many)
Wood Sandpiper	<i>Tringa glareola</i>	Broome Port
Asian Dowitcher	<i>Limnodromus semipalmatus</i>	Broome Bird Observatory
Long-toed Stint	<i>Calidris subminuta</i>	Broome Port
Pectoral Sandpiper	<i>Calidris melanotos</i>	Broome Port
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Broome Port
Ruff	<i>Philomachus pugnax</i>	Broome Port
Common Tern	<i>Sterna hirundo</i>	Broome Port
Bridled Tern	<i>Sterna anaethetus</i>	Broome Port
White-winged Black Tern	<i>Chlidonias leucopterus</i>	Broome Port (many)
Common Noddy	<i>Anous stolidus</i>	Broome Port
Wedge-tailed Shearwater	<i>Puffinus pacificus</i>	Yardoogarra, 50 km south
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>	Broome Port
Lesser Frigatebird	<i>Fregata ariel</i>	Broome Port (many)
Masked Booby	<i>Sula dactylatra</i>	No local records
Brown Booby	<i>Sula leucogaster</i>	Broome Port (many)

Many of the wader species listed in Table B have been recorded from the beaches and mud flats in the vicinity of the Port of Broome (see plates 1 to 4). Some species have been recorded in the area in large numbers such as the Ruddy Turnstone, Curlew Sandpiper, Greater Sand Plover and Grey-tailed Tattler. In all, 43 migratory wader or marine species listed under the EPBC Act have been recorded in the Broome area. Many of these species have been recorded along the Beaches and coastline surrounding the Project Area (such as Ruddy Turnstone, Curlew Sandpiper, Greater Sand Plover and Grey-tailed Tattler). The Beaches and mudflats surrounding the Port of Broome area lie outside the Project Area for the project – occurring 500m to the east. As a result habitat supporting numerous conservation significant migratory waterbird species is unlikely to be impacted by the proposed project. A number of individual Common Sandpipers were observed flying over the proposed Project Area, moving from one side of the peninsula to the other.

Painted Snipe have been recorded from the Roebuck Plains (Birds Australia, 2009). This species inhabits the surrounds and shallows of wetlands and marshlands and so is unlikely to occur within the Project Area. The Pin-tailed Snipe and Swinhoe's Snipe have been recorded from Broome (few records). These species inhabit coastal freshwater wetlands and so are unlikely to occur within the Project Area. The Shearwaters, Storm Petrel, Masked Booby, Brown Booby, Frigatebird are largely marine species, mostly breeding on off-shore islands. They are unlikely to utilise habitat within the Project Area.

#### Conservation Significance Level 2

##### Grey Falcon

##### *Falco hypoleucos*

The Grey Falcon is nomadic, inhabiting lightly timbered riverine plains. It appears to have a distribution centred around ephemeral or permanent drainage lines, utilising old nests of other species situated in the tallest trees along the river systems (Garnett and Crowley 2000). The Grey Falcon has been recorded at the Broome Bird Observatory, 15 km east of the Project Area. This species is unlikely to rely on the Pindan in the vicinity of the Project Area, however may occur as a rare visitor.

##### Australian Bustard

##### *Ardeotis australis*

The Australian Bustard is listed as Priority 4 by the DEC and Near Threatened by Garnett and Crowley (2000). This species is a large, ground-dwelling bird known to occur in open or lightly-wooded country in Australia (extinct in south-eastern Australia) and southern New Guinea. It is nomadic and may range over very large areas, largely dependent on rainfall and hence food availability. The Australian Bustard has been recorded from the Broome Bird Observatory and from Willie Creek, 15 km north-west of the Project Area. This species prefers open grasslands and woodlands and as such is unlikely to occur within the Project Area.

##### Bush Stone-curlew

##### *Burhinus grallarius*

The ground-dwelling Bush Stone-curlew is listed as Priority 4 by the DEC and Near Threatened by Garnett and Crowley (2000). This species has a distribution covering the majority of the continent with preferred habitat being grassy woodland (Frith, 1976). Three recent records of the Bush –Stone-curlew come from within 10 km of



Broome, from habitats including Pindan (Birds Australia, 2009). The Bush Stone-curlew has been recorded from the survey area, near Reddell Beach (Birds Australia, 2009). This species is likely to occur within the Project Area.

Chestnut backed Button-quail

*Turnix castanota magnifica*

The Chestnut-backed Button-quail is classified as Priority 4 by the DEC. This species is known from the northern Kimberley and was recorded from the Roebuck Plains in 2000 (DEC Threatened Species Database, 2007). This species generally occurs in eucalypt woodland and open forest. It is not expected to occur within the Project Area as there are no local records.

Flock Bronzewing

*Phaps histrionica*

The Flock Bronzewing is listed as Priority 4 by the DEC. This species inhabits treeless or sparsely wooded grassy plains within reach of open water (DEC, 2007). The Flock Bronzewing has been recorded from the Roebuck Plains 35 km south-east of the Project Area (Birds Australia, 2009). However, due to a lack of suitable habitat this species is unlikely to occur in the study area.

Pictorella Mannikin

*Heteromunia pectoralis*

The Pictorella Mannikin is listed as Priority 4 by the DEC. This species of finch occurs in the drier northern tropical grasslands of Australia (DEC, 2007). This species has been recorded from Broome in 2005 (DEC Threatened Species Database, 2007), however is not likely to occur in the Pindan within the study area.

Masked Owl

*Tyto novaehollandiae*

The northern subspecies of the Masked Owl is listed as Priority 1 by the DEC. This subspecies occurs in dense forest and woodland across northern Australia. Since the study area lies outside the core range and lacks suitable habitat for this species, the Masked Owl is unlikely to occur in the Project Area.

### Conservation Significance Level 3

Letter-winged Kite

*Elanus scriptus*

Grey Goshawk

*Accipiter novaehollandiae*

Yellow Chat

*Ephthianura crocea*

The above species have scattered distributions and have been recorded from the Broome region (Grey Goshawk from Roebuck, Yellow Chat from Broome Bird Observatory and Letter-winged Kite from Broome). However these species do not typically occur in Pindan vegetation and are unlikely to depend on habitat within the study area.



**Plate 1:** Hundreds of waders recorded in a roost along the coastline Roebuck Bay



**Plate 2.** Terek Sandpiper (with yellow leg band) on coastline adjacent to the Port.



**Plate 3.** Mixed wader flocks along Roebuck Bay.



**Plate 4.** Mixed Wader Flock

#### 4.2.5 Mammals

A total of 37 mammal species may occur in the study area, including 35 native and four introduced species (see Table 5). Five native mammal species were recorded from within the Project Area. These were:

1. Northern Brushtail Possum (*Trichosurus arnhemensis*)
2. Agile Wallaby (*Macropus agilis*)
3. Black Flying-fox (*Pteropus alecto*)
4. Northern Freetail Bat (*Chaerephon jobensis*)
5. Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

The Black Flying-fox (*Pteropus alecto*) and Agile Wallaby (*Macropus agilis*) were both observed within Pindan vegetation during spotlighting. Scats attributable to the Northern Brush-tailed Possum (*Trichosurus arnhemensis*) were recorded on a number of occasions both within the Project Area and adjacent areas (see Plate 5, Table C). Possum scats were recorded mostly under Fig trees, below large hollows within Figs or on Fig branches.



Plate 5. Brush-tailed Possum scats collected from the Project Area.



Plate 6. Hollow within Fig Tree.

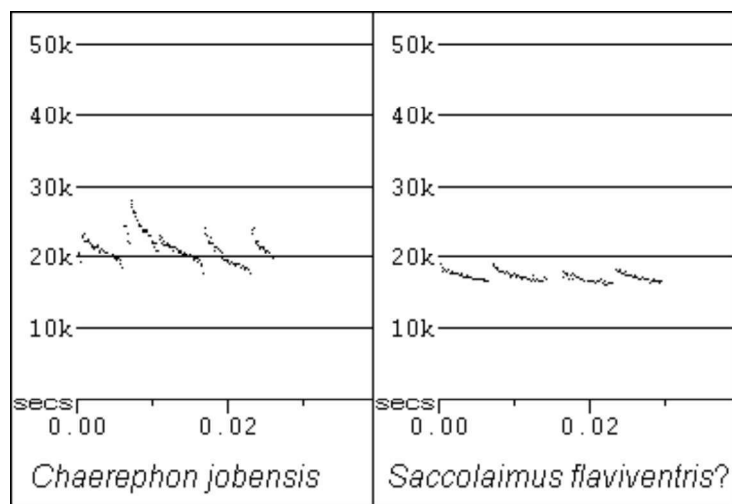
**Table C.** Possum records and significant hollows within the Project Area

Record	Easting	Northing	Comments
Possum Scats	414801.1	8010895	Scat pile
Possum Scats	414974.4	8010403	Scat pile
Possum Scats	415287	8011160	Scat pile
Possum Scats	415588.3	8010433	Scat pile
Possum Scats	414816.6	8011389	Scat pile
Tree Hollow	415103.4	8010756	Scat pile
Tree Hollow	415069.9	8010746	Fig Hollow
Tree Hollow	415454.3	8010411	Fig Hollow
Tree Hollow	415482.5	8010416	Fig Hollow
Tree Hollow	415588.3	8010433	Fig Hollow
Tree Hollow	414754.5	8011457	Fig Hollow
Tree Hollow	415018.9	8010706	Fig Hollow

Note Table B lists records obtained opportunistically, and does not include all tree hollows contained within the Project Area.

Two bat species, the Northern Freetail Bat and the Yellow-bellied Sheathail Bat were recorded using the ANABAT Bat detector. Only a small number of calls were recorded using the ANABAT of which two sequences were sufficient length and quality for analysis. The details of the ANABAT analysis are listed below:

Species Name		Fmax (kHz)	Fmin (kHz)	DUR (ms)
Northern Freetail Bat	<i>Chaerephon jobensis</i>	23.3 (±3.5)	21.6 (±2.3)	6.8 (±2.6)
Yellow-bellied Sheathail Bat	<i>Saccolaimus flaviventris</i>	18.6 (±0.7)	16.3 (±0.2)	11.2 (±0.9)



Ten mammal species of conservation significant have been recorded from the Broome region. These species are discussed below. A total of seven conservation significant mammal species may occur within the Project Area or have a home range that includes the study area.

#### Conservation Significance Level 1

##### Bilby

##### *Macrotis lagotis*

The Bilby is listed as Vulnerable by Maxwell *et al.* (1996) and the relevant state and commonwealth acts. The species formerly utilised a wide range of habitat types across the continent. Extant populations are restricted to a variety of “tall shrublands, open woodlands, hummock grasslands and sparse forblands” (Maxwell *et al.*, 1996). Threats to the species include altered fire regimes, introduced grazers and predators. The species appears to remain widespread in the Great Sandy Desert (M. Bamford pers. obs.) and scattered populations occur across the northern Pilbara, including close to Port Hedland. In the Great Sandy Desert, the species appears most common in acacia shrublands associated with paleo-drainage lines, where the soils are sandy loams.

There have been a number of recent sightings of Bilbies near Broome including records from Roebuck (25km east of Broome) in 1998 (DEC Threatened Fauna Database, 2009). Observations made by staff of the Broome Bird Observatory have been in Pindan, however this species is unlikely to occur on site due to the proximity to disturbances and feral predators. No sign of this species was recorded during the field survey. There is a low potential that this species could be a rare visitor to the site.

##### Northern Marsupial Mole

##### *Notoryctes caurinus*

The Northern Marsupial Mole is listed as Endangered under the *EPBC Act* and *WA Wildlife Conservation Act*. This blind marsupial lives mostly underground in sand dunes, interdune flats and sandy soils along river flats. It occasionally comes to the surface, apparently more frequently after rain (Maxwell *et al.* 1996). The Northern Marsupial Mole has been collected from six localities in the Gibson and Great Sandy Deserts. However this species is poorly known with very few recent records. The Project Area lies outside the known range for this species with the closest records coming from the Great Sandy Desert.

##### Golden Bandicoot

##### *Isoodon auratus auratus*

The Golden Bandicoot (*Isoodon auratus auratus*) formerly occurred in the Broome area. This species persists has undergone a large range reduction and has not been recorded near Broome since 1895 (Department of Environment and Conservation Threatened Fauna Database, 2008). The Golden Bandicoot persists in small, fragmented populations on the Dampier Peninsula. This species is unlikely to occur within the Project Area. No signs of bandicoots were observed from the Project Area.

The Golden-backed Tree-rat (*Mesembriomys macrurus*, CS1) formerly occurred across much of northern Australia, including the Dampier Peninsula (recorded from Waterbank in 1895). This species previously inhabited hollows within Eucalypt-acacia woodland on red sandy plains (Strahan, 1995). In Western Australia the Golden-backed Tree-rat is now confined to near-coastal areas in the north-western

Kimberley. The south-western Kimberley population, which includes Dampierland, is now considered extinct (Strahan, 1995).

#### Conservation Significance Level 2

Spectacled Hare-Wallaby (mainland subsp) *Lagorchestes conspicillatus leichardtii*

The Spectacled Hare-Wallaby (mainland subsp.) is listed as Priority 3 by the DEC and Lower Risk (near threatened) by Maxwell *et al.* (1996). Within Western Australia, this species is now restricted to a few small isolated patches in the Pilbara and Kimberley. It inhabits tropical grasslands and long unburnt Spinifex. Threats to the species may include those that alter habitat, such as altered fire regimes and introduced grazers e.g. cattle and rabbits; and introduced predators e.g. foxes and feral cats (Maxwell *et al.* 1996). It can also be vulnerable to roadkill and also suffers from the impacts of frequent fires. The Spectacled Hare-Wallaby has been recorded near Broome with two records from the Roebuck Plains in 2004 (DEC Threatened Species Database, 2009). The Project Area probably lacks suitable dense grassland for the species.

Kerakenga/Lakeland Downs Mouse *Leggadina lakedownensis*

The Lakeland Downs Mouse is classified as Priority 4 by the DEC. Populations of the Lakeland Downs Mouse appear to fluctuate dramatically, probably in response to environmental conditions and food availability. This species is known to occur on sandy soils and cracking clays in Western Australia, and tropical tussock grasslands or woodlands in Queensland (DEC, 2009). The study area lies within the current range of *Leggadina lakedownensis* however due to a lack of suitable habitat this species is unlikely to occur within the Project Area.

Scaly-tailed Possum *Wyulda squamicaudata*

The Scaly-tailed Possum is listed as Priority 3 by the DEC. This species is patchily distributed in the coastal north-west Kimberley in low open woodland, riparian forest, and vine thicket (Menkhorst and Knight, 2004). The Scaly-tailed Possum formerly occurred in the region however currently appears to be confined to the coastal Kimberley, including Prince Regent River Reserve, Mitchell Plateau, Kalumburu, Bigge Island and Boongaree Island (Menkhorst and Knight, 2004). There are two records from the Broome area in 1970 (DEC, 2009). However, the Project Area lies outside the current recognised distribution of the Scaly-tailed Possum.

Water Rat *Hydromys chrysogaster*

The Water Rat is listed as Priority 4 by DEC and is found in Australia, New Guinea, and a number of adjacent islands. In Western Australia, isolated populations occur in south-west, and on a number of offshore islands, including Barrow, Bernier, and Dorre Islands (Olsen 1983). The Water-rat generally occupies habitat in the vicinity of permanent water (fresh or brackish), although it can also be found in marine environments, including mangroves and occurs along the Pilbara coastline (DEC, 2008). Substantial declines have been noted in south-western Western Australia and along inland waterways affected by salinity and degradation (DEC, 2008). The Water

Rat has been recorded from the Broome area (DEC, 2009) however is unlikely to occur within the proposed Project Area due to a lack of suitable habitat.

### Conservation Significance Level 3

Northern Brush-tailed Possum	<i>Trichosurus vulpecula arnhemensis</i>
Northern Pipistrelle	<i>Pipistrellus westralis</i>
Northern Blossom Bat	<i>Macroglossus minimus</i>

The northern Pipistrelle has a scattered distribution along the north-coast of Australia. The Northern Pipistrelle occurs primarily within mangroves however in the south-western Kimberley (Dampier Peninsula) this species also occurs in Pindan vegetation (Strahan, 1995). This species may occur within the study area.

The Northern Brush-tailed Possum has a scattered distribution across the north of Western Australia (Kimberley) and the Northern Territory. Its distribution includes Pindan vegetation on the Dampier Peninsula. In Western Australia, the Brush-tailed Possum has declined over much of its range, especially in arid and semi-arid areas (Strahan, 1995). This species was recorded from the Project Area.

The Northern Blossom Bat is considered locally common in rainforest, tropical riverine woodland and mangroves across northern Australia (Menkhorst and Knight, 2004). This species roosts in trees under large leaves in dense cover, under loose bark or in the entrance of large hollows. Broome lies at the western extremity of this species range. This species may occur within the study area.

#### 4.2.6 Listed conservation significance and short-range endemic invertebrates

Invertebrates in general are beyond the scope of environmental impact assessment because there are so many species and their taxonomy is so poorly understood, but it is possible to focus on a small range of taxa that are short-range endemics, and those species that are of listed conservation significance. Harvey (2002) notes that the majority of invertebrate species that have been classified as short-range endemics have common life history characteristics such as poor powers of dispersal or confinement to discontinuous habitats. Several groups, therefore, have particularly high instances of short-range endemic species: Gastropoda (snails and slugs), Oligochaeta (earthworms), Onychophora (velvet worms), Araneae (mygalomorph spiders), Schizomida (schizomids; spider-like arachnids), Diplopoda (millipedes), Phreatoicidea (phreatoicidean crustaceans), and Decapoda (freshwater crayfish).

The Broome Peninsula area contains some habitat suitable to support short-range endemic species. Such habitat includes monsoon thickets, rocky outcrops and rock crevices, and areas within depressions where moisture is concentrated. However the proposed Project Area comprises Pindan vegetation, a habitat not known to promote short-range endemism.

Conservation of short-range endemic invertebrates may be achieved by protecting habitat with little knowledge of the species present. Disturbances to vine thickets, coastal dunes and rocky outcrops should be avoided.

## 5. IMPACT ASSESSMENT

The Broome Port Authority proposes to clear approximately 54 ha (inclusive of roads) of vegetation within the Project Area. An additional 8 hectares may be cleared by the Yawuru Native Title Holders (RNTBC) Aboriginal Corporation (or its nominated entity) for related purposes. The Project Area is situated between the Port Drive and Kavite Road and comprises mostly Pindan vegetation (Pindan 1, FCT4, see Figure 1).

Development of the Project Area can potentially adversely impact upon fauna in a number of ways. For example:

- Death/injury of fauna during clearing, grading and impacts with vehicles/machinery;
- Loss of habitat (clearing);
- Fragmentation of habitat;
- Obstructions (e.g. pipes on ground, roads) to the movements of terrestrial fauna;
- Impacts to surface and groundwater flows (through vegetation clearing)
- Introduction of permanent water storages;
- Disturbance of fauna in nearby areas from light, noise;
- Changes in the abundance of feral species;
- Direct and indirect impacts of dust.

The DEC has also highlighted several key issues relevant to the environmental management and environmental impact assessment of local fauna populations on the Broome Peninsula (Coffey Natural Systems, 2009). These include:

1. Disturbances to hollow-bearing trees - a significant habitat for fauna in the region. Such habitat provides value for hollow roosting species such as bats, some birds, pythons and arboreal mammals
2. Loss of habitat supporting conservation significant species, particularly the Peregrine Falcon and Bush Stone-Curlew
3. Removal of vegetation and habitat connectivity, reduction of faunal dispersal capabilities and impendence to fauna movement across the Peninsula
4. Edge effects and degradation of remaining vegetated fragments and faunal habitats.

Some impacts upon fauna are unavoidable. Of concern are long-term, deleterious impacts upon biodiversity. These are discussed below under the following categories:

- Habitats. Impacts may be significant if the habitat is rare, a large proportion of the habitat is affected and/or the habitat supports significant fauna.
- Significant fauna. Impacts may be significant if species of conservation importance are affected.
- Processes. Ecological processes are complex and can include hydrology, fire, predator/prey relationships and spatial distribution of a population (see discussion below). Impacts upon ecological processes may be significant if large numbers of species or large proportions of populations are affected.



- Patterns of biodiversity. Species are not distributed evenly across the landscape or even within one vegetation/landform type. There may be zones of high biodiversity such as particular habitats or ecotones (transitions between habitats).

### 5.1 Habitat Types

The main habitat types of the Port of Broome area are described in section 4.1 (above). These are:

1. **Pindan Vegetation.** Pindan 1. This is the major habitat type within the Project Area.
2. **Pindan Vegetation.** Pindan 2: This habitat occurs in the northern parts of the survey area.
3. **Thickets and large shrubs of *Ficus aculeata* var. *indecora*.** This habitat is significant as large mature trees and shrubs contain hollows suitable for birds and arboreal mammals ( a significant resource flagged by DEC)..
4. **Monsoon Thickets.** This habitat type occurs outside the Project Area.
5. **Coastal Shrubland on Primary Dunes** This habitat occurs mostly outside the Project Area however intergrades with Pindan 1 on the projects western margins.
6. **Tall Dunes on the eastern margin of the peninsula.** This habitat occurs on the sheltered eastern side of the southern Broome Peninsula outside of the Project Area.
7. **Mangrove communities.** This habitat is limited to patches along the Roebuck Bay shoreline. It does not occur within the Project Area.
8. **Beaches and mud flats.** Occur along the coastline with an extensive area of intertidal mudflats occurring the eastern shoreline of the Broome Peninsula, adjacent to and north of the Broome Port.
9. **Minor Rocky Headlands.** Rocky Headlands occur along the coastline.

The extent and impact on each habitat type can be summarised as follows:

1. Pindan 1 (FCT4):
  - Representation. Widespread in region, this habitat occurs on pindan soil on the southern half of the survey area.
  - Conservation significance. Some significant species may be present. Likely species include: *Lerista separanda*, *Simoselaps minimus*, *Ctenotus colletti*, *Morethia storri*, Bush Stone-curlew and Northern Blossom Bat. *Diporiphora pindan*, Rainbow Bee-eater and the Northern Brushtail Possum were recorded within this habitat. The Bush Stone-curlew has been recorded on site in this habitat (Birds Australia, 2009). This habitat contains some large hollow-bearing trees (particularly within Eucalypt and Fig species), a significant habitat for fauna in the region. Such habitat provides value for hollow roosting species such as bats, some birds, pythons and arboreal mammals (Coffey Natural Systems, 2009)
  - Impact. Most of the Project Area contains this habitat.
  - Significance of impact. Moderate. The clearance of up to 62 ha of vegetation within the Dampierland Bioregion (bioregion group 3) is considered by the EPA to be a “high” impact under the category of size and scale of a proposal

(EPA Guidance Statement 56), but the loss is localised and the habitat is widespread in the region. The habitat may support some species of conservation significance such as the Bush Stone-curlew. Disturbances to large hollow-bearing trees should be avoided, a significant resource flagged by the DEC.

2. Pindan 2 (FCT5):
  - Representation. Widespread in region, this habitat occurs on pindan soils north of Gantheaume Point, east of Gantheaume Point in the centre of the survey area and one on the western edge of the survey area.
  - Conservation significance. Some significant species may be present. Likely species include: *Diporiphora pindan*, *Ctenotus colletti*, *Morethia storri*, Rainbow Bee-eater, Northern Brushtail Possum, Bush Stone-curlew and Northern Blossom Bat. This habitat contains some large hollow-bearing trees (particularly within Eucalypt, Corymbia and Fig species), a significant fauna resource in the region. Such habitat provides value for hollow roosting and breeding species (such as bats, some birds, pythons and arboreal mammals, Coffey Natural Systems, 2009).
  - Impact. FCT5 lies outside the Project Area.
  - Significance of impact. Low as small area of habitat expected to be disturbed and habitat is widespread in local area.
  
3. Thickets and large shrubs of *Ficus aculeata* var. *indecora* (occurs within FCT4 and FCT5).
  - Representation. This Fig species occurs in thickets or single shrubs and is scattered throughout the survey area. Large stands occur within the Project Area, particularly in the eastern parts. Scattered areas also occur north of Gantheaume Point, east of Gantheaume Point in the centre of the survey area and a small area within the western vegetated corridor.
  - Conservation significance. This habitat is significant as large mature trees and shrubs contain hollows providing roosting, sheltering and breeding opportunities for many birds, bats, pythons and arboreal mammals such as possums. DEC has also flagged tree hollows as a significant habitat in the Broome area (Coffey Natural Systems, 2009). Some significant species are likely to utilise thickets and large shrubs of *Ficus aculeata* var. *indecora* including the Bush Stone-curlew. Within the Project Area numerous Fig stands observed had scat piles of Brush-tail Possums underneath - evidence of their use of this habitat.
  - Impact. This habitat will be impacted by the proposed disturbance. Two areas containing Fig thickets are proposed to be disturbed. The retention of stands of Fig trees on the western side of the Project Area is recommended to retain some hollows in the local area.
  - Significance of impact. Moderate. Habitat is significant however the retention of some habitat will ensure some tree hollows remain in the local area.
  
4. Open Woodland of mixed species and monsoon thicket on lower slopes behind dunes and secondary dunes (FCT3 and small areas of FCT1).
  - Representation. Scattered along the margins of Dampier Peninsula particularly the western side. On the Broome Peninsula this habitat occurs on

- the western coast along Cable Beach. Discontinuous vine thickets occur in depressions and swales between dune ridges. A small area of disturbed vegetation of this habitat type occurs at the very southern tip of the peninsula. Clearing and developmental activities have led to the quality of the vegetation in this area to decline.
- Conservation significance. This habitat equates to DEC TEC (Threatened Ecological Community) 67 Monsoon Vine thickets on coastal sand dunes of Dampier Peninsula. This habitat is classified as Vulnerable. The remnant vine thicket patches of Dampier Peninsula support many species which are at the southern limits of their range and are more often found in rainforest vegetation associated with the wetter parts of northern Australia. Vine thickets provide a significant fauna habitat and many species are restricted to this habitat in the region. Some significant species may be present. Likely species include: *Simoselaps minimus*, *Lerista apoda*, Oriental Cuckoo, Rainbow Bee-eater, Northern Brushtail Possum and Northern Blossom Bat.
  - Impact. This habitat lies outside the Project Area.
  - Significance of impact. None anticipated.
5. Coastal Shrublands on Primary Dunes (FCT1):
- Representation. Widespread in region, this habitat occurs on the crests of foredunes or on the leeward side of the foredune, on the western coastline of the survey area, north of Gantheaume Point along Cable Beach and to the west of Entrance Point along the coastline.
  - Conservation significance. Coastal dunes are a significant and disturbance sensitive habitat in the area. A number of conservation species may be present and some fauna species are likely to be restricted to this habitat type. Coastal dunes also provide habitat to a number of marine species such as turtles and marine birds. Some significant species may be present. *Ctenopus angusticeps* has been recorded in similar habitat in the region. Other conservation significant species include *Lerista separanda* and *Simoselaps minimus*
  - Impact. This habitat lies outside the Project Area.
  - Significance of impact. None anticipated.
6. Open Woodland of *Corymbia polycarpa* tall secondary dunes (FCT2):
- Representation. This habitat occurs on the sheltered eastern side of the southern Broome Peninsula, on Roebuck Bay.
  - Conservation significance. Some significant species may be present. Likely species include: *Lerista separanda*, *Simoselaps minimus*, *Lerista apoda*, *Morethia storri*, Rainbow Bee-eater, Bush Stone Curlew, Northern Brushtail Possum and Northern Blossom Bat. This habitat may contain some large hollow-bearing trees, a significant fauna resource in the region. Such habitat provides value for hollow roosting species (such as bats, some birds, pythons and arboreal mammals).
  - Impact. This habitat will not be impacted by the proposed disturbance.
  - Significance of impact. None anticipated.
7. Mangrove communities:
- Representation. Scattered in region. Small areas of Mangrove communities occur along the Roebuck Bay shoreline.

- Conservation significance. Highly significant habitat supporting a fauna assemblage largely restricted to this habitat type including several mangrove bird species. This habitat is also sensitive to disturbance. Numerous conservation significant species are likely to utilise this habitat including the Water Rat, Northern Pipistrelle, Northern Blossom Bat and a large number of migratory bird species listed under the EPBC Act.
  - Impact. This habitat will not be impacted by the proposed disturbance.
  - Significance of impact. None anticipated.
8. Beaches and mud flats along the coastline.
- Representation. Widespread in region, beaches and mudflats fringe the majority of the peninsula and also fringe the majority of the Port of Broome management area.
  - Conservation significance. Highly significant habitat supporting a fauna assemblage largely restricted to this habitat type. This habitat is also sensitive to disturbance. Numerous conservation significant species are likely to utilise this habitat including the Water Rat, Oriental Pratincole and a large number of migratory bird species listed under the EPBC Act. Many conservation significant migratory wader species have been recorded in this habitat on site including the Common Sandpiper, Ruddy Turnstone, Curlew Sandpiper, Red-necked Stint, Great Knot, Greater Sand Plover, Grey-tailed Tattler, Whimbrel, Little Tern and Common Greenshank.
  - Impact. This habitat will not be impacted by the proposed disturbance.
  - Significance of impact. None anticipated.

Minor areas of rocky headlands also lie outside the Project Area.

### Fig Thickets

Fig thickets and tree hollows are a significant and relatively sparse fauna resource in the local area (DEC comments within Coffey Natural Systems, 2009). Aerial imagery shows thickets of *Ficus aculeata* var. *indecora* to have a clumped and localised distribution on the Broome Peninsula. Tree hollows provide breeding, roosting and sheltering opportunities for many local fauna species including parrots, bats, possums and arboreal reptiles such as some pythons and varanids. Conservation significant fauna known to inhabit tree hollows include the locally significant Northern Brush-tailed Possum and Northern Blossom Bat.

A number of fig thickets with tree hollows occur within the Project Area (Table B lists some of the locations). An area on the western side of the Project Area contains several Fig thickets with numerous hollows as well as a smaller area on the eastern side (see Figure 4). Importantly, not all Fig trees contain hollows. Hollows were only observed in old, mature trees.

**Figure 4.** Areas of Pindan with Fig thickets in the Project Area. The green polygons enclose the stands of Fig trees.



The retention of a north-south corridor west of Kavite Rd is proposed to retain some of the fauna values of the site and to sustain some movement of fauna and genetic flow along the Broome Peninsula. It is recommended that some areas of Fig trees be included in this corridor to retain some tree hollows in the local area, if possible.

## 5.2 Significant species

The desktop review found that 88 significant fauna species expected to occur within the Survey Area. Conservation significant fauna in the region includes three Frog, six reptile, 69 bird and 10 mammal species. However, some species are likely to be infrequent visitors to the site and many of these species are unlikely to be present in habitats found within the Project Area. For example, the majority of these species are conservation significant migratory waterbirds.

Forty three species listed as migratory or marine under the EPBC Act (CS1) have been recorded along the Broome Port shoreline near the proposed project. The Broome area is recognised internationally as an important area for many of these bird species. These populations are supported by the large intertidal mud flats of Roebuck Bay including in the Broome Port area.

Despite these records, the occurrence of migratory, marine and coastal species within the Project Area is likely to be minimal, with these species unlikely to be dependent on habitats occurring within the proposed Project Area. Occasional sandpipers and terns were observed flying over the Project Area during the site inspection. Indirect impacts on wader populations may arise during the construction of the project through elevated noise, dust and lighting and elevated number of people visiting and utilising the local area. Increased human activity within Roebuck Bay is a concern for the long-term viability of wader populations in the local area.

Conservation significant species expected to occur in the local area are listed in Table 5 and impacts anticipated to arise from the proposed project discussed in Table 6. Of the conservation significant species expected, 15 were recorded in the Project Area or are considered likely to utilise habitat within the Project Area. These are:

- Peregrine Falcon (CS1: recorded in survey area)
- Fork-tailed Swift (CS1, recorded in survey area)
- Rainbow Bee-eater (CS1, recorded in Project Area)
- Bush Stone-curlew (CS2, recorded at Project Area)
- Barn Swallow (CS1, recorded at project)
- Northern Brush-tailed Possum (CS3, recorded at project)
- Northern Pipistrelle (CS3, likely, suitable habitat)
- Northern Blossom Bat (CS3, likely, suitable habitat)
- *Ctenopus angusticeps* (CS1, recorded in region)
- *Lerista separanda* (CS2, recorded 1km from project)
- *Simoselaps minimus* (CS2, recorded 1km from project)
- *Diporiphora pindan* (CS3, recorded at project)
- *Ctenopus colletti* (CS3, potential to occur, recorded in region)
- *Lerista apoda* (CS3, suitable habitat present)
- *Morethia storri* (CS3, suitable habitat present)

An additional five species have the potential to be rare visitors to the Project Area. However these species are not expected to be dependent on habitat within the Project Area. These are

- Oriental Cuckoo (CS1, recorded in greater region)
- Grey Falcon (CS1, recorded in greater region)
- Letter-winged Kite (CS3, rare nomad to Broome area)
- White throated Needle-tail (CS1, recorded in greater region)
- Bilby (CS1, some records near Broome)

These species are briefly described above (Sections 4.2), listed in Table 5 and impacts are summarised in Table 6.

Impacts on all significant species except the Northern Brush-tail Possum are expected to be low because of the small size of the proposed project and the availability of similar habitat outside the impact zone. The Project Area is likely to form only a component of the foraging range of the Peregrine Falcon, Rainbow Bee-eater, Northern Pipistrelle, Fork-tailed Swift and Barn Swallow. Disturbances to breeding habitat of these species within the Project Area are unlikely, although the Rainbow Bee-eater may nest within the Project Area. The Northern Blossom Bat may utilise tree hollows within the Project Area. Additionally, more sedentary species, such as the Bush Stone-curlew, *Lerista separanda*, *Diporiphora pindan*, *Ctenopus colletti*, *Lerista apoda*, *Morethia storri* and *Simoselaps minimus*, are likely to reside within the Project Area.

The potential impact on the Brush-tail Possum is considered to be higher than for other significant species because it is sedentary, is a large mammal that is likely to be present in only small numbers, and it is vulnerable to a number of impacting processes such as loss of shelter sites, predation by feral species and roadkill.

The proposed development may impact on these species and species that are not considered to be of conservation significance in several ways:

- Increased road-kill of slow-moving or ground dwelling species e.g. pythons;
- Loss of habitat;
- Increasing the number of introduced predators e.g. feral cats and foxes; and
- Altering the local fire regime.
- Alteration of local hydrology
- Disturbance or loss of breeding sites

To minimise these potential impacts, a number of recommendations are made (see Recommendations).

### *Ecological processes*

Many of the potential impacts of proposed developments upon fauna can be related to ecological processes, and this is recognised under the EPBC Act, in which threatening processes are listed, and in the literature (see **Appendix 2**). A number of ecological processes can be related to the impacts upon fauna of the project, and these are discussed below.

#### 5.3.1 Increased mortality

Direct mortality of common species during clearing is unavoidable but can be minimised (see below). Direct mortality of rare species, and ongoing mortality such as due to roadkill, may have a significant impact. Fragmentation of habitat can severely affect wildlife and lead to mortality through collision with vehicles (Jackson and Griffen 2000; Scheik and Jones 1999; Clevenger and Waltho 2000). Dufty (1989) suggested that the greatest cause of adult mortality in populations of Eastern Barred Bandicoots (*Peremeles gunni*) was due to collisions with vehicles. Jones (2000) documented the sudden decline in a population of Eastern Quolls (*Dasyurus viverrinus*) and Tasmanian Devils (*Sarcophilus harrisi*) directly attributed to increased road mortality following the upgrade of a local road. Direct and ongoing mortality (in particular from road collisions) may be a concern for the viability of species that occur at low population densities in areas adjacent to the lease area. This could be a concern, for example, for the Bush Stone-curlew.

#### 5.3.2 Loss of habitat affecting population survival

Some loss of habitat is inevitable but can be minimised through controls during clearing. Rehabilitation of disturbed areas may also be implemented. The small area of impact in relation to the surrounding landscape means that loss of habitat is unlikely to have short-term adverse impacts upon fauna populations in the region. However, ongoing vegetation clearing in the Broome Port area is a concern. Approximately 30 ha have been approved for clearing adjacent to the proposed project resulting in over 80 hectares of native vegetation loss in the local area. Other areas adjacent to the Port have been cleared in recent years. These successive clearing events result in the cumulative loss and increasing fragmentation of habitat along the Broome Peninsula, and the proposal represents further loss.

The DEC has identified habitat fragmentation as a concern for fauna conservation on the Broome Peninsula. The retention of native vegetation in areas assigned for conservation will retain some of the fauna values of the local area, particularly if the conservation areas contain significant fauna habitats (eg. monsoon thickets). If further areas are planned to be cleared then long-term planning should consider the careful placement of environmental corridors and conservation reserves to maximise the fauna values of the local area. In the future, intensive fauna studies may be valuable to identify the fauna values of conservation areas and the effectiveness of fauna corridors, and to enhance the knowledge of the local terrestrial fauna.

The Broome Peninsula appears to have been relatively under surveyed considering the level of disturbance in the local area, with few terrestrial fauna records for the region on NatureMap (DEC, 2009). Due to the size and scale of the project, an extended Level 1 Fauna Assessment was commissioned by Coffey Natural Systems. A Level 1 survey provides basic fauna information for environmental impact assessment.



Further fauna studies should be considered if additional vegetation clearance is planned and to monitor fauna populations in adjacent areas.

### 5.3.3 Loss of habitat affecting population movements and gene flow

The Project Area forms part of a continuous strip of native vegetation extending north-south along the western side of the Broome Peninsula. This area of intact vegetation allows for the movement of fauna, and is likely to facilitate population movements and genetic flow. A continuous corridor of vegetation along the Broome Peninsula is likely to be important for local fauna, particularly by allowing for genetic exchange in more sedentary species.

The proposed clearing of up to 62 ha of Pindan vegetation extends approximately 700m east – west across the Broome Peninsula. In this area, the Broome Peninsula is narrow (approximately 1.5km east – west) and contains numerous cleared or developed areas associated with the Port and industry.

The DEC has identified habitat fragmentation as a concern for fauna conservation on the Broome Peninsula. The proposed project will result in habitat loss and there reduce habitat connectivity, reduce fauna dispersal capabilities and create and impedance to fauna movement. This impact can however be reduced by the retention of vegetated corridors allowing for fauna movement. The Port of Broome has suggested a western vegetated corridor will remain along the western margins of the Project Area.

To minimise habitat loss and fragmentation and sustain the movement of some fauna along the peninsula it is recommended that the western margin of the Project Area be retained. The retention of a corridor of vegetation extending north –south through the proposed Project Area should be considered. This should occur parallel to and east of Kavite Rd and be wide enough to include some stands of Figs to preserve some hollows – a significant habitat in the area. This will also enhance and buffer the significant coastline vegetation which includes monsoon thickets (a TEC) on the western edge of the Broome Peninsula.

A narrow strip of intact native vegetation occurs along the coastline in the vicinity of the proposed project (west of Kavite Rd). This narrow strip may be susceptible to degradation and edge effects. The retention of vegetation on the eastern side of Kavite Rd (within the Project Area) will increase the size and width of this environmental corridor (which in turn is likely to increase the corridor's capacity for fauna movement and genetic flow) and will also enhance and buffer habitat along the coastline.

A number of significant habitats occur in adjacent areas. Habitats such as the mangrove communities, coastal mud flats, beaches and vine thicket are recognised as significant fauna habitat in the region, supporting numerous species of conservation significance. Some of these habitats fall within the proposed Environmental Corridor as part of the Port of Broome's environmental management plan.

#### 5.3.4 Species interactions, including predators and other feral species

Introduced species, including the Feral Cat and Fox, may have adverse impacts upon native species. In particular, several mammal species expected in the area are sensitive to predation by Cats and Foxes. The Feral Cat is present in the area and the Fox has spread to the northern edge of the Great Sandy Desert in recent years, including Dampier Downs Station (M. Bamford pers. obs). Both can increase in abundance around industrial areas due either to the inadvertent increase in food supply from scraps and increases in the abundance of rodents, or to deliberate feeding by personnel. The Cane Toad may potentially colonise the region in the next 10 years and poses a threat to several species.

#### 5.3.5 Hydroecology

Interruptions of hydroecological processes can have massive effects because they underpin primary production in ecosystems and there are specific, generally rare habitats that are hydrology-dependent. Roads may alter both surface and sub-surface hydrology. However, hydroecological impacts from the proposed expansion are likely to be minimal, mainly because of the small scale of the project within the surrounding landscape.

#### 5.3.6 Climate change

As a result of human-induced climate change, the climatic 'envelope' (the climatic zone within which a species exists, Soule *et al.* 2004) of many species will physically shift or even cease to exist. Some species may not be able to keep pace with the geographical movement (or disappearance) of their climatic envelope. Conversely, climate change may exacerbate the spread of other species or disease into areas where they currently do not occur. Loss of coastal habitats due to sea level rise may need to be considered, especially as this may affect proposed conservation areas west of Kavite Road.

#### 5.3.7 Fire

Fire is a natural feature of the environment on the Dampier Peninsula, but frequent, extensive fires may adversely impact some fauna, particularly mammals. Fire Management strategies may be implemented as part of management of the Project Area to protect long-unburnt habitats that may be important for fauna.

#### 5.3.8 Light, noise and disturbance

Impacts of light and noise upon fauna are difficult to predict. As such, it is best to take a precautionary approach. The death of very large numbers of insects has been reported around some remote minesites and attracts other fauna (including introduced predators), as well as presumably reducing the populations of insects in surrounding habitats. These factors may need to be considered in the local area. The impact of disturbance is also hard to gauge, but this may be an important consideration because of roosting of migratory waterbirds along Roebuck Bay just east of the Project Area. Roosting waterbirds are sensitive to disturbance, such as from people walking along the beach, and there may be an increase in this sort of disturbance as a result of the project.

## 6. MANAGEMENT AND MONITORING RECOMMENDATIONS

Impacts upon fauna due to the construction and operation of the Project that are of particular concern relate to loss and fragmentation of habitat, and increased disturbance. Also of concern are, potential impacts from roadkill, and changes in hydrology, the fire regime and the abundance of introduced predators. Recommendations to minimise potential impacts are discussed below.

### **Recommendation 1:**

Limit loss of habitat by minimising clearing of native vegetation. This includes the regrowth areas which may contribute to fauna habitat. Also, prevent degradation of vegetation surrounding study areas by increasing the awareness of personnel and restricting access to areas of adjacent vegetation.

#### **Reason:**

Retain as much habitat as possible, in the best condition possible. This will help retain the fauna values already present at the site and facilitate rehabilitation.

### **Recommendation 2:**

Retain a corridor of vegetation extending north – south through the Project Area. This should occur parallel to and east of Kavite Rd and be wide enough to include some stands of Figs to preserve some hollows – a significant habitat in the area.

#### **Reason:**

The removal of vegetation and habitat connectivity, reduction of faunal dispersal capabilities and impendence to fauna movement across the Peninsula are key issues raised by the DEC in relation to environmental impact assessment. , The retention of vegetation along the western side of the proposed project will retain some habitat connectivity along the peninsula and maintain some faunal dispersal capabilities. . This will also enhance and buffer the significant coastline vegetation which includes monsoon thickets (a TEC) on the western edge of the Broome Peninsula. The exact size and location of a western vegetated corridor should be determined in consultation with DEC.

### **Recommendation 3:**

Consider Environmental Corridors and significant fauna habitats in the long-term planning of the Port's development.

#### **Reason:**

A number of significant fauna habitats occur in the local area, including intertidal mudflats, mangroves, coastal dunes and monsoon thickets. The preservation and management of these areas should be considered by the Port of Broome.

### **Recommendation 4:**

Large hollow bearing trees should be retained. Fig thickets should be included within any areas set aside for conservation.

#### **Reason:**

The clearance of such habitat should be avoided as hollows provides habitat to many species such as bats, some birds, pythons and arboreal mammals.

**Recommendation 5:**

Feral fauna, particularly Cats (and Foxes if they become established around Broome), should not be encouraged. Feral animal control strategies should be implemented where necessary.

**Reason:**

Cats and Foxes are significant predators of native wildlife.

**Recommendation 6:**

Although hydrological impacts are considered unlikely, any effects on groundwater or surface hydrology should be minimised.

**Reason:**

Hydrological changes can have far-reaching consequences on surrounding ecosystems.

**Recommendation 7:**

Conduct fauna monitoring as part of ongoing management of the port area..

**Reason:**

A number of conservation significant species may occur in the area. By increasing the knowledge of fauna in the area local (including within areas set aside for conservation) biodiversity and habitat values can be better managed. Additionally a fauna survey of the Environmental Corridor may assist in future management practices.

## 7. CONCLUSIONS

- A total of 385 native vertebrate fauna species may occur on the Broome Peninsula or utilise a home range that includes the Broome Peninsula, based on distribution and possible habitat types.
- Fifteen conservation significant species are likely to occur in the study area or utilise a home range that includes the study area. These include: 5 CS1 species (Rainbow Bee-eater, Fork-tailed Swift, Peregrine Falcon, Barn Swallow, *Ctenotus angusticeps*), 3 CS2 species (*Lerista separanda*, *Simoselaps minimus*, Bush Stone-curlew) and 7 CS3 species (*Ctenotus colletti*, *Diporiphora pindan*, *Lerista apoda*, *Morethia storri*, Northern Brushtail Possum, Northern Pipistrelle, Northern Blossom Bat).
- The Bush Stone-curlew, Rainbow Bee-eater, Barn Swallow, Peregrine Falcon and Fork-tailed Swift have been recorded within the vicinity of the Project Area.
- A number of conservation significant migratory waterbirds have been recorded from the beaches and mudflats within the Port of Broome area.
- Large, hollow bearing trees (Figs and *Corymbia* sp.) are present within the Project Area. The loss of these trees should be avoided if possible. Hollows provides habitat to many species such as bats, some birds, pythons and arboreal mammals.
- The establishment of an environmental corridor within the proposed project is recommended to minimise the impacts on local fauna.
- A fauna survey of the Environmental Corridor may assist in future management practises.

Impacts are summarised in accordance with EPA Guidance in Table 6.

**TABLE 1. Frogs Expected in the Broome area.** Expected occurrence is primarily based on known species distributions and available habitats. Levels of Conservation Significance are discussed in the “Assessment of Conservation Significance” section. Species recorded during the site inspection are listed (x) as well as species recorded on site by databases, literature or by personnel communication (R).

FROGS	Conservation Significance	Survey Area 2009
<b>Hylidae (tree-frogs)</b>		
Giant Frog <i>Cyclorana australis</i>		
Long-footed Frog <i>Cyclorana longipes</i>		
Green Tree Frog <i>Litoria caerulea</i>		X
Rocket Frog <i>Litoria nasuta</i>		
Desert Tree Frog <i>Litoria rubella</i>		
Roth’s Tree Frog <i>Litoria rothi</i>		
<b>Myobatrachidae (ground-frogs)</b>		
Ornate Frog <i>Limnodynastes ornatus</i>		
Desert Spadefoot <i>Notaden nichollsi</i>		
Derby Toadlet <i>Uperoleia aspera</i>	CS3*	
Mjoberg’s Toadlet <i>Uperoleia mjobergi</i>	CS3*	
Mole Toadlet <i>Uperoleia talpa</i>	CS3*	
<b>Total Number of Species Expected</b>	<b>11</b>	<b>1</b>

\* Restricted to bioregion

**TABLE 2. Reptiles Expected in the Broome area.** Expected occurrence is primarily based on known species distributions and available habitats. Levels of Conservation Significance are discussed in the “Assessment of Conservation Significance” section. Species recorded during the site inspection are indicated (X). Species previously recorded on-site by NatureMap, personal communication or literature are also indicated (R).

<b>Reptiles</b>				
<b>Common Name</b>	<b>Species Name</b>	<b>Conservation Significance</b>	<b>2009 Survey</b>	<b>Previous Records</b>
<b>Gekkonidae</b> (geckoes)				
Fat-tailed Gecko	<i>Diplodactylus conspicillatus</i>			
	<i>Diplodactylus stenodactylus</i>			
Northern Dtella	<i>Gehyra australis</i>		X	
	<i>Gehyra nana</i>			
Pilbara Dtella	<i>Gehyra pilbara</i>			
	<i>Gehyra purpurascens</i>			
Tree Dtella	<i>Gehyra variegata</i>			
Asian House Gecko	<i>Hemidactylus frenatus</i>	Introduced	X	
Bynoe’s Gecko	<i>Heteronotia binoei</i>			
	<i>Oedura rhombifera</i>			
Beaked Gecko	<i>Rhynchoedura ornata</i>			
	<i>Strophurus ciliaris aberrans</i>			
	<i>Strophurus jeanae</i>			
<b>Pygopodidae</b> (legless-lizards)				
	<i>Delma tineta</i>			
Burton’s Legless Lizard	<i>Lialis burtonis</i>			R
<b>Agamidae</b> (dragon lizards)				
Gilbert’s Dragon	<i>Amphibolurus gilberti</i>		X	
Long-nosed Dragon	<i>Amphibolurus longirostris</i>			
Chameleon Dragon	<i>Chelosania brunnea</i>			
Friiled Lizard	<i>Chlamydosaurus kingii</i>			R
Ring-tailed Dragon	<i>Ctenophorus caudicinctus</i>			
Military Dragon	<i>Ctenophorus isolepis</i>			
Central Netted Dragon	<i>Ctenophorus nuchalis</i>			
Pindan Dragon	<i>Diporiphora pindan</i>	CS3: restricted	X	
	<i>Diporiphora winneckeii</i>			
Dwarf Bearded Dragon	<i>Pogona minor mitchelli</i>			
<b>Varanidae</b> (goannas or monitor lizards)				
Ridge-tailed Monitor	<i>Varanus acanthurus</i>			
	<i>Varanus brevicauda</i>			
Pygmy Mulga-monitor	<i>Varanus gilleni</i>			
Sand Goanna	<i>Varanus gouldii</i>		X	
	<i>Varanus panoptes panoptes</i>			
Spotted Tree Monitor	<i>Varanus scalaris</i>			
	<i>Varanus tristis tristis</i>		X	
<b>Scincidae</b> (skink lizards)				
	<i>Carlia munda</i>			
	<i>Carlia rufilatus</i>			

<b>Reptiles</b>				
<b>Common Name</b>	<b>Species Name</b>	<b>Conservation Significance</b>	<b>2009 Survey</b>	<b>Previous Records</b>
	<i>Carlia triacantha</i>			
	<i>Cryptoblepharus metallicus</i>			
	<i>Cryptoblepharus ruber</i>		X	
	<i>Cryptoblepharus tyttos</i>			
	<i>Ctenotus angusticeps</i>	CS1		
	<i>Ctenotus colletti</i>	CS3: restricted		
	<i>Ctenotus inornatus</i>		X	
	<i>Ctenotus pantherinus ocellifer</i>			
	<i>Ctenotus serventyi</i>			
Broad-Banded Sandswimmer	<i>Eremiascincus richardsonii</i>			
	<i>Glaphyromorphus isolepis</i>		X	
	<i>Lerista apoda</i>	CS3: restricted		
	<i>Lerista bipes</i>			
	<i>Lerista greeri</i>			
	<i>Lerista griffini</i>			
	<i>Lerista labialis</i>			
	<i>Lerista separanda</i>	CS2		R
	<i>Menetia greyii</i>			
	<i>Menetia maini</i>			
	<i>Morethia ruficauda ruficauda</i>			
	<i>Morethia storri</i>	CS3: restricted		
	<i>Notoscincus ornatus wotjulum</i>			
	<i>Proablepharus tenuis</i>			
Centralian Blue-tongue	<i>Tiliqua multifasciata</i>			
Eastern Blue-tongue	<i>Tiliqua scincoides intermedia</i>		X	
<b>Typhlopidae</b> (blind snakes)				
	<i>Ramphotyphlops braminus</i>			
	<i>Ramphotyphlops diversus</i>			
	<i>Ramphotyphlops grypus</i>			
<b>Boidae</b> (pythons)				
Children's Python	<i>Antaresia childreni</i>			
Stimson's Python	<i>Antaresia stimsoni stimsoni</i>			
Black-headed Python	<i>Aspidites melanocephalus</i>			R
Water Python	<i>Liasis mackloti</i>			
Olive Python	<i>Liasis olivaceus olivaceus</i>			
<b>Colubridae</b> (rear-fanged snakes)				
Common Tree Snake	<i>Dendrelaphis punctulata</i>			
White-bellied Mangrove Snake	<i>Fordonia leucobalia</i>			
<b>Elapidae</b> (front-fanged snakes)				
Desert Death Adder	<i>Acanthophis pyrrhus</i>			
	<i>Brachyuropis roperi</i>			
Half-girdled Snake	<i>Brachyuropis semifasciatus</i>			
Olive Whip Snake	<i>Demansia olivacea</i>			
Yellow-faced Whip	<i>Demansia psammophis</i>			
	<i>Demansia reticulata</i>			
Moon Snake	<i>Furina ornata</i>			R



<b>Reptiles</b>				
<b>Common Name</b>	<b>Species Name</b>	<b>Conservation Significance</b>	<b>2009 Survey</b>	<b>Previous Records</b>
Mulga Snake	<i>Pseudechis australis</i>			R
Ringed Brown Snake	<i>Pseudonaja modesta</i>			
Western Brown Snake	<i>Pseudonaja nuchalis</i>			
	<i>Simoselaps anomalus</i>			
	<i>Simoselaps minimus</i>	CS2		R
Little Spotted Snake	<i>Suta punctata</i>			
<b>Total Number of Species Expected</b>		<b>82</b>		
<b>Total Number of Species Recorded during Site Inspection: 10</b>				
<b>Total Number of Species Recorded in Survey Area: 17</b>				

**TABLE 3. Birds Expected in the Broome area.** Expected occurrence is primarily based on known species distributions and available habitats. Levels of Conservation Significance are discussed in the “Assessment of Conservation Significance” section. Species recorded during the 2009 site inspection are listed (x) as well as species recorded on site by databases, literature or by personal communication (R). Those species recorded within the proposed area of disturbance are listed under the column “Project Area” with species recorded outside this area listed under “Survey Area”.

<b>Birds</b>				
<b>Common Name</b>	<b>Species Name</b>	<b>Conservation Significance</b>	<b>Project Area</b>	<b>Survey Area</b>
<b>Phasianidae</b> (pheasants and quails)				
Brown Quail	<i>Coturnix ypsilophora</i>			
<b>Anseranatidae</b> (Magpie Goose)				
Magpie Goose	<i>Anseranas semipalmata</i>	EPBC Marine		
<b>Anatidae</b> (ducks and swans)				
Hardhead	<i>Aythya australis</i>			
Plumed Whistling-Duck	<i>Dendrocygna eytoni</i>			X
Wandering Whistling-Duck	<i>Dendrocygna arcuata</i>			X
Freckled Duck	<i>Stictonetta naevosa</i>			
Black Swan	<i>Cygnus atratus</i>			
Radjah Shelduck	<i>Tadorna radjah</i>			
Australian Wood Duck	<i>Chenonetta jubata</i>			
Green Pygmy-goose	<i>Nettapus pulchellus</i>			
Pacific Black Duck	<i>Anas superciliosa</i>			X
Australasian Shoveler	<i>Anas rhynchotis</i>			
Grey Teal	<i>Anas gracilis</i>			X
Chestnut Teal	<i>Anas castanea</i>			
Garganey	<i>Anas querquedula</i>			
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>			
<b>Podicipedidae</b> (grebes)				
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>			
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>			
Great Crested Grebe	<i>Podiceps cristatus</i>			
<b>Procellariidae</b> (Petrels, Shearwaters, Diving-Petrels)				
Streaked Shearwater	<i>Calonectris leucomels</i>	EPBC MIG		
Wedge-tailed Shearwater	<i>Puffinus pacificus</i>	EPBC MIG		
Hutton's Shearwater	<i>Puffinus huttoni</i>			
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>	EPBC MIG		
<b>Sulidae</b> (Gannets, Boobies)				
Masked Booby	<i>Sula dactylatra</i>	EPBC MIG		
Brown Booby	<i>Sula leucogaster</i>	EPBC MIG		X
<b>Fregatidae</b> (Frigatebirds)				
Lesser Frigatebird	<i>Fregata ariel</i>	EPBC MIG		X
<b>Anhingidae</b>				
Darter	<i>Anhinga melanogaster</i>			
<b>Phalacrocoracidae</b> (cormorants)				
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>			
Pied Cormorant	<i>Phalacrocorax varius</i>			
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>			
Great Cormorant	<i>Phalacrocorax carbo</i>			
<b>Pelecanidae</b> (pelicans)				
Australian Pelican	<i>Pelecanus conspicillatus</i>			

<b>Ardeidae</b> (herons and egrets)				
White-faced Heron	<i>Egretta novaehollandiae</i>			
Little Egret	<i>Egretta garzetta</i>			
White-necked Heron	<i>Ardea pacifica</i>			
Eastern Reef Egret	<i>Egretta sacra</i>		X	X
Great Egret	<i>Ardea alba</i>	CS1		
Intermediate Egret	<i>Ardea intermedia</i>			
Cattle Egret	<i>Ardea ibis</i>	CS1		
Striated Heron	<i>Butorides striatus</i>			X
Nankeen Night Heron	<i>Nycticorax caledonicus</i>			
<b>Threskiornithidae</b> (ibis and spoonbills)				
Glossy Ibis	<i>Plegadis falcinellus</i>	CS1		
Australian White Ibis	<i>Threskiornis moluucca</i>			X
Straw-necked Ibis	<i>Threskiornis spinicollis</i>			
Royal Spoonbill	<i>Platalea regia</i>			
Yellow-billed Spoonbill	<i>Platalea flavipes</i>			
<b>Ciconiidae</b> (storks)				
Black-necked Stork	<i>Ephippiorynchus asiaticus</i>			
<b>Accipitridae</b> (kites, hawks and eagles)				
Eastern Osprey	<i>Pandion cristatus</i>	CS1		X
Black-shouldered Kite	<i>Elanus axillaris</i>		X	
Letter-winged Kite	<i>Elanus scriptus</i>	CS3: nomadic, fewer than 5 records per year		
Square tailed Kite	<i>Lophoictinia isura</i>			
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>			
Black (Fork-tailed) Kite	<i>Milvus migrans</i>			X
Whistling Kite	<i>Haliastur spheonurus</i>			X
Brahminy Kite	<i>Haliastur indus</i>			X
White bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	CS1: EPBC MIG		X
Swamp Harrier	<i>Circus approximans</i>			
Spotted Harrier	<i>Circus assimilis</i>			
Brown Goshawk	<i>Accipiter fasciatus</i>		X	X
Grey Goshawk	<i>Accipiter novaehollandiae</i>	CS3: few records for subregion		
Red Goshawk	<i>Erythrotriorchus radiatus</i>	CS1		
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>			
Wedge-tailed Eagle	<i>Aquila audax</i>			
Little Eagle	<i>Hieraetus morphnoides</i>			
<b>Falconidae</b> (falcons)				
Black Falcon	<i>Falco subniger</i>			
Peregrine Falcon	<i>Falco peregrinus</i>	CS1		
Australian Hobby	<i>Falco longipennis</i>			
Grey Falcon	<i>Falco hypoleucos</i>	CS2		
Brown Falcon	<i>Falco berigora</i>			
Nankeen Kestrel	<i>Falco cenchroides</i>			X
<b>Gruidae</b> (cranes)				
Brolga	<i>Grus rubicunda</i>			
<b>Rallidae</b> (Rails, Crakes)				
Buff-banded Rail	<i>Gallirallus philippensis</i>			
Black-tailed Native-hen	<i>Gallinula ventralis</i>			
<b>Otididae</b> (bustards)				
Australian Bustard	<i>Ardeotis australis</i>	CS2		
<b>Turnicidae</b> (button-quails)				
Little Button-quail	<i>Turnix velox</i>			
Red-backed Button-quail	<i>Turnix maculosa</i>			
Chestnut-backed Button-quail	<i>Turnix castanota magnifica</i>	CS2		

Red-chested Button-quail	<i>Turnix pyrrhotorax</i>			
<b>Scolopacidae</b> (Curlews, Sandpipers, Snipes, Godwits)				
Pin-tailed Snipe	<i>Gallinago stenura</i>	EPBC MIG		
Swinhoe's Snipe	<i>Gallinago megala</i>	EPBC MIG		
Black-tailed Godwit	<i>Limosa limosa</i>	EPBC MIG		X
Bar-tailed Godwit	<i>Limosa lapponica</i>	EPBC MIG		X
Little Curlew	<i>Numenius minutus</i>	EPBC MIG		
Whimbrel	<i>Numenius phaeopus</i>	EPBC MIG		X
Eastern Curlew	<i>Numenius madagascariensis</i>	EPBC MIG		X
Common Redshank	<i>Tringa totanus</i>	EPBC MIG		
Marsh Sandpiper	<i>Tringa stagnatilis</i>	EPBC MIG		
Common Greenshank	<i>Tringa nebularia</i>	EPBC MIG		X
Wood Sandpiper	<i>Tringa glareola</i>	EPBC MIG		
Terek Sandpiper	<i>Xenus cinereus</i>	EPBC MIG		X
Common Sandpiper	<i>Actitis hypoleucos</i>	EPBC MIG	X	X
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	EPBC MIG		X
Ruddy Turnstone	<i>Arenaria interpres</i>	EPBC MIG		X
Asian Dowitcher	<i>Limnodromus semipalmatus</i>	EPBC MIG		
Great Knot	<i>Calidris tenuirostris</i>	EPBC MIG		X
Red Knot	<i>Calidris canutus</i>	EPBC MIG		
Sanderling	<i>Calidris alba</i>	EPBC MIG		
Red-necked Stint	<i>Calidris ruficollis</i>	EPBC MIG		X
Long-toed Stint	<i>Calidris subminuta</i>	EPBC MIG		
Pectoral Sandpiper	<i>Calidris melanotos</i>	EPBC MIG		
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	EPBC MIG		
Curlew Sandpiper	<i>Calidris ferruginea</i>	EPBC MIG		X
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	EPBC MIG		
Ruff	<i>Philomachus pugnax</i>	EPBC MIG		
<b>Rostratulidae</b> (Painted Snipe)				
Painted Snipe	<i>Rostratula benghalensis</i>	EPBC MIG		
<b>Burhinidae</b> (stone-curlews)				
Bush Stone-curlew	<i>Burhinus grallarius</i>	CS2		
Beach Stone-curlew	<i>Esacus neglectus</i>			
<b>Haematopodidae</b> (Oystercatchers)				
Pied Oystercatcher	<i>Haematopus longirostris</i>			X
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>			
<b>Charadriidae</b> (Lapwings, Plovers, Dotterels)				
Black-winged Stilt	<i>Himantopus himantopus</i>			X
Pacific Golden Plover	<i>Pluvialis fulva</i>	EPBC MIG		X
Grey Plover	<i>Pluvialis squatarola</i>	EPBC MIG		X
Red-capped Plover	<i>Charadrius ruficapillus</i>			X
Lesser Sand Plover	<i>Charadrius mongolus</i>	EPBC MIG		
Greater Sand Plover	<i>Charadrius leschenaultii</i>	EPBC MIG		X
Oriental Plover	<i>Charadrius veredus</i>	EPBC MIG		
Black-fronted Dotterel	<i>Euseyonis melanops</i>			
Red-kneed Dotterel	<i>Erythrogonys cinctus</i>			
Masked Lapwing	<i>Vanellus miles</i>			X
<b>Glareolidae</b> (pratincoles)				
Oriental Pratincole	<i>Glareola maldivarum</i>	CS1 EPBC MIG		
Australian Pratincole	<i>Stiltia isabella</i>			
<b>Laridae</b> (Gulls, Terns)				
Silver Gull	<i>Larus novaehollandiae</i>			X
Gull-billed Tern	<i>Sterna nilotica</i>			X
Caspian Tern	<i>Sterna caspia</i>			
Lesser Crested Tern	<i>Sterna bengalensis</i>			
Crested Tern	<i>Sterna bergii</i>			X
Roseate Tern	<i>Sterna dougallii</i>			

Common Tern	<i>Sterna hirundo</i>	EPBC MIG		
Little Tern	<i>Sterna albifrons</i>	EPBC MIG		
Fairy Tern	<i>Sterna nereis</i>			
Bridled Tern	<i>Sterna anaethetus</i>	EPBC MIG		
Whiskered Tern	<i>Chlidonias hybridus</i>			X
White-winged Tern	<i>Chlidonias leucopterus</i>	EPBC MIG		
Sooty Tern	<i>Sterna fuscata</i>			
Common Noddy	<i>Anous stolidus</i>	EPBC MIG		
<b>Columbidae</b> (pigeons and doves)				
Rock Dove	<i>Columba livia</i>	Introduced		
Flock Bronzewing	<i>Phaps histrionica</i>	CS2		
Peaceful Dove	<i>Geopelia placida</i>		X	X
Diamond Dove	<i>Geopelia cuneata</i>			
Bar-shouldered Dove	<i>Geopelia humeralis</i>		X	X
Common Bronzewing	<i>Phaps chalcoptera</i>			
Crested Pigeon	<i>Ocyphaps lophotes</i>		X	X
Pied Imperial Pigeon	<i>Ducula bicolor</i>			
<b>Cacatuidae</b> (cockatoos)				
Red-tailed Black-Cockatoo	<i>Calyptorhynchus banksii</i>			
Galah	<i>Cacatua roseicapilla</i>			
Little Corella	<i>Cacatua sanguinea</i>			X
<b>Psittacidae</b> (lorikeets and parrots)				
Cockatiel (wiero)	<i>Nymphicus hollandicus</i>			
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>		X	X
Varied Lorikeet	<i>Psitteuteles versicolor</i>			
Red-winged Parrot	<i>Aprosmictus erythropterus</i>		X	X
Budgerigar	<i>Melopsittacus undulatus</i>			
<b>Cuculidae</b> (cuckoos)				
Oriental Cuckoo	<i>Cuculus saturatus</i>	CS1		
Pallid Cuckoo	<i>Cuculus pallidus</i>			
Brush Cuckoo	<i>Cacomantis variolosus</i>			
Black-eared Cuckoo	<i>Chrysococcyx osculans</i>			
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>		X	X
Little Bronze-Cuckoo	<i>Chrysococcyx minutillus</i>			R
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>			
<b>Centropidae</b> (Coucals)				
Pheasant Coucal	<i>Centropus phasianinus</i>		X	X
<b>Strigidae</b> (hawk-owls)				
Southern Boobook Owl	<i>Ninox novaeseelandiae</i>			
Barking Owl	<i>Ninox connivens</i>			R
<b>Tytonidae</b> (barn owls)				
Barn Owl	<i>Tyto alba</i>			
Grass Owl	<i>Tyto capensis</i>			
Masked Owl	<i>Tyto novaehollandiae kimberli</i>	CS2		
<b>Podargidae</b> (frogmouths)				
Tawny Frogmouth	<i>Podargus strigoides</i>		X	X
<b>Aegothelidae</b> (owlet-nightjars)				
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>			
<b>Caprimulgidae</b> (nightjars)				
Spotted Nightjar	<i>Eurostopodus argus</i>			
<b>Apodidae</b> (swifts)				
Fork-tailed Swift	<i>Apus pacificus</i>	CS1		
White-throated Needletail	<i>Hirundapus caudacutus</i>	CS1		

House Swift	<i>Apus affinis</i>			
<b>Halcyonidae</b> (forest kingfishers)				
Blue-winged Kookaburra	<i>Dacelo leachii</i>		X	X
Red-backed Kingfisher	<i>Todiramphus pyrrhopygia</i>			
Sacred Kingfisher	<i>Todiramphus sanctus</i>		X	
<b>Meropidae</b> (bee-eaters)				
Rainbow Bee-eater	<i>Merops ornatus</i>	CS1	X	X
<b>Coraciidae</b> (Rolers)				
Dollarbird	<i>Eurystomus orientalis</i>			X
<b>Climacteridae</b> (treecreepers)				
Black-tailed Treecreeper	<i>Climacteris melanura</i>			
<b>Maluridae</b> (fairy-wrens)				
Variegated Fairy-wren	<i>Malurus lamberti</i>		X	X
Red backed Fairy-wren	<i>Malurus melanocephalus</i>		X	X
<b>Pardalotidae</b> (pardalotes)				
Red-browed Pardalote	<i>Pardalotus rubricatus</i>			
Striated Pardalote	<i>Pardalotus striatus</i>			
<b>Acanthizidae</b> (Gerygones, Thornbills)				
Weebill	<i>Smicrornis brevirostris</i>			
White throated Gerygone	<i>Gerygone olivacea</i>		X	X
Mangrove Gerygone	<i>Gerygone levigaster</i>			
Western Gerygone	<i>Gerygone fusca</i>			
Dusky Gerygone	<i>Gerygone tenebrosa</i>			X
<b>Meliphagidae</b> (honeyeaters)				
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>			
Little Friarbird	<i>Philemon citreogularis</i>		X	X
Yellow-throated Miner	<i>Manorina flavigula</i>			
Singing Honeyeater	<i>Lichenostomus virescens</i>		X	X
White-gaped Honeyeater	<i>Lichenostomus unicolor</i>			
Grey-headed Honeyeater	<i>Lichenostomus keartlandi</i>			
Yellow-tinted Honeyeater	<i>Lichenostomus flavescens</i>		X	X
Black-chinned Honeyeater	<i>Melithreptus gularis</i>		X	X
White-throated Honeyeater	<i>Melithreptus albogularis</i>			
Brown Honeyeater	<i>Lichmera indistincta</i>		X	X
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>			X
Banded Honeyeater	<i>Certhionyx pectoralis</i>			
Red-headed Honeyeater	<i>Myzomela erythrocephala</i>			R
Black Honeyeater	<i>Certhionyx niger</i>			
Pied Honeyeater	<i>Certhionyx variegatus</i>			
Yellow Chat	<i>Ephthianura crocea</i>	CS3: restricted range		
<b>Petroicidae</b> (Australian robins)				
Jacky Winter	<i>Microeca fascinans</i>			
Lemon-bellied Flycatcher	<i>Microeca flavigaster</i>			R
Red-capped Robin	<i>Petroica goodenovii</i>			
Hooded Robin	<i>Melanodryas cucullata</i>			
<b>Pomatostomidae</b> (Australian babblers)				
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>		X	X
<b>Neosittidae</b> (sittellas)				
Varied Sittella	<i>Daphoenositta chrysoptera</i>			
<b>Pachycephalidae</b> (whistlers)				
Rufous Whistler	<i>Pachycephala rufiventris</i>		X	X
Mangrove Golden Whistler	<i>Pachycephala melanura</i>			X
White-breasted Whistler	<i>Pachycephala lanioides</i>			R
Grey Shrike-thrush	<i>Colluricincla harmonica</i>		X	X
Crested Bellbird	<i>Oreoica gutturalis</i>			
<b>Dicruridae</b> (flycatchers)				
Broad-billed Flycatcher	<i>Myiagra ruficollis</i>			X

Leaden Flycatcher	<i>Myiagra rubecula</i>			
Restless Flycatcher	<i>Myiagra inquieta</i>			X
Magpie-lark	<i>Grallina cyanoleuca</i>		X	X
Grey Fantail	<i>Rhipidura albiscapa</i>			
Northern Fantail	<i>Rhipidura rufiventris</i>			
Mangrove Grey Fantail	<i>Rhipidura phasiana</i>			R
Willie Wagtail	<i>Rhipidura leucophrys</i>		X	X
<b>Campephagidae</b> (cuckoo-shrikes trillers)				
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		X	X
White bellied Cuckoo-shrike	<i>Coracina papuensis</i>			
White-winged Triller	<i>Lalage sueurii</i>			
<b>Oriolidae</b> (Orioles)				
Olive backed Oriole	<i>Oriolus sagittatus</i>			
<b>Artamidae</b> (woodswallows, butcherbirds)				
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>			
Masked Woodswallow	<i>Artamus personatus</i>			
White-browed Woodswallow	<i>Artamus superciliosus</i>			
Black-faced Woodswallow	<i>Artamus cinereus</i>		X	
Little Woodswallow	<i>Artamus minor</i>			
Grey Butcherbird	<i>Cracticus torquatus</i>			
Pied Butcherbird	<i>Cracticus nigrogularis</i>		X	X
Australian Magpie	<i>Gymnorhina tibicen</i>			
<b>Corvidae</b> (ravens and crows)				
Little Crow	<i>Corvus bennetti</i>			
Torresian Crow	<i>Corvus orru</i>			X
<b>Ptilonorhynchidae</b> (Bowerbirds)				
Great Bowerbird	<i>Chlamydera nuchalis</i>		X	X
<b>Alaudidae</b> (larks)				
Singing Bushlark	<i>Mirafra javanica</i>			
<b>Motacillidae</b> (pipits, wagtails)				
Richard's Pipit	<i>Anthus novaeseelandiae</i>			
Yellow Wagtail	<i>Motacilla flava</i>	CS1		
<b>Passeridae</b> (finches and allies)				
Zebra Finch	<i>Taeniopygia guttata</i>			X
Double-barred Finch	<i>Taeniopygia bichenovii</i>			
Long-tailed Finch	<i>Poephila acuticauda</i>			
Painted Finch	<i>Emblema pictum</i>			
Chestnut-breasted Mannikin	<i>Lonchura castaneothorax</i>			
Pictorella Mannikin	<i>Heteromunia pectoralis</i>	CS2		
Gouldian Finch	<i>Erythrura gouldiae</i>	CS1		
<b>Dicaeidae</b> (flower-peckers)				
Mistletoebird	<i>Dicaeum hirundinaceum</i>		X	X
<b>Hirundinidae</b> (swallows)				
Barn Swallow	<i>Hirundo rustica</i>	CS1: EPBC MIG		X
Welcome Swallow	<i>Hirundo neoxena</i>			
Red-rumped Swallow	<i>Hirundo daurica</i>			
Tree Martin	<i>Hirundo nigricans</i>		X	X
Fairy Martin	<i>Hirundo ariel</i>			
<b>Sylviidae</b> (Old World warblers)				
Rufous Songlark	<i>Cincloramphus mathewsi</i>			
Brown Songlark	<i>Cincloramphus cruralis</i>			
Golden headed Cisticola	<i>Cisticola exilis</i>			
<b>Zosteropidae</b> (White-eyes)				
Yellow White-eye	<i>Zosterops luteus</i>			
<b>Total recorded during site visit</b>			33	76
<b>Total Number of Species Expected: 255</b>				

**TABLE 4. Mammals Expected in the Broome area.** Expected occurrence is primarily based on known species distributions and available habitats. Levels of Conservation Significance are discussed in the “Assessment of Conservation Significance” section. Introduced mammals are indicated by “Int.” in the Conservation Significance column

MAMMALS		Conservation Status	2009 Survey
<b>Tachyglossidae</b> (echidnas)			
Echidna	<i>Tachyglossus aculeatus</i>		
<b>Dasyuridae</b>			
Long-tailed Planigale	<i>Planigale ingami</i>		
<b>Peramelidae</b> (bandicoots and bilbies)			
Bilby	<i>Macrotis lagotis</i>	CS1	
Golden Bandicoot	<i>Isodon auratus auratus</i>	CS1	
<b>Phalangeridae</b> (possums)			
Northern Brush-tailed Possum	<i>Trichosurus arnhemensis</i>	CS3: declining species	X
Scaly-tailed Possum	<i>Wyulda squamicaudata</i>	CS2 (P3)	
<b>Macropodidae</b> (kangaroos and wallabies)			
Spectacled Hare-wallaby	<i>Lagorchestes conspicillatus</i>	CS2	
Red Kangaroo	<i>Macropus rufus</i>		
Agile Wallaby	<i>Macropus agilis</i>		X
Northern Nailtail Wallaby	<i>Onychogalea unguifera</i>		
<b>Pteropodidae</b> (fruit bats or flying-foxes)			
Northern Blossom Bat	<i>Macroglossus minimus</i>	CS3: edge of range	
Black Flying-fox	<i>Pteropus alecto</i>		X
Little Red Flying-fox	<i>Pteropus scapulatus</i>		
<b>Emballonuridae</b> (sheath-tail bats)			
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>		X
Common Sheath-tail Bat	<i>Taphozous georgianus</i>		
<b>Mollosidae</b> (mastiff bats)			
Northern Freetail Bat	<i>Chaerophon jobensis</i>		X
Beccari's Freetail Bat	<i>Mormopterus beccari</i>		
Mangrove Freetail Bat	<i>Mormopterus loriae</i>		
<b>Vespertilionidae</b> (vespertilionid bats)			
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		
Hoary Wattled Bat	<i>Chalinolobus nigrogriseus</i>		
Common Bentwing-bat	<i>Miniopterus schreibersii orianae</i>		
Northern Long-eared Bat	<i>Nyctophilus arnhemensis</i>		
Eastern Long-eared Bat	<i>Nyctophilus bifax daedalus</i>		
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>		
Northern Pipistrelle	<i>Pipistrellus westralis</i>	CS3: habitat limited	
Little Broad-nosed Bat	<i>Scotorepens greyii</i>		
Northern Broad-nosed Bat	<i>Scotorepens sanborni</i>		
Northern Cave Bat	<i>Vespadelus caurinus</i>		
Finlayson's Cave Bat	<i>Vespadelus finlaysoni llatus</i>		
<b>Muridae</b> (rodents)			
Lakeland Downs Mouse	<i>Leggadina lakedownensis</i>	CS2	
Delicate Mouse	<i>Pseudomys delicatulus</i>		
Western Chestnut Mouse	<i>Pseudomys nanus</i>		
Water Rat	<i>Hydromys chrysogaster</i>	CS2	



MAMMALS	Conservation Status	2009 Survey
<b>INTRODUCED MAMMALS</b>		
House Mouse	<i>Mus musculus</i>	
Black Rat	<i>Rattus rattus</i>	
Feral Cat	<i>Felis catus</i>	X
Dog	<i>Canus lupis</i>	X
<b>Total Number of Native Species Expected: 33</b>		7
<b>Total Number of Introduced Species Expected: 4</b>		

TABLE 5. Conservation status of significant fauna species recorded or expected to occur in the Broome Port Project Area. See Appendix 1 for explanation of status codes. Species previously recorded in the Project Area (by Birds Australia, NatureMap) are included.

SPECIES	EPBC	WA Act	JAMBA	CAMBA	BONN	P2	P3	P4	CS3	Likely to occur within Project Area
<b>FROGS</b>										
Derby Toadlet									+	No
Mjoberg's Toadlet									+	No
Mole Toadlet									+	No
<b>REPTILES</b>										
Airlie Island Ctenotus	VUL	VUL								Potential
						+			+	Recorded
						+			+	Recorded
									+	Yes
									+	Yes
									+	Potential
Pindan Dragon									+	Recorded
<b>BIRDS</b>										
Great Egret	MIG		+	+	+					No
Cattle Egret	MIG		+	+	+					No
Glossy Ibis	MIG			+	+					No
Osprey	MIG									No
Letter-winged Kite									+	Rare Vagrant
White bellied Sea-Eagle	MIG			+						No
Red Goshawk	VUL	VUL								No
Grey Goshawk									+	No
Peregrine Falcon		SCH 4								Recorded
Grey Falcon								+		Rare Vagrant
Chestnut backed Button-quail								+		Potential



**TABLE 6. Impacts upon fauna species of conservation significance expected in the Project Area.**

Species Name	Nature and significance of likely impact		Action required
	Nature of impact	Significance	
Peregrine Falcon ( <i>Falco peregrinus</i> )	Minor loss of foraging habitat.	Low (disturbance and habitat loss unlikely)	Retain Fauna Corridor.
Bush Stone-curlew ( <i>Burhinus grallarius</i> )	Some loss of habitat and disturbance. Potential for impacts from introduced predators. Roadkill possible.	Low (disturbance and habitat loss unlikely).	Minimise disturbance footprint Retain Fauna Corridor.
Rainbow Bee-eater ( <i>Merops ornatus</i> )	Negligible.	Negligible (widespread species).	None required, although nesting may occur along roads and grading of road verges during the spring breeding period could be avoided. Retain Fauna Corridor.
Migratory Waders and EPBC listed Birds	No loss of habitat, potential impacts resulting from noise, light, increased human activity.	Low (small area of impact).	Minimise disturbance footprint.
Fork-tailed Swift ( <i>Apus pacificus</i> )	Negligible.	None (aerial species).	Retain Fauna Corridor.
Barn Swallow ( <i>Hirundo rustica</i> )	Negligible.	Negligible	Minimise disturbance footprint. Retain Fauna Corridor.
<i>Diporiphora pindan</i>	Some loss of habitat.	Low (small area of disturbance).	Minimise disturbance footprint. Retain Fauna Corridor.
<i>Ctenopus colletti</i>	Some loss of habitat.	Low (small area of disturbance).	Minimise disturbance footprint. Retain Fauna Corridor.
<i>Lerista separanda</i>	Some loss of habitat.	Low (small area of disturbance).	Minimise disturbance footprint. Retain Fauna Corridor.
<i>Simoselaps minimus</i>	Some loss of habitat.	Low (small area of disturbance).	Minimise disturbance footprint. Retain Fauna Corridor.
Northern Brush-tailed Possum	Some loss of habitat, loss of breeding and roosting sites – tree hollows	Moderate (small area of disturbance, however loss of breeding habitat).	Minimise disturbance footprint. Retain Fig thickets and large hollow bearing trees. Retain Fauna Corridor.
Northern Pipistrelle	Some loss of habitat.	Low (small area of disturbance).	Minimise disturbance footprint. Retain large hollow bearing trees. Retain Fauna Corridor.
Northern Blossom Bat	Some loss of habitat.	Low (small area of disturbance).	Minimise disturbance footprint. Retain large hollow bearing trees. Retain

			Fauna Corridor.
<i>Ctenotus angusticeps</i>	Some loss of habitat.	Low (small area of disturbance, Project Area does not contain habitat known to be preferred by this species, potential for occurrence).	Minimise disturbance footprint. Retain Fauna Corridor.
<i>Morethia storri</i>	Some loss of habitat.	Low (small area of disturbance).	Minimise disturbance footprint. Retain Fauna Corridor.

Note: A fauna corridor should be retained to reduce impacts on local species. It is recommended a fauna corridor be retained to include native vegetation adjacent to and east of Kavite Rd, extend north – south throughout the Project Area and include some stands of Fig trees to retain tree hollows.

**TABLE 7.** The potential impacts to fauna of the proposal as assessed following the guidance of the EPA’s Guidance Statement No. 56. (Terrestrial fauna surveys for environmental impact assessment in Western Australia, EPA 2004).

<b>Factor</b>	<b>Impact and explanation</b>
Degree of habitat degradation or clearing within the local area or region.	Moderate (project lies within of a region of continuous habitat however some vegetation clearance and degradation in the immediate vicinity – associated with Port area, size of Project Area is moderate)
Size/scale of proposal/impact.	High (up to 62 ha of remnant native vegetation may be disturbed - Bioregion Group 3).
Rarity of vegetation and landforms.	Low (impacted vegetation and landforms are extensive in sub-region).
Refugia.	Low: Pindan does not promote short-range endemism, habitat is continuous over a larger area.
Fauna protected under international agreements or treaties, Specially Protected or Priority Fauna.	Moderate (faunal assemblage includes species of high conservation significance but impacts on these species is expected to be low (see Table 6)).
Size of remnant and condition/intactness of habitat and faunal assemblage.	Low (Project Area comprises intact remnant vegetation, areas of previously disturbed vegetation occur nearby; as well as regrowth vegetation from a previous disturbance)
Ecological linkage.	Moderate (the Pindan vegetation of the Project Area is continuous with the surrounding landscape, no linear or rare habitats occur within proposed Project Area, however project will reduce linkage along the peninsula, interrupting north –south linkage).
Heterogeneity or complexity of the habitat and faunal assemblage.	Low (Project Area has low habitat heterogeneity and a complex faunal assemblage).

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## Appendix 1. Categories used in the assessment of conservation status.

### **IUCN categories (based on review by Mace and Stuart 1994) as used for the Environmental Protection and Biodiversity Conservation (EPBC) Act and the WA Wildlife Conservation Act.**

- Extinct.** Taxa not definitely located in the wild during the past 50 years.
- Extinct in the Wild.** Taxa known to survive only in captivity.
- Critically Endangered.** Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered.** Taxa facing a very high risk of extinction in the wild in the near future.
- Vulnerable.** Taxa facing a high risk of extinction in the wild in the medium-term future.
- Near Threatened.** Taxa that risk becoming Vulnerable in the wild.
- Conservation Dependent.** Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
- Data Deficient (Insufficiently Known).** Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
- Least Concern.** Taxa that are not Threatened.

### **Schedules used in the WA Wildlife Conservation Act.**

- Schedule 1.** Rare and Likely to become Extinct.
- Schedule 2.** Extinct.
- Schedule 3.** Migratory species listed under international treaties.
- Schedule 4.** Other Specially Protected Fauna.

### **WA Department of Conservation and Land Management Priority species** (species not listed under the Conservation Act, but for which there is some concern).

- Priority 1.** Taxa with few, poorly known populations on threatened lands.
- Priority 2.** Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
- Priority 3.** Taxa with several, poorly known populations, some on conservation lands.
- Priority 4.** Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
- Priority 5.** Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).

## Appendix 2. Ecological Processes

Ecological processes are processes that maintain ecosystems and biodiversity. They are important for the assessment of impacts of development proposals, because ecological processes make ecosystems sensitive to change. The issue of ecological processes, impacts and conservation of biodiversity has an extensive literature. Following are examples of the sorts of ecological processes that need to be considered.

### Ecological processes relevant to the conservation of biodiversity in Australia (Soule *et al.* 2004):

- Critical species interactions (highly interactive species);
- Long distance biological movement;
- Disturbance at local and regional scales;
- Global climate change;
- Hydroecology;
- Coastal zone fluxes;
- Spatially-dependent evolutionary processes (range expansion and gene flow); and
- Geographic and temporal variation of plant productivity across Australia.

(Taken from [http://www.wilderness.org.au/articles/wc\\_science](http://www.wilderness.org.au/articles/wc_science), viewed on the 10<sup>th</sup> November 2009)

### Threatening processes (EPBC Act)

Under the EPBC Act (1999), a key threatening process is an ecological interaction that threatens or may threaten the survival, abundance or evolutionary development of a threatened species or ecological community. There are currently 17 key threatening processes listed by the federal Department of the Environment, Water, Heritage and the Arts).

- Competition and land degradation by feral/unmanaged Goats (*Capra hircus*);
- Competition and land degradation by feral Rabbits (*Oryctolagus cuniculus*);
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*);
- Incidental catch (bycatch) of Sea Turtles during coastal otter-trawling operations within Australian waters north of 28 degrees South;
- Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations;
- Infection of amphibians with chytrid fungus resulting in *chytridiomycosis*;
- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris;

- Land clearance;
- Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean;
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases;
- Predation by exotic rats on Australian offshore islands of less than 1000 km<sup>2</sup> (100,000 ha);
- Predation by feral Cats (*Felis catus*);
- Predation by the European Red Fox (*Vulpes vulpes*);
- Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (*Sus scrofa*);
- *Psittacine Circoviral* (beak and feather) Disease affecting endangered *psittacine* species;
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*);
- The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta*.

(Taken from <http://www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl> , viewed on the 10<sup>th</sup> November 2009)