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Western Desert Resources Limited
Roper Bar Iron Ore Project



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APPENDIX D: Roper Bar Iron Ore Project EIS Terrestrial Biodiversity Technical Report



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Acronym Definitions

BOM – Bureau of Meteorology

CSIRO – Commonwealth Scientific and Industrial Research Organisation

CR – Critically Endangered

DD – Data Deficient

DNRETAS – Department of Natural Resources, Environment, The Arts and Sport

DSEWPC – Department of Sustainability, Environment, Water, Population and Communities

EC – Electrical Conductivity

EN – Endangered

EPBC Act – Environmental Protection and Biodiversity Conservation Act 1999

ESCP – Erosion and Sediment Control Plan

GDE – Groundwater Dependent Ecosystems

IBRA – Interim Biogeographic Regionalisation for Australia

IPA – Indigenous Protected Area

IUCN – International Union for the Conservation of Nature

LC – Least Concern

MLA – Mining Lease Application

NAFF – North Australian Freshwater Fish

NCTWR – National Centre for Tropical Wetland Research

NRETAS – Natural Resources, Environment the Arts and Sport

NE – Not Evaluated

N.T. – Northern Territory

NT – Near Threatened

NTPWC – Northern Territory Parks and Wildlife Commission

NVIS – National Vegetation Information System

SOCS – Site of Conservation Significance

TPWC Act – Territory Parks and Wildlife Conservation Act 2000

VU – Vulnerable

WDRL – Western Desert Resources Limited



Appendices

FAUNA APPENDICES

Appendix D-1	Total Fauna Species List
Appendix D-2	Fauna Survey Data (MLA)
Appendix D-3	Fauna Survey Data (Haul Road)
Appendix D-4	Fauna Survey Data (Port)
Appendix D-5	Bat Report
Appendix D-6	Near Threatened Fauna Species
Appendix D-7	Listed Migratory & Marine Fauna Species

FLORA APPENDICES

Appendix D-8	Total Flora Species Identified within MLA area
Appendix D-9	Vegetation Type Descriptions (MLA)
Appendix D-10	Sensitive Habitat Surveys (Haul Road)
Appendix D-11	Vegetation Type Descriptions (Port Facility Area)
Appendix D-12	Vegetation and Habitat Datasheet (blank example)



D-1. Introduction

EcOz Environmental Services was contracted by Western Desert Resources Limited (WDRL) to undertake ecological surveys and assessment for the first stage of the Roper Bar Iron Ore Mine (known as the Roper Bar Project). Information presented in this report informs the decisions made for the Environmental Impact Statement (EIS) for the project.

1.1 Focus Areas

The first stage of the Roper Bar Project includes development within three key areas which are inclusive of:

- **Mining Lease Application Areas** – (here after referred to as the MLA areas) this area includes all MLA's as shown in Figure 1. The land within these boundaries is targeted for four open cut pits (3 pits being less than 50m deep and one pit up to 100m deep), a processing plant, and ancillary infrastructure (total area approximately 425 ha). A more detailed description of the proposed development and map of the potential disturbance footprint is provided in Section D-4;
- **Haul Road Corridor** – this area is targeted for a 165km long x 30m wide unsealed road from the MLA areas to the stockyard at Bing Bong Port. The survey area corridor is 4km either side of the proposed road alignment; and
- **Port & Stockyard** – this area is targeted for the development of iron stockyard facility and modification of an existing coastal port facility at Bing Bong (managed by Xstrata) and will entail construction of a conveyor belt from the stockyard to the barge loading facility. Vegetation clearing will total approximately 17.5 hectares.

The three areas are depicted in Figure 1. From this point forward the three areas of focus are collectively referred to as the first stage of the Roper Bar Project Area.

1.2 Scope of Work

The objectives for assessing the terrestrial and freshwater fish ecology were to:

- Describe and characterise the existing biodiversity within the focus areas for development and hence may be affected through disturbance;
- Identify the presence of listed protected areas, sites of natural significance and sensitive habitats within the focus areas for development;
- Identify and describe the location of notable flora and fauna communities or species which occur within the focus areas and which may require specific management attention; and
- Scope the potential environmental impacts from the development proposals to the identified environmental values and assess the level of risk or concern.

This study and report is intended to provide the detailed baseline information underpinning management decisions only, and does not address potential ecological impacts nor recommend specific mitigation measures. Management measures associated with the proposed development are addressed within the main chapter of the EIS. This report describes the regional context of the project area, followed by a separate assessment of the ecology for each component area (MLA areas, haul road route, and port facility). The final chapter consolidates all matters of conservation significance identified from desktop research and field investigations, with particular consideration for priority species and habitat which may require management actions beyond the general minimal impact standards.

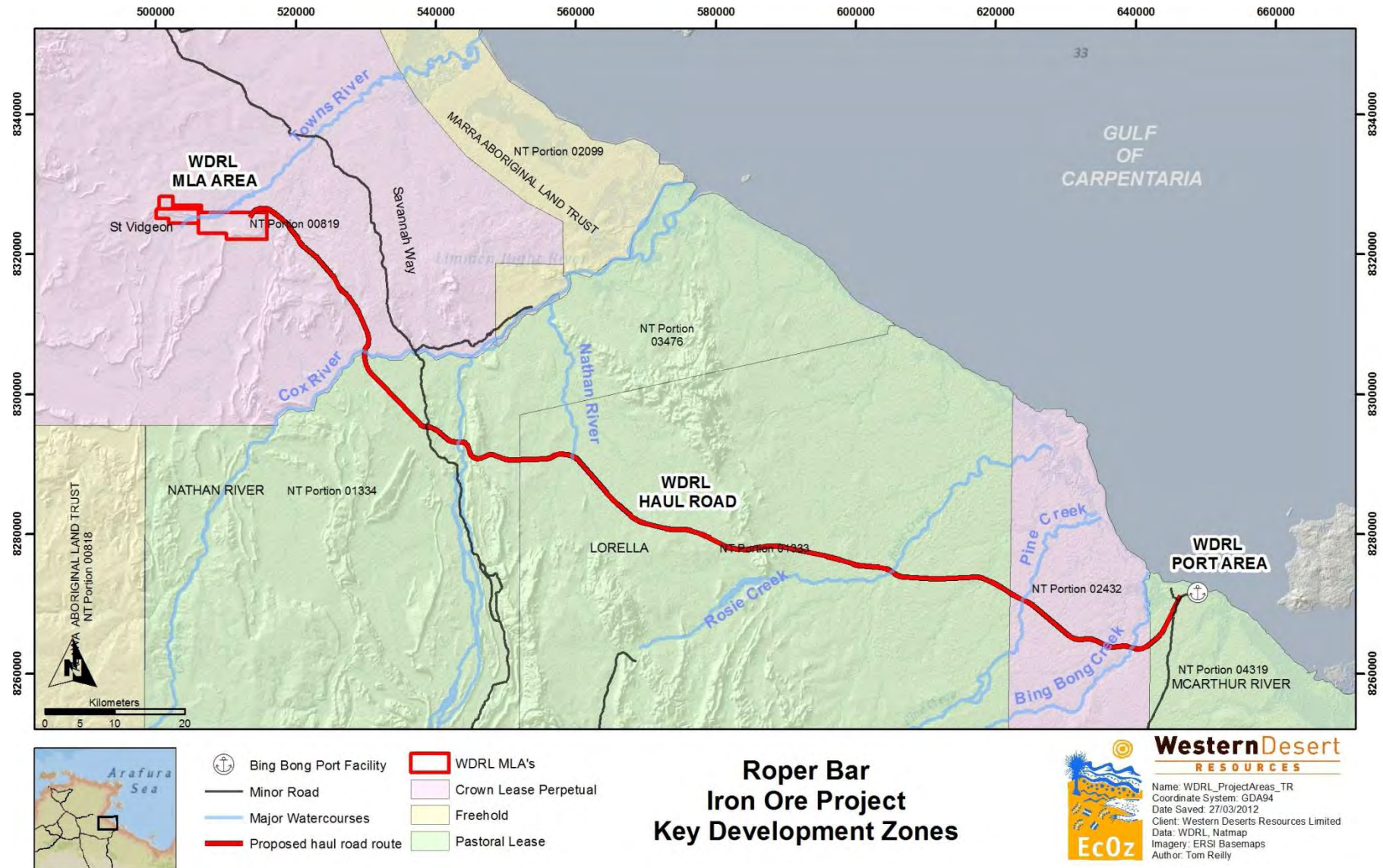


Figure 1: Locations for three proposed development zones



D-2. Methodology

An assessment of terrestrial ecology (conducted between Oct 2010 and March 2012) for the three focus areas of potential impact has included the following actions:

- **A Desktop Review** – collation of available baseline environmental information for the proposed development areas and the wider region from existing datasets and reports;
- **Vegetation Survey and Mapping** – mapping and characterisation of key vegetation types and survey for threatened and introduced plant species has been applied to areas targeted for a greater level of disturbance. In the case of extensive areas such as the transport route, existing land system mapping was ground-truthed and supplemented with habitat characterisations associated with fauna surveys;
- **Terrestrial Fauna Survey** – surveys of key impact areas and also habitat that is more likely to feature threatened or notable species. This was done through standard survey methods, employing Wet and Dry season surveys where possible;
- **Freshwater Fish Surveys** – surveys in creeks and billabongs associated with the MLA areas, including downstream refuge areas in the Towns River and Little Towns River; and
- **Targeted Surveys**
 - o Bare-rumped Sheath-tail Bat surveys were conducted within the proposed mining area to gain a greater appreciation of the presence and distribution of the species, and therefore the potential cumulative impacts for mining targeting outcrop areas featuring caves;
 - o Sensitive Habitat surveys along the haul road corridor; and
 - o Assessment of migratory shorebird potential at the proposed coastal port upgrade.

The following outlines the methods applied in greater detail.

2.1 Desktop Review

Prior to designing and conducting on-ground surveys the most up-to-date understanding of the ecological context for the project area was established through collating information from previous studies and existing datasets. The data enquiry included broad scale reviews of climate data, geomorphology, land system and vegetation mapping, the existing flora and fauna records, known distributions and preferred habitats for flora and fauna species, as well as the current status of disturbance in the region. A list of the primary sources of information is presented in Table 1.



Table 1: A summary of key information sources informing the ecological context

Aspect	Primary Information Sources
Climate	The Bureau of Meteorology online data
Bioregions	- Baker B, Price O, Woinarski J, Gold S, Connors G, Fisher A & Hempel C. (2005). <i>Northern Territory Bioregions – Assessment of Key Biodiversity Values and Threat</i>. Department of Natural Resources, Environment and The Arts, Palmerston, Northern Territory. - NRETA, 2005, <i>Northern Territory Draft Parks Master Plan: Gulf Fall and Uplands Bioregion Conservation Values and Environmental Resources</i>. Department of Natural Resource Environment and The Arts.
Land Systems	- Aldrick, JM, & Wilson, PL, 1990, <i>Land Systems of the Southern Gulf Region 1: 250,000 scale. Technical Report Number 42</i>. Conservation Commission of the Northern Territory, Darwin. - Wilson, B, Brocklehurst, P, Clark, M and Dickinson, K 1990, <i>Vegetation Survey of the Northern Territory - Technical Report No. 49</i>, Conservation Commission of the Northern Territory, Darwin.
Biological Surveys	- King, S & McKean, JL 1982, <i>A Biological Survey of St Vidgeon Station</i>. Internal report to the Conservation Commission of the Northern Territory, Darwin. - Griffiths, AD, Materne, CM & Sherwell, JD 1997, <i>Biological Survey of the Proposed Limmen Gate National Park</i>. Parks and Wildlife Commission of the Northern Territory.
Sites of Conservation Significance (SoCS)	- Environment Australia, 2001, <i>A Directory of Important Wetlands in Australia</i>, Third Edition. Environment Australia, Canberra. - Harrison, L, McGuire, L, Ward, S, Fisher, A, Pavey, C Fegan, M and Lynch, B 2009, <i>An inventory of sites of international and national significance for biodiversity values in the Northern Territory</i>. Department of Natural Resources, Environment, The Arts and Sport, Northern Territory, Darwin.
Notable Flora and Fauna Species	EPBC Protected Matters Search Tool, Department of the Sustainability, Environment, Water, Populations, and Communities (DSEWPC) holds mapped locations of World Heritage properties, Ramsar wetlands, threatened species, migratory species, marine species, threatened ecological communities and protected areas.
Fire Frequency	North Australian Fire Information (NAFI) - a web-based dataset (managed by the NT Government, CDU, Australian Government, and Bushfires NT), which records the fire history of any given area. Information such as the time of the last burn, the frequency of fires and the frequency of late burns can be accessed and an idea of the overall fire impact of the region can be suggested from the available information.
Invasive species	NT NRM INFONET – a map-based profiler for natural resource information from a variety of sources. This is a collaboration between the NT NRM Board, the Tropical Savannas Cooperative Research Centre and the Northern Territory Department of Natural Resources, Environment and the Arts.



A review of flora and fauna which are recorded to occur or predicted to occur within the proposed impact zones was compiled from the following sources:

Datasets managed by the DNRETAS:

- **Northern Territory Flora & Fauna Atlas** – a dataset maintained by the Parks and Wildlife Service point recording locations for fauna species (and other details) identified through biological surveys (either as validated incidental observations or voucher specimens) conducted in the Northern Territory under a Wildlife Permit;
- **Museum and Art Gallery of the Northern Territory database** – a dataset for vouchered fauna specimens; and
- **Northern Territory Holtze database** – a dataset for the location and details for vouchered plant specimens.

Other Datasets or Enquiry Tools:

- **Atlas of Living Australia** – a database on all the known species in Australia aggregated from a wide range of data providers; museums, herbaria, community groups, government departments, individuals and universities;
- **Fish Atlas of Northern Australia** – is compiled by North Australian Freshwater Fish (NAFF), a collaborative project between National Centre for Tropical Wetland Research (NCTWR) and the Centre for Riverine Landscapes (Griffith University); and
- **Birddata, Birds Australia** – a database created through community input and managed by which records the distribution (location) and abundance of bird species across Australia at particular points in time using set range of survey methods.

Australian Government Data Enquiry Tools:

- **EPBC Protected Matters Search Tool** – an online enquiry tool managed by DSEWPC which interrogates a range of existing flora and fauna data as well as predictive modelling to speculate on the presence of species within a particular search area.

Database searches covered the full extent of the potential impact zones with a significant buffer as indicated in Figure 9 and Figure 10.

2.2 Vegetation Surveys and Mapping

Existing vegetation mapping for the Northern Territory Gulf is very limited and consists of:

- Vegetation mapping completed for the whole Territory at 1:1,000,000 scale (Wilson *et al.* 1990), which has been updated to meet NVIS Version 3.1 standards; and
- Land system mapping at 1:250,000 scale (Aldrick *et al.* 1990).

Of these two vegetation type datasets, the land system mapping is the more functional dataset for the Gulf region, due to its finer scale.

The proposed project area traverses a distance of greater than 160km. Over this extensive area, varying levels of disturbance are proposed within discrete envelopes and this has required that different levels of mapping and vegetation survey be applied for each focus area. Existing vegetation mapping has either been refined or supplemented depending on the level of the proposed disturbance and the information required for management directions. The vegetation surveys carried out for this report fit within three main assessment types:



- Fine scale vegetation mapping (1:25,000 scale) – delineating and describing vegetation types;
- Habitat characterisation – either confirming existing land system mapping or characterising particular areas either relating to fauna assessments or survey for notable habitat; and
- Local assessment for the presence of weed species.

A summary of the levels of vegetation assessment applied to each of the three key development areas is presented in Table 2.

All levels of vegetation mapping and habitat characterisations have followed the Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping (Brocklehurst *et al.* 2007), with some minor modifications. Vegetation mapping and habitat characterisation comply with descriptions to NVIS Level V, which encompasses a description of the broad structural formation (e.g. woodland, canopy height and projective cover) and the dominant species in three strata (Upper overstorey, Midstorey and Ground Layer). In all cases disturbance attributes such as grazing, fire and introduced plants have been recorded as part of the vegetation assessments which enables some interpretation of vegetation condition.

Weed assessment has focused on detecting weed presence along accessible road sides and some limited surveying within high value habitats along the haul road. Recording weed presence aligns with the Guidelines for Weed Data Collection in the Northern Territory – Version 3 (2010) whereby the weed density (in terms of cover) is estimated within a nominated area (a 25m x 25m quadrat in most cases).

The following outlines the focus and justification for vegetation assessment for each the proposed development envelopes.

Mine and Site Camp Area

Given the MLA areas are potentially targeted for substantial disturbance (inclusive of alteration to ground water levels and rehabilitation with altered substrates) vegetation mapping has been refined to NVIS level V at 1:25,000 scale. The main purpose and objectives for mapping and surveying the vegetation within this development area have included:

- Providing a fine scale map and description of the existing vegetation types to NVIS level V; and
- Scoping the potential for notable species (i.e. rare, threatened or restricted in range).

The resultant vegetation map and assessment compliments additional environmental studies for the Mine and Camp site including:

- Interpreting surface flows, presence of wetlands and seasonally inundated areas;
- Identifying the range aquatic ecosystems present within the potential impact zone and hence targeting surveys to examine the values of these systems;
- Providing a base map for interpreting the presence of likely ground water dependent ecosystems; and
- Providing a basis for defining potential rehabilitation objectives and targets.

Haul Road

Land Systems and Vegetation Types

The proposed haul road traverses 165km and crosses several land system and vegetation types. The majority of land systems which the transport route plans to intersect are extensive and common within the Gulf area and the Northern Territory. The main purpose of vegetation assessment for this potential development zone has been to confirm and supplement existing land system mapping at (1:250,000 scale by Aldrick *et al.* 1990) and primarily focus on delineating and characterising notable habitats (or those preferably avoided) within a 6km wide corridor of the potential transport route (3km either side of the centre line). The notable habitats targeted included: rocky ridges, tributaries, water bodies and vegetation types inclusive of rainforest, monsoonal vine thicket and riparian vegetation.



These habitat types and land forms were targeted as they are more likely to feature either a diverse range of plant and animal species or species, assemblages which are less typical to the region or prone to cause significant local management concerns and therefore of particular concern for any level of disturbance.

Due to the extensive area to be assessed, the vegetation assessment objectives for this development area were to:

- Confirm the general descriptions for land systems occurring within the 6km buffer zone of the potential transport corridor; and
- Identify and briefly delineate and characterise notable or high value habitat occurring within the transport corridor, and particularly those to be avoided.

Assessment of the vegetation and notable habitat along the haul road corridor was conducted by a helicopter reconnaissance and targeted on-ground survey. Due to the length of the proposed road it has not been possible to survey for plant species of concern along the entire route.

Assessment of vegetation types traversed by the proposed haul road route was undertaken through desktop studies with reference to the Land Systems of the Southern Gulf Region, Northern Territory (Aldrick and Wilson 1990). Further assessment involved flying the haul road route once in a helicopter and determining the dominant flora species and vegetation type boundaries from the air. These were later cross-checked on ArcGIS against land system vegetation mapping. This work confirmed that the land system mapping vegetation descriptions are largely correct (Figure 26). Given the rapid method of assessing vegetation types along the haul road route misidentification of dominant species is likely. However, rapid assessment has determined the mapping to be largely representative of vegetation communities encountered along the haul road route so it will serve the purpose of informing this report.

Flora Survey Sites

The identification of survey sites of interest were undertaken with the aid of ArcGIS software and using existing land system mapping. Bing aerial imagery (a base map provided by ESRI) and Geosciences Australia watercourse data was applied to identify areas of interest. Imagery for initial identification was set at a scale of 1:30,000 to best cover the 6km corridor applied to the haul road route. Rock outcrops and waterbodies identified from the imagery were digitised and a point location with a unique identifier attributed to each shape for upload to a GPS unit.

Field references used during the survey included a survey map of the haul road corridor, including rocky land systems and waterbody shapes, point location and the haul road line. This data was additionally uploaded onto a GPS unit to accurately locate these features in the field. Once located the sensitive habitat feature was described and given a habitat value of either high or low. Rocky sandstone ridges were attributed with a high value and flat rocky hills a low value. Waterbodies with water present during the survey were given a high habitat value, with a low value attributed to depression devoid of water. Additional sensitive habitats (i.e. sinkholes, erosion sensitive zones, monsoon forest etc.) that were not identified from the aerial imagery were surveyed and given a unique identifier.

Riparian vegetation was surveyed at a number of major watercourse crossings. Crossing locations were determined on ground from current haul road location data supplied by Western Desert Resources. Riparian surveys recorded data on patch width and vegetation structural descriptions with the percentage cover and average height recorded for the dominant species present at each site. Habitat photographs were taken at each site and aerial photographs taken from the helicopter to show the approximate location of survey sites.

Opportunistic weed surveys were conducted along the haul road route to gain a preliminary understanding of existing weed presence. Detailed weed surveys are planned to occur prior to vegetation clearing and construction of the haul road.



Coastal Port Facilities

The coastal port facilities is an area which is targeted for limited clearing (17 ha). The main purpose of vegetation assessment for this zone has focused on refining existing mapping to NVIS level V at approximately 1:30,000 scale using aerial imagery and ground-truthing. As the total potential disturbance area is small (compared to the MLA areas), and is already particularly disturbed and weed infested, the level of vegetation assessment has been confined to characterising the habitat only. Further assessment will be required to determine the scope of weed management issues.

Table 2: Summary of vegetation mapping and surveys undertaken for this report

Proposed Zone of Impact	Purpose and Level of Vegetation Mapping and Survey Applied
MLA areas	Purpose: Fine scale description of the vegetation types and identification of notable plant species (threatened, rare or restricted in range) and assemblages which require specific management attention. Level of mapping and survey: Vegetation mapping at ~1:25,000 scale NVIS level V. Aerial photography: 25cm x 25cm cell size (12th July 2008) Extent: 36km² Number of survey sites: 107 (62 full reference, 45 check sites) Timing of surveys: October 2010, May 2011 and February 2012
Haul Road Corridor	Purpose: Broad scale ground-truthing of the existing land system mapping at 1:250,000 scale; and Habitat and identification, delineation and characterisation of high value habitat types, namely: rainforest, monsoonal vine thicket, billabongs, rocky ridges or escapements and riparian habits which may be sensitive to disturbance and require specific management attention. Level of mapping and survey: Data collection to ground-truth existing land system mapping at 1:250,000 scale using helicopter survey points (i.e. rapid assessment) and several detailed vegetation assessments at fauna survey locations (5 survey locations totalling 21 survey sites) which aligned to NVIS Level V documenting the dominant species (contributing >5% cover) within three strata. Notable habitat was targeted along the haul road and surveyed at a level detailed enough to determine respective habitat quality. Aerial photography: Bing Maps (ESRI basemap layer) and Google Earth Pro were viewed at a scale between 1:25,000 and 1:50,000. Extent: Total length of 164km and width of 6km (984km²) Number of survey sites: 41 outcrop, 112 waterbody, 7 river crossings Timing of survey: Feb 2012
Coastal Port Facilities	Purpose: Fine scale description of the vegetation types and identification of notable plant species (threatened, rare or restricted in range) and assemblages which may require specific management attention. Level of mapping and survey: Preliminary vegetation mapping and habitat characterisation at ~1:30,000 scale aligning with NVIS level V - documenting the dominant species (contributing >5% cover) within three strata in all distinct vegetation communities. Aerial photography: Bing Maps (ESRI basemap layer) and Google Earth Pro were viewed at a scale of 1:25,000. Extent: approx. 0.1km² Number of survey sites: 12 Timing of survey: February 2012



2.2.1 General

In all cases recent aerial photography (at least 1:25,000) has been used to inform the visual interpretation of vegetation boundaries within the key focus areas. This preliminary interpretation assisted with selecting survey sites.

Details of the sampling regime specifically applied for each of the proposed development zones is outlined within the sections addressing each assessment zone.

Attributes and Data

Survey sites for vegetation mapping and habitat characterisation comprised of an area of 25m by 25m, or in the case of riparian or narrow rocky ridges, an area of 10m by 50m was used. A vegetation survey site complied with one of three categories: a full characterisation site, check site or a road note as defined by Brocklehurst *et al.* (2007). Appendix D-12 presents the data sheet used in the field. The full range of attributes recorded for a vegetation survey site contributing towards vegetation mapping includes:

- **Site location:** GPS coordinates and general description;
- **Habitat information:** Landform pattern and element, vegetation patch size, aspect, slope, surface soil type (broad category only), estimated soil depth, estimated drainage capacity and percentage ground cover for standing biomass, litter, bare earth and pebble/rock/outcrop, presence of fallen logs, mistletoe, flowering plants and termite mounds (and their type);
- **Status of disturbance:** The time since the last fire and scorch height as well as the presence and extent (estimated cover) of weed species and the presence and stability of erosion;
- **Broad Structural information:** The estimated crown separation ratio, the estimated percentage canopy cover or ground cover for the main three vegetation strata and their height range and average height;
- **Floristic and Structural Formation:** For vegetation mapping a full list of species present is compiled along with canopy heights and percentage cover for each species in the strata; and
- **Basal Sweep:** Estimates of basal area for overstorey species using a basal wedge (for both live and dead trees) to given an estimate of species dominance.

For habitat characterisation and ground-truthing existing land systems mapping the level of data collection aligns with a check site as described in Brocklehurst *et al.* (2007). The above attributes were applied with some exceptions: for the floristic component only the dominant species (i.e. those contributing greater than 5% cover) and their associated cover and height are recorded, and the basal sweep component is omitted. For habitat characterisation comments are added to the floristics component to indicate which species are flowering or fruiting.

The methods of gathering data against the key attributes align with those recommended in Brocklehurst *et al.* (2007), however some minor modifications were applied. These modifications include: a slightly larger quadrat size (25m x 25m opposed to 20m x 20m), estimating tree heights rather than measuring with a clinometer, and simplified observations and categories for soil characteristics and depth.

As recommended by the Northern Territory Guidelines (Brocklehurst *et al.* 2007) estimates for canopy percentage cover is based on the crown being treated as opaque for the upper storey. This approach accommodates for seasonal deciduousness. Percentage cover estimates for the mid and ground strata are assessed using the percentage foliage cover (the percentage of the sample site occupied by vertical projection of foliage and branches).

Landform observations follow Speight (2009) in the Australian Soil and Land Survey Field Handbook (3rd Edition Yellow Book).

Incidental records for weeds and fire were noted in all of survey areas and their surrounds and particular attention was paid to existing road corridors.



“Vegetation mapping is not an exact science, but rather an applied science that imposes boundaries on a transition or continuum (often temporal and spatial)” (Brocklehurst *et al.* 2007). To provide some consistency in interpreting vegetation types no more than four observers contributed to completing the vegetation mapping and habitat characterisations.

Targeted Flora Surveys

While a number of plant species are rare, restricted in range, threatened or only known from the Gulf bioregions no targeted surveys for notable species were conducted within any of the proposed project areas. However, the sampling regime and timing (during or just after the Wet season in 2011 and 2012) for vegetation assessments for the MLA, is seen as sufficient to detect the presence of ephemeral and any rarer plant species within this zone. However, the probability of detecting less common, threatened or rare species within the haul road corridor and coastal areas through the methods applied is very low. These components are targeted for further future assessments which will increase the probability of lesser known species to be detected.

Survey Timing

All vegetation surveys coincided with the timing for fauna assessments which were carried out during the build-up rains (Oct – Nov) or the early (Dec – Feb) to late Wet season (March – April). This timing was selected to maximise detecting ephemeral plant species. Plant species were identified in the field as far as possible. Where species could not be identified in the field voucher specimens were taken and pressed for identification at the NT Herbarium.

Nomenclature

The species nomenclature for plants follows the Checklist for Vascular Plants for the Northern Territory (Short *et al.* 2011).

Data Limitations

Detecting rare or ephemeral species is a particular challenge for vegetation assessments and especially for extensive areas. No targeted plant species surveys were conducted for any of the proposed development envelopes.

2.2.2 MLA

Vegetation types of the MLA areas were mapped and described through a preliminary interpretation of aerial photography, delimiting obvious vegetation types and boundaries at 1:30,000 scale. This preliminary map provided the basis for selecting sites for fauna survey and vegetation survey for the more common vegetation types. Preliminary mapping and vegetation descriptions were refined through a series of targeted on-ground surveys. These surveys were carried out in three sets which included:

- October 2012 – associated with initial fauna surveys in the build-up and contributed to forming the initial data set for the dominant vegetation types;
- May 2011 – mid to late Wet season which contributed to extending and refining the breadth of vegetation types and boundaries; and
- February 2012 – a final consolidation survey to ensure sufficient quantitative data to permit charactering and confirming nominated vegetation types through averaging key attributes.

For all extensive vegetation types within the study area at least three full characterisation sites were sampled to form the basis of the vegetation description and permit averaging. In some instances minor vegetation units could not be sampled with sufficient samples in order to conduct statistics. Vegetation survey sites were dispersed across the survey area (refer to Figure 14) to capture variation in topography and disturbance (e.g. fire) as well as those areas targeted for disturbance and those targeted to remain



intact. In all cases vegetation survey sites were placed within representative patches of a vegetation type discernible from the aerial imagery.

Sampling Intensity

A total of 107 flora sites were sampled and surveyed within the 36km² area, including 62 full characterisation and 45 check sites were selected (refer to Figure 14). This sampling density meets the minimum of four sites per km² as recommended by Brocklehurst *et al.* (2007) for mapping at 1:25,000.

Targeting Notable Species

A field list of regional species was used to suggest areas and species (e.g. rare, restricted range, data deficient or threatened) requiring special attention. Species identification in the field was assisted with the use of *The Plants of Limmen National Park*, an unpublished collation of keys, species descriptions and species lists compiled by NRETAS.

Analysis & Compiling Vegetation Descriptions

Attributes for each vegetation type were compiled by averaging data from three reference sites (or two reference sites for small or less common vegetation units) for each discerned type. Height and cover data have been used to generate average abundance, height and frequency summaries for the description of each vegetation type. Frequencies for all species in each vegetation type were calculated via a unique count of each species per site (e.g. if a species is present in multiple strata it is counted at present within the site only once), then per vegetation type.

Vegetation descriptions are composed of up to 5 species which are above 20% frequency in each of the three strata. Species are listed in descending order of frequency with species that achieved a 100% frequency listed first. However, using frequency data alone does not readily permit conveying that the vegetation cover within a type may be dominated by a particular suite of species. To overcome this limitation, where possible, species with high cover values are listed first if they occurred with several other species that are also of the same frequency. For example if three species are consistently present within a vegetation types they will ranked the same frequency. If one of these three species generally dominates the cover and structure this species is placed first in the description to convey this dominance. Species which were not dominant are listed by strata under other species.

All vegetation mapping was undertaken using ArcMap (version 10) Geographic Information System software in GDA94 Zone 53.

2.2.3 Haul Road

Sampling Regime and Site Selection

On ground surveys, aided by GIS and remote sensing data, were undertaken to both determine the habitat value of the targeted sensitive habitat types and provide information to help direct design and construction of the road to minimise impacts on sensitive areas along the route. The survey area includes a 6km corridor with the haul road route being the centreline (see **Error! Reference source not found.** to **Error! Reference source not found.**). Vegetation assessment aimed to align with NVIS Level V in areas where sensitive habitat was identified.

Key habitat types targeted for delineating included:

- **Rocky ridges** – Targeted rocky outcrops with large areas of exposed rock face, crevices and gullies.
- **Rivers/creeks/tributaries**
 - o Major – Rivers and Creeks (Limmen River, Cox River, Nathan River, Rosie Creek, Pine Creek, Bing Bong Creek)
 - o Minor – creeks/tributaries were mapped but not examined on the ground.



- **Water bodies** – The waterbodies targeted were mainly permanent *Melaleuca* swamps and billabongs. Limited survey effort, only identification and recommendation towards avoiding these features.
- **Vegetation types**
 - o Monsoon Forest (often occurs in spring fed gullies with sandstone outcrops)
 - o Monsoon Vine Thicket (coastal vegetation type)
 - o Riparian (distinct vegetation supported along creeks and rivers)
 - o Mangroves (coastal and lower reaches of major river systems)
- **Other features** – Sinkholes and springs

The survey of the rocky outcrops, riparian zones and waterbodies along the haul road route was undertaken with the use of a helicopter over a five day period in early February 2012 by an EcOz botanist.

The survey included the following assessment intensity:

- 37 rocky outcrops ground-truthed and rated;
- 4 rocky outcrops assessed in detail (as part of fauna surveys);
- 7 riparian/creek crossings; and
- 112 waterbodies ground-truthed.

Collected field data was entered into an excel spread sheet with the information used to update the preliminary survey mapping within ArcGIS 10. Updated map data for the surveyed sensitive habitats was then assessed to give recommendations on considerations required to reduce the overall impacts that the haul road construction will have on local sensitive habitats. Maps were produced using ArcGIS 10 with accompanying tables providing point locations, descriptions, habitat values and recommendations for each area surveyed.

Limitations of Survey and Methods

The sensitive habitat survey has been conducted within a 3km wide buffer from the haul road route (i.e. 6km corridor). Given that road design changes may occur during the time of survey to reroute the road anywhere with the buffer short comings in data collection are likely. Changes to the proposed route since the survey was conducted have resulted in the riparian assessment site at Rosie Creek no longer being located along the current haul road route. Recommendations given resulting from this survey are preliminary as the survey may not have focused on the final haul road route. An onground check of recommendations prior to construction of the road will determine if further recommendations are required to minimise impacts on sensitive habitats along the final route.

Although vegetation classification attempts to place vegetation into “types” and place boundaries around these types, in reality vegetation is a continuum. Vegetation communities feature a reasonable amount of variation within a classified type due to soils, rainfall, surface drainage, fire history and other factors. The boundaries between vegetation types may not always be clear due to a gradual transition. For example extensive ground-truthing was necessary to separate the occurrences of *Melaleuca viridiflora* and *Melaleuca citrolens* dominated communities. Within all *Melaleuca* communities within the survey area, *Melaleuca viridiflora* and *Melaleuca citrolens* are both almost always present but in significantly different proportions. The dominance of each species is not readily delineated from the aerial imagery alone.

The extent of the survey does influence the degree to which different, but reasonably similar, vegetation types can be distinguished from each other. The survey of the potential MLA may have clumped subtypes which would become more apparent through surveying a more extensive area. For example the stands of Lancewood (*Acacia shirleyi*) in this survey have been regarded as a single type. There may be subtypes of Lancewood as the understory species varies depending on the surrounding vegetation (e.g. *Melaleuca* Woodland or *Eucalyptus* Woodland).

Vegetation type 3 is an aggregate of vegetation communities for two very different substrates (white quartz sandstone and iron stone ridge) however vegetation composition and structure are similar due to the



abundance or large rocks and rock outcrop. Although differences are apparent between the two substrates these sites haven been grouped together based on broadly similar species compositions. Sampling over a larger area may distinguish the two communities more readily.

Small patches of *Callitris intratropica* dominated Woodlands were found scattered through the surveyed area, however, these are not mapped nor described as a separated vegetation unit due to their small size. This vegetation type is scattered within a few different vegetation types.

2.2.4 Port

Sampling Regime and Site Selection

Vegetation types of the port area were mapped and described through a preliminary interpretation of aerial photography, delimiting obvious vegetation types and boundaries at 1:30,000. This preliminary map provided the basis for selecting sites for fauna survey and vegetation survey for the more common vegetation types. Preliminary mapping and vegetation descriptions were refined through one field survey carried out in February 2012 – associated with fauna surveys. Flora sites were selected for each vegetation types, however no sites were established in mangroves or salt flats.

Sampling Intensity

A total of seven full characterisation and five check sites (conferring with the levels of data collection recommend by Brocklehurst *et al.* 2007) were selected and surveyed (refer to Figure 40). This sampling density is below the minimum of four sites per km² as recommended by Brocklehurst *et al.* (2007) for mapping at 1:25,000, but was regarded as suitable for the purpose of this preliminary vegetation mapping exercise. Vegetation in the vicinity if the actual proposed iron ore stockyard, conveyor belt and barge loading facility was surveyed at greater detail (i.e. vine thickets, *Melaleuca* woodlands, beefwood woodlands, Cypress Pine woodlands) than surrounding vegetation units (salt flats, mangroves, beach dunes, and paperbark swamps).

Limitations

Detailed ground-truthing of vegetation types was not possible due to project time frames, which resulted in the survey area not having survey effort applicable to vegetation mapping to a scale of 1:25,000. Therefore vegetation types proposed for disturbance were targeted during on-grounds works to an adequate level of survey.

Although vegetation classification attempts to place vegetation into “types” and place boundaries around these types, in reality vegetation is a continuum (apart from mangrove communities). Vegetation communities feature a reasonable amount of variation within a classified type due to soils, rainfall, surface drainage, fire history and other factors. The boundaries between vegetation types may not always be clear due to a gradual transition.



2.3 Groundwater Dependant Ecosystem Assessment

Potential ground water interaction and dependence for the vegetation types within the MLA areas has been investigated in the Groundwater Report (Appendix E of the EIS document). The method of assessing ground dependency involved overlaying modelled contours for an average ground water level with the vegetation mapping. Vegetation types which intersect with the predicted ground water being within the root zone (set at 10m), and also with characters suggesting potential ground water dependency, were interpreted to have a high potential for some level of ground water dependency.

2.4 Terrestrial Fauna Survey

A series of fauna surveys were conducted for all three potential zones of impact (MLA areas, haul road route and coastal port) in order to characterise habitat types and species present within the study areas (see Figure 2 for an overview, and more detailed figures in later sections).

A standard fauna survey and assessment methodology (see 2.4.2 below) was applied with the aim of characterising habitats and their associated species. Applying standard approaches permits some degree of relating species presence with particular habitat types. It also allows for explicit assumptions about the likely diversity present in similar habitats which have not being surveyed, and permits some comparison with surveys conducted in different locations which have also been assessed using the same standard.

A primary objective for the WDRL field assessments was “to increase the level of confidence that all notable habitat and species will be accounted for within or in the near vicinity of the proposed development”. As a consequence, surveys primarily targeted areas more likely to feature a greater range of species within the area or species and habitat which may be more sensitive to disturbance. A lesser emphasis was placed on sampling the more common or extensive (and generally less biodiverse) habitats found throughout the project areas. However, in the case of the MLA areas and the coastal port, sampling ensured that habitat types definitely targeted for clearing or significant disturbance were targeted.

2.4.1 Site Selection

Existing land system mapping together with preliminary vegetation mapping from aerial imagery assisted with the selection of survey sites (as detailed vegetation mapping was not available at the time of fauna survey mobilisation).



MLA Areas

Four standard fauna surveys were conducted within the MLA areas, which included two surveys in the build-up period (October 2010) and two surveys in the early Dry season (June 2011). This aimed to capture the main temporal differences to species assemblages at this location. A total of 14 sites were established during these surveys (Table 3), all targeting habitat proposed to be disturbed by mining operations and also includes replicate sites to ensure that spatial differences within similar habitat was captured to a degree.

Table 3: Fauna survey site location, vegetation types, and survey design for MLA areas

Survey & Site Locations	Coordinates	Vegetation type	Survey design
Area E			
Site 1	E511149 N8324009	Eucalyptus woodland on rocky substrate	Quadrat
Site 2	E512339 N8323528	Eucalyptus woodland on rocky substrate	Quadrat
Site 3	E515134 N8323612	Eucalyptus woodland on low ironstone ridge	Transect
Site 4	E515004 N8324697	Eucalyptus woodland on low ironstone ridge	Transect
Area F			
Site 5	E512611 N8325793	Eucalyptus woodland on sandstone ridge	Transect
Site 6	E511396 N8325485	Melaleuca woodland on flood-out	Quadrat
Site 9	E507950 N8325313	Eucalyptus woodland on rocky ironstone ridge	Transect
Site 10	E508254 N8325406	Mixed woodland riparian zone	Transect
Site 11	E509219 N8325557	Eucalyptus woodland riparian zone	Transect
Mine Camp & Airstrip			
Site 7	E501322 N8327545	Eucalyptus woodland on sandy plain	Quadrat
Site 8	E503549 N8326608	Acacia in slight depression on sandy plain	Quadrat
Site 8b	E501804 N8327419	Eucalyptus woodland on sandy plain	Quadrat
Site 12	E504702 N8326722	Eucalyptus woodland on sandy plain	Quadrat
Site 13	E505114 N8326459	Eucalyptus woodland on sandstone ridge	Transect
Site 14	E505913 N8326877	Eucalyptus woodland on sandy plain	Quadrat
Site 15	E506126 N8326814	Cypress pine woodland on sandy plain	Quadrat



Haul Road Transport Corridor

Five standard fauna surveys were conducted along the haul road corridor in locations that were considered to support typical habitat for the area (i.e. open woodland) and habitat regarded to potentially support higher biodiversity values (i.e. the rocky ridges and gullies). The majority of the haul road corridor travels through extensive areas of similar vegetation type so fauna assessments were aimed at habitats and locations of greater interest along its length. All survey locations contained a similar selection of target habitat (rocky ridge and woodland) at an attempt to replicate vegetation types along the haul road length and to account for spatial differences in species assemblages. A total of 21 fauna sites were established during these surveys (Table 4), which occurred between November 2011 and February 2012.

Table 4: Fauna survey site location, vegetation types, and survey design for haul road corridor

Survey & Site Locations	Coordinates	Vegetation type	Survey design
Lower Towns			
Site 1	E529919 N8334746	Eucalyptus woodland on sandy soil	Quadrat
Site 2	E529836 N8335106	Eucalyptus woodland on sandy soil	Quadrat
Site 3	E529598 N8335315	Melaleuca woodland on flood-out	Quadrat
Site 4	E529195 N8335374	Eucalyptus woodland on sandy soil	Quadrat
Site 5	E528552 N8335399	Eucalyptus woodland on sandy soil	Quadrat
Site 6	E528224 N8334945	Melaleuca woodland on flood-out	Quadrat
Upper Towns			
Site 1	E514285 N8326080	Eucalyptus woodland on sandstone ridge	Transect
Site 2	E514611 N8326226	Melaleuca woodland on flood-out	Quadrat
Site 3	E514276 N8326355	Corymbia woodland on sandy soil	Quadrat
Site 4	E515313 N8326492	Eucalyptus woodland on sandy soil	Quadrat
Site 5	E515061 N8326333	Eucalyptus woodland on sandstone ridge	Transect
Site 6	E514744 N8326079	Melaleuca woodland on flood-out	Quadrat
Cox – Ridges & Woodlands			
Site 1	E528950 N8310600	Corymbia on rocky ridge with outcropping	Transect
Site 2	E529066 N8310385	Melaleuca woodland on swamp	Quadrat
Site 3	E529436 N8310095	Mixed woodland on sandy soil	Quadrat
Site 4	E528800 N8310350	Melaleuca riparian zone	Transect
Limmen – Ridges & Woodlands			
Site 1	E545890 N8290882	Mixed woodland on rocky crest	Transect
Site 2	E546240 N8291003	Eucalyptus woodland on sandy plain	Quadrat
Site 3	E545915 N8291213	Eucalyptus woodland on flood-out plain	Quadrat
Rosie – Ridges & Woodlands			
Site 1	E583400 N8278610	Eucalyptus woodland on sandy plain	Quadrat
Site 2	E582720 N8278565	Corymbia woodland on sandy plain	Quadrat
Site 3	E583083 N8278048	Mixed woodland on sandstone escarpment	Transect



Port Facility and Stockpile Area

One standard fauna survey was conducted for the proposed stockpile facility and conveyor belt alignment. Seven sites were surveyed to include the main vegetation types present in areas proposed to be cleared and disturbed (Table 5). The survey was conducted in late February 2012, which was selected to incorporate migratory species assessment of the coastline adjacent to the proposed barge loading facility.

Table 5: Fauna survey site location, vegetation types, and survey design for port

Survey & Site Locations	Coordinates	Vegetation type	Survey design
Site 1	E645432 N8268966	Melaleuca open woodland on sandy loam	Transect
Site 2	E645303 N8269271	Cypress pine stand on sandy loam	Transect
Site 3	E645736 N8270449	Mixed species open woodland on sandy loam	Transect
Site 4	E646573 N8271219	<i>Grevillea</i> open woodland on clay	Transect
Site 5	E646828 N8271417	Old wooded sandy beach rise with signs of vine-thicket. Highly weed impacted	Transect
Site 6	E648030 N8271939	Chenier with patchy Monsoon Vine-thicket and high leaf-litter load	Transect
Site 7	E646007 N8271515	Freshwater <i>Melaleuca</i> swamp with high <i>Parkinsonia</i> weed impact	Transect

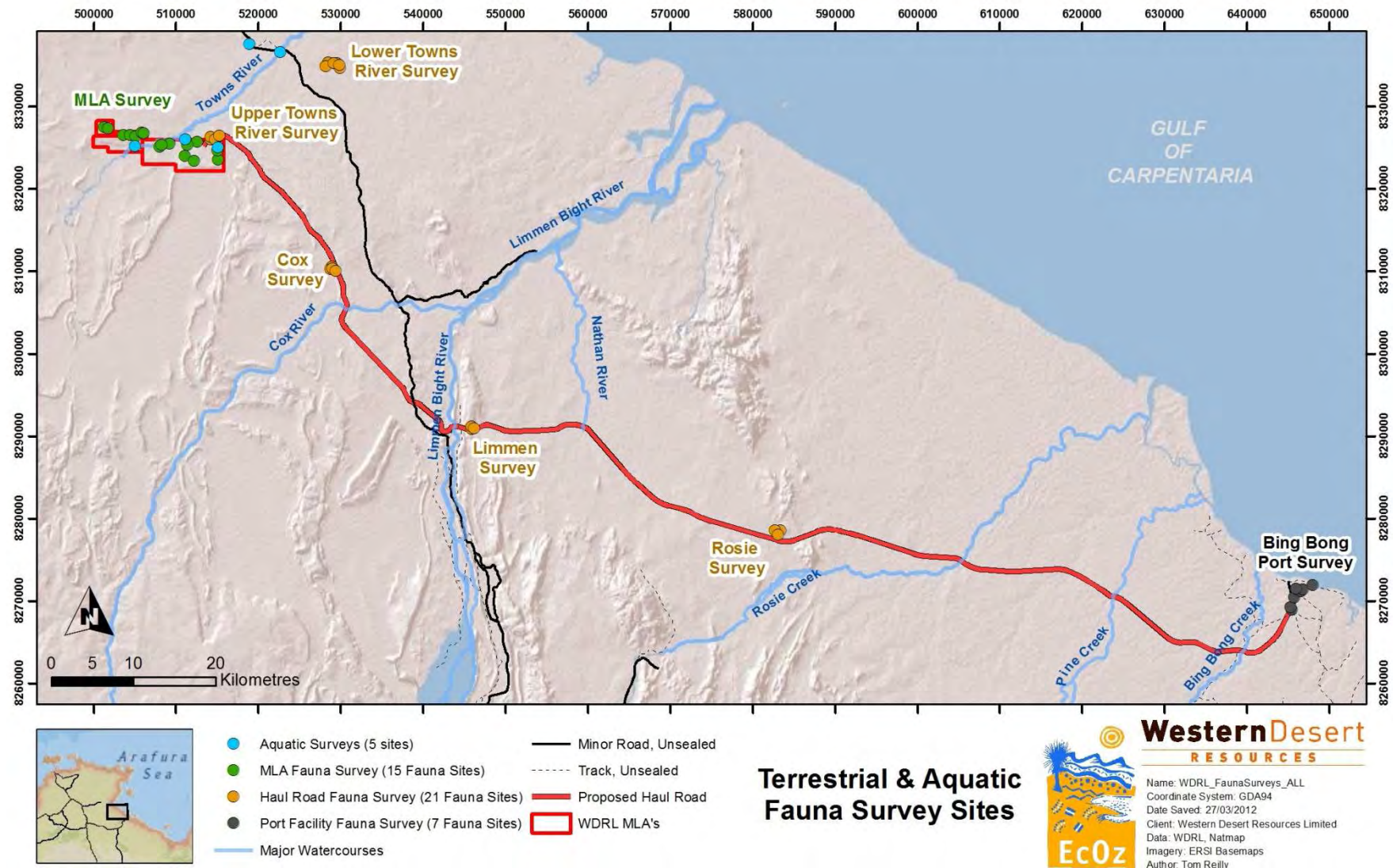


Figure 2: Map of all fauna survey locations conducted for the survey



2.4.2 Survey Design

The methods for fauna survey (including habitat descriptions) followed the *Northern Territory Survey Methods for Flora and Fauna Surveys Used for Standard Biodiversity Unit Survey Sites* (an unpublished report of NRETAS provided in 2008). This involves a three night trapping and searching program within a 50m by 50m quadrat (or similar are in transect formation). Where possible at two areas of the same habitat type, located at least 500m apart, were surveyed to account for variability with the same 'category' of habitat. This methodology is a standard approach for fauna surveys in the northern bioregions of the Northern Territory. Fauna survey techniques are detailed below.

All surveys were undertaken under Wildlife permit no. 38863.

Site Layout

The layout of traps at each survey quadrat is based on the standard and accepted NT fauna survey guidelines which involves a 50m x 50m quadrat (or equivalent) comprising:

- Twenty Elliott traps around the perimeter – five on each side approximately 8m apart;
- Four cage traps, one in each corner;
- Four pitfall traps, with 10m of drift fence; and
- Eight funnel traps, set along pitfall drift fences.

Pitfall traps were 20L white plastic buckets which were dug to ground level and set with 10m of drift-fence. Where possible, the pits were located across different microhabitats within the quadrat. Funnel traps were set on the end of the drift fence. Silver reflective thermafoil (roof insulation) were set over pits and funnel traps to protect animals from dehydration and predation from raptors. The pits and funnels were opened for the duration of the survey (three nights and three days) and were checked early each morning and mid-afternoon. Some variations to the trap design were implemented for sites with a large degree of outcrop – prohibiting digging pit traps. For these sites a greater number of funnel traps were used either with drift nets or placed against rock faces or fallen logs.

The Elliott and cage traps were baited each afternoon, opened overnight and closed for the duration of the day. Trapping occurred for a three night period, and the bait used was a mixture of quick oats, peanut butter, and sardines in oil. Bait was removed from traps during the day to reduce ant attraction to the trapping area.

All trapped animals were identified and released near the capture point. The purpose of this survey was to investigate species diversity rather than population size so the mark capture recapture method was not used. Genetic samples were acquired for species which were of special note.

Bird Survey

Birds were surveyed within a 100x100m area with the trapping quadrat being central. Bird counts were carried out over 15 minute blocks using binoculars and call recognition during the early morning (6am – 9.30am), late afternoon (3.30pm – 5pm) and one night (after 730pm). Only birds within the quadrat were counted as using the survey site – birds merely flying across or overhead or situated nearby were counted as incidental records. Raptors were included in the bird count if they were hunting overhead.

Bird call broadcasting was undertaken (opportunistically) in suitable habitat for target species. The main species targeted were Masked Owl, Purple-crowned Fairy-wren, and Owlet Nightjar.

Shane Crees, a geologist working for WDRL and a keen bird-watcher, contributed regular lists of bird sightings he made within the MLA areas throughout 2011. These included some species which were not recorded during field surveys.



Bat Survey

Bat species present were assessed by using Anabat II Bat Detector and also Dx500 Bat Detectors, which were set up to record data either overnight or the early part of the evening (for one night only) at a central location within each survey area.

Kyle Armstrong from Specialised Zoological was contracted to analyse all bat call sequences and provide a summary report noting bat species presence.

Physical trapping methods and roost searches were used for investigating the presence of Bare-rumped Sheath-tailed Bat (*Saccolaimus saccolaimus nudiclunatus*), within the MLA areas. This is discussed in Section 2.5.

Active Searching

Survey sites were actively searched five times for reptiles, mammals, and their scats and signs, including three daytime searches (morning, midday, and late afternoon) and two nocturnal searches.

Active searches lasted for 20 minutes and involved:

- Turning rocks and logs, raking through leaf litter and grass, looking under bark, behind trees, in crevices, etc.;
- Recording the number of individuals of each species; and
- Recording scats, bones and other signs where they could be confidently attributed to species.

Opportunistic observations made while travelling between quadrats were also recorded in an 'incidentals' list.

Gehyra borrooloola is a restricted range species and was specifically targeted during the fauna surveys, as any records would suggest range extensions according to current distribution maps. *Gehyra borrooloola* is a rock outcrop dwelling gecko and was targeted during active searching surveys that encountered this habitat type (which occurred on many occasions within the MLA areas and along the haul road corridor). This species can only be confirmed using spotlight searches, and if present is relatively easy to locate and identify (although there is discussion in terms of species complexes associated with *Gehyra borrooloola* and *G. australis*).

Habitat Description

The habitat for each fauna survey site was described using a range of data (aligning to both NVIS and NRETAS Standards for Biodiversity Assessment) (see blank datasheet example in Appendix D-12).

2.4.3 Nomenclature

Nomenclature and classification of fauna species refers to the Classification of Wildlife of the NT – January 2007 (NRETAS). At the time of writing this report the Northern Territory listings of threatened species was under review and at the stage of seeking public comment.

2.4.4 Data Limitations

- The results of these surveys are only a snapshot in time, and do not allow for temporal variations or species migrations;
- Sampling, as against censussing, is logistically necessary due to limited human resources. Moreover, a larger degree of sampling is required to account for all the abovementioned variations with a high level of confidence;
- Sampling is logistically necessary due to resources – can never capture the full range of variations.
- Scats cannot always be correctly attributed to species, however where they can be confidently identified, they provide an accurate indication of the presence and habitat preferences of certain species (Telfer *et al.* 2006);



- Detection of nocturnal species by spotlight potentially only detects about 25% of the animals present (e.g. Goldingay & Sharpe 2004), and is affected by environmental factors (Wayne *et al.* 2005). Specific survey conditions can be selected to improve spotlight detection efficiency (Wayne *et al.* 2005);
- Read & Moseby (2001a) concluded that environmental factors affect capture rates. Unfortunately, planning logistics for fauna surveys such as this around specific environmental conditions is very difficult. Planning to survey in the Dry season allows the best chance of favourable conditions;
- The trapping and search methodologies utilised in this study predominantly targeted only threatened species identified during desktop surveys and therefore did not necessarily provide an unbiased or complete indication of species diversity within an area or allow for other threatened species not identified on the database (Cunningham *et al.* 2005, Read & Moseby 2001b, Thompson *et al.* 2005);
- Fauna and Flora Atlas records are biased toward previous NT Government survey sites and accessible sites often recognised for their unique biodiversity. Therefore, a lack of records at any particular site is more likely to indicate that the area has not been previously surveyed rather than indicate that various species are not present in the area.

2.5 Freshwater Fish Surveys

Freshwater fish surveys were conducted within and downstream of the MLA areas in October 2011. No surveys were conducted along the haul road corridor and port facility as these proposed developments are not expected to result in significant long term disturbance of wetland or riparian zones. However, WDRL will commit to further investigatory work in selected areas along the haul road corridor and port area to gain a better understanding of freshwater fish species in the region (which is currently understudied according to NT Museum). Aquatic life-stages of insects (macro-invertebrates) were not sampled as part of this survey.

Freshwater fish surveys were conducted to:

- Provide a list of species present in the river and creek systems with the MLA areas;
- Gain a wider understanding of the aquatic environments on or adjacent to the lease so that the potential impacts can be assessed and appropriate management practices can be implemented to mitigate potential impacts; and
- Endeavour to identify any threatened freshwater fish species on or downstream from the lease that may require special consideration.

2.5.1 Site Selection

The upper and middle reaches of the Towns River meander through the MLA areas and thence into the Limmen Bight in the western Gulf of Carpentaria. The highest flows occur during the Wet season, associated with monsoonal activity and cyclones. In the vicinity of the MLA areas, the tributaries are ephemeral and usually cease to flow through the Dry season. The timing of the river ceasing to flow during the Dry season is likely to be affected by the magnitude and persistence of the previous Wet season.

Freshwater fish fauna surveys were conducted at five sites in October 2011 by David Wilson (aquatic specialist), with three within the MLA areas (on the Towns River), and one each on Magaranyi River and Yumanji Creek – the two major tributaries downstream of the Towns River (Table 6 and Figure 24). Selection criteria included:

- Habitat types common within the area of potential impact;
- Most likely to feature a diverse range of species; and
- Likely to be targeted for significant disturbance.

Additionally, the ability to access areas was a major consideration for selection of sampling sites.



The Freshwater fish surveys were carried out under a Section 17 License No. S17/3236 under the Fisheries Act.

Table 6: Freshwater fish survey site locations and habitats

Survey & Site Locations	Coordinates	Location & Habitat	Survey Techniques
MLA AREAS			
Site 1	15° 08' 55" S 135° 02' 49" E	Upper reach of Towns River on MLA lease at western extremity of the F East deposit. An isolated pool in a seasonally flowing creek.	All (except gill net)
Site 3	15° 08' 28" S 135° 06' 14" E	A series of waterholes 16km SW of Site 2. Located on Towns River in WDR lease at eastern end of F East deposit. Relatively deep waterhole adjacent to rocky spur.	All
Site 4	15° 09' 00" S 135° 08' 27" E	A series of small, swampy waterholes fed by a small soak on WDR lease near E East deposit. Drains into Magaranyi River. Shallow swamp where a small stream cuts through a low ridge.	All (except gill net)
DOWNSTREAM OF MLA AREAS			
Site 2	15° 02' 41" S 135° 12' 40" E	Crossing of Savannah Way and Towns River to approximately 400m upstream and 55m downstream. Lowland river at limits of tidal influence.	All
Site 5	15° 02' 11" S 135° 10' 36" E	Crossing of the Savannah Way and Yumanji Creek (Little Towns River). Long, lowland river pools connected by small riffles.	All

2.5.2 Survey Design

Survey Techniques

The range of freshwater fish present for each survey site was assessed using a variety of methods, depending on the nature of the site. The range of assessment methods applied include:

- **Gill nets** – Multi-panel gillnets 35m in length and with a drop of 2m consisting of seven 5m long panels each with a different mesh size: 26, 44, 58, 76, 100, 126, and 150 millimetres (knot to knot). The differing mesh sizes permits sampling of a wide range of fish species and sizes (e.g. from small rainbow fish to adult barramundi). Where possible, two sets of nets were set with one at right angles to the bank, and one parallel to the bank to ensure capture of fish species which utilise bank overhangs and open water. The nets were tied or anchored and buoyed (working from a small dinghy) so that they remain stationary. The nets were left for approximately an hour in the afternoon, and then re-set for another hour in the evening at sunset. Gill nets were set for no more than one hour at a time and regularly checked, to minimise stress and mortalities. Gill nets were not used at Sites 1 and 4 due to insufficient water depths.
- **Scoop or push nets** – These nets were used at each site to collect fauna from in-stream habitats such as thick macrophytes (aquatic vegetation) and undercut banks;
- **Cast nets** – These were used at each site and are particularly effective at catching a broad range of species in turbid shallow waters;
- **Baited traps** – Shrimp nets were used, baited with cat food. These traps were set at sundown for approximately two hours;



- Hook and line – A hook and line is useful for capturing carnivorous species from amongst snags where the use of nets is not possible. Fish and reptiles (especially turtles) can be caught using this technique;
- Dip net and torch – Additional sampling with scoop nets and small aquarium dip nets was carried out at each locality at night. Many small fish freeze in a bright torch beam which enables the capture of nocturnally active fish species less difficult; and
- Streamside observations – Many species can be identified simply by observing them from the stream bank. The effectiveness of this technique is strongly influenced by weather and time of day. Observations of fauna can be assisted by the use of polarising glasses.

Each site was sampled for a day and night for a more complete census of freshwater fish, unless the water body was small and clearly not worthy of intensive sampling (e.g. a shallow creek).

Water Quality

For each site the following parameters were recorded:

- Water temperature, pH and electrical conductivity (EC) recorded by a Hannah electronic hand held meter, and reagent test kits;
- Alkalinity and Hardness were measured by Aquasonic reagent test kits;
- The maximum water depth was recorded for each site; and
- Turbidity was measured using a Secchi disk or estimated by observation.

Site Description

Each site was described with regard to the nature of watercourse, substrate, banks and aquatic vegetation. Also, photographs of each sampling site were taken and a brief description of surrounding area (e.g. riparian zones) was recorded in field notes.

2.5.3 Nomenclature

Nomenclature for fish, crustaceans and molluscs follows CSIRO Division of Marine and Atmospheric Research Codes for Australian Aquatic Biota (Yearsley *et al.* 1997).

2.5.4 Data Limitations

- The results of this survey are only a snapshot in time, and do not allow for temporal variations or species migrations;
- This survey did not focus on the sampling of macro-invertebrates as the timing of the survey did not coincide with the optimal time to sample these communities (i.e. early Dry season recessional flow period);
- The freshwater reaches of the Towns River have been subject to only very limited survey effort and consequently there are few historical records for species in this river; and
- One valuable survey technique – direct observation by snorkelling – was not used because of the potential presence of Saltwater Crocodiles (*Crocodylus porosus*).



2.6 Targeted Surveys

2.6.1 Bare-rumped Sheath-tailed Bat (*Saccolaimus saccolaimus nudicluniatus*)

There are two geographically separated populations of Bare-rumped Sheath-tailed Bat (*Saccolaimus saccolaimus nudicluniatus*) in Australia – north-eastern Queensland and the Northern Territory. These two populations may possibly represent two different subspecies or even species (DSEWPC 2012). Little is known about this species' ecology and distribution, and collectively the two populations are listed as Critically Endangered under the EPBC Act. There are few records for the Northern Territory population. It was first recorded in 1979 and, until recently, all records were from the Kakadu lowlands. In 2001 a specimen of this subspecies was collected at E528572 N8366561 (Z53 GDA94), which is 45km northwest of the MLA areas close to the mouth of the roper river (NRETAS NT Fauna Atlas).

Based on existing data, the quality of the habitat within the MLA areas and the species' threatened status, a targeted survey was conducted within the vicinity of the MLA areas in order to gain a greater appreciation of the presence and distribution of these species, and therefore any potential cumulative impacts from mining targeting outcrop areas featuring caves.

Kyle Armstrong from Specialised Zoological was contracted to undertake a targeted survey for this species. Techniques used (see Appendix D-5 for details) were:

- Analysis of bat call sequences;
- Night trapping across waterways using mist nets and harp traps; and
- Searches of tree hollows for roosts using a pole camera apparatus.

DNA samples were taken from captured bats for laboratory analysis.

2.6.2 Migratory Shorebird Potential

Shorebirds listed under international treaties and the EPBC Act have been recorded in the vicinity of the proposed barge loading facility. An assessment on migratory shorebird abundance and habitat was undertaken around Bing Bong to determine possible impacts of the coastal development. The assessment included a comprehensive desktop review of shorebird records from the following data sources:

- NRETAS Fauna Atlas;
- Atlas of Living Australia; and
- the Chatto (2003) survey.

A field visit in February 2012 was also undertaken to inspect the barge loading facility in terms of habitat viability and to determine whether shorebirds were present at the time of survey. This included a short helicopter survey to achieve a broader scale perspective of shorebird habitat along the coastline of this region.

Existing records and data for the Limmen Bight coastal floodplains, which are downstream from the MLA areas and northern section of the haul road, were deemed sufficient and so no surveys were undertaken in that area.

2.6.3 Groundwater Dependancy Ecosystems

Groundwater-dependent ecosystems (GDE's) are defined as 'ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide' (modified from Clifton *et al.* 2007 and Tomlinson, 2011 as cited in Richardson, 2011a).

Smith *et al.* (cited in Dresel *et al.* 2010) – authors of a risk-based approach to groundwater management for terrestrial groundwater dependent ecosystems – add a time dimension to the definition of ground water



dependency. They define GDE's as those which rely wholly or partially on groundwater to maintain an adequate level of ecosystem function and maintenance of community composition over multiple generations of the longest lived species within the community.

Richardson *et al.* (2011a) recommend three classes of GDE's:

- **Type 1 – Aquifer and cave ecosystems:** typically include karst aquifer systems, fractured rock and saturated (consolidated and unconsolidated) sedimentary environments. The hyporheic zones (regions beneath and alongside a stream bed, where there is mixing of shallow groundwater and surface water) of rivers, floodplains and coastal environments are also included in Type 1.
- **Type 2 – Ecosystems dependent on the surface expression of groundwater:** includes wetlands, lakes, seeps, springs, river baseflow, coastal areas and estuaries that constitute brackish water and marine ecosystems. In these cases, the groundwater extends above the earth surface, as a visible expression.
- **Type 3 – Ecosystems dependent on subsurface presence of groundwater:** includes terrestrial vegetation that depends on groundwater (via the capillary fringe) either fully or on a seasonal or episodic basis in order to prevent water stress and generally avoid adverse impacts to their condition. In these cases, groundwater is not visible from the earth surface. These types of ecosystem can exist wherever the watertable is within the root zone of the plants, either permanently or episodically.

Terrestrial vegetation, wetlands and river base flow systems (aligning with type 2 and 3 GDE's) possibly occur within the MLA areas. These forms of GDE's were targeted for an assessment. Details of the process and criteria used to assess the presence of GDE's and risks of impact from potential dewatering of pits is outlined in Chapter 3.10 of the Roper Bar Iron Ore EIS. The presence of GDE's has largely been determined by mapping vegetation types, a data layer indicating the spatial sense of where groundwater is likely to exist within a given depth range, as well as investigating key recharge or discharge areas. The results of this assessment are briefly described in Section 4.4 of this report.

The haul road corridor and port facility may feature GDE's. As there are no planned disturbances to ground water levels, quality or functionality within these areas, detailed ground water assessments within these proposed development zones have not been undertaken as part of the environmental studies towards the EIS. An assessment of GDE's for the coastal port area are briefly outlined in Section 6.3.3 but are at a speculative level only, based on prior studies of ground water systems and preliminary vegetation mapping. See also Chapter 6.

2.7 Evaluating Notable Species and Sensitive Habitat

Identification of Notable Species

Notable flora and fauna species are either, threatened, rare, restricted in range, endemic to the bioregion or the Northern Territory, migratory, or keystone to protecting biodiversity values. The majority of notable species are listed under Northern Territory and/or Commonwealth legislation as threatened, migratory or marine species – or a combination of these. Some, however, lack sufficient data to accurately assess their status.

The International Union for the Conservation of Nature (IUCN) nominates a set of criteria used to identify species at risk to extinction used to define categories of risk (Figure 3).

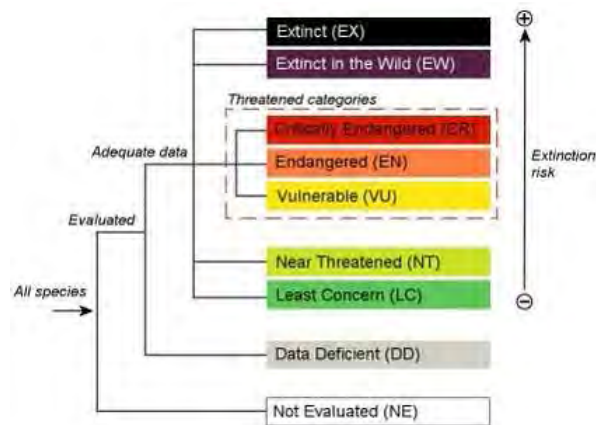


Figure 3: The IUCN Red List categories of risk for threatened species

(Source: http://www.eoearth.org/article/IUCN_Red_List_Categories_and_Criteria)

These criteria and categories are used by both the NT Government to identify threatened species and habitat which are listed under the TPWC Act, and the Commonwealth Government to identify nationally threatened species under EPBC Act.

For the purpose of this review flora and fauna species are identified as notable if listed as:

- Threatened under the EPBC Act;
- Threatened under the TPWC Act;
- Near Threatened or Data Deficient under the TPWC Act;
 - o Near Threatened (NT) is a conservation status assigned to a species that may be considered threatened in the near future but does not currently qualify for a threatened status;
 - o Data Deficient (DD) is a status applying to a species for which there is currently insufficient distribution and population data to make an assessment of the risk of extinction. Data Deficient is not a category of threat but further information may suggest that threatened classification may be appropriate. Due to the remote nature of the Northern Territory several species are classed as Data Deficient. While data deficient species are included in the database searches, for the purpose of this report these records and species have not been interrogated further unless they were recorded during the field survey;
- Listed as migratory species under the EPBC Act;
- Listed as marine species under the EPBC Act; and
- Those which are not listed but are naturally rare, endemic to the bioregion, or which have a restricted range.



Identification of Sensitive Habitat or Vegetation Types

In terms of conserving catchment-based ecological resilience a habitat or geographic place may be considered 'sensitive' because it:

- Supports threatened taxa or communities;
- Serves important ecological or hydrological functions;
- Serves as an important corridor for the movement of individuals, range extension or genetic exchange between otherwise disjunct populations;
- Provides habitat during times of vulnerability or adverse conditions (e.g. drought);
- Supports a concentration of a diverse range or abundance of species within a local area (i.e. a sub-catchment);
- Supports a disjunction population or degree of genetic diversity for a species that is not well represented elsewhere; or
- Serves as a representation of habitat in sound condition which is more often in adverse condition in the catchment or bioregion.

In addition, the Northern Territory Land Clearing Guidelines (NRETAS 2010) includes riparian vegetation as a significant or sensitive vegetation community that requires buffers. The minimum buffer width is dependent on the hierarchy of stream order in the area targeted for clearing.

Assessment of "sensitive" habitat (particularly within the haul road corridor) places a particular focus on tributaries, wetlands, vegetation types and landforms which may form particular refugia such as: riparian vegetation, mangroves, monsoon forest, monsoon vine thicket and freshwater swamps, all rivers and tributaries, likely habitat corridors and geological features which may support unique ecosystems such as escarpments, gorges, gullies and springs. These areas may or may not be protected under legislation; but they may be locally or regionally significant therefore warrant specific consideration and protection from disturbance. These areas should be avoided altogether, buffered or recommended for specific management actions to minimise adverse impact.



D-3. Desktop Review

3.1 Climate

The project area experiences a tropical climate with a distinct a Wet and Dry season, which strongly influences temporal variability of faunal activity (and flora/habitat/resource presence) throughout the year. The Wet season typically occurs between November and April, and the Dry season between April and November. The Wet season is associated with monsoon troughs and occurrence of tropical lows/cyclones which produce significant rainfall events, and often result in flood events. In contrast, the Dry season experiences negligible rain which results in river/creek flow reduction/cessation and billabongs/wetlands drying up or at least reducing to small pools.

The project area experiences an average rainfall between 600 – 800mm per year. The closest weather stations to the project area are Ngukurr (Station 14609) and Limmen River (Station 14645), which are approximately 60km to the north and south respectively.

Mean maximum monthly rainfall ranges between 182 and 252mm (January) and a mean minimum monthly rainfall ranges between 0.1 and 0.7mm (August) for Ngukurr and Limmen River. The mean daily minimum temperatures at Ngukurr range from 15.1 to 25.5°C and a maximum mean daily temperature range from 29.6 – 38.9 °C. Average annual evaporation is approximately 2,400mm for the region which, even in the wettest of years, exceeds the annual rainfall.

All information was sourced from Bureau of Meteorology in December 2012. More detailed climate discussion with figures and tables is available in the Roper Bar Iron Ore EIS 2012.

3.2 Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into units of broadly similar landform, geology and biodiversity (Baker *et al.* 2005). The project falls within two bioregions (Figure 4):

- Gulf Fall and Upland; and
- Gulf Coastal bioregions.

Gulf Falls and Uplands Bioregion

This bioregion includes Lawn Hill (in Queensland), and parts of Elsey NP and the recently established Limmen NP in the Northern Territory. The Gulf Falls and Uplands bioregion comprises undulating terrain with scattered low, steep rocky hills. The most extensive vegetation is woodland dominated by *Eucalyptus* and *Corymbia* species with spinifex understorey, and woodland dominated by *Eucalyptus* species with tussock grass understorey.

The rocky sandstone ranges of this bioregion have some significant refugial values, and include some endemic or near-endemic species. Threatened species include the highly localised and endangered Carpentarian Grasswren (*Amytornis dorotheae*) and the endangered Gouldian Finch (*Erythrura gouldiae*), with additional restricted range species such as *Gehyra borrooloola* and *Cryptoblepharus zoticus* which are dependent on rocky range habitat.

Important rivers within this bioregion include the Roper and McArthur Rivers. Riparian areas are generally in reasonably good condition, but are suffering some degradation from uncontrolled livestock, other feral animals (buffalo, horses, pigs, and donkey). More localised conservation issues include weed infestations, pollution associated with mining, and altered fire regimes.

This bioregion supports 10 species listed as threatened federally or in the State/Territory.

(Source: NRETAS website)



Gulf Coastal Bioregion

This bioregion includes two large reserves – Barranyi (North Pellew Island) and the recently declared Limmen NP and Limmen Gate Marine Park. The Gulf Coastal bioregion comprises gently undulating coastal plains with scattered rugged areas of sandstones and sediments. The Pellew islands are an important refuge area, containing populations of many species which have declined or become regionally extinct from the adjacent mainland. The islands are relatively undisturbed and in unusually good condition. The islands, and some mainland coastal areas, are also nationally significant as nesting sites for marine turtles and colonial seabirds, and as feeding sites for migratory shorebirds.

Much of the bioregion is in reasonably good condition, although this is being destabilised by increasing impacts of weeds, feral animals, changed fire regimes and grazing. There are also more localised impacts from mining and exploration. Condition is generally better on the islands than on the mainland

Three nationally significant wetlands are recognised from this bioregion:

- Borroloola bluebush swamps (NT006: wetland types B14 and B13),
- Limmen Bight (Port Roper) tidal wetlands system (NT007: wetland types A7, A8, A9, A6 and A2), and
- Port McArthur tidal wetlands system (NT008: wetland types A1, A7, A8, A6, A2, A9 and B5).

These are generally in good condition, but are affected by feral animals, and have occasional or potential threats from commercial fishing and/or pollution associated with mining.

The main rivers include the lower reaches of the Roper, McArthur, Calvert, Robinson, Limmen Bight, Wearyan, Foelsche and Towns Rivers. Riparian areas are generally in reasonably good condition, but are suffering some degradation from uncontrolled livestock, other feral animals (buffalo, horses, pigs and donkey). More localised conservation issues include weed infestations, pollution associated with mining, and altered fire regimes.

No ecosystems are formally recognised as threatened, however rainforest patches, riparian areas and some wetlands hold high conservation value and are sensitive to disturbance.

This bioregion includes 16 species listed as threatened at national of Territory level. This includes a six marine turtles, of which at least 4 have significant populations and/or nesting sites within this bioregion. Two of the listed threatened mammal species – Carpentarian Antechinus (*Pseudantechinus mimulus*) and Canefield Rat (*Rattus sordidus*) occur in the Northern Territory but only within this bioregion. The Canefield Rat is only known to occur on the Pellew Islands but the Carpentarian Antechinus has recently been recorded on the mainland. The significant seabird breeding colonies are currently unreserved and warrant formal protection.

(Source: NRETAS website)



3.3 Sites of Conservation Significance

The MLA areas do not occur within a Site of Conservation Significance (SOCS). Downstream from the MLA areas and first half of the haul road is the Limmen Bight SOCS. The haul road corridor and coastal port facility fall within the northern tip of the McArthur River Coastal Floodplain SOCS (Figure 4).

Limmen Bight

The huge coastal mudflats of Limmen Bight are among the most important areas for migratory shorebirds in the Northern Territory, supporting large numbers of waders (including more than 1% of the world's Grey-tailed Tattlers and Great Knots). The site also includes a number of off-shore islands.

The site is significant for its environmental attributes which include:

- Eight threatened fauna species;
- Ten plant species are endemic to the Northern Territory;
- Four species of marine turtle breed on the islands within this SOCS (but are not known to breed on the mainland coast) making it nationally significant for this family;
- Internationally significant breeding colonies of Roseate Terns;
- Significant numbers of shorebirds, with the highest count of more than 38,000 (in 1994); and
- A large part of this site listed as a Wetland of National Significance in A Directory of Important Wetlands in Australia (EA 2001).

(Source: Harrison *et al.* 2009)

McArthur River Coastal Floodplain

The McArthur River Coastal Floodplain is recognised as having outstanding conservation values which attract very large aggregations of migratory shorebirds. Waterbirds breed in the mangroves at the site, and seabirds use coastal sand spits for nesting.

The site is both significant for its environmental attributes which include:

- Six threatened fauna species;
- Eight plant species are endemic to the Northern Territory;
- Marine turtles frequent the waters adjacent to this site and around the Sir Edward Pellew Islands, but are not known to breed on the mainland coast in this area;
- Nationally significant breeding colonies of Little Terns;
- Significant numbers of shorebirds, with the highest count of more than 27,000 (in 1996); and
- A large part of this site listed as a Wetland of National Significance (EA 2001).

(Source: Harrison *et al.* 2009)

Although not formally assessed it is likely that these two systems would comply with Ramsar consideration and listing due to the large numbers of both shorebirds and waterbirds (Chatto 2003).



Figure 4: The project in relation to bioregions and Sites of Conservation Significance



3.4 Topography and Geomorphology

The project area is located within the broad-scale drainage system known as the 'Gulf Fall' (Aldrick & Wilson 1992). All rivers and creeks within this system flow towards the Gulf of Carpentaria, with the MLA areas located on the upper reaches of the Towns River, approximately 46 km upstream of where it flows into the Gulf. The Towns River for most of its distance downstream of the project area, flows across a broad, flat, coastal floodplain, and there is very little rise in elevation between the Gulf coastline and the project area. The project area is only between 20m and 60m above sea level (Figure 5).

At a broadscale, the MLA areas and first two-thirds of the haul road corridor are located within undulating terrain comprising scattered low, steep hills on Proterozoic and Palaeozoic sedimentary rocks, in places overlain by lateritised Tertiary material (as defined for the 'Gulf Falls and Uplands' bioregion by Woinarski 2001; Baker 2005; and DSEWPAC 2011).

The last third of the haul road corridor to the port traverses across gently undulating to flat coastal plains with scattered rugged areas of Proterozoic sandstones and Tertiary sediments (i.e. the IBRA 'Gulf Coastal' bioregion). Soils are predominantly sandy red earths and shallow gravelly sands.

Bing Bong Port is located on the Gulf coast within an area of coastal sand dunes, sand sheets, and chenier plains adjacent to tidal mud flats, tidal creeks, and mangroves. Land systems for each project component are discussed in Sections D-4, D-5, and D-6.

3.5 Fire Activity

Fires are a regular occurrence in the bioregion and in the past 5 years a majority of the landscape has been burnt at least once (see Figure 6). The 2009 fires were particularly widespread. All of the MLA areas have experienced fire recently, as has most of the haul road route – with two exceptions; a patch east of Limmen River, and one in the sandstone plains midway between Limmen Bight River and Rosie Creek. In contrast, very little of the vegetation within the greater port vicinity has been burnt recently. The coastal area often contains wetter swales and floodplains that are good barriers to fire.

Late burn fires are typically hotter than those occurring earlier in the Dry season. They are often anthropogenic in origin and their effect on native flora and fauna is usually more detrimental because of their intensity. As Figure 7 shows, most of the area containing the haul road corridor has experienced multiple late burns in recent times.

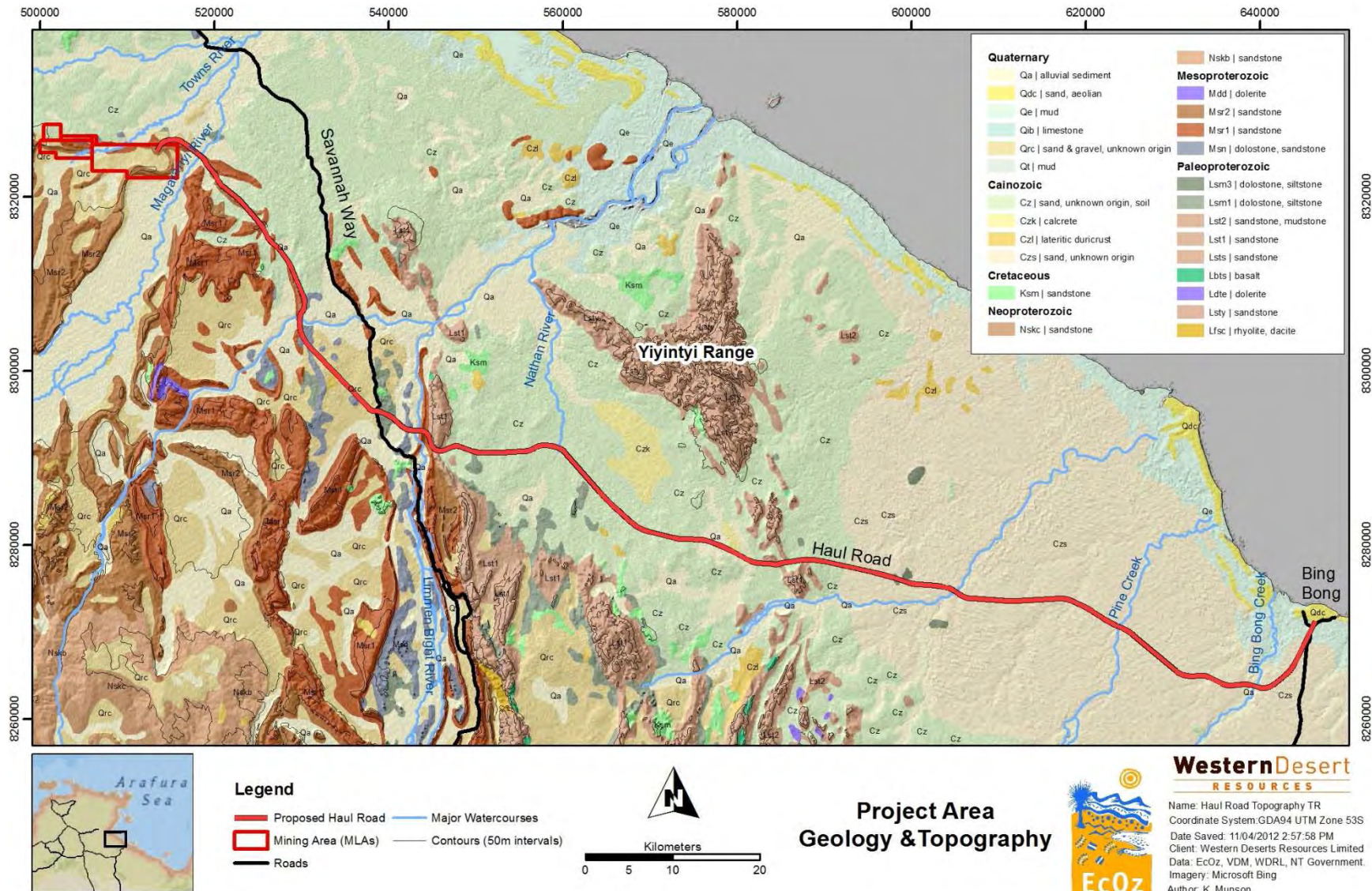


Figure 5: Map of topography and geology of the project area

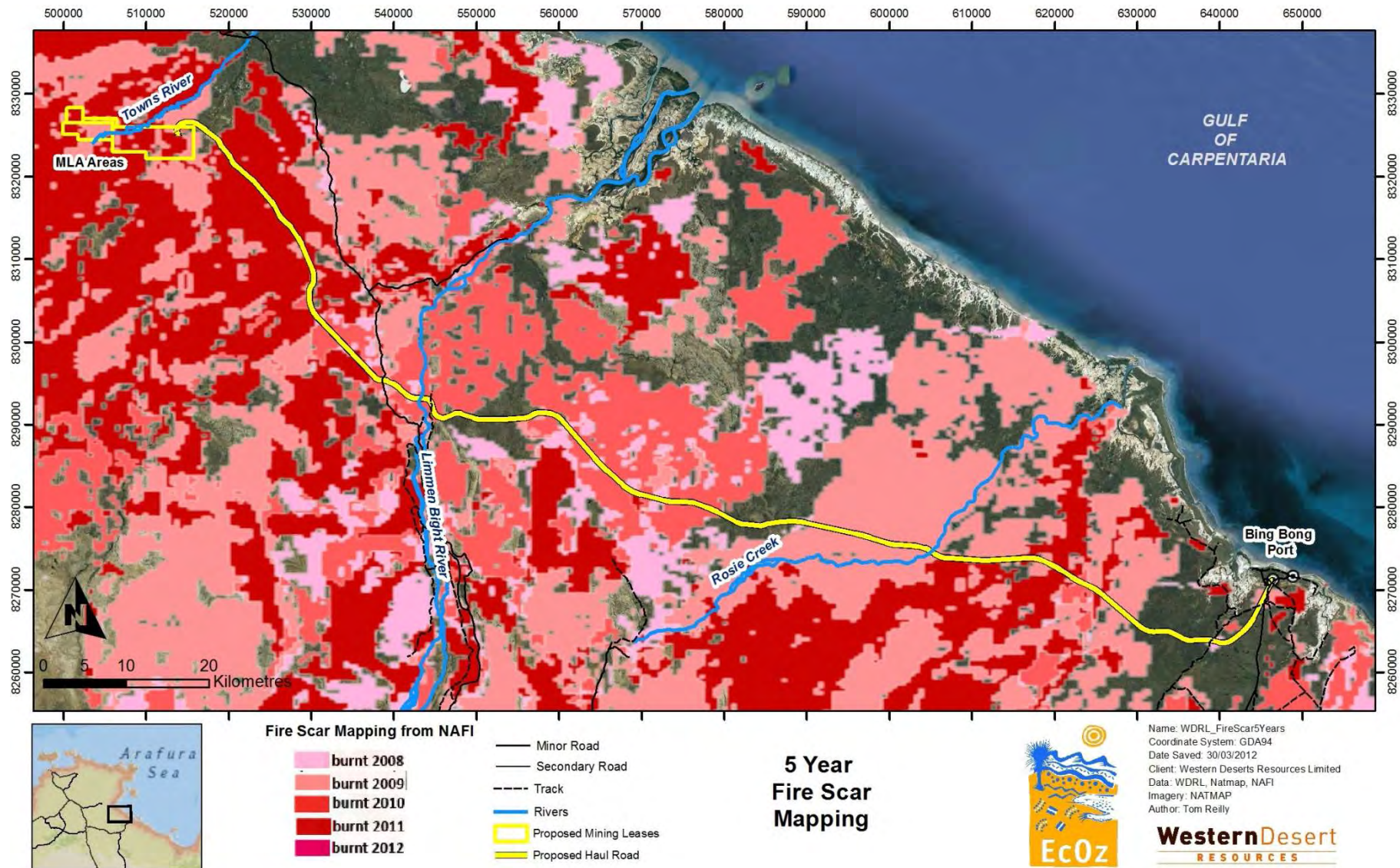


Figure 6: Five-year fire scar map of the project area and surrounding region

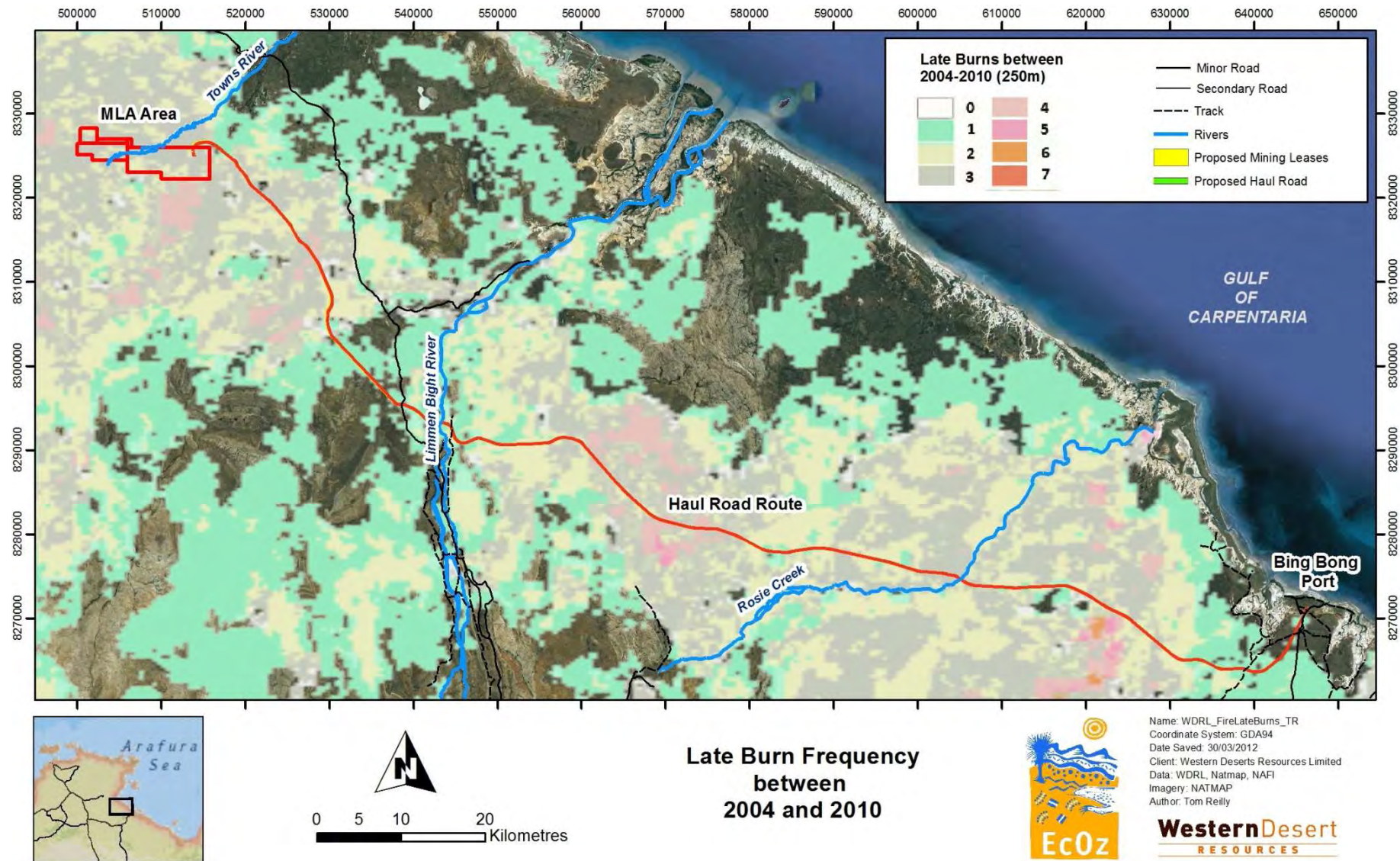


Figure 7: Late burn fire scars and frequency between 2004 and 2010



3.6 Weeds

Weed data was collected for the project area using NT Flora Atlas database records (NRETAS) and also records requested from the NT Weeds Branch. The results indicated that the MLA areas are mostly weed-free, however the haul road and port areas are located within catchments that contain several declared weeds and also weeds of national significance. The presence of the weeds is likely due to the existing land use being pastoralism. Existing weed information is presented in Figure 8 and more detail about weeds (and pests) is provided in Appendix F of the EIS.

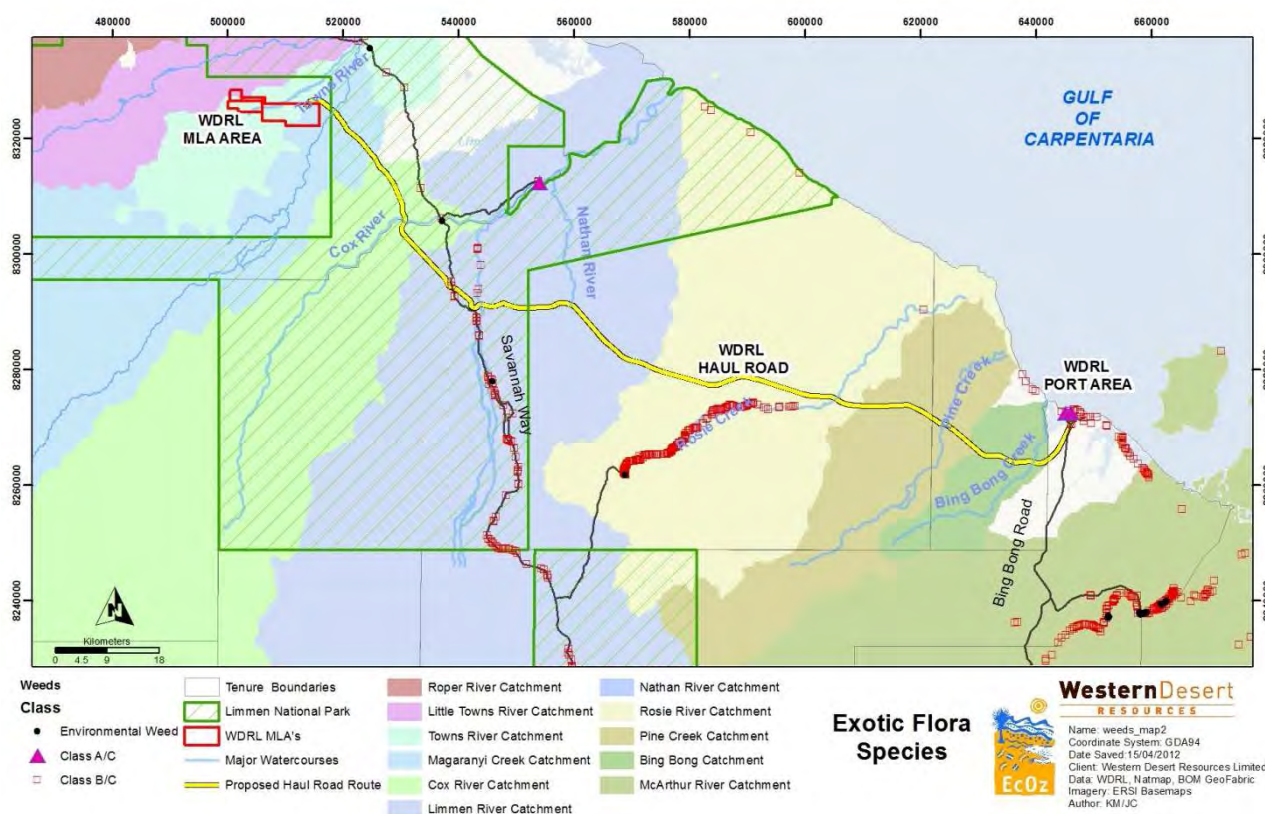


Figure 8: Existing weed records for the project area

3.7 Existing Flora & Fauna Records

The project area and surrounds have been subject to very little biological research, leaving an uncertain picture of the biological richness of the Southern Gulf of Carpentaria (Griffiths *et al.* 1997).

For this project, two sets of desktop flora and fauna surveys were undertaken – a combined one for the MLA areas and haul road, and another for the port facility and stockyard (see Figure 9 and 10). The areas encompassing both the MLA areas and haul road contain similar habitat and so a combined desktop survey was appropriate. Given that the region has experienced limited historical surveying, a large area of contiguous habitat was included within the scope of the desktop survey. The other desktop survey was of a 10 kilometre radius of the proposed port location to incorporate the particular habitats of this area that are different to those of the rest of the project. Both surveys comprised records from the database searches mentioned in Section 2.1. In addition, NT listed threatened species that are not federally listed but that could, from assessing distribution, occur within the search areas were also included. Obvious errors, such as those arising from data entry, were vetted.



3.7.1 Fauna Records

Nearly 500 species of vertebrates have been recorded within the two Gulf bioregions, including 20 threatened species (Baker *et al.* 2005). Two of these are endemic to the bioregions – Carpentarian Grasswren (*Amytornis dorotheae*) to the Gulf Fall and Uplands bioregion, and Canefield Rat (*Rattus sordidus*) to the Gulf Coastal bioregion (more specifically, the Sir Edward Pellew Islands group). In addition, three other non-threatened reptile species have ranges restricted to these two bioregions – Agile Snake-eyed Skink (*Cryptoblepharus zoticus*), Carpentarian Ctenotus (*Ctenotus striaticeps*) and Borroloola Dtella (*Gehyra borroloola*). Together the Gulf bioregions feature a reasonably high number of threatened fauna and flora species compared to other bioregions which may, in part, be reflective of the extensive.

The history of fauna surveys within the search area is very limited. The only general survey of the area was in 1996 by the NTPWC for the then-proposed Limmen Gate NP (Griffiths *et al.* 1997) – see Section 9.1. An extensive survey was undertaken as part of the assessment of the McArthur River mine (Calaby, 1976), with follow-ups in 1992 (Gambold, 1992 and Hollingsworth *et al.* 1992) but these were south of the greater project area. Some fauna sampling has occurred on the surrounding pastoral leases of Balbirini, Broadmere, Bauhinia Downs and St. Vidgeon stations (King & McKean 1982; Low and Dobbie 1988; and Low, Dobbie & Foster 1989a and 1989b). A focussed survey on the threatened Carpentarian Grasswren (*Amytornis dorotheae*) included sites on Nathan River and Billengarah Stations (Martin & McKean 1986) – see Section 7.1.3. Surveys of the threatened Carpentarian Rock-rat (*Zyzomys palatalis*) included Bauhinia Downs Station (Churchill 1996).

For aquatic records, the Fish Atlas of Northern Australia (NAFF 2007) recorded ten species of fish from a single site surveyed by Midgley in 1983. The location of this site corresponds to field survey Site 2 – the Towns River crossing on the Savannah Way adjacent to the MLA areas.

As Figure 9 illustrates, most records for the area are from opportunistic records collected along easily accessible areas such roads and waterways. No threatened species have been recorded within the MLA areas. The only records proximate to the haul road are in the immediate area surrounding the intersection of the Savannah Way with the haul road. The NT Atlas does not include fish records and so no sawfish records exist for the MLA areas or haul road route. Instead, waterways providing suitable habitat for sawfish have been highlighted in Figure 9.

Existing fauna species records from each of the desktop searches is included in Figure 9, including total numbers of listed species. A full species list is in Appendix D-1.

Table 7: Summary of desktop fauna surveys

	MLA / Haul road	Port	Combined Total
Amphibian	24	1	24
Reptile	94	52	121
Bird	216	174	249
Mammal	51	24	63
Fish	31	21	32
TOTAL	416	272	489
Threatened	38	23	49
Migratory	62	56	60
Marine	45	133	144



3.7.2 Flora Records

Flora surveys within the search area are limited to NT herbarium surveys of the Limmen National Park (proposed) area, plus vegetation data collected during NT government fauna surveys. The Holtze database (NT Herbarium) indicates that 1142 species have been recorded within the survey area for the MLA/Haul road search area, and 206 species within the port search area (Table 8 and Figure 10).

There are four threatened species and 32 species endemic to the bioregions (Baker et al. 2005). Most of these species are grasses or small ephemeral forbs, and are likely to occur in drainage areas.

Table 8: Summary of desktop flora surveys

	MLA / Haul road	Port
Threatened	1	-
Near Threatened	9	1
Not Evaluated	28	7
Data Deficient	48	6
TOTAL	1142	206
Endemic	57	11
Exotic	32	3
Weeds – A Class	1	-
Weeds – B Class	6	5

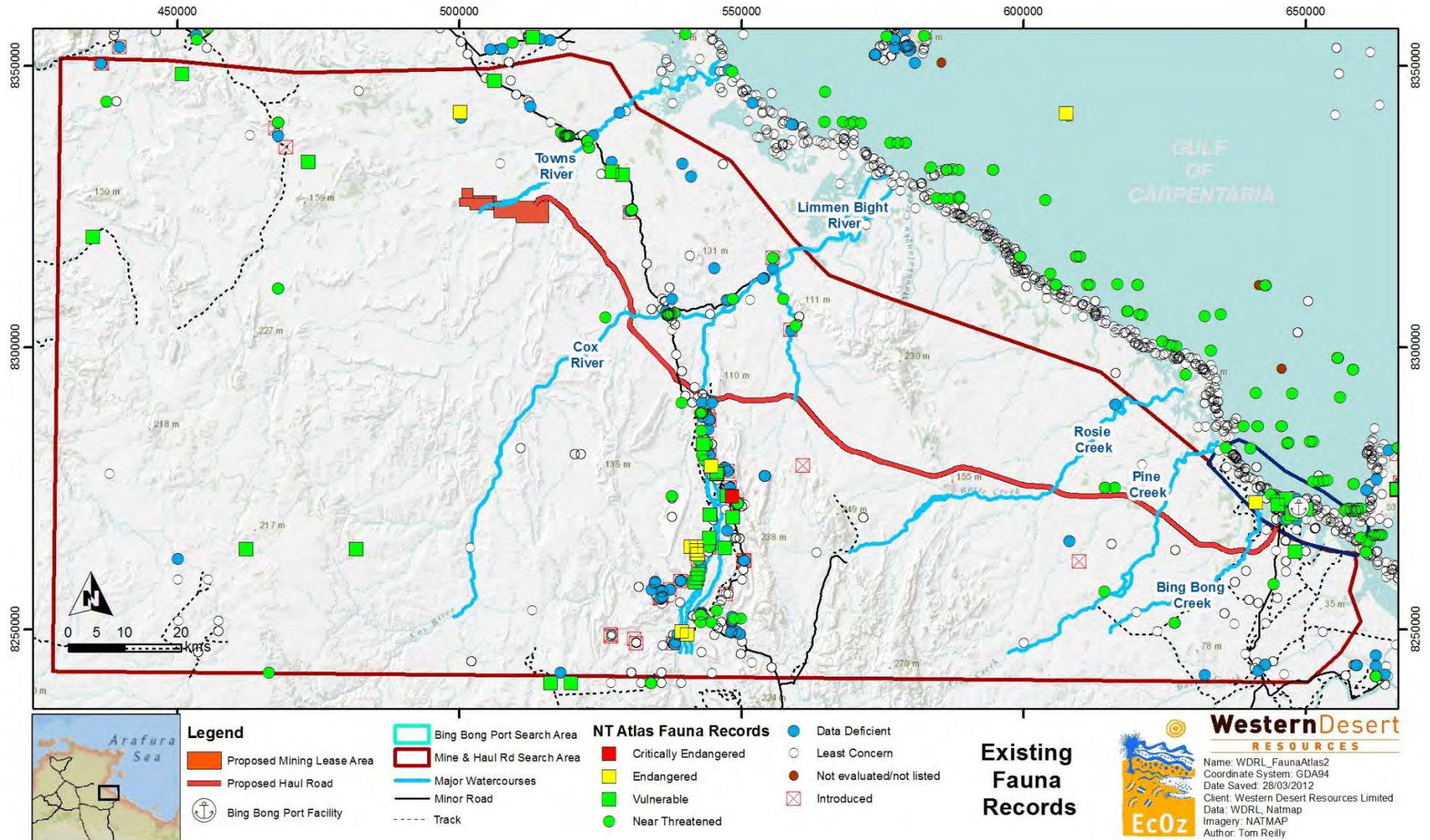


Figure 9: Map of existing fauna records for the project area

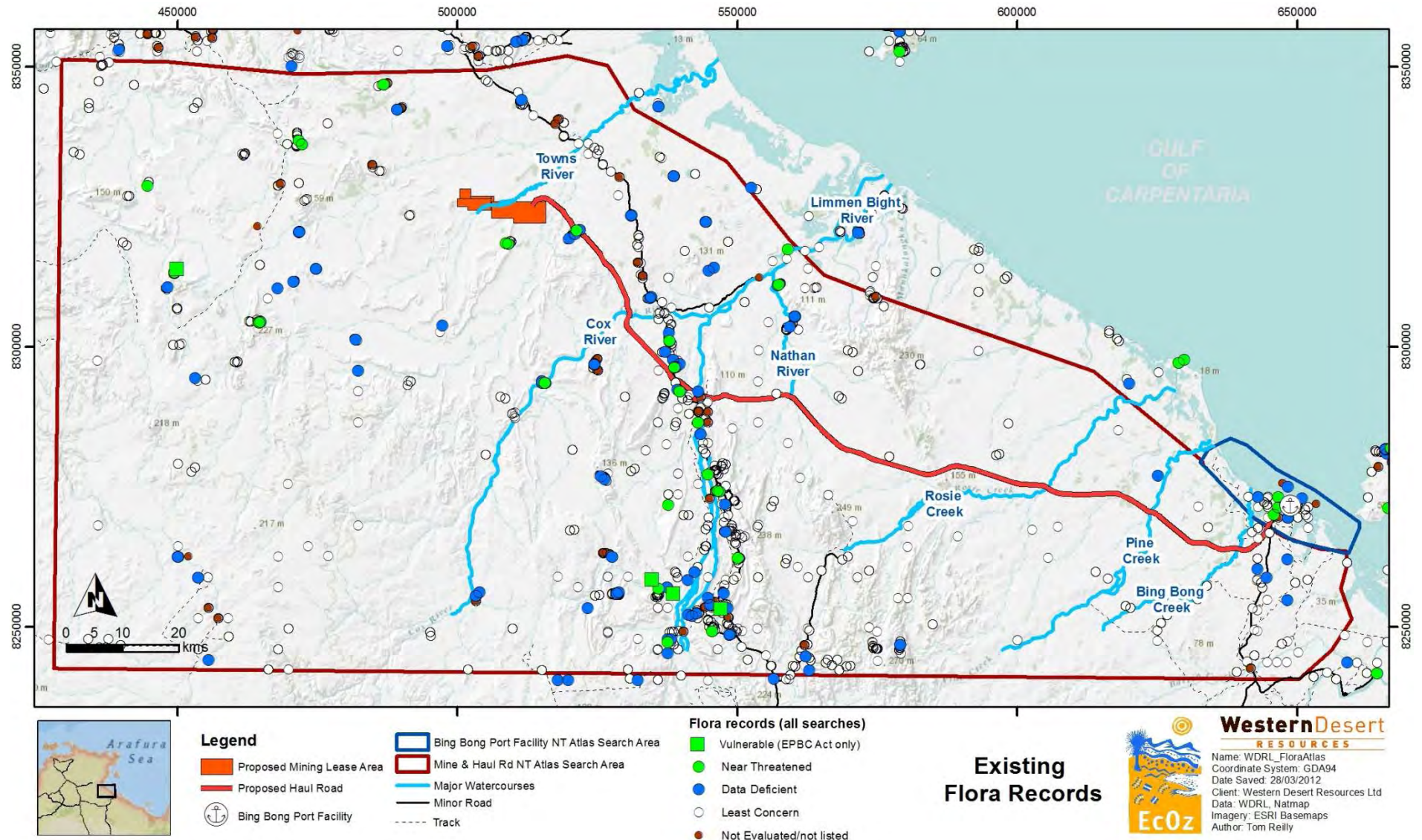


Figure 10: Map of existing flora records for the project area



D-4. Mine and Camp Area

4.1 Introduction

All mining activities and the site camp will occur within the MLA areas (includes open pit mining, waste rock dumps, process plant, camp facility, laydown pads, and other associated mining infrastructure/operations). A total of 415 hectares of vegetation will be removed for mining purposes within the MLA areas (see Figure 11). As this area is going to be highly disturbed by the proposed mining activities, the level of survey effort to record flora and fauna has been conducted at a high level in order to design or manage the project area to reduce impact on ecological values. Biological surveys within the MLA areas included:

- Vegetation surveys and mapping to NVIS level 5 which has resulted in a 1:25000 vegetation map for the MLA areas;
- Terrestrial fauna surveys in Wet and Dry seasons to capture temporal variations in species assemblages. This included physical bat trapping techniques to target the EPBC listed Bare-rumped Sheathtail bat;
- Freshwater fish surveys were completed in late Dry season in billabongs and downstream refugia within the project area; and
- Groundwater Dependant Ecosystems surveys, to determine whether open pit dewatering activities will impact on surface vegetation.

The majority of the Towns River catchment – which the MLA areas are situated within – consists of flat or undulating alluvial plains which are inundated to varying degrees. Shallow to moderately deep stream channels cross the alluvial plains running in a north-easterly direction. The plains are interspersed with low stony hills and drier rises. The most significant topographic and geological features are narrow, linear, rocky, quartz sandstone and ironstone ridges which rise to about 30 m. These ridges, which are steep sided in places, primarily run east-west but form a distinct ‘U’ shape enclosing the eastern boundary of lease area. The ridges and hills influence the drainage. The majority of the surface flow within the MLA areas flows predominantly north-east to the Towns River and a minor proportion flows from the southern ridges, south-east to Magaranyi Creek.

The major landforms within the MLA areas are low ironstone and sandstone ridges, seasonally inundated melaleuca swamps, creek-lines, and flat sandy plains supporting mixed *Eucalyptus* and Lancewood woodlands. The upper and middle reaches of the Towns River meanders through the MLA areas. However, in the vicinity of the MLA areas the creek lines are ephemeral and usually cease flow during the Dry season with remaining water being reduced to isolated pools and billabongs.

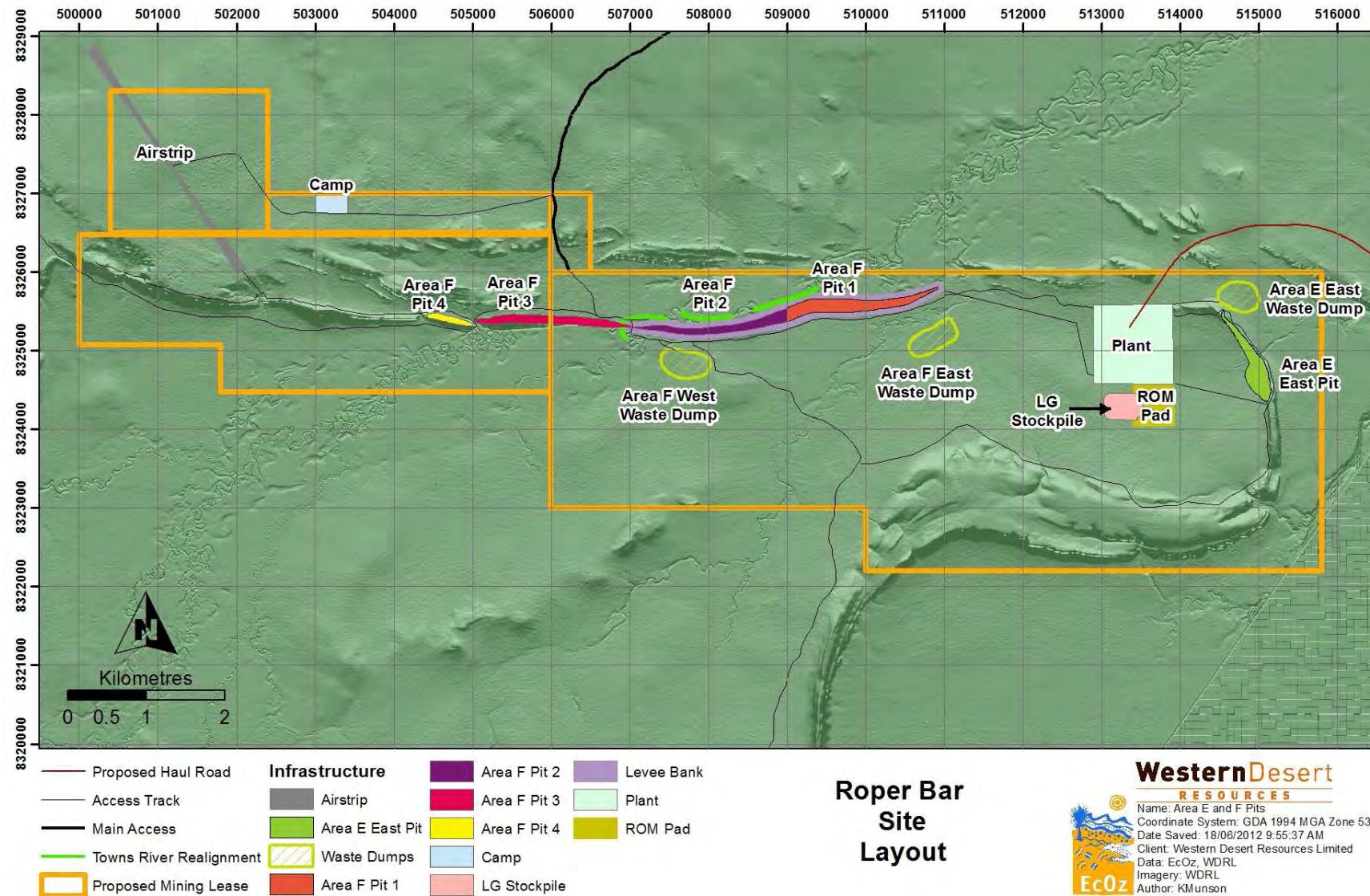


Figure 11: Proposed site layout plans within the MLA areas



4.2 Land Systems

Seven land systems fall within the MLA areas, however only three are located in the proposed mining zones, including the Bukalara (Asb), Frog (Taf), and McArthur (Tam) land systems (Figure 12). More detailed descriptions of land systems are provided in Chapter 3 of the EIS document.

4.3 Vegetation Surveys

4.3.1 Summary of Vegetation Types

Geology, landform and soils have a dominant influence in shaping the vegetation types present. Broadly, five broadly defined vegetation types dominate the MLA areas, and these correlate with five main land forms (described below and in Table 9).

Acacia Woodlands (Group A): Lancewood (*Acacia shirleyi*) open forest is found in fire shadow areas adjacent to Melaleuca swamps or at the base of low hills. *Acacia shirleyi* and *Callitris intratropica* and may also be found scattered within or around the edge of some vegetation types, most notably vegetation type 5.

Eucalyptus/Corymbia Woodlands over Hummock Grass (Group B): The well-drained rocky ridges, stony rises, and slight slopes adjoining these rocky areas (with well drained and sandier soils) are dominated by *Corymbia* and *Eucalyptus* woodland. In the northern part of the lease this woodland type the understorey is dominated by *Triodia* species or is a mosaic of either a Hummock grass or Tussock grass, whereas in the southern part of the lease the understorey is dominated by heath (e.g. *Bossea* and *Jacksonia* species). Woodlands on the slight slopes transition into the other major habitat type *Melaleuca* open woodland.

Eucalyptus/Corymbia Woodlands over Tussock Grass (Group C): Some small areas of *Eucalyptus tectifica* and *E. pruinosa* open woodlands are patchily distributed on higher clay content soils usually not too distant from the rocky rises. *Eucalyptus pruinosa* may often be present in an eco-tone between upland *Eucalyptus* woodland and *Melaleuca citrolens* open woodland and in some case may be found within expanses of *Melaleuca citrolens* vegetation types. Occasional heavy clay areas amongst the *Melaleuca* plain support *Excoecaria parvifolia* woodlands with a distinct heavy clay soil flora.

Melaleuca Woodlands (Group D): The *Melaleuca* open woodlands occupy large parts of the MLA areas. The frequency and length of inundation varies as does the clay content of the soil. *Melaleuca citrolens* tend to occupy the sites with a greater clay content and for the most part drier or less inundated sites. *Melaleuca viridiflora* occupies both sandier dry sites as well as wetter sites including billabongs and swamps.

Wetlands and Riparian Woodlands (Group E): The diffuse drainage system of the Towns Creek dissects the main mine lease area and features floodplain, major and minor creek-lines as well as billabongs and wetlands. *Asteromyrtus symphyocarpa* is most common in vegetation types associated with these systems while *Melaleuca viridiflora* is also abundant. *Eucalyptus* and *Corymbia* are generally sparse and scattered within these land forms but feature *Corymbia polycarpa* in the areas transitioning into a drier landform. Also within these drainage areas *Eucalyptus microtheca* occurs on some of the more clayey floodplains and minor creek-lines and on the outer edge of wetlands. *Eucalyptus camaldulensis* is common along the major creek-lines but either scattered to absent throughout the other drainage areas.

A total of 20 distinct vegetation units exist within the MLA areas (refer to Table 10 and Figure 14). Detailed descriptions are provided in Appendix D-9.



Table 9: Five main vegetation and landform types present within the MLA areas

Broad Vegetation Types	Land form description	% of total survey area	Area (ha)
Eucalyptus/Corymbia Woodlands over Hummock Grass	Undulating plains: Drier plains with a slight elevation and sandy loam soils and varying degree of clay subsoil	45.5	1628.9
Melaleuca Woodlands	Inundated plains: Frequently inundated areas with sandy loam soils	31.6	1132.3
Wetlands and Riparian Woodlands	Stream channels: major and minor stream channels transitioning into billabongs	2.6	91.5
Eucalyptus/Corymbia Woodlands over Tussock Grass	Low stony hills: Low rock and gravel covered hills	15.8	566.4
Acacia Woodlands	Rocky Ridges: Ironstone and white quartz sandstone, boulder dominated hills up to 30m high	4.6	164.2

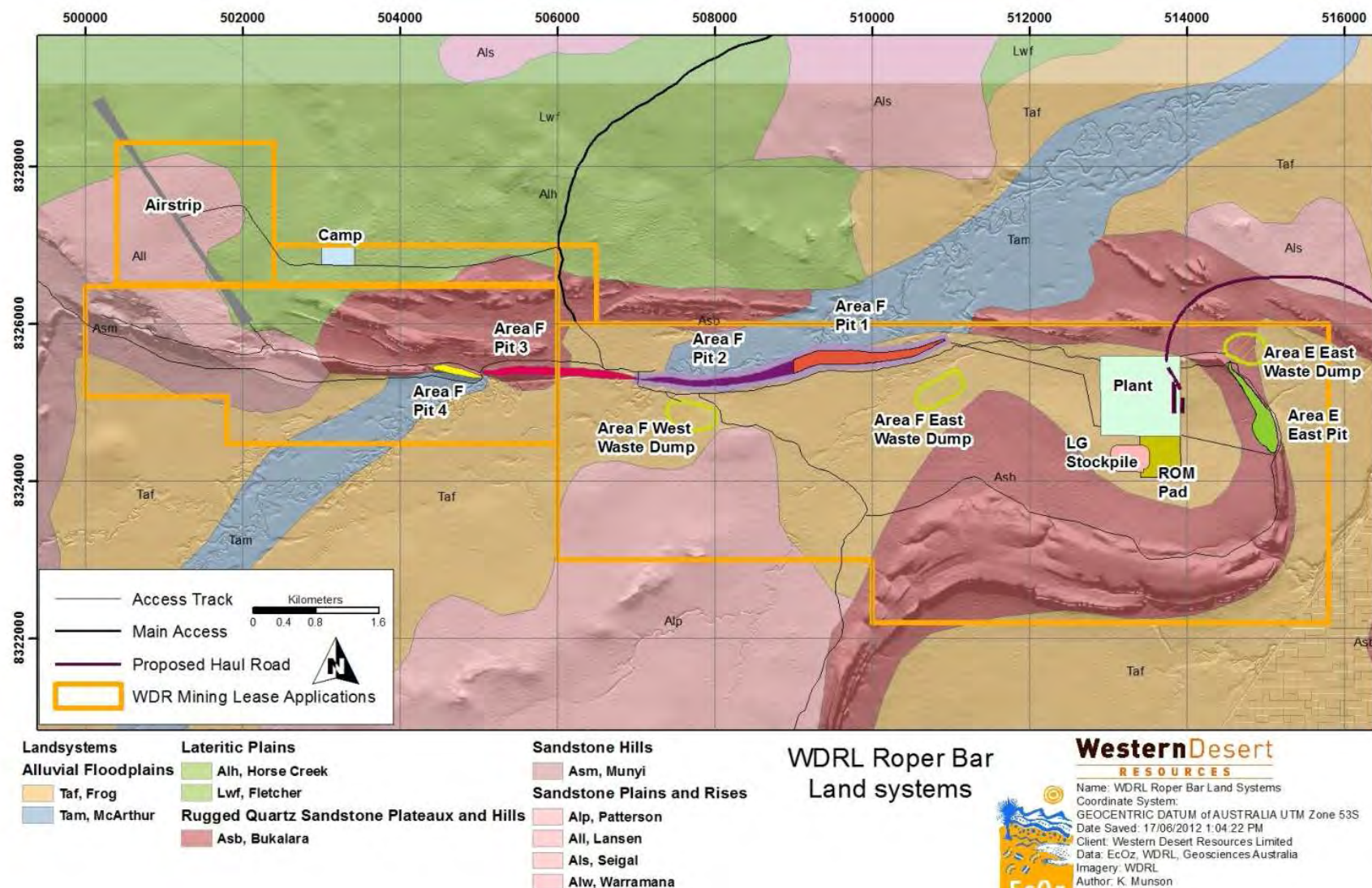


Figure 12: Map of land systems associated with the MLA areas



Table 10: Vegetation Types identified within the MLA areas (summary table only)

Veg. Type	Area km ²	Mapped area (%)	Vegetation Community Description - NVIS
A: Acacia Woodlands			
1	0.9	2.6	<i>Acacia shirleyi</i> Mid High Open Forest over <i>Acacia shirleyi</i> +/- <i>Melaleuca viridiflora</i> , <i>Corymbia ferruginea</i> , <i>Petalostigma banksii</i> Mid Sparse Shrubland over <i>Schizachyrium fragile</i> , +/- <i>Eulalia aurea</i> , <i>Chrysopogon fallax</i> Low Open Tussock Grassland.
B: Eucalyptus/Corymbia Woodlands over Hummock Grass			
2	5.6	15.8	<i>Corymbia ferruginea</i> +/- <i>Eucalyptus tetradonta</i> , <i>Eucalyptus phoenicea</i> , <i>Eucalyptus miniata</i> Mid Open Woodland over <i>Acacia galioides</i> , <i>Bossiaea bossiaeioides</i> +/- <i>Acacia gonocarpa</i> , <i>Jacksonia odontoclada</i> , <i>Petalostigma quadriloculare</i> Tall Sparse Shrubland over +/- <i>Triodia procera</i> , <i>Gompholobium subulatum</i> , <i>Eriachne ciliata</i> , <i>Bulbostylis barbata</i> , <i>Tephrosia leptoclada</i> Mid Open Hummock Grassland.
3	1.6	4.6	+/- <i>Corymbia ferruginea</i> , <i>Eucalyptus tetradonta</i> , <i>Eucalyptus miniata</i> Low Open Woodland over +/- <i>Acacia multisiliqua</i> , <i>Grevillea dryandra</i> , <i>Jacksonia odontoclada</i> , <i>Erythrophleum chlorostachys</i> , <i>Acacia conspersa</i> Tall Sparse Shrubland over +/- <i>Triodia procera</i> , <i>Acacia galioides</i> , <i>Eriachne ciliate</i> , <i>Gompholobium subulatum</i> , <i>Bulbostylis barbata</i> Low Open Hummock Grassland.
8	5.0	14	<i>Corymbia ferruginea</i> , <i>Eucalyptus tetradonta</i> +/- <i>Eucalyptus miniata</i> , <i>Eucalyptus phoenicea</i> Mid Open Woodland over <i>Distichostemon hispidulus</i> +/- <i>Acacia conspersa</i> , <i>Acacia galioides</i> , <i>Alphitonia pomaderoides</i> , <i>Boronia lanuginosa</i> , <i>Bossiaea bossiaeioides</i> Tall Sparse Shrubland over +/- <i>Triodia bitextura</i> , <i>Eriachne obtusa</i> , <i>Evolvulus alsinoides</i> , <i>Gompholobium subulatum</i> Low Open Hummock Grassland.
C: Eucalyptus/Corymbia Woodlands over Tussock Grass			
4	0.3	0.8	<i>Eucalyptus pruinosa</i> and <i>Melaleuca citrolens</i> +/- <i>Atalaya hemiglauca</i> , <i>Corymbia confertiflora</i> Low Open Woodland over <i>Acacia galioides</i> , <i>Carissa lanceolata</i> , <i>Maytenus cunninghamii</i> +/- <i>Dolichandrone heterophylla</i> , <i>Dodonaea lanceolata</i> Mid Sparse Shrubland over <i>Bulbostylis barbata</i> , <i>Eulalia aurea</i> , <i>Evolvulus alsinoides</i> , <i>Indigastrium parviflorum</i> and <i>Triodia bitextura</i> Low Open Tussock Grassland.
6	0.6	1.7	<i>Corymbia polycarpa</i> , <i>Erythrophleum chlorostachys</i> +/- <i>Eucalyptus tetradonta</i> Mid Woodland over <i>Alphitonia pomaderoides</i> +/- <i>Acacia torulosa</i> , <i>Wrightia saligna</i> , <i>Acacia platycarpa</i> , <i>Grevillea pteridifolia</i> Tall Sparse Shrubland over +/- <i>Senna oligoclada</i> , <i>Waltheria indica</i> , <i>Aristida holathera</i> , <i>Bonamia pannosa</i> , <i>Eriachne obtusa</i> Low Tussock Grassland.
11	0.07	0.2	<i>Terminalia canescens</i> , <i>Terminalia bursarina</i> , <i>Hakea arborescens</i> Tall Sparse Shrubland over <i>Alloterosopsis semialata</i> , <i>Chrysopogon fallax</i> , <i>Pseudopogonatherum contortum</i> , <i>Schizachyrium fragile</i> Low Open Tussock Grassland.
15	1.4	4	<i>Eucalyptus tetradonta</i> , <i>Erythrophleum chlorostachys</i> +/- <i>Corymbia polycarpa</i> , <i>Corymbia ferruginea</i> Mid Open Woodland over <i>Erythrophleum chlorostachys</i> , <i>Eucalyptus tetradonta</i> , <i>Alphitonia pomaderoides</i> , <i>Dolichandrone heterophylla</i> , <i>Ehretia saligna</i> Tall Sparse Shrubland over <i>Sorghum plumosum</i> , <i>Eriachne obtusa</i> , <i>Whiteochloa airoides</i> , <i>Corchorus sidoides</i> , <i>Evolvulus alsinoides</i> , <i>Glycine tomentella</i> Mid Open Tussock Grassland.
12	0.3	0.8	<i>Eucalyptus tectifera</i> Mid Open Woodland over <i>Carissa lanceolata</i> +/- <i>Flueggea virosa</i> , <i>Grewia retusifolia</i> , <i>Maytenus cunninghamii</i> , <i>Petalostigma banksii</i> Mid Isolated Shrubs over <i>Chrysopogon fallax</i> , <i>Eulalia aurea</i> , <i>Sorghum plumosum</i> +/- <i>Alloterosopsis semialata</i> , <i>Fimbristylis dichotoma</i> Mid Closed Tussock Grassland.
D: Melaleuca Woodlands			
5	5.0	14	<i>Melaleuca citrolens</i> , <i>Hakea lorea</i> +/- <i>Corymbia polycarpa</i> , <i>Eucalyptus pruinosa</i> Low Open Woodland over <i>Melaleuca citrolens</i> , <i>Petalostigma banksii</i> , <i>Terminalia canescens</i> , <i>Wrightia saligna</i> , <i>Maytenus cunninghamii</i> Mid Sparse Shrubland over <i>Chrysopogon fallax</i> , <i>Eriachne obtusa</i> , <i>Evolvulus alsinoides</i> , <i>Glycine tomentella</i> , <i>Habenaria ochroleuca</i> Low Closed Tussock Grassland.



Veg. Type	Area km ²	Mapped area (%)	Vegetation Community Description - NVIS
7	2.3	6	<i>Melaleuca citrolens</i> +/- <i>Melaleuca viridiflora</i> , <i>Eucalyptus pruinosa</i> Mid Open Woodland over <i>Grevillea striata</i> +/- <i>Carissa lanceolata</i> , <i>Cochlospermum gregorii</i> , <i>Ehretia saligna</i> , <i>Flueggea virosa</i> Tall Sparse Shrubland over <i>Eulalia aurea</i> +/- <i>Alloteropsis semialata</i> , <i>Murdannia graminea</i> , <i>Sorghum plumosum</i> , <i>Chrysopogon fallax</i> Mid Closed Tussock Grassland.
9	8.5	24	<i>Melaleuca viridiflora</i> +/- <i>Asteromyrtus symphyocarpa</i> , <i>Grevillea striata</i> , <i>Bauhinia cunninghamii</i> , <i>Brachychiton diversifolius</i> Low Open Woodland over <i>Petalostigma banksii</i> +/- <i>Brachychiton paradoxus</i> , <i>Dolichandrone heterophylla</i> , <i>Hakea arborescens</i> , <i>Melaleuca citrolens</i> Tall Open Shrubland over <i>Alloteropsis semialata</i> , <i>Eulalia aurea</i> , <i>Chrysopogon fallax</i> , <i>Eriachne obtuse</i> , <i>Crinum uniflorum</i> Mid Tussock Grassland.
16	1.3	3.5	<i>Melaleuca viridiflora</i> , <i>Terminalia canescens</i> +/- <i>Corymbia polycarpa</i> , <i>Eucalyptus pruinosa</i> Low Open Woodland over <i>Petalostigma banksii</i> , <i>Helicteres cana</i> +/- <i>Acacia galioides</i> , <i>Melaleuca citrolens</i> , <i>Acacia conspersa</i> Tall Isolated Shrubs over <i>Alloteropsis semialata</i> , <i>Grevillea dryandri</i> , <i>Merremia incisa</i> , <i>Oldenlandia mitrasacmoides</i> +/- <i>Triodia procera</i> Mid Open Hummock Grassland.
20	0.5	1.4	<i>Melaleuca nervosa</i> , <i>Melaleuca viridiflora</i> +/- <i>Corymbia polycarpa</i> Low Open Woodland over Tall Shrubland of <i>Acacia holosericea</i> , <i>Alphitonia pomaderroides</i> , <i>Asteromyrtus symphyocarpa</i> +/- <i>Acacia tropica</i> , <i>Grevillea pteridifolia</i> Tall Shrubland over <i>Eulalia aurea</i> +/- <i>Aristida holathera</i> , <i>Chrysopogon fallax</i> , <i>Chrysopogon latifolius</i> , <i>Desmodium brownii</i> Mid Closed Tussock Grassland.
E: Wetlands and Riparian Woodlands			
13	0.3	0.3	<i>Excoecaria parvifolia</i> , <i>Melaleuca citrolens</i> +/- <i>Eucalyptus pruinosa</i> , <i>Terminalia bursarina</i> Low Woodland over <i>Acacia umbellata</i> +/- <i>Sarcostemma viminalis</i> , <i>Terminalia volucris</i> , <i>Acacia gonoclada</i> , <i>Carissa lanceolata</i> Tall Sparse Shrubland over <i>Eulalia aurea</i> , <i>Aristida latifolia</i> , <i>Chrysopogon fallax</i> , <i>Sorghum plumosum</i> , <i>Neptunia dimorphantha</i> Mid Tussock Grassland.
14	0.1	0.3	<i>Eucalyptus camaldulensis</i> , <i>Corymbia polycarpa</i> +/- <i>Melaleuca nervosa</i> , <i>Melaleuca viridiflora</i> Low Open Woodland over <i>Acacia holosericea</i> , <i>Acacia tropica</i> , <i>Asteromyrtus symphyocarpa</i> , <i>Grevillea pteridifolia</i> +/- <i>Acacia drepanocarpa</i> Mid Isolated Shrubs over <i>Chrysopogon fallax</i> , <i>Waltheria indica</i> +/- <i>Aristida holathera</i> , <i>Zornia prostrata</i> , <i>Pseudoraphis spinescens</i> Low Open Tussock Grassland.
17	0.45	1.3	<i>Melaleuca viridiflora</i> +/- <i>Asteromyrtus symphyocarpa</i> , <i>Psydrax paludosa</i> Low Woodland over <i>Melaleuca viridiflora</i> +/- <i>Asteromyrtus symphyocarpa</i> , <i>Psydrax paludosa</i> Tall Shrubland over +/- <i>Cyperus holoschoenus</i> , <i>Pseudoraphis spinescens</i> , <i>Commelina agrostophylla</i> , <i>Eragrostis fallax</i> , <i>Eulalia aurea</i> Low Tussock Grassland.
18	0.75	2	<i>Asteromyrtus symphyocarpa</i> , <i>Melaleuca viridiflora</i> +/- <i>Melaleuca citrolens</i> , <i>Corymbia polycarpa</i> Low Woodland over <i>Petalostigma banksii</i> +/- <i>Acacia holosericea</i> , <i>Cochlospermum fraseri</i> Tall Sparse Shrubland over +/- <i>Alloteropsis semialata</i> , <i>Chrysopogon fallax</i> , <i>Fimbristylis simplex</i> , <i>Drosera indica</i> , <i>Eriachne obtusa</i> Low Closed Tussock Grassland.
19	0.21	0.6	<i>Melaleuca viridiflora</i> +/- <i>Eucalyptus microtheca</i> , <i>Eucalyptus camaldulensis</i> Low Open Woodland over +/- <i>Acacia holosericea</i> , <i>Asteromyrtus symphyocarpa</i> , <i>Melaleuca citrolens</i> , <i>Antidesma ghesaembilla</i> , <i>Breynia cernua</i> Tall isolated shrubs over <i>Chrysopogon fallax</i> , <i>Eulalia aurea</i> , <i>Melochia corchorifolia</i> , <i>Pseudoraphis spinescens</i> +/- <i>Commelina agrostophylla</i> Low Closed Tussock Grassland.
21	0.04	0.1	<i>Corymbia polycarpa</i> , <i>Erythrophleum chlorostachys</i> Mid Open Woodland over <i>Acacia tropica</i> , <i>Grevillea pteridifolia</i> Tall Shrubland over <i>Ischaemum australe</i> , <i>Triodia procera</i> Mid Closed Tussock Grassland.

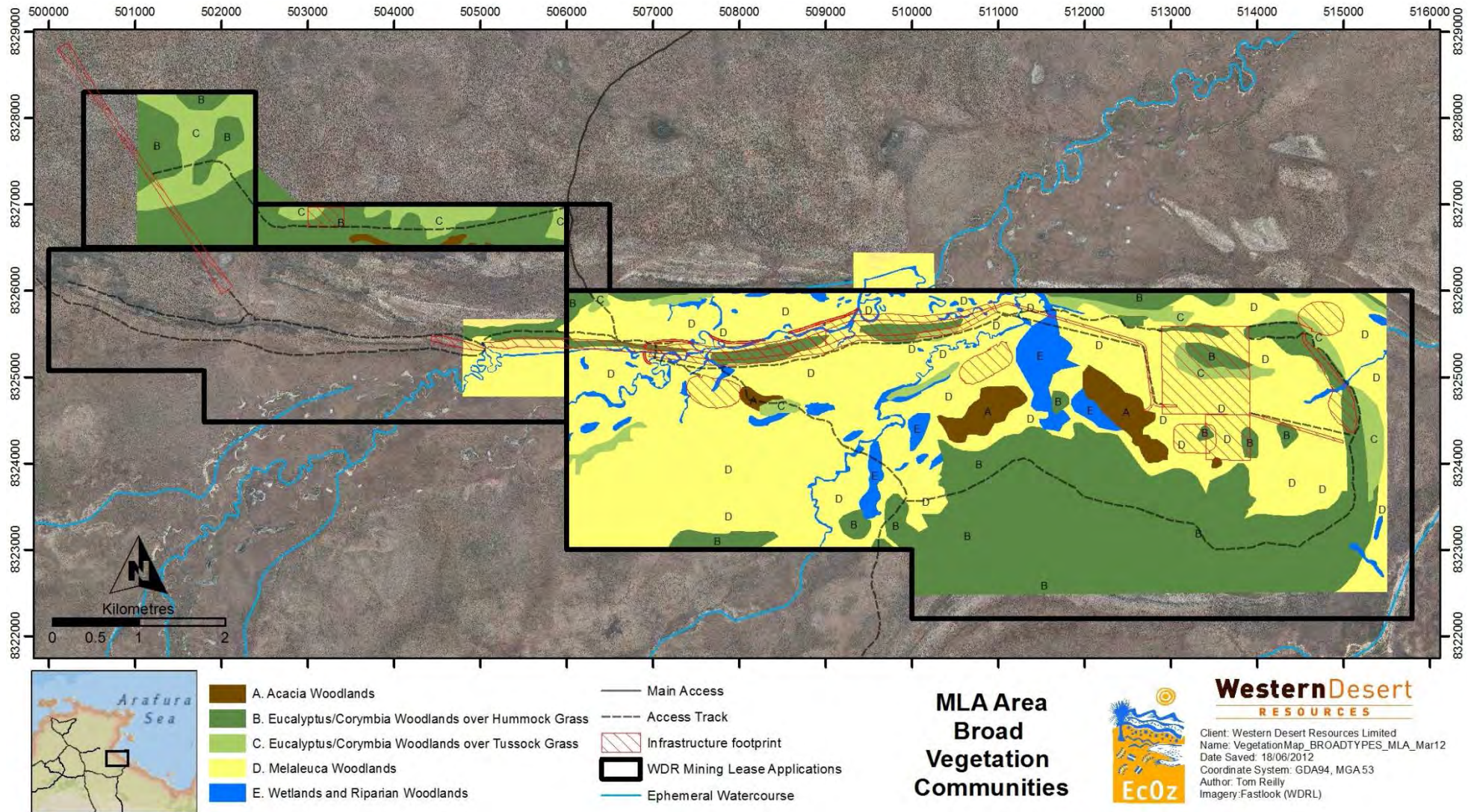


Figure 13: Five main vegetation types within the MLA areas and site camp area

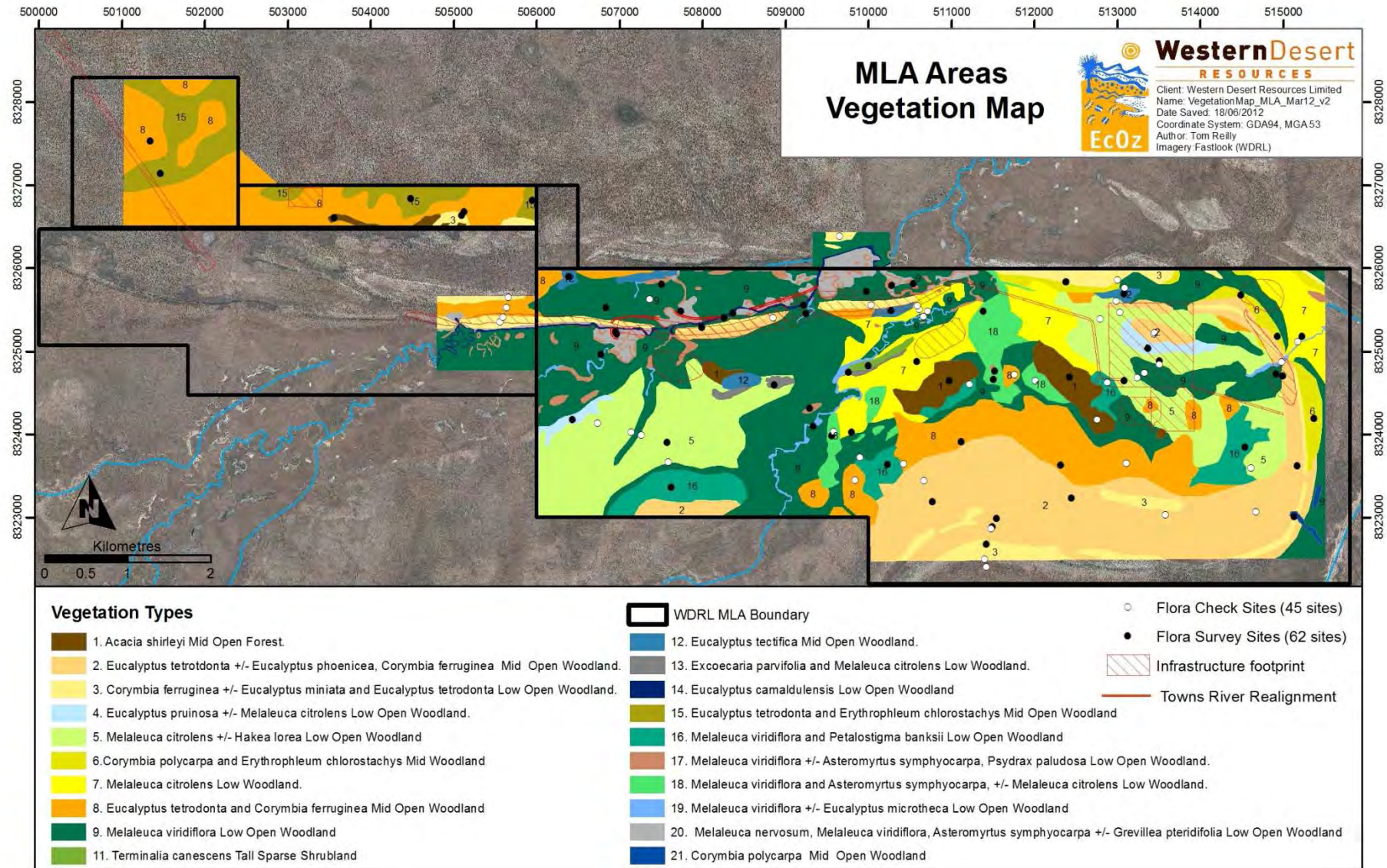


Figure 14: Detailed vegetation mapping of the MLA areas



4.3.2 Vegetation Condition

The fire regime suggested from NAFI together with evidence inclusive of vegetation types such as a very thick stand of *Eucalyptus tetradonta*, extensive areas lancewood, patches of *Callitris intratropica* in good condition together with the average scorch height in most other vegetation types suggests that the general area does not exhibit significant disturbance from fire. However, there are some localised areas which suggest these areas may be burnt frequently or suffer from fire damage due to their drier nature such as the southern low hills. Extensive areas were burnt in 2011 (but early season burns). Overall, possibly the remote location (which reduces the probability of human induced fire) together with the extensive inundated areas and the rocky ridges may offer some protection from frequent broadscale fire.

No weeds were identified within the survey area, and there was low impact from stray livestock and feral pigs at the site.

4.3.3 Notable Flora Records

No threatened flora species were recorded during the surveys, however there are several species that are notable records for the region (i.e. range extensions or species listed as either Near Threatened or Data Deficient under the TPWC Act).

Psyrax paludosa

Psyrax paludosa (Data Deficient) is a large shrub to small tree 3 – 4m high, with small greyish leaves. When young, the leaves of the tree are smaller and the growth structure reminiscent of *Terminalia* species – see Figure 15.

This species occurs in Qld (24 records in the QLD Herbarium) and the NT (three records including specimens collected February 2012 on lease area). The majority of records are on the Cape York Peninsula. In the NT, the few herbarium records are sourced from two general localities: from tributaries of the Towns river and near Bing Bong where it is associated with shallow swamps or minor drainage lines with *Melaleuca viridiflora* and *Asteromyrtus symphyocarpa*. In the lease area the species was recorded from a total of 4 sites which closely match the habitat previously described for this species.

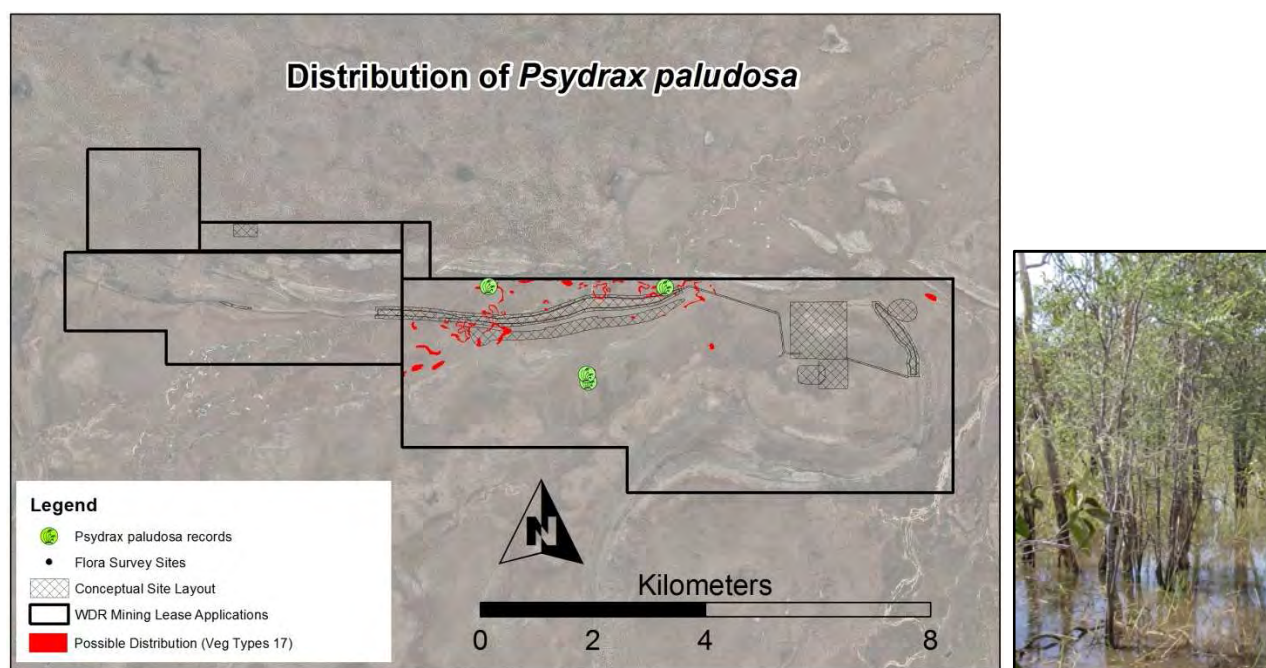
Psyrax paludosa occurs predominantly on Vegetation type 17 *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Psyrax paludosa* Low Open Woodland, where it is one of the dominant species.

In the NT this species is classified as data deficient meaning that appropriate data on abundance and/or distribution are lacking in order to define whether the species is threatened or otherwise. However unlike some other cryptic species, which can easily be overlooked, this large woody species is unlikely to have been overlooked in areas that have been surveyed.

Likely effect of mining disturbance on species

Most of the potential distribution of this species is close to the proposed areas of direct disturbance with the pit area bisecting vegetation type 17. Potential impacts include direct disturbance to wetlands due to the pit and re-alignment of waterways. Sedimentation downstream of the pits is also a risk for a proportion of the population. Being a perennial species that is long lived, there would be some resilience to changes in hydrology and sedimentation but in the longer term these factors may reduce recruitment of new plants.

Upstream of the pit changes in surface hydrology could result in changes to the inundation regime. The maintenance of the 'gaps' between the low ranges would be important as they would limit or hold back water flows which would result in flooding upstream of the gaps. Widening and deepening of these gaps may contribute to a large change in flooding regimes.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 15: Distribution of *Psydrax paludosa* within the MLA areas

Fimbristylis dolera

Fimbristylis dolera (Data Deficient) is a stout, annual sedge with pithy/spongy stems – see Figure 16.

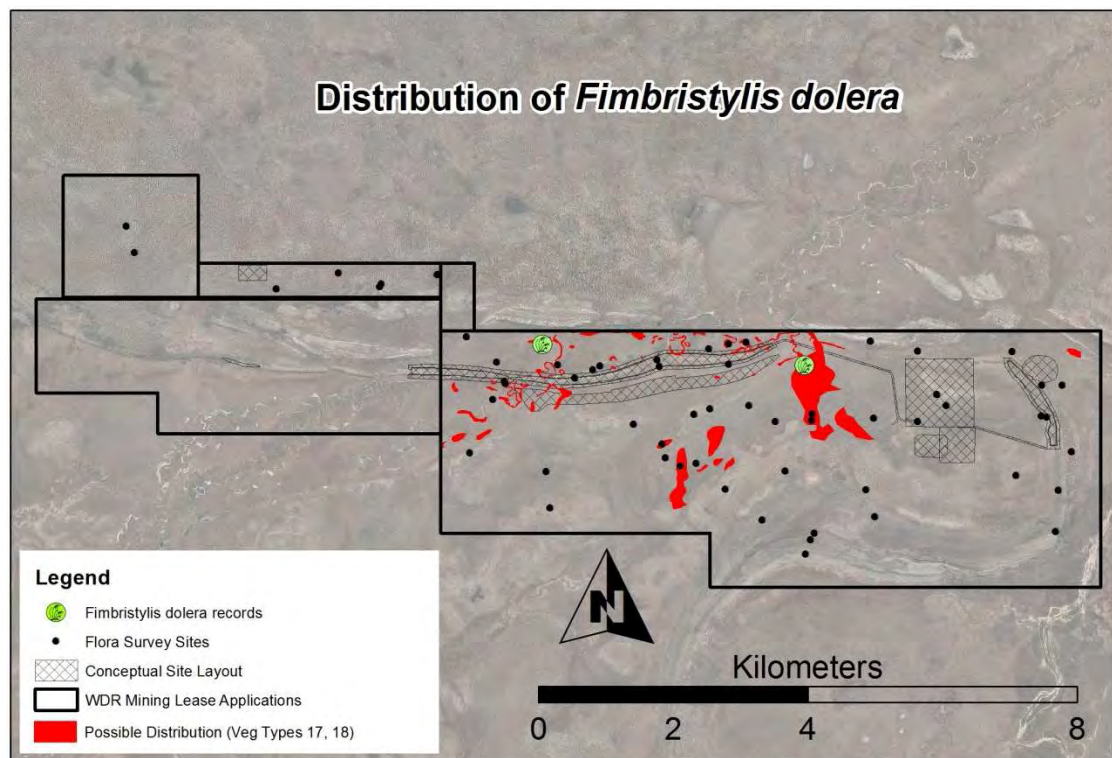
There are nine records of *Fimbristylis dolera* in Australian herbaria (Qld 3, NT 6) and two additional records from plants recorded in the lease area. All NT records are from the Roper and Gulf river catchments.

It is found growing on the edges of swamps and shallowly inundated *Melaleuca* swamps, vegetation types 17 – *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Psydrax paludosa* Low Open Woodland and 18 – *Melaleuca viridiflora* and *Asteromyrtus symphyocarpa*, +/- *Melaleuca citrolens* Low Woodland. It was rarely encountered, with very few plants being found.

Likely effect of mining disturbance on species

There is a portion of suitable habitat of *Fimbristylis dolera* likely to be affected by the impacts of mining. While some of the habitat is affected by the direct impact of the pit, haul road, infrastructure and works, floodplains and swamps downstream of the pit and infrastructure sites may be affected by sedimentation and changes in surface hydrology. It is also possible that upstream of the pits hydrology could be changed unless there is careful consideration of the of the landscape features that govern surface drainage, such as the gaps between the ranges that the creek run through.

As this species is an annual, it may be sensitive to changes in hydrology and sedimentation levels. This could mean a decline or increase in population depending on the ecology of the species. Some species for example may benefit from disturbance.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 16: Distribution of *Fimbristylis dolera* within the MLA areas

Ophioglossum gramineum

Ophioglossum gramineum (Near Threatened) is a primitive fern with a perennial root stock and a single “leaf” – see Figure 17.

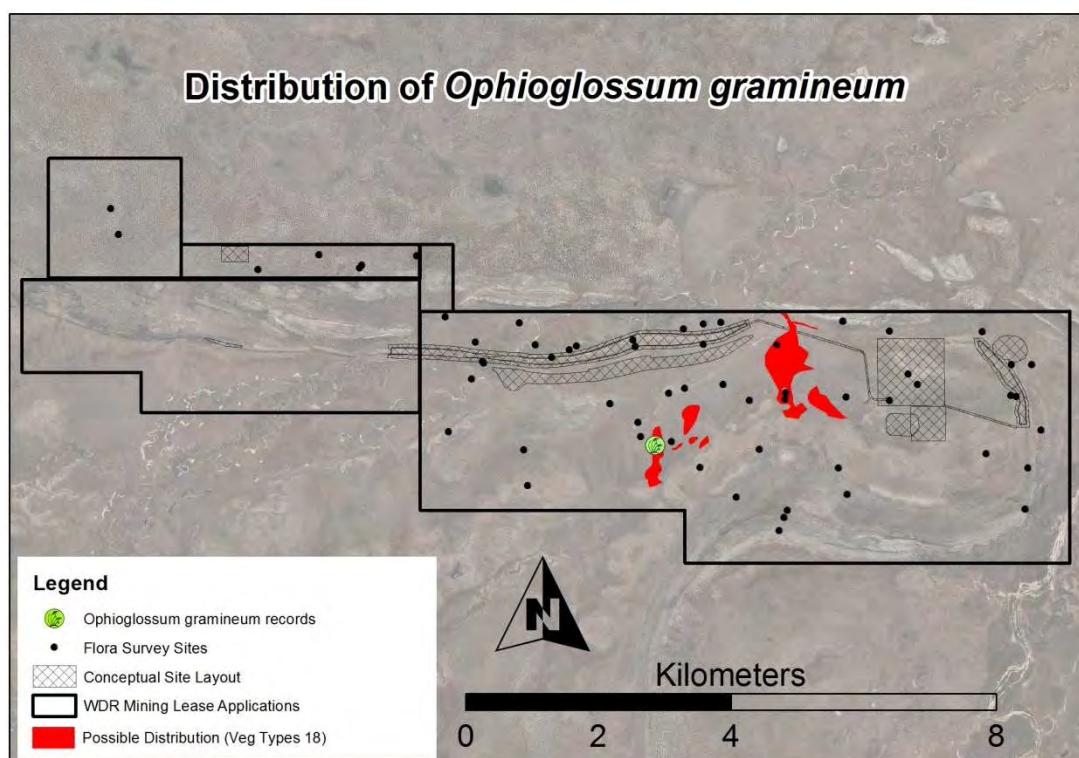
This species has an Australia-wide distribution with 65 records in Australian herbaria including 12 in the NT herbarium. In the NT it has a scattered distribution from semi-arid areas through to the Top End sandstone, Darwin region and the Gulf of Carpentaria.

On the mining lease it was found on seasonally and shallowly inundated/ very wet *Melaleuca* woodlands. This species was only observed at one site on vegetation type 18 – *Melaleuca viridiflora* and *Asteromyrtus symphyocarpa* +/- *Melaleuca citrolens* Low Woodland. It is also dependent on sparse ground cover and is unlikely to be found where there is a thick cover of grasses. It is quite a difficult species to detect and would only be detectable during the Wet season, thus it is probable that it is more widespread than indicated by our survey.

Likely effect of mining disturbance on species

The effects of mining disturbance on the known location of this species would seem to be negligible as it is somewhat distant from the development areas on the lease. Any changes in hydrology would be buffered due to the distance from the development areas.

If we look at the likely distribution of this species in vegetation type 18, more than half of the distribution of the species will be directly or indirectly impacted. Changes in sedimentation could be quite significant as this species is 5cm high and could be physically smothered by sediment in a habitat that rarely experiences sediment loads. A change in hydrology may disadvantage this species either due to less suitable condition for germination and growth, or through an increase in grass cover brought about by less frequent inundation.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 17: Distribution of *Ophioglossum gramineum* within the MLA areas

Hygrochloa cravenii

Hygrochloa cravenii (Data Deficient) is an aquatic grass up to 1m with tall straight stems and a straight flower head, giving it a linear appearance. It has a hollow stem at the base and may have some trailing stems – see Figure 18.

This species is endemic to the NT where 13 records from approximately nine are held by the NT Herbarium. The record found in the lease area extends the known locations to ten. The NT distribution ranges from Darwin, to the eastern Top End and the Gulf where around half or the records are located.

It was only seen at one location despite many swamps being visited during the course of the survey. Present only on vegetation type 17 - *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Psydrax paludosa* Low Open Woodland.

Likely effect of mining disturbance on species

The single record of this species on the lease area is somewhat distant from the impacts of the mining pit and site infrastructure and any changes to hydrology would likely be moderated by this distance. *Hygrochloa cravenii* is quite a distinctive grass and was not seen at any other sites during the survey of the lease area. However it is possible that it occurs downstream, off of the lease area. It has been recorded further down the Towns River catchment (NT Herbarium – Holtze Database).

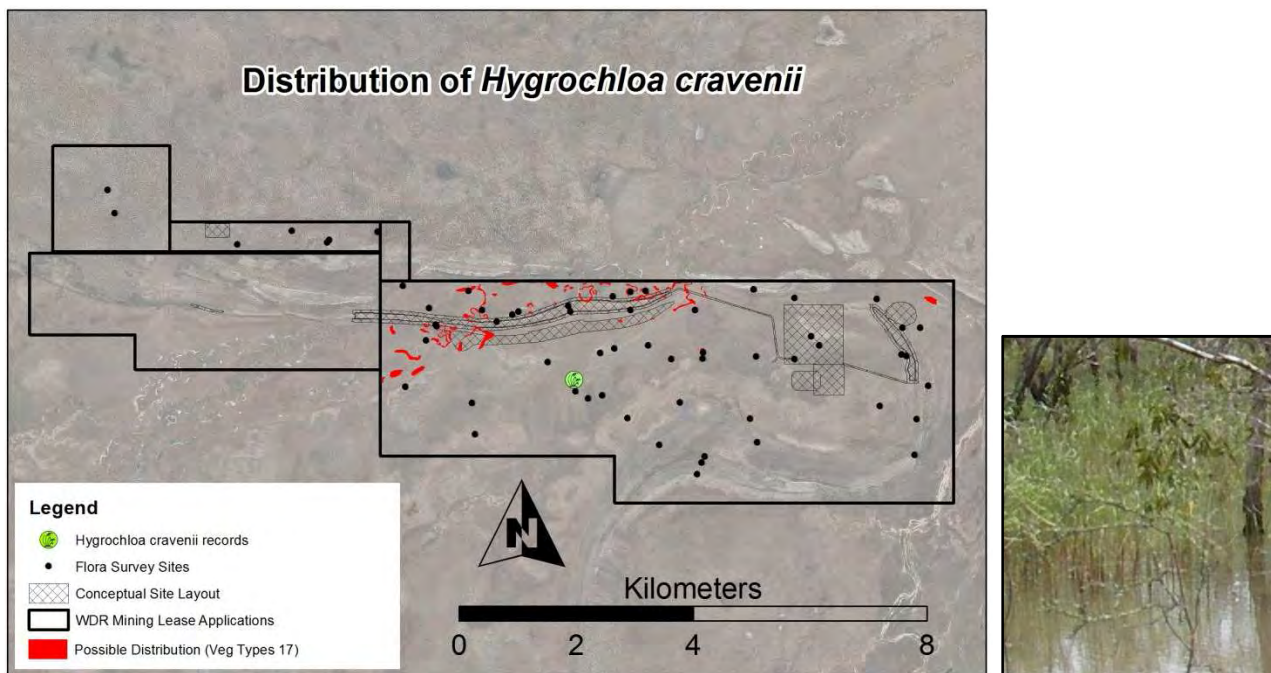
It is also feasible that from time to time, this species may spread to other swamps in the area as many aquatic plants are easily spread by water birds.

Considering the possible wider distribution of this species in swamps on and off the lease area, a large area of suitable habitat could be impacted by mine activities. Sedimentation and changes in surface hydrology downstream from the pit areas are likely impacts and as well as possible changes in surface hydrology upstream.



It is unknown whether an increase or decrease in inundation levels or length of inundation would benefit this species.

Control of grazing animals may be beneficial to this species as its growth form does not appear to impart resilience to grazing.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 18: Distribution of *Hygrochloa cravenii* within the MLA areas

Utricularia sp. affin fistulosa

Utricularia sp. affin fistulosa (Data Deficient) is a diminutive ephemeral herb with a white flower. This species was found in very wet ground on vegetation type 18 – *Melaleuca viridiflora* and *Asteromyrtus symphyocarpa*, +/- *Melaleuca citrolens* Low Woodland – see Figure 19. Several other *Utricularia* species were also present on this vegetation type.

Upon investigation in the herbarium, no species name for this entity could be positively allocated. It was close to *U. fistulosa* but this species occurs on sandstone habitats and has some quite different features. It is probable that this species is a short range endemic (I. Cowie, NRETAS pers. comm.) and more specimens would need to be collected to describe it more effectively.

It was not observed at any sites other than where it was collected (where it was common but at the end of its flowering season), but it is likely that with some targeted surveys at the right time of year, more populations could be found.

It must be emphasised that species that flower exclusively during the Wet season, in inaccessible areas are likely to be under-surveyed and difficult to detect. It is likely that other populations could be found on and off of the lease area if surveys targeting this species were conducted at the right time of year.

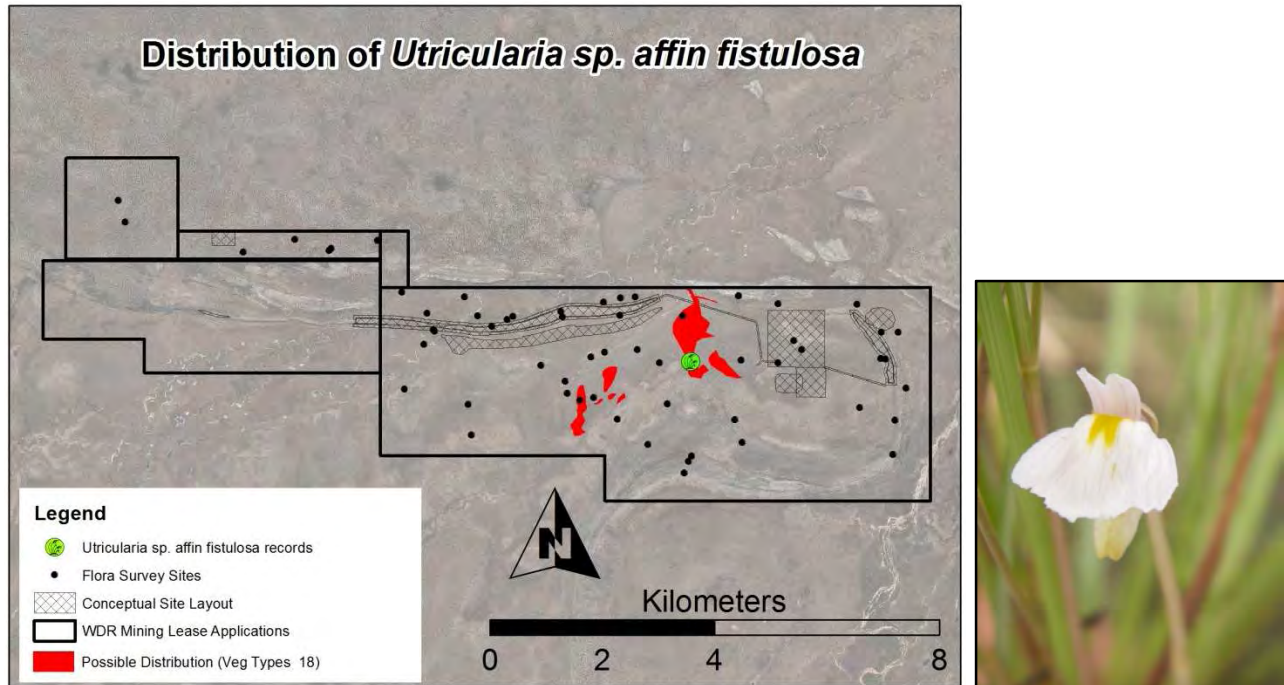
Likely effect of mining disturbance on species

Mining impacts will not directly affect the only current known site for this species or the vegetation type in which this species was found. Mining impacts such as sedimentation may indirectly affect the habitat of this species. The habitat this species occurs in is normally subject to shallow, clear water surface flows that originate from surface seepage. Any sedimentation within this habitat would thus be an unusual event and many of the species may not be adapted to the effects of sedimentation. *Utricularia* species rely on part of



their nutrition on traps attached to their roots which catch microscopic organisms. It is possible that sedimentation may interfere with the action of these traps or with the types and abundance of microorganisms that are present in the water.

Changes in hydrology are likely to have significant effects on *Utricularia* species because they rely on aquatic microorganisms for part of their nutrition. Hydrology changes may also affect the success of germination and establishment of *Utricularia* species.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 19: Distribution of *Utricularia* sp. within the MLA areas

Nymphoides exiliflora

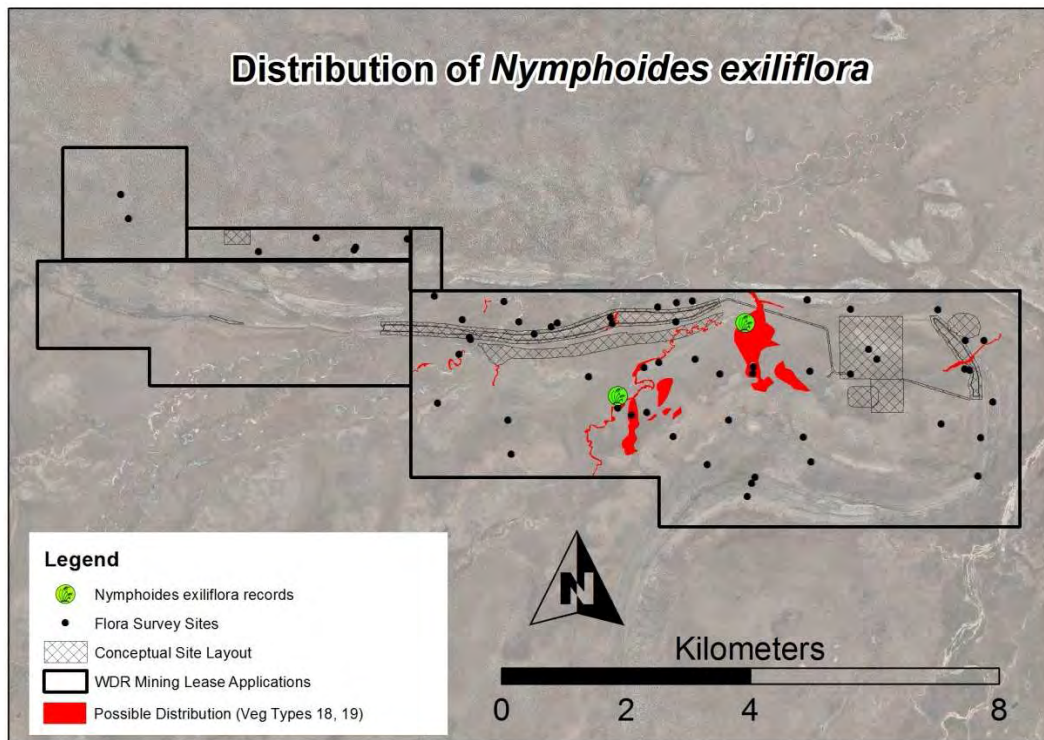
Nymphoides exiliflora (Data Deficient) is an aquatic, herbaceous plant with yellow flowers and floating leaves – see Figure 20.

It has nine records within the NT and over 100 records in QLD. Within the NT records lie within eastern Arnhem Land and the Gulf.

It is often found on the edge of drying waterholes and swamps. In the lease area it is found in swamps and shallowly and seasonally inundated *Melaleuca viridiflora* woodlands and minor creek-lines. It was found on vegetation type 18 – *Melaleuca viridiflora* and *Asteromyrtus symphyocarpa*, +/- *Melaleuca citrolens* Low Woodland and 19 – *Melaleuca viridiflora* +/- *Eucalyptus microtheca* Low Open Woodland. It was never found in large numbers. The habitat of this species is likely to extend beyond the lease area, associated with the floodplain of the Towns River.

Likely effect of mining disturbance on species

Mining impacts will not have an large impact on the habitat of this species through the placement of site infrastructure. Indirectly vegetation types 18 and 19 will possibly be affected by sedimentation and changes in hydrology. It is not known how this species will be affected by changes in hydrology or sedimentation.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 20: Distribution of *Nymphoides exiliflora* within the MLA areas

Fimbristylis subaristata

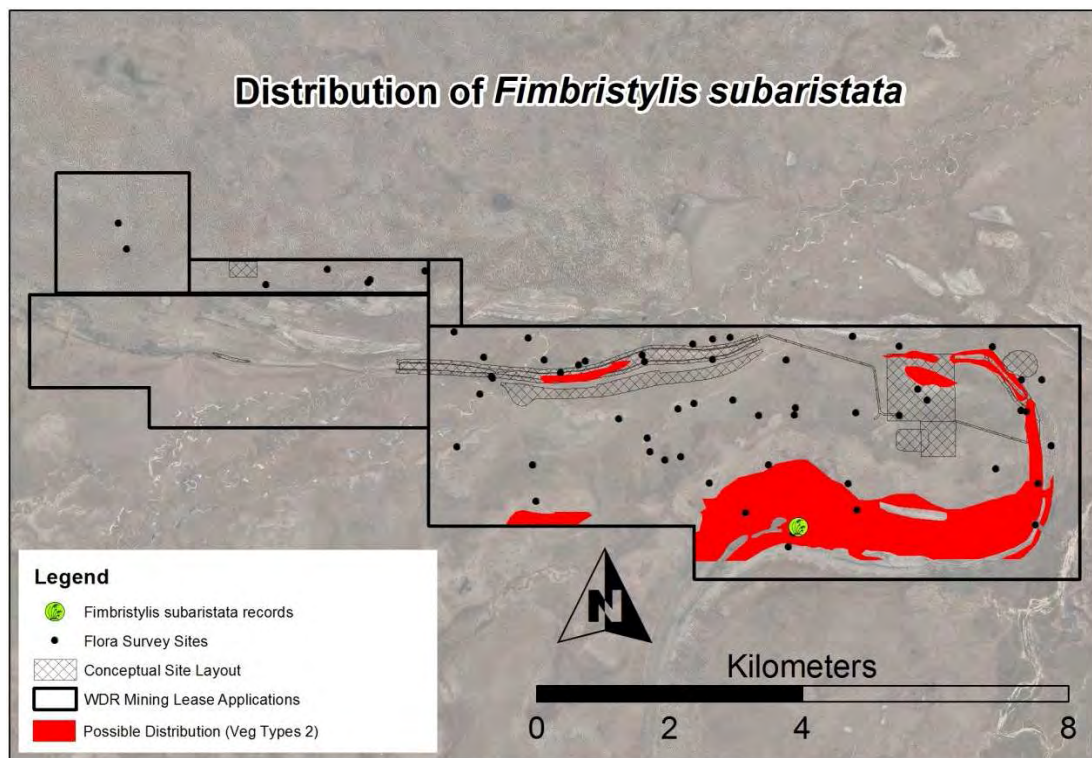
Fimbristylis subaristata (Data Deficient) is a sparse, annual sedge to 20 cm high – see Figure 21.

There are 21 specimens of *Fimbristylis subaristata* in Australian herbaria (most in QLD) and three of those in the NT where it has been collected on sandy gravelly substrates in the western Top End. This species would be difficult to identify from a specimen taken during the Dry season as much of the fertile material would have disintegrated. For this reason it is possible that the species is more widespread in the NT than is indicated by the number of collections.

It was found growing in open woodland on gravelly soil in vegetation type 2 – *Corymbia ferruginea* +/- *Eucalyptus tetradonta*, *Eucalyptus phoenicea*, Mid Open Woodland.

Likely effect of mining disturbance on species

The effect of mining disturbance on this species is limited with only a small proportion of the total habitat on the lease (vegetation type 2) being affected by direct impacts.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 21: Distribution of *Fimbristylis subaristata* within the MLA areas

Drosera fulva

Drosera fulva (Data Deficient) is a perennial herb growing in a rosette with reddish leaves or petioles and tall flower spikes (up to 36cm) that droop when in fruit – see Figure 22.

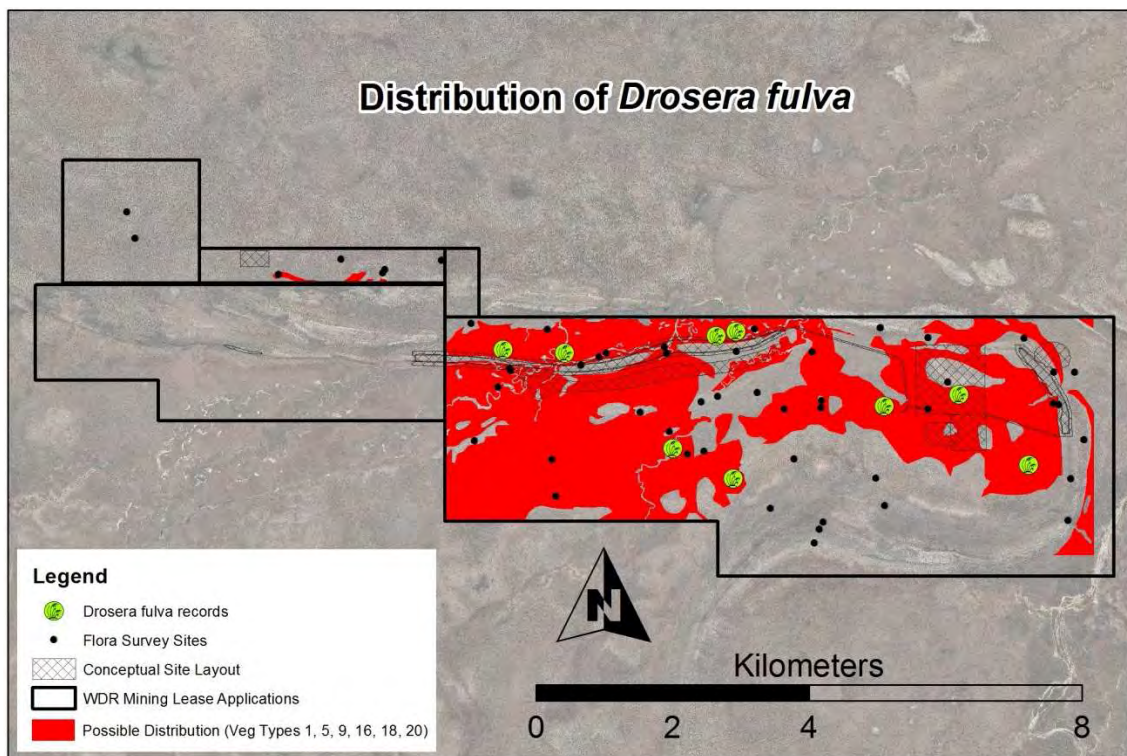
There are 21 records of this species in Australian herbaria, most within NT and in, or close to the Darwin Coastal Bioregion.

It occurs on a range of vegetation types (six in total) but has more records within seasonally and shallowly inundated *Melaleuca* woodlands. It occurs on a number of survey sites where there was not dense ground cover and what not uncommonly seen. It was found in a high proportion of sites on Vegetation type 9 – *Melaleuca viridiflora* Low Open Woodland and Vegetation type 20 – *Melaleuca nervosa*, *Melaleuca viridiflora*, *Asteromyrtus symphyocarpa* +/- *Grevillea pteridifolia* Low Open Woodland.

Likely effect of mining disturbance on species

Drosera fulva has a widespread distribution on the lease area and presumably well beyond, although NT herbarium records from the Gulf region do not reflect this. It is patchily present throughout the lower lying undulating plains country but not recorded from *Corymbia* and *Eucalyptus* woodlands.

Although mining impacts will directly and indirectly affect some of the habitat of this species, much of the available habitat within the lease area will not be impacted. Impacts are likely to include sedimentation and changes to surface hydrology except in sites that are not seasonally inundated.



(note that conceptual site layout has slightly changed since this map was created, please refer to Figure 11)

Figure 22: Distribution of *Drosera fulva* within the MLA areas

4.3.4 Introduced Plant Species

No weed species were recorded within the MLA areas.

4.4 Groundwater Dependant Ecosystems

Based on the contours for groundwater depth overlaid upon vegetation types the vegetation which has the greatest potential for groundwater dependency are located largely along the Towns River and the string of billabongs moving to the north. Most of the vegetation types within this area are targeted for disturbance by realignment of a section of the Towns River, which will be a far more significant impact than drawdown of groundwater associated with dewatering of the proposed pits. If these vegetation types are water dependent then realignment of the Towns River may result in the significant alterations to the vegetation types establishing. This will be particularly so if the groundwater levels in the new localities are deeper and less accessible. For more detail see Chapter 6.3 in the Roper Bar Iron Ore Project EIS.

4.5 Terrestrial Fauna Surveys – MLA areas

Prior to the WDRL field surveys undertaken for this report there were no flora and fauna records in the NT Atlas for approximately 15 to 20km area surrounding the MLA areas, with all those records being focused along the Savannah Way tourist route – see Figure 9. The sections below summarise fauna site habitat descriptions, survey results, and a combined total fauna list of desktop and survey results.

4.5.1 Fauna Site Habitat Descriptions

All fauna survey sites are presented in Figure 23. Habitat description summaries and photos for each fauna site are included in Table 11. More detail in relation to vegetation community descriptions and structure is provided in Section 6.2.



Table 11: Fauna site habitat descriptions – MLA areas surveys

Site	Photo	Description
F1		Vegetation Type: 8, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus tetradonta</i> and <i>Corymbia ferruginea</i> Mid Open Woodland Landform: Lower slopes with gravelly substrates Soil: Brown sands with low amounts of pebbles and many small stones. Habitat Notes: Leaf litter (low), hollows (scattered), fallen logs (scattered), termites (sparse domes). Impacts: low feral animal activity/sign, no weeds, high fire frequency.
F2		Vegetation Type: 2, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus tetradonta</i> +/- <i>Eucalyptus phoenicea</i>, <i>Corymbia ferruginea</i> Mid Open Woodland Landform: Lower slopes with gravelly substrates Soil: Brown clayey sand with low amounts of pebbles and small stones. Habitat Notes: Leaf litter (low), hollows (scattered), fallen logs (scattered), termites (common domes). Impacts: low feral animal activity/sign, no weeds, high fire frequency.
F3		Vegetation Type: 3, refer to Appendix D-9 for details Vegetation Description: <i>Corymbia ferruginea</i> +/- <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> Low Open Woodland. Landform: Low ironstone ridge. Some outcropping to 2m. Upper slopes and rocky ridges Soil: Reddish brown sands (high rock and outcrop) Habitat Notes: Rejuvenating vegetation after severe fire. Leaf litter (low), hollows (scattered), fallen logs (scattered), termites (sparse domes), rock crevices/shelter (moderate). Impacts: low feral animal sign, no weeds, high fire freq.
F4		Vegetation Type: 3, refer to Appendix D-9 for details Vegetation Description: <i>Corymbia ferruginea</i> +/- <i>Eucalyptus miniata</i> & <i>Eucalyptus tetradonta</i> Low Open Woodland. Landform: Low ironstone ridge. Some outcropping to 2m. Upper slopes and rocky ridges Soil: Reddish brown sands (high rock and outcrop) Habitat Notes: Rejuvenating vegetation after severe fire. Leaf litter (low), hollows (scattered), fallen logs (scattered), termites (sparse domes), rock crevices/shelter (moderate). Impacts: no feral animal sign, no weeds, high fire freq.



Site	Photo	Description
F5		Vegetation Type: 3, refer to Appendix D-9 for details Vegetation Description: <i>Corymbia ferruginea</i> +/- <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> Low Open Woodland. Landform: Sandstone Quartz rocky ridges. Soil: Greyish sandy loams. High rock content Habitat Notes: Leaf litter (low), hollows (common), fallen logs (common), termites (sparse), rock crevices/shelter (moderate). Impacts: no feral animal sign, no weeds, high fire freq.
F6		Vegetation Type: 18, refer to Appendix D-9 for details Vegetation Description: <i>Melaleuca viridiflora</i> and <i>Asteromyrtus symphyocarpa</i>, +/- <i>Melaleuca citrolens</i> Low Woodland Landform: Low lying depressions/flood-out plains. Prolonged seasonal inundated areas. Soil: Dark, medium to heavy clay Habitat Notes: Leaf litter (moderate), hollows (low), fallen logs (absent), termites (sparse, magnetic), cracking clay present, waterlogged soil present. Impacts: low feral animal sign, no weeds, high fire freq.
F7		Vegetation Type: 1, refer to Appendix D-9 for details Vegetation Description: <i>Acacia shirleyi</i> Mid Open Forest. Landform: Slight depression within sand plain Soil: Brownish yellow, loamy clay Habitat Notes: Leaf litter (low), hollows (abundant), fallen logs (abundant), flowering/seeding plants (absent), termites (common, dome), good shelter and shade from higher canopy cover. Impacts: low feral animal sign, no weeds, mod fire freq.
F8a		Vegetation Type: 8, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus tetradonta</i> and <i>Corymbia ferruginea</i> Mid Open Woodland Hummock grass U/S Landform: Plain, sandy substrates. Soil: Brown, loamy sands Habitat Notes: Leaf litter (low to moderate), hollows (abundant), fallen logs (common), flowering/seeding plants (scattered), termites (abundant, dome) Impacts: low feral animal sign, no weeds, high fire freq.



Site	Photo	Description
F8b		Vegetation Type: 8, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus tetradonta</i> and <i>Corymbia ferruginea</i> Mid Open Woodland Hummock grass U/S Landform: Flat plain, sandy substrates. Soil: Brown, loamy sands Habitat Notes: Leaf litter (low to moderate), hollows (abundant), fallen logs (common), flowering/seeding plants (scattered), termites (abundant, dome) Impacts: low feral animal sign, no weeds, high fire freq.
F9		Vegetation Type: 3, refer to Appendix D-9 for details Vegetation Description: <i>Corymbia ferruginea</i> +/- <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> Low Open Woodland. Landform: Upper slopes and rocky ridges, ironstone rock Soil: Brownish grey loamy sand, high rock content Habitat Notes: Leaf litter (low to moderate), hollows (common), fallen logs (common), flowering/seeding plants (scattered), termites (abundant, dome), rock crevices/shelter (high). Close to Towns Creek (300m). Impacts: no feral animal sign, no weeds, mod fire freq.
F10		Vegetation Type: 14, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus camaldulensis</i> Low Open Woodland plus <i>Melaleuca</i> spp. and <i>Asteromyrtus symphyocarpa</i>, Landform: Riparian zone, creek line (upper Towns River) Soil: Yellow sands, high rock content Habitat Notes: Small pools present, high litter load in some areas (i.e. banked up debris), steep sandy banks to 2m, hollows present in eucalyptus. Impacts: mod feral animal sign, no weeds, low fire freq.
F11		Vegetation Type: 14, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus camaldulensis</i> Low Open Woodland Landform: Riparian zone, creek line (upper Towns River) Soil: Yellow sand, no rocks Habitat Notes: Possibly permanent water hole (shallow), hollows present in Eucalyptus, steep sandy banks Impacts: mod feral animal sign, no weeds, low fire freq.



Site	Photo	Description
F12		Vegetation Type: 8, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus tetradonta</i> and <i>Corymbia ferruginea</i> Mid Open Woodland Hummock grass U/S Landform: Flat plain, sandy substrates. Base of sandstone outcrop. Soil: Brown, loamy sands, low rock content Habitat Notes: termites (common), litter (low), hollows (common), fallen logs (scattered) Impacts: low feral animal sign, no weeds, high fire freq.
F13		Vegetation Type: 3, refer to Appendix D-9 for details Vegetation Description: <i>Corymbia ferruginea</i> +/- <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> Low Open Woodland. Landform: Upper slopes and rocky ridges, sandstone quartz rock type Soil: greyish sands, high rock content. Habitat Notes: termites (low), hollows (common), fallen logs (low), rock crevices/shelter (moderate). Impacts: low feral animal sign, no weeds, low fire freq.
F14		Vegetation Type: 15, refer to Appendix D-9 for details Vegetation Description: <i>Eucalyptus tetradonta</i> and <i>Erythrophleum chlorostachys</i> Mid Woodland with tussock grass understorey Landform: Sand Plain Soil: Light brown sandy loams Habitat Notes: hollows (moderate), fallen logs (scattered), termites (moderate), mid and lower storey vegetation cover present. Impacts: mod feral animal sign, no weeds, mod fire freq.
F15		Vegetation Description: Cypress Pine (<i>Callitris intratropica</i>) Woodland with tussock grass under storey. This vegetation community was not described nor mapped as a separate vegetation type. It is patchily distributed through the MLA particularly in veg type 5 Landform: Sand Plain Soil: Deep brown sands Habitat Notes: Hollows (common), fallen logs (abundant), fire protected, good shelter and shade from higher canopy cover, termites (common), litter (moderate). Impacts: low feral animal sign, no weeds, low fire freq.

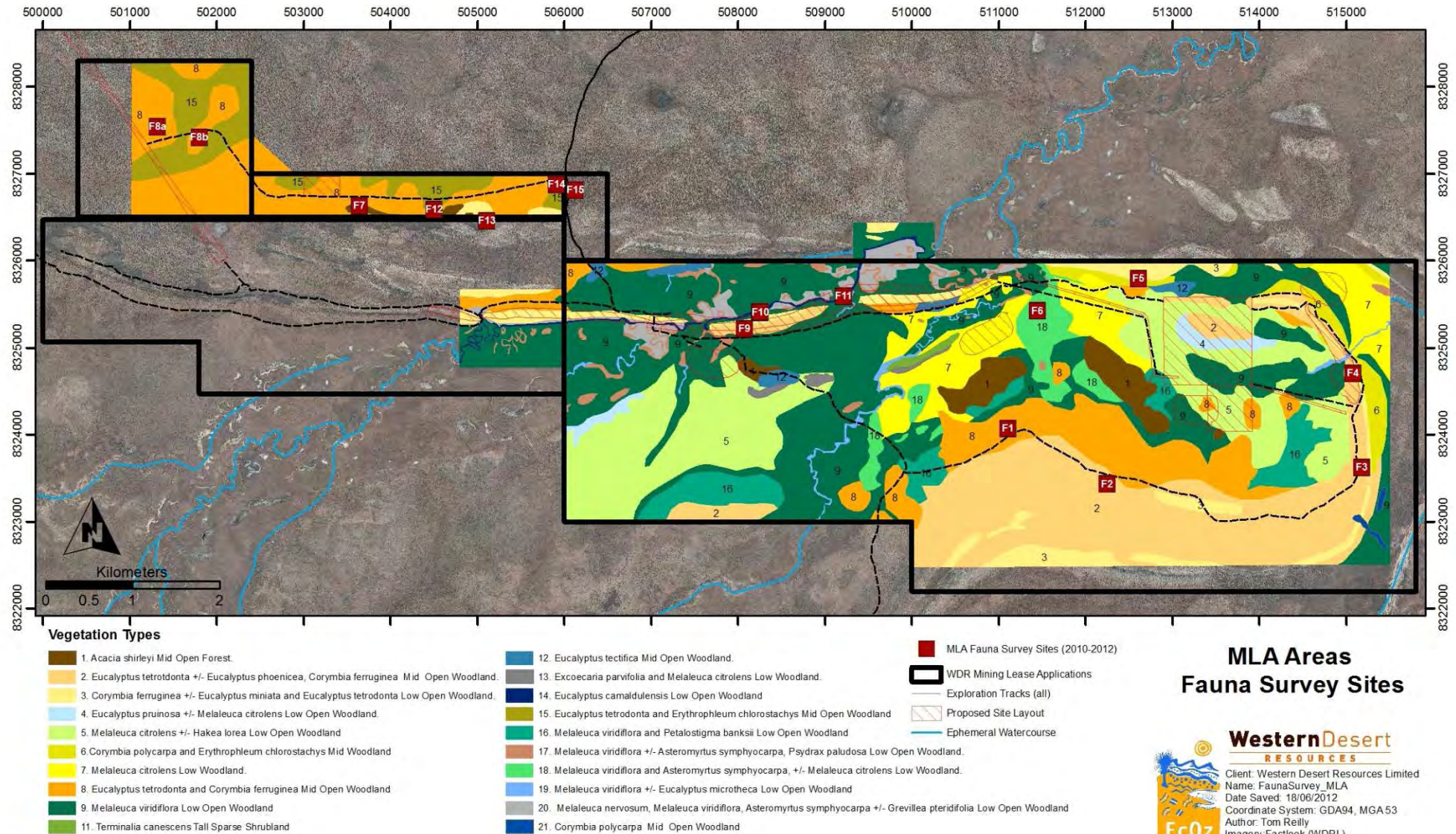


Figure 23: Map of fauna survey sites within the MLA areas



4.5.2 Fauna Survey Results

The Wet and Dry season field surveys of the MLA areas recorded a total of 150 fauna species, comprising of 13 amphibians, 34 reptiles, 91 birds, and 19 mammals. Four introduced species were identified. The majority of species were identified through trapping, active search techniques, and incidental observations. Species lists, status, and identification method are provided in the Appendix D-2. Summary descriptions by faunal group are provided below. Desktop search data is summarised in Section 3.5 and listed in Appendix D-1.

The majority of species recorded during the survey are common and generally widespread throughout similar habitat in the region (based on existing data records). Three threatened species (as per TPWC Act) were identified during the survey:

- Mertens' Water Monitor (*Varanus mertensi*);
- Australian Bustard (*Ardeotis australis*); and
- Emu (*Dromaius novaehollandiae*).

No species listed as threatened under the EPBC Act were identified, however four listed migratory species (all birds) and 24 listed marine species (23 birds and one reptile) were recorded.

Fauna methodology and survey limitations are provided in Section 2.3.

Amphibians

A total of 13 amphibians was recorded from the surveys, mainly from pit traps and active searches (Appendix D-2). Most species were recorded from the two dampest sites – F6 and F10 – and several species were recorded at multiple sites, indicating their generalist habitat preferences. The least productive sites were all in or adjacent to Vegetation Type 2 – mixed Eucalypt mid open woodland – which occurs in drier areas with low shelter. Amphibians from the genus *Crinia* and the genus *Uperoleia* were captured but could not be identified to species level without a reference call.

- No threatened species were identified.
- Two Data Deficient species were identified – *Litoria australis* and *Opisthodon ornatus*. These species are common and widespread throughout this region, and also the across northern Australia.
- The remaining species (including the unidentified *Crinia* and *Uperoleia* species) are all listed as Least Concern.
- One introduced species was identified, Cane Toad (*Chaunus marinus*), which was recorded in abundance at a majority of sites throughout the MLA areas.

Reptiles

A total of 34 reptiles was recorded from the survey, mainly from pit traps, funnel traps and active searches (Appendix D-2). Geckoes (nine species), skinks (nine species) and dragons (seven species) were well-represented in regards to diversity, habitat and abundance. The rocky ridges especially contained high richness of *Diporiphora magna*, *Diporiphora albilabris*, *Heteronotia binoei*, *Ctenotus inornatus*, and *Ctenotus spaldingi*. The restricted range Borroloola Dtella (*Gehyra borroloola*) was recorded on the rocky ridges at Site 4 (which is within Area E) and Site 5, but not similar Site 3. An estimate of 50 reptiles per hectare was calculated during surveys in October 2010.

- One threatened species, Mertens' Water Monitor (*Varanus mertensi*), which is listed as Vulnerable was recorded as an incidental observation in a billabong associated with flood-out areas of the upper Towns River in the vicinity of Area F East, as well as adjacent to the MLA areas at the Towns River and Little Towns River crossings of the Savannah Way;



- One Data Deficient species, *Antaresia childreni*, and one Not Evaluated species, *Cryptoblepharus ruber*, were identified. These are both common and widespread in suitable habitat throughout northern Australia. The status of *Antaresia childreni* is proposed to be changed to Least Concern.
- The remaining species are all listed as Least Concern.
- One listed marine species – Freshwater Crocodile (*Crocodylus johnstoni*) – was recorded.
- No introduced reptile species were identified.

Birds

A total of 91 bird species from 47 families was identified during the survey (Appendix D-2). Very few waterbirds and waders (shorebirds) were recorded, reflecting the paucity of permanent water within the MLA areas and that there are ample areas of habitat offsite, such as the Towns and Little Towns Rivers.

- Two threatened species were recorded:
 - Emu (*Dromaius novaehollandiae*) is listed as Vulnerable and was recorded at Site 7. Widespread across Australia, there is poorly quantified evidence to suggest this species has experienced a population reduction in the north of its range (because of altered fire regimes. A proposed review of the NT Threatened Species List downgrades the Emu's status to Near Threatened.
 - Australian Bustard (*Ardeotis australis*) is also listed as Vulnerable and was recorded at Sites 2, 4 and 6, as well as incidentally. As with the Emu, with whom the Australian Bustard shares a similar distribution and ecology, the claimed population reduction of this species is questionable, hence its status is earmarked to be reduced to Least Concern.
- One Near Threatened species, Bush Stone-curlew (*Burhinus grallarius*), was recorded at a number of different sites, as well as incidentally. This species is common and widespread in suitable fox-free habitat throughout northern Australia.
- Three Data Deficient species were recorded – Black Bittern (*Ixobrychus flavicollis*), Blue-winged Kookaburra (*Dacelo leachii*), and a Snipe (*Gallinago* species – not possible to identify except if in the hand), as was a Not Evaluated species– White-throated Needletail (*Hirundapus caudacutus*). The statuses for both Black Bittern (*Ixobrychus flavicollis*) and Blue-winged Kookaburra (*Dacelo leachii*) are proposed to be revised to Least Concern.
- The remaining species are all listed as Least Concern.
- Four listed migratory species and 23 listed marine species were observed, all are common and widespread throughout the savannah.
- No introduced bird species were recorded.

Mammals

Eleven mammal species were recorded from the survey, mainly from pit traps, Elliot traps and active searches (Appendix D-2). In addition, seven species of bat were captured or identified acoustically (see Appendix D-5). The total number of mammal species, therefore, was 19. All but one bat species were recorded on multiple occasions. Aside from bat species, only the Common Rock-rat (*Zyzomys argurus*) was recorded with any regularity – occurring at four separate sites, all of which were rocky habitats within the eastern MLA areas targeted for ore extraction. Two macropod species were recorded, but with only a total of three sightings, suggesting a low abundance.

- No threatened species were recorded.
- Two Near Threatened species were recorded – Orange Leaf-nosed Bat (*Rhinonicteris aurantia*) at riparian Site 11 and Western Chestnut Mouse (*Pseudomys nanus*) at Site 14.



- The remaining species are all listed as Least Concern.
- Three introduced species were recorded – Pig, Swamp Buffalo, and Donkey. None were recorded at more than two sites.

4.5.3 Summary

Field and desktop surveys identify a total of 460 fauna species that are found, or potentially occur, within the MLA areas and surrounds (Table 12). During the field surveys trap success was low for both reptiles and mammals, making the identification of key habitats for these difficult. Amphibian species clearly favoured damper habitats – especially those that are seasonally inundated. Birds and freshwater fish species identified during field surveys were typical for the region with no surprising records. The bat species identified are predominantly tree-roosting species; possibly reflecting the absence of significant rocky outcrop and rock types prone to cave development within proximity to the locality.

Table 12: Total fauna species within the MLA areas – data from desktop and field surveys.

	Number of species
Amphibian	24
Reptile	97
Bird	222
Mammal	51
Freshwater Fish	65
TOTAL	460

4.6 Freshwater Fish Surveys

A freshwater fish survey identified a total of 28 species. No threatened species were recorded during these surveys and all species recorded are common and generally widespread in the region. Desktop search data are summarised in Section 3.7 and listed in Appendix D-1. Species lists, conservation status, and identification methods are provided in the Appendix D-2.

Habitat description summaries and photos for each survey site are included in Table 13 and locations shown in Figure 24.

Description of Aquatic Environments

The project area is located within the middle reaches of the Towns River catchment, which is approximately 5441km² in extent. From its headwaters (approximately 30m AMSL), the Towns River catchment drains in a north-east direction for total length of 130km, before it enters the Gulf of Carpentaria. The MLA areas are located approximately 50km from the Towns River mouth and 20km upstream of the tidal influence in the vicinity of the Savannah Way road crossing. All freshwater fish survey sites were in the freshwater reaches of the river, except for Site 2, which was located within the upper tidal reaches of the system.

Stream flows in the aquatic habitats surveyed are restricted to during and just after the Wet season (November to April) and permanent surface waters are confined to remnant in-stream pools and off-stream billabongs during the Dry season (May to October). The frequency and size of permanent waterbodies generally increases moving down the catchment, and it is these locations which are likely to act as refuges for aquatic fauna during the Dry season.

The extent and quality of habitats suitable for aquatic fauna generally increases further downstream in the catchment. In many cases, the upper reaches of the Towns River within the MLA areas is characterised by deeply incised, sinuous and often-braided channels that follow a typical pool-riffle sequence. Active sections



of erosion along stream banks are common, which may be linked to the limited riparian vegetation along the stream edges (e.g. root material associated with large trees). Naturally high turbidity in the water column means that macrophytes are generally not present. Consequently, habitat quality for fish and other aquatic species within the stream channels may be limited, particularly in the upper stream reaches.

Species Diversity

The total number of fish species observed within the Towns River catchment (28 species) is slightly lower than the average for river basins of northern Australia (36 species – Pusey 2011). Fish species biodiversity generally increases with catchment size (Pusey 2011), so the relatively small size of the Towns River catchment likely explains the reduced biodiversity observed.

The above habitat observations are reflected in the freshwater fish species diversity, with the number of species increasing from the furthest upstream Site 1 (i.e. zero species recorded) to the furthest downstream Sites 2 and 5 (i.e. 29 and 25 species, respectively). Within river catchments, fish species diversity usually increases moving further downstream in the catchment (Pusey 2011). The high diversity of fish species at Site 2 can be in part attributed the presence of some estuarine species from the eastern site of the Savannah Way Road) which is within very upper tidal reaches of the Towns River.

The lower, more estuarine reaches of the Towns River where judged to be likely habitat for freshwater sawfish (Dave Wilson pers comm. 2011).

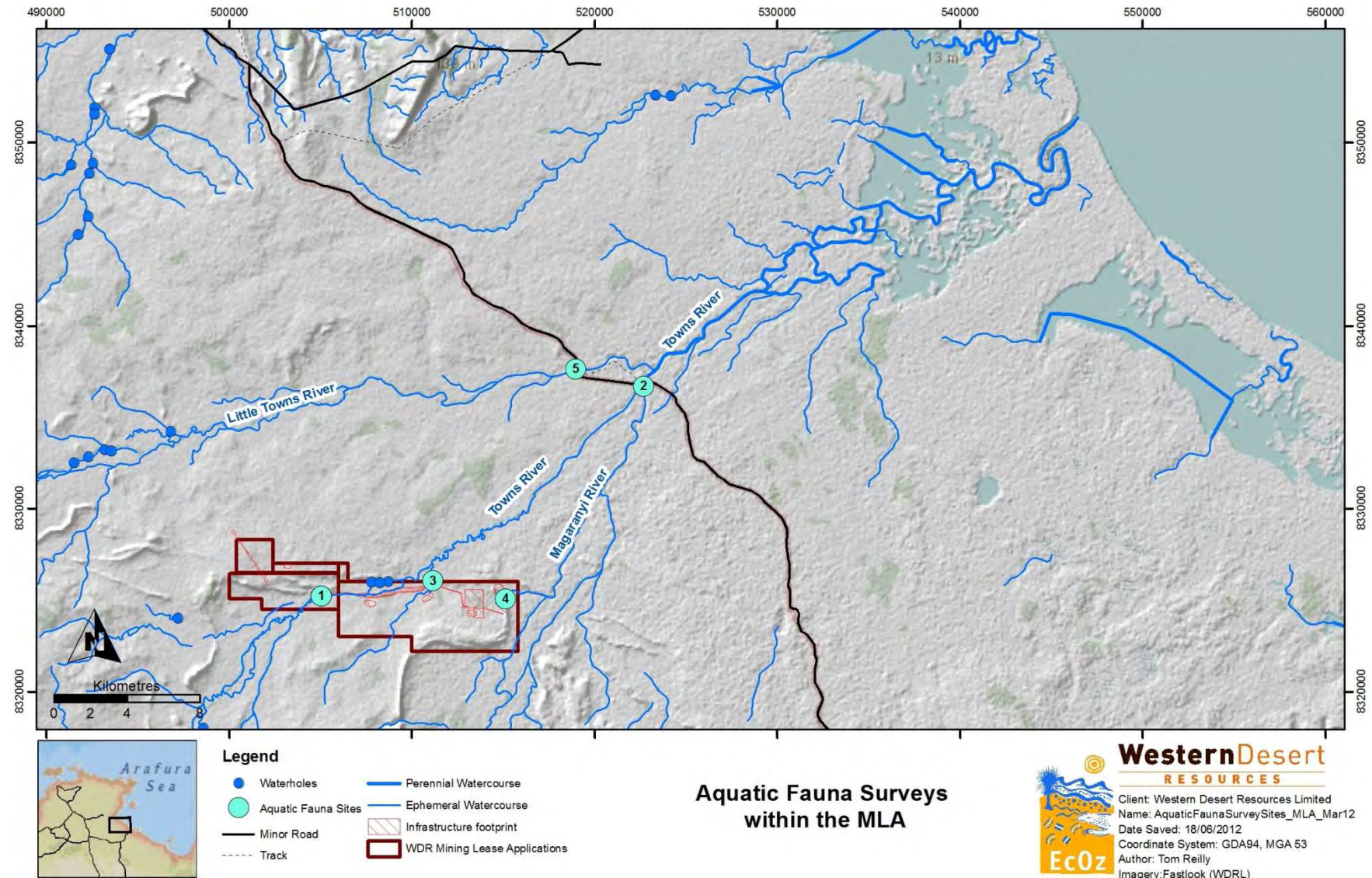


Figure 24: Locations of freshwater fish survey sites (MLA area and downstream of MLA only)



Table 13: Freshwater fish survey site habitat descriptions – MLA areas surveys

Site	Photo	Description
Site 1		Habitat: Isolated pool in a seasonally flowing creek Substrate: Earthen with small pebbles Bank Erosion: Active erosion on outer bend Disturbances: Nil Average Width: 7m Clarity: <0.1m Maximum Depth: 0.5m Vegetation Cover: 10% Velocity: Nil Macrophytes: Nil Colour: Pale grey Weather: Fine 0/8 cloud
Site 2		Habitat: Lowland river at limits of tidal influence. Substrate: Sand with scattered medium to large rocks. Bank Erosion: Nil Disturbances: Nil Average Width: 20m Clarity: 1.2m Maximum Depth: 2m Vegetation Cover: 20-30% Velocity: Nil Macrophytes: Nil Colour: Green/blue Weather: Fine. 1/8 cloud.
Site 3		Habitat: Relatively deep waterhole adjacent to rocky spur. Substrate: Clay/soil with scattered medium to large rocks at south-western end. Bank Erosion: Nil Disturbances: Nil Average Width: 20m Clarity: 0.2m Maximum Depth: 2m Vegetation Cover: 10% Velocity: Nil Macrophytes: Nil Colour: light brown Weather: Dry. 3/8 cloud.
Site 4		Habitat: Shallow swamp, small stream cuts through a low ridge Substrate: Earth with some pebbles and rock. Also leaf litter Bank Erosion: Nil Disturbances: Some pig damage. Average Width: 10m Clarity: <0.05 to 0.5m (undefined) Vegetation Cover: 80% Maximum Depth: 0.8m Macrophytes: Nil Velocity: Nil Weather: Dry 4/8 cloud Colour: brown to clear
Site 5		Habitat: Long, lowland river pools connected by small riffles. Substrate: Sand. Banks with tree roots, leaf litter and few rocks. Bank Erosion: Nil Disturbances: Nil Average Width: 5m Clarity: 1.2m Maximum Depth: 2m Vegetation Cover: 80% Velocity: Nil Macrophytes: Nil Colour: Green Blue Weather: Fine 1/8 cloud



4.7 Bare-rumped Sheathtail Bat Surveys

The Bare-rumped Sheathtail Bat was not captured, observed or its call recorded during the targeted survey for this species. Calls of *Saccolaimus* species were conspicuously abundant (but not quantified) in the survey area, but it is anticipated that many, if not all, of these derive from the Yellow-rumped Sheathtail Bat (*Saccolaimus flaviventris*).

The presence, therefore, of *Saccolaimus saccolaimus* was not confirmed in any of the project areas. This suggests that either it was not present, or that ability to detect and distinguish this species was limited. Kyle Armstrong, who undertook the survey, concluded that its presence is still a possibility given the observation of several large vertical hollows in tree trunks in the *Eucalyptus tetradonta* – *Eucalyptus miniata* Mid Open Woodland.

The detailed bat report is provided in Appendix D-5.

4.8 Sensitive Habitats

None of the vegetation communities are listed under any legislation (TPWC or EPBC Acts) but some types are locally noteworthy from the perspective of conserving habitat which is in good condition, features more of the atypical species, or contributes to the hydrology and connectivity within this mid part of the Towns catchment. The communities considered locally notable, and the justifications for this, are outlined below.

Tall *Eucalyptus tetradonta* and *Erythrophleum chlorostachys* Woodland (Vegetation type 15) and ***Callitris* Woodland** occurring within a distinct patch near the existing exploration camp. Both of these vegetation communities are not uncommon within the survey area. However, these particular patches have obviously been sheltered from the impacts of fire over several years and are in particularly good condition. From a fauna perspective the dense patch of Vegetation type 15 is notable due to the diversity of woodland bird species. It was also the only site at which a Sugar Glider (*Petaurus breviceps*) and the Chestnut Mouse (*Pseudomys nanus*) were observed (however Sugar Glider scats were recorded near site 13). The Sugar Glider utilised the area despite the continuous noise of a nearby generator. The nearby patch of *Callitris* was also notable for the diversity of woodland bird species.

The ***Melaleuca* Woodlands** which are often inundated are notable as they contribute to the local hydrology and more often feature the more uncommon ephemeral plant species. Vegetation type 18, which falls within this category, is particularly noteworthy as is probably the wettest form of the *Melaleuca viridiflora* vegetation types; indicated by the presence of *Asteromyrtus*. This vegetation type features the most notable plant species including the two data deficient species, *Nymphoides exiliflora* & *Fimbristylis dolera*, and one near threatened species, *Ophioglossum gramineum*. It also features the only record of the *Utricularia* species, which probably has a limited range or likely to be endemic to at least the Gulf Falls Upland Bioregion (pers comm. Ian Cowie NRETAS). There is only one record for this *Utricularia* species within the surveyed area and this is intended to be cleared and altered for the construction of a storage area. From a fauna perspective this habitat type also features the higher diversity of amphibians.

The ***Eucalyptus camaldulensis* Woodlands** (Vegetation type 14) occurring along stream channels is the only vegetation type where *Eucalyptus camaldulensis* (River Red Gum) occurs within the project area. Stream channels in the surrounds also feature River Red Gums in similar small quantities. A very small area (90m²) is proposed to be affected by potential mining. However, the seasonal flows within this vegetation type support connectivity within this mid part of the Towns Catchment. From a fauna perspective this habitat type also features the higher diversity of amphibians. However, none of these are only found within this habitat type. The Towns River flowing through the mining MLA is targeted for major disturbance and realignment.



***Corymbia polycarpa* Mid Woodland** (Vegetation type 21) associated with a seepage in the south-eastern ridges flowing towards the Magaranyi Creek. This seepage may be prone to flowing all year round in good Wet seasons. The seepage was initially thought to be a potential spring (as the water was still flowing in October 2011, a particularly wet year) but water quality and ground water depths suggest a shallower more ephemeral source. The vegetation associated with the seepage has been mapped as an individual vegetation type for the area but the floristics are not considerably different from Vegetation type 6 *Corymbia polycarpa* and *Erythrophleum chlorostachys* occurring at the base of the rocky ridges. Mining will alter the hydrology and most certainly eliminate this vegetation type (type 21).

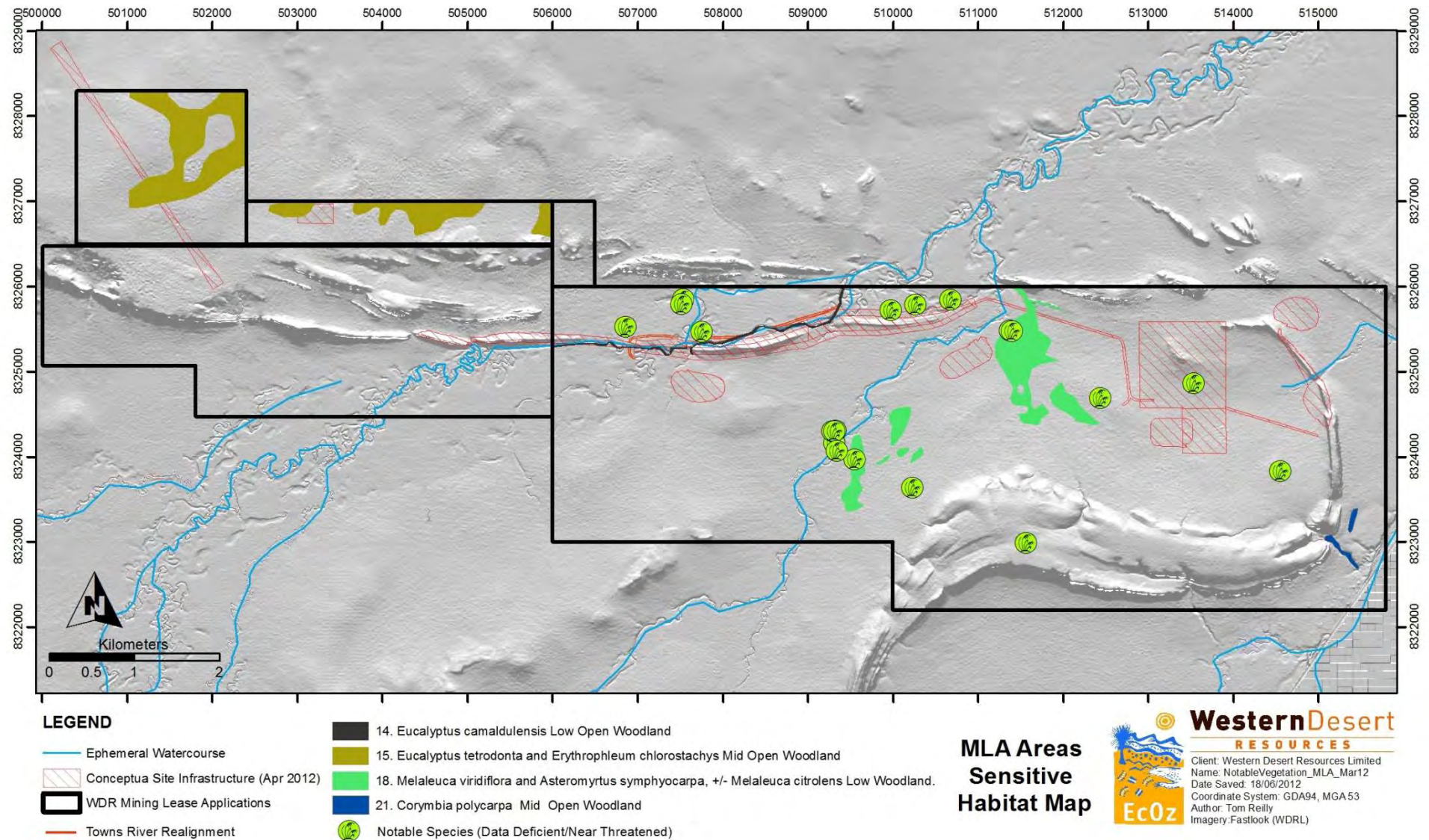


Figure 25: Notable habitat identified within MLA areas



D-5. Haul Road Route

5.1 Introduction

WDRL propose to construct a haul road from the process plant (in the MLA areas) to the Bing Bong Port facility, which will require a 50m (maximum scenario) wide strip of cleared vegetation for a distance of 165km (approximately 820ha). The haul road corridor crosses a number of major rivers and creeks. The proposed haul road traverses a variety of landforms broadly ranging from alluvial floodplains, coastal dunes, lateritic plains, rugged quartz sandstone plateaux and hills, sandstone hills, sandstone plains and rises and tidal flats (refer to Section 5.2 on land systems for more detail). Detailed vegetation surveys at a finer scale were not considered necessary for the haul road corridor, due to the relatively minor and localised impact of the linear development, and the large patch size of most vegetation communities encountered along the route. Instead, surveys along the proposed route focused on identifying and assessing the value of sensitive habitat or habitat of higher conservation value that should be avoided and even potentially buffered.

Previous survey history indicates that the general region is fairly data poor (see Section 3.4), and mostly include species identified along the Savannah Way and major creeks/rivers.

Biological surveys undertaken for the haul road as part of this report were:

- Preliminary Land System Ground-truthing for the entire haul road route using a survey area 3km either side of the haul road (i.e. resulting in a 6km corridor);
- Sensitive Habitat Mapping within the 6km haul road survey corridor. Mapping focused on identifying rocky outcrop areas, water bodies, and riparian vegetation. Each mapped location was also assessed in terms of its habitat value to provide an indication of areas that require protection from haul road disturbances; and
- Terrestrial fauna surveys were conducted at five sites along the haul road corridor to include a range of sensitive and common habitat types. Sites focused on collecting data from rocky ridge habitat, and also a range of woodland and lowland areas which are widespread but under-surveyed.

5.2 Land Systems

A detailed description of land systems located along the haul road route is given in Chapter 3. Vegetation descriptions, including structure and dominant species, have been attributed to each land system surveyed within this report. Where there is large diversity in landform within a land system classification, diversity in flora has been described as a mosaic of vegetation types. A total of 18 different land systems are crossed by the proposed haul road route, and a further five occur within 3km either side (Table 14 and Figure 26).

The highest diversity in land systems encountering the haul road are located within the first 50km of the route, between the project area and the Limmen Bight River, where over 20 changes in classification occur. This section is dominated by the following land systems and associated mid high open woodland vegetation:

- Seigal (*Eucalyptus miniata*, *E. tetradonta*, and *Corymbia ferruginea*)
- Bukalara (*C. dichromophloia*)
- Emmerugga (*E. leucophloia*)
- Frog (*E. tectifera*, *C. terminalis* and *Erythrophleum chlorostachys*)
- Wearyan (*Melaleuca citrolens*)



Sections of the McArthur land system were also present along both the Cox River and Limmen Bight River. Vegetation within this land system is dominated by *C. terminalis* and *E. microtheca* with tall fringing riparian vegetation often including *Melaleuca spp.*

The remainder of the haul road (approximately 113 km), located between the Limmen Bight River and the Bing Bong Port, traverses larger individual land system areas, changing approximately 15 times for every 50km along the route. This section is dominated by the following land systems and associated tall open woodland vegetation:

- Horse Creek (*E. tetradonta*, *Callitris intratropica*, *E. miniata* and *C. ferruginea*)
- Fletcher (*E. tetradonta*)
- Rosie (*E. tetradonta* with *M. viridiflora* and *Asteromyrtus symphyocarpa* on low lying areas)
- Running (*E. tetradonta*)

The McArthur land system also occurs within this section of the haul road along the Nathan River, Rosie Creek, Pine Creek and Bing Bong Creek systems. For more detailed assessments of riparian vegetation within the McArthur land system see Section 5.4 and Appendix D-10 (riparian assessment surveys).

Full vegetation descriptions and occurrence of each land system along the haul road route are described in Table 14, which also shows the distance that each land system is traversed by the haul road and the maximum area proposed for clearing during construction. This area has been calculated with a maximum 50m width cleared along the haul road route. The maximum total area proposed for clearing is approximately 821ha.

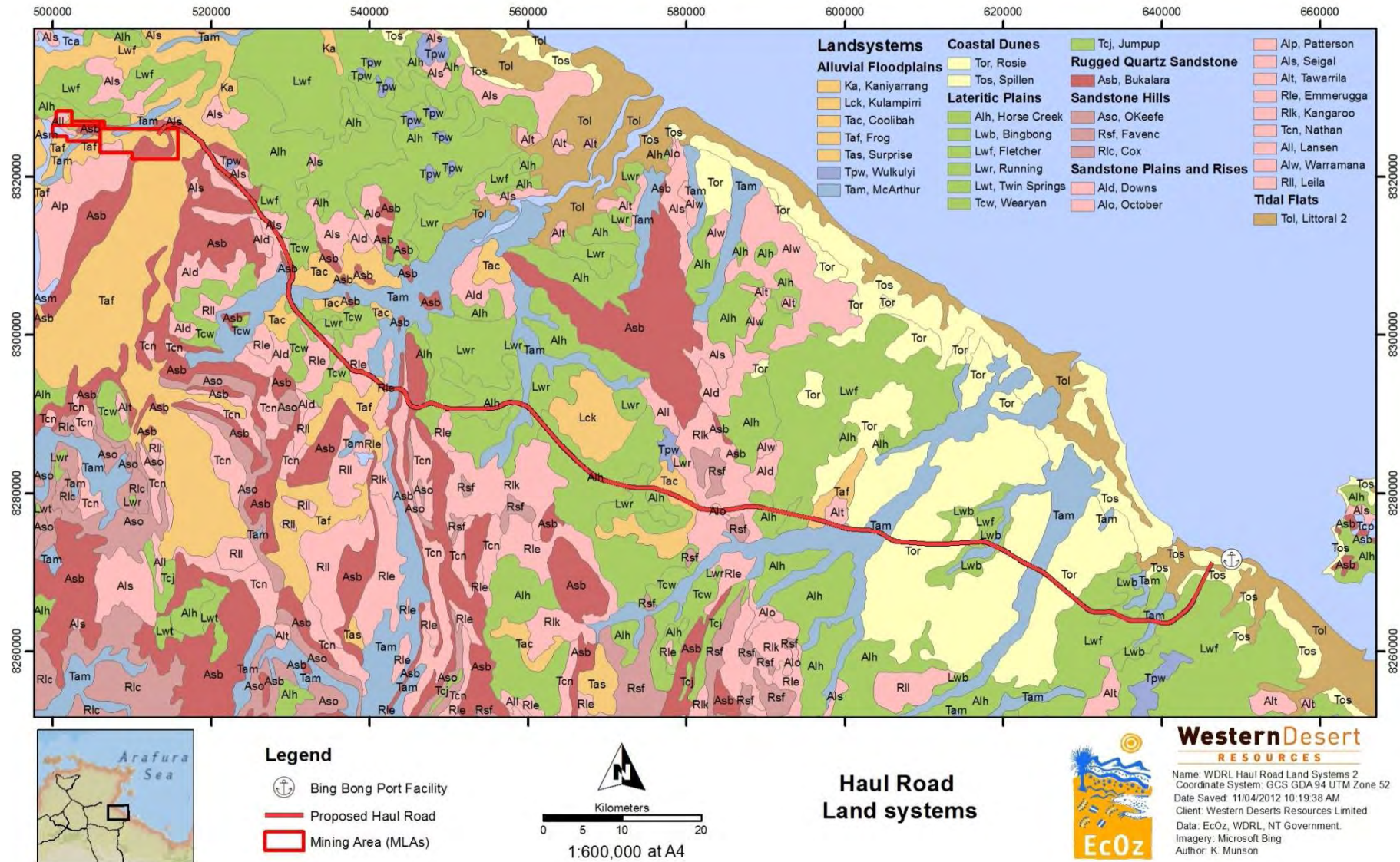


Figure 26: Land systems along the haul road route and surrounds



Table 14: Land system and vegetation descriptions along the haul road route

Land System		Landform	Soils	Vegetation	Occurrence	Distance & clearing area along Haul Rd	
						(km)	(ha)
Ald	Downs	Gently undulating plains and rises on mainly fine-grained sandstones	Sandy yellow earths and siliceous sands	Mid-high woodland of <i>Melaleuca viridiflora</i> with <i>Pandanus spiralis</i> and <i>C. polycarpa</i>	Two small occurrences near road, but not on road, in area around Cox River	0	0
Alh	Horse Creek	Gently undulating plains on sandstone with deep sandy soils and isolated swampy depressions	Siliceous sands and earthy sands	Tall open woodland of <i>E. tetradonta</i> , <i>Callitris intratropica</i> , <i>E. miniata</i> and <i>C. ferruginea</i> . <i>Corymbia polycarpa</i> and <i>Melaleuca viridiflora</i> occur on wetter areas	Common between the Limmen Bight River and Rosie Creek	26.7	133.5
Alo	October	Very rocky gently undulating rises on massive sandstones	Lithosols	Mid-high open woodland of <i>C. dichromophloia</i>	One small occurrence where road crosses Yiyintyi Range	1.3	6.5
Als	Seigal	Gently undulating to undulating rises with abundant, often linear rocky outcrops and shallow sandy soils	Lithosols, minor siliceous and earthy sands.	Mid-high open woodland of <i>E. miniata</i> , <i>E. tetradonta</i> and <i>C. ferruginea</i> with <i>C. dichromophloia</i> and <i>E. leucophloia</i>	Common between Project Area and Cox River	13.2	66
Alt	Tawarrila	Undulating rises to low hills with some rocky outcrops on sandstone	Lithosols and siliceous sands	Mid-high open woodland of <i>C. phoenicea</i> with <i>C. polycarpa</i> on lower slopes	One small occurrence west of Rosie Creek crossing	1.8	9
Asb	Bukalara	Rugged rocky plateaux and steep, linear ridges on massive sandstones	Lithosols and shallow siliceous sands	Mid-high open woodland of <i>Corymbia dichromophloia</i> with <i>E. miniata</i> , <i>E. tetradonta</i> and <i>E. leucophloia</i>	Between Project Area and Cox River and also around Limmen Bight River	8.4	42
Aso	O'Keefe	Broad breached anticlines and dissected structural plateaux on sub-horizontally bedded sandstones of the Roper Group with sandstone columns	Shallow siliceous sands	Mid-high open woodland of <i>E. miniata</i> , <i>E. tetradonta</i> and <i>C. ferruginea</i>	Occurs south of Limmen Bight River crossing, but not on actual road	1.3	6.5



Land System		Landform	Soils	Vegetation	Occurrence	Distance & clearing area along Haul Rd	
						(km)	(ha)
Lck	Kulampirri	Gently undulating plains on the Kulampirri Travertine Beds comprising lacustrine or spring-related calcrete deposits	Solodic	Tall open woodland of <i>C. bella</i> with mixed grassland	One large occurrence on north-eastern side of road between Nathan River crossing and Yiyintyi Range; road does not cross this land system	0	0
Lwb	Bingbong	Incised, undulating rises flanking streams which are eroding into the laterite carapace of Lwf (Fletcher)	Ferruginous lithosols and earthy sands	Mid-high open woodlands of <i>Eucalyptus tetrodonta</i> with <i>Callitris intratropica</i>	occurs along Bing Bong Creek and also a small creek between the Rosie and Pine Creek crossings	3.6	18
Lwf	Fletcher	Level to very gently undulating plains on ferruginous material (laterite) that has been re-exposed from a sub-marine position, with swales in a sub-coastal orientation.	Earthy sands and yellow podzolic soils	Tall open woodland of <i>E. tetrodonta</i> with <i>Melaleuca viridiflora</i> , <i>M. nervosa</i> and <i>Callitris intratropica</i>	Common between Yiyintyi Range and Bing Bong	23.1	115.5
Lwr	Running	Gently undulating plains and rises on ferruginised, mainly arenaceous sediments	Lateritic podzolics and lithosols	Tall open woodland of <i>E. tetrodonta</i> with <i>C. dichromophloia</i> , <i>C. ferruginea</i> , <i>E. miniata</i> and <i>C. phoenicea</i>	Scattered along road between Project Area and Yiyintyi Range	16.1	80.5
Rle	Emmerugga	Undulating to rolling low hills on mainly argillaceous sediments	Lithosols and brown earths	Mid-high open woodland of <i>E. leucophloia</i> with some <i>E. tectifera</i> , <i>C. terminalis</i> , and <i>Erythrophleum chlorostachys</i>	Mainly between Cox and Limmen Bight River crossings	6.8	34
Rlk	Kangaroo	Gently undulating to undulating rises on mainly argillaceous sediments	Shallow yellow earths and yellow podzolics	Mid-high open woodland of <i>E. tectifera</i> , <i>E. terminalis</i> and <i>Erythrophleum chlorostachys</i> with <i>Melaleuca viridiflora</i> , <i>Pandanus spiralis</i> and <i>C. polycarpa</i> on low lying areas	Occurs either side of Yiyintyi Range	5.9	29.5
Rsf	Favenc	Steep hills on mainly argillaceous sediments	Lithosols and brown earths	Mid-high open woodland of <i>C. dichromophloia</i> , <i>E. miniata</i> and <i>E. tetrodonta</i>	North and south of the road where it crosses through Yiyintyi Range; but road does not actually cross this land system	0	0



Land System		Landform	Soils	Vegetation	Occurrence	Distance & clearing area along Haul Rd	
						(km)	(ha)
Tac	Coolibah	Level to gently undulating plains on unconsolidated transported materials, rarely sedentary	Grey and brown clays, minor black earths	Tall open grassland of <i>Chrysopogon fallax</i> and <i>Eulalia aurea</i> with some <i>E. microtheca</i> and <i>E. pruinosa</i>	Around Cox River crossing and west of Yiyintyi Range	6.5	32.5
Taf	Frog	Broad sandy floodplains, terraces and lower colluvial slopes	Deep siliceous and earthy sands, sandy yellow earths and sandy solodic soils	Mid-high open woodland of <i>E. tectifera</i> , <i>C. terminalis</i> and <i>Erythrophleum chlorostachys</i> with some <i>C. bella</i> on sandy floodplains	West of Limmen Bight River crossing and west of Rosie Creek crossing	6.2	31
Tam	McArthur	Broad or narrow fluvial corridors conducting regional drainage across various land systems towards the coast	Grey and brown clays, red and yellow earths and siliceous sands	Mid-high open woodland of <i>C. terminalis</i> and <i>E. microtheca</i> with some <i>C. bella</i> and <i>C. polycarpa</i> . Tall fringing riparian vegetation often includes <i>Melaleuca spp.</i>	At all river and creek crossings	15.6	78
Tcn	Nathan	Pediments and side slopes of broad valleys on detritus and argillaceous sediments	Yellow earths, siliceous sands and brown clays	Mid high open woodland of <i>C. terminalis</i> and <i>Erythrophleum chlorostachys</i> with some <i>Bauhinia cunninghamii</i> and <i>Melaleuca citrolens</i>	Only on east side of Limmen Bight River crossing	2	10
Tcw	Wearyan	Gently undulating plains and pediplains on transported material or argillaceous sediments	Yellow podzolics and solodic soils	Mid-high woodlands of <i>Melaleuca citrolens</i>	East and west of Cox River crossing	4.6	23
Tol	Littoral	Tidal mud flats with channels and estuaries	Laterite sheets commonly exposed, undifferentiated marine deposits	Mostly bare areas with isolated clumps of <i>Melaleuca acacioides</i> and halophytic forbs with fringing mangroves along shoreline and tidal waterways	Only at Bing Bong	0.5	2.5
Tor	Rosie	Almost level plains on old sea-floor deposits with regular dune swale systems or isolated sand dunes, in a sub-coastal orientation	Earthy sands and yellow podzolic soils	Tall open woodland of <i>E. tetradonta</i> with <i>Melaleuca viridiflora</i> and <i>Asteromyrtus symphyocarpa</i> on low lying areas	Common between Yiyintyi Range and Bing Bong Creek	20.3	101.5



Land System		Landform	Soils	Vegetation	Occurrence	Distance & clearing area along Haul Rd	
						(km)	(ha)
Tos	Spillen	Coastal sand sheets, dunes and cheniers with minor intervening tidal flats	Siliceous sands and yellow podzolic soils	Tall grasslands of <i>Chrysopogon elongata</i> with some <i>Melaleuca viridiflora</i> , <i>M. nervosa</i> , <i>Pandanus spiralis</i> and <i>C. bella</i>	Bing Bong only	1.6	8
Tpw	Wulkulyi	Seasonal and perennial swamps and poorly drained, low-lying areas	Humic gleys, yellow podzolic soils and undifferentiated clay soils	Mid-high woodlands of <i>Melaleuca nervosa</i>	Two isolated occurrences north of road but none actually on the road	0	0



5.3 Vegetation Surveys

National Vegetation Information System (NVIS) data has been applied across the entire project area (mining area, haul road route and port facility). Vegetation types are described at NVIS level 3 providing detail on growth form, height and cover of characteristic species in the dominant stratum (Hnatiuk, *et al.* 2009). Detailed information including dominant species in the upper and ground strata and general landform features are provided in Table 15.

The vegetation map presented in Figure 27 and Figure 28 has identified that the haul road route is set to traverse large sections of *Eucalyptus* woodland located on flat to undulating plains (Veg ID 570) located east of the Limmen Bight River and continuing through to the Bing Bong port facility. This vegetation type is dominated by *Eucalyptus tetradonta*, *Corymbia ferruginea* and *Erythrophleum chlorostachys* in the upper stratum. Intersected by this section of the haul road are also a number of small isolated patches of *Melaleuca nervosa* & *M. viridiflora* woodland (Veg ID 321) on the drainage flats. An area of low floodplain is also located along the southern section of Rosie Creek, supporting a *Chrysopogon* (mixed) low tussock grassland (Veg ID 336) dominated by *Eucalyptus microtheca* +/- *Terminalia platyphylla* +/- *Ventilago viminalis*. This section of the haul road also crosses two small patches of *Corymbia* low open woodland dominated by *Corymbia dichromophloia*, *Eucalyptus tetradonta* and *Corymbia ferruginea* located on well-draining upland plains (Veg ID 342) near the Limmen Bight River and Rosie Creek crossings. It is suspected that the NVIS data applied to the mapping displays inaccuracies as accurate corresponding land form features displayed within the map are located slightly north east of the Veg ID 342 mapping boundaries. Detailed location surveys of both the *Melaleuca* woodland (Veg ID 321) and *Corymbia* low open woodland (Veg ID 342) vegetation types have been undertaken by EcOz aimed at minimising impacts and avoiding these areas and results are shown in the sensitive habitat survey (see Section 5.4.3).

The section of haul road beginning at the mining area and continuing through to the Limmen Bight River fall almost entirely within *Eucalyptus* woodland (Veg ID 324) dominated by *Eucalyptus tectifica*, *Corymbia terminalis* and *Erythrophleum chlorostachys* located on flat to undulating plains. A small area within this section of the haul road also runs alongside *Eucalyptus* woodland (Veg ID 570) described above and makes up the majority of the vegetation traversed by the haul road.

Table 15: NVIS vegetation descriptions of vegetation types in the vicinity of the haul road route

NVIS Level 3	Veg ID	Description (adapted from NVIS community descriptions)
Acacia low woodland	391	Upper storey: <i>Acacia shirleyi</i> . Ground: <i>Eriachne ciliata</i> , <i>Paspalidium raram</i> , <i>Schizachyrium fragile</i> . Environment: Lateritic sandstone outcrops, plateaux, breakaways to north/rises and plains to south; gravelly lithosols, some shallow red, yellow and black earths; well drained.
Acacia woodland	392	Upper storey: <i>Acacia shirleyi</i> , <i>Eucalyptus</i> spp. Ground: <i>Eriachne ciliata</i> , <i>Chrysopogon fallax</i> , <i>Paspalidium raram</i> . Environment: Lateritic sandstone outcrops, plateaux, breakaways to north/rises and plains to south; gravelly lithosols, some shallow red, yellow and black earths; well drained.
Aglaia (mixed) mid closed forest	1062	Upper storey: <i>Aglaia sapindina</i> +/- <i>Syzygium</i> spp. +/- <i>Calophyllum</i> sil. Environment: Springs throughout Top End.



NVIS Level 3	Veg ID	Description (adapted from NVIS community descriptions)
Avicennia (mixed) low open forest	1048	Upper storey: <i>Ceriops tagal</i>, <i>Avicennia marina</i> +/- <i>Lumnitzera racemosa</i>. Mid storey: <i>Aegialitis annulata</i>. Ground: <i>Halosarcia indica</i>, <i>Halosarcia halocnemoides</i>. Environment: Usually surrounded by salt pans or on the landward edge, in areas only inundated during spring tides.
Avicennia low closed forest	1053	Upper storey: <i>Avicennia marina</i> +/- <i>Excoecaria ovalis</i> +/- <i>Ceriops tagal</i>. Mid storey: +/- <i>Aegialitis annulata</i> +/- <i>Avicennia marina</i>. Ground: +/- <i>Avicennia marina</i> +/- <i>Sporobolus virginicus</i>. Environment: Found on the seaward edge as a pioneer and on the landward edge that is only inundated by the highest tides.
Avicennia low open forest	1047	Upper storey: <i>Avicennia marina</i>, <i>Ceriops tagal</i>, <i>Bruguiera spp</i>, <i>Rhizophora stylosa</i>. Mid storey: <i>Ceriops tagal</i>, <i>Avicennia marina</i>, <i>Osbornia octodonta</i>. Ground: <i>Avicennia marina</i>, <i>Ceriops tagal</i>, <i>Aegialitis annulata</i>. Environment: Diverse range of intertidal environments from the seaward edge, to accreting banks (as fringe), to the landward edge.
Canarium (mixed) mid closed forest	1061	Upper storey: <i>Canarium australianum</i> +/- <i>Ficus spp</i> +/- <i>Diospyros spp</i>. Environment: Coastal and sub-coastal regions on generally well drained sites. Class groups 9, 12, 14-16 JRS abstract. Many more spp than listed here.
Ceriops low closed forest	1049	Upper storey: <i>Ceriops tagal</i>, <i>Bruguiera spp</i> +/- <i>Excoecaria ovalis</i>. Mid storey: <i>Ceriops tagal</i> +/- <i>Aegiceras corniculatum</i> +/- <i>Scyphiphora hydrophyllacea</i>. Ground: <i>Ceriops tagal</i> +/- <i>Aegialitis annulata</i>. Environment: Generally occurs on erosion banks and towards the upper intertidal limit. Only inundated by spring tides.
Chrysopogon (mixed) low tussock grassland	336	Upper storey: <i>Eucalyptus microtheca</i> +/- <i>Terminalia platyphylla</i> +/- <i>Ventilago viminalis</i>. Mid storey: <i>Carissa lanceolata</i>, <i>Excoecaria parvifolia</i>, <i>Hakea chordophylla</i>. Ground: <i>Chrysopogon fallax</i>, <i>Aristida latifolia</i>, <i>Eulalia aurea</i>. Environment: Associated with floodplains of water courses, heavy grey clay alluvial soils.
Corymbia low open woodland	342	Upper storey: <i>Corymbia dichromophloia</i>, <i>Eucalyptus tetrodonta</i>, <i>Corymbia ferruginea</i>. Mid storey: <i>Grevillea refracta</i>, <i>Acacia galioides</i> var. <i>galioides</i>, <i>Terminalia canescens</i>. Ground: <i>Triodia pungens</i>, <i>Eriachne ciliata</i>, <i>Eriachne obtusa</i>. Environment: Well drained upland plains, moderately deep sands, occasionally lithosols.
Corymbia low open woodland	343	Upper storey: <i>Corymbia dichromophloia</i>, <i>Eucalyptus miniata</i>, <i>Erythrophleum chlorostachys</i>. Mid storey: <i>Acacia spp.</i>, <i>Grevillea spp.</i>, <i>Calytrix spp</i>. Ground: <i>Triodia pungens</i>, <i>Triodia microstachya</i>, <i>Eriachne ciliata</i>. Environment: Rugged sandstone plateaux, extensive areas of bare rock. Stony to gravelly shallow sands.



NVIS Level 3	Veg ID	Description (adapted from NVIS community descriptions)
Eucalyptus low open woodland	345	Upper storey: <i>Eucalyptus leucophloia</i> +/- <i>Erythrophleum chlorostachys</i> +/- <i>Corymbia ferruginea</i> . Mid storey: <i>Carissa lanceolata</i> , <i>Terminalia canescens</i> , <i>Erythrophleum chlorostachys</i> . Ground: <i>Triodia pungens</i> , <i>Sorghum spp.</i> , <i>Chrysopogon fallax</i> . Environment: Rocky side-slopes or tops of sandstone plateaux, shallow, skeletal gravelly sands.
Eucalyptus woodland	324	Upper storey: <i>Eucalyptus tectifica</i> , <i>Corymbia terminalis</i> , <i>Erythrophleum chlorostachys</i> . Mid storey: <i>Flueggea virosa</i> , <i>Terminalia canescens</i> , <i>Carissa lanceolata</i> . Ground: <i>Sehima nervosum</i> , <i>Chrysopogon fallax</i> , <i>Sorghum plumosum</i> . Environment: Flat to undulating plains, mainly loam to clay loam soils.
Eucalyptus woodland	570	Upper storey: <i>Eucalyptus tetradonta</i> , <i>Corymbia ferruginea</i> , <i>Erythrophleum chlorostachys</i> . Mid storey: <i>Bossiaea bossiaeoidea</i> , <i>Alphitonia excelsa</i> , <i>Distichostemon hispidulus</i> . Ground: <i>Triodia pungens</i> , <i>Eriachne obtusa</i> , <i>Schizachyrium fragile</i> . Environment: Flat to gently sloping or undulating plains, occasional rises and low hills, well drained sands and earthy sands
Halosarcia low sparse samphire shrubland	413	Ground: <i>Halosarcia indica</i> , <i>Tecticornia australasica</i> , <i>Suaeda arbusculoides</i> . Environment: Between seaward mangrove communities and landward upland communities, and in depressions adjacent to tidal flats and mangal communities.
Melaleuca low open woodland	361	Upper storey: <i>Melaleuca viridiflora</i> +/- <i>Eucalyptus polycarpa</i> +/- <i>Corymbia latifolia</i> . Mid storey: <i>Pandanus spiralis</i> , <i>Livistona humilis</i> , <i>Grevillea pteridifolia</i> . Ground: <i>Chrysopogon fallax</i> , <i>Themeda avenacea</i> , <i>Sorghum spp.</i> . Environment: Poorly drained sites fringing water courses or in drainage depressions. Soils range from yellow podzolics to yellow earths and gravelly sands.
Melaleuca low woodland	358	Upper storey: <i>Melaleuca citrolens</i> , <i>Eucalyptus pruinosa</i> +/- <i>Melaleuca viridiflora</i> . Mid storey: <i>Flueggea virosa</i> , <i>Carissa lanceolata</i> , <i>Terminalia canescens</i> . Ground: <i>Chrysopogon fallax</i> , <i>Sorghum plumosum</i> , <i>Eulalia aurea</i> . Environment: Moderately drained plains, with yellow earth or earthy sand soils.
Melaleuca low woodland	323	Upper storey: <i>Melaleuca citrolens</i> , <i>Melaleuca viridiflora</i> , <i>Eucalyptus pruinosa</i> . Mid storey: <i>Calytrix exstipulata</i> , <i>Terminalia canescens</i> , <i>Carissa lanceolata</i> . Ground: <i>Chrysopogon fallax</i> , <i>Pseudoraphis spinescens</i> , <i>Eriachne ciliata</i> . Environment: Low woodland/open-woodland, drainage flats
Melaleuca low woodland	320	Upper storey: <i>Melaleuca viridiflora</i> , <i>Melaleuca cajuputi</i> +/- <i>Melaleuca dealbata</i> . Mid storey: <i>Pandanus spiralis</i> , <i>Melaleuca viridiflora</i> , <i>Barringtonia acutangula</i> . Ground: <i>Eleocharis brassii</i> , <i>Eleocharis sphacelata</i> , <i>Hymenachne acutigluma</i> . Environment: Low woodland, drainage flats.



NVIS Level 3	Veg ID	Description (adapted from NVIS community descriptions)
Melaleuca open forest	360	Upper storey: <i>Melaleuca leucadendra</i> , <i>Melaleuca argentea</i> +/- <i>Melaleuca cajuputi</i> . Mid storey: <i>Pandanus spiralis</i> , <i>Barringtonia acutangula</i> , <i>Pandanus aquaticus</i> . Ground: <i>Germainia truncatiglumis</i> , <i>Vetiveria</i> spp., <i>Pseudoraphis spinescens</i> . Environment: Open-forest, riparian/springs.
Melaleuca open forest	330	Upper storey: <i>Melaleuca cajuputi</i> , <i>Melaleuca viridiflora</i> +/- <i>Melaleuca leucadendra</i> . Mid storey: <i>Melaleuca cajuputi</i> , <i>Acacia auriculiformis</i> , <i>Melaleuca viridiflora</i> . Ground: <i>Eleocharis dulcis</i> , <i>Pseudoraphis spinescens</i> , <i>Leersia hexandra</i> . Environment: Open-forest, floodplain proper.
Melaleuca woodland	316	Upper storey: <i>Melaleuca viridiflora</i> , <i>Melaleuca leucadendra</i> +/- <i>Melaleuca argentea</i> . Mid storey: <i>Barringtonia acutangula</i> , <i>Melaleuca viridiflora</i> , <i>Pandanus aquaticus</i> . Ground: <i>Chrysopogon fallax</i> , <i>Heteropogon contortus</i> , <i>Pseudoraphis spinescens</i> . Environment: Woodland, river/creek-line
Melaleuca woodland	321	Upper storey: <i>Mel nervosa</i> , <i>Mel viridiflora</i> +/- <i>Melaleuca dealbata</i> . Mid storey: <i>Asteromyrtus symphyocarpa</i> , <i>Mel viridiflora</i> , <i>Grevillea pteridifolia</i> . Ground: <i>Triodia pungens</i> , <i>Pseudoraphis spinescens</i> , <i>Schizachyrium</i> spp. Environment: Low woodland, drainage flats
Melaleuca woodland	383	Upper storey: <i>Mel viridiflora</i> , <i>Melaleuca leucadendra</i> +/- <i>Eucalyptus polycarpa</i> var. <i>polycarpa</i> . Mid storey: <i>Melaleuca viridiflora</i> , <i>Sesbania cannabina</i> , <i>Melaleuca leucadendra</i> . Ground: <i>Pseudoraphis spinescens</i> , <i>Fimbristylis</i> spp., <i>Eleocharis dulcis</i> . Environment: Woodland/open-forest, billabongs
Rhizophora (mixed) mid closed forest	1050	Upper storey: <i>Rhizophora</i> spp, <i>Bruguiera</i> spp, <i>Xylocarpus mekongensis</i> . Mid storey: <i>Bruguiera parviflora</i> , <i>Ceriops tagal</i> , <i>Bruguiera</i> spp. Ground: <i>Aegialitis annulata</i> , <i>Acanthus ilicifolius</i> . Environment: Landward edges in upper tidal reaches of creeks and rivers where there is a high freshwater influence.
Rhizophora mid closed forest	1051	Upper storey: <i>Rhizophora stylosa</i> +/- <i>Camptostemon schultzei</i> . Mid storey: <i>Rhizophora stylosa</i> +/- <i>Aegiceras corniculatum</i> . Ground: +/- <i>Rhizophora stylosa</i> +/- <i>Avicennia marina</i> +/- <i>Aegialitis annulata</i> . Environment: Occurs along the seaward edge, low intertidal zone with roots regularly submerged during high tides.
Vetiveria (mixed) tussock grassland	412	Upper storey: <i>Pandanus spiralis</i> , <i>Grevillea striata</i> , <i>Grewia retusifolia</i> . Ground: <i>Vetiveria elongata</i> , <i>Sorghum plumosum</i> , <i>Eriachne obtusa</i> . Environment: Calcareous sands on well drained dunes and coastal plains.

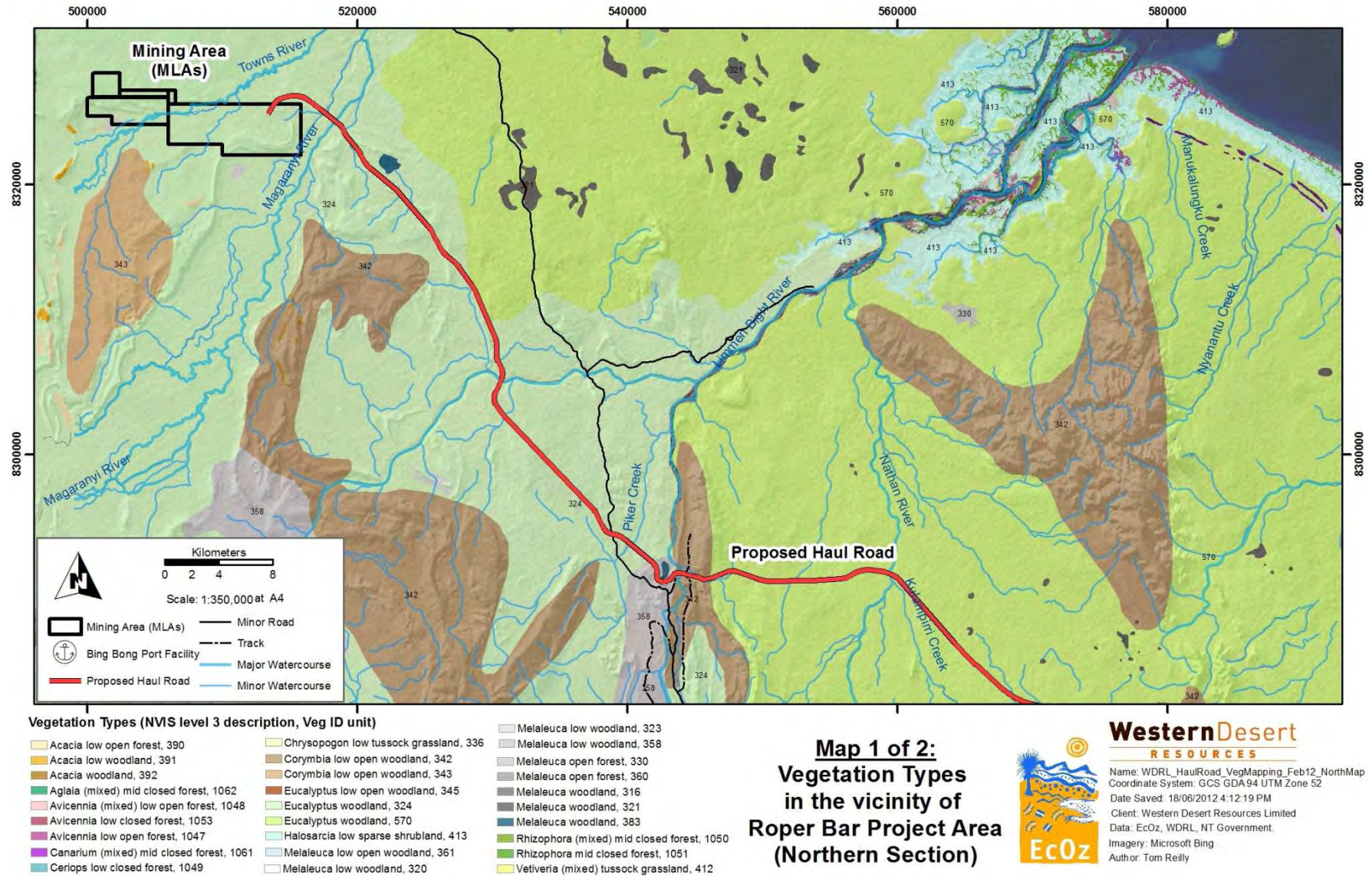


Figure 27: Haul road (and surrounds) vegetation map (NVIS level 3) – northern section of haul road

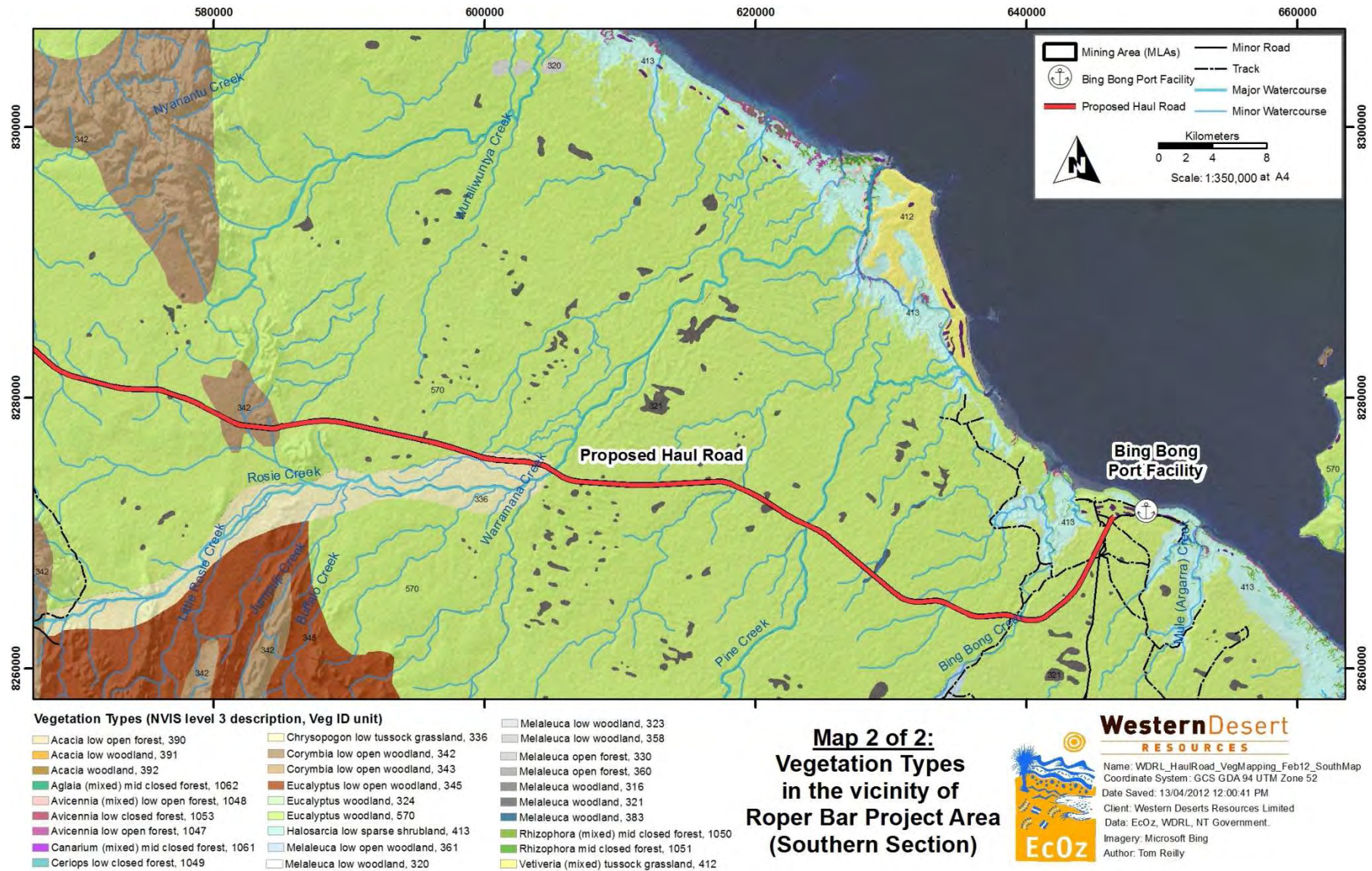


Figure 28: Haul road (and surrounds) vegetation map (NVIS level 3) – southern section of haul road



5.3.1 Notable flora records

Surveys conducted along the haul road did not identify any flora of conservation significance, however, surveys were not undertaken at a spatial and temporal scale to be confident of this statement. Analysis of herbarium data indicates that no threatened flora species under the TPWC Act have been previously recorded in the region, however many data deficient and near threatened species do exist. Also the possibility of undescribed short range endemics is regarded as high (due to limited survey effort in the region). All potential notable species highlighted by desktop research are provided in tables in Section 7.2.

Solanum carduiforme (of the bush tomato group), is vulnerable under the EPBC Act, and has been previously recorded in the Limmen Gate area, approximately 40 km to the south of the haul road corridor. This species is known to occur on conglomerate rock formations and larger sandstone ridges. The species is Data Deficient in the Northern Territory.

5.4 Terrestrial Fauna Surveys – Haul Road

5.4.1 Fauna Site Habitat Descriptions

Fauna surveys were conducted in five localities along the 165km haul road, including Upper Towns, Lower Towns, Cox River, Limmen River and Rosie Creek. These surveys were selected to collect fauna data on various sandstone hills and escarpments located along the haul road corridor, and also survey more common vegetation units (i.e. Eucalyptus/Corymbia woodlands, Melaleuca depressions) where the majority of the disturbance will occur (i.e. road clearing activities).

The sub-sections below describe each fauna site and provide a site map for each locality.

Lower Towns River Fauna Survey Area

Lower Towns River survey locality was chosen to represent typical downstream terrestrial fauna habitat, and also focus on lowland habitat types typically encountered along the haul road alignment but difficult to access by vehicle (at the time of survey) – see Figure 29 and Table 16.

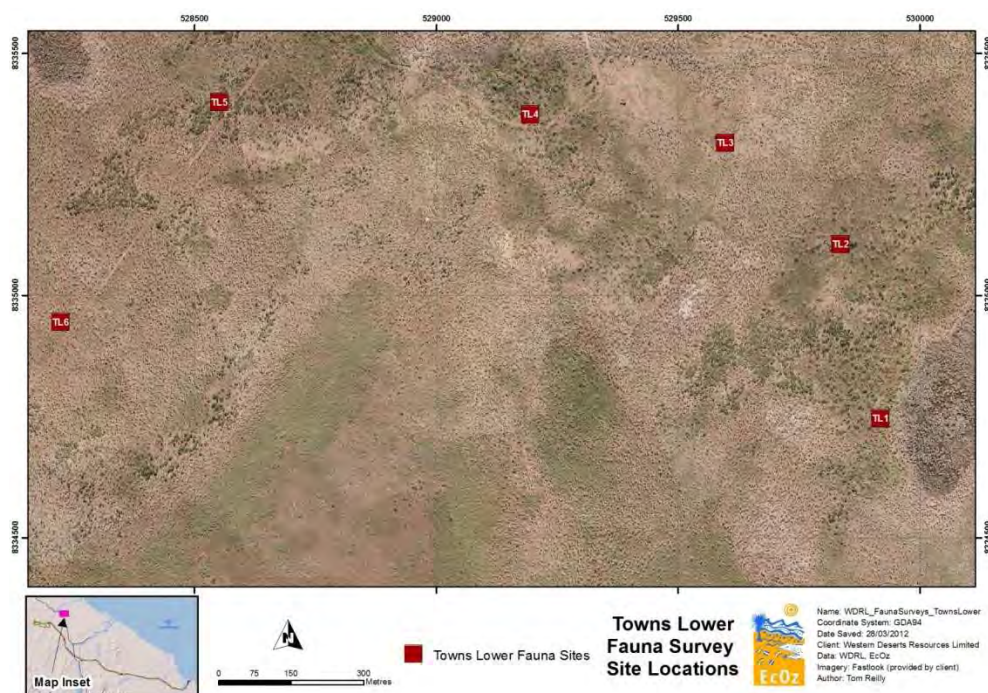


Figure 29: Map of the Lower Towns River fauna surveys sites



Table 16: Fauna site habitat descriptions – Lower Towns haul road surveys

Towns Survey – Lower Reaches		
Site 1 	Vegetation Description: <i>Eucalyptus tectifica</i> and <i>Corymbia confertiflora</i> open woodland overtopping <i>Heteropogon contortus</i> in the ground stratum Landform: Woodland Soil: Deep light brown sandy soil Habitat Notes: Moderate leaf litter (18% cover) and a low level of fallen logs and tree hollows Impacts: Low level pig damage	U1: <i>Eucalyptus tectifica</i> and <i>Corymbia confertiflora</i> (6 %cover, 8-12m height) M1: <i>Eucalyptus tectifica</i>, <i>Corymbia confertiflora</i>, <i>Bossiaea bossiaeioides</i>, <i>Melaleuca viridiflora</i>, <i>Hakea arborescens</i>, <i>Acacia difficilis</i>, <i>Planchonia careya</i>, <i>Brachychiton diversifolius</i>, <i>Strychnos lucida</i>, <i>Exocarpos latifolius</i>, <i>Diospyros humilis</i> (65% cover, 0.5-8m height) G1: <i>Heteropogon contortus</i>, <i>Melaleuca citrolens</i>, <i>Cassytha filiformis</i>, <i>Jasminum molle</i> (80% cover, 0-0.5m height).
Site 2 	Vegetation Description: <i>Corymbia polycarpa</i> open woodland overtopping <i>Heteropogon contortus</i> in the ground stratum Landform: Woodland Soil: Deep dark brown sandy soil Habitat Notes: Deep leaf litter (75% cover) with a moderate level of fallen logs Impacts: Moderate level pig damage	U1: <i>Corymbia polycarpa</i> (12 %cover, 8-12m height) M1: <i>Pouteria sericea</i>, <i>Bossiaea bossiaeioides</i>, <i>Corymbia polycarpa</i>, <i>Diospyros humilis</i>, <i>Strychnos lucida</i>, <i>Ehretia saligna</i>, <i>Flueggea virosa</i> subsp. <i>melanthesoides</i>, <i>Brachychiton paradoxus</i>, <i>Alphitonia excelsa</i>, <i>Acacia difficilis</i>, <i>Acacia platycarpa</i>, <i>Melaleuca viridiflora</i>, <i>Margaritaria dubium-traceyi</i>, (60% cover, 0.5-8m height) G1: <i>Heteropogon contortus</i>, <i>Grass sp.</i>, <i>Cassytha filiformis</i>, <i>Abrus precatorius</i> subsp. <i>precatorius</i> (20% cover, 0-0.5m height).
Site 3 	Vegetation Description: <i>Melaleuca citrolens</i> and <i>Melaleuca viridiflora</i> low open woodland overtopping <i>Acacia nuperrima</i> in the ground stratum Landform: Flood-out Soil: Deep light brown sandy soil Habitat Notes: Shallow leaf litter (10% cover) with a low level of fallen logs and tree hollows Impacts: None surveyed	U1: <i>Melaleuca citrolens</i>, <i>Melaleuca viridiflora</i> and <i>Excoecaria parvifolia</i>, (12 %cover, 3-6m height) M1: <i>Hakea arborescens</i>, <i>Melaleuca citrolens</i>, <i>Acacia holosericea</i>, <i>Acacia hammondii</i>, <i>Corymbia confertiflora</i>, <i>Flueggea virosa</i>, <i>Premna acuminata</i>, <i>Grewia retusifolia</i>, <i>Waltheria indica</i>, <i>Marsdenia australis</i> and <i>Acacia leptocarpa</i> (6% cover, 1-3m height) G1: <i>Acacia nuperrima</i>, <i>Sorghum plumosum</i>, <i>Helicteres cana</i>, <i>Chrysopogon fallax</i> (70% cover, 0-1m height).



Towns Survey – Lower Reaches		
Site 4 	Vegetation Description: <i>Eucalyptus tectifica</i> and <i>Corymbia polycarpa</i> open woodland overtopping <i>Sorghum plumosum</i> in the ground stratum Landform: Woodland Soil: Deep light brown sandy soil Habitat Notes: Moderate level of leaf litter (20% cover) with an abundance of fallen logs Impacts: None surveyed	U1: <i>Eucalyptus tectifica</i>, <i>Corymbia polycarpa</i> and <i>Corymbia confertiflora</i> (30 %cover, 7-15m height) M1: <i>Melaleuca viridiflora</i>, <i>Bossiaea bossiaeioides</i>, <i>Corymbia polycarpa</i>, <i>Hakea arborescens</i>, <i>Carissa lanceolata</i>, <i>Acacia leptocarpa</i>, <i>Acacia holosericea</i>, <i>Diospyros humilis</i>, <i>Acacia lamprocarpa</i>, <i>Margaritaria dubium-traceyi</i> (60% cover, 1-7m height) G1: <i>Heteropogon contortus</i>, <i>Hibbertia</i> sp., <i>Sorghum intrans</i>, <i>Grass</i> sp. (80% cover, 0-1m height).
Site 5 	Vegetation Description: <i>Eucalyptus tetradonta</i> open woodland overtopping <i>Chrysopogon fallax</i> in the ground stratum Landform: Woodland Soil: Deep light brown sandy soil Habitat Notes: shallow leaf litter (65% cover) with an abundance of fallen logs Impacts: Moderate level pig damage	U1: <i>Eucalyptus tetradonta</i> (3 %cover, 7-10m height) M1: <i>Callitris intratropica</i>, <i>Melaleuca viridiflora</i>, <i>Dodonaea oxyptera</i>, <i>Acacia hammondii</i>, <i>Hakea arborescens</i>, <i>Bossiaea bossiaeioides</i>, <i>Flueggea virosa</i> subsp. <i>melanthesoides</i> and <i>Acacia umbellata</i>, (30% cover, 1-7m height) G1: <i>Sorghum plumosum</i>, <i>Heteropogon contortus</i>, <i>Eragrostis</i> sp., and <i>Rhynchospora</i> sp. (20% cover, 0-1m height).
Site 6 	Vegetation Description: <i>Melaleuca viridiflora</i> low open woodland Landform: Flood-out Soil: Deep light brown sandy soil Habitat Notes: Shallow leaf litter (30% cover) with an abundance of fallen logs Impacts: None surveyed	U1: <i>Melaleuca viridiflora</i> (12 %cover, 4-7m height) M1: <i>Bossiaea bossiaeioides</i>, <i>Hakea arborescens</i>, <i>Acacia gonoclada</i>, <i>Alphitonia excelsa</i>, <i>Grevillea parallela</i>, <i>Acacia platycarpa</i>, <i>Acacia hammondii</i>, <i>Flueggea virosa</i> subsp. <i>melanthesoides</i>, <i>Ehretia saligna</i> and <i>Excoecaria parvifolia</i> (8% cover, 0.8-4m height) G1: <i>Chrysopogon fallax</i>, <i>Grass</i> sp., <i>Asteromyrtus symphyocarpa</i> and <i>Rhynchospora</i> sp. (40% cover, 0-0.5m height).

Upper Towns River Fauna Survey Area

Upper Towns River survey locality was chosen to increase understanding of fauna assemblages within sandstone outcrop and woodland habitat close to the MLA areas. This location has low rocky hills, with only some sections outcropping and creating linear rock faces – see Figure 30 and Table 17. Target species included Northern Quoll and Borroloola Dtella, plus other sandstone dependant species that may be supported in isolated low rocky hills and associated foothill woodlands.

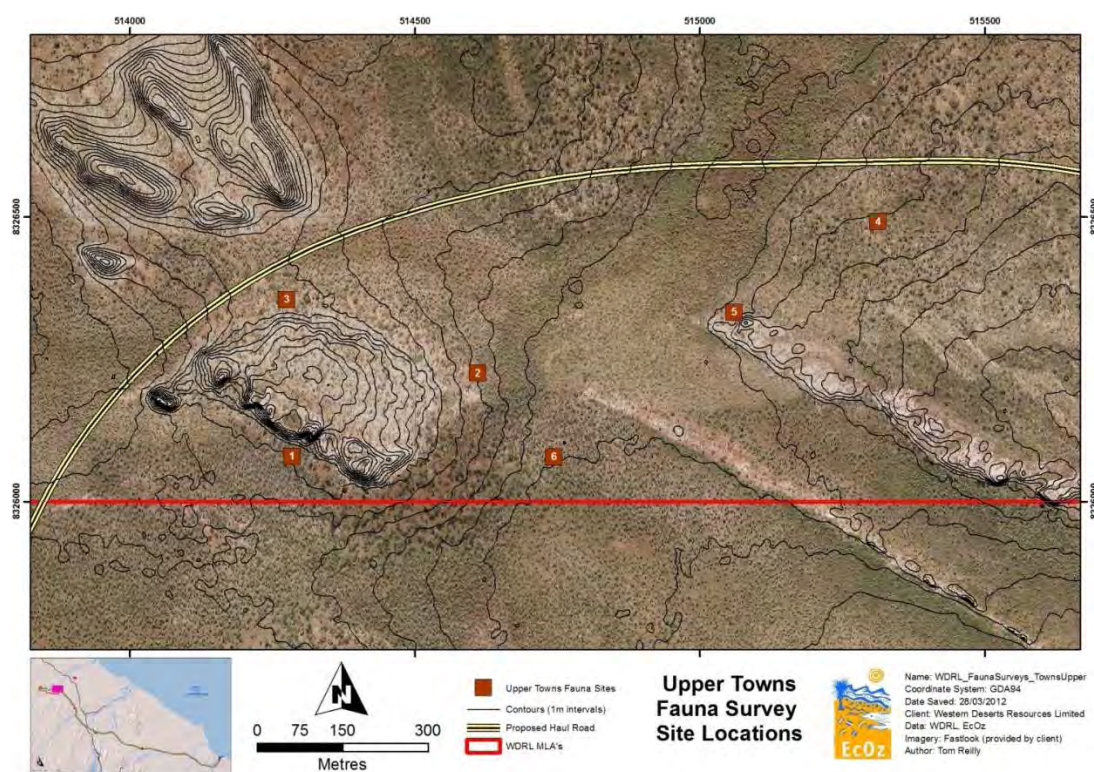


Figure 30: Map of the upper Towns River fauna survey sites (close to MLA areas)

Table 17: Fauna site habitat descriptions – Upper Towns haul road surveys

Towns Survey – Upper		
Site 1		
	Vegetation Description: <i>Eucalyptus miniata</i> open woodland overtopping <i>Triodia bitextura</i> in the ground stratum Landform: Rocky sandstone ridge Soil: Skeletal brown sandy soil Habitat Notes: Moderate level of leaf litter (30% cover) with an abundance of fallen logs and rocky crevices Impacts: None surveyed	U1: <i>Eucalyptus miniata</i> , <i>Corymbia ferruginea</i> and <i>Eucalyptus tetrodonta</i> (8 %cover, 8-13m height) M1: <i>Eucalyptus tetrodonta</i> , <i>Erythrophleum chlorostachys</i> , <i>Eucalyptus miniata</i> , <i>Corymbia ferruginea</i> , <i>Acacia conspersa</i> , <i>Acacia dimidiata</i> , <i>Grevillea refracta</i> , <i>Jacksonia odontoclada</i> and <i>Buchanania obovata</i> (18% cover, 0.8-8m height) G1: <i>Triodia bitextura</i> , <i>Tephrosia spechtii</i> , <i>Boronia lanuginosa</i> and <i>Phyllanthus carpentariae</i> (30% cover, 0-0.8m height).
Site 2		
	Vegetation Description: <i>Melaleuca viridiflora</i> low open woodland overtopping <i>Dapsilanthus elatior</i> in the ground stratum Landform: Flood-out Soil: Deep light brown sandy soil Habitat Notes: Shallow leaf litter (25% cover) with a moderate level of fallen logs Impacts: Moderate level of pig damage	U1: <i>Melaleuca viridiflora</i> and <i>Corymbia polycarpa</i> (30 %cover, 5-8m height) M1: <i>Melaleuca viridiflora</i> , <i>Verticordia cunninghamii</i> , <i>Acacia tropica</i> , <i>Grevillea pteridifolia</i> , <i>Alphitonia excelsa</i> and <i>Excoecaria parvifolia</i> (8% cover, 0.5-5m height) G1: <i>Dapsilanthus elatior</i> , <i>Xyris complanata</i> , <i>Ectrosia leporina</i> <i>Triodia bitextura</i> and Grass sp.(50% cover, 0-0.5m height).



Towns Survey – Upper

Site 3



Vegetation Description: *Corymbia polycarpa* open woodland overtopping *Triodia bitextura* in the ground stratum
Landform: Woodland
Soil: Deep light brown sandy soil
Habitat Notes: Moderate leaf litter (35% cover) with an abundance of fallen logs and tree hollows
Impacts: None surveyed

U1: *Corymbia polycarpa* and *Erythrophleum chlorostachys* (12 %cover, 7-14m height)
M1: *Erythrophleum chlorostachys*, *Grevillea pteridifolia*, *Wrightia saligna*, *Alphitonia excelsa*, *Excoecaria parvifolia*, *Grevillea refracta*, *Hibbertia lepidota*, *Gompholobium subulatum*, *Jacksonia odontoclada*, and *Grevillea parallela* (8% cover, 1-7m height)
G1: *Triodia bitextura*, *Aristida* sp., *Thaumastochloa* sp., *Eriachne* sp. and *Grewia breviflora* (25% cover, 0-1m height).

Site 4



Vegetation Description: *Eucalyptus tetradonta* overtopping *Jacksonia odontoclada* in the ground stratum
Landform: Woodland
Soil: Deep light brown sandy soil
Habitat Notes: Moderate leaf litter (50% cover) with an abundance of fallen logs and flowering plants
Impacts: None Surveyed

U1: *Eucalyptus tetradonta* (5 %cover, 7-13m height)
M1: *Eucalyptus tetradonta*, *Grevillea refracta*, *Acacia conspersa*, *Bossiaea bossiaeoides*, *Ehretia saligna*, *Stenocarpus acacioides*, *Acacia drepanocarpa*, *Brachychiton paradoxus*, *Distichostemon hispidulus*, *Melaleuca viridiflora* and *Cassytha filiformis* (10% cover 1-7m height)
G1: *Jacksonia odontoclada*, *Boronia lanuginosa* and *Triodia bitextura* (35%, cover, 0-1m height).

Site 5



Vegetation Description: *Eucalyptus miniata* overtopping *Triodia bitextura* in the ground stratum
Landform: Rocky sandstone ridge
Soil: Skeletal brown sandy soil
Habitat Notes: Shallow leaf litter (5% cover) with a moderate level of tree hollows and fallen logs and an abundance of rock crevices
Impacts: None surveyed

U1: *Eucalyptus miniata* (5 %cover, 6-13m height)
M1: *Eucalyptus miniata*, *Acacia drepanocarpa*, *Corymbia ferruginea*, *Hakea arborescens*, *Grevillea refracta*, *Gompholobium subulatum*, *Jacksonia dilatata* and *Tephrosia conspicua* (8% cover, 1-6m height)
G1: *Triodia bitextura*, *Jacksonia odontoclada*, *Phyllanthus carpentariae* and *Calytrix brownii* (20% cover, 0-1m height).

Site 6



Vegetation Description: *Melaleuca viridiflora* low open woodland overtopping *Aristida* sp. In the ground stratum
Landform: Flood out
Soil: Deep light brown sandy soil
Habitat Notes: Shallow leaf litter (20% cover) with abundant flowing plants and a moderate level of fallen logs
Impacts: Moderate level of pig damage

U1: *Melaleuca viridiflora* (35 %cover, 6-8m height)
M1: *Excoecaria parvifolia*, *Melaleuca viridiflora*, *Ehretia saligna*, *Terminalia canescens*, *Brachychiton paradoxus*, *Hakea chordophylla* and *Margaritaria dubium-traceyi* (6% cover, 0.5-6m height)
G1: *Aristida* sp. and *Acacia nuperrima* (70% cover, 0-0.5m height).



Cox River Fauna Survey Area

Cox River survey locality was chosen as a replicate survey location comparable to Limmen and Rosie survey locations. Four locations were sampled (plus opportunistic surveys), with three sites using standard fauna survey protocol (Section 2.3) and one focusing on fauna utilising a minor riparian zone (a tributary of Cox River) – see Figure 31 and Table 18. The location was selected due to its close proximity to four habitat types including sandstone outcrop, *Corymbia* woodland, riparian zone, and a seasonal depression with mixed woodland and wetland species.

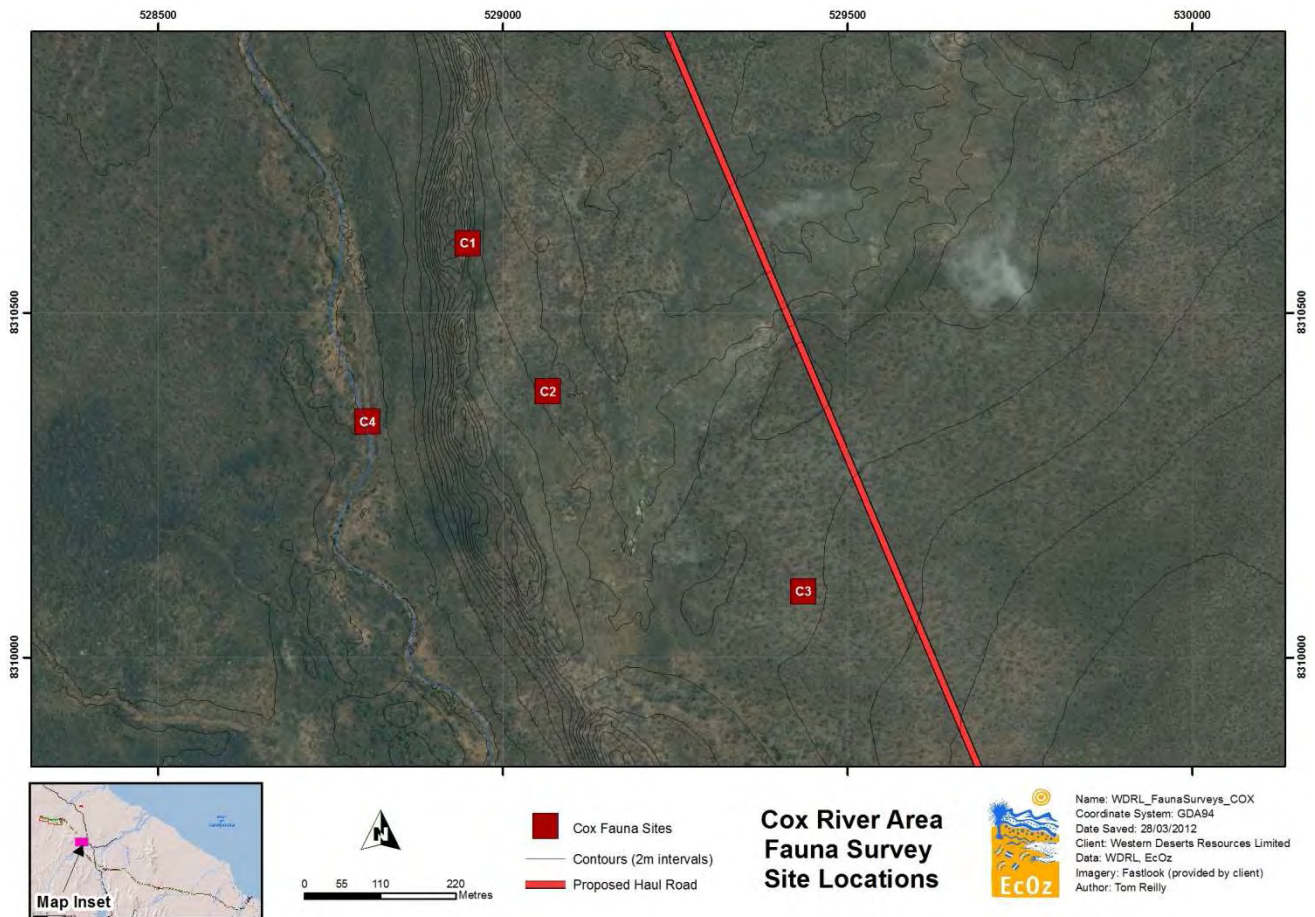


Figure 31: Map of Cox River survey sites



Table 18: Fauna site habitat descriptions – Cox River haul road surveys

Towns Survey – Cox River		
Site 1 	Vegetation Description: <i>Corymbia ferruginea</i> Landform: Rocky sandstone ridge with outcropping Soil: Brown shallow earth soils Habitat Notes: Rock crevices, rock faces, high seed resources, high vegetation cover, moderate leaf litter, 100m from permanent creek Impacts: Minor impact from cattle in saddles	U1: <i>Petalostigma pubescens</i>, <i>Erythrophleum chlorostachys</i> <i>Owenia vernicosa</i>, <i>Corymbia ferruginea</i> and <i>Eucalyptus tetrodonta</i> (35 %cover, 6-8m height) M1: <i>Wrightia saligna</i> and <i>Calytrix exstipulata</i> (6% cover, 0.5-6m height) G1: <i>Bulbostylis barbata</i>, <i>Tacca leontopetaloides</i>, <i>Merremia incisa</i>, <i>Spermacoce sp.</i>, <i>Corchorus sidoides</i>, <i>Portulaca filifolia</i>, <i>Gonocarpus leptothecus</i>, <i>Setaria surgens</i>, <i>Bonamia pannosa</i>, and <i>Glycine tomentella</i> <i>Vigna lanceolata</i> var. <i>filiformis</i> (70% cover, 0-0.5m height).
Site 2 	Vegetation Description: <i>Melaleuca viridiflora</i> +/- <i>Callitris intratropica</i> Landform: Swamp depression, ephemeral Soil: brown to yellow clay Habitat Notes: hollows common, vegetation cover, no water close by, high grass cover, Impacts: none identified	U1: <i>Melaleuca citrolens</i>, <i>Callitris intratropica</i>, <i>Grevillea striata</i>, <i>Petalostigma pubescens</i>, <i>Eucalyptus microtheca</i> and <i>Hakea arborescens</i> (35 %cover, 6-8m height) M1: <i>Melaleuca citrolens</i>, <i>Grevillea striata</i>, <i>Calytrix exstipulata</i>, <i>Carissa lanceolata</i>, <i>Ehretia saligna</i> and <i>Brachychiton diversifolius</i> (6% cover, 0.5-6m height) G1: <i>Tacca leontopetaloides</i>, <i>Breynia cernua</i>, <i>Sorghum plumosum</i> and <i>Triodia sp.</i> (70% cover, 0-0.5m height).
Site 3 	Vegetation Description: <i>Eucalyptus tetrodonta</i> and <i>Corymbia ferruginea</i> Mid Open Woodland, hummock grass understorey Landform: Slightly undulating plains Soil: brown loamy sand with minor gravel Habitat Notes: fallen logs scarce, patchy mid story cover, low leaf litter, tree hollows scarce, Impacts: none identified	U1: <i>Eucalyptus tetrodonta</i>, <i>Corymbia ferruginea</i>, <i>Corymbia terminalis</i> and <i>Alphitonia excelsa</i> (35 %cover, 6-8m height) M1: <i>Petalostigma pubescens</i>, <i>Bossiaea bossiaeoidea</i> and <i>Brachychiton paradoxus</i>, (6% cover, 0.5-6m height) G1: <i>Evolvulus alsinoides</i>, <i>Merremia incisa</i>, <i>Spermacoce sp.</i> and <i>Grass sp.</i> (70% cover, 0-0.5m height).
Site 4 	Vegetation Description: <i>Melaleuca woodland</i>, +/- <i>Asteromyrtus symphyocarpa</i>, <i>Eucalyptus camaldulensis</i> Landform: Riparian Zone (minor watercourse), a tributary of Cox River. Soil: Gravel, plus coarse river sand Habitat Notes: Flowing water present about 1m maximum depth Impacts: Feral pigs, horses	Not available for this community



Limmen River Fauna Survey Area

The Limmen River survey locality was chosen to target sensitive habitat in the approximate location where the haul road crosses the escarpment (close to Savannah Way and the Four Archers) – see Figure 32 and Table 19. Sites targeted sandstone escarpment, gully, and foothill woodlands close to permanent creek.

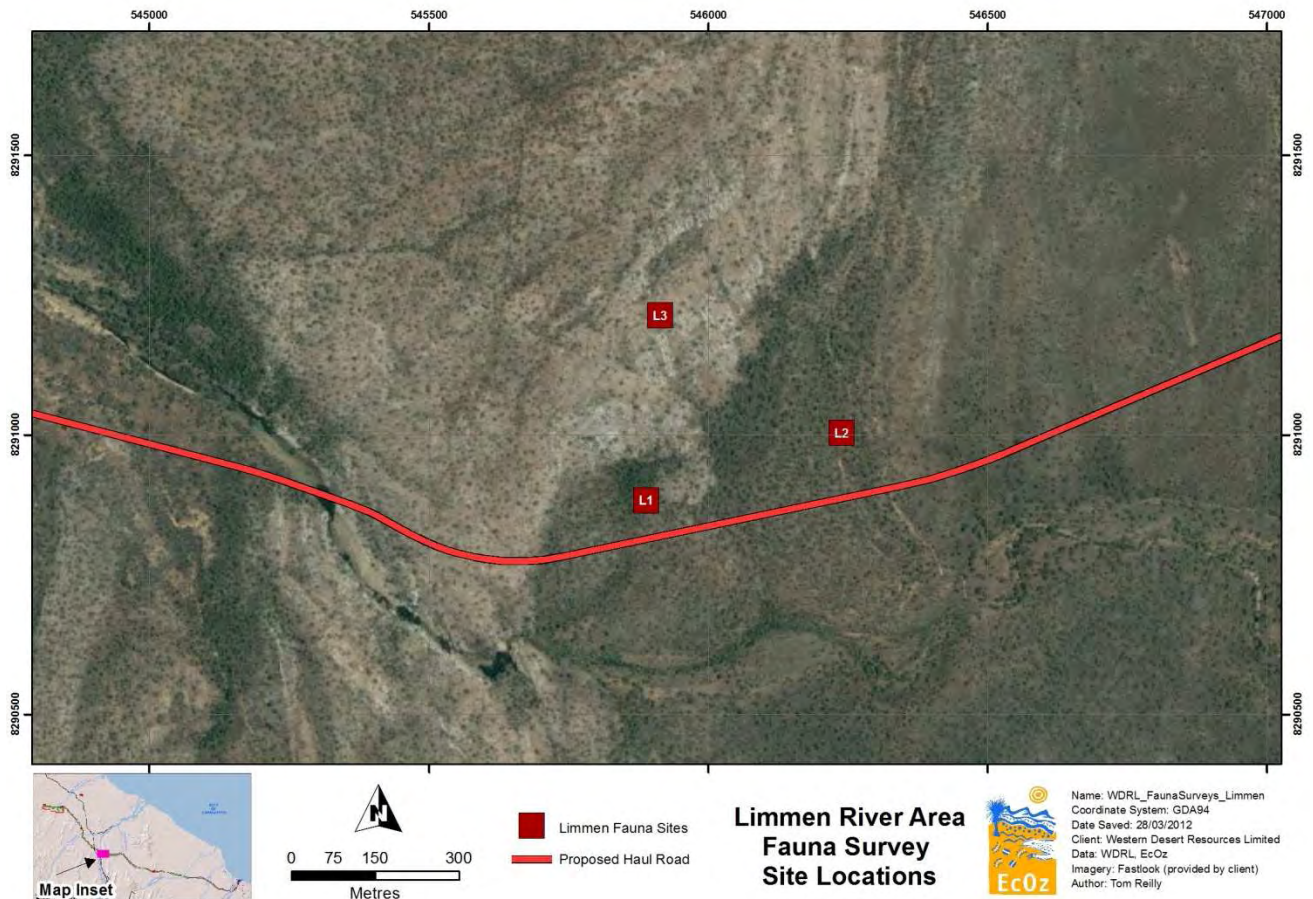


Figure 32: Map of Limmen River fauna survey sites



Table 19: Fauna site habitat descriptions – Limmen River haul road surveys

Limmen River Fauna Survey Site Descriptions		
Site 1 	Vegetation Description: <i>Buchanania obovata</i> and <i>Terminalia carpentariae</i> Low Open Woodland over <i>Triodia bitextura</i> Landform: Rocky Hill, Crest Soil: Shallow, brown, sandy Loam Habitat Notes: White quartz sandstone boulders 50%, 5% gravel, 5% bare soil, 5-10% litter and 20-25% standing vegetation cover. Nearest Permanent water 500 – 1000m. Impacts: no visible disturbance, 2+ years since fire impact	U1: <i>Buchanania obovata</i>, <i>Terminalia carpentariae</i>, <i>Owenia vernicosa</i> + <i>Acacia plectocarpa</i> subsp. <i>tanumbirinensis</i> and <i>Gardenia Megasperma</i> (10 cover, 4-6m height) over M1: <i>Clerodendrum floribundum</i>, <i>Hibiscus</i> sp (8% cover, 1-1.6m height) over G1: <i>Triodia bitextura</i> +/- <i>Stemodia lythrifolia</i>, Sedges, <i>Solanum</i> species and <i>Cheilanthes</i> species (25% cover, 0.5-.035m height).
Site 2 	Vegetation Description: <i>Corymbia ptychocarpa</i> Mid Open Forest T7d fringed with <i>Eucalyptus tetrodonta</i> and <i>Eucalyptus miniata</i> Mid Woodland T7c Landform: Plain, Channel Bench Soil: Moderately deep, yellowish brown sandy loam Habitat Notes: clear flowing seepage or spring dissecting the site. 80% standing vegetation cover, 15% litter, 5% bare earth and <1% gravel. Nearest Permanent water 100-300m. Impacts: evidence of fire damage, sign of cattle in the near vicinity, 2+ years since the last fire.	U1: <i>Corymbia ptychocarpa</i>, <i>Eucalyptus tetrodonta</i> and <i>Eucalyptus miniata</i> (70%- 60% cover, 10-12m height) M1: <i>Buchanania obovata</i>, <i>Terminalia carpentariae</i> <i>Grevillea parallela</i> (5% cover, 2-4m height) G1: <i>Mnesithea rottboellioides</i>, <i>Whiteochloa</i> species, <i>Heteropogon contortum</i>, <i>Tacca leontopetaloides</i> (80% 1-1.5m height).
Site 3 	Vegetation Description: <i>Eucalyptus tetrodonta</i> with <i>Eucalyptus miniata</i> Mid Woodland Landform: Plain, Stream channel and Stream bed Soil: Deep, reddish, sandy loam Habitat Notes: 35% standing vegetation, 15% bare earth, 5% litter, 5% rock cover <5% gravel. Nearest Permanent water 500 – 1000m. Scattered tree hollows and logs. Impacts: Evidence of fire damage, 2+ years since the last fire height)	U1: <i>Eucalyptus tetrodonta</i>, <i>Eucalyptus miniata</i> (20% cover, 12-15m height) over M1: <i>Buchanania obovata</i>, <i>Grevillea heliosperma</i>, <i>Grevillea parallela</i> (5% cover, 4-6m height) G1: <i>Bossiaea bossiaeooides</i>, <i>Triodia bitextura</i>, <i>Whiteochloa</i> species, +/- <i>Alloterospis semialata</i>, <i>Eriachne obtuse</i> and sedges (35% cover, 0.25 – 1.6m



Rosie Creek Fauna Survey Area

The Rosie Creek survey locality was selected to represent target an isolated rocky hill that was highlighted as sensitive habitat during reconnaissance helicopter surveys of the haul route – see Figure 33 and Table 20. This location has several spring-fed and deeply incised rocky gullies, which is a unique habitat type encountered along the haul road alignment. Survey sites included a spring fed rocky gully, and two woodlands at the base of the rocky hill. Rosie creek is approximately 5km downstream (south) of the fauna locality.

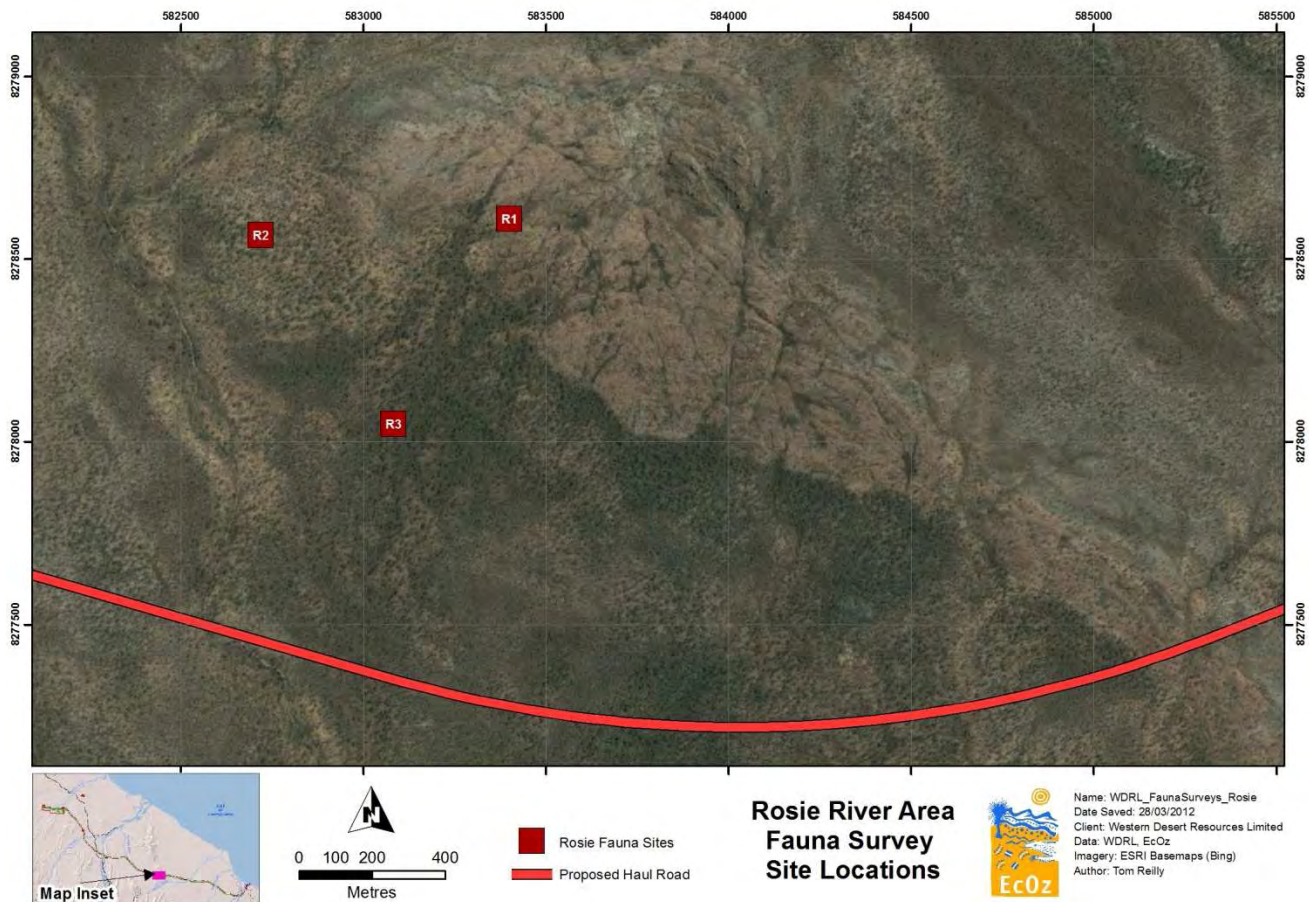


Figure 33: Map of Rosie Creek fauna survey sites



Table 20: Fauna site habitat descriptions – Rosie Creek haul road surveys

Rosie – Ridge & Woodlands		
Site 1 	Vegetation Description: <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i> Mid Woodland T7i Landform: Alluvial Plain, Bench Soil: Shallow, yellowish brown, sandy loam Habitat Notes: 30-40% standing vegetation, 60% litter, 5% bare earth, 5% laterite gravel. Tree hollows and logs – common. Nearest Permanent water 500 – 1000m. Impacts: no obvious fire scotch, years since last fire 3+. Evidence of cattle in the area but not within site	U1: <i>Eucalyptus miniata</i>, <i>Eucalyptus tetradonta</i>, (35% cover, 12-15m height) over M1: <i>Acacia conspersa</i>, <i>Jacksonia odontoclada</i>, <i>Bossiaea bossiaeoidea</i>, <i>Acacia oncinocarpa</i>, +/- <i>Acacia dimidiata</i>, <i>Acacia leptocarpa</i>, <i>Alphitonia pomaderoides</i> and <i>Distichostemon hispidulus</i> (45% cover, 1-7m height) over G1: <i>Triodia bitextura</i>, <i>Jacksonia odontoclada</i>, <i>Bossiaea bossiaeoidea</i> (45% cover, 0.35-1m height)
Site 2 	Vegetation Description: <i>Corymbia polycarpa</i> Mid Open Woodland T7i/c Landform: Alluvial Plain, Fan Soil: Moderately Deep, yellowish brown, sandy loam Habitat Notes: 70% standing vegetation, 15% litter, <5% laterite gravel and 5-10% bare earth. Scattered tree hollows and fallen logs. Nearest Permanent water 500 – 1000m. Impacts: Minor pig diggings evident. Significant sign of cattle (but very old dung). 2+ years since last fire and scorch height 4m.	U1: <i>Corymbia polycarpa</i>, (15% cover, 12-13m height) over M1: <i>Acacia torulosa</i>, <i>Grevillea pteridifolia</i> +/- <i>Alphitonia pomaderoides</i>, <i>Pandanus spiralis</i>, <i>Melaleuca viridiflora</i> and <i>Asteromyrtus</i> species (25% cover, 3-5m height) over G1: <i>Xyris</i> species, <i>Eriachne obtusa</i>, <i>Dapsilanthus spathaceus</i>, and <i>Alloterospis semialata</i> and sedges +/- <i>Sagittaria plumosum</i> (70% cover, 0.25-0.45m height)
Site 3 	Vegetation Description: Isolate <i>Eucalyptus tetradonta</i> trees T6bi over <i>Grevillea pteridifolia</i> and <i>Acacia latifolia</i> Low Woodland T6i Landform: Sandstone Escarpment, Stream Channel Soil: light grey, high rock content Habitat Notes: Clear flowing seepage or spring at the base of the stream channel surrounded by rock crevices and caves. 65% rock (mostly boulders), 20-30% standing vegetation, 5% litter, 5% gravel, 5% bare earth. Nearest Permanent water >1000m. Impacts: cattle sign within 200m of the area, evidence of an extreme fire within last 5 years scorch height 7m on nearby <i>Corymbia polycarpa</i>	Species Composition by Strata: U1: <i>Eucalyptus tetradonta</i> (5% cover, 6-8m height) over M1: <i>Grevillea pteridifolia</i>, <i>Acacia torulosa</i>, <i>Melaleuca viridiflora</i>, <i>Jacksonia dilatata</i> +/- <i>Corymbia ferruginea</i>, <i>Verticordia cunninghamii</i>, <i>Owenia vernicosa</i>, <i>Boronia lanceolata</i> (25-30% cover, 2-6m height) over G1: <i>Spinifex</i> species, <i>Dapsilanthus spathaceus</i>, <i>Drosera indica</i> (30% cover, 0.15-0.6m height)



5.4.2 Fauna Survey Results

The surveys recorded a total of 151 native fauna species, comprising of 15 amphibians, 29 reptiles, 92 birds, and 20 mammals. Four introduced species were identified. The majority of species were identified through trapping, active search techniques, and incidental observations. Species lists are provided in the sections below, and site data is provided in Appendix D-3. Summary descriptions by faunal group for each are provided below.

The majority of species recorded during the survey are common and generally widespread throughout similar habitat in the region. One Threatened species (as per the TPWC Act) was identified during the survey – Mertens' Water Monitor (*Varanus mertensi*). No species listed as threatened under the EPBC Act were identified, however two listed migratory species (both birds) and 21 listed marine species (20 birds and 1 reptile) were recorded.

Amphibians

A total of 15 amphibians was recorded from the surveys, mainly from pit traps and active searches (Appendix D-3). Most were recorded around freshwater swamps, creeks and pools in the area. Amphibians from the genus *Uperoleia* were trapped but could not be identified to species level without a reference call. The most prolific species were those preferring grasslands and seasonally inundated habitats. Three species of amphibians were recorded once only; three others twice only.

- No threatened species were identified.
- Three Data Deficient species were identified – *Litoria australis*, *Litoria bicolor*, and *Opisthodon ornatus*. These species are common and widespread throughout this region, and also the across northern Australia.
- One Introduced species was identified, Cane Toad (*Chaunus marinus*), which was identified at each location along the haul road.
- The remaining species (including the unidentified *Uperoleia* species) are all listed as Least Concern.

Reptiles

A total of 29 reptiles was recorded from the survey, mainly from pit traps, funnel traps and active searches (Appendix D-3). Geckoes and skinks were the best represented families, as well as the dragon species *Diporiphora magna*. Few snakes were recorded and nine species of reptiles were recorded only once. The Rosie site contained five species not found anywhere else.

- One threatened species, Mertens' Water Monitor (*Varanus mertensi*), which is listed as Vulnerable was identified at both Cox and Rosie sites in and along creeks.
- One Data Deficient species was recorded, *Cryptoblepharus australis*, a common and widespread skink in suitable habitat throughout northern Australia.
- The remaining species are all listed as Least Concern.
- One listed marine species – Freshwater Crocodile (*Crocodylus johnstoni*) – was recorded.
- No introduced reptile species were identified.

Birds

A total of 92 native bird species from 37 families was identified during the survey (Appendix D-3). Birds were most active in the hours of dawn and dusk, and bird count numbers were maximized by varying the sites visited at these times. The Limmen and Towns (Lower) sites were the driest and contained the least avian



diversity. The riparian zone and adjacent ridge at the Cox site were the most diverse, followed by the ridge at Rosie. This is possibly due to the Cox survey area being directly adjacent to a flowing tributary of Cox River.

- No threatened species were recorded.
- One Near Threatened species was recorded, Bush Stone-curlew (*Burhinus grallarius*), at the Cox site. This species is common and widespread in suitable fox-free habitat throughout northern Australia.
- Two Data Deficient species were recorded – Black Bittern (*Ixobrychus flavicollis*) and Blue-winged Kookaburra (*Dacelo leachii*). The statuses for both of these are proposed to be altered to Least Concern.
- The remaining species are all listed as Least Concern.
- Two listed migratory species and 20 listed marine species were recorded – all are common and widespread throughout the savannah.
- No introduced species were recorded.

Mammals

Fifteen mammal species were recorded from the survey, mainly from Elliott traps (Appendix D-3). In addition, five species of bat were identified acoustically (see Appendix D-5), with the call records of three other species not distinguishable unambiguously. The total number of confirmed mammal species, therefore, was 20.

Apart from bats, the majority of species were recorded only once – there was a single mammal sighting at the Towns (Lower) site, and only one species was recorded (in abundance) at Towns (Upper). The Rosie site included six species not found at other sites, and was by far the most productive site, especially site 3 which was located in a spring fed gully.

- No Threatened species were recorded.
- Two Near Threatened species were identified:
 - Western Chestnut Mouse (*Pseudomys nanus*) at Cox, Limmen and Towns (Upper) sites – this species is common in a range of habitats across northern Australia; and
 - Orange Leaf-nosed Bat (*Rhinonictis aurantia*), was recorded at Rosie and Limmen sites.
- One Data Deficient species, Sandstone Pseudantechinus (*Pseudantechinus bilarni*), was recorded at the Rosie site. This little-known species is probably common in rugged sandstone country of the Top End – its status is proposed to be changed to Least Concern.
- The remaining species are listed as Least Concern.
- Three introduced species were recorded – Pig, Swamp Buffalo, and Cattle. Considerable damage to riparian habitat by Pigs feeding was evident at the Cox site.

5.4.3 Summary

Field and desktop surveys identify a total of 416 fauna species that are found, or potentially occur, within the haul road corridor areas (Table 21). During the field surveys trap success was low, especially for reptiles, however it is apparent that the Rosie site supports a different and richer mammal and reptile assemblage to the other sites. Amphibian species clearly favoured damper habitats, and bird diversity increased with proximity to water. Despite the remoteness of most of the haul road survey sites introduced species were detected and their impacts on habitat obvious.



Table 21: Total fauna species within the haul road corridor – data from desktop and field surveys

	No. of species
Amphibian	25
Reptile	93
Bird	209
Mammal	43
Freshwater Fish	46
TOTAL	416

5.5 Sensitive Habitats

There are no listed or formally recognised areas of conservation significance along the route of the proposed Haul road. Aside from a number of localities featuring riparian vegetation and wetlands none of other higher priority vegetation types such as rainforest, monsoon vine thicket and monsoon forest were found within the route corridor.

The capacity to identify locally or regionally significant habitat is limited by the extent of surveys and data within the vicinity of the haul road. Despite the limited information a number of localities which do present particular value for biodiversity on a regional scale are identified and discussed below.

The wetlands, minor tributaries and riparian vegetation along the haul route were all assumed to be high value to the regional biodiversity, but particularly those which are extensive, regularly inundated or feature permanent or near permanent water. Most of the extensive wetlands are *Melaleuca* swamps which are not uncommon but are obviously features to avoid disturbing.

Surveys along the haul road corridor focused on identifying and assessing the value of sensitive habitat or habitat of higher conservation value that should be avoided, and potentially buffered. Sensitive habitats identified along the haul road are described below.

It is important to note that the choice of haul road route primarily reflected archeological concerns and road engineering considerations. A consequence of these is that the sensitive habitats described below have largely been circumvented (apart from unavoidable river and creek crossings) as they represent less than ideal road construction environments and/or contain culturally significant sites.

5.5.1 Mapping Results

The mapping of sensitive habitats along the haul road presents the results of on ground and aerial surveys of these areas along the route (see Figure 34 to Figure 37). The level of habitat value attributed to larger features is indicated by colour codes. The habitat value of smaller features may not be clearly determined from the map so reference to information in tables provides clarity (which are presented in Appendix D-10). Maps of the haul road sensitive habitats have been divided into four maps for increased detail and easier reference.

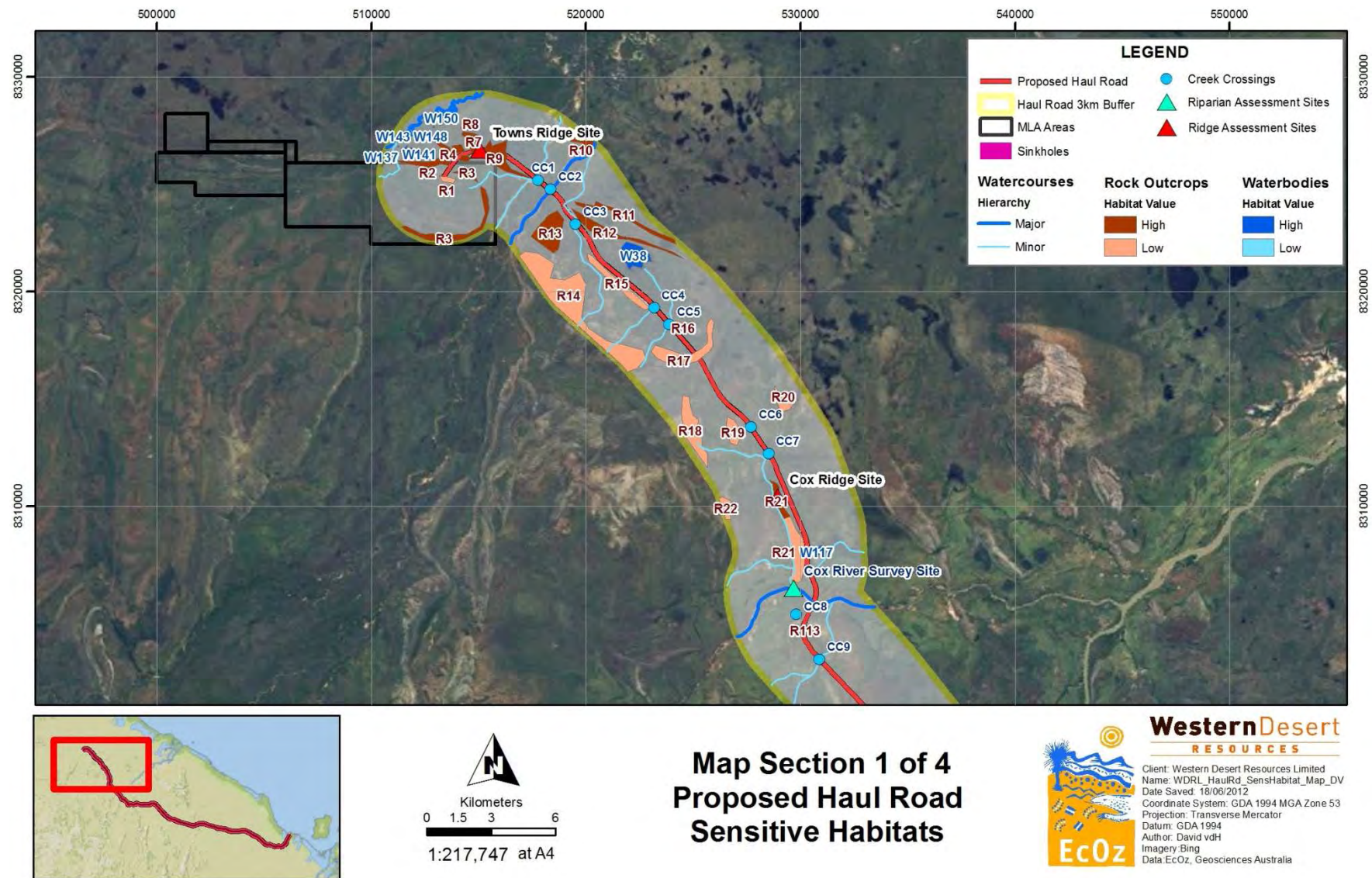


Figure 34: Map 1 of 4 – Haul road sensitive habitat surveys

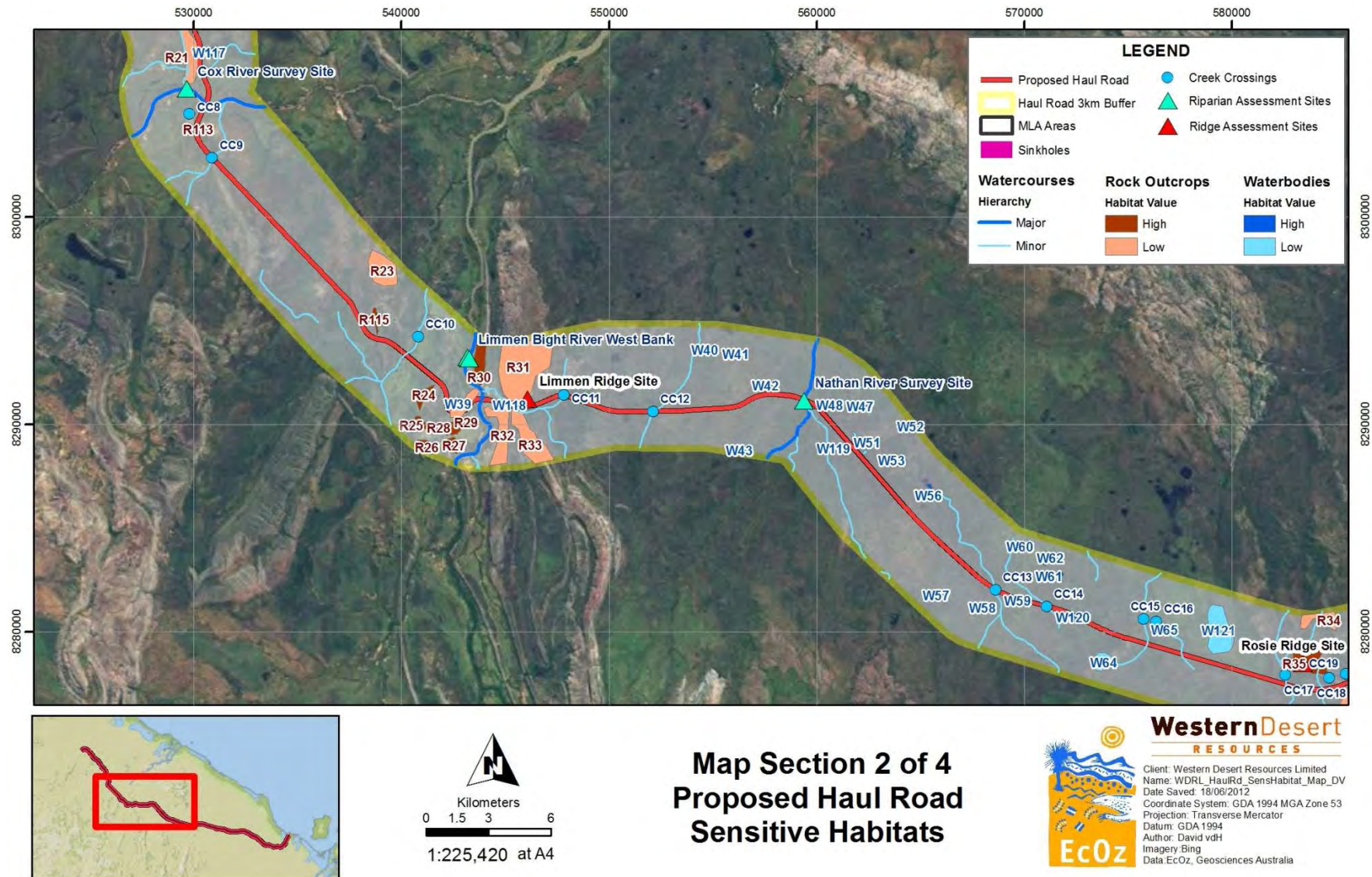


Figure 35: Map 2 of 4 – Haul road sensitive habitat surveys

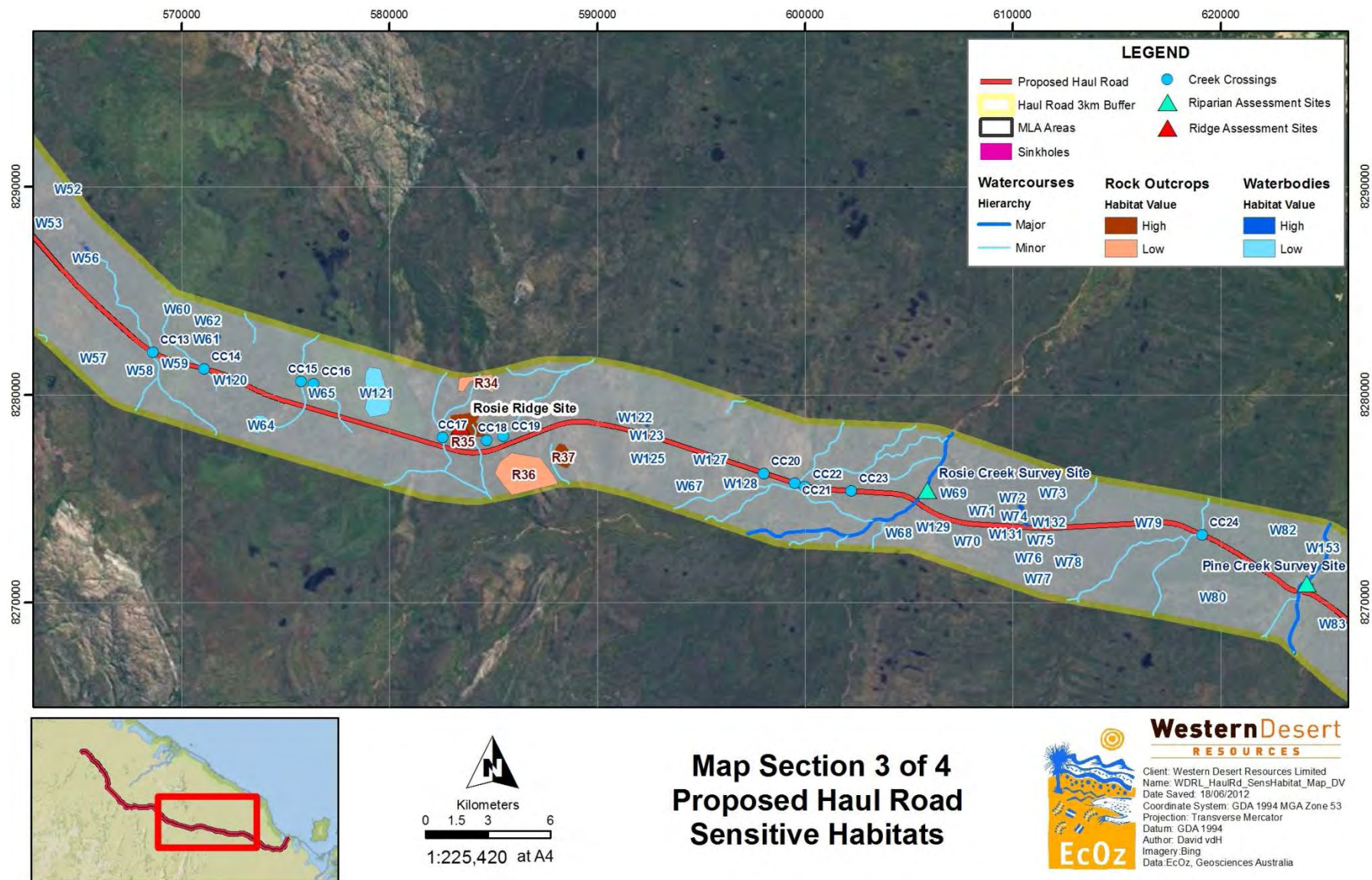


Figure 36: Map 3 of 4 – Haul road sensitive habitat surveys

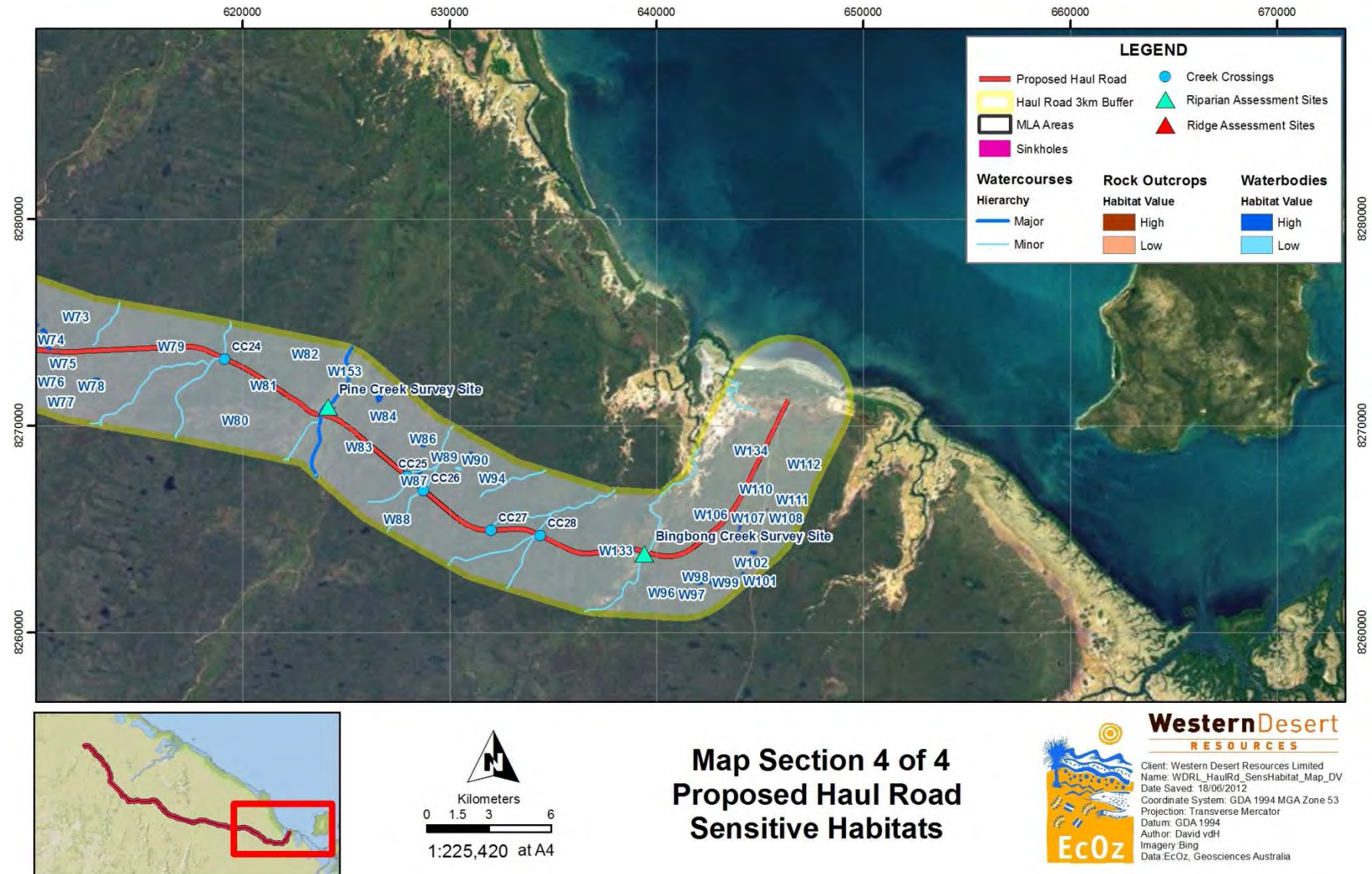


Figure 37: Map 4 of 4 – Haul road sensitive habitat surveys



5.5.2 Rocky Sandstone Ridges

Rocky sandstone ridges are geological 'islands' within the savanna. Because they are often protected from frequent fire events, sandstone ridges provide potential refuge for threatened or restricted range species: such as Rock Rats, Sandstone Antechinus (*Pseudantechinus bilarni*), Borrooloola Dtella (*Gehyra borrooloola*) and Agile Snake-eyed Skink (*Cryptoblepharus zoticus*) that are susceptible to disturbance. Cave-forming rock also provides additional habitat for bats. There is also the possibility that *Solanum carduiforme* (a rare form of bush tomato which is vulnerable under the EPBC Act) could also occur in these sandstone ridges, as it has been identified in the Limmen Gate area 40km to the south of the haul road.

Three sandstone outcrops were identified close to the proposed haul road alignment (labeled as R7, R115, and R116 in Figure 34 to Figure 37) have been identified within haul road corridor. It was recommended that these areas are avoided with a minimum 50m buffer during construction of the haul road, which was adopted by WDRL. It was also recommended that direct impacts are minimised at a number of both high and low value sandstone areas (R1, R9, R17, R21 and R30). The survey also identified that there are large areas of high value rocky outcrop and ridge habitat in the northern reaches of the haul road corridor, all outside of the proposed clearing path.

Locations, descriptions, habitat value and recommendations for each sandstone outcrop surveyed are shown in Appendix D-10.

5.5.3 The Yiyintyi Ranges

The Yiyintyi ranges are an isolated entity of the Arnhemland upland plateau. The ranges consist of pink, flaggy, medium grained quartz sandstone and feature dissected plateaus and fault springs (Nott 2005).

The greater proportion of the Yiyintyi ranges is located as an extensive and broad range to the north of the haul road corridor. To the south the Yiyinti formation is present as less extensive but somewhat ribbon-like or parallel, linear ridges. The haul road corridor passes through foothills in the near proximity of Rosie River, at point where scattered patches of the Yiyintyi formation loosely connect these two major extents. Results from the fauna survey located within this land type suggest that these ranges are particularly diverse from a regional perspective.

Although the level of sampling is quite limited (for the extent of the Yiyintyi ranges) the Rosie River survey site featured the greater diversity of birds and mammals compared to any of the other haul road survey locations. The fauna survey site (R3) actually on the ranges was the most diverse compared to other associated habitats in the near vicinity (e.g. drainage and woodland areas).

Five of recorded mammal species from the Rosie River survey location were not recorded for any of the other survey locations along the haul Road route. There was also an unconfirmed, but highly likely, sighting of Ghost Bats (*Macroderma gigas*) at the Rosie River sandstone survey site (R3), see below.

Of particular note for the Rosie River survey site within the Yiyintyi sandstone, was a significant range extension (400km) for the frog species *Limnodynastes lignarius* (confirmed by the NT museum by photographs and recording of the call) which is also a new species record for the Gulf Fall Upland Bioregion. This species is more typically found in north western parts of Northern Territory with the nearest records being in locations such as Kakadu.

Based on the limited level of data available the Yiyintyi rangeland system is obviously significant at a bioregional scale. With a greater level of survey effort, and particularly a focus on collecting genetic information, the significance of these ranges may be greater than currently suggested.



5.5.4 Waterbodies

Waterbodies provide an important extended water source available to fauna within the broader landscape. The construction of the haul road could potentially result in changes to surface hydrology. Identifying these areas is important to ensure road design and construction minimises impact on waterbodies.

It is recommended that waterbodies are avoided during construction of the haul road. A minimum 50m buffer should be put in place around these waterbodies and extend to all waterbodies identified during the survey.

Field surveys of waterbodies along the haul road 6km corridor has identified a number of high value areas transected by the proposed route (W59, W65, W79, W126, W127, W131, W132 and W133) (maps shown in Figure 34 to Figure 37). These were classified as high value due to presence of permanent or semi-permanent water and established *Melaleuca* communities (see Figure 38 – right).

A closed sink hole (i.e. linked to groundwater) with calcrete substrate was also located during the surveys at 571720E and 8281632N approximately 15km south east of the proposed Nathan River haul road crossing (see Figure 38 – left). This is a unique habitat type and will not be crossed or impacted by the haul road development (i.e. road drainage will direct water away from sink hole and be buffered by at least 100 m).

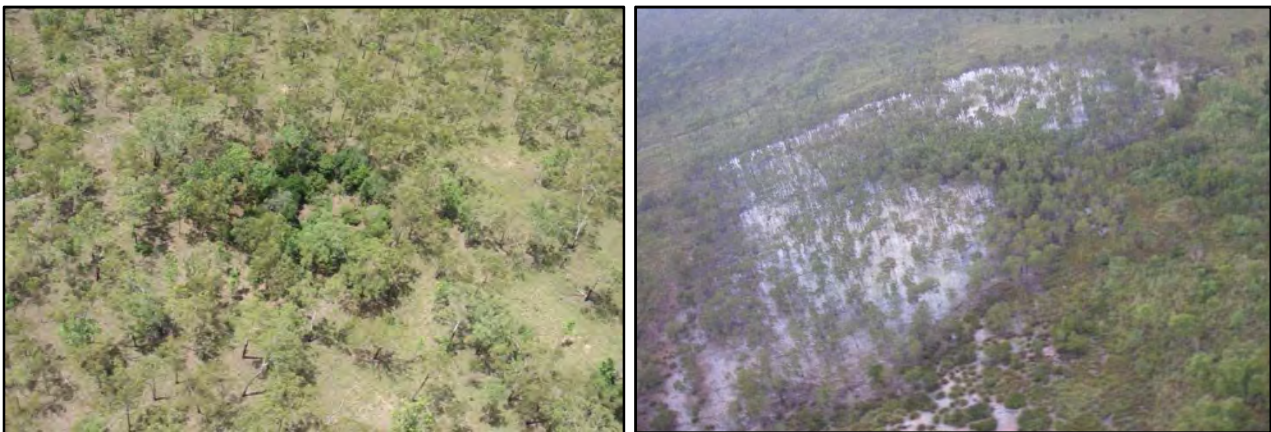


Figure 38: Photo of sinkhole – SH1 (left image); typical high value waterbody (right image)

Road design adjacent to these areas should minimise impacts from road drainage by directing it towards overland flow so that runoff is filtered through ground vegetation prior to settling in waterbody depressions. Moreover, an approved ESCP of the haul road construction will also prevent erosion resulting in sedimentation of these high value habitat areas.

Locations, descriptions, habitat value and recommendations for each waterbody surveyed are shown in Appendix D-10.

5.5.5 Major Watercourse and Minor Creek Crossings

The haul road corridor intersects with a number of rivers and creeks (Figure 34 to Figure 37). The major rivers and creeks along the haul road route are associated with north-south linearly arranged sandstone landforms. The Limmen Bight in particular, breaks through the tall sandstone escarpment at a location called the Four Arches. Areas where the tributaries intercept or align with the rocky relief are likely to feature a significant proportion of the regions terrestrial and aquatic species. Compared to the vast majority of the land which the haul road traverses, the rivers and sandstone ranges present a diversity of habitats in close proximity. The rocky ridges and ranges feature, either or both surface or ground feed water flows, rocky crevices and a range of vegetation types associated the surface drainage. The flows from the major rivers feed into estuarine habitat (approx. 40km downstream of the likely haul road) and many of these are likely to



feature the three species of freshwater sawfish and possibly Gulf Snapping Turtle, all of which are listed as threatened. Moreover, riparian habitat provides refugia during fires and offers potential habitat for threatened and restricted species.

The presence of riparian vegetation is geographically restricted to the edge of waterways. Riparian vegetation assessment sites were surveyed at seven proposed haul road crossing sites located at six major water courses along the route. Given the broad width of the Limmen Bight River, both banks were assessed. Only one bank was assessed at the Cox and Nathan Rivers and the Rosie, Pine and Bing Bong Creeks. Assessment of riparian habitats at proposed crossing points shows that in general riparian vegetation strips surrounding watercourses along the haul road are narrow and subject to seasonal flood events, resulting in high impact on species present.

No flora species of conservation significance were located during the survey, however one grass species *Enteropogon minutus* listed as data deficient was recorded on both banks of the Limmen Bight River. All of the seven survey sites were located in the McArthur Land System described as “Mid-high open woodland of *Corymbia terminalis* and *Eucalyptus microtheca* with some *C. bella* and *C. polycarpa*. Tall fringing riparian vegetation often includes *Melaleuca* spp.” (Aldrick and Wilson 1990). Survey sites were typically dominated by riparian species in the upper stratum including *Melaleuca* spp., *Casuarina cunninghamiana*, *Eucalyptus camaldulensis* and *Lophostemon grandiflorus*. This differed at the proposed crossing at Bing Bong Creek where *Callitris intratropica* was recorded as dominant in the upper stratum. This species was frequently observed in the landscape around Bing Bong Creek within the Fletcher Land System.

Weeds were opportunistically surveyed at each of the proposed crossing sites. Bellyache Bush *Jatropha gossypifolia* (Class A under the *Weeds Management Act 2001*) was identified near the riparian assessment site. Management of this Class A riparian weed must eradicate and prevent the spread of the species as it can highly impact native riparian vegetation. Given its difficulty to manage, preventing further spread is a high management priority for this species. Other classified weed species surveyed adjacent to riparian vegetation included *Hyptis suaveolens* and *Sida acuta* (Class B under the *Weeds Management Act 2001*) at 3 of the 7 sites surveyed.

In constructing the haul road bridges or culverts will be constructed, depending on the width, depth and flow of the watercourse to be crossed. It is recommended that culverts be put in place during construction of the haul road to minimise the disruption of surface water flows.

Vegetation descriptions and photo plates for each riparian assessment site are provided in Appendix D-10.



D-6. Port Development

6.1 Introduction

WDRL proposed to develop a stockyard area, conveyor route (with maintenance track), and barge loading facility as part of their coastal development.

Biological surveys conducted for the port development as part of the EIS investigation included:

- Preliminary Vegetation Mapping in the vicinity of the proposed port infrastructure, with effort towards identifying sensitive or restricted habitat.
- Terrestrial Fauna Surveys. One fauna survey (including seven sites) was conducted to include the main vegetation types to be impacted by the port development.
- Shorebird Habitat Potential. Targeted the tidal flats adjacent to the proposed barge loading facility (i.e. which is the currently Bing Bong Port). Helicopter survey of the surrounding coastline was also conducted to gain broader scale perspective of the site.
- Opportunistic Weed Surveys. Conducted in the general project area to gain an understanding of what weeds currently exist in the area.

The vegetation for the port area has been previously described as part of the McArthur River Mine EIS to a rough scale of 1:50,000 (Hollingsworth *et al.* 1992). Several vegetation communities were identified, including coastal vine thickets, mangroves, coastal plains, coastal woodlands, salt flats, and cypress pine.

6.2 Land Systems

Three land systems fall within the proposed port development (Aldrick and Wilson 1990), including:

- **Littoral** – Tidal mud flat with channel and estuaries;
- **Fletcher** – Level to very gently undulating plains on ferruginous material that has been re-exposed from a former sub-marine position, with swales in a sub-coastal orientation; and
- **Spillen** – Coastal sand sheet, dune and cheniers with minor intervening tidal flats.

Location of these land systems in relation to the proposed port development is illustrated in Figure 39.

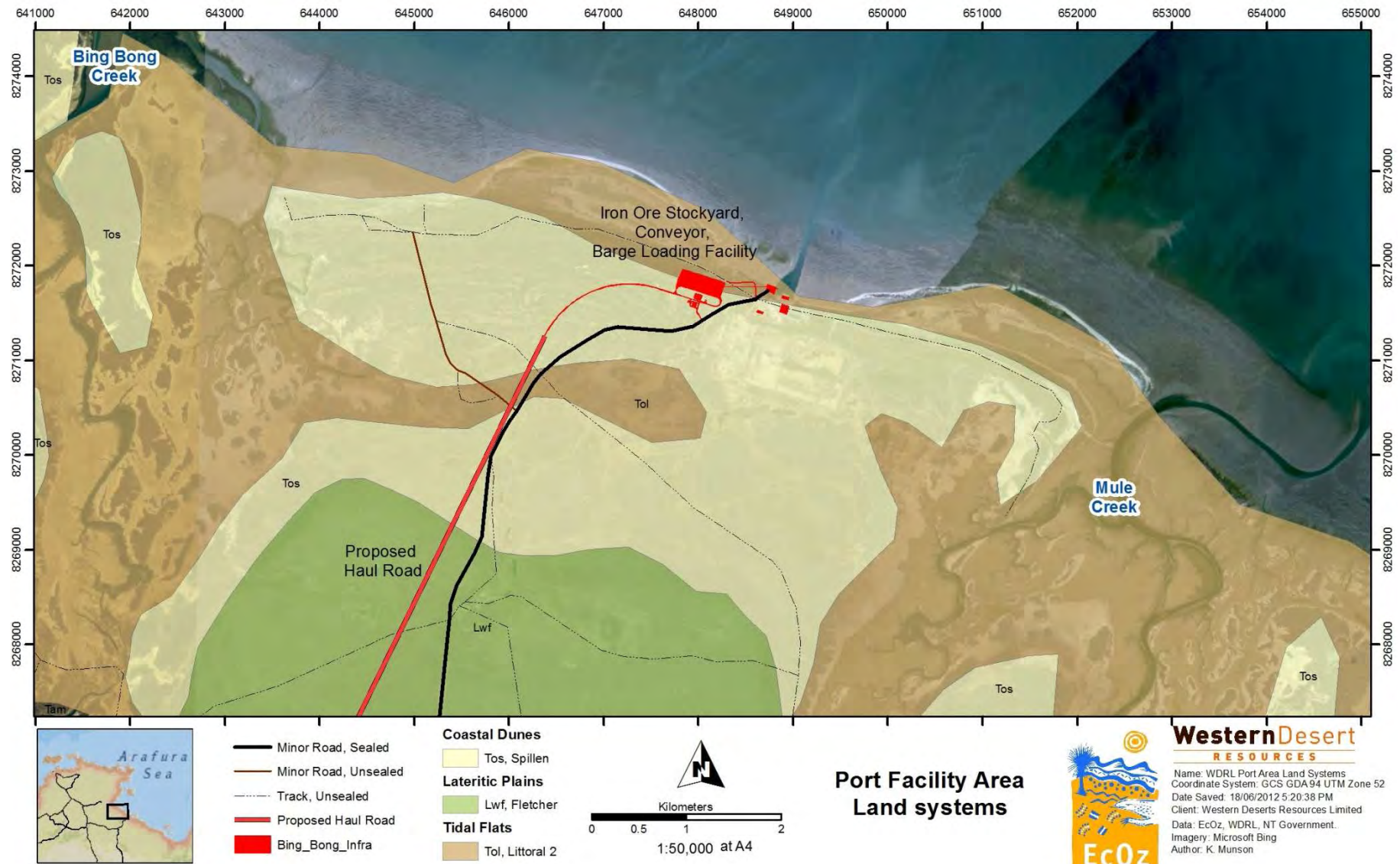


Figure 39: Land system map of the coastal port area and proposed development plans



6.3 Preliminary Vegetation Assessment

6.3.1 Summary of Vegetation Types

The distribution and range of vegetation types within the port development area are depicted in Figure 40. Landform, soils, and distance from the shoreline has a dominant influence in shaping the vegetation types present at this location. Broadly, the land forms which dominate the port area include:

- **Beach Ridges:** Coastal Dune (sandy substrate)
- **Chenier Ridges:** Beach ridges that have sandy soils with high shell content.
- **Saline flats:** Saline flats and flood-out zones of Bing Bong creek and Mule Creek
- **Low Coastal Plains:** Depressions and lowland flood-out areas, seasonally inundated, commonly with high clay content.
- **Sandy Rises:** Slight sandy rises nested within coastal plains

Thirteen distinct vegetation units (with the five broadly defined vegetation communities) were identified during the surveys (described in Table 22 and illustrated in Figure 40).

Slight and low lying land forms dominate the vegetation of the port area. Major influences on vegetation are the height above sea level, soil texture, incidence of fresh water inundation and fire frequency.

The coastal beach dunes occupy a dynamic zone where the build-up and removal of sand is an ongoing process. This zone is occupied by *Casuarina equisetifolia* woodland and other obligate coastal species which are widespread throughout northern Australia and much of tropical Asia.

The coastal dunes transition into a series of older consolidated beach dunes that extend inland for just over 1km. Directly adjacent and inland of the beach dunes, the vegetation transitions into coastal dry Monsoon Vine Thicket. This vegetation type is largely reflective of a lack of fire in the coastal fringe afforded by the protection of a series of parallel dunes and moister swales, rather than significant soil differences.

Beyond the Monsoon Vine Thicket, dunes are dominated by *Corymbia bella* Woodland with a shrubby understorey that includes Monsoon Vine Thicket species. Swales between dunes are dominated by *Melaleuca viridiflora* and *Chrysopogon elongatus* with the *Melaleuca* upper layer varying in cover from woodland to almost absent. The movement of water in these swales is directed towards the eastern part of the site towards the salt flats, where it terminates in fresh water lagoons or swamps adjacent to the salt flats. These semi-permanent swamps are dominated by *Melaleuca viridiflora* and *M. acacioides* and often have an understorey of *Pseudoraphis spinescens*.

The Salt flat vegetation has developed in coastal areas of infrequent tidal influence, but with high salt levels. Chenopod species, which are adapted to higher salt levels, are the dominant life form within this sparsely vegetated area, while grasses are mostly absent. These salt flats transition into Mangrove communities.

Inland beyond these sand dominated land forms are clay dominated vegetation types which transition into salt water influenced habitats to the east and west. These clay dominated vegetation types feature a sparse tree layer or *Excoecaria parvifolia* or *Grevillea striata*.

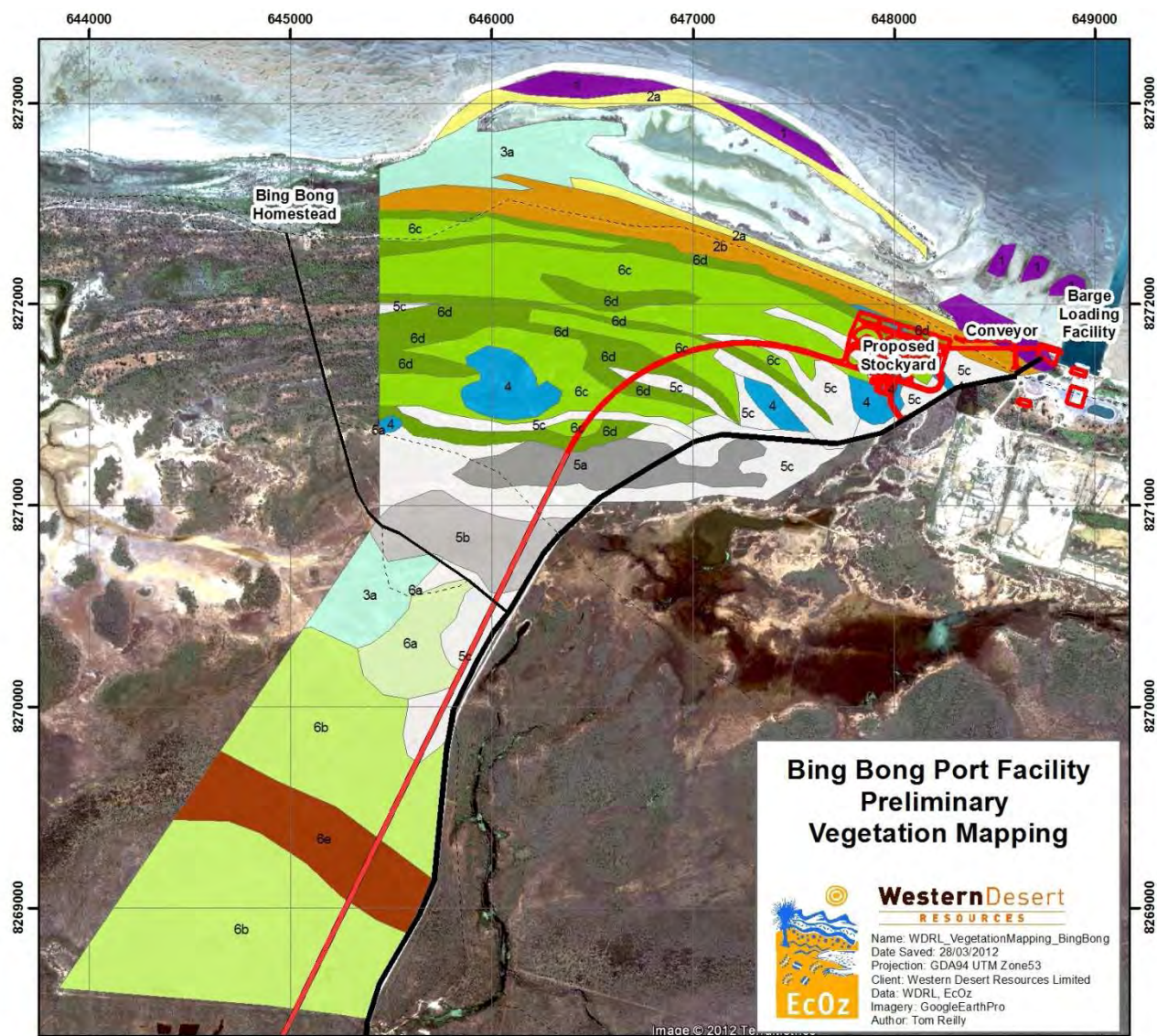
Further inland and slightly more elevated and sandy are *Melaleuca* and *Corymbia* dominated woodlands with a tussock grass understorey. Sandier rises within this woodland contain *Callitris intratropica* woodland. Within this *Callitris* woodland the lighter soils have most likely resulted in a lower grass biomass, which have in turn supported less frequent or less intense fires.

The main vegetation types to be impacted by the port facility and associated infrastructure are described in Appendix D-11.



Table 22: Vegetation type summaries for the port facility area and surrounds

Mangroves
1a: Mangrove community complex +/- <i>Pemphis acidula</i> , <i>Excoecaria ovalis</i> , <i>Lumnitzera racemosa</i> Low Closed Forest.
Coastal Dune
2a: <i>Casuarina equisetifolia</i> woodland +/- <i>Pandanus spiralis</i> , <i>Passiflora foetida</i> , and <i>Acacia</i> spp. Mid Open Woodland.
2b: Mixed monsoon vine thicket +/- <i>Corymbia bella</i> , <i>Diospyros</i> sp., <i>Flueggea virosa</i> , <i>Premna acuminata</i> , <i>Exocarpos latifolia</i> , <i>Barringtonia acutangula</i> , <i>Ficus virens virens</i> Low Closed Forest
Tidal Saline Flats
3a: +/- <i>Halosarcia indica</i> , <i>Tecticornia australasica</i> , <i>Suaeda arbusculoides</i> Low Open Chenopod Shrubland
Swamps
4: <i>Melaleuca viridiflora</i> +/- <i>Melaleuca acacioides</i> Low Woodland over <i>Pseudoraphis spinescens</i> Low Tussock Grassland
Coastal Grasslands
5a: <i>Grevillea striata</i> +/- <i>Diospyros humilis</i> , <i>Petalostigma banksii</i> , <i>Margaritaria dubium-traceyi</i> Low Open Woodland over <i>Chrysopogon elongatus</i> and <i>Eulalia aurea</i> Tall Tussock Grassland
5b Coastal Grasslands: <i>Excoecaria parvifolia</i> Low Open Woodland over <i>Chrysopogon fallax</i> Tall Tussock Grassland
5c Coastal Grasslands: <i>Grevillea striata</i> , <i>Pandanus spiralis</i> , Isolated Trees over <i>Grewia retusifolia</i> Isolated Shrubs over <i>Chrysopogon fallax</i> +/- <i>Sarga</i> spp., <i>Eriachne</i> spp., Tall Tussock Closed Grassland.
Coastal Woodlands
6a: <i>Melaleuca viridiflora</i> +/- <i>Corymbia ferruginea</i> , <i>Corymbia bella</i> , Mid Open Woodland over <i>Chrysopogon elongatus</i> , <i>Grewia retusifolia</i> Tall Tussock Grassland.
6b: <i>Melaleuca viridiflora</i> +/- <i>Petalostigma banksii</i> , <i>Alphitonia pomaderroides</i> Low Open Woodland over <i>Heteropogon triticeus</i> Mid Tussock Grassland.
6c: <i>Melaleuca viridiflora</i> +/- <i>Corymbia bella</i> Low Woodland over <i>Chrysopogon elongatus</i> Tall Tussock Grassland.
6d: <i>Corymbia bella</i> Mid Open Forest over +/- <i>Acacia</i> spp., <i>Pandanus spiralis</i> , <i>Hyptis suaveolens</i> , Sparse Mid Shrubland.
6e: <i>Callitris intratropica</i> Mid Woodland over +/- <i>Hakea arborescens</i> , <i>Alphitonia pomaderroides</i> Tall Sparse Shrubland over <i>Heteropogon triticeus</i> Mid Open Tussock Grassland



- Proposed Port Facility Infrastructure — Minor Road, Sealed - - - - Track, Unsealed
— Proposed Haul Road — Minor Road, Unsealed
- Vegetation Communities (Bing Bong)**
- 1. Mangrove community complex +/- *Pemphis acidula*, *Excoecaria ovalis*, *Lumnitzera racemosa* Low Closed Forest.
 - 2a. *Casuarina equisetifolia* woodland +/- *Pandanus spiralis*, *Passiflora foedta*, and *Acacia* spp. Mid Open Woodland.
 - 2b. Mixed monsoon vine thicket +/- *Corymbia bella*, *Diosporos* sp., *Flueggea virosa*, *Premna acuminata*, *Exocarpus latifolia*, *Barringtonia acutangula*, *Ficus virens virens* Low Closed Forest
 - 3a. +/- *Halosarcia indica*, *Tecticornia australasica*, *Suaeda arbusculoides* Low Open Chenopod Shrubland
 - 4. *Melaleuca viridiflora* +/- *Melaleuca acacioides* Low Woodland over *Pseudoraphis spinescens* Low Tussock Grassland
 - 5a. *Grevillea striata* +/- *Diosporos humilis*, *Petalostigma banksii*, *Margaritara dubium-traceyi* Low Open Woodland over *Chrysopogon elongatus* and *Eulalia aurea* Tall Tussock Grassland
 - 5b. *Excoecaria parvifolia* Low Open Woodland over *Chrysopogon fallax* Tall Tussock Grassland
 - 5c. *Grevillea striata*, *Pandanus spiralis*, Isolated Trees over *Grewia retusifolia* Isolated Shrubs over *Chrysopogon fallax* +/- *Sarga* spp., *Eriachne* spp., Tall Tussock
 - 6a. *Melaleuca viridiflora* +/- *Corymbia ferruginea*, *Corymbia bella*, Mid Open Woodland over *Chrysopogon elongatus*, *Grewia retusifolia* Tall Tussock Grassland.
 - 6b. *Melaleuca viridiflora* +/- *Petalostigma banksii*, *Alphitonia pomaderoides* Low Open Woodland over *Heteropogon triticeus* Mid Tussock Grassland.
 - 6c. *Melaleuca viridiflora* +/- *Corymbia bella* Low Woodland over *Chrysopogon elongatus* Tall Tussock Grassland.
 - 6d. *Corymbia bella* Mid Open Forest over +/- *Acacia* spp., *Pandanus spiralis*, *Hyptis suaveolens*, Sparse Mid Shrubland.
 - 6e. *Callitris intratropica* Mid Woodland over +/- *Hakea arborescens*, *Alphitonia pomaderoides* Tall Sparse Shrubland over *Heteropogon triticeus* Mid Open Tussock Grassland

Figure 40: Preliminary vegetation map of the port facility development



6.3.2 Vegetation Condition

The vegetation condition is variable within the port facility locality, with the majority of the areas proposed for development being located in poor to medium condition. The proposed iron ore stockyard area and proposed conveyor line is impacted by livestock and associated cattle infrastructure (i.e. dams, stockyard, tracks), with high impact being recorded at dams and natural waterbodies. The proposed infrastructure is parallel to the existing McArthur River Mine haul road and port. These areas were infested with a variety of weed species, including Weeds of National Significance (see Section 6.3.6).

Fire impact in the area was fairly low, which is confirmed by fire scar and late burn mapping presented in Section 3.5 (NAFI 2012).

The coastal vegetation in the immediate area of the barge loading facility and conveyor consists of a small patch of mangrove regrowth (fringed with several weed species), depauperate coastal vine thickets, and *Melaleuca* low woodlands.

6.3.3 Notable Species Records

No threatened or other notable plant species were identified during the flora surveys at the port facility.

A summary of possible notable species (from data provided by NRETAS and gathered during project surveys during 2011 and 2012) is provided in Section 7.2. From this summary, species that are noted as recorded from the project area or are likely to occur in the port development area have been expanded upon below in an effort to highlight species and habitats of concern.

The majority of the notable plant species that occur close to the Bing Bong port areas are associated with aquatic fresh water habitats. Below is a summary of the habitats in the area and the species that are most likely to be found in them.

Swamps

Species recorded within the development area

- *Peplidium maritimum* (Near Threatened) has been recorded from within the Bing Bong development area. This species has been recorded on a number of habitats on the site where it occurs on the edges of fresh water lagoons, moist estuarine and sub tidal areas.

Species recorded very close to development area

- *Triglochin multifructa* (Data Deficient) and *Vallisneria caulescens* (Data Deficient) are submerged aquatic species which are found in standing water. They thus occupy a relatively small area in the landscape but may be subject to run off related sedimentation or pollution. There are several shallow swamps in development area where these species could occur.
- *Eriocaulon carpentariae* occurs on the edges of fresh water swamps of which there are several in the north of the development area.

Species recorded as Likely or Highly likely to be found in the vicinity of the development area.

Although not found within the development area the following species have either been found nearby or have been found in very similar habitats to those found in the development area.

- *Nesaea crinipes* (Data Deficient) is found on the edges of swamps and waterholes and may be found in swamps in the mid or northern parts of the site.
- *Nymphoides exiliflora* (Data Deficient) is found in swamps and shallowly and seasonally inundated *Melaleuca viridiflora* woodlands. It may be found in the swamps in the northern part of the site.
- *Psydrax paludosa* (Data Deficient) is usually found submerged with other tall shrubs/ small trees such as *Asteromyrtus symphyocarpa* and *Melaleuca viridiflora*. It may be present in swamps in the northern part of the site.



- *Poranthera microphylla* (Data Deficient) is an ephemeral herb of damp situations. It may occur on swamp edges in the northern part of the site as well as riparian areas or wet spots within woodland.

Salt flats

Species recorded very close to development area

- *Tecticornia halocnemoides subsp. tenuis* (Data Deficient) is a species of salt flats. Although they occur in the area the disturbance footprint is unlikely to encounter a significant area of suitable habitat for this species.

Species recorded as likely or highly likely to be found in the vicinity of the development area.

- *Omegandra kanisii* (Near Threatened) is found in a range of sub tidal situations including riparian areas and tidal flats. It may be found on ecotones between fresh water and tidal areas which includes the swampy areas in the north of the development site as well as the sparse woodlands with *Grevillea striata* and *Excoecaria parvifolia*.

Eucalyptus and Corymbia Woodlands

Species recorded very close to development area

- *Heliotropium prostratum* (Data Deficient) is an annual herb found growing in sandy and gravelly woodlands. It is most likely to be found in the non-dune woodlands to the south of the site.

Species recorded as likely or highly likely to be found in the vicinity of the development area.

- *Tephrosia procera* (Near Threatened) – although many occurrences of this species are from sandstone woodland, there is one coastal occurrence of this species where it occurs on Sandy, shelly substrates in woodland. It is possible that this species may occur in the development site on dune vegetation types close to the coast.
- *Gomphrena humilis* (Data Deficient) is a species with few records in the NT. The current records are somewhat ambiguous as to its' preferred habitat but include gravelly sites which may be provided by the woodlands in the south of the site. As it has been recorded in swamp grassland it may also be present in the *Melaleuca* woodlands on the site.

Melaleuca woodlands

Species recorded as likely or highly likely to be found in the vicinity of the development area.

- *Drosera fulva* (Data Deficient) occurs on seasonally and shallowly inundated/very wet Melaleuca woodlands. It may occur on the Melaleuca woodlands at the southern end of the development area if the tussock grass layer is sparse.
- *Ophioglossum gramineum* (Near Threatened) occurs on seasonally and shallowly inundated/very wet Melaleuca woodlands. It may occur on the Melaleuca woodlands at the southern end of the development area if the tussock grass layer is sparse but will only be detectable during the Wet season.



6.3.4 Introduced Plant Species

Environmental assessments of the Bing Bong port, ore stock yards and loading facility have identified 3 declared B class (growth and spread to be controlled) weeds, including:

Declared Weeds

- Parkinsonia (*Parkinsonia aculeata*) – a Weed of National Significance (WONS). Parkinsonia is declared a Class B (growth and spread to be controlled) and Class C (not to be introduced to the Northern Territory) in accordance with the NT Weeds Management Act. Parkinsonia is well established on the edge of a semi-permanent freshwater swamp, and was also located on the coast adjacent to the existing port facility. It is likely that this weed is widespread in suitable habitat in the area. Management of this species will be high priority for WDRL to ensure that it is not spread as a result of construction or mining operations. There may also be potential offset options to eradicate infestation in the local region;
- Hyptis (*Hyptis suaveolens*) – a Class B (spread to be controlled) and Class C (not to be introduced to the Northern Territory) weed in accordance with the NT Weeds Management Act. Hyptis was well established in cheniers (old beach ridges) and some lowland coastal plains; and
- Sida (*Sida acuta*) – Spinyhead Sida is declared a Class B (growth and spread to be controlled) and Class C (not to be introduced to the Northern Territory) weed in accordance with the NT Weeds Management Act. Scattered individuals.

Further weed records of the Bing Bong Port catchment provided by the weeds department show the following additional species present:

- Chinese Apple – *Ziziphus mauritiana* (Class A)
- Grader Grass – *Themeda quadrivalvis* (Class B)

Non-declared weeds,

The following are non-declared weeds worthy of management consideration:

- Buffel Grass (*Cenchrus ciliaris*) – Environmental Weed, but not a declared weed in the NT. Buffel Grass was located some road sides in disturbed sand piles. Scattered individuals. Low infestation;
- Passion Vine (*Passiflora foetida*) – Environmental Weed, but not a declared weed in the NT. There are infestations of Passion Vine throughout the coast vine thicket vegetation. Widespread infestation;
- Kapok Bush (*Aerva javanica*) – Environmental Weed, but not a declared weed in the NT. Kapok bush is scattered along the road sides, likely spread through slashing and grading road maintenance activities. Low infestation;
- Cobbler's Peg (*Bidens bipinnata*) – Environmental Weed, but not a declared weed in the NT. Scattered individuals; and
- Purple Chloris (*Chloris inflata*) – Environmental Weed, but not a declared weed in the NT. Scattered individuals.

Existing developmental impacts at the Bing Bong Port area has resulted in an incursion of weeds and subsequent records located in and around the proposed stock yard and loading facility. Two of these weeds (Chinese Apple and Grader Grass) have not yet been recorded within neighbouring catchments along the haul road route. Targeted weed surveys will be undertaken to identify the extent of weed populations and determine management requirements to both eradicate in the case of Class A weeds and control the growth and spread of Class B weeds during the construction of both the port facility and the adjoining haul road. For further information on weed manage and controls at the Bing Bong Port facility and along the haul road route refer to the Weeds Chapter.



6.4 Fauna Surveys

6.4.1 Habitat Descriptions of Fauna Sites

Habitat description summaries and photos for each fauna site are included in Table 23 and site locations are mapped in Figure 41. More detail in relation to vegetation community descriptions and structure is provided in Section 6.2.

Table 23: Fauna site habitat descriptions – port facility surveys

Site	Photo	Description
Site 1		Vegetation Description: <i>Melaleuca viridiflora</i> low open woodland over <i>Heteropogon triticeus</i> Landform: Flat Plain Soil: Sandy Loam with clay Habitat Notes: low level of flowering plants, high grass cover, small hollows (reptiles), no mistletoe, small termite mounds common, low amount of leaf litter.
Site 2		Vegetation Description: <i>Callitris intratropica</i> over <i>Heteropogon triticeus</i> Landform: Slight Rise Soil: Sandy Loams Habitat Notes: Minor cattle impact, fire scars present but low impact, good level of fallen logs, low leaf litter, high canopy cover, not many flowering plants.
Site 3		Vegetation Description: <i>Melaleuca viridiflora</i> and <i>Corymbia polycarpa</i> over <i>Chrysopogon fallax</i>. Isolated <i>Eucalyptus bella</i> Landform: Flat Plain Soil: Deep Sandy Loam, some surface clay Habitat Notes: High cattle impact due to proximity to cattle stockyard, no hollows, Raptor nests (Sparrowhawk) in <i>Eucalyptus bella</i>, low termite mounds common.



Site	Photo	Description
Site 4		Vegetation Description: <i>Grevillea striata</i> open woodland over grasses <i>Chrysopogon fallax</i>, with some minor groved areas of <i>Diospyros humilis</i>, <i>Petalostigma banksii</i> and <i>Margaritaria dubium-traceyi</i> Landform: Lowland Soil: Clay Habitat Notes: Narrow hollows present in dead beefwood (good for reptiles), isolated groved trees provided good shelter/shade, moderate level of leaf litter, termite mounds common.
Site 5		Vegetation Description: <i>Eucalyptus bella</i> with mixed Acacia species over <i>C. fallax</i> and <i>Hyptis</i>. Limited sign of vine-thicket community Landform: Chenier, old beach rise or sandy rise. Soil: Sand Habitat Notes: High weed impact (<i>Hyptis</i>, passion vine), high cattle impact, close to water (man-made dam), large Eucalyptus trees but no obvious hollows, low fire impact
Site 6		Vegetation Description: Patchy Monsoon Vine-thicket, with <i>Eucalyptus bella</i> Landform: Chenier, low shell dune adjacent to coast. Soil: Sand, with high shell content Habitat Notes: Dense veg with high leaf litter load, especially in vine-thicket patches, many small hollows and fallen logs.
Site 7		Vegetation Description: Large <i>Melaleuca viridiflora</i> over <i>Pseudoraphis spinescens</i>. Some groved <i>Melaleuca acacioides</i> Landform: Freshwater Swamp Soil: Clay Habitat Notes: Permanent water, large hollows, flowering plants, high cattle impact, high weed impact on the swamp fringe (<i>Parkinsonia</i>).

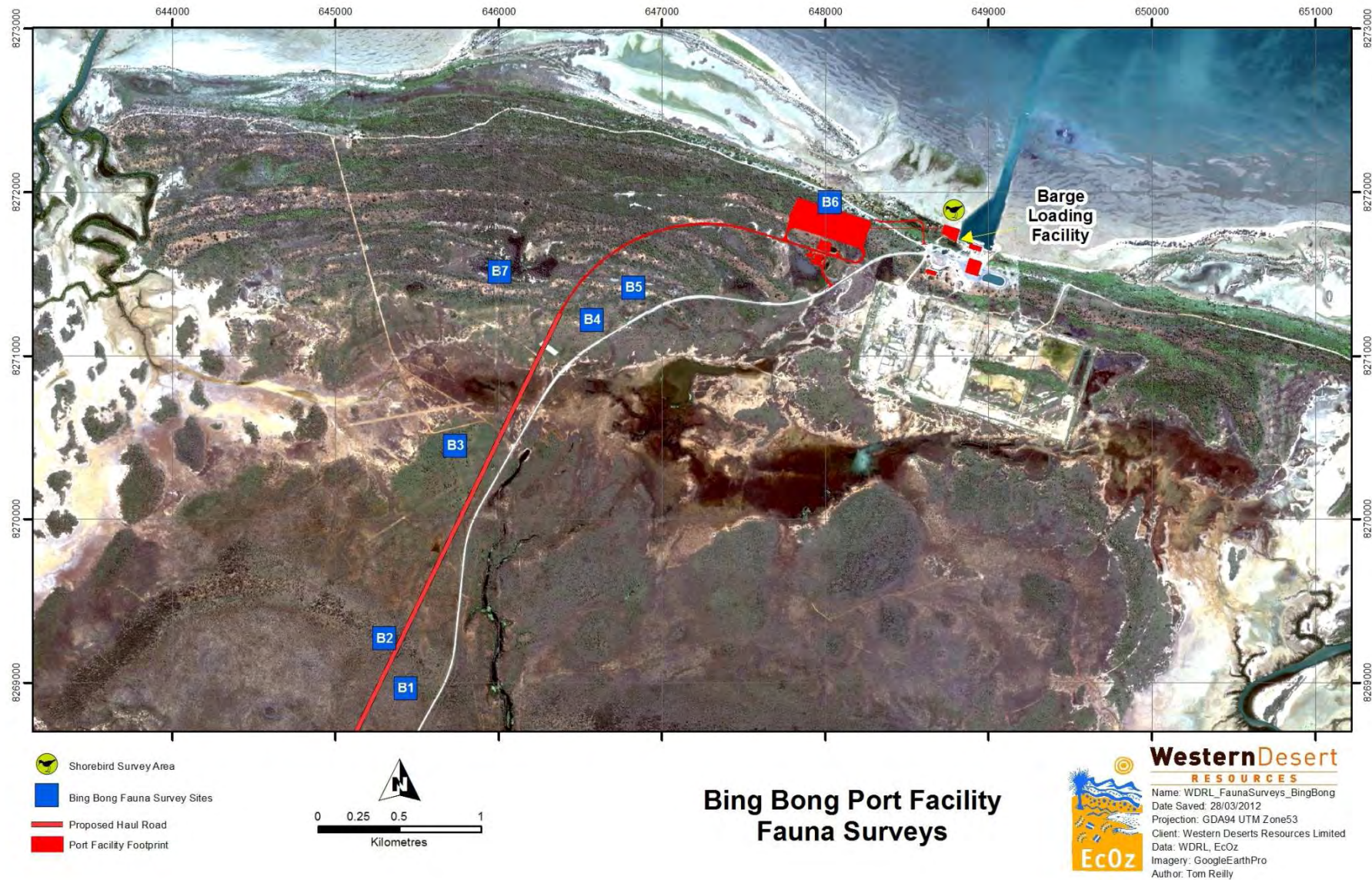


Figure 41: Map of fauna survey sites within the port facility area



6.4.2 Fauna Survey Results

The survey recorded a total of 115 fauna species, comprising of 8 amphibians, 16 reptiles, 81 birds, and 6 mammals. Three introduced species were identified. The majority of species were identified through trapping, active search techniques, and incidental observations. Species lists, status, and identification method are provided in the Appendix D-4. Summary descriptions by faunal group are provided below.

The majority of species recorded during the survey are common and generally widespread throughout similar habitat in the region. One threatened species (as per the TPWC Act) was identified during the survey – Mertens' Water Monitor (*Varanus mertensi*). No species listed as Threatened under the EPBC Act were identified, however 13 listed migratory species (all birds) and 29 listed marine species (all birds) were recorded.

Amphibians

A total of 8 amphibians was recorded from the port development surveys, mainly from pit traps and active searches (Appendix D-4). Most were recorded around freshwater swamps and pools in the project area. In addition to the species identified, amphibians from the genus *Crinia* and the genus *Uperoleia* were trapped but could not be identified to species level without a reference call.

- No threatened species were identified.
- Three Data Deficient species were identified – *Litoria australis*, *Litoria bicolor*, and *Opisthodon ornatus*. These species are common and widespread across northern Australia.
- The remaining species (including the unidentified *Crinia* and *Uperoleia* species) are all listed as Least Concern in the NT.
- One introduced species was identified, Cane Toad (*Chaunus marinus*), which was recorded at all sites throughout the port facility area.

Reptiles

A total of 16 reptiles was recorded from the survey, mainly from pit traps and active searches (Appendix D-4). Ten species were recorded once only. Two skink (*Carlia*) species and Gilbert's Dragon (*Lophognathus gilberti*) were the only reptiles recorded regularly.

- One threatened species, Mertens' Water Monitor (*Varanus mertensi*), which is listed as Vulnerable was identified on several occasions in man-made dam highly disturbed by feral animals (mainly cattle and pigs) within the project area.
- Four Data Deficient species – *Dendrelaphis punctulata*, *Demansia papuensis*, *Demansia vestigiata*, *Antaresia children* were identified. The statuses of the latter three are proposed to be changed to Least Concern.
- One Not Listed species – *Brachyuophis roperi*; and one Not Evaluated species – *Cryptoblepharus ruber*, were identified. These are both common and widespread in suitable habitat throughout northern Australia.
- The remaining species are all listed as Least Concern.
- No introduced reptile species were identified.

Birds

A total of 81 native bird species was identified during the survey (Appendix D-4) from 41 families. This is quite a large total for a small survey area, and reflects the diversity of habitats within and proximate. Birds were most active in the hours of dawn and dusk, and bird count numbers were maximized by varying the



sites visited at these times. The least number of species was observed in the weed-infested Site 6, however visibility was also lowest at this site because of the vines.

- No threatened species were recorded.
- One Data Deficient species was recorded – Blue-winged Kookaburra (*Dacelo leachii*). The status of this species is proposed to be changed to Least Concern.
- The remaining species are all listed as Least Concern.
- Thirteen listed migratory species and 29 listed marine species were recorded. Some of these were migratory shorebirds (see Section 7.1.2).
- No introduced species were recorded.

Mammals

Six mammal species were recorded during the surveys (Appendix D-4), with only Western Chestnut Mouse (*Pseudomys nanus*) seen more than once. No species of bat were distinguishable unambiguously (see Appendix D-5).

- No confirmed threatened species were recorded. A *Rattus* species was trapped whose identification is yet to be confirmed due to ambiguity of the mammal key on several features. An ear clip was collected to facilitate identification through DNA sequencing. The likely identification is Dusky Rat (*Rattus colletti*), which is a Least Concern species but would be a considerable distribution extension for the species based on existing information. Alternatively, the species could be Canefield Rat (*Rattus sordidus*) which is currently considered Vulnerable, but is currently only found on the neighbouring Sir Edward Pellew island group. This information will be provided in the supplement report if necessary.
- One Near Threatened species was identified, Western Chestnut Mouse (*Pseudomys nanus*). This species is common in a range of habitats across northern Australia.
- The remaining species are both listed as Least Concern.
- Two Introduced species were recorded – Pig and Cattle.

6.4.3 Summary

Field and desktop surveys identify a total of 264 fauna species that are found, or potentially occur, within the MLA areas (Table 24). During the field surveys trap success was low for both reptiles and mammals, making the identification of key habitats for these difficult. Bird diversity was high due to the variety of habitats at and around the survey site.

Table 24: Total fauna species within the port facility – data from desktop and field surveys

	No. of species
Amphibian	9
Reptile	58
Bird	182
Mammal	15
Freshwater Fish	n/a
TOTAL	264



6.5 Sensitive Habitats

None of the vegetation communities associated with the Bing Bong Port facility are listed under any legislation (TPWC or EPBC Acts). Some vegetation types are locally noteworthy from the perspective of conserving habitat which is in good condition, features more of the atypical species, maintains landform stability, or contributes to the hydrology and connectivity of this coastal community. The vegetation communities considered locally sensitive and the justifications are outlined below.

6.5.1 Mangroves

A small coastal mangrove community is located within the project area, adjacent to the proposed barge loading facility (Figure 43). The majority of foreshore in the local area is devoid of mangrove species, with aerial imagery confirming that this community is locally restricted to minor patches, possibly due to previous cyclone history in the region and diurnal tides with a narrow tide range. More extensive mangrove communities are supported in nearby creeks and estuaries, as these areas provide greater protection from severe weather events.

No flora surveys were undertaken in the mangrove community within the project area, however previous survey data collected during the McArthur River Mine EIS identified *Pemphis acidula*, *Excoecaria ovalis*, *Lumnitzera racemosa*, and possibly *Excoecaria agallocha* (uncommon mangrove species).



Figure 42: Photo of mangroves that will be impacted by the conveyor belt and barge facility

6.5.2 Monsoon Vine Thicket Community

The monsoon vine thick community includes a series of beach ridges or cheniers composed of sand and shell deposits (Figure 44). These cheniers are characteristic of coastal areas in this region and can occur several kilometres from the coast. Some are interspersed with saline drainage floors or swales. Species supported are typical of coastal monsoon vine thicket, however the chenier vine thicket community in the vicinity of the conveyor and stockyard rarely attains the dense closed-canopy structure typical of a monsoon vine thicket community. Vegetation ranges from tall shrublands, to mid-high woodlands, and small patches of dense, often entwined trees, shrubs, and vines. *Eucalyptus bella* (Northern Ghost Gum) is the characteristic tree species. *Melaleuca viridiflora* occur in perched water table between cheniers.

Much of the vine thickets were highly infested with weeds in the local area, mainly smothered by Passion Vine (*Passiflora foetida*). Declared weeds included Hyptis (*Hyptis suaveolens*) and Sida (*Sida acuta*), both



Class B weeds under the NT Weeds Management Act. Other environmental weed species identified included Kapok Bush (*Aerva javanica*), Cobbler's Peg (*Bidens bipinnata*) and Buffel Grass (*Cenchrus ciliaris*).



Figure 43: Photo of coastal monsoon vine thicket adjacent to the proposed conveyor

6.5.3 Cypress Pine Woodland

There is a stand of Cypress Pine (*Callitris intratropica*) a few kilometres from the coast that will be associated with the haul road development rather than the port facility (Figure 45). The Cypress Pine stand is linear in shape, and is approximately 100m wide and a 1 km long. No Cypress Pine stands occur in the barge loading or stockyard area. Cypress Pine stands have a fairly restricted distribution in the region.

Callitris intratropica is the dominant upper storey species, with *Hakea arborescens* being co-dominant and over a Speargrass (*Heteropogon triticeus*) understory. The vegetation community is bordered by *Melaleuca* woodlands on either side that site slightly lower in the landscape.



Figure 44: Photo of a Cypress Pine Woodland close to the proposed port facility and haul road



6.5.4 *Melaleuca* Swamp

This is a relatively large freshwater swamp supporting a shallow water body that has been highly impacted by weeds, cattle and pigs (Figure 46). Water is likely to persist on the surface until the late Dry season, and quickly fills after rainfall.

Large *Melaleuca viridiflora* (up to 10m) are the dominant over storey species with *Pseudoraphis spinescens* being the dominant ground layer. There are some groves of *Melaleuca acacioides* on the southern edge of the water body.

The swamp is fringed with well-established *Parkinsonia* (*Parkinsonia aculeate*), which is a Weed of National Significance.



Figure 45: Photos of *Melaleuca* Swamp close to the proposed iron ore stockyard



D-7. Conclusion

7.1 Fauna

Existing data suggests that a total of 192 notable fauna species (as defined in Section 2.7) potentially occur within the combined search areas. This broad list of species are presented in three separate tables – threatened species, near threatened species, marine and migratory species – in Appendix D-6 and Appendix D-7. This list has undergone a screening process to produce a shortlist of those species which are both plausibly present and potentially vulnerable to disturbance from developments associated with the project.

The first level of screening involved the 138 species listed under the EPBC Act as marine and/or migratory, but not threatened (Appendix D-7). Firstly, the consideration of marine species does not fall within the ambit of this report (e.g. sea snakes), and so these have been excluded. Secondly, most of the listed migratory species are common and widespread across tropical Australia (e.g. Rainbow Bee-eater, Whistling Kite etc.). Because of this, none of these species present as a management concern for the Roper Bar Iron Ore Project, and they have therefore been excluded from the shortlist of priority species. Note, however, that migratory shorebirds are considered collectively in Section 7.1.2.

The second level of screening involved the remaining 54 notable fauna species – threatened, near threatened and restricted range species. The vast majority have broad distributions with no critical habitats (such as breeding areas) known to exist within the project areas or their near vicinity. Therefore these species have been excluded from further consideration as a management concern to the Roper Bar Project.

The outcome of the screening process is a shortened list of 22 priority fauna which may occur within or near the proposed project areas, and which are potentially vulnerable to disturbance from developments associated with the project, and therefore warrant further consideration for impacts from the Roper Bar Project. This shortlist is discussed below.

7.1.1 Priority Fauna Species

The shortlist of 22 priority fauna species which may occur within or near the proposed project areas is presented in (Figure 46 & Table 25). These are species requiring consideration in the EIS because they are either listed as threatened or else have restricted ranges. All existing records for the project area and surrounds are presented in Figure 46.

[Note: The NT Atlas contains a record (dated 1977) in the search area for Alexandria Toadlet (*Uperoleia orientalis*) – a very restricted range species listed under the TPWC Act as Data Deficient. This record is likely to be erroneous – field guides, including a recently revised edition (Tyler and Knight 2011), state that this species has been seen only once in the past 175 years and that historic records are from the Barkly Tablelands (~500kms to the south). There is insufficient information to determine whether the Alexandria Toadlet is justifiably a species.]

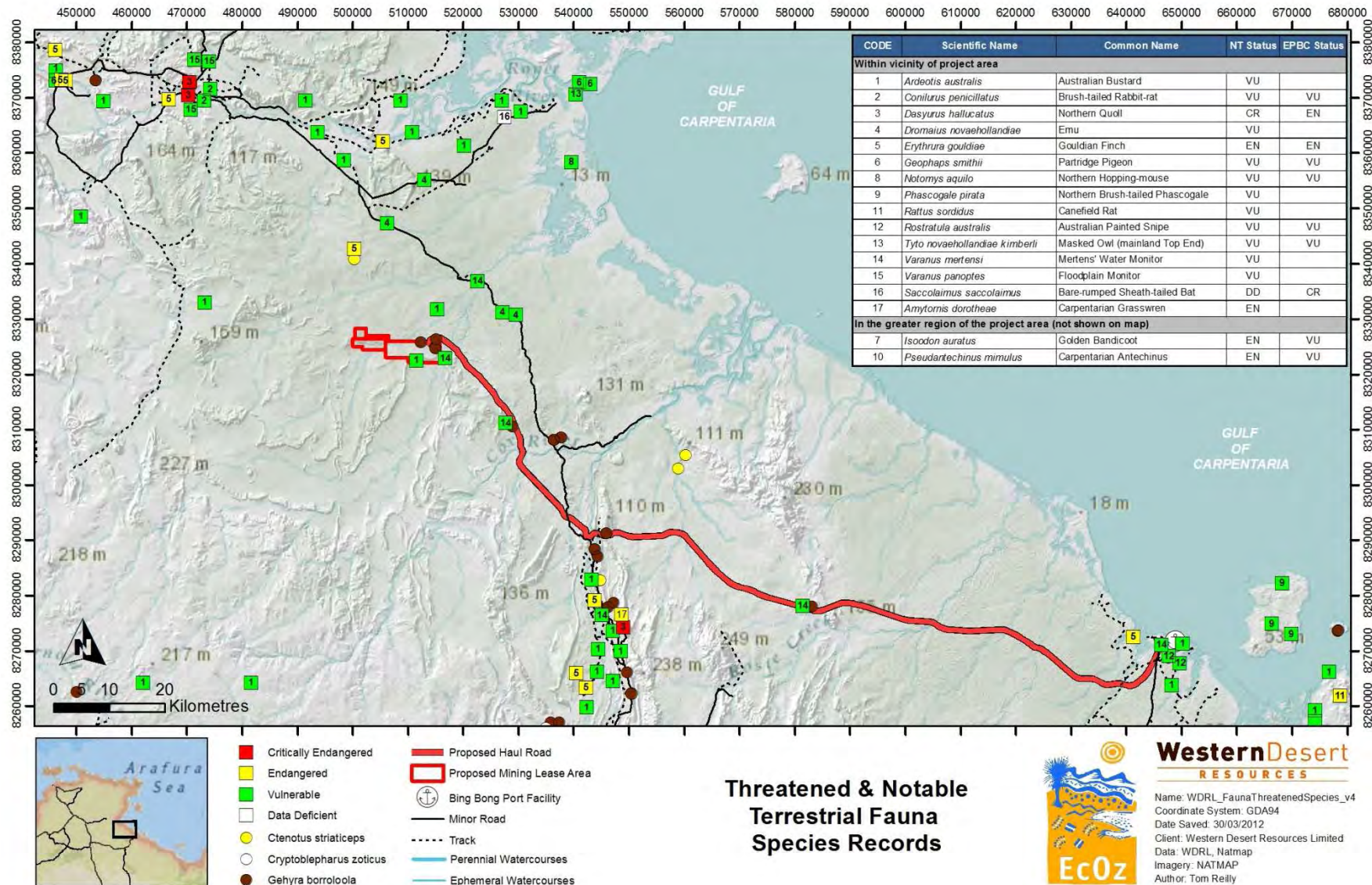


Figure 46: Map of threatened and notable fauna species records within the project area and surrounds



Table 25: Priority fauna within the project area

Table Key	1 = Atlas of Living Australia 2 = NT Atlas (inc Museum) 3 = EPBC 4 = Distribution occurs within area	H = Haul Rd M = Mine P = Port	EN – Endangered CR – Critically Endangered VU – Vulnerable NT – Near Threatened LC – Least Concern NE – Not Evaluated DD – Data Deficient	* = proposed reduction of status # = proposed increase of status

Scientific Name	Common Name	Status		Record			Distribution	Ecology	Threats	Likelihood		
		Aus	NT	MLA/Haul	Port	Survey				MLA	Haul	Port
BIRD												
<i>Amytornis dorotheae</i>	Carpentarian Grasswren	-	EN	4	-	-	Gulf of Carpentaria hinterland, between Limmen River, NT and Mount Isa, Qld.	NT population restricted to dissected, topographically complex, sandstone and conglomerate hills and plateaux with infrequent fires.	Changed fire regimes	may	likely	-
<i>Ardeotis australis</i>	Australian Bustard	-	VU*	2	2	M	Inland and north Australia. Small groups Territory-wide; more common in the north.	Open country preferring grasslands, low shrublands and grassy woodlands. Proposed downgrade of status to Least Concern.	Changed fire regimes, grazing	known	known	known
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	NE	3	-	-	South-east Australia and south-west WA. A vagrant to the NT.	Freshwater wetlands and lakes with tall reedbeds or rushes. Usually solitary.	Habitat alteration, agriculture	may	may	may
<i>Dromaius novaehollandiae</i>	Emu	-	VU*	2	-	M	Australia-wide apart from settled areas.	Wide variety of open and lightly-wooded habitats. Proposed downgrade of status to Near Threatened.	Changed fire regimes, grazing	known	known	may
<i>Erythrotriorchis radiatus</i>	Red Goshawk	VU	VU	4	-	-	Kimberley, Top End and North-east Australia.	Solitary and very thinly dispersed. Coastal and sub-coastal areas in wooded and forested lands, especially riverine forests. Frequently nests in the tallest tree within one km of permanent water.	Habitat clearance	likely	likely	may
<i>Erythrura gouldiae</i>	Gouldian Finch	EN	EN*	2,3	2	-	Sparsely distributed across northern Australia from the Kimberley to north-central Qld.	Favours annual and perennial grasses (especially <i>Sorghum</i>), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing <i>Eucalyptus</i> trees.	Changed fire regimes, grazing	known	known	may



SCIENTIFIC NAME	COMMON NAME	STATUS		RECORD			DISTRIBUTION	ECOLOGY	THREATS	LIKELIHOOD		
		Aus	NT	MLA/Haul	Port	Survey				MLA	Haul	Port
<i>Falcunculus frontatus whitei</i>	Crested Shrike-tit (northern)	VU	VU*	3	-	-	A narrow band between latitudes of 14°S and 17°S from the Kimberley, WA to Borrooloola, NT. Not recorded in the McArthur River-Borrooloola area for over 80 years.	Eucalyptus open woodlands - especially with <i>Eucalyptus opaca</i> , not dominated by a thick shrub-layer, and that are prone to being waterlogged seasonally. Proposed downgrade of status to Near Threatened.	Changed fire regimes	likely	likely	may
<i>Rostratula australis</i>	Australian Painted Snipe	VU	VU	1	2,3	-	Scattered across Australia - responsive to high rainfall.	Nomadic. Inhabits fringes of permanent and temporary wetlands, swamps and inundated grasslands.	Habitat alteration, agriculture	known	known	known
<i>Tyto novaehollandiae kimberli</i>	Masked Owl (northern)	VU	VU	3	3	-	Kimberley and Top End.	Eucalypt tall open forests (especially dominated by <i>Eucalyptus miniata</i> and <i>Eucalyptus tetradonta</i>). Probably occupy large exclusive home ranges (~5-10km ²).	Changed fire regimes	likely	likely	likely
FISH												
<i>Pristis clavata</i>	Dwarf Sawfish	VU	VU	3	3	-	Northern Australia from central WA to central Qld.	Inshore marine waters, estuaries, river mouths, and in waters adjacent to sandy and muddy beaches.	Fishing	may	likely	may
<i>Pristis microdon</i>	Freshwater Sawfish	VU	VU	3	3	-	Northern Australia from north-west WA to central Qld.	Juveniles and sub-adults inhabit muddy bottoms of freshwater areas and upper reaches of estuaries, adults prefer coastal and offshore waters up to 25m depth.	Fishing	may	likely	may
<i>Pristis zirjon</i>	Green Sawfish	VU	VU	3	3	-	Widely distributed in Indian and Pacific Oceans, but only from Darwin Harbour in the Northern Territory. Relatively common in eastern Gulf of Carpentaria.	Areas with a muddy substrate and is frequently found in shallow water. Inhabits marine inshore waters, estuaries, lagoons and freshwater, but most records are from marine and estuarine areas.	Fishing, habitat degradation	may	likely	may
MAMMAL												
<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	VU	VU#	3	3	-	North-west WA and north-west Top End within 130km of coast.	Moist areas with dense grassy understorey within coastal she-oak woodlands, sclerophyll forest and <i>Pandanus</i> thickets.	Grazing, changed fire regimes, feral cats	may	may	may
<i>Dasyurus hallucatus</i>	Northern Quoll	EN	CR	2,3	3	-	Five regional populations across Qld, the NT and WA. In the NT restricted to the Top End.	Originally a wide range of habitats, now mostly restricted to rocky areas.	Feral cats, disease, changed fire regimes and cane toads	may	known	may



SCIENTIFIC NAME	COMMON NAME	STATUS		RECORD			DISTRIBUTION	ECOLOGY	THREATS	LIKELIHOOD		
		Aus	NT	MLA/Haul	Port	Survey				MLA	Haul	Port
<i>Saccolaimus saccolaimus nudicluniat</i>	Bare-rumped Sheath-tailed Bat	CR	DD#	3	-	-	Few records for this sub-species - all from either Kakadu or Roper River, NT.	Open <i>Pandanus</i> woodland fringing the sedgelands of rivers. Also recorded in <i>Eucalypt</i> tall open forests.	Habitat clearance	may	may	may
<i>Xeromys myoides</i>	Water Mouse	VU	DD	3	3	-	Three disjunct populations in coastal region from Kimberley, WA to Brisbane, Qld. Patchily distributed in Top End of Northern Territory.	Saline grassland, mangroves, margins of freshwater swamps, lakes close to foredunes.	Habitat removal	may	may	may
REPTILE												
<i>Cryptoblepharus zoticus</i>	Agile Snake-eyed Skink	-	NE	2	-	-	Restricted range: greater southern Gulf hinterlands	Sandstone escarpments, outcrops and ridges.	-	likely	likely	-
<i>Ctenotus striaticeps</i>	Carpentarian Ctenotus	-	LC	1,2	-	-	Restricted range: greater southern Gulf hinterlands	Hard stony substrates with hummock grass understory.	-	likely	likely	may
<i>Elseya lavarackorum</i>	Gulf Snapping Turtle	EN	LC#	-	3	-	Rivers that discharge into the Gulf of Carpentaria, including Limmen, Roper, Robinson and Nicholson Rivers.	In deeper, permanent pools of steep, rocky gorges and river reaches with intact river banks.	Destruction of river banks by large introduced mammals	may	likely	may
<i>Gehyra borrooloola</i>	Borrooloola Dtella						Restricted range: greater southern Gulf hinterlands	Sandstone escarpments, outcrops and ridges.	-	likely	likely	-
<i>Varanus mertensi</i>	Mertens' Water Monitor	-	VU	2	-	H, M, P	Tropics and sub-tropics from the Kimberley, NT to Cape Yorke, Qld.	In water and along edges of watercourses and lagoons.	Cane toads	known	known	known
<i>Varanus panoptes</i>	Floodplain Monitor	-	VU	4	-	-	Tropics and sub-tropics from the Kimberley, NT to Brisbane, Qld.	Broad range of habitats.	Cane toads	likely	likely	likely



7.1.2 Migratory Shorebirds

The Gulf of Carpentaria is recognised as an extremely important area for seabirds and shorebirds, including many that are listed under the EPBC Act. The extensive intertidal mudflats of both the Limmen Bight and the McArthur River floodplains are among the most important areas for migratory shorebirds in the Northern Territory due to the high biomass in the extensive soft sediment habitats which provide an abundant food source (Chatto and Baker 2008). They are both listed Sites of Conservation Significance (SOCS).

McArthur River SOCS

Large concentrations of shorebirds (more than 5,000) have been counted near the mouth of the McArthur River, which is an important staging area for migratory birds (Environment Australia 2001).

Chatto (2003) undertook targeted shorebird surveys along the coast of the Northern Territory. Within the survey 'block' that incorporates Bing Bong Port the five most abundant shorebird species were found to be:

- Black-tailed Godwit (*Limosa limosa*);
- Great Knot (*Calidris tenuirostris*);
- Red-necked Stint (*Calidris ruficollis*);
- Curlew Sandpiper (*Calidris ferruginea*); and
- Bar-tailed Godwit (*Limosa lapponica*).

Currently all these species are listed as Least Concern under the TWPC Act, however proposed changes to the list of threatened species recommend Great Knot and Curlew Sandpiper be listed as Vulnerable, and Bar-tailed Godwit as Endangered.

Consultants acting on behalf of McArthur River Mine have undertaken migratory bird surveys and documented a significant increase in migratory shorebirds in the most recent survey in comparison with previous counts in 2008 and 2003 (EMS cited in Xstrata Zinc 2010). The surveys were noted to highlight "the importance of the Port McArthur area, east of Bing Bong, as a nationally and globally significant migratory bird staging area and indicated that the Bing Bong Port area is not used by a large number of birds" (Xstrata Zinc 2010).

This conclusion concurs with our field surveys and habitat analysis. The port of Bing Bong lies on the westernmost extent of the McArthur River floodplain (see Figure 47). There is far less suitable habitat for shorebirds at this extreme – the intertidal zone being narrower and much sandier than the mudflats closer to the river mouth. Ground surveys around the port area yielded few shorebirds (in numbers and species), and the helicopter survey disturbed only two flocks of a few hundred birds in each, and these were more than ten kilometres from the port.

Limmen Bight SOCS

Limmen Bight SOCS is approximately 40km downstream of the MLA areas. Counts of more than 38,000 shorebirds have been recorded in the Limmen Bight (in a survey done at a time when a number of the migratory shorebird species would have already departed) with flocks in numerous, well spread sites (Chatto 2003). Internationally significant numbers of the following shorebirds have been recorded (NRETAS 2009):

- Great Knot (*Calidris canutus*);
- Black-tailed Godwit (*Limosa limosa*);
- Red Knot (*Calidris canutus*);
- Grey-tailed Tattler (*Tringa brevipes*); and
- Black-winged Stilt (*Himantopus himantopus*).

Currently all these species are listed as Least Concern under the TWPC Act, however proposed changes to the list of threatened species recommend Great Knot is listed as Vulnerable.

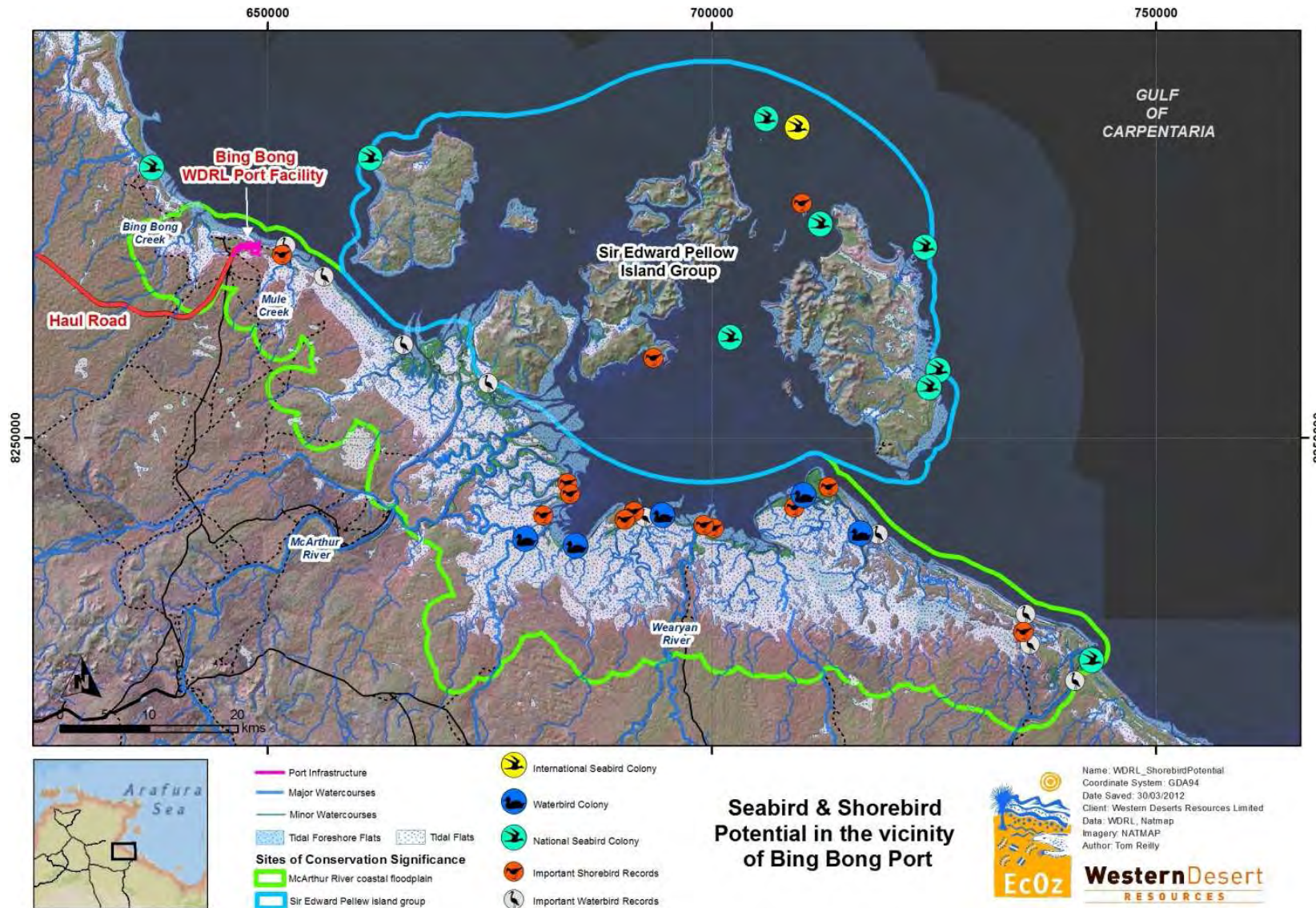


Figure 47: Location of port in relation to known seabird, waterbird, and shorebird colonies

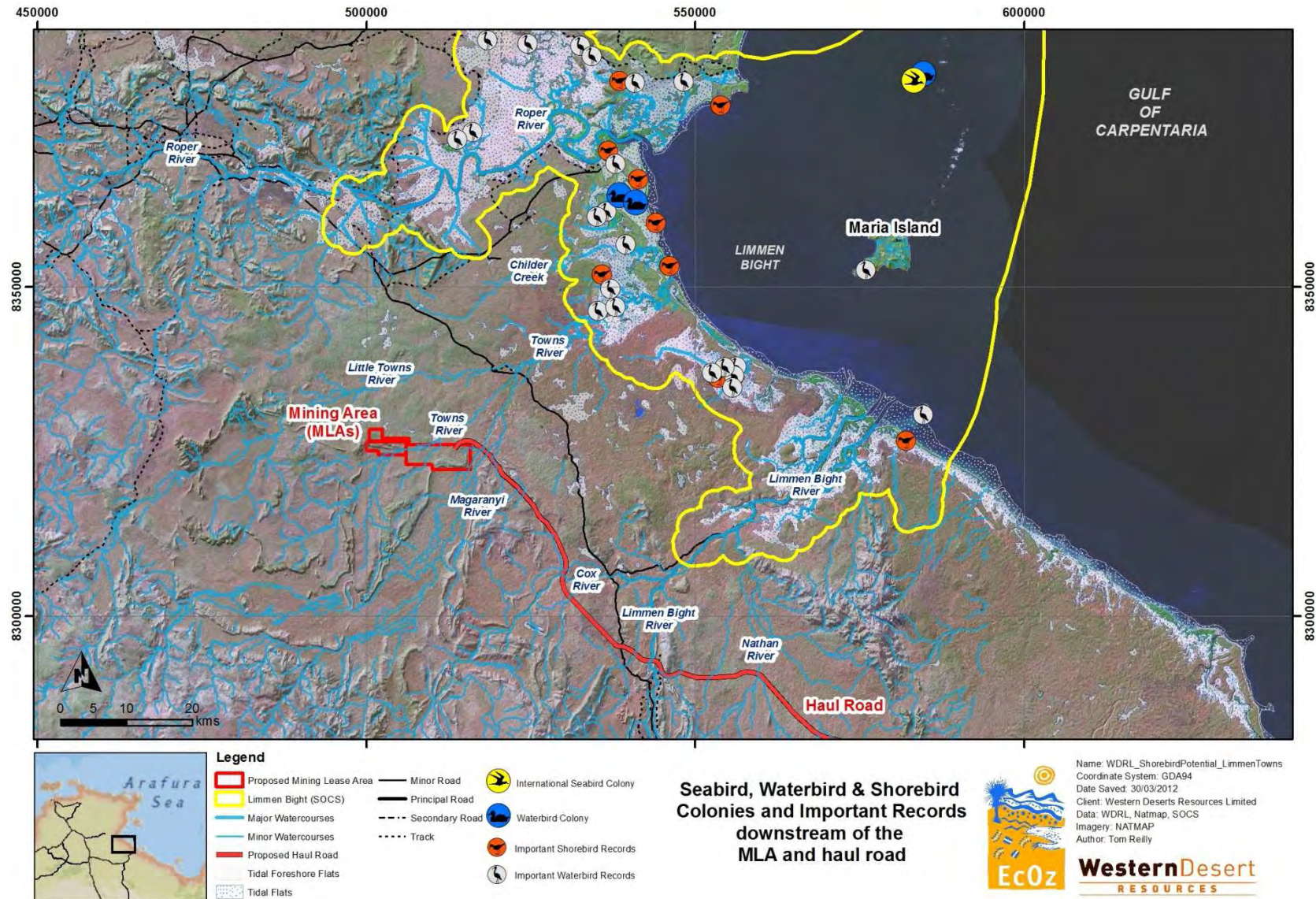


Figure 48: Location of MLA and haul road in relation to known seabird, waterbird, and shorebird colonies



7.1.3 Notable Fauna Records

As is to be expected the field surveys of the MLA / Haul Road and of the port facility yielded less species than the cumulative historic records of the desktop surveys. It is interesting to note, however, that both MLA areas and haul road corridor field surveys found fauna species which have not been previously recorded within the data search area (Table 26). Included are common birds such as Australasian Pipit (*Anthus novaeseelandiae*) and White-throated Needletail (*Hirundapus caudacutus*), highlighting how under-surveyed the Gulf bioregions are. More significantly, the Carpenter Frog (*Limnodynastes lignarius*) record represents a ~400km range extension. The observation of Long-footed Frog (*Litoria longipes*) at two sites places this species in the middle of this previously record-deficient region.

Table 26: Species recorded in field surveys that have not been not previously recorded

Scientific Name	Common Name	Where found
MAMMAL		
<i>Demansia simplex</i>	Grey Whip Snake	MINE
<i>Isodon macrourus</i>	Brown Bandicoot	PORT
BIRD		
<i>Anthus novaeseelandiae</i>	Australasian Pipit	HAUL
<i>Calidris alba</i>	Sanderling	PORT
<i>Chalcites osculans</i>	Black-eared Cuckoo	MINE
<i>Esacus magnirostris</i>	Beach Stone-curlew	PORT
<i>Falco peregrinus</i>	Peregrine Falcon	PORT
<i>Gerygone levigaster</i>	Mangrove Gerygone	PORT
<i>Hirundapus caudacutus</i>	White-throated Needletail	MINE
<i>Hydroprogne caspia</i>	Caspian Tern	PORT
<i>Megalurus timoriensis</i>	Tawny Grassbird	PORT
<i>Numenius madagascariensis</i>	Eastern Curlew	PORT
<i>Pachycephala simplex</i>	Grey Whistler	MINE
<i>Pluvialis squatarola</i>	Grey Plover	PORT
AMPHIBIAN		
<i>Limnodynastes convexiusculus</i>	Marbled Frog	HAUL
<i>Limnodynastes lignarius</i>	Carpenter Frog	HAUL
REPTILE		
<i>Brachyuophis semifasciatus</i>	Half-girdled Snake	HAUL
<i>Chelodina canni</i>	Cann's Long-necked Turtle	PORT
<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko	MINE
<i>Liasis fuscus</i>	Water Python	PORT
<i>Varanus gouldii</i>	Sand Monitor	MINE, HAUL



7.1.4 Proposed Status Changes

In 2010, the Northern Territory Government initiated a review of the conservation status of all species in the Northern Territory. There have been two rounds of public consultation on the Threatened Species list. Although the final findings are yet to be released, a list of proposed changes following the first round of public consultation have been published. On that list are six species known or likely to occur within the proposed development site (see Table 27).

Table 27: Recorded species with proposed increase in threatened status

Scientific Name	Common Name	Current Status	Proposed Status	Records
<i>Varanus mitchelli</i>	Mitchell's Water Monitor	DD	VU	Haul road / MLA (desktop)
<i>Pseudechis australis</i>	King Brown Snake	LC	NT	MLA (desktop), Haul road (field)
<i>Hipposideros stenotis</i>	Northern Leaf-nosed Bat	LC	VU	MLA (analysis)
<i>Rattus tunneyi</i>	Pale Field Rat	NT	VU	MLA (desktop)
<i>Isodon macrourus</i>	Northern Brown Bandicoot	LC	NT	Port (field)
<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	VU	EN	Haul road, MLA, port (EPBC)

7.1.5 Comparison with 1996 Field Surveys

In 1996 a wildlife field survey was undertaken in the area of the then-proposed Limmen Gate National Park by the NTPWC (Griffiths *et al.* 1997). Forty-five quadrats were surveyed in seven major habitats between April and June – Table 28 summarises the results. The MLA areas and haul road are located within and adjacent to the habitat surveyed in 1996. A comparison of that survey with the combined MLA / haul road field surveys for this report is largely congruent, with only total reptile species varying significantly. The 1996 survey identified 28% more reptile species than the field surveys in this report, possibly reflecting seasonal differences in activity.

Table 28: Comparison of 1996 and 2011-2 survey totals

	Field	Limmen Gate
Amphibian	17	13
Reptile	42	54
Bird	120	118
Mammal	23	24
TOTAL	202	209

The 1996 survey report made a number of general observations:

- Reptile species richness did not correspond with any one particular vegetation type, but a distinct reptile fauna was associated with sandstone habitats. As the field surveys undertaken for this report found far fewer reptile species no patterns of habitat association could be discerned;
- Avian richness was highest in riparian forests and lowest in *Eucalyptus foelscheana* low open woodland. This correlates with proximity to water and floristic diversity. For the MLA areas and haul road a similar correlation between proximity to water and avian richness was identified – the most bird species recorded within the MLA areas, by far, was at riparian site. Similarly for the haul road both a riparian site and a ridge site adjacent to a creek had the highest avian richness;



- Mammal fauna was relatively poor and significantly restricted to rocky sandstone ranges (possibly because they provide refuges from habitat degradation caused by cattle). Very few small mammals such as dasyurids and rodents were recorded. In contrast, for this report, of the 18 species of native mammals recorded within the MLA areas and haul road surveys, half were small mammals. The rocky sandstone site at Rosie contained the highest mammal richness;
- Five bat species were recorded – a low tally likely due to inadequate sampling. The field surveys for this report yielded ten confirmed species, and a few more whose call records are ambiguous; and
- Amphibian fauna was relatively rich, featuring species able to live in wide variety of habitats. The field surveys for this report have added four more species.

7.2 Flora

One threatened species (under EPBC or TPWC Acts) was identified during desktop review, and none were detected during field surveys of the project area (desktop searches includes an extensive area surrounding the project area – see Figure 10). The proposed Limmen National Park (currently under declaration process) is known to support a high number of data deficient species for the Northern Territory. This report included all data deficient and near threatened species as 'notable species' and Table 29 identifies the likelihood of these species occurring within the proposed project boundaries.

Note that all voucher specimens of data deficient species were submitted to the NT Herbarium (in Darwin) to add to their collection and help fill current information gaps.

7.2.1 Priority Flora Species

The one threatened flora species identified as potentially occurring within the project area was *Solanum carduiforme* (of the bush tomato group), which is Vulnerable under the EPBC Act and Data Deficient in the Northern Territory. This species has been previously recorded in the Limmen Gate area, approximately 40km to the south of the haul road corridor. This species is known to occur on conglomerate rock formations and larger sandstone ridges.



Table 29: Notable flora species within the project area

Table Key	VU – Vulnerable
	NT – Near Threatened
	LC – Least Concern
	NE – Not Evaluated
	DD – Data Deficient

SCIENTIFIC NAME	Status		DISTRIBUTION	ECOLOGY	Existing Records	LIKELIHOOD		
	Aus	NT				Mine	Haul	Port
AMARANTHACEAE								
<i>Omegandra kanisii</i>	-	NT	Kakadu, Gulf of Carpentaria, NE QLD.	Coastal plains and riparian areas with some tidal influence.	Recorded from the Roper and Macarthur Rivers.	may	may	likely
<i>Tecticornia halocnemoides subsp. tenuis</i>	-	DD	Coastal VRD & Gulf.	Coastal chenopod shrub lands with saline influence.	Recorded in the vicinity of Bing Bong.	may	may	likely
<i>Gomphrena humilis</i>	-	DD	In the NT occurs in the Gulf Fall Uplands and Gulf Coastal Bioregions. Also QLD.	Recorded on swampy grassland and gravelly laterite ridges and roadsides in the NT.	Recorded in the vicinity of Bing Bong.	may	may	likely
APONOGETONACEAE								
<i>Aponogeton queenslandicus</i>	-	DD	Two NT records in Gulf. Widely distributed in QLD.	Rooted aquatic in Melaleuca dominated swamp.	Recorded in Limmen Bight River catchment.	may	likely	may
ARECACEAE								
<i>Arenga australasica</i> (Australian Sugar Palm)	VU	-	Far northern coastline of NT. Also Queensland.	Restricted to permanently wet, well developed rainforest.	Not recorded in the Roper Catchment.	may	may	may
BORAGINACEAE								
<i>Heliotropium prostratum</i>	-	DD	Most records in NT from Gulf coastal and Gulf Fall Uplands Bioregions, QLD.	Sandy, gravelly soils in a variety of habitats.	Recorded in all gulf catchments from the Towns to McArthur River.	may	may	likely
<i>Heliotropium leptaleum</i>	-	DD	Most NT records south of 15 degrees. Also WA, QLD, SA.	Sandy soils including creeks and levees.	Recorded from the Limmen Bight River catchment.	may	likely	may
CLEOMACEAE								
<i>Cleome oxalidea</i>	-	DD	Most records from semi-arid NT. Gulf records from the northern fringes of population. Also QLD, WA.	In Gulf recorded from wet habitats adjacent to rivers or swamps.	Recorded in Towns River and Limmen Bight River catchments.	may	may	may
CONVULVULACEAE								
<i>Ipomoea brassii</i>	-	DD	In NT, recorded from Rosie Creek catchment and from the NT/QLD Border. Also QLD.	In watercourses and seasonally inundated Melaleuca woodland.	Recorded from Rosie Creek and Nicholson River catchments.	may	may	may
CYPERACEAE								



SCIENTIFIC NAME	Status		DISTRIBUTION	ECOLOGY	Existing Records	LIKELIHOOD		
	Aus	NT				Mine	Haul	Port
<i>Fimbristylis dolera</i>	-	DD	Catchments of rivers feeding into the Gulf of Carpentaria, in NT. Also Qld	Annual species found on edges of shallow seasonal Melaleuca swamps.	Roper River, Cox River, Towns River, Limmen Bight River catchments.	known	likely	may
<i>Fimbristylis subaristata</i>	-	DD	Kimberley WA, NT, Top End, North QLD.	Annual sedge in woodlands on gravelly sandy substrates.	Not previously recorded from Gulf Fall and Uplands Bioregion.	known	may	may
DROSERACEAE								
<i>Drosera fulva</i>	-	DD	Darwin region to Gulf and North QLD.	Seasonally wet Melaleuca woodlands (in Gulf).	Recorded in Towns River catchment.	known	likely	likely
ERIOCAULACEAE								
<i>Eriocaulon carpentariae</i>	-	DD	Distribution centred on the Gulf of Carpentaria.	On edges of seasonal swamps and lagoons.	Most gulf records from the McArthur River catchment.	may	may	likely
FABACEAE								
<i>Tephrosia procera</i>	-	NT	Most records in NT Victoria Bonaparte Bioregion with several records in the Gulf Coastal Bioregion.	Perennial tall shrub that occurs on sandy soils (including coastal) and sandstone woodland in the NT.	Recorded from Coastal situation East of McArthur River.	may	may	likely
GOODENIACEAE								
<i>Goodenia quadrifida</i>	VU	-	Far north coast, coastal floodplains.	Restricted to flood plain edges on the Adelaide and Mary Rivers.	Not Recorded in the Roper catchment.	may	may	may
<i>Goodenia malvina</i>	-	DD	In NT, most records from Gulf Fall Uplands. WA – Ord and Kimberly.	Cracking clay grasslands/ swamps.	Recorded in Roper River catchment, Limmen Bight River catchment.	may	likely	may
<i>Goodenia minutiflora</i>	-	DD	In NT most records in Gulf Fall Uplands and Gulf Coastal.	Occurs in cracking clay and heavy clay seasonally inundated depressions.	Recorded in Roper River catchment, Limmen Bight River catchment.	may	likely	may
HALORAGACEAE								
<i>Gonocarpus implexus</i>	-	DD	WA, Kimberly. NT Arnhem Plateau and Gulf Coastal.	Associated with damp sand areas (seepage, streamside) in Sandstone dominated areas.	Recorded in Limmen Bight River catchment.	may	likely	may
HYDROCHARITACEAE								
<i>Vallisneria caulescens</i>	-	DD	In the NT, Alligator Rivers area and McArthur River. QLD, WA.	Submerged aquatic in near-coastal fresh water lagoons.	Recorded in the vicinity of Bing Bong.	may	may	likely
<i>Najas pseudograminea</i>	-	DD	NT Top End, Gulf Coastal bioregion. Also WA – Kimberly.	Submerged aquatic on seasonal swamps.	Recorded from the Cox River catchment.	may	likely	may
JUNCAGINACEAE								
<i>Triglochin multifructa</i>	-	DD	Disjunct distribution near Bing Bong in the NT. Also QLD, NSW.	Submerged aquatic in near coastal fresh water lagoons.	Recorded in the vicinity of Bing Bong.	may	may	likely
LAURACEAE								
<i>Endiandra limnophila</i> (Native Walnut)	-	VU	Top End of NT, near coast.	Occurs in well-developed wet rainforest in the far north west NT.	Not recorded in the Roper catchment.	may	may	may



SCIENTIFIC NAME	Status		DISTRIBUTION	ECOLOGY	Existing Records	LIKELIHOOD		
	Aus	NT				Mine	Haul	Port
LENTIBULARIACEAE								
<i>Utricularia simmonsii</i>	-	DD	Disjunct records from near Darwin, Gulf Coastal Bioregion and north Queensland.	In Gulf, growing on sandy mud substrates in association with shallow flowing streams in Melaleuca swamps.	Recorded from Limmen Bight River catchment.	may	likely	may
LOGANIACEAE								
<i>Mitrasacme patens</i>	-	DD	In NT recorded from Katherine and Limmen Bight Catchment. Also QLD.	In Gulf recorded from sandy soils with <i>Melaleuca viridiflora</i> .	Recorded from Limmen Bight River catchment & Vanderlin Island.	may	may	may
LORANTHACEAE								
<i>Amyema herbertiana</i>	-	DD	In NT, recorded in Gulf River Catchments.	Recorded growing on <i>Melaleuca citrolens</i> .	Recorded from Limmen Bight, Roper and McArthur River catchments.	may	may	may
LYTHRACEAE								
<i>Nesaea crinipes</i>	-	DD	Most NT records within Gulf Coastal and Gulf Fall and Uplands Bioregion.	Spreading herb found on edges of waterholes, swamps and damp situations.	Recorded in the vicinity of Bing Bong.	may	likely	likely
MENYANTHACEAE								
<i>Nymphoides exiliflora</i>	-	DD	Eastern Top End and Gulf Coastal Bioregion. Widespread in eastern QLD.	Margins of shallow swamps.	Not Previously recorded from Gulf Fall and Uplands Bioregion	known	likely	likely
OHPIOGLOSSACEAE								
<i>Ophioglossum gramineum</i>	-	NT	Australia-wide.	Damp depressions, often poorly drained.	Previously recorded from Gulf Fall and Uplands and Gulf Coastal Bioregions.	known	likely	likely
OROBANCHACEAE								
<i>Rhamphicarpa australiensis</i>	-	NT	In NT most records north of 20 degrees.	Occurs on swamp and stream edges.	Recorded from Limmen Bight catchment.	may	likely	may
PEDALIACEAE								
<i>Josephinia imperatricis</i>	-	NT	Most NT records on near coastal islands. Disjunct record in Gulf Coastal Bioregion. Also QLD.	In Gulf recorded as found growing in a lawn.	Recorded from Nathan River Homestead.	may	may	may
PHRYMACEAE								
<i>Peplidium maritimum</i>	-	NT	NT, WA, QLD, NSW.	Estuarine, sub tidal and near coastal lagoons in the NT.	Recorded in the vicinity of Bing Bong.	may	may	known
PHYLLANTHACEAE								
<i>Sauropus hubbardii</i>	-	NT	NT endemic. Most records on cracking clay habitats between the latitudes of 15 & 20 degrees.	Sub shrub of heavy clay soil plains with sparse tree layer.	Recorded from the Limmen Bight River catchment.	may	likely	may



SCIENTIFIC NAME	Status		DISTRIBUTION	ECOLOGY	Existing Records	LIKELIHOOD		
	Aus	NT				Mine	Haul	Port
<i>Dicarpidium monoicum</i>	-	DD	Scattered across northern WA, NT and Qld.	Sub shrub of sandstone escarpments.	Recorded in Limmen Bight and McArthur River catchments.	may	likely	may
<i>Poranthera microphylla</i>	-	DD	Scattered throughout the NT and in all states.	Damp sand and seasonal seepage areas in Northern NT.	Recorded in Limmen Bight and McArthur River catchments.	may	likely	known
POACEAE								
<i>Cymbopogon dependens</i>	-	DD	In NT, far southern NT and Top End. Also WA.	In Northern NT, on rock walls & rocky slopes – often sandstone.	Recorded from Limmen Bight and Little Towns River catchments.	may	likely	may
<i>Enteropogon minutu</i>	-	DD	In the NT, most records from the Roper and Gulf of Carpentaria River Catchments. Also QLD.	Riparian grass on heavy clay soil river systems.	Recorded from Roper, Limmen Bight and McArthur River catchments.	may	likely	may
<i>Eragrostis concinna</i>	-	DD	NT Top End, Gulf Coastal and Gulf Fall Uplands. QLD Gulf of Carpentaria Bioregions.	Most NT records associated with heavy clay soil swamps or grasslands.	Recorded from Limmen Bight River catchment.	may	likely	may
<i>Eriachne vesiculosa</i>	-	DD	Patchily distributed In Northern NT. Most records in Gulf of Carpentaria.	Occurs in riparian and alluvial situations on light soils.	Recorded from Foelsche and Limmen Bight River catchments.	may	likely	may
<i>Ischaemum australe var. villosum</i>	-	DD	In NT, Southern Top End.	Perennially moist swamps or creek lines.	Recorded from Limmen Bight River catchment.	may	likely	may
<i>Hygrochloa cravenii</i>	-	DD	Scattered from near Darwin to Bing Bong.	Emergent aquatic grass in shallow swamps.	Recorded in many Gulf catchments	known	likely	may
<i>Triodia latzii</i>	-	NT	Most records in Gulf Coastal and Gulf Fall Uplands, also Tanami.	Hummock grass on rocky and sandy substrates.	Recorded in many Gulf catchments	likely	likely	may
RUBIACEAE								
<i>Oldenlandia mitrasacmoides subsp. nigricans</i>	-	DD	In NT recorded from Groote Eylandt and Limmen Bight River catchment. Also QLD. One record in Arnhemland. Other records from Gulf of Carpentaria inland to the Sturt Plateau.	In Gulf, recorded on silty sand near watercourses.	Recorded from Limmen Bight River catchment.	may	may	may
<i>Psydrax saligna</i>	-	DD		Shrub to small tree associated with sandstone escarpments, often as base of slopes.	Recorded from Limmen Bight River catchment.	may	likely	may
<i>Psydrax paludosa</i>	-	DD	Gulf, Towns River catchment to Bing Bong area.	Tall perennial shrub growing in shallow swamps and minor creek lines with <i>Asteromyrtus symphyocarpa</i> .	Towns River catchment, Bing Bong area.	known	may	known
<i>Spermacoce brachystema</i>	-	DD	Most NT records in semi-arid areas. Also WA, QLD, NSW.	Sandy soils with gravelly substrates.	Limmen Bight catchment and in the vicinity of Bing Bong.	may	may	may
SOLANACEAE								
<i>Solanum carduiforme</i> (Thorny Solanum)	VU	-	Kimberly WA, eastern Kimberly NT and the Gulf of Carpentaria hinterland NT.	Occurs on skeletal soils and outcrop (mostly sandstone).	Recorded in the Towns River catchment.	may	likely	may



7.3 Sensitive Habitat

7.3.1 MLA Areas

None of the vegetation communities are listed under any legislation (TPWC or EPBC Acts) but some types are locally noteworthy from the perspective of conserving habitat which is in good condition, features more of the atypical species, or contributes to the hydrology and connectivity within this mid part of the Towns catchment. The communities considered locally notable are listed below and described in Section 4.8.

- *Melaleuca* Woodlands (seasonally inundated areas);
- *Eucalyptus camaldulensis* Woodlands (riparian);
- Tall *Eucalyptus tetrodonta* and *Erythrophleum chlorostachys* Woodland and *Callitris* Woodland; and
- *Corymbia polycarpa* Mid Woodland (associated with a localised seepage zone or ephemeral spring)

These vegetation communities are widespread in the region, but retain important biodiversity values (i.e. shelter for fauna, refuge, hollows, permanent water, food resource etc.) that are worthy of management consideration during the development of the mine plan. WDRL have aimed to reduce impact on these communities where possible during the construction of the mine and associated infrastructure.

7.3.2 Haul Road

There are no listed or formally recognised areas of conservation significance along the proposed haul road route. Aside from a number of localities featuring low sandstone ridges, riparian vegetation and wetlands, none of other higher priority vegetation types such as rainforest, monsoon vine thicket and monsoon forest were found within the haul road survey area (which included a 6 km corridor).

However, a number of localities do present particular value for biodiversity on a regional scale. Surveys along the haul road corridor focused on identifying and assessing the value of sensitive habitat or habitat of higher conservation value that should be avoided, and potentially buffered from the development. These sensitive habitats are listed below and described in full in Section 5.6.

- Rocky Sandstone Ridges (includes scattered occurrences of low rocky hills, and also the southern reaches of the Yiyintyi Ranges);
- Waterbodies (includes *Melaleuca* swamps and seasonally inundated lowlands); and
- Watercourses (includes major rivers, and smaller creek and tributary crossings).

Coordinates for all surveyed locations of sensitive habitat has been provided to WDRL for use in determining the route of lowest environmental impact between the MLA areas and Bing Bong Port. The main areas that were prioritised for environmental consideration for the design and alignment of the haul road alignment are Limmen River crossing, and ridges and rocky hills to the east of Limmen River and west of Rosie Creek crossing.

7.3.3 Port Facility

None of the vegetation communities associated with the Bing Bong Port facility are listed under any legislation (TPWC or EPBC Acts). However, some vegetation types are locally noteworthy from the perspective of conserving habitat which is in good condition, features more of the atypical species, maintains landform stability, or contributes to the hydrology and connectivity of this coastal community. The vegetation communities considered locally sensitive are listed below and are outline in Section 6.5.

- Mangroves
- Monsoon Vine Thicket Community
- Cypress Pine Woodland
- *Melaleuca* Swamp



D-8. Further Biological Investigations

Recommendations for further studies and ongoing monitoring to fill in information gaps revealed in the compilation of this report are:

- **Identification and surveying of potential habitat for the following species**
 - o Northern Quoll (*Dasyurus hallucatus*) – surveys to focus on the escarpment crossing adjacent to Limmen River, as this is the only location identified within the project area to possibly support Northern Quoll.
 - o Freshwater Sawfish (*Pristis microdon*) – surveys to focus on all major river systems downstream of the MLA areas and haul road.
 - o Carpentarian Grasswren (*Amytornis dorotheae*) – surveys to focus around escarpments and rocky hills adjacent to Limmen River and Rosie Creek, as these locations are the only locations within the project area to possibly support Carpentarian Grasswrens.
- **Weed Surveys**
 - o Bing Bong Port facility (as this is a potential weed source – spread potential – during haul road construction and operation/road maintenance).
 - o Complete weed survey of final haul road alignment (covering up and downstream environments) to gain a baseline of weed infestations in the project area, which will be an auditable item post approvals).
- **Habitat Assessments and Other Investigations**
 - o Flora and habitat surveys of locations chosen as haul road construction sources (i.e. gravel pits, borrow pits, scapes etc.).
 - o General fauna assessment (may or may not require a trapping program) in locations chosen as haul road construction sources (i.e. gravel pits, borrow pits, scapes etc.).



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Appendix D-1 – Total Fauna Species List



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Table 1-1: List of fauna species for the entire project area as identified from desktop and field surveys, as well as distribution analysis.

Table Key				
1 = Atlas of Living Australia	CR = Critically Endangered	DD = Data Deficient	* = proposed reduction of status	H = Haul Rd
2 = NT Atlas (inc Museum)	EN = Endangered	LC = Least Concern	# = proposed increase of status	M = Mine
3 = EPBC	VU = Vulnerable	(Int) = Introduced		P = Port
4 = Distribution occurs within area	NT = Near Threatened	NE = Not Evaluated		
5 = WDRL geologist (birds)				

SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD		
		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
BIRD								
ACANTHIZIDAE								
Gerygone albogularis	White-throated Gerygone	-	LC	-	-	1,2,5	1,2	H,M,P
Gerygone chloronota	Green-backed Gerygone	-	LC	-	-	1,2	-	M
Gerygone levigaster	Mangrove Gerygone	-	LC	-	-	-	1,2	P
ACCIPITRIDAE								
Accipiter cirrocephalus	Collared Sparrowhawk	-	LC	-	-	1,2	2	M,P
Accipiter fasciatus	Brown Goshawk	-	LC	-	x	1,2,5	1,2	H,M
Accipiter novaehollandiae	Grey Goshawk	-	LC	-	-	1	-	-
Aquila audax	Wedge-tailed Eagle	-	LC	-	-	1,2,5	1,2	M
Circus approximans	Swamp Harrier	-	LC	-	x	-	1,2	-
Circus assimilis	Spotted Harrier	-	LC	-	-	1,2	-	M
Elanus axillaris	Black-shouldered Kite	-	LC	-	-	-	1,2	-
Haliaeetus leucogaster	White-bellied Sea-eagle	-	LC	x	x	2	1,2	H,M,P
Haliastur indus	Brahminy Kite	-	LC	-	x	1,2	1,2	-
Haliastur sphenurus	Whistling Kite	-	LC	-	x	1,2,5	1,2	H,M,P
Hamirostra melanosternon	Black-breasted Buzzard	-	LC	-	-	1,2	-	-
Hieraaetus morphnoides	Little Eagle	-	LC	-	-	1,2	1	H
Lophoictinia isura	Square-tailed Kite	-	NT	-	-	1	-	-
Milvus migrans	Black Kite	-	LC	-	-	1,2,5	1,2	P
Pandion cristatus	Eastern Osprey	-	LC	x	x	1,2	1,2	P
ACROCEPHALIDAE								
Acrocephalus australis	Australian Reed-Warbler	-	NT	-	x	4	4	-
AEGOTHELIDAE								
Aegotheles cristatus	Australian Owlet-nightjar	-	LC	-	-	1,2,5	-	M
ALAUDIDAE								
Mirafrja javanica	Singing Bushlark	-	LC	-	-	1,2	1,2	-
ALCEDINIDAE								
Ceyx azureus	Azure Kingfisher	-	LC	-	-	1,2	1,2	H
ANATIDAE								
Anas gracilis	Grey Teal	-	LC	-	-	1,2	1,2	-
Anas superciliosa	Pacific Black Duck	-	LC	-	-	1,2	1,2	H,P
Aythya australis	Hardhead	-	LC	-	-	1,2	1,2	-
Dendrocygna arcuata	Wandering Whistling-Duck	-	LC	-	x	1,2	1,2	H
Dendrocygna eytoni	Plumed Whistling-Duck	-	LC	-	-	1,2,5	-	M*, P



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD		
		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	-	LC	-	-	1,2	1,2	-
<i>Nettapus pulchellus</i>	Green Pygmy-Goose	-	LC	-	x	1,2	1,2	P
<i>Tadorna radjah</i>	Radjah Shelduck	-	LC	-	x	1,2	-	P
ANHINGIDAE								
<i>Anhinga novaehollandiae</i>	Australasian Darter	-	LC	-	-	1,2	1,2	M
ANSERANATIDAE								
<i>Anseranas semipalmata</i>	Magpie Goose	-	LC	-	x	1,2,3	1,2,3	M
APODIDAE								
<i>Apus pacificus</i>	Fork-tailed Swift	-	LC	x	x	-	1,2	-
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	NE	-	x	-	-	M
ARDEIDAE								
<i>Ardea ibis</i>	Cattle Egret	-	LC	x	x	1,2	-	-
<i>Ardea intermedia</i>	Intermediate Egret	-	LC	-	x	1,2,5	1,2	-
<i>Ardea modesta</i>	Eastern Great Egret	-	LC	x	x	1,2,5	1,2	M*
<i>Ardea pacifica</i>	White-necked Heron	-	LC	-	-	1,2,5	1,2	M
<i>Ardea sumatrana</i>	Great-billed Heron	-	LC	-	-	1,2	1,2	-
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	NE	-	-	3	-	-
<i>Butorides striata</i>	Striated Heron	-	LC	-	-	1,2	1,2	P
<i>Egretta garzetta</i>	Little Egret	-	LC	-	x	1,2	1,2	M,P
<i>Egretta novaehollandiae</i>	White-faced Heron	-	LC	-	-	1,2,5	1,2	-
<i>Egretta picata</i>	Pied Heron	-	LC	-	-	1,2	1,2	P
<i>Egretta sacra</i>	Eastern Reef Egret	-	LC	x	x	-	1,2	-
<i>Ixobrychus flavicollis</i>	Black Bittern	-	DD	-	-	1,2	1	M
<i>Nycticorax caledonicus</i>	Nankeen Night Heron	-	LC	-	x	1,2,5	1,2	H,M
ARTAMIDAE								
<i>Artamus cinereus</i>	Black-faced Woodswallow	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	-	LC	-	-	1,2	-	H
<i>Artamus minor</i>	Little Woodswallow	-	LC	-	-	1,2,5	-	H,M
<i>Artamus personatus</i>	Masked Woodswallow	-	LC	-	-	1,2	-	H
<i>Artamus superciliosus</i>	White-browed Woodswallow	-	LC	-	-	1	-	-
<i>Cracticus nigrogularis</i>	Pied Butcherbird	-	LC	-	-	1,2,5	1,2	H,M
<i>Cracticus tibicen</i>	Australian Magpie	-	LC	-	-	1,2,5	1,2	M
BURHINIDAE								
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	NT	-	-	1,2,5	-	H,M
<i>Esacus magnirostris</i>	Beach Stone-curlew	-	LC	-	x	-	1,2	P
CACATUIDAE								
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	-	LC	-	-	1,2	1,2	H,P
<i>Cacatua sanguinea</i>	Little Corella	-	LC	-	-	1,2	1,2	P
<i>Calyptorhynchus banksii</i>	Red-tailed Black-cockatoo	-	LC	-	-	1,2,5	1,2	H,M
<i>Eolophus roseicapilla</i>	Galah	-	LC	-	-	1,2,5	1,2	H,M
<i>Nymphicus hollandicus</i>	Cockatiel	-	LC	-	-	1,2	1,2	H
CAMPEPHAGIDAE								
<i>Coracina maxima</i>	Ground Cuckoo-shrike	-	LC	-	-	1	-	-
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	LC	-	x	1,2,5	1,2	H,M,P
<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	-	LC	-	x	1,2,5	1,2	H,M



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		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Coracina tenuirostris</i>	Cicadabird	-	LC	x	x	1	-	-
<i>Lalage leucomela</i>	Varied Triller	-	LC	-	-	1,2	-	-
<i>Lalage sueurii</i>	White-winged Triller	-	LC	-	-	1,2,5	1,2	H,M,P
CAPRIMULGIDAE								
<i>Caprimulgus macrurus</i>	Large-tailed Nightjar	-	LC	-	x	5	-	-
CASUARIIDAE								
<i>Dromaius novaehollandiae</i>	Emu	-	VU	-	-	1,2	-	M
CHARADRIIDAE								
<i>Charadrius leschenaultii</i>	Greater Sand Plover	-	LC	x	x	2	1,2	P
<i>Charadrius mongolus</i>	Lesser Sand Plover	-	LC	x	x	-	1,2	-
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	LC	-	x	2	1,2	-
<i>Charadrius veredus</i>	Oriental Plover	-	LC	x	x	2	-	-
<i>Euseyonis melanops</i>	Black-fronted Dotterel	-	LC	-	x	1,2	1,2	-
<i>Erythronyx cinctus</i>	Red-kneed Dotterel	-	LC	-	x	1	1,2	-
<i>Pluvialis fulva</i>	Pacific Golden Plover	-	LC	x	x	-	2	-
<i>Pluvialis squatarola</i>	Grey Plover	-	LC	x	x	-	1,2	P
<i>Vanellus miles</i>	Masked Lapwing	-	LC	-	-	2,5	1,2	M,P
CICONIIDAE								
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	LC	-	-	1,2,5	1,2	M,P
CISTICOLIDAE								
<i>Cisticola exilis</i>	Golden-headed Cisticola	-	LC	-	-	1,2	1,2	P
<i>Cisticola juncidis</i>	Zitting Cisticola	-	LC	-	-	1	-	-
CLIMACTERIDAE								
<i>Climacteris melanura</i>	Black-tailed Treecreeper	-	LC	-	-	1,2,5	-	M
COLUMBIDAE								
<i>Chalcophaps indica</i>	Emerald Dove	-	LC	-	-	1	-	-
<i>Ducula bicolor</i>	Pied Imperial Pigeon	-	LC	-	x	1,2	1,2	P
<i>Geopelia cuneata</i>	Diamond Dove	-	LC	-	-	1,2,5	1,2	M
<i>Geopelia humeralis</i>	Bar-shouldered Dove	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Geopelia striata</i>	Peaceful Dove	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Geophaps plumifera</i>	Spinifex Pigeon	-	LC	-	-	1,2	-	-
<i>Ocyphaps lophotes</i>	Crested Pigeon	-	LC	-	-	1,2	1,2	-
<i>Phaps chalcoptera</i>	Common Bronzewing	-	LC	-	-	1,2,5	1,2	M
<i>Phaps histrionica</i>	Flock Bronzewing	-	NT	-	-	1	-	-
CORACIIDAE								
<i>Eurystomus orientalis</i>	Dollarbird	-	LC	-	x	1,2,5	1,2	H,P
CORCORACIDAE								
<i>Struthidea cinerea</i>	Apostlebird	-	LC	-	-	1,2,5	-	M
CORVIDAE								
<i>Corvus bennetti</i>	Little Crow	-	LC	-	-	-	1,2	-
<i>Corvus orru</i>	Torresian Crow	-	LC	-	-	1,2,5	1,2	H,M,P
CUCULIDAE								
<i>Cacomantis pallidus</i>	Pallid Cuckoo	-	LC	-	x	1,2,5	1,2	H,M,P
<i>Cacomantis variolosus</i>	Brush Cuckoo	-	LC	-	-	1,2,5	1,2	H
<i>Centropus phasianinus</i>	Pheasant Coucal	-	LC	-	-	1,2,5	1,2	H,M,P



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		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo	-	LC	-	x	1,2	1,2	H
<i>Chalcites minutillus</i>	Little Bronze-Cuckoo	-	LC	-	x	1,2	1,2	H
<i>Chalcites osculans</i>	Black-eared Cuckoo	-	LC	-	x	-	-	M
<i>Eudynamys orientalis</i>	Eastern Koel	-	LC	-	x	1,2,5	2	H,P
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	-	LC	-	x	1,2,5	1,2	H,P
ESTRILDIDAE								
<i>Erythrura gouldiae</i>	Gouldian Finch	EN	EN	x	-	1,2,3	1,2	-
<i>Heteromunia pectoralis</i>	Pictorella Mannikin	-	NT	-	-	1,2	-	-
<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin	-	LC	-	-	1,2	-	-
<i>Neochmia phaeton</i>	Crimson Finch	-	LC	-	-	1,2	-	H
<i>Neochmia ruficauda</i>	Star Finch	-	NT	-	-	1	-	-
<i>Poephila acuticauda</i>	Long-tailed Finch	-	LC	-	-	1,2	1,2	H,M
<i>Poephila personata</i>	Masked Finch	-	LC	-	-	1,2,5	-	H,M,P
<i>Taeniopygia bichenovii</i>	Double-barred Finch	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Taeniopygia guttata</i>	Zebra Finch	-	LC	-	-	1	-	-
EUROSTOPIDAE								
<i>Eurostopodus argus</i>	Spotted Nightjar	-	LC	-	x	1,2,5	1,2	H,M,P
FALCONIDAE								
<i>Falco berigora</i>	Brown Falcon	-	LC	-	-	1,2,5	1,2	H,M
<i>Falco cenchroides</i>	Nankeen Kestrel	-	LC	-	x	1,2	1,2	H
<i>Falco hypoleucos</i>	Grey Falcon	-	NT	-	-	1	-	-
<i>Falco longipennis</i>	Australian Hobby	-	LC	-	-	1,2,5	1,2	-
<i>Falco peregrinus</i>	Peregrine Falcon	-	LC	-	-	-	-	P
<i>Falco subniger</i>	Black Falcon	-	LC	-	-	1,2	-	H
GLAREOLIDAE								
<i>Glareola maldivarum</i>	Oriental Pratincole	-	LC	x	x	-	1,2	-
<i>Stiltia isabella</i>	Australian Pratincole	-	LC	-	x	1,2	1,2	-
GRUIDAE								
<i>Grus rubicunda</i>	Brolga	-	LC	-	-	1,2,5	1,2	H,M,P
HAEMATOPODIDAE								
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	LC	-	-	-	2	-
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	-	LC	-	-	2	1,2	P
HALCYONIDAE								
<i>Dacelo leachii</i>	Blue-winged Kookaburra	-	DD	-	-	1,2,5	1,2	H,M,P
<i>Todiramphus chloris</i>	Collared Kingfisher	-	LC	-	-	1,2	1,2	-
<i>Todiramphus macleayii</i>	Forest Kingfisher	-	LC	-	x	1,2	-	M
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher	-	LC	-	-	1,2,5	1,2	M,P
<i>Todiramphus sanctus</i>	Sacred Kingfisher	-	LC	-	x	1,2,5	1,2	H,M,P
HIRUNDINIDAE								
<i>Hirundo rustica</i>	Barn Swallow	-	LC	x	x	3	3	-
<i>Petrochelidon ariel</i>	Fairy Martin	-	LC	-	-	1,2	-	-
<i>Petrochelidon nigricans</i>	Tree Martin	-	LC	-	x	1,2	1,2	-
JACANIDAE								
<i>Irediparra gallinacea</i>	Comb-crested Jacana	-	LC	-	-	1,2	-	-
LARIDAE								



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		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Chlidonias hybrida</i>	Whiskered Tern	-	LC	-	x	2	1,2	P
<i>Chlidonias leucopterus</i>	White-winged Black Tern	-	LC	x	x	-	2	-
<i>Chroicocephalus novaehollandiae</i>	Silver Gull	-	LC	-	x	1,2	1,2	P
<i>Gelochelidon nilotica</i>	Gull-billed Tern	-	LC	-	x	2	1,2	-
<i>Hydroprogne caspia</i>	Caspian Tern	-	LC	x	x	-	1,2	P
<i>Onychoprion anaethetus</i>	Bridled Tern	-	LC	x	x	-	4	-
<i>Sterna dougallii</i>	Roseate Tern	-	LC	-	x	-	1	-
<i>Sterna hirundo</i>	Common Tern	-	LC	x	x	-	1,2	-
<i>Sternula albifrons</i>	Little Tern	-	LC	x	x	-	1,2	-
<i>Thalasseus bengalensis</i>	Lesser Crested Tern	-	LC	x	x	-	1,2	-
<i>Thalasseus bergii</i>	Crested Tern	-	LC	-	x	-	1,2	-
MALURIDAE								
<i>Amytornis dorotheae</i>	Carpentarian Grasswren	-	EN	-	-	4	-	-
<i>Malurus coronatus</i>	Purple-crowned Fairy-wren	-	NT	-	-	1,2	1,2	-
<i>Malurus lamberti</i>	Variegated Fairy-wren	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	-	LC	-	-	1,2,5	1,2	H,M,P
MEGALURIDAE								
<i>Cincloramphus mathewsi</i>	Rufous Songlark	-	LC	-	-	1,2	-	-
<i>Megalurus timoriensis</i>	Tawny Grassbird	-	LC	-	-	-	1,2	P
MELIPHAGIDAE								
<i>Cissomela pectoralis</i>	Banded Honeyeater	-	LC	-	-	1,2,5	-	H,M
<i>Conopophila rufogularis</i>	Rufous-throated Honeyeater	-	LC	-	-	1,2	1,2	H,M,P
<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	-	LC	-	-	1,2,5	1,2	H
<i>Epthianura crocea</i>	Yellow Chat	-	LC	-	-	-	1	-
<i>Epthianura tricolor</i>	Crimson Chat	-	LC	-	-	1,2	-	-
<i>Grantiella picta</i>	Painted Honeyeater	-	LC	-	-	1	-	-
<i>Lichenostomus flavescens</i>	Yellow-tinted Honeyeater	-	LC	-	-	1,2	1,2	H
<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater	-	LC	-	-	1,2	-	-
<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater	-	LC	-	-	1,2	-	-
<i>Lichenostomus unicolor</i>	White-gaped Honeyeater	-	LC	-	-	1,2	1,2	H,M,P
<i>Lichenostomus virescens</i>	Singing Honeyeater	-	LC	-	-	1,2	1,2	H,M,P
<i>Lichmera indistincta</i>	Brown Honeyeater	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Manorina flavigula</i>	Yellow-throated Miner	-	LC	-	-	1,2,5	-	-
<i>Melithreptus albogularis</i>	White-throated Honeyeater	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Melithreptus gularis</i>	Black-chinned Honeyeater	-	LC	-	-	1,2	-	H
<i>Myzomela erythrocephala</i>	Red-headed Honeyeater	-	LC	-	-	1,2	1,2	-
<i>Myzomela obscura</i>	Dusky Honeyeater	-	LC	-	-	1,2	-	-
<i>Philemon argenteiceps</i>	Silver-crowned Friarbird	-	LC	-	-	1,2,5	1,2	H,M
<i>Philemon buceroides</i>	Helmeted Friarbird	-	LC	-	-	1	-	-
<i>Philemon citreogularis</i>	Little Friarbird	-	LC	-	-	1,2,5	1,2	H,M
<i>Purnella albifrons</i>	White-fronted Honeyeater	-	LC	-	-	1	-	-
<i>Ramsayornis fasciatus</i>	Bar-breasted Honeyeater	-	LC	-	-	1,2,5	1	H,M,P
MEROPIIDAE								
<i>Merops ornatus</i>	Rainbow Bee-eater	-	LC	x	x	1,2,5	1,2	H,M,P
MONARCHIDAE								



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		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Grallina cyanoleuca</i>	Magpie-lark	-	LC	-	x	1,2,5	1,2	M
<i>Myiagra alecto</i>	Shining Flycatcher	-	LC	-	-	1,2	1,2	-
<i>Myiagra inquieta</i>	Restless Flycatcher	-	LC	-	-	1,2,5	1,2	H,M
<i>Myiagra rubecula</i>	Leaden Flycatcher	-	LC	-	-	1,2,5	1	M
<i>Myiagra ruficollis</i>	Broad-billed Flycatcher	-	LC	-	-	-	1,2	-
MOTACILLIDAE								
<i>Anthus novaeseelandiae</i>	Australasian Pipit	-	LC	-	x	-	1,2	H
NECTARINIIDAE								
<i>Dicaeum hirundinaceum</i>	Mistletoebird	-	LC	-	-	1,2,5	1,2	H,M
NEOSITTIDAE								
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	LC	-	-	1,2,5	-	H,M
ORIOLIDAE								
<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Sphecotheres vieilloti</i>	Australasian Figbird	-	LC	-	-	1	-	-
OTIDIDAE								
<i>Ardeotis australis</i>	Australian Bustard	-	VU	-	-	1,2,5	1,2	M
PACHYCEPHALIDAE								
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	LC	-	-	1,2,5	1	H,M
<i>Colluricincla megarhyncha</i>	Little Shrike-thrush	-	LC	-	-	1,2	1,2	P
<i>Colluricincla woodwardi</i>	Sandstone Shrike-thrush	-	LC	-	-	1,2	-	M
<i>Falcunculus frontatus whitei</i>	Crested Shrike-tit (northern)	VU	VU	x	-	3	-	-
<i>Oreoica gutturalis</i>	Crested Bellbird	-	LC	-	-	1	-	-
<i>Pachycephala lanoides</i>	White-breasted Whistler	-	LC	-	-	1,2	1,2	P
<i>Pachycephala melanura</i>	Mangrove Golden Whistler	-	LC	-	-	-	1,2	-
<i>Pachycephala rufiventris</i>	Rufous Whistler	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Pachycephala simplex</i>	Grey Whistler	-	LC	-	-	-	-	M
PARDALOTIDAE								
<i>Pardalotus rubricatus</i>	Red-browed Pardalote	-	LC	-	-	1,2	1,2	-
<i>Pardalotus striatus</i>	Striated Pardalote	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Smicromis brevirostris</i>	Weebill	-	LC	-	-	1,2,5	-	H,M
PELECANIDAE								
<i>Pelecanus conspicillatus</i>	Australian Pelican	-	LC	-	x	2	1,2	M
PETROICIDAE								
<i>Melanodryas cucullata</i>	Hooded Robin	-	-	-	-	1,2,5	-	-
<i>Microeca fascians</i>	Jacky Winter	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Microeca flavigaster</i>	Lemon-bellied Flycatcher	-	LC	-	-	1,2	1	H
<i>Poecilodryas superciliosa</i>	White-browed Robin	-	NT	x	-	1,2	-	-
PHALACROCORACIDAE								
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant	-	LC	-	-	1,2,5	1,2	-
<i>Phalacrocorax carbo</i>	Great Cormorant	-	LC	-	-	2	-	-
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	-	LC	-	-	2	2	M*,P
<i>Phalacrocorax varius</i>	Pied Cormorant	-	LC	-	-	2	1,2	-
PHASIANIDAE								
<i>Coturnix ypsilophora</i>	Brown Quail	-	LC	-	-	1,2,5	-	M,P
PODARGIDAE								



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<i>Podargus strigoides</i>	Tawny Frogmouth	-	LC	-	-	1,2,5	-	H,M
PODICIPEDIDAE								
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	-	LC	-	-	1,2	-	P
POMATOSTOMIDAE								
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	LC	-	-	1,2,5	1,2	H,M,P
PSITTACIDAE								
<i>Aprosmictus erythropterus</i>	Red-winged Parrot	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Melopsittacus undulatus</i>	Budgerigar	-	LC	-	-	1,2,5	-	-
<i>Platycercus venustus</i>	Northern Rosella	-	LC	-	-	1,2,5	-	H
<i>Psephotus dissimilis</i>	Hooded Parrot	-	NT	-	-	1,2	-	-
<i>Psitteuteles versicolor</i>	Varied Lorikeet	-	LC	-	-	1,2,5	-	M
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	LC	-	-	1,2,5	1,2	H,M,P
PTILONORHYNCHIDAE								
<i>Ptilonorhynchus nuchalis</i>	Great Bowerbird	-	LC	-	-	1,2,5	1,2	H,M,P
RALLIDAE								
<i>Fulica atra</i>	Eurasian Coot	-	LC	-	-	1,2	-	-
<i>Gallirallus philippensis</i>	Buff-banded Rail	-	LC	-	x	5	-	M
RECURVIROSTRIDAE								
<i>Himantopus himantopus</i>	Black-winged Stilt	-	LC	-	x	2	1,2	-
RHIPIDURIDAE								
<i>Rhipidura albiscapa</i>	Grey Fantail	-	LC	-	-	1,2,5	-	M
<i>Rhipidura dryas</i>	Arafura Fantail	-	LC	-	x	1,2	-	-
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	LC	-	-	1,2,5	1,2	H,M,P
<i>Rhipidura phasiana</i>	Mangrove Grey Fantail	-	LC	-	-	-	1,2	-
<i>Rhipidura rufiventris</i>	Northern Fantail	-	LC	-	-	1,2,5	1,2	H
ROSTRATULIDAE								
<i>Rostratula australis</i>	Australian Painted Snipe	VU	VU	x	x	1	2,3	-
SCOLOPACIDAE								
<i>Actitis hypoleucos</i>	Common Sandpiper	-	LC	x	x	2	2	-
<i>Arenaria interpres</i>	Ruddy Turnstone	-	LC	x	x	2	1,2	P
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	LC	x	x	-	1,2	-
<i>Calidris alba</i>	Sanderling	-	LC	x	x	-	-	P
<i>Calidris canutus</i>	Red Knot	-	LC	x	x	2	1,2	-
<i>Calidris ferruginea</i>	Curlew Sandpiper	-	LC	x	x	-	1,2	-
<i>Calidris ruficollis</i>	Red-necked Stint	-	LC	x	x	2	1,2	-
<i>Calidris tenuirostris</i>	Great Knot	-	LC	x	x	2	1,2	-
<i>Gallinago sp.</i>	Snipe species	-	DD	x	x	-	-	M
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	-	NE	x	x	-	1,2	-
<i>Limosa lapponica</i>	Bar-tailed Godwit	-	LC	x	x	-	1,2	-
<i>Limosa limosa</i>	Black-tailed Godwit	-	LC	x	x	2	1,2	-
<i>Numenius madagascariensis</i>	Eastern Curlew	-	LC	x	x	-	1,2	P
<i>Numenius minutus</i>	Little Curlew	-	LC	x	x	1,2	1,2	-
<i>Numenius phaeopus</i>	Whimbrel	-	LC	x	x	1,2	1,2	P
<i>Tringa brevipes</i>	Grey-tailed Tattler	-	LC	x	x	2	1,2	P
<i>Tringa nebularia</i>	Common Greenshank	-	LC	x	x	2	1,2	P



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		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Tringa stagnatilis</i>	Marsh Sandpiper	-	LC	x	x	-	1,2	-
<i>Xenus cinereus</i>	Terek Sandpiper	-	LC	x	x	-	2	-
STRIGIDAE								
<i>Ninox connivens</i>	Barking Owl	-	LC	-	-	1,2	-	-
<i>Ninox novaeseelandiae</i>	Southern Boobook	-	LC	-	x	1,2,5	-	H,M,P
THRESKIORNITHIDAE								
<i>Platalea flavipes</i>	Yellow-billed Spoonbill	-	LC	-	-	1,2	-	-
<i>Platalea regia</i>	Royal Spoonbill	-	LC	-	-	1,2	1,2	M*
<i>Plegadis falcinellus</i>	Glossy Ibis	-	LC	x	x	1,2	1,2	P
<i>Threskiornis molucca</i>	Australian White Ibis	-	LC	-	x	1,2	1,2	M*
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	-	LC	-	x	1,2,5	1,2	H,M
TIMALIIDAE								
<i>Zosterops luteus</i>	Yellow White-eye	-	LC	-	-	1,2	1,2	P
TURNICIDAE								
<i>Turnix maculosus</i>	Red-backed Button-quail	-	LC	-	-	1,2	-	H,M
<i>Turnix pyrrhotorax</i>	Red-chested Button-quail	-	LC	-	-	1,2	-	H
<i>Turnix velox</i>	Little Button-quail	-	LC	-	-	1	-	-
TYTONIDAE								
<i>Tyto javanica</i>	Eastern Barn Owl	-	LC	-	-	1,2	-	-
<i>Tyto longimembris</i>	Eastern Grass Owl	-	NT	-	-	1	-	-
<i>Tyto novaehollandiae kimberli</i>	Masked Owl (northern)	VU	VU	-	-	3	3	-
AMPHIBIAN								
BUFONIDAE								
<i>Chaunus marinus</i>	Cane Toad	-	(Int)	-	-	1,2	-	H,M,P
HYLIDAE								
<i>Litoria alboguttata</i>	Striped Burrowing Frog	-	LC	-	-	1,2	-	-
<i>Litoria australis</i>	Giant Frog	-	DD	-	-	1,2	1,2	M,P
<i>Litoria bicolor</i>	Northern Dwarf Tree-frog	-	DD	-	-	1,2	-	H,P
<i>Litoria caerulea</i>	Green Tree-frog	-	LC	-	-	1,2	-	H,M,P
<i>Litoria coplandi</i>	Copland's Rock Frog	-	LC	-	-	1,2	-	-
<i>Litoria cultripes</i>	Knife-footed Frog	-	LC	-	-	1	-	-
<i>Litoria inermis</i>	Peters' Frog	-	LC	-	-	1,2	-	M
<i>Litoria longipes</i>	Long-footed Frog	-	LC	-	-	1	-	P
<i>Litoria maculosa</i>	Daly Waters Frog	-	LC	-	-	1	-	-
<i>Litoria nasuta</i>	Rocket Frog	-	LC	-	-	1,2	-	H,M
<i>Litoria pallida</i>	Pale Frog	-	LC	-	-	1,2	-	H,M
<i>Litoria rothii</i>	Roth's Tree-frog	-	LC	-	-	1,2	-	H,M
<i>Litoria rubella</i>	Red Tree-frog	-	LC	-	-	1,2	-	H,M
<i>Litoria tornieri</i>	Tornier's Frog	-	LC	-	-	1,2	-	M,P
<i>Litoria wotjulumensis</i>	Wotjulum Frog	-	LC	-	-	1,2	-	M
LIMNODYNASTIDAE								
<i>Limnodynastes lignarius</i>	Carpenter Frog	-	LC	-	-	-	-	H
<i>Limnodynastes convexiusculus</i>	Marbled Frog	-	LC	-	-	-	-	H
<i>Notaden melanoscaphus</i>	Northern Spadefoot Toad	-	LC	-	-	1,2	-	H,P



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<i>Opisthodon ornatus</i>	Ornate Burrowing Frog	-	DD	-	-	1,2	-	H,M,P
MYOBATRACHIDAE								
<i>Crinia bilingua</i>	Bilingual Froglet	-	LC	-	-	1,2	-	-
<i>Crinia deserticola</i>	Desert Froglet	-	LC	-	-	1,2	-	-
<i>Crinia remota</i>	Remote Froglet	-	LC	-	-	1,2	-	-
<i>Uperoleia inundata</i>	Floodplain Toadlet	-	LC	-	-	2	-	H
<i>Uperoleia lithomoda</i>	Stonemason Toadlet	-	LC	-	-	2	-	H,M
MAMMAL								
BALAENOPTERIDAE								
<i>Balaenoptera edeni</i>	Bryde's Whale	-	DD	x	x	-	3	-
<i>Balaenoptera musculus</i>	Blue Whale	EN	DD	x	x	-	3	-
<i>Megaptera novaeangliae</i>	Humpback Whale	VU	DD	x	x	-	3	-
BOVIDAE								
<i>Bos taurus</i>	Cattle	-	(Int)	-	-	1,2	-	-
<i>Bubalus bubalis</i>	Swamp Buffalo	-	(Int)	-	-	1,2	-	H,M
CANIDAE								
<i>Canis lupus</i>	Dingo	-	LC	-	-	1,2	-	M
DASYURIDAE								
<i>Dasyurus hallucatus</i>	Northern Quoll	EN	CR	-	-	1,2,3	3	-
<i>Planigale ingrami</i>	Long-tailed Planigale	-	LC	-	-	1	1,2	H,M
<i>Planigale maculata</i>	Common Planigale	-	LC	-	-	1,2	-	H
<i>Pseudantechinus bilarni</i>	Sandstone Antechinus	-	DD	-	-	1,2	-	H
<i>Sminthopsis macroura</i>	Stripe-faced Dunnart	-	LC	-	-	1,2	-	-
DELPHINIDAE								
<i>Delphinus delphis</i>	Short-beaked Common Dolphin	-	DD	-	x	-	3	-
<i>Grampus griseus</i>	Risso's Dolphin	-	DD	-	x	-	3	-
<i>Orcinus orca</i>	Killer Whale	-	DD	x	x	-	3	-
<i>Orcaella heinsohni</i>	Australian Snubfin Dolphin	-	LC	x	x	-	3	-
<i>Sousa chinensis</i>	Indo-Pacific Humpbacked Dolphin	-	LC	x	x	-	3	-
<i>Stenella attenuata</i>	Pantropical Spotted Dolphin	-	DD	x	x	-	3	-
<i>Tursiops aduncus</i>	Indo-Pacific Bottlenose Dolphin	-	NE	x	x	-	3	-
DUGONGIDAE								
<i>Dugong dugon</i>	Dugong	-	NT	x	x	-	1,2	-
EMBALLONURIDAE								
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	-	LC	-	-	1,2	1,2	M
<i>Saccolaimus saccolaimus</i>	Bare-rumped Sheath-tailed Bat	CR	DD	-	-	3	-	-
<i>Taphozous georgianus</i>	Common Sheath-tailed Bat	-	LC	-	-	1,2	-	M,H
EQUIDAE								
<i>Equus asinus</i>	Donkey	-	(Int)	-	-	1	-	M
<i>Equus caballus</i>	Horse	-	(Int)	-	-	1,2	-	H
FELIDAE								
<i>Felis catus</i>	Cat	-	(Int)	-	-	1,2	3	-
HIPPOSIDERIDAE								
<i>Hipposideros ater</i>	Dusky Leaf-nosed Bat	-	LC	-	-	1,2	-	M



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		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Hipposideros stenotis</i>	Northern Leaf-nosed bat	-	NT	-	-	4	-	-
<i>Rhinonictis aurantia</i>	Orange Leaf-nosed bat	-	NT	-	-	1,2	-	H,M
MACROPODIDAE								
<i>Lagorchestes conspicillatus</i>	Spectacled Hare-wallaby	-	NT	-	-	1,2	-	-
<i>Macropus agilis</i>	Agile Wallaby	-	LC	-	-	1,2	1,2	H,P
<i>Macropus antilopinus</i>	Antilopine Wallaroo	-	LC	-	-	1	-	M
<i>Macropus robustus</i>	Common Wallaroo	-	LC	-	-	1,2	-	H,M
<i>Macropus rufus</i>	Red Kangaroo	-	LC	-	-	1,2	-	-
<i>Onychogalea unguifera</i>	Northern Nailtail Wallaby	-	NT	-	-	1,2	-	M
<i>Petrogale brachyotis</i>	Short-eared Rock-wallaby	-	LC	-	-	1,2	-	-
MEGADERMATIDAE								
<i>Macroderma gigas</i>	Ghost Bat	-	NT	-	-	4	-	-
MOLOSSIDAE								
<i>Chaerephon jobensis</i>	Northern Free-tailed Bat	-	LC	-	-	1,2	-	H,M
<i>Mormopterus loriae</i>	Little Free-tailed Bat	-	LC	-	-	1,2	1,2	-
MURIDAE								
<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	VU	VU	-	-	3	3	-
<i>Melomys burtoni</i>	Grassland Melomys	-	LC	-	-	1,2	-	-
<i>Notomys alexis</i>	Spinifex Hopping-mouse	-	LC	-	-	1	-	-
<i>Pseudomys delicatulus</i>	Delicate Mouse	-	LC	-	-	1,2	-	-
<i>Pseudomys nanus</i>	Western Chestnut Mouse	-	NT	-	-	1,2	1,2	H,M,P
<i>Rattus colletti</i>	Dusky Rat	-	LC	-	-	1,2	-	P
<i>Rattus tunneyi</i>	Pale Field-rat	-	NT	-	-	1,2	-	-
<i>Rattus villosissimus</i>	Long-haired Rat	-	NT	-	-	1,2	-	-
<i>Xeromys myoides</i>	Water Mouse	VU	DD	-	-	3	3	-
<i>Zyomys argurus</i>	Common Rock-rat	-	LC	-	-	1,2	-	H,M
PERAMELIDAE								
<i>Isodon macrourus</i>	Northern Brown Bandicoot	-	LC	-	-	-	-	P
PETAURIDAE								
<i>Petaurus breviceps</i>	Sugar Glider	-	LC	-	-	1,2	-	M
PSEUDOCHEIRIDAE								
<i>Petropseudes dahli</i>	Rock Ringtail	-	LC	-	-	1,2	-	H
PTEROPODIDAE								
<i>Macroglossus minimus</i>	Northern Blossom Bat	-	LC	-	-	1	-	-
<i>Pteropus alecto</i>	Black Flying-fox	-	LC	-	-	1,2	-	H
<i>Pteropus scapulatus</i>	Little Red Flying-fox	-	LC	-	-	1,2	-	-
SUIDAE								
<i>Sus scrofa</i>	Pig	-	(Int)	-	-	1,2	-	H,M
TACHYGLOSSIDAE								
<i>Tachyglossus aculeatus</i>	Echidna	-	LC	-	-	1,2	-	-
VESPERTILIONIDAE								
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	LC	-	-	1,2	1,2	H,M
<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	-	LC	-	-	1,2	-	M
<i>Myotis macropus</i>	Large-footed Myotis	-	LC	-	-	-	1,2	-
<i>Nyctophilus arnhemensis</i>	Northern Long-eared Bat	-	LC	-	-	1,2	1,2	-



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<i>Scotorepens greyii</i>	Little Broad-nosed Bat	-	LC	-	-	1,2	1,2	M
<i>Vespadelus caurinus</i>	Northern Cave Bat	-	LC	-	-	1,2	-	H
<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat	-	LC	-	-	1,2	-	-
REPTILE								
ACROCHORDIDAE								
<i>Acrochordus arafurae</i>	Arafura File Snake	-	LC	-	-	2	-	-
AGAMIDAE								
<i>Chlamydosaurus kingii</i>	Friiled Lizard	-	LC	-	-	1,2	-	M
<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon	-	LC	-	-	1,2	-	H,M
<i>Diporiphora albilabris</i>	White-lipped Dragon	-	LC	-	-	2	-	M
<i>Diporiphora arnhemica</i>	Diporiphora arnhemica	-	LC	-	-	2	-	-
<i>Diporiphora bennettii</i>	Robust Dragon	-	LC	-	-	2	-	M
<i>Diporiphora bilineata</i>	Two-Lined Dragon	-	LC	-	-	2	1,2	M,P
<i>Diporiphora lalliae</i>	Diporiphora lalliae	-	LC	-	-	2	-	-
<i>Diporiphora magna</i>	Diporiphora magna	-	LC	-	-	2	1,2	H,M
<i>Lophognathus gilberti</i>	Gilbert's Dragon	-	LC	-	-	1,2	1,2	H,M,P
<i>Lophognathus temporalis</i>	Northern Water Dragon	-	LC	-	-	1	-	-
<i>Tympanocryptis lineata</i>	Lined Earless Dragon	-	LC	-	-	1,2	1,2	-
CHELONIIDAE								
<i>Caretta caretta</i>	Loggerhead Turtle	EN	EN	x	x	-	2,3	-
<i>Chelonia mydas</i>	Green Turtle	VU	LC	x	x	-	1,2,3	-
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	VU	DD	x	x	-	3	-
<i>Natator depressus</i>	Flatback Turtle	VU	DD	x	x	-	3	-
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	EN	DD	x	x	-	3	-
CHELUIDAE								
<i>Chelodina canni</i>	Cann's Long-necked Turtle	-	LC	-	-	-	-	P
<i>Elseya lavarackorum</i>	Gulf Snapping Turtle	EN	LC	-	-	-	3	-
<i>Emydura subglobosa</i>	Diamond Head Turtle	-	NL	-	-	1,2	-	-
<i>Macrochelodina rugosa</i>	Northern Long-necked Turtle	-	LC	-	-	1,2	-	-
<i>Wollumbinia latisternum</i>	Saw-Shelled Turtle	-	LC	-	-	2	-	-
COLUBRIDAE								
<i>Boiga irregularis</i>	Brown Tree Snake	-	DD	-	-	1,2	-	-
<i>Dendrelaphis punctulata</i>	Green Tree Snake	-	DD	-	-	2	-	P
<i>Tropidonophis mairii</i>	Keelback	-	LC	-	-	1,2	-	-
CROCODYLIDAE								
<i>Crocodylus johnstoni</i>	Freshwater Crocodile	-	LC	-	x	1,2	-	H,M*
<i>Crocodylus porosus</i>	Saltwater Crocodile	-	LC	x	x	2	2	-
DERMOCHELYIDAE								
<i>Dermochelys coriacea</i>	Leatherback Turtle	EN	VU	x	x	-	3	-
ELAPIDAE								
<i>Acalyptophis peronii</i>	Horned Sea Snake	-	LC	-	x	-	3	-
<i>Acanthophis praelongus</i>	Northern Death Adder	-	NT	-	-	4	-	-
<i>Aipysurus duboisii</i>	Dubois' Sea Snake	-	LC	-	x	-	3	-
<i>Aipysurus eydouxii</i>	Spine-tailed Sea Snake	-	LC	-	x	-	3	-



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<i>Aipysurus laevis</i>	Golden Sea Snake	-	LC	-	x	-	3	-
<i>Astrotia stokesii</i>	Stokes' Sea Snake	-	LC	-	x	-	3	-
<i>Brachyurophis roperi</i>	Northern Shovel-nosed Snake	-	NL	-	-	1,2	-	P
<i>Brachyurophis semifasciatus</i>	Half-girdled Snake	-	LC	-	-	-	-	H
<i>Demansia olivacea</i>	Olive Whip Snake	-	DD	-	-	2	1,2	-
<i>Demansia papuensis</i>	Papaun Whip Snake	-	DD	-	-	2	-	P
<i>Demansia simplex</i>	Grey Whip Snake	-	LC	-	-	-	-	M
<i>Demansia vestigiata</i>	Black Whip Snake	-	DD	-	-	2	-	P
<i>Disteira kingii</i>	Spectacled Sea Snake	-	LC	-	x	-	3	-
<i>Disteira major</i>	Olive-headed Sea Snake	-	LC	-	x	-	3	-
<i>Emydocephalus annulatus</i>	Turtle-headed Sea Snake	-	LC	-	x	-	3	-
<i>Enhydrina schistosa</i>	Beaked Sea Snake	-	LC	-	x	-	3	-
<i>Furina ornata</i>	Orange-naped Snake	-	LC	-	-	1,2	-	M
<i>Hydrelaps darwiniensis</i>	Black-ringed Mud Snake	-	LC	-	x	-	2	-
<i>Hydrophis atriceps</i>	Black-headed Sea Snake	-	DD	-	x	-	3	-
<i>Hydrophis czeblukovi</i>	Geometerical Sea Snake	-	DD	-	x	-	3	-
<i>Hydrophis elegans</i>	Bar-bellied Sea Snake	-	LC	-	x	-	3	-
<i>Hydrophis inornatus</i>	Plain Sea Snake	-	DD	-	x	-	3	-
<i>Hydrophis mcdowelli</i>	Small-headed Sea Snake	-	LC	-	x	-	3	-
<i>Hydrophis ornatus</i>	Plain Sea Snake	-	LC	-	x	-	3	-
<i>Hydrophis pacificus</i>	Large-headed Sea Snake	-	LC	-	x	-	3	-
<i>Lapemis curtus</i>	Short Sea Snake	-	LC	-	x	-	3	-
<i>Parahydrophis mertoni</i>	Northern Mangrove Sea Snake	-	LC	-	x	-	3	-
<i>Pelamis platurus</i>	Yellow-bellied Sea Snake	-	LC	-	x	-	3	-
<i>Pseudechis australis</i>	King Brown Snake	-	LC	-	-	1,2	-	M
<i>Pseudonaja nuchalis</i>	Western Brown Snake	-	LC	-	-	1,2	-	H
<i>Pseudonaja textilis</i>	Eastern Brown Snake	-	LC	-	-	1,2	-	-
<i>Vermicella annulata</i>	Bandy Bandy	-	LC	-	-	1,2	-	-
GEKKONIDAE								
<i>Crenadactylus ocellatus</i>	Clawless Gecko	-	LC	-	-	1,2	-	-
<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko	-	LC	-	-	-	-	M
<i>Gehyra australis</i>	Northern Dtella	-	LC	-	-	1,2	-	H,M
<i>Gehyra borrooloola</i>	Borrooloola Dtella	-	LC	-	-	1,2	-	H,M
<i>Gehyra nana</i>	Northern Spotted Rock Dtella	-	LC	-	-	1,2	-	H
<i>Heteronotia binoei</i>	Bynoe's Gecko	-	LC	-	-	1,2	1,2	H,M
<i>Lucasium immaculatum</i>	Pale-striped Ground Gecko	-	LC	-	-	1,2	-	-
<i>Lucasium stenodactylum</i>	Crowned Gecko	-	LC	-	-	1,2	-	M
<i>Oedura marmorata</i>	Marbled Velvet Gecko	-	LC	-	-	1,2	-	H,M
<i>Oedura rhombifer</i>	Zig-zag Gecko	-	LC	-	-	1,2	-	M
<i>Rhynchoedura ornata</i>	Beaked Gecko	-	LC	-	-	1,2	-	M
<i>Strophurus ciliaris</i>	Spiny-tailed Gecko	-	LC	-	-	1,2	-	M
PYGOPODIDAE								
<i>Delma borea</i>	Rusty-topped Delma	-	LC	-	-	2	-	H,P
<i>Delma tincta</i>	Black-necked Snake-lizard	-	LC	-	-	2	1,2	M
<i>Lialis burtonis</i>	Burton's Legless Lizard	-	LC	-	-	1,2	1,2	-
<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot	-	LC	-	-	1	-	-



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<i>Pygopus steelescotti</i>	Northern Hooded Scaly-foot	-	LC	-	-	1,2	-	-
PYTHONIDAE								
<i>Antaresia childreni</i>	Children's Python	-	DD	-	-	1,2	1,2	M,P
<i>Antaresia stimsoni</i>	Stimson's Python	-	LC	-	-	1	-	-
<i>Aspidites melanocephalus</i>	Black-headed Python	-	LC	-	-	1,2	2	M
<i>Liasis fuscus</i>	Water Python	-	LC	-	-	-	-	P
<i>Liasis olivaceus</i>	Olive Python	-	LC	-	-	1,2	-	H
SCINCIDAE								
<i>Carlia amax</i>	Two-Spined Rainbow Skink	-	LC	-	-	1,2	-	H,M,P
<i>Carlia gracilis</i>	Slender Rainbow Skink	-	LC	-	-	1,2	-	-
<i>Carlia macfarlani</i>	MacFarlane's Rainbow Skink	-	LC	-	-	1,2	-	-
<i>Carlia munda</i>	Striped Rainbow Skink	-	LC	-	-	1,2	1,2	H,M,P
<i>Carlia triacantha</i>	Three-Spined Rainbow Skink	-	LC	-	-	1,2	-	H
<i>Cryptoblepharus australis</i>	Inland Snake-eyed Skink	-	NE	-	-	1	1	H
<i>Cryptoblepharus carnabyi</i>	Carnaby's Snake-Eyed Skink	-	LC	-	-	1,2	2	-
<i>Cryptoblepharus megastictus</i>	Spotted Snake-Eyed Skink	-	LC	-	-	1,2	-	-
<i>Cryptoblepharus mertensi</i>	Mertens' Snake-eyed Skink	-	NE	-	-	2	-	-
<i>Cryptoblepharus metallicus</i>	Metallic Snake-eyed Skink	-	NE	-	-	1,2	2	H,M
<i>Cryptoblepharus pannosus</i>	Ragged Snake-eyed Skink	-	NE	-	-	2	-	-
<i>Cryptoblepharus plagiocephalus</i>	Aboreal Snake-Eyed Skink	-	LC	-	-	1,2	1	-
<i>Cryptoblepharus ruber</i>	Tawny Snake-eyed Skink	-	NE	-	-	1,2	-	P
<i>Cryptoblepharus zoticus</i>	Agile Snake-eyed Skink	-	NE	-	-	2	-	-
<i>Ctenotus helenae</i>	Helen's Ctenotus	-	LC	-	-	1,2	1,2	-
<i>Ctenotus inornatus</i>	Plain Ctenotus	-	LC	-	-	1,2	1,2	H,M,P
<i>Ctenotus pantherinus</i>	Leopard Ctenotus	-	LC	-	-	1,2	-	-
<i>Ctenotus robustus</i>	Robust Ctenotus	-	LC	-	-	1,2	-	M
<i>Ctenotus saxatilis</i>	Rock Ctenotus	-	LC	-	-	1,2	-	-
<i>Ctenotus spaldingi</i>	Spalding's Ctenotus	-	LC	-	-	1,2	1,2	H,M,P
<i>Ctenotus striaticeps</i>	Carpentarian Ctenotus	-	LC	-	-	1,2	-	-
<i>Ctenotus vertebralis</i>	Scant-Striped Ctenotus	-	LC	-	-	1,2	-	M
<i>Eremiascincus fasciolatus</i>	Narrow-Banded Sand Swimmer	-	LC	-	-	1,2	-	-
<i>Glaphyromorphus isolepis</i>	Smooth-Tailed Skink	-	LC	-	-	1,2	-	H,M
<i>Lerista carpentariae</i>	Carpentarian Lerista	-	LC	-	-	1,2	-	-
<i>Lerista griffini</i>	Griffin's Lerista	-	LC	-	-	1,2	-	-
<i>Lerista orientalis</i>	Eastern Lerista	-	LC	-	-	1,2	-	-
<i>Menetia greyii</i>	Grey's Menetia	-	LC	-	-	1,2	1,2	-
<i>Menetia maini</i>	Main's Menetia	-	LC	-	-	1,2	-	-
<i>Morethia ruficauda</i>	Red-Tailed Snake-Eyed Skink	-	LC	-	-	1,2	-	-
<i>Morethia storri</i>	Storr's Snake-Eyed Skink	-	LC	-	-	1,2	-	H
<i>Notoscincus ornatus</i>	Ornate Snake-Eyed Skink	-	LC	-	-	1,2	-	-
<i>Proablepharus kinghorni</i>	Kinghorn's Snake-Eyed Skink	-	LC	-	-	1	-	-
<i>Proablepharus tenuis</i>	Slender Snake-Eyed Skink	-	LC	-	-	1,2	1,2	H,M
<i>Tiliqua multifasciata</i>	Centralian Blue-Tongued Lizard	-	LC	-	-	1,2	-	-
TYPHLOPIDAE								
<i>Ramphotyphlops ligatus</i>	Robust Blind Snake	-	LC	-	-	2	-	-



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD		
		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
VARANIDAE								
<i>Varanus acanthurus</i>	Ridge-tailed Monitor	-	LC	-	-	1,2	-	-
<i>Varanus glebopalma</i>	Long-Tailed Rock Monitor	-	DD	-	-	1,2	-	-
<i>Varanus gouldii</i>	Sand Monitor	-	LC	-	-	-	-	H,M
<i>Varanus mertensi</i>	Mertens' Water Monitor	-	VU	-	-	1,2	-	H,M,P
<i>Varanus mitchelli</i>	Mitchell's Water Monitor	-	DD	-	-	1,2	-	-
<i>Varanus panoptes</i>	Floodplain Monitor	-	VU	-	-	4	-	-
<i>Varanus primordius</i>	Northern Ridge-tailed Monitor	-	NT	-	-	1	-	-
<i>Varanus scalaris</i>	Spotted Tree Monitor	-	DD	-	-	1,2	-	-
<i>Varanus tristis</i>	Black-tailed Monitor	-	LC	-	-	1,2	1,2	-
FISH								
PRISTIDAE								
<i>Pristis clavata</i>	Dwarf Sawfish	VU	VU	-	-	3	3	-
<i>Pristis microdon</i>	Freshwater Sawfish	VU	VU	-	-	3, 6	3	-
<i>Pristis zirjon</i>	Green Sawfish	VU	VU	-	-	3	3	-
SYNGNATHIDAE								
<i>Campichthys tricarinatus</i>	Pacific Short-bodied Pipefish	-	-	-	x	3	3	-
<i>Choeroichthys brachysoma</i>	Pig-snouted Pipefish	-	-	-	x	3	3	-
<i>Choeroichthys suillus</i>	Fijian Banded Pipefish	-	-	-	x	3	3	-
<i>Corythoichthys amplexus</i>	Reticulate Pipefish	-	-	-	x	3	3	-
<i>Corythoichthys flavofasciatus</i>	Bluestripe Pipefish	-	-	-	x	3	3	-
<i>Doryrhamphus excisus</i>	Cleaner Pipefish	-	-	-	x	3	3	-
<i>Doryrhamphus janssi</i>	Girdled Pipefish	-	-	-	x	3	3	-
<i>Festucalex cinctus</i>	Brock's Pipefish	-	-	-	x	3	3	-
<i>Halicampus brocki</i>	Mud Pipefish	-	-	-	x	3	3	-
<i>Halicampus grayi</i>	Spiny-snout Pipefish	-	-	-	x	3	3	-
<i>Halicampus spinirostris</i>	Ribboned Pipehorse	-	-	-	x	3	3	-
<i>Haliichthys taeniophorus</i>	Blue-speckled Pipefish	-	-	-	x	3	3	-
<i>Hippichthys cyanospilos</i>	Beady Pipefish	-	-	-	x	3	3	-
<i>Hippichthys penicillus</i>	Spiny Seahorse	-	-	-	x	3	3	-
<i>Hippocampus histrix</i>	Spotted Seahorse	-	-	-	x	3	3	-
<i>Hippocampus kuda</i>	Flat-face Seahorse	-	-	-	x	3	3	-
<i>Hippocampus planifrons</i>	Hedgehog Seahorse	-	-	-	x	3	3	-
<i>Hippocampus spinosissimus</i>	Pallid Pipehorse	-	-	-	x	3	-	-
<i>Solegnathus hardwickii</i>	Bentstick Pipefish	-	-	-	x	3	-	-
<i>Trachyrhamphus bicoarctatus</i>	Straightstick Pipefish	-	-	-	x	3	-	-
Other								
<i>Ambassis interruptus</i>	Longspine Glassfish	-	-	-	-	-	-	M
<i>Ambassis macleayii</i>	Macleay's Glassfish	-	-	-	-	-	-	M
<i>Ambassis sp.</i>	Glassfish	-	-	-	-	6	-	M
<i>Amniataba percoides</i>	Barred Grunter	-	-	-	-	6	-	M
<i>Anodontigglanis dahl</i>	Toothless Catfish	-	-	-	-	6	-	-
<i>Arius berneyi</i>	Berney's Catfish	-	-	-	-	6	-	-
<i>Arius midgeleyi</i>	Silver Cobbler	-	-	-	-	6	-	-



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD		
		Aus	NT	Mig	Mar	MLA/ Haul	Port	Survey
<i>Arius sp.</i>	Fork-talked Catfish	-	-	-	-	6	-	-
<i>Arrhamphus scerlolepis</i>	Snubnose Garfish	-	-	-	-	-	-	M
<i>Chanos chanos</i>	Milkfish	-	-	-	-	-	-	M
<i>Craterocephalus stercusmuscarum</i>	Fly-specked Hardyhead	-	-	-	-	6	-	M
<i>Elops hawaiiensis</i>	Hawaiian Giant Herring	-	-	-	-	-	-	M
<i>Glossamia aprion</i>	Mouth Almighty	-	-	-	-	6	-	M
<i>Glossogobius giurus</i>	Tank Goby	-	-	-	-	6	-	M
<i>Hephaestus fuliginosus</i>	Sooty Grunter	-	-	-	-	6	-	M
<i>Hypseleotris compressa</i>	Empire Gudgeon	-	-	-	-	-	-	M
<i>Hypseleotris sp.</i>	Golden Gudgeon	-	-	-	-	6	-	-
<i>Lates calcarifer</i>	Barramundi	-	-	-	-	6	-	M
<i>Leiopotherapon unicolor</i>	Spangled Perch	-	-	-	-	6	-	M
<i>Liza alata</i>	Diamond Mullet	-	-	-	-	-	-	M
<i>Megalops cyprinoides</i>	Oxeye Herring	-	-	-	-	6	-	M
<i>Melanotaenia splendida inornata</i>	Chequered Rainbowfish	-	-	-	-	-	-	M
<i>Mogurnda mogurnda</i>	Northern Purple-spotted Gudgeon	-	-	-	-	6	-	M
<i>Nematalosa erebi</i>	Bony Bream	-	-	-	-	6	-	M
<i>Neoarius leptaspis</i>	Boofhead Catfish	-	-	-	-	6	-	-
<i>Neoarius sp.</i>	Unidentified Catfish	-	-	-	-	-	-	M
<i>Neosilurus ater</i>	Black Catfish	-	-	-	-	-	-	M
<i>Neosilurus hyrtl</i>	Hyrtl's Catfish	-	-	-	-	-	-	M
<i>Neosilurus sp.</i>	Catfish	-	-	-	-	6	-	-
<i>Oxyeleotris lineolata</i>	Sleepy Cod	-	-	-	-	6	-	M
<i>Porochilus rendahli</i>	Rendahl's Catfish	-	-	-	-	-	-	M
<i>Rhincodon typus</i>	Whale Shark	VU	NL	x	x	-	3	-
<i>Scatophagus argus</i>	Spotted Scat	-	-	-	-	-	-	M
<i>Scortum ogilbyi</i>	Gulf Grunter	-	-	-	-	6	-	-
<i>Strongylura krefftii</i>	Freshwater Longtom	-	-	-	-	6	-	M
<i>Toxotes chatareus</i>	Seven-spot Archerfish	-	-	-	-	6	-	M



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Appendix D-2 – Fauna Survey Data (MLA)



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Table 2-1: Reptiles found from MLA field survey

Note: Only presence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Aus	NT	1n	1	2	3	4	5	6	7	8	8b	9	10	11	12	13	14	15
AGAMIDAE																				
<i>Chlamydosaurus kingii</i>	Friiled Lizard	-	LC	i		a					p									
<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon	-	LC						a											
<i>Diporiphora albilabris</i>	White-lipped Dragon	-	LC	i			a	a			a									
<i>Diporiphora bennettii</i>	Robust Dragon	-	LC					f												
<i>Diporiphora bilineata</i>	Two-Lined Dragon	-	LC	i	a	p														
<i>Diporiphora magna</i>	-	-	LC	i	p	a						a	a	a		a	a			f
<i>Lophognathus gilberti</i>	Gilbert's Dragon	-	LC	i										a,f	a	a	a			
COLUBRIDAE																				
<i>Tropidonophis mairii</i>	Keelback	-	LC												p					
ELAPIDAE																				
<i>Demansia simplex</i>	Grey Whip Snake	-	LC												p					
<i>Furina ornata</i>	Orange-naped Snake	-	LC	i																
<i>Pseudechis australis</i>	King Brown Snake	-	LC						a											
GEKKONIDAE																				
<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko	-	LC		a	p														
<i>Gehyra australis</i>	Northern Dtella	-	LC	i		a		a	a		a	a		a			a			
<i>Gehyra borrooloola</i>	Borrooloola Dtella	-	LC					a	a											
<i>Heteronotia binoei</i>	Bynoe's Gecko	-	LC	a			a	a	a			p		a			f	a	a	f
<i>Lucasium stenodactylum</i>	Crowned Gecko	-	LC	a		p					p						a			
<i>Oedura marmorata</i>	Marbled Velvet Gecko	-	LC					a												
<i>Oedura rhombifer</i>	Zig-zag Gecko	-	LC	a																
<i>Rhynchoedura ornata</i>	Beaked Gecko	-	LC	a	a	a					p						a			
<i>Strophurus ciliaris</i>	Spiny-tailed Gecko	-	LC	i				a						a			a			
PYGOPODIDAE																				
<i>Delma tincta</i>	Black-necked Snake-lizard	-	LC							a										
PYTHONIDAE																				
<i>Aspidites melanocephalus</i>	Black-headed Python	-	LC	a																
<i>Antaresia childreni</i>	Children's Python	-	DD	i																
SCINCIDAE																				



SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au s	N T	I n	1	2	3	4	5	6	7	8	8 b	9	1 0	1 1	1 2	1 3	1 4	1 5
<i>Carlia amax</i>	Two-Spined Rainbow Skink	-	L C				a	a, p	a		a, p	a, p		a, f	a		a		f, p	f, p
<i>Carlia munda</i>	Striped Rainbow Skink	-	L C	i										a	a, p	a				
<i>Cryptoblepharus metallicus</i>	Metallic Snake-eyed Skink	-	N E	i		a				a	p					a	a			
<i>Ctenotus inornatus</i>	Plain Ctenotus	-	L C			a	a, p	a, f	a, f		a		f	f	a		a, e		f	
<i>Ctenotus robustus</i>	Robust Ctenotus	-	L C		a												a			
<i>Ctenotus spaldingi</i>	Spalding's Ctenotus	-	L C		p										a, p				f	
<i>Ctenotus vertebralis</i>	Scant-Striped Ctenotus	-	L C						p		a		p				a			
<i>Glaphyromorphus isolepis</i>	Smooth-Tailed Skink	-	L C						a, f						p					
<i>Proablepharus tenuis</i>	Slender Snake-Eyed Skink	-	L C																	p
VARANIDAE																				
<i>Varanus gouldii</i>	Sand Goanna	-	L C								a						a			
<i>Varanus mertensi</i>	Mertens' Water Monitor	-	V U	i																



Table 2-2: Amphibians found from MLA field survey

Note: Only prescence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au s	NT	I n	1	2	3	4	5	6	7	8	8 b	9	10	1 1	1 2	1 3	1 4	1 5
BUFONIDAE																				
<i>Chaunus marinus</i>	Cane Toad	-	(Int)	i			a	a, e	a	a, c, e, p			a	a	a, e, p	a				
HYLIDAE																				
<i>Litoria australis</i>	Giant Frog	-	DD												a					
<i>Litoria caerulea</i>	Green Tree-frog	-	LC								a			a	a		a			
<i>Litoria inermis</i>	Peters' Frog	-	LC	i																
<i>Litoria nasuta</i>	Rocket Frog	-	LC	a			a		a											
<i>Litoria pallida</i>	Pale Frog	-	LC	i					a, p						p					
<i>Litoria rothii</i>	Roth's Tree-frog	-	LC	i					a						a	a				
<i>Litoria rubella</i>	Red Tree-frog	-	LC	i					a	a					a					
<i>Litoria tornieri</i>	Tornier's Frog	-	LC	i											a	a				
<i>Litoria wotjulumensis</i>	Wotjulum Frog	-	LC											a	a	a				
LIMNODYNASTIDAE																				
<i>Notaden melanoscaphus</i>	Northern Spadefoot Toad	-	LC				a	p		p					a, p					
<i>Opisthodon ornatus</i>	Ornate Burrowing Frog	-	DD				a			p					a, p					
MYOBATRACHIDAE																				
<i>Uperoleia lithomoda</i>	Stonemason Toadlet	-	LC						a	p										



Table 2-3: Mammals found from MLA field survey

Note: Only prescence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au s	NT	I n	1	2	3	4	5	6	7	8	8 b	9	1 0	1 1	1 2	1 3	1 4	1 5
BOVIDAE																				
<i>Bubalus bubalis</i>	Swamp Buffalo	-	(Int)	i													a			
DASYURIDAE																				
<i>Planigale ingrami</i>	Long-tailed Planigale	-	LC					e		p										
EQUIDAE																				
<i>Equus asinus</i>	Donkey	-	(Int)							a										
HIPPOSIDERIDA E																				
<i>Hipposideros ater</i>	Dusky Leaf-nosed Bat	-	LC													a				
<i>Rhinonictis aurantia</i>	Orange Leaf-nosed bat	-	NT													a				
MACROPODIDAE																				
<i>Macropus antilopinus</i>	Antilopine Wallaroo	-	LC	i																
<i>Macropus robustus</i>	Common Wallaroo	-	LC			a	a													
MURIDAE																				
<i>Pseudomys nanus</i>	Western Chestnut Mouse	-	NT																p	
<i>Zyzomys argurus</i>	Common Rock-rat	-	LC				e	e	a					e						
PETAURIDAE																				
<i>Petaurus breviceps</i>	Sugar Glider	-	LC																a	
SUIDAE																				
<i>Sus scrofa</i>	Pig	-	(Int)						a						a					



Table 2-4: Birds found from MLA field survey

Note: Only prescence / absence data recorded in these tables.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au s	N T	I n	1	2	3	4	5	6	7	8	8 b	9	10	11	12	13	14	15
ACANTHIZIDAE																				
<i>Gerygone albogularis</i>	White-throated Gerygone	-	L C	x									x					x	x	x
<i>Gerygone chloronota</i>	Green-backed Gerygone	-	L C												x					
ACCIPITRIDAE																				
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	-	L C	x										x						
<i>Accipiter fasciatus</i>	Brown Goshawk	-	L C													x				
<i>Aquila audax</i>	Wedge-tailed Eagle	-	L C	x																
<i>Circus assimilis</i>	Spotted Harrier	-	L C		x									x						
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	-	L C	x																
<i>Haliastur sphenurus</i>	Whistling Kite	-	L C	x				x	x				x	x	x		x			
AEGOTHELIDAE																				
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	-	L C	x		x	x			x		x			x					
ANSERANATIDAE																				
<i>Anseranas semipalmata</i>	Magpie Goose	-	L C	x							x									
APODIDAE																				
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	N E	x																
ARDEIDAE																				
<i>Ardea pacifica</i>	White-necked Heron	-	L C												x					
<i>Egretta garzetta</i>	Little Egret	-	L C												x					
<i>Ixobrychus flavicollis</i>	Black Bittern	-	D D	x																
<i>Nycticorax caledonicus</i>	Nankeen Night Heron	-	L C	x																
ARTAMIDAE																				
<i>Artamus cinereus</i>	Black-faced Woodswallow	-	L C	x								x			x					
<i>Artamus minor</i>	Little Woodswallow	-	L C	x						x										
<i>Cracticus nigrogularis</i>	Pied Butcherbird	-	L C	x	x	x	x	x		x			x			x		x	x	x
<i>Cracticus tibicen</i>	Australian Magpie	-	L C					x					x					x		x
BURHINIDAE																				
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	N T	x				x	x	x		x								
CACATUIDAE																				
<i>Calyptrorhynchus</i>	Red-tailed Black-	-	L	x																



SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au s	N T	I n	1	2	3	4	5	6	7	8	8 b	9	1 0	1 1	1 2	1 3	1 4	1 5
<i>banksii</i>	cockatoo		C																	
<i>Eolophus roseicapilla</i>	Galah	-	L C	x									x						x	x
CAMPEPHAGIDAE																				
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	L C	x			x		x	x						x	x			
<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	-	L C	x	x					x				x			x			x
<i>Lalage sueurii</i>	White-winged Triller	-	L C	x									x							
CASUARIIDAE																				
<i>Dromaius novaehollandiae</i>	Emu	-	V U								x									
CHARADRIIDAE																				
<i>Vanellus miles</i>	Masked Lapwing	-	L C	x																
CICONIIDAE																				
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	L C	x																
CLIMACTERIDAE																				
<i>Climacteris melanura</i>	Black-tailed Treecreeper	-	L C	x	x							x					x			
COLUMBIDAE																				
<i>Geopelia cuneata</i>	Diamond Dove	-	L C							x										
<i>Geopelia humeralis</i>	Bar-shouldered Dove	-	L C												x					
<i>Geopelia striata</i>	Peaceful Dove	-	L C	x				x	x	x		x	x	x	x	x	x	x		x
<i>Phaps chalcoptera</i>	Common Bronzewing	-	L C	x					x				x							
CORCORACIDAE																				
<i>Struthidea cinerea</i>	Apostlebird	-	L C	x														x	x	x
CORVIDAE																				
<i>Corvus orru</i>	Torresian Crow	-	L C	x						x			x		x		x	x		
CUCULIDAE																				
<i>Cacomantis pallidus</i>	Pallid Cuckoo	-	L C	x	x		x													
<i>Centropus phasianinus</i>	Pheasant Coucal	-	L C		x	x		x	x		x			x	x					
<i>Chalcites osculans</i>	Black-eared Cuckoo	-	L C		x															
ESTRILDIDAE																				
<i>Poephila acuticauda</i>	Long-tailed Finch	-	L C	x						x					x					
<i>Poephila personata</i>	Masked Finch	-	L C	x											x					
<i>Taeniopygia bichenovii</i>	Double-barred Finch	-	L C	x		x			x					x	x	x				
EUROSTOPIDAE																				
<i>Eurostopodus argus</i>	Spotted Nightjar	-	L C	x														x		
FALCONIDAE																				
<i>Falco berigora</i>	Brown Falcon	-	L C	x						x										
GRALLINIDAE																				
<i>Grallina cyanoleuca</i>	Magpie-lark	-	L	x												x				



SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au	N	I	1	2	3	4	5	6	7	8	8	9	1	1	1	1	1	1
		s	T	n									b		0	1	2	3	4	5
			C																	
GRUIDAE																				
<i>Grus rubicunda</i>	Brolga	-	L	x																
			C																	
HALCYONIDAE																				
<i>Dacelo leachii</i>	Blue-winged Kookaburra	-	D	x	x			x	x				x		x			x	x	
<i>Todiramphus macleayii</i>	Forest Kingfisher	-	L	x																
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher	-	L	x	x				x											
<i>Todiramphus sanctus</i>	Sacred Kingfisher	-	L	x		x			x								x			
			C																	
MALURIDAE																				
<i>Malurus lamberti</i>	Variegated Fairy-wren	-	L	x																
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	-	L	x	x	x	x	x	x	x					x				x	x
			C																	
MELIPHAGIDAE																				
<i>Cissomela pectoralis</i>	Banded Honeyeater	-	L	x				x	x	x			x	x	x			x	x	
<i>Conopophila rufogularis</i>	Rufous-throated Honeyeater	-	L	x										x						
<i>Lichenostomus unicolor</i>	White-gaped Honeyeater	-	L					x												
<i>Lichenostomus virescens</i>	Singing Honeyeater	-	L	x														x		
<i>Lichmera indistincta</i>	Brown Honeyeater	-	L		x	x							x		x			x		x
<i>Melithreptus albogularis</i>	White-throated Honeyeater	-	L	x				x				x	x		x					x
<i>Philemon argenticeps</i>	Silver-crowned Friarbird	-	L	x	x			x	x					x	x				x	x
<i>Philemon citreogularis</i>	Little Friarbird	-	L	x																
<i>Ramsayornis fasciatus</i>	Bar-breasted Honeyeater	-	L	x																
			C																	
MEROPIIDAE																				
<i>Merops ornatus</i>	Rainbow Bee-eater	-	L	x			x			x		x		x	x			x		x
			C																	
MONARCHIDAE																				
<i>Grallina cyanoleuca</i>	Magpie-lark	-	L	x	x			x												
<i>Myiagra inquieta</i>	Restless Flycatcher	-	L	x	x		x	x					x	x	x	x				x
<i>Myiagra rubecula</i>	Leaden Flycatcher	-	L																	x
			C																	
NECTARINIIDAE																				
<i>Dicaeum hirundinaceum</i>	Mistletoebird	-	L	x																
			C																	
NEOSITTIDAE																				
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	L		x			x		x										
			C																	
ORIOIIDAE																				
<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	L																	x
			C																	
OTIDIDAE																				
<i>Ardeotis australis</i>	Australian Bustard	-	V	x		x		x		x										
			U																	
PACHYCEPHALIDAE																				



SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au s	N T	I n	1	2	3	4	5	6	7	8	8 b	9	1 0	1 1	1 2	1 3	1 4	1 5
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	L C									x								
<i>Colluricincla woodwardi</i>	Sandstone Shrike-thrush	-	L C											x						
<i>Pachycephala rufiventris</i>	Rufous Whistler	-	L C	x	x	x		x	x	x		x	x	x	x		x	x	x	x
<i>Pachycephala simplex</i>	Grey Whistler	-	L C					x												
PARDALOTIDAE																				
<i>Pardalotus striatus</i>	Striated Pardalote	-	L C	x									x		x			x	x	x
<i>Smicronis brevirostris</i>	Weebill	-	L C	x	x			x	x						x					
PELECANIDAE																				
<i>Pelecanus conspicillatus</i>	Australian Pelican	-	L C	x													x			
PETROICIDAE																				
<i>Microeca fascians</i>	Jacky Winter	-	L C	x	x	x			x						x					
PHASIANIDAE																				
<i>Coturnix ypsilophora</i>	Brown Quail	-	L C	x	x			x							x					
PODARGIDAE																				
<i>Podargus strigoides</i>	Tawny Frogmouth	-	L C	x							x	x	x		x					
POMATOSTOMIDAE																				
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	L C	x						x			x		x	x	x	x		
PSITTACIDAE																				
<i>Aprosmictus erythropterus</i>	Red-winged Parrot	-	L C	x	x				x				x	x	x			x		
<i>Platycercus venustus</i>	Northern Rosella	-	L C																	
<i>Psitteuteles versicolor</i>	Varied Lorikeet	-	L C	x					x				x					x		x
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	L C	x		x														
PTILONORHYNCHIDAE																				
<i>Ptilonorhynchus nuchalis</i>	Great Bowerbird	-	L C									x		x						x
RALLIDAE																				
<i>Gallirallus philippensis</i>	Buff-banded Rail	-	L C	x																
RHIPIDURIDAE																				
<i>Rhipidura albiscapa</i>	Grey Fantail	-	L C																	x
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	L C	x						x	x				x	x				
SCOLOPACIDAE																				
<i>Gallinago sp.</i>	Snipe species	-	D D	x																
STRIGIDAE																				
<i>Ninox novaeseelandiae</i>	Southern Boobook	-	L C	x								x								x
THRESKIORNITHIDAE																				
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	-	L C							x										
TURNICIDAE																				



SCIENTIFIC NAME	COMMON NAME	STATUS		MINE																
		Au s	N T	I n	1	2	3	4	5	6	7	8	8 b	9	1 0	1 1	1 2	1 3	1 4	1 5
<i>Turnix maculosus</i>	Red-backed Button-quail	-	L C							x										



Table 2-5: Freshwater vertebrates found from MLA field survey

Note: Only presence / absence data recorded in these tables. Full trap data are available.

X = species identified during MLA field surveys

Scientific Name	Common Name	Status		Sites				
		Aus	NT	1	2	3	4	5
FISH								
<i>Ambassis interruptus</i>	Longspine Glassfish	-	-		X			
<i>Ambassis macleayi</i>	Macleay's Glassfish	-	-		X	X	X	X
<i>Ambassis sp.</i>	North-west Glassfish	-	-		X			
<i>Amniataba percoides</i>	Barred Grunter	-	-		X	X		X
<i>Arrhamphus scerlolepis</i>	Snubnose Garfish	-	-		X			
<i>Chanos chanos</i>	Milkfish	-	-		X			
<i>Craterocephalus stercusmuscarum</i>	Flyspecked Hardyhead	-	-		X			X
<i>Elops hawaiiensis</i>	Hawaiian Giant Herring	-	-		X			
<i>Glossamia aprion</i>	Mouth Almighty	-	-		X	X	X	X
<i>Glossogobius giurus</i>	Tank Goby	-	-		X			X
<i>Hephaestus fuliginosus</i>	Sooty Grunter	-	-		X			X
<i>Hypseleotris compressa</i>	Empire Gudgeon	-	-		X			
<i>Lates calcarifer</i>	Barramundi	-	-		X			X
<i>Leiopotherapon unicolor</i>	Spangled Perch	-	-		X	X	X	X
<i>Liza alata</i>	Diamond Mullet	-	-		X			
<i>Megalops cyprinoides</i>	Oxeye Herring	-	-		X			
<i>Melanotaenia splendida inornata</i>	Chequered Rainbowfish	-	-		X	X	X	X
<i>Mogurnda mogurnda</i>	Northern Purplespotted Gudgeon	-	-				X	X
<i>Nematolosa erebi</i>	Bony Bream	-	-		X	X		X
<i>Neoarius sp.</i>	Unidentified Catfish	-	-		X			
<i>Neosilurus ater</i>	Black Catfish	-	-		X			X
<i>Neosilurus hyrtlii</i>	Hyrtl's Catfish	-	-			X		
<i>Oxyeleotris lineolata</i>	Sleepy Cod	-	-			X		X
<i>Porochilus rendahli</i>	Rendahl's Catfish	-	-			X		X
<i>Scatophagus argus</i>	Spotted Scat	-	-		X			X
<i>Strongylura krefftii</i>	Freshwater Longtom	-	-		X			X
<i>Toxotes chatareus</i>	Sevenspot Archerfish	-	-		X	X		X
REPTILES								
<i>Crocodylus johnstoni</i>	Freshwater Crocodile	-	LC		X			X



Appendix D-3 – Fauna Survey Data (Haul Road)



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Table 3-1: Reptiles found from Haul Road field survey

Note: Only prescence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		HAUL RD																											
				Cox					Limmen				Townns (lower)						Townns (upper)						Rosie						
		Au s	NT	I n	1	2	3	4	I n	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	I n	1	2	3			
AGAMIDAE																															
Chlamydosaurus kingii	Friilled Lizard	-	LC																								a				
Ctenophorus caudicinctus	Ring-tailed Dragon	-	LC						i																						
Diporiphora magna	-	-	LC				a		i		a		p	a, f	p	a	a,p	a, p	a,f, p			a, f	a	f, p			a				
Lophognathus gilberti	Gilbert's Dragon	-	LC					a		f												f									
COLUBRIDAE																															
Tropidonophis mairii	Keelback	-	LC																						i						
CROCODYLIDAE																															
Crocodylus johnstoni	Freshwater Crocodile	-	LC					a																							
ELAPIDAE																															
Brachyuropsis semifasciatus	Half-girdled Snake	-	LC				f																								
Pseudonaja nuchalis	Western Brown Snake	-	LC								f																				
GEKKONIDAE																															
Gehyra australis	Northern Dtella	-	LC		a							a														a					
Gehyra borrooloola	Borrooloola Dtella	-	LC		a						a					a												a			
Gehyra nana	Northern Spotted Rock Dtella	-	LC		a																										
Heteronotia binoei	Bynoe's Gecko	-	LC		a, f							a, f			p	a,f, p					p			f			a				
Oedura marmorata	Marbled Velvet Gecko	-	LC									a				a															
Oedura rhombifer	Zig-zag Gecko	-	LC																							a					
Strophurus ciliaris	Spiny-tailed Gecko	-	LC																							a					
PYGOPODIDAE																															



SCIENTIFIC NAME	COMMON NAME	STATUS		HAUL RD																											
		Au s	NT	Cox					Limmen				Towns (lower)						Towns (upper)						Rosie						
				I n	1	2	3	4	I n	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	I n	1	2	3			
<i>Delma borea</i>	Rusty-topped Delma	-	LC				a																								
PYTHONIDAE																															
<i>Liasis olivaceus</i>	Olive Python	-	LC		a																										
SCINCIDAE																															
<i>Carlia amax</i>	Two-Spined Rainbow Skink	-	LC		a, f	p				a		a	a, f	f	a	a	a,f		a,f	a,f	a	a, f	a	a	i	a		a			
<i>Carlia munda</i>	Striped Rainbow Skink	-	LC							p	p		a, f	f, p	a	a	a	f	a,f, p	a, p	a	a, f	a,f, p	a, f		a,f, p					
<i>Carlia triacantha</i>	Three-Spined Rainbow Skink	-	LC										a, f				a														
<i>Cryptoblepharus australis</i>	Inland Snake-eyed Skink	-	D D																					i	a						
<i>Ctenotus inornatus</i>	Plain Ctenotus	-	LC		a, f					a, f	p		a, f	f	a,f, p	f	e,p	p													
<i>Ctenotus spaldingi</i>	Spalding's Ctenotus	-	LC		a	f	f							f, p	p		f	f,p	p					f		p					
<i>Ctenotus vertebralis</i>	Scant-Striped Ctenotus	-	LC				f, p																			a					
<i>Glaphyromorphus isolepis</i>	Smooth-Tailed Skink	-	LC							f, p	f							f		f											
<i>Morethia storri</i>	Storr's Snake-Eyed Skink	-	LC									a													p	a					
<i>Proablepharus tenuis</i>	Slender Snake-Eyed Skink	-	LC				f			a												p			a						
VARANIDAE																															
<i>Varanus gouldii</i>	Sand Goanna	-	LC				s																								
<i>Varanus mertensi</i>	Mertens' Water Monitor	-	V U					a																i							



Table 3-2: Amphibians found from Haul Road field survey

Note: Only prescence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		HAUL RD																									
		Aus	NT	Cox					Limmen				Towns (lower)						Towns (upper)						Rosie				
				In	1	2	3	4	In	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	In	1	2	3	
BUFONIDAE																													
Chaunus marinus	Cane Toad	-	(Int)	i						a,c,p	a,c	a,e,f					e		e			a	a			a			
HYLIDAE																													
Litoria australis	Giant Frog	-	DD	i				a																					
Litoria bicolor	Northern Dwarf Tree-frog	-	DD					a			a														i			a	
Litoria caerulea	Green Tree-frog	-	LC				a			a																			
Litoria nasuta	Rocket Frog	-	LC							a															i			a	
Litoria pallida	Pale Frog	-	LC					a	i																i				
Litoria rothii	Roth's Tree-frog	-	LC								a																		
Litoria rubella	Red Tree-frog	-	LC				f	a								p		a			a	a			i				
Litoria wotjulumensis	Wotjulum Frog	-	LC																							a		a	
LIMNODYNASTIDAE																													
Limnodynastes convexiusculus	Marbled Frog	-	LC		e																								
Limnodynastes lignarius	Carpenter Frog	-	LC																									a	
Notaden melanoscaphus	Northern Spadefoot Toad	-	LC			p	p							p	p	p		p		p									
Opisthodon ornatus	Ornate Burrowing Frog	-	DD				f								p			f			p		p			i	a,p	p	
MYOBATRACHIDAE																													
Uperoleia inundata	Floodplain Toadlet	-	LC							a	a,p	a,e														i	a	a,p	a
Uperoleia lithomoda	Stonemason Toadlet	-	LC											p	p	p					p			p					



Table 3-3: Mammals found from Haul Road field survey

Note: Only prescence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		HAUL RD																									
		Aus	NT	Cox					Limmen				Towns (lower)						Towns (upper)						Rosie				
				In	1	2	3	4	In	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	In	1	2	3	
BOVIDAE																													
Bubalus bubalis	Swamp Buffalo	-	(Int)		a																								
DASYURIDAE																													
Planigale ingrami	Long-tailed Planigale	-	LC											p															
Planigale maculata	Common Planigale	-	LC																									e	
Pseudantechinus bilarni	Sandstone Antechinus	-	DD																									e	
EMBALLONURIDAE																													
Taphozous georgianus	Common Sheath-tailed Bat	-	LC																									a	
EQUIDAE																													
Equus caballus	Horse	-	(Int)					a																					
MACROPODIDAE																													
Macropus agilis	Agile Wallaby	-	LC						i																				
Macropus robustus	Common Wallaroo	-	LC								s																	a	
MURIDAE																													
Pseudomys nanus	Western Chestnut Mouse	-	NT			e				e									e		e	c,e	e	e					
Rattus colleti	Dusky Rat	-	LC																							c			
Zyomys argurus	Common Rock-rat	-	LC		e																							e	
PSEUDOCHEIRIDAE																													
Petropseudes dahli	Rock Ringtail Possum	-	LC																									a	
PETAURIDAE																													
Petaurus breviceps	Sugar Glider	-	LC																						s		s		
PTEROPODIDAE																													
Pteropus alecto	Black Flying-fox	-	LC	i																									
SUIDAE																													
Sus scrofa	Pig	-	(Int)					a																					



Table 3-4: Birds found from Haul Road field survey

Note: Only prescence / absence data recorded in these tables.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		HAUL RD																											
				Cox					Limmen				Town's (lower)						Town's (upper)						Rosie						
		Aust	NT	In	1	2	3	4	In	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	In	1	2	3			
ACANTHIZIDAE																															
Gerygone albogularis	White-throated Gerygone	-	LC		x					x				x	x	x				x		x		x							
ACCIPITRIDAE																															
Accipiter cirrocephalus	Collared Sparrowhawk	-	LC																									x			
Accipiter fasciatus	Brown Goshawk	-	LC		x																					x					
Aquila audax	Wedge-tailed Eagle	-	LC																							x					
Haliaeetus leucogaster	White-bellied Sea-eagle	-	LC	x																											
Haliastur sphenurus	Whistling Kite	-	LC		x	x																									
Hieraaetus morphnoides	Little Eagle	-	LC						x																						
ALCEDINIDAE																															
Ceyx azureus	Azure Kingfisher	-	LC					x																							
ANATIDAE																															
Anas superciliosa	Pacific Black Duck	-	LC					x																							
Dendrocygna arcuata	Wandering Whistling-Duck	-	LC	x																											
ARDEIDAE																															
Ixobrychus flavicollis	Black Bittern	-	DD																						x						
Nycticorax caledonicus	Nankeen Night Heron	-	LC					x																							
ARTAMIDAE																															
Artamus cinereus	Black-faced Woodswallow	-	LC	x																											
Artamus leucorhynchus	White-breasted Woodswallow	-	LC						x																						
Artamus minor	Little Woodswallow	-	LC		x																x							x			
Artamus personatus	Masked Woodswallow	-	LC						x																						
Cracticus nigrogularis	Pied Butcherbird	-	LC			x	x		x				x		x		x	x					x	x	x	x	x	x			
Cracticus tibicen	Australian Magpie	-	LC																					x							



		STATUS		HAUL RD																											
SCIENTIFIC NAME	COMMON NAME	Aust	NT	Cox					Limmen				Town's (lower)						Town's (upper)						Rosie						
				In	1	2	3	4	In	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	In	1	2	3			
BURHINIDAE																															
Burhinus grallarius	Bush Stone-curlew	-	NT	x																											
CACATUIDAE																															
Cacatua galerita	Sulphur-crested Cockatoo	-	LC						x						x				x	x	x	x	x	x	x						
Calyptorhynchus banksii	Red-tailed Black-cockatoo	-	LC						x																		x				
Eolophus roseicapilla	Galah	-	LC				x					x											x								
Nymphicus hollandicus	Cockatiel	-	LC	x																											
CAMPEPHAGIDAE																															
Coracina novaehollandiae	Black-faced Cuckoo-shrike	-	LC		x			x					x		x	x					x				x		x	x			
Coracina papuensis	White-bellied Cuckoo-shrike	-	LC		x				x	x	x				x				x	x	x	x	x	x		x					
Lalage sueurii	White-winged Triller	-	LC	x										x	x	x															
COLUMBIDAE																															
Geopelia humeralis	Bar-shouldered Dove	-	LC		x	x		x	x	x					x		x		x	x	x	x	x	x				x			
Geopelia striata	Peaceful Dove	-	LC		x			x	x	x	x	x			x	x		x	x				x		x		x				
Phaps chalcoptera	Common Bronzewing	-	LC																							x					
CORACIIDAE																															
Eurystomus orientalis	Dollarbird	-	LC										x		x	x				x				x							
CORVIDAE																															
Corvus orru	Torresian Crow	-	LC		x			x	x												x					x					
CUCULIDAE																															
Cacomantis pallidus	Pallid Cuckoo	-	LC		x																										
Cacomantis variolosus	Brush Cuckoo	-	LC		x				x					x		x	x	x	x	x		x	x	x	x	x					
Centropus phasianinus	Pheasant Coucal	-	LC	x					x				x						x			x	x	x							
Chalcites basalis	Horsfield's Bronze-Cuckoo	-	LC																							x					
Chalcites minutillus	Little Bronze-Cuckoo	-	LC	x																											
Eudynamys orientalis	Eastern Koel	-	LC	x					x																						
Scythrops novaehollandiae	Channel-billed Cuckoo	-	LC						x																						
ESTRILDIDAE																															
Neochmia phaeton	Crimson Finch	-	LC							x																					
Poephila acuticauda	Long-tailed Finch	-	LC					x									x	x								x		x			
Poephila personata	Masked Finch	-	LC		x			x																							
Taeniopygia bichenovii	Double-barred Finch	-	LC		x	x		x	x	x							x														
EUROSTOPIIDAE																															



		STATUS		HAUL RD																											
SCIENTIFIC NAME	COMMON NAME	Aust	NT	Cox					Limmen				Town's (lower)						Town's (upper)						Rosie						
				In	1	2	3	4	In	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	In	1	2	3			
<i>Eurostopodus argus</i>	Spotted Nightjar	-	LC	x																								x			
FALCONIDAE																															
<i>Falco berigora</i>	Brown Falcon	-	LC										x														x				
<i>Falco cenchroides</i>	Nankeen Kestrel	-	LC	x																											
<i>Falco subniger</i>	Black Falcon	-	LC							x																					
GRUIDAE																															
<i>Grus rubicunda</i>	Brolga	-	LC	x																											
HALCYONIDAE																															
<i>Dacelo leachii</i>	Blue-winged Kookaburra	-	DD					x	x	x						x	x				x		x	x	x		x		x		
<i>Todiramphus sanctus</i>	Sacred Kingfisher	-	LC					x	x												x						x				
MALURIDAE																															
<i>Malurus lamberti</i>	Variegated Fairy-wren	-	LC		x									x					x									x			
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	-	LC		x	x			x	x		x			x		x			x	x			x	x	x		x	x		
MELIPHAGIDAE																															
<i>Cissomela pectoralis</i>	Banded Honeyeater	-	LC							x	x	x																			
<i>Conopophila rufogularis</i>	Rufous-throated Honeyeater	-	LC		x			x	x																		x				
<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	-	LC																								x	x		x	
<i>Lichenostomus flavescens</i>	Yellow-tinted Honeyeater	-	LC																									x			
<i>Lichenostomus unicolor</i>	White-gaped Honeyeater	-	LC		x				x											x	x	x	x	x	x						
<i>Lichenostomus virescens</i>	Singing Honeyeater	-	LC		x	x		x	x																		x		x	x	
<i>Lichmera indistincta</i>	Brown Honeyeater	-	LC		x				x	x	x	x	x	x	x		x	x		x	x		x			x	x	x	x		
<i>Melithreptus albogularis</i>	White-throated Honeyeater	-	LC		x	x			x		x	x										x					x				
<i>Melithreptus gularis</i>	Black-chinned Honeyeater	-	LC																								x				
<i>Philemon argenticeps</i>	Silver-crowned Friarbird	-	LC		x			x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x		
<i>Philemon citreogularis</i>	Little Friarbird	-	LC						x								x						x								
<i>Ramsayornis fasciatus</i>	Bar-breasted Honeyeater	-	LC						x											x	x			x			x				
MEROPIDAE																															
<i>Merops ornatus</i>	Rainbow Bee-eater	-	LC		x				x	x				x	x	x					x	x						x	x		
MONARCHIDAE																															
<i>Grallina cyanoleuca</i>	Magpie-lark	-	LC															x	x												
<i>Myiagra inquieta</i>	Restless Flycatcher	-	LC		x				x	x		x			x					x				x	x						
<i>Myiagra rubecula</i>	Leaden Flycatcher	-	LC								x																				
MOTACILLIDAE																															



		STATUS		HAUL RD																											
SCIENTIFIC NAME	COMMON NAME	Aust	NT	Cox					Limmen				Town's (lower)						Town's (upper)						Rosie						
				In	1	2	3	4	In	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	In	1	2	3			
<i>Anthus novaeseelandiae</i>	Australasian Pipit	-	LC						x	x																					
NECTARINIIDAE																															
<i>Dicaeum hirundinaceum</i>	Mistletoebird	-	LC		x			x		x																x	x				
NEOSITTIDAE																															
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	LC									x								x	x						x				
ORIOLOIDAE																															
<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	LC		x				x						x			x	x			x									
PACHYCEPHALIDAE																															
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	LC						x	x																	x				
<i>Colluricincla woodwardi</i>	Sandstone Shrike-thrush	-	LC																									x			
<i>Pachycephala rufiventris</i>	Rufous Whistler	-	LC		x			x	x	x	x			x	x	x	x	x	x	x	x	x	x	x				x			
PARDALOTIDAE																															
<i>Pardalotus striatus</i>	Striated Pardalote	-	LC		x				x	x	x	x																x			
<i>Smicronis brevirostris</i>	Weebill	-	LC		x	x	x	x	x																			x			
PETROICIDAE																															
<i>Microeca fascians</i>	Jacky Winter	-	LC		x				x	x		x															x				
<i>Microeca flavigaster</i>	Lemon-bellied Flycatcher	-	LC							x																					
PODARGIDAE																															
<i>Podargus strigoides</i>	Tawny Frogmouth	-	LC						x																			x			
POMATOSTOMIDAE																															
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	LC		x				x	x							x	x			x					x					
PSITTACIDAE																															
<i>Aprosmictus erythropterus</i>	Red-winged Parrot	-	LC				x	x			x							x				x				x	x	x			
<i>Platycercus venustus</i>	Northern Rosella	-	LC																								x				
<i>Psitteuteles versicolor</i>	Varied Lorikeet	-	LC																									x			
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	LC		x	x			x												x	x	x	x	x	x					
PTILONORHYNCHIDAE																															
<i>Ptilonorhynchus nuchalis</i>	Great Bowerbird	-	LC		x				x	x			x																		
RHIPIDURIDAE																															
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	LC		x				x	x				x							x	x	x	x	x	x	x				
<i>Rhipidura rufiventris</i>	Northern Fantail	-	LC							x	x	x																			
STRIGIDAE																															
<i>Ninox novaeseelandiae</i>	Southern Boobook	-	LC	x																								x			



SCIENTIFIC NAME		COMMON NAME		STATUS		HAUL RD																											
						Cox				Limmen				Town's (lower)						Town's (upper)						Rosie							
				Aust	NT	In	1	2	3	4	In	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6	In	1	2	3		
THRESKIORNITHIDAE																																	
Threskiornis spinicollis		Straw-necked Ibis	-	LC	x																												
TURNICIDAE																																	
Turnix maculosus		Red-backed Button-quail	-	LC														x															
Turnix pyrrhotorax		Red-chested Button-quail	-	LC																					x								



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Appendix D-4 – Fauna Survey Data (Port)



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Table 4-1: Reptiles found from Port field survey

Note: Only presence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		SITE						
		Aus	NT	In	1	2	3	4	5	6
AGAMIDAE										
<i>Diporiphora bilineata</i>	Two-Lined Dragon	-	LC	i						a
<i>Lophognathus gilberti</i>	Gilbert's Dragon	-	LC					f	a,p	a,p
<i>Dendrelaphis punctulata</i>	Green Tree Snake	-	DD	i					a	
ELAPIDAE										
<i>Demansia vestigiata</i>	Black Whip Snake	-	DD							a
<i>Brachyuropsis roperi</i>	Northern Shovel-nosed Snake	-	NL			f				
<i>Demansia papuensis</i>	Papaun Whip Snake	-	DD	i						
PYGOPODIDAE										
<i>Delma borea</i>	Rusty-topped Delma	-	LC		a					
PYTHONIDAE										
<i>Antaresia childreni</i>	Children's Python	-	DD					f		
<i>Liasis fuscus</i>	Water Python	-	LC	i						
SCINCIDAE										
<i>Carlia amax</i>	Two-Spined Rainbow Skink	-	LC		f,p	a,p	p			
<i>Carlia munda</i>	Striped Rainbow Skink	-	LC		p		p	a,p		p
<i>Ctenotus inornatus</i>	Plain Ctenotus	-	LC		f					
<i>Ctenotus spaldingi</i>	Spalding's Ctenotus	-	LC		a,f	p				
<i>Cryptoblepharus ruber</i>	Tawny Snake-eyed Skink	-	NE			a				
VARANIDAE										
<i>Varanus mertensi</i>	Mertens' Water Monitor	-	VU	i						
CHELUIDAE										
<i>Chelodina canni</i>	Cann's Long-necked Turtle	-	LC	i						



Table 4-2: Amphibians found from Port field survey

Note: Only presence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		SITE							
		Aus	NT	In	1	2	3	4	5	6	
BUFONIDAE											
<i>Chaunus marinus</i>	Cane Toad	-	(Int)		p	e	a	p	e	e	
HYLIDAE											
<i>Litoria australis</i>	Giant Frog	-	DD				a			a	
<i>Litoria bicolor</i>	Northern Dwarf Tree-frog	-	DD				a	a,p	a	a	
<i>Litoria caerulea</i>	Green Tree-frog	-	LC							a	
<i>Litoria tornieri</i>	Tornier's Frog	-	LC							a	
<i>Litoria longipes</i>	Long-footed Frog	-	LC					p	p		
LIMNODYNASTIDAE											
<i>Notaden melanoscaphus</i>	Northern Spadefoot Toad	-	LC		p	p					
<i>Opisthodon ornatus</i>	Ornate Burrowing Frog	-	DD							a,p	

Table 4-3: Mammals found from Port field survey

Note: Only presence / absence data recorded in these tables. Full trap data are available.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		SITE							
		Aus	NT	In	1	2	3	4	5	6	
BOVIDAE											
<i>Bos taurus</i>	Cattle	-	(Int)	i							
MACROPODIDAE											
<i>Macropus agilis</i>	Agile Wallaby	-	LC	i							
MURIDAE											
<i>Pseudomys nanus</i>	Western Chestnut Mouse	-	NT						e		
<i>Rattus colletti</i>	Dusky Rat	-	LC		e						
SUIDAE											
<i>Sus scrofa</i>	Pig	-	(Int)	s							
PERAMELIDAE											
<i>Isodon macrourus</i>	Northern Brown Bandicoot	-	LC							e	



Table 4-4: Birds found from Port field survey

Note: Only presence / absence data recorded in these tables.

Table Key	a = active search c = cage e = Elliot trap f = funnel trap	i = incidental p = pit fall trap s = signs (eg. scats, scratchings)	CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near Threatened	DD = Data Deficient LC = Least Concern (Int) = Introduced NE = Not Evaluated

SCIENTIFIC NAME	COMMON NAME	STATUS		SITE						
		Aus	NT	In	1	2	3	4	5	6
ACANTHIZIDAE										
<i>Gerygone albogularis</i>	White-throated Gerygone	-	LC		x					
<i>Gerygone levigaster</i>	Mangrove Gerygone	-	LC	x						
ACCIPITRIDAE										
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	-	LC				x	x		
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	-	LC	x						
<i>Haliastur sphenurus</i>	Whistling Kite	-	LC		x		x	x	x	
<i>Milvus migrans</i>	Black Kite	-	LC	x						
<i>Pandion cristatus</i>	Eastern Osprey	-	LC	x						
ANATIDAE										
<i>Anas superciliosa</i>	Pacific Black Duck	-	LC	x						
<i>Dendrocygna eytoni</i>	Plumed Whistling-Duck	-	LC	x						
<i>Nettapus pulchellus</i>	Green Pygmy-Goose	-	LC	x						
<i>Tadorna radjah</i>	Radjah Shelduck	-	LC	x						
ARDEIDAE										
<i>Butorides striata</i>	Striated Heron	-	LC	x						
<i>Egretta garzetta</i>	Little Egret	-	LC	x						
<i>Egretta picata</i>	Pied Heron	-	LC	x						
ARTAMIDAE										
<i>Artamus cinereus</i>	Black-faced Woodswallow	-	LC				x			
CACATUIDAE										
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	-	LC	x						
<i>Cacatua sanguinea</i>	Little Corella	-	LC						x	
CAMPEPHAGIDAE										
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	LC		x				x	x
<i>Lalage sueurii</i>	White-winged Triller	-	LC				x			
CHARADRIIDAE										
<i>Charadrius leschenaultii</i>	Greater Sand Plover	-	LC	x						
<i>Pluvialis squatarola</i>	Grey Plover	-	LC	x						
<i>Vanellus miles</i>	Masked Lapwing	-	LC	x						
CICONIIDAE										
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	LC	x						
CISTICOLIDAE										
<i>Cisticola exilis</i>	Golden-headed Cisticola	-	LC	x						
COLUMBIDAE										
<i>Ducula bicolor</i>	Pied Imperial Pigeon	-	LC	x						



SCIENTIFIC NAME	COMMON NAME	STATUS		SITE						
		Aus	NT	In	1	2	3	4	5	6
<i>Geopelia humeralis</i>	Bar-shouldered Dove	-	LC		x	x			x	x
<i>Geopelia striata</i>	Peaceful Dove	-	LC				x			
CORACIIDAE										
<i>Eurystomus orientalis</i>	Dollarbird	-	LC			x	x	x	x	
CORVIDAE										
<i>Corvus orru</i>	Torresian Crow	-	LC				x		x	
CUCULIDAE										
<i>Cacomantis pallidus</i>	Pallid Cuckoo	-	LC		x	x				
<i>Centropus phasianinus</i>	Pheasant Coucal	-	LC	x						
<i>Eudynamys orientalis</i>	Eastern Koel	-	LC				x			x
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	-	LC	x						
ESTRILDIDAE										
<i>Poephila personata</i>	Masked Finch	-	LC	x						
<i>Taeniopygia bichenovii</i>	Double-barred Finch	-	LC						x	
EUROSTOPIDAE										
<i>Eurostopodus argus</i>	Spotted Nightjar	-	LC	x						
FALCONIDAE										
<i>Falco peregrinus</i>	Peregrine Falcon	-	LC	x						
GRUIDAE										
<i>Grus rubicunda</i>	Brolga	-	LC	x						
HAEMATOPODIDAE										
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	-	LC	x						
HALCYONIDAE										
<i>Dacelo leachii</i>	Blue-winged Kookaburra	-	DD			x			x	
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher	-	LC	x						
<i>Todiramphus sanctus</i>	Sacred Kingfisher	-	LC		x		x			
LARIDAE										
<i>Chroicocephalus novaehollandiae</i>	Silver Gull	-	LC	x						
<i>Chlidonias hybrida</i>	Whiskered Tern	-	LC	x						
<i>Hydroprogne caspia</i>	Caspian Tern	-	LC	x						
MALURIDAE										
<i>Malurus lamberti</i>	Variegated Fairy-wren	-	LC						x	
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	-	LC		x	x	x	x	x	
MEGALURIDAE										
<i>Megalurus timoriensis</i>	Tawny Grassbird	-	LC				x			
MELIPHAGIDAE										
<i>Conopophila rufogularis</i>	Rufous-throated Honeyeater	-	LC		x			x	x	x
<i>Lichenostomus unicolor</i>	White-gaped Honeyeater	-	LC	x						
<i>Lichenostomus virescens</i>	Singing Honeyeater	-	LC			x				
<i>Lichmera indistincta</i>	Brown Honeyeater	-	LC		x		x		x	
<i>Melithreptus albogularis</i>	White-throated Honeyeater	-	LC		x	x	x			
<i>Ramsayornis fasciatus</i>	Bar-breasted Honeyeater	-	LC		x		x			x
MEROPIIDAE										
<i>Merops ornatus</i>	Rainbow Bee-eater	-	LC					x	x	



SCIENTIFIC NAME	COMMON NAME	STATUS		SITE							
		Aus	NT	In	1	2	3	4	5	6	
MONARCHIDAE											
<i>Grallina cyanoleuca</i>	Magpie-lark	-	LC	x							
<i>Myiagra inquieta</i>	Restless Flycatcher	-	LC			x	x				
<i>Myiagra rubecula</i>	Leaden Flycatcher	-	LC		x	x		x			
ORIOLIDAE											
<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	LC					x			
PACHYCEPHALIDAE											
<i>Colluricincla megarhyncha</i>	Little Shrike-thrush	-	LC		x	x					
<i>Pachycephala rufiventris</i>	Rufous Whistler	-	LC		x						
<i>Pachycephala lanioides</i>	White-breasted Whistler	-	LC	x							
PARDALOTIDAE											
<i>Pardalotus striatus</i>	Striated Pardalote	-	LC		x	x					
PETROICIDAE											
<i>Microeca fascinans</i>	Jacky Winter	-	LC						x		
PHALACROCORACIDAE											
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	-	LC	x							
PHASIANIDAE											
<i>Coturnix ypsilophora</i>	Brown Quail	-	LC	x							
PODICIPEDIDAE											
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	-	LC	x							
POMATOSTOMIDAE											
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	LC				x	x	x		
PSITTACIDAE											
<i>Aprosmictus erythropterus</i>	Red-winged Parrot	-	LC		x			x			
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	LC							x	
PTILONORHYNCHIDAE											
<i>Ptilonorhynchus nuchalis</i>	Great Bowerbird	-	LC			x					
RHIPIDURIDAE											
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	LC		x	x	x				
SCOLOPACIDAE											
<i>Arenaria interpres</i>	Ruddy Turnstone	-	LC	x							
<i>Calidris alba</i>	Sanderling	-	LC	x							
<i>Numenius madagascariensis</i>	Eastern Curlew	-	LC	x							
<i>Numenius phaeopus</i>	Whimbrel	-	LC	x							
<i>Tringa nebularia</i>	Common Greenshank	-	LC	x							
<i>Tringa brevipes</i>	Grey-tailed Tattler	-	LC	x							
STRIGIDAE											
<i>Ninox novaeseelandiae</i>	Southern Boobook	-	LC	x							
THRESKIORNITHIDAE											
<i>Plegadis falcinellus</i>	Glossy Ibis	-	LC	x							
TIMALIIDAE											
<i>Zosterops luteus</i>	Yellow White-eye	-	LC							x	



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Appendix D-5 – Bat Report



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Bat survey

from the Western Desert Resources

Towns River project area,

Northern Territory

Type: Field survey and analysis

Prepared for: EcOz Environmental

Date: 16 April 2012

Job No.: SZ247

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SUMMARY

Western Desert Resources Limited (WDRL) is seeking approval to mine iron ore reserves in the Roper Bar Region of the Northern Territory. It is proposed that the mined product will be transported to the existing port facility of Bing Bong via a 164 km long haul road to enable the transshipment of product to overseas markets. This proposal collectively is named the Roper Bar Iron Ore (RBIO) Project.

Most survey effort described in the present report was focused in the MLA – Towns River part of the project area, with acoustic surveys for bats undertaken over a longer time frame at proposed haul road sites (Cox, Limmen, Rosie Creek) and a port facility at Bing Bong. A comprehensive approach was taken to surveying the entire bat assemblage in the MLA – Towns River project area, plus giving special effort to determining if bats of conservation significance (bare-rumped sheath-tailed bat *Saccolaimus saccolaimus*) occurs in the MLA – Towns River project area. This included deployment of electronic bat detectors, capture effort with mist nets and harp traps, DNA barcoding to confirm morphologically-based species level identifications, and searches for and pole-mounted camera examinations of potential *Saccolaimus* roost sites in the hollows of larger trees.

At least eight species of bat are present in the MLA – Towns River project area, but one of them is more likely to roost outside of it (*Taphozous georgianus*) given the observed lack of caves and crevices suitable for this species. In other parts of the project area, at least 10 species were present, including *Rhinonicteris aurantia* and *Vespadelus caurinus* that use caves for daytime roosting. DNA barcoding suggested the possibility of one extra cryptic form related to *Scotorepens greyii*, which cannot be resolved further without context genetic reference data.

There is currently no firm evidence that the bare-rumped sheath-tailed bat *Saccolaimus saccolaimus* utilises the MLA – Towns River project area for roosting or foraging, or indeed other parts of the project area. However its presence is still a possibility, given the observation of several large vertical hollows in tree trunks in *Eucalyptus tetrodonta* – *E. miniata* Mid Open Woodland and the single historical record from the Roper Bar area.

Echolocation calls of *Saccolaimus* were conspicuously abundant (but not quantified) in the MLA – Towns River project area, though it is anticipated that many if not all of these derive from *S. flaviventris*. However, species level identifications in *Saccolaimus* based on echolocation call characteristics are limited by a lack of known robust diagnostic features that allow them to be distinguished, though new call types have recently been characterised and presented as of 13 April 2012.

A novel method for investigating tree hollows for tree-roosting bats with a pole-mounted camera proved to be challenging (especially with regard to manoeuvring equipment into the hollow), but still has potential if the apertures of hollows are within 10 m of the ground.

1.0 INTRODUCTION

Western Desert Resources Limited (WDRL) is seeking approval to mine iron ore reserves within existing mining leases under application MLA 28264 and 28963 in the Roper Bar Region of the Northern Territory. It is proposed that the mined product will be transported to the existing port facility of Bing Bong via a 164 km long haul road to enable the transshipment of product to markets in China. This proposal collectively is named the Roper Bar Iron Ore (RBIO) Project.

As part of the development application, an environmental impact assessment has been undertaken, part of which includes effort to document the bat assemblage in the RBIO Project area. Some of this involves the deployment of electronic 'bat detectors' that make recordings of the ultrasonic echolocation calls of bats, which can be used to identify species. Particular attention was given to determining if bat species of conservation significance, as listed by both the Northern Territory and Commonwealth Governments, were present. Initial acoustic surveys (Specialised Zoological 2010, 2011) highlighted the possible presence of the bare-rumped sheath-tailed bat *Saccolaimus saccolaimus*, which is listed as 'Critically Endangered' under the *Environment Protection and Biodiversity Conservation Act 1999*¹ and as 'Data Deficient' (subspecies not identified) under the Northern Territory *Territory Parks and Wildlife Conservation Act 2000*². The species is also listed as 'Least Concern' by the IUCN because of its wide distribution from India to the Solomons and northern Australia (Csorba et al. 2008³). This report details a targeted field survey effort conducted specifically to determine if *S. saccolaimus* occurs within the MLA – Towns River project area (plus the identity of other bat species present), and includes acoustic surveys for all bat species from other areas within the RBIO Project boundaries.

The current Australian distribution of *S. saccolaimus* in authoritative field guides and mammal accounts (Churchill 2008; Hall et al. 2008; Csorba et al. 2008; SEWPaC 2012) includes the eastern edge of the Cape York peninsula, and apparently isolated populations in the north-west of the Northern Territory (including Kakadu National Park; McKean et al. 1981, Thomson 1991), and the Roper Bar area of the Northern Territory. The Queensland population is referred to *S. saccolaimus nudicluniat* and it is this form that is specifically listed as Critically Endangered under the Commonwealth *EPBC Act 1999*. The currently accepted taxonomy allocates all Australian populations to *S. s. nudicluniat*, but the validity of this trinomial has been questioned, and the possibility that the Northern Territory populations represent a different subspecies has also been mentioned (see taxonomic notes in Duncan et al. 1999, Milne and Woinarski 2006; Schulz and Thomson 2007; Csorba et al. 2008, SEWPaC 2012).

The closest record of *S. saccolaimus* to the RBIO Project is a single occurrence at the Roper River mouth on 25/09/2001 (E528572 N8366561 Z53 GDA94; NRETAS Reference NT Atlas database⁴). The lack of other records in this same area and further east towards the Borroloola area may simply be a function of the lack of survey effort and the difficulty of distinguishing it morphologically and acoustically from other bats (e.g. Milne et al. 2009). In

¹ http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66889

² http://www.nretas.nt.gov.au/__data/assets/pdf_file/0016/10843/barerumped_sheathtailbat_dd.pdf

³ <http://www.iucnredlist.org/apps/redlist/details/19802/0>

⁴ <http://www.nretas.nt.gov.au/plants-and-animals/animals/requests>

terms of remote detection using bat detectors, the echolocation call of *S. saccolaimus* is very similar to two other species of Australian *Saccolaimus*, as well as two free-tailed bats in the genera *Chaerephon* and *Mormopterus*. To some extent, the use of relatively new 'full spectrum' bat detectors can allow the sheath-tailed and free-tailed bats to be distinguished from each other on the basis of their harmonic patterns. To distinguish the two *Saccolaimus* species likely to be present in the RBIO Project area, there are some subtle features in feeding buzz attributes between *S. saccolaimus* and *S. flaviventris* that might allow differentiation of these (e.g. Corben 2010).

In the present survey targeting *S. saccolaimus*, we considered that bats make use of two different habitats (roosting, foraging), each of which may be separate both spatially and structurally. Based on its wing shape (=airframe) this species likely forages over a wide area, and thus potentially over a wide range of vegetation habitats. However, because of its body size and roosting preferences, it might be limited to certain vegetation types for roosting. Only some vegetation communities may contain a preponderance of tree species that are large enough and have a propensity to form hollows. Little is known about the type and extent of its roosting habitat but in the Northern Territory and from an observation at Iron Range, *S. saccolaimus* is known to roost in Darwin Stringybark *Eucalyptus tetrodonta* (SEWPaC 2012), which is present in the project area.

2.0 AIMS

1. Determine which species of bat occur in the MLA – Town's River project area (Figure 1), based on a comprehensive survey approach.
2. Determine if the bare-rumped sheath-tailed bat *Saccolaimus saccolaimus* uses the MLA – Town's River project area for either foraging or roosting habitat.
3. Determine which species of bat occur in other parts of the RBIO Project area based on acoustic recordings of echolocation calls.

3.0 METHODS

3.1 Survey approach and timing

A comprehensive approach was taken to derive an inventory of bat species in the project area, with particular effort given to locating and identifying bats of conservation significance, namely the bare-rumped sheath-tailed bat *Saccolaimus saccolaimus*. This approach included:

- Collating a list of expected species for the project area based on the most current and authoritative list in Milne and Pavey (2011);
- Making acoustic recordings and species identifications of bat echolocation calls with electronic bat detectors at various localities within the RBIO Project area;

and in the MLA – Towns River project area (Figure 1):

- Trapping with mist nets and harp traps to augment identifications based on acoustic recordings;
- Evaluating the utility of searching tree hollows for roosts of *Saccolaimus* spp. with a pole-camera apparatus;
- Searching for caves and bat roosts;
- Confirming field identification of bat captures with a genetic DNA barcode;
- Confirming field identifications of *Saccolaimus* spp. via morphological comparison with museum specimens and published accounts.

The Commonwealth Government's *Survey guidelines for Australia's threatened bats* (DEWHA 2010) was consulted for information on suggested methods and survey effort during the development of this approach.

In addition to the comprehensive approach conducted within the MLA – Towns River project boundary, acoustic recordings were made at various other locations in the wider area as part of the project assessment by EcOz Environmental over a longer period of time. Some of these recordings have been submitted by Specialised Zoological to EcOz Environmental on previous occasions, and the identifications made there have been updated based on experience in later surveys (Specialised Zoological 2010, 2011; project numbers SZ181, SZ239). The raw results of those acoustic surveys are reported again here, and further details and comment specifically on these is included in the main report by EcOz Environmental. The timing of each acoustic survey was as follows:

Project area	Period
MLA	13/10/2010 – 16/10/2010 (SZ181)
MLA	20/6/2011 – 25/6/2011 (SZ239)
MLA	26/10/2011 – 2/11/2011
MLA – Towns River	30/1/2012 – 3/2/2012
Cox River	30/1/2012 – 2/2/2012
Limmen River	31/2/2012 – 2/2/2012
Bing Bong	22/2/2012 – 25/2/2012
Rosie Creek	23/2/2012 – 25/2/2012

3.2 Acoustic detection

The ultrasonic echolocation calls of bats, which are produced for spatial orientation and prey detection in flight, are useful for taxonomic identification because each species produces a unique and distinguishable (in many cases; see Milne 2002 for examples in the Northern Territory) signal type. Analysis of the recordings made using electronic 'bat detectors' can reveal echolocating bat diversity at sampling sites with minimal effort as part of a comprehensive approach to surveying bats. On the present survey, acoustic recordings were made with AnaBat SD1 bat detectors (Titley Scientific, Brisbane), which were chosen for their ease of use and deployment, and the efficiency of data storage; plus D500x full spectrum recorders (Pettersson Elektronik AB, Sweden) that retain amplitude information and features such as harmonic structure that can potentially be useful for species identification.

AnaBat detectors were waterproofed in plastic boxes, and microphones (ST1) on an extension lead were placed in a funnel made from a plastic drink bottle to reduce the chance of water exposure. The use of funnels reduces slightly the zone of signal detection, but was unavoidable given the possibility of heavy rain. The D500x units were also placed in waterproof boxes with microphones on 1 m extension leads and protected by a PVC pipe (microphone was positioned flush with the edge of the pipe). The detectors were employed as passive stationary data recorders, being set in position prior to dusk and collected after dawn, and with the microphone capsule tied to trees at a height of c. 1 m. The equipment was placed in a variety of habitats to maximise the potential to encounter all species present. A GPS position was recorded at each recording site and associated with the serial number of the recording unit and deployment date.

Echolocation signals from AnaBat detectors were divided by a factor of 8, and stored automatically on a Compact Flash card, with each sequence of calls receiving a time and date stamp. The sensitivity was set to around 7. The recording settings for the D500x were as follows: sampling frequency 300 kHz, Pre-trigger off, Recording length 1 sec, HP filter yes, Autorec yes, Trigger source 0, Trigger sensitivity 1 High, Input Gain 45, Trigger level 30, Interval 0, Timer 19:00 – 06:00.

3.3 Analysis of acoustic recordings

AnaBat recordings were downloaded using CFC Read ver. 4.3s software. The output consisted of two sets of data: 1. the individual sequence files produced during interpretation by CFC Read software, which are organised into folders representing a single night's recording; and 2. the continuous representation of the AnaBat recordings in ZCA and MAP files, which show all of the signals detected by the AnaBat microphone but which have not been parsed into individual sequence files according to default interpretation parameters. The signals in both parsed sequence files and the ZCA and MAP files were examined in AnalookW ver. 3.8s software, and three parameters were measured on good quality search phase pulses in a subset of representative call sequences: pulse duration (milliseconds), maximum frequency (kHz) and characteristic frequency (the point at the end of the flattest portion of a pulse before any terminal secondary frequency sweep; kHz). A fourth variable was measured on Constant Frequency calls: the frequency with the greatest number of cycles

(the flattest part of the call, designated as Fpz in AnalookW software). Identifications were made based on a comparison of pulse shapes and measurements with those in Milne (2002).

The recordings made with the D500x detectors were analysed using a hybrid automated – manual approach, given the significant memory size of the dataset (42.6 GB from MLA – Towns River; 26.9 GB from Rosie's Camp – Bing Bong) and the lack of a reference library set of calls in full spectrum format from the study area. Firstly, the WAV format files were converted to Zero Crossings files compatible with AnalookW software using the Anabat Converter ver. 0.3 Java batch utility written by Sikken (2012) (using automatic thresholding in 50 ms chunks). Subsequently, the dataset was further reduced by employing a filter to exclude ZCA files containing only noise (relevant settings being: Smoothness 50, Body over 2000 ms, Fc and Fmin 10 kHz minimum, Fmax 10 kHz minimum, Slope S1 -9999 to 9999, Duration 2 ms minimum). The resulting subset of ZCA files was examined in AnalookW software in a similar fashion to those recorded directly by AnaBat detectors. It is acknowledged that the WAV to ZCA batch conversion software does not perform as well as AnalookW software (K.N. Armstrong unpubl. obs.), and both programmes cannot readily distinguish calls buried in the sound floor, however for poorer quality ZCA files the spectrographic representation in the corresponding WAV file was examined to assist in the identification.

The search phase echolocation calls of *S. flaviventris* and *S. saccolaimus* are very similar in structure and characteristic frequency, but both are readily distinguishable from molossid bat species based on their harmonic structure. In situations where calls with a characteristic below 25 kHz had features indicative of either *Saccolaimus* spp., *Chaerephon jobensis* or *Mormopterus beccarii*, the harmonic structure was examined in the WAV files, with Emballonuridae being distinguished from Molossidae based on the presence of a fundamental component around 10 kHz. The molossid species were distinguished from each other based on patterns of structure in successive pulses in the same sequence.

Particular attention was paid to call sequences of *Saccolaimus* that contained approach and feeding buzz calls, given some apparent differences noted in Asia by Corben (2010). In addition to details of that presentation, an unpublished AnaBat call dataset of *S. saccolaimus* from Cairns generously donated by Greg Ford was used as a basis for distinguishing the two species, but for nearly all call sequences, no distinguishing features were recognised. Several feeding buzzes with characteristics of *S. flaviventris* were noted, but none of the buzzes with relatively high characteristic frequency and serpentine pulse shape (cf. search phase pulses) were observed.

3.4 Identification from acoustic recordings – limitations and considerations

Several caveats and considerations are noted with regard to the identification of bat species based on recordings of their echolocation calls, of relevance to this survey:

- Two or more bat species may produce calls that are so similar that they cannot be distinguished reliably using the available methods or reference recordings (examples in Milne 2002).

- A single bat species may produce more than one call type (e.g. search phase calls, approach phase calls, clutter calls) that might suggest the presence of more than one species. With sufficient experience of related species, it is generally possible for a bat echolocation specialist to take this into account, and to base identifications on the typically more diagnostic search phase calls.
- Absolute abundance of each species or call type at a site cannot be estimated from bat detector recordings because it is not possible to distinguish between relatively few bats passing the detector but contributing many calls, and a larger number of individuals passing the detector with each contributing relatively few calls.
- Finally, it should be noted that in all acoustic surveys the 'detectability' of each species is influenced by several factors such as bat detector model (microphone sensitivity profile and zone of reception, mode of recording, and the type of built-in preamplification and filter components), atmospheric conditions and characteristics of echolocation calls. Species that produce ultra-high frequency (> 100 kHz) calls or those that produce calls with low amplitude (e.g. long-eared bats *Nyctophilus* spp.) will have relatively short detection distances, which will lead to their being under-represented or even missed altogether in an acoustic survey. The detectability of different call types is also influenced by atmospheric conditions, most notably relative humidity and temperature that act together to attenuate ultrasound, the effects of which are dramatic at higher frequencies (e.g. Armstrong and Kerry 2011). Thus, acoustic detection represents only one component of a comprehensive survey approach for bats, and targeted effort is required for species with lower acoustic detectability.

3.5 Trapping

Not all bat species in the Northern Territory can be identified reliably from their echolocation calls (Milne 2002), and there are several species that must be captured in order to make an unambiguous identification. In addition, trapping is recommended to obtain a more complete inventory of bats in a given assemblage because of several biases in the acoustic survey technique (e.g. Duffy et al. 2000; see also point 4 in section 3.4). Trapping was conducted on four of the five available survey nights (31/1/2012 – 3/2/2012) using mist nets and harp traps. This activity was conducted under a permit issued by the Northern Territory Parks and Wildlife Commission (permit number 43654), and all procedures were approved by the Animal Ethics Committee of The University of Adelaide (project number S-2011-195).

Mist nets were placed over pools and rivers to maximise the chance of capturing bats. Previously Milne et al. (2005) and Milne (2006:79) had identified greater richness of bats in riparian and adjacent areas, and it was anticipated that high flying species such as *Saccolaimus* would be more likely to encounter a mist net set over water than one set in open woodland. Three mist nets were arranged in an 'N' configuration over a small creek (*Melaleuca viridiflora* +/- *Eucalyptus microtheca* Low Open Woodland; site M01; 31/1/2012); three nets were strung across a wide flowing river in the south-east corner of the project area (*Melaleuca viridiflora* Low Open Woodland; site M02; 1 – 2/2/2012); and a single net was strung across a pool in the Towns River (*Melaleuca nervosum* Low Open Woodland; site M03; 3/2/2012). Vegetation habitats are defined as per the vegetation survey described in the

main report, as determined by EcOz Environmental. Nets were attended at all times for between 3 – 5 hours after the end of civil twilight. In addition, a harp trap was left for two full nights in thick riparian vegetation surrounding a small creek flowing from a rocky outcrop (*Corymbia polycarpa* Mid Open Woodland; site H01; 1 – 2/2/2012).

Captured bats were given a field identification based on their appearance and by noting distinguishing characters described by Churchill (2008). A wing biopsy was taken for genetic analysis (see section 3.7 below), and the individuals were released within 2 hours at the capture site. Only one individual was euthanised (using 0.1 mL Nembutal; under the South Australian Museum's 'Licence to possess an S4 drug', licence number 2011-76256): the single specimen of *Saccolaimus* captured at M03 on 3/2/2012.

3.6 Searches for roosts

Two types of bat roost were considered during the survey: caves and crevices in rocky outcrops; hollows and beneath the bark of trees. The use of a helicopter to access water bores across the MLA – Towns River project area during the survey period provided an excellent opportunity to check the entire lease for rocky outcrop and make a determination of whether those formations observed could provide underground habitat suitable for bats (transect HEL01; Figure 2). The vegetation communities across the project area were also observed from the helicopter in order to define patches that had the largest hollow-forming tree species (typically *Eucalyptus tretrodonta* and *E. miniata*).

Three relatively brief (c. 1-hour long) searches were made in *Eucalyptus* woodland habitats for roosts of *S. saccolaimus* using a novel method based on video observation. A small video camera and white LED light source was attached to the end of a 10 m telescopic carbon fishing rod and either lowered down into vertical hollows (1 – 2 m) or poked into horizontal hollows. The video feed was recorded onto a small digital recorder for later examination. A variety of hollows were targeted, particularly those large enough to contain bats of medium size (i.e. *Saccolaimus* spp.) such as deep vertical hollows in the main trunk. Usage of this type of hollow has been noted previously, for example a recent discovery of a colony in Cairns (G. Ford pers. comm. 27/1/2012). While it has been used by other bat researchers in Australia previously (e.g. Reardon 2000), the pole camera is not a standard piece of equipment for surveying bats as part of environmental assessments in Australia, and it was essentially being evaluated for its utility on the present survey.

3.7 Identification from DNA barcoding

The identity of captured bats was to be confirmed through DNA barcoding, given that the area has not been surveyed well for bats previously, and to provide a more robust basis for species name allocation compared to a simple morphological examination in the field. A tissue biopsy was taken from the wing membrane of each capture using a sterile 4 mm dermal punch, and stored in 50:50 saline:ethanol solution.

In the laboratory, the biopsies were first soaked for 24 hours in phosphate buffered saline solution to remove the ethanol, and then extracted with a Gentra DNA purification kit. Two

mitochondrial DNA markers (bases 49–706 of the Cytochrome Oxidase I gene [COI]; bases 1–801 of the Cytochrome-*b* gene [Cytb]) were then amplified by PCR in 25 uL volumes containing a final concentration of 1x PCR buffer (Applied Biosystems), 2 mM MgCl, 250 uM of each dNTP, 5 uM each primer, 1 unit of Amplitaq Gold (Applied Biosystems) and 1 uL of 1/20 diluted template DNA. The following primers were used (names from the database of the Evolutionary Biology Unit of the South Australian Museum): COI: forward M1243 (containing an M13f-21 tail; underlined) 5'-TGTAACACGACGGCCAGTTCTCAACCAACCACAAAGACATTGG-3', reverse M1244 (containing an M13-pUCR tail; underlined) 5'-CAGGAAACAGCTATGACTAGACTTCTGGGTGGCCAAAGAATCA-3' (VF1_t1 and VR1_t1 of Ivanova et al. 2007); Cytb: forward M1226 5'-AATGACATGAAAAATCACCGTTGT-3' (Molcit-f of Ibáñez et al. 2006); reverse M040 5'-AAATAGGAARTATCAYTCTGGTTTTRAT-3' (MVZ16 of Smith and Patton 1993). PCR thermocycling conditions were as follows: initial denaturation at 94°C for 5 mins, followed by 35 cycles of 94°C for 30 secs, 50°C for 30 secs and 72°C for 1 min, with a final extension of 72°C for 10 mins. PCR products were purified on a vacuum manifold with a Multiscreen®384 PCR plate (Millipore), and the subsequent steps were outsourced to the Australian Genome Research Facility. Products were sequenced using Big Dye Terminator ver. 3.1 chemistry using the 'forward' primers only, and run on an ABI DNA capillary sequencer.

Sequences were edited and aligned manually in Bioedit ver. 7.09 (Hall 1999), and trimmed to equal length for further analysis. A distance based Neighbour Joining phylogram was created in PAUP* ver. 4.10b software (Swofford 2002) to illustrate the genetic distance relationships amongst samples.

4.0 RESULTS

4.1 Expected species

A maximum total of 22 species was expected from the Roper River – Limmen – Borroloola area based on the distribution records compiled in Milne and Pavey (2011), of which three species are listed in an elevated or data deficient conservation category (*S. saccolaimus*; *Macroderma gigas*; *Rhinonictoris aurantia*; Table 1). Within any one locality, the species assemblage is likely to be smaller than this regional total, on the basis of the habitats present. In addition to these, there are two species that might also occur in this area, but are currently only known from records adjacent to the region (Northern leaf-nosed bat *Hipposideros stenotis*; Pallid long-eared bat *Nyctophilus daedalus*). Both of these species are known from relatively few records and might be distributed sparsely across their range (Milne and Pavey 2011).

4.2 Acoustic detection

A total of 12 AnaBat sessions and 10 D500x sessions were made in the MLA – Towns River project area (Table 2; Figures 1 – 4), in addition to a further 33 recording nights over several surveys in other parts of the project area (Table 3). All represent a full night of passive stationary recording.

At least six species of echolocating bat were identified from the acoustic recordings made in the MLA – Towns River project area, with the possibility of several others that cannot be distinguished reliably from their echolocation call characteristics. In addition, at least one species of flying-fox *Pteropus* sp. was observed at three sites, however identification to species could not be made. At least nine species were identified as being present in the other parts of the project area, with the possibility of others that could not be distinguished based on echolocation call characteristics (Table 3).

Details supporting the identifications are provided, as recommended by the Australasian Bat Society (ABS 2006). A summary of pulse parameters is provided in Table 4, and representative call sequences are illustrated in Figure 4. Further data is available should verification be required.

4.3 Trapping

A total of 20 individuals from five species was captured at four trapping sites, most being from mist nets spread over water bodies (Table 5). The majority of captures came from a broad river habitat in the south-east of the MLA – Towns River project area. Long-eared bats (*Nyctophilus geoffroyi*) were captured in mist nets (M01, M02) and a harp trap (H1) in riparian vegetation away from the main river channel. The understorey vegetation at site H1 was relatively dense. One individual of *Saccolaimus* was captured as it flew low over a long pool in the Towns River. It was identified to species (*S. flaviventris*) on the basis of a relatively broad inter-canine width (6.05), according to the scheme in Milne et al. (2009), plus the absence of a palpable lambdoidal crest (KN Armstrong unpubl). The specimen has been lodged in the South Australian Museum (temporary accession number BS5949 temporary accession number 12.052).

The trapping effort was helpful for confirming the presence of both *Scotorepens greyii* and *Chalinolobus nigrogriseus*. These two species produce echolocation calls with similar characteristic frequency and pulse structure variation, and are difficult to distinguish reliably from each other. Likewise, trapping confirmed the presence of other species that are problematic to identify from their echolocation calls: *S. flaviventris* (calls are similar to *S. saccolaimus*), and *N. geoffroyi* (calls are similar to *N. arnhemensis* and *N. daedalus*), however the presence or absence of the other 'alternative' species could not be confirmed without their capture.

4.4 Searches for roosts

Three traverses were made for tree roosts of *Saccolaimus* spp. in *Eucalyptus tetradonta* Mid Open Woodland (DT01) and in riparian communities such as *Melaleuca nervosum* Low Open Woodland / *Eucalyptus camaldulensis* Low Open Woodland (DT02, DT03). A total of 10 trees were inspected with the pole camera, two of which were relatively deep vertical hollows in the main trunk of the tree (Table 6). No bats of any species were observed.

Rocky outcrop, as observed on the various helicopter flights around the project area (e.g. HEL01; Figure 2) was limited to a few areas, and none appeared to be of significant elevation or structure to form caves or crevices suitable for cave roosting bats.

4.5 Identification from DNA barcoding

The purpose of DNA barcoding the tissue samples taken from field captures was to confirm species identity, given that some diagnostic morphological characters are not always obvious when in the field, there was some variation observed in the fur colour of small vespertilionid bats, and there was the possibility of morphologically cryptic species in this region that has seen relatively few bat surveys. Identification to family and genus was straightforward based on external morphological characters (Churchill 2008), however species-level identity based on both morphology and expectations derived from generalised distributions in field guides such as Churchill (2008) was to be confirmed using DNA markers.

Most of the tissue biopsies from the captured bats amplified successfully for both Cytochrome-*b* and Cytochrome Oxidase I mitochondrial DNA markers. A distance phylogram created for each marker grouped samples of the same species into clades based on the genetic distances between each sample (Figure 6). Unfortunately, very few DNA sequences from Australian bats are available as context in GenBank (URL: <http://www.ncbi.nlm.nih.gov/>), which limited the association of the test samples with reference DNA sequences from reliably identified species. However, field identifications were still able to be confirmed by the observing whether there was significant genetic distance within putative species sets that would be indicative of more than one species. In the case of *Chaerephon jobensis*, *Chalinolobus nigrogriseus* and *Nyctophilus geoffroyi* the observed degree of genetic variation was indicative of one species only. In the case of small vespertilionids (biopsy codes V1 – V9; S1), there were two distinct well supported clades within putative *Scotorepens greyii*. One of the clades is likely to be *S. greyii*, and the other may either represent genetic variation within the species, or a second species.

5.0 DISCUSSION

5.1 Bat diversity

A total of 22 species are likely to be present in the Roper River – Limmen – Borroloola region based on compiled records and derived distribution limits in Milne and Pavey (2011) (Table 1). Within any one locality, the species assemblage is likely to contain fewer species than this regional total, on the basis of the habitats present. In the case of the MLA – Towns River project area, the absence of cave roosting bats such as *Hipposideros ater*, *Rhinonictoris aurantia*, *Vespadelus caurinus* and *V. finlaysoni* may be explained by the absence of significant rocky outcrop and rock types prone to cave development within a few kilometres of the locality, while the presence of *Taphozous georgianus* is explained by their relatively large capacity for long distance flight based on wing morphology (e.g. Bullen and McKenzie 2002). In addition, the absence of species such as *Mormopterus loriae cobourgiana*, *Pipistrellus westralis* and *Nyctophilus arnhemensis* is not surprising given the distance from coastal habitats, which these species appear to prefer (e.g. Churchill 2008).

In the case of haul road sites (Limmen River, Rosie Creek), there were more species detected, with the additional species roosting in caves during the day: *Rhinonictoris aurantia* and *Vespadelus caurinus*. The addition of cave forming rock promotes biodiversity and increases the habitat value of those localities. In the case of the proposed port site at Bing Bong, bat richness was relatively low compared to other sites (acoustic records available only, and bearing in mind relative acoustic sampling effort), but further future effort might detect species that prefer mangal and other coastal habitats such as *Mormopterus loriae*, *Nyctophilus arnhemensis* and *Pipistrellus westralis*.

Overall bat diversity in the MLA – Towns River project area was moderate, with only eight species detected. Most of these were tree-roosting species, with the exception of *Taphozous georgianus*, which roosts in caves and could have reached the project area from roosts located several kilometres away, given the observed lack of significant cave-forming rocky outcrop in the project area. The combination of both acoustic recordings and trapping was valuable in terms of maximising the detection of species for two reasons: 1. most species could be identified from multiple sites (=habitat types) within the project area with minimal effort and based on reference acoustic signatures described by Milne (2002); and 2. for situations where two species could not be differentiated from each other because of their very similar echolocation call characteristics, trapping was able to confirm the presence of both candidates in the project area (e.g. *Chalinolobus nigrogriseus* and *Scotorepens greyii*) or indicate which of several candidates could be confirmed at a minimum (e.g. *Nyctophilus geoffroyi*).

Bats captured in mist nets and harp traps could be identified reliably to genus level based on descriptions in field guides such as Churchill (2008), however there was some potential for both misidentification or the presence of cryptic taxa at the species level. DNA barcoding was used to verify the putative species level identifications. While publically available genetic context data from Australian bat species is generally lacking, which prevented the association of the DNA barcodes with reference genetic sequences from known species (at least within the timeframe of this study), the amount of genetic variation within clades (= main branches) of each phylogram was relatively small, indicating that only one species was present per genus. However, in the case of small vespertilionids putatively attributable to

Scotorepens greyii, there was the potential for a second unknown taxon (samples S1, V2) based on a moderately deep genetic split within this morphological group. The genetic distance between the two subclades (S1, V2 versus V4 – V9) was not deep enough to suggest generic differences (e.g. indicative of misidentification at the genus level). The lack of reference genetic material prevents further comment, but the DNA barcode of this form could be available for comparison in the future if other sequences become available, and thus there is the possibility of retrospective identification.

5.2 Detection of the Bare-rumped Sheath-tailed Bat

The presence of *S. saccolaimus* was not confirmed in any of the project areas, which suggests that either it was not present, or that ability to detect and distinguish this species was limited. The most likely reason is the latter. Assuming that it is relatively rare compared to *S. flaviventris*, most of the many calls attributable to a species of *Saccolaimus* might derive from *S. flaviventris*. The capture of one individual of *Saccolaimus flaviventris* could be reliably identified on the basis of its relatively large outer canine width (Milne et al. 2009), with subsequent verification based on the examination of series of both species curated at the Northern Territory Museum and Art Gallery. In the future, further work on call analysis and the acquisition of reference calls might allow a non-invasive and remote method of distinguishing *S. saccolaimus* on the basis of its echolocation calls. At the recent 15th Australasian Bat Conference (11 – 13 April 2012; Melbourne), there were two talks that presented new acoustic information on *S. saccolaimus* which indicated a better likelihood of being able to distinguish this species from *S. flaviventris*. A retrospective analysis of the data collected during the present RBIO Project might detect some of these newly described diagnostic call types, and further information will be forthcoming on this from Specialised Zoological.

A few limitations were noted in regard to the searches conducted for roost sites of *S. saccolaimus* with the pole-mounted camera. Apart from the effort and time requirement by biologists (e.g. in comparison with placing bat detectors by non-specialists), the insertion of cameras sufficiently deep enough into hollows to encounter the bats required some skill for manipulation (bearing in mind the height at which hollows may occur), and the probability of encountering bats was considered to be less than 100% given the narrowness of hollow structures and presence of internal crevices. Despite these limitations, it could be a good way to inspect a wide area and help narrow down possible roost hollows for further attention without introducing a safety hazard from tree climbing. In the context of the MLA - Towns River area, there is a relatively large woodland of eucalypts that might be valuable to investigate further in the future.

6.0 CONCLUSIONS

1. At least eight species of bat are present in the MLA – Towns River project area, but one of them is more likely to roost outside of it (*Taphozous georgianus*) given the observed lack of caves and crevices suitable for this species. In other parts of the project area, at least 10 species were present, including species such as *Rhinonictes aurantia* and *Vespadelus caurinus* that use caves for daytime roosting. DNA barcoding suggested the possibility of one extra cryptic form related to *Scotorepens greyii*, which cannot be resolved further without context genetic reference data.
2. There is currently no firm evidence that the bare-rumped sheath-tailed bat *Saccolaimus saccolaimus* utilises the MLA – Towns River project area for roosting or foraging, or other parts of the project area. However its presence is still a possibility, given the observation of several large vertical hollows in tree trunks in *Eucalyptus tetrodonta* – *E. miniata* Mid Open Woodland and the single historical record from the Roper Bar area.
3. Echolocation calls of *Saccolaimus* were conspicuously abundant (but not quantified) in the MLA – Towns River project area, though it is anticipated that many if not all of these derive from *S. flaviventris*. However, species level identifications in *Saccolaimus* based on echolocation call characteristics are limited by a lack of known robust diagnostic features that allow them to be distinguished, though new call types have recently been characterised and presented as of 13 April 2012.
4. A novel method for investigating tree hollows for tree-roosting bats with a pole-mounted camera proved to be challenging (especially with regard to manoeuvring equipment into the hollow), but still has potential if the apertures of hollows are within 10 m of the ground.

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Table 1. Species known to occur in the Roper River – Limmen – Borroloola area, based on records and comments in Milne and Pavey (2011), with conservation status given under four schemes: BAP: Bat Action Plan (Duncan et al. 1999); TPWCA: Northern Territory *Territory Parks and Wildlife Conservation Act 2000*; EPBC: *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*; IUCN: International Union for the Conservation of Nature Red List (Csorba et al. 2008). Nomenclature as per Armstrong and Reardon (2006).

Species	BAP	TPWCA	EPBC	IUCN
Black flying-fox <i>Pteropus alecto</i>	LR/lc	LC	—	LR/lc
Little red flying-fox <i>Pteropus scapulatus</i>	LR/lc	LC	—	LR/lc
Yellow-bellied sheath-tailed bat <i>Saccolaimus flaviventris</i>	LR/lc	LC	—	LR/lc
Bare-rumped sheath-tailed bat <i>Saccolaimus saccolaimus</i>	CR/A1a	DD	—	LR/lc
Bare-rumped sheath-tailed bat <i>S. s. nudicluniatus</i>	—	—	CE	—
Common sheath-tailed bat <i>Taphozous georgianus</i>	LR/lc	LC	—	LR/lc
Ghost bat <i>Macroderma gigas</i>	LR/nt	DD	—	VU/C1
Dusky leaf-nosed bat <i>Hipposideros ater</i>	LR/lc	LC	—	LR/lc
Orange leaf-nosed bat <i>Rhinonicteris aurantia</i>	LR/lc	NT	—	LR/lc
Gould's wattled bat <i>Chalinolobus gouldii</i>	LR/lc	LC	—	LR/lc
Hoary wattled bat <i>Chalinolobus nigrogriseus</i>	LR/lc	LC	—	LR/lc
Large-footed myotis <i>Myotis macropus</i>	LR/lc	LC	—	LR/lc
Arnhem long-eared bat <i>Nyctophilus arnhemensis</i>	LR/lc	LC	—	LR/lc
Lesser long-eared bat <i>Nyctophilus geoffroyi</i>	LR/lc	LC	—	LR/lc
Pygmy long-eared bat <i>Nyctophilus walkeri</i>	LR/lc	LC	—	LR/lc
Forest pipistrelle <i>Pipistrellus adamsi</i>	LR/lc	LC	—	LR/lc
Northern Pipistrelle <i>Pipistrellus westralis</i>	LR/lc	LC	—	LR/lc
Little broad-nosed bat <i>Scotorepens greyii</i>	LR/lc	LC	—	LR/lc
Northern cave bat <i>Vespadelus caurinus</i>	LR/lc	LC	—	LR/lc
Finlayson's cave bat <i>Vespadelus finlaysoni</i>	LR/lc	LC	—	LR/lc
Northern free-tailed bat <i>Chaerephon jobensis</i>	LR/lc	LC	—	LR/lc
Beccari's free-tailed bat <i>Mormopterus beccarii</i>	LR/lc	LC	—	LR/lc
Little free-tailed bat <i>Mormopterus loriae</i>	DD	—	—	LR/lc
Western little free-tailed bat <i>Mormopterus loriae cobourgiana</i>	—	LC	—	—

Table 2. Species identified at each site in the MLA - Towns River project area from overnight recordings made with AnaBat and D500x detectors (raw results; ND: not distinguishable unambiguously based on acoustic recordings; refer to capture records in Table 5). See Figures 1 – 3 for the location of recording sites.

				<i>C. gouldii</i>	<i>C. jobensis</i>	<i>C. nigrogriseus</i> / <i>S. greyii</i>	<i>Nyctophilus</i> sp.	<i>S. flaviventris</i> / <i>S. saccolaimus</i>	<i>T. georgianus</i>
Date	Unit	Site	GPS						
MLA – Towns River January – February 2012									
30/01/2012	AnaBat serial 3060	Camp	53L 506050 8326900	H	—	ND	ND	ND	H
30/01/2012	AnaBat serial 3230	AN01	53L 507457 8325266	H	—	ND	—	ND	H
30/01/2012	AnaBat serial 3186	AN02	53L 510520 8325695	H	H	ND	ND	ND	H
30/01/2012	D500x serial 161	D01	53L 507374 8325195	—	—	ND	—	ND	—
30/01/2012	D500x serial 162	D02	53L 510632 8325676	—	—	—	—	—	—
31/01/2012	AnaBat serial 3060	AN03	53L 506056 8326857	—	—	ND	ND	ND	—
31/01/2012	AnaBat serial 3230	AN04	53L 513402 8323164	—	—	ND	ND	ND	—
31/01/2012	AnaBat serial 3186	AN05	53L 507407 8325264	H	—	ND	ND	ND	—
31/01/2012	D500x serial 161	D03	53L 501283 8327316	—	—	—	—	—	—
31/01/2012	D500x serial 162	D04	53L 509392 8324155	—	—	ND	—	ND	—
1/02/2012	AnaBat serial 3230	AN06	53L 515272 8322957	H	—	ND	ND	ND	—
1/02/2012	AnaBat serial 3186	AN07	53L 515701 8322888	H	H	ND	ND	ND	H
1/02/2012	AnaBat serial 3060	AN08	53L 515747 8322945	H	H	ND	ND	ND	H
1/02/2012	D500x serial 161	D05	53L 515215 8322965	—	—	ND	—	ND	—
1/02/2012	D500x serial 162	D06	53L 515732 8322898	H	H	ND	ND	ND	H
2/02/2012	AnaBat serial 3186	AN09	53L 515377 8322817	—	—	ND	—	ND	H
2/02/2012	AnaBat serial 3230	AN10	53L 515770 8323016	H	H	ND	ND	ND	H
2/02/2012	D500x serial 161	D07	53L 515138 8322951	—	—	ND	—	ND	—
2/02/2012	D500x serial 162	D08	53L 515749 8322933	H	H	ND	ND	ND	H
3/02/2012	AnaBat serial 3186	AN11	53L 504863 8325256	H	H	ND	ND	ND	—
3/02/2012	AnaBat serial 3230	AN12	53L 522655 8336898	H	H	ND	ND	ND	H
3/02/2012	D500x serial 162	D09	53L 507677 8325301	H	—	ND	—	ND	—
3/02/2012	D500x serial 161	D10	53L 522585 8336728	—	—	ND	ND	ND	—

Table 3. Species identified at each site in other parts of the project area from overnight recordings made with AnaBat and D500x detectors (raw results; ND: not distinguishable unambiguously based on acoustic recordings).

Date	Unit	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>C. nigrogriseus</i> / <i>S. greyii</i>	<i>Nyctophilus</i> sp.	<i>Pipistrellus</i> sp.	<i>R. aurantia</i>	<i>S. flaviventris</i> / <i>S. saccolaimus</i>	<i>T. georgianus</i>	<i>V. caurinus</i>
MLA October 2010 (SZ181)										
13/10/2010	AnaBat serial 1156	—	—	ND	—	—	—	ND	H	—
14/10/2010	AnaBat serial 1156	H	—	ND	—	—	—	ND	H	—
16/10/2010	AnaBat serial 1156	—	—	ND	—	—	—	ND	—	—
MLA June 2011 (SZ239)										
20/06/2011	AnaBat serial 4229	—	—	ND	—	—	—	—	—	—
21/06/2011	AnaBat serial 4229	—	—	ND	—	—	—	ND	—	—
22/06/2011	AnaBat serial 4229	—	—	ND	—	—	—	—	—	—
23/06/2011	AnaBat serial 4229	—	—	ND	—	—	—	—	—	—
24/06/2011	AnaBat serial 4229	—	—	ND	—	—	—	ND	—	—
25/06/2011	AnaBat serial 4229	—	—	ND	ND	—	—	ND	—	—
MLA October – November 2011										
26/10/2011	AnaBat serial 1156	—	—	ND	—	—	—	ND	—	—
28/10/2011	AnaBat serial 1156	—	—	ND	—	—	—	ND	—	—
29/10/2011	AnaBat serial 1156	—	—	ND	—	—	—	ND	—	—
1/11/2011	AnaBat serial 1156	—	—	ND	—	—	—	ND	—	—
2/11/2011	AnaBat serial 1156	—	—	ND	—	—	—	ND	—	—
Cox River January – February 2012										
30/01/2012	AnaBat serial 1156	H	—	ND	—	—	—	ND	—	—
31/01/2012	AnaBat serial 1156	—	—	ND	—	—	—	ND	—	—
1/02/2012	AnaBat serial 1156	H	—	ND	—	—	—	ND	—	—
2/02/2012	AnaBat serial 1156	—	H	ND	—	—	—	ND	H	—
Limmen River January – February 2012										
31/01/2012	AnaBat serial 3006	H	—	ND	—	—	—	ND	—	—
1/02/2012	AnaBat serial 3006	H	ND	ND	—	—	—	ND	H	H
2/02/2012	AnaBat serial 3006	H	—	ND	ND	—	H	—	H	—
Rosie Creek February 2012										
22/02/2012	AnaBat serial 3006	—	H	ND	—	—	—	ND	—	H
23/02/2012	AnaBat serial 3006	H	—	ND	—	—	—	ND	H	H
24/02/2012	AnaBat serial 3006	H	—	ND	—	—	—	ND	H	H
25/02/2012	AnaBat serial 3006	—	—	ND	—	—	—	ND	H	H
23/02/2012	D500x serial 161	—	—	ND	—	—	—	ND	H	H
24/02/2012	D500x serial 161	—	—	ND	—	—	H	ND	H	H
25/02/2012	D500x serial 161	—	—	ND	ND	—	—	ND	H	H
Bing Bong February 2012										
22/02/2012	AnaBat serial 1156	—	—	ND	—	—	—	—	—	—
23/02/2012	AnaBat serial 1156	—	—	—	—	—	—	ND	—	—
24/02/2012	AnaBat serial 1156	—	—	—	—	—	—	—	—	—
25/02/2012	AnaBat serial 1156	—	—	ND	—	—	—	—	—	—
24/02/2012	D500x serial 162	—	—	ND	—	ND	—	ND	—	—

Table 4. Summary of variables from representative call sequences of the species identified and the call types recognised.

Species	s,p ¹	Duration (msec) ²	Max Frequency (kHz) ²	Char frequency (kHz) ²
Gould's wattled bat <i>Chalinolobus gouldii</i>	3,56	8.2 ± 2.1 4.4 – 13.7	36.9 ± 6.0 30.1 – 52.6	29.6 ± 2.0 26.7 – 34.2
Northern free-tailed bat <i>Chaerephon jobensis</i>	5,73	9.3 ± 4.2 4.3 – 21.4	31.5 ± 5.4 20.0 – 38.8	22.9 ± 2.1 18.4 – 27.1
Hoary wattled bat <i>Chalinolobus nigrogriseus</i> / Little broad-nosed bat <i>Scotorepens greyii</i>	7,96	5.8 ± 1.2 3.4 – 8.3	48.8 ± 5.7 40.2 – 65.6	38.5 ± 1.1 36.0 – 40.2
Unidentified long-eared bat <i>Nyctophilus</i> sp.	8,30	3.8 ± 0.6 3.0 – 5.2	65.2 ± 6.4 55.9 – 82.5	48.7 ± 3.6 43.2 – 57.1
Northern pipistrelle <i>Pipistrellus adamsi</i> / Northern pipistrelle <i>Pipistrellus westralis</i>	4,13	4.8 ± 1.0 3.0 – 6.9	53.0 ± 3.5 48.8 – 60.2	47.6 ± 1.4 45.5 – 49.7
Orange leaf-nosed bat <i>Rhinonictis aurantia</i>	1,2	7.3 – 9.5		(Fpz) ³ 111.2
Yellow-bellied sheath-tailed bat <i>Saccolaimus flaviventris</i> / Bare-rumped sheath-tailed bat <i>Saccolaimus saccolaimus</i>	9,63	12.5 ± 2.9 8.6 – 20.1	25.3 ± 2.6 17.5 – 28.5	19.8 ± 1.3 16.4 – 22.0
Common sheath-tailed bat <i>Taphozous georgianus</i>	6,28	13.8 ± 1.8 9.8 – 16.8	25.6 ± 0.7 24.5 – 28.1	24.7 ± 0.4 24.0 – 25.6
Northern cave bat <i>Vespadelus caurinus</i>	6,54	4.6 ± 0.7 3.1 – 5.7	69.4 ± 4.4 63.0 – 84.2	62.1 ± 0.9 60.2 – 64.5

¹ s,p: number of sequences measured, combined total number of pulses measured; ² Mean ± SD; range; ³ The frequency with the greatest or peak number of cycles, designated as 'Fpz' in AnalookW.

Table 5. Details of bats captured and observed during the survey in the MLA – Towns River project area. See Figure 4 for some representative photographs.

Date	Site	GPS	Field identification	DNA ID	Sex	Age	Forearm mm	Biopsy label	Photos
Captures									
31/01/2012	M01	53L 509392 8324155	<i>Nyctophilus geoffroyi</i>	<i>N. geoffroyi</i>	Female	Adult	36.6	N1	3633-3636
1/02/2012	M02	53L 515751 8322949	<i>Nyctophilus geoffroyi</i>	<i>N. geoffroyi</i>	Female	Adult	35.4	N2	3637-3641
1/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	No data	Female	Adult	32.5	V1	3642-3645
1/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	<i>S. greyii</i>	Female	Adult	31.7	V2	3646-3652
1/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	No data	Female	Adult	33.99	V3	3653-3657
1/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	<i>S. greyii</i>	Female	Adult	32.45	V4	3658-3661
1/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	<i>S. greyii</i>	Female	Adult	32.9	V5	3662-3665
1/02/2012	M02	53L 515751 8322949	<i>Chaerephon jobensis</i>	<i>C. jobensis</i>	Female	Adult	48.56	CJ1	3666-3668
1/02/2012	M02	53L 515751 8322949	<i>Chaerephon jobensis</i>	<i>C. jobensis</i>	Male	Adult	49.51	CJ2	3669-3674
1/02/2012	H01	53L 515218 8322973	<i>Nyctophilus geoffroyi</i>	<i>N. geoffroyi</i>	Female	Adult	34.8	N3	3697-3701
2/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	<i>S. greyii</i>	Female	Subadult?	32.5	V6	3702-3705
2/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	<i>S. greyii</i>	Male	Adult	30.64	V7	3706-3710
2/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	<i>S. greyii</i>	Female	Subadult?	33.01	V8	3711-3714
2/02/2012	M02	53L 515751 8322949	<i>Chalinolobus nigrogriseus</i>	<i>C. nigrogriseus</i>	Female	Subadult?	34.52	CN1	3715-3719
2/02/2012	M02	53L 515751 8322949	<i>Chalinolobus nigrogriseus</i>	<i>C. nigrogriseus</i>	Female	Subadult?	34.74	CN2	3720-3722
2/02/2012	M02	53L 515751 8322949	<i>Scotorepens greyii</i>	<i>S. greyii</i>	Female	Adult	33.68	V9	3723-3728
2/02/2012	M02	53L 515751 8322949	<i>Chalinolobus nigrogriseus</i>	<i>C. nigrogriseus</i>	Female	Subadult?	35.33	CN3	3729-3731
3/02/2012	M03	53L 507733 8325315	<i>Scotorepens greyii</i>	<i>Scotorepens</i> sp.	Male	Adult	32.13	S1	3732-3736
3/02/2012	M03	53L 507733 8325315	<i>Chalinolobus nigrogriseus</i>	<i>C. nigrogriseus</i>	Female	Adult	32.94	CN4	3737-3740
3/02/2012	M03	53L 507733 8325315	<i>Saccolaimus flaviventris</i>	No data	Female	Adult	76.7	SF1	3741-3756
Observations									
30/1/2012	D02	53L 510632 8325676	<i>Pteropus</i> sp.		—	—	—	—	—
31/1/2012	AN05	53L 507407 8325264	<i>Pteropus</i> sp.		—	—	—	—	—
1/2/2012	M02	53L 515751 8322949	<i>Pteropus</i> sp.		—	—	—	—	—
2/2/2012	M02	53L 515751 8322949	<i>Pteropus</i> sp.		—	—	—	—	—

Table 6. Details of traverses and trees examined for roosts of *Saccolaimus*.

Date	Traverse	Tree No.	GPS	Hollow type ¹	Bats observed
30/01/2012	DT01	T01	53L 510364 8325652	TP	—
30/01/2012	DT02	T02	53L 507239 8325265	TP	—
30/01/2012	DT02	T03	53L 507072 8325267	TP	—
31/01/2012	DT03	T04	53L 505967 8326897	TP	—
31/01/2012	DT03	T05	53L 505958 8326892	SV	—
31/01/2012	DT03	T06	53L 505926 8326880	SV	—
31/01/2012	DT03	T07	53L 505884 8326930	SV	—
31/01/2012	DT03	T08	53L 505750 8327112	TD	—
31/01/2012	DT03	T09	53L 505874 8327185	TV	—
31/01/2012	DT03	T10	53L 505951 8327259	TV	—

¹ TP: living tree, hollow at broken branch close to (proximal to) the main trunk; TD: living tree, hollow at distal end of branch; TV: living tree, vertical hollow in main trunk; SV: dead stag, vertical hollow in main trunk.

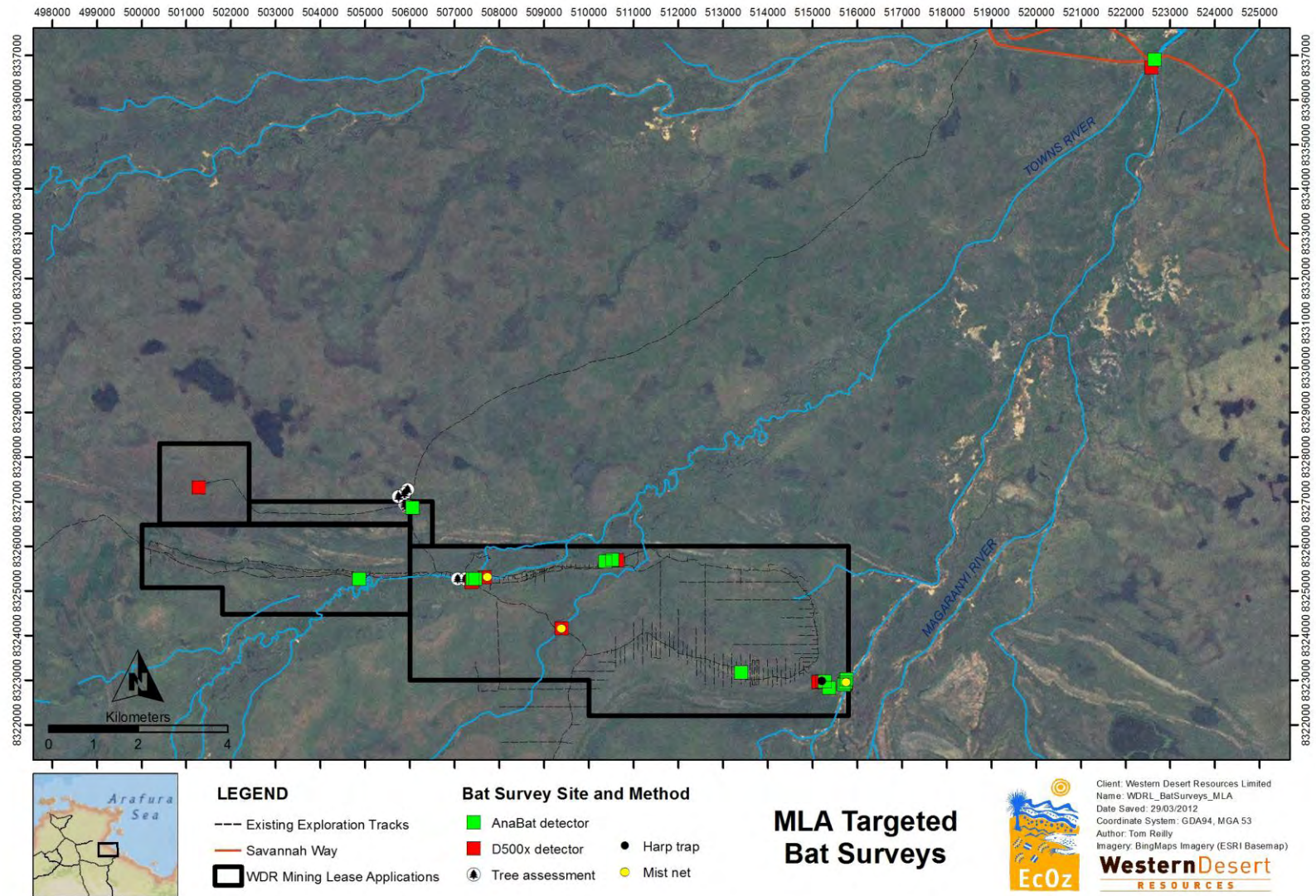


Figure 1. Location of the MLA – Towns River project area, and lease boundaries, and relative locations of sampling sites (see Figures 2 and 3 for further details).

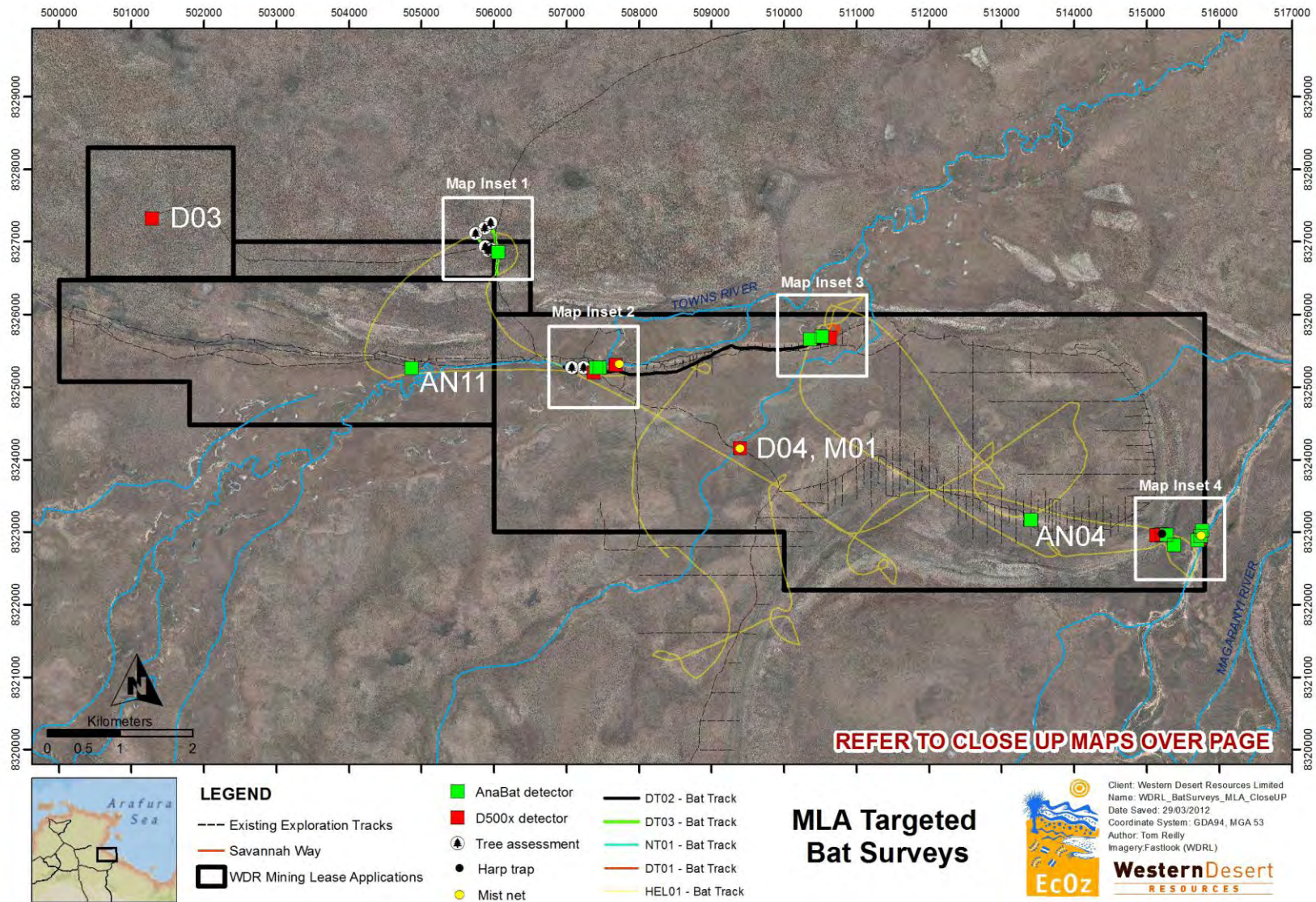


Figure 2. Locations of acoustic recording and trapping sites in the MAL – Towns River project area. See Figure 3 for further details.

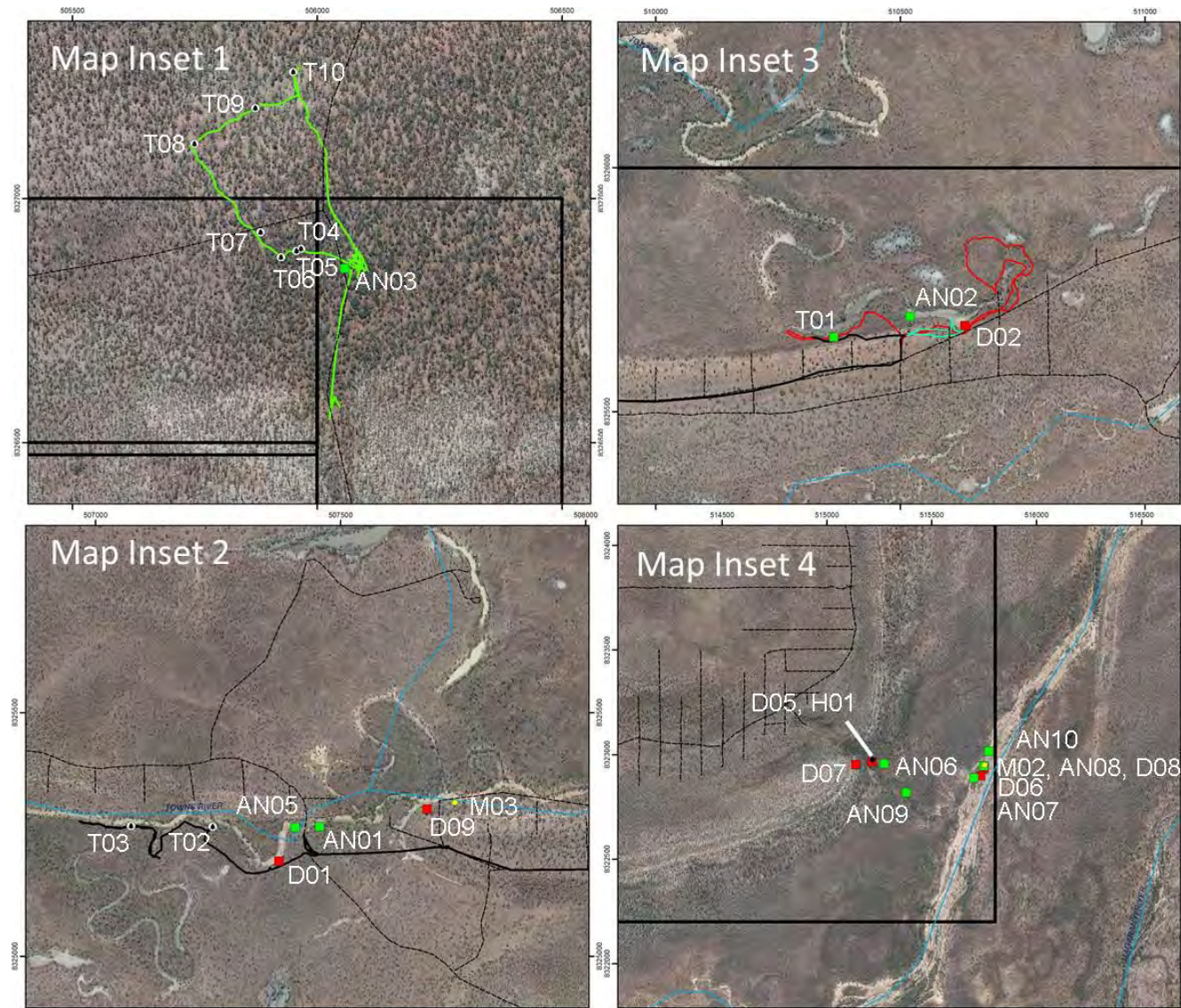


Figure 3. Further details of the acoustic recording and trapping sites in the MLA – Towns River project area. See Figure 2 for explanation of codes.



Figure 4a. Site photographs showing the vegetation structure at selected acoustic recording sites (top: AN04, AN10, AN11; bottom: D03, D07, D10).



Figure 4b. Site photographs showing the vegetation structure at selected trapping sites (top: H01, M01; bottom: M02, M03).



Figure 4c. Representative photographs of the species captured (species and biopsy code; top: *Chaerephon jobensis* CJ2, *Chalinolobus nigrogriseus* CN1, *Nyctophilus geoffroyi* N1; bottom: *Saccolaimus flaviventris* SF1, *Scotorepens greyii* V1, *Scotorepens* sp. V2).

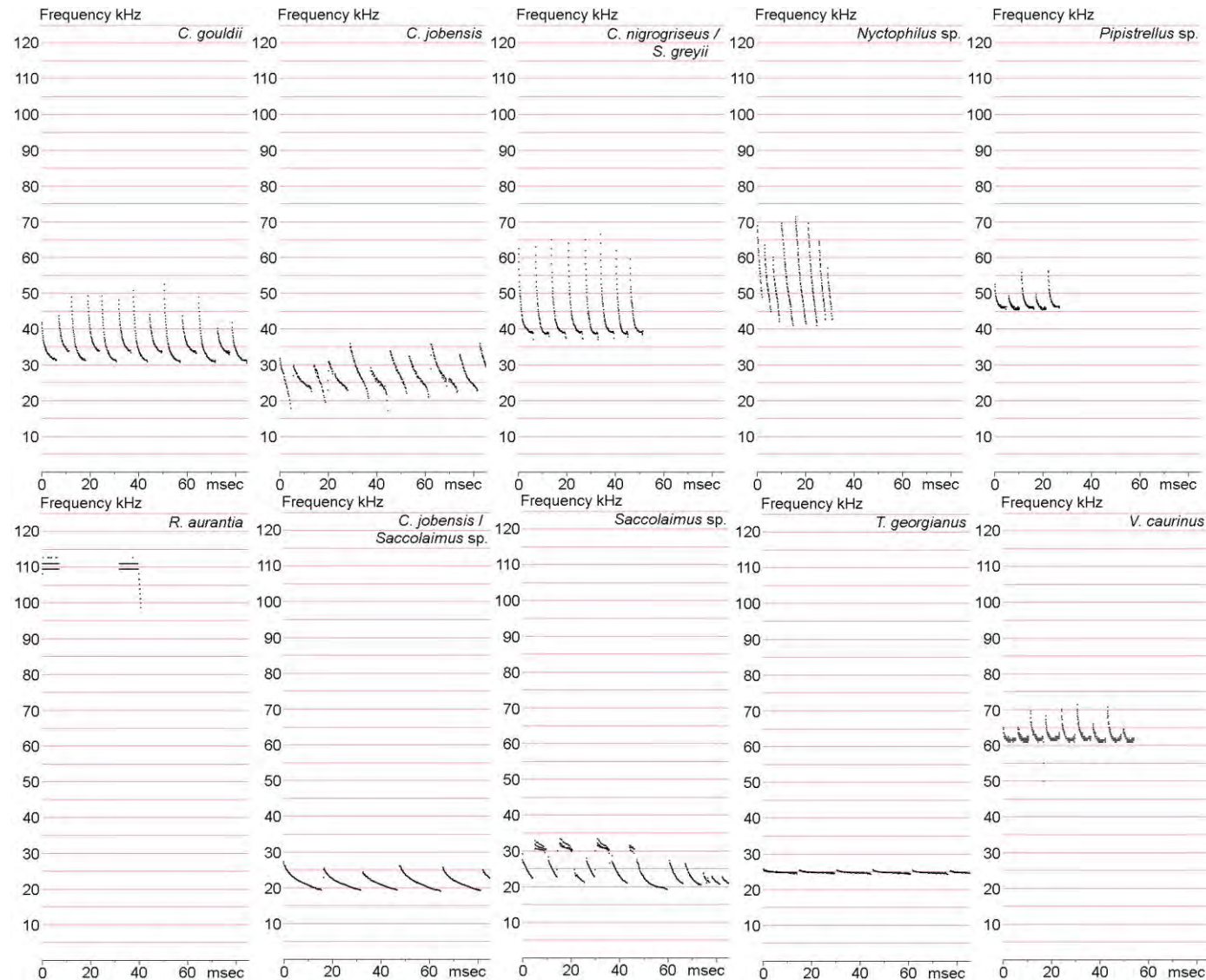


Figure 5. Representative call sequences of the species identified (time is compressed between pulses).

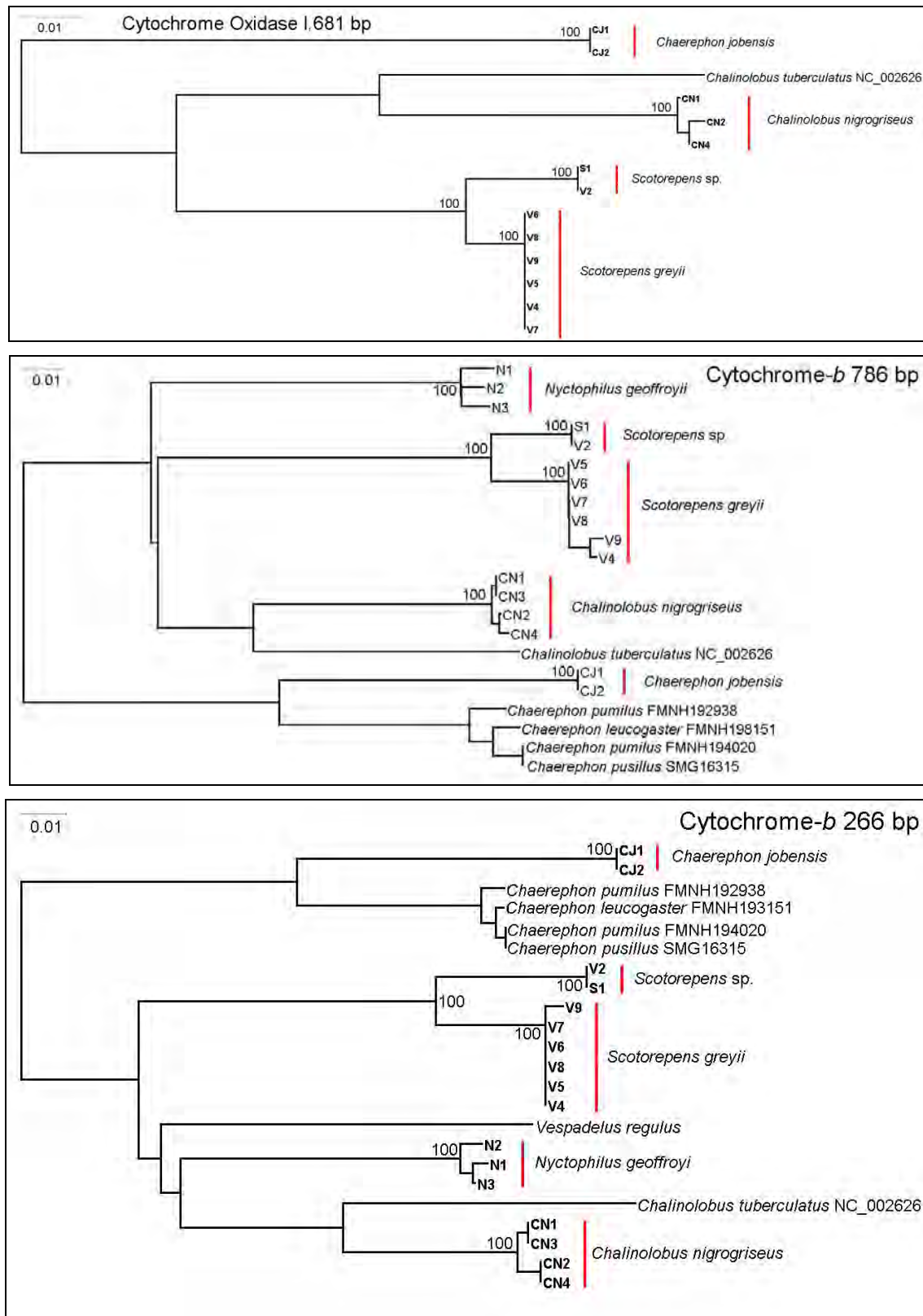


Figure 6. Identifications based on Cytochrome Oxidase 1 and Cytochrome-b, with two phylograms given for the latter marker, since one *Vespadelus* reference sequence was relatively short (bp: base pairs). Bootstrap values are given at relevant nodes, and reference sequences (those without a red bar) were taken from Genbank. Scale represents the proportion of nucleotide substitutions. See Table 5 for further information associated with the tissue biopsy codes.



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Appendix D-6 – Near Threatened Fauna Species



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Table 6-1: Listed Near Threatened Species (TPWC Act)

Table Key	1 = Atlas of Living Australia 2 = NT Atlas (inc Museum) 3 = EPBC 4 = Distribution occurs within area 5 = WDRL geologist (birds)	* = proposed reduction of status # = proposed increase of status	H = Haul Rd M = Mine P = Port	K = Known M = May L = Likely

SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD			NORTHERN TERRITORY DISTRIBUTION	ECOLOGY	LIKELIHOOD		
		Aus	NT	Mig	Mar	Mine/ Haul	Port	Survey			Mine	Haul	Port
BIRD													
<i>Acrocephalus australis</i>	Australian Reed-Warbler	-	NT	-	x	4	4	-	Throughout Northern Territory - mostly winter migrants from southern Aust.	Reeds and rushes.	likely	likely	likely
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	NT	-	-	2	-	H,M	Inland and northern Australia. Stronghold in the fox-free north.	Broad range of habitats.	known	known	likely
<i>Falco hypoleucos</i>	Grey Falcon	-	NT	-	-	4	-	-	Irruptive - stronghold southern Northern Territory.	Lightly treed inland plains and timbered watercourses.	may	may	may
<i>Heteromunia pectoralis</i>	Pictorella Mannikin	-	NT	-	-	2	-	-	Northern Territory above 400mm isobar.	Tall grass in Acacia woodlands near water.	known	known	likely
<i>Lophoictinia isura</i>	Square-tailed Kite	-	NT	-	-	4	-	-	Sparsely distributed throughout Australia. In Northern Territory above 500mm isobar.	Woodlands. Pairs occupy with large territories.	likely	likely	may
<i>Malurus coronatus macgillvrayi</i>	Purple-crowned Fairy-wren (eastern)	-	NT	-	-	2	2	-	East NT from lower Roper River to border, and inland ~200kms.	Pandanus and paper bark thickets with tall cane-grass and dense cover, fringing waterways and lakes. Proposed downgrade of status to Near Threatened.	known	known	may



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD			NORTHERN TERRITORY DISTRIBUTION	ECOLOGY	LIKELIHOOD		
		Aus	NT	Mig	Mar	Mine/ Haul	Port	Survey			Mine	Haul	Port
<i>Neochmia ruficauda</i>	Star Finch	-	NT	-	-	4	-	-	Top End and Gulf above 800mm isobar.	Grassy flats, reeds and bushes near water.	likely	likely	may
<i>Phaps histrionica</i>	Flock Bronzewing	-	NT	-	-	4	-	-	Very nomadic. Possible anywhere in the Northern Territory, but generally in drier country.	Treeless grassy plains, spinifex and saltbush with nearby water.	may	may	may
<i>Poecilodryas superciliosa</i>	White-browed Robin	-	NT	x	-	4	-	-	Across Top End and coastal Gulf.	Riverine gallery forest and rainforest.	likely	likely	may
<i>Psephotus dissimilis</i>	Hooded Parrot	-	NT	-	-	2	-	-	Endemic to inland Top End. Single record for the development area from 1915.	Dry, open woodlands with termite mounds.	may	may	may
<i>Tyto longimembris</i>	Eastern Grass Owl	-	NT	-	-	4	-	-	Irruptive into Northern Territory from north-east coast Australia.	Preference for tall green grass.	likely	likely	likely
MAMMAL													
<i>Dugong dugon</i>	Dugong	-	NT	x	x	-	2	-	Northern Australia southern Queensland to central Western Australia. Stronghold is northern Australia.	Calm, shallow, coastal waters with sea-grass beds.	-	-	known
<i>Hipposideros stenotis</i>	Northern Leaf-nosed bat	-	NT #	-	-	4	-	-	Central Top End, central Gulf (either side of border).	Sandstone cliffs, gorges and waterholes bordered by paperbarks. Roosts in caves and boulder piles.	may	may	may
<i>Lagorchestes conspicillatus</i>	Spectacled Hare-wallaby	-	NT	-	-	2	-	-	Central Northern Territory and Arnhem Land.	Tropical tussock and hummock grassland.	known	known	likely



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD			NORTHERN TERRITORY DISTRIBUTION	ECOLOGY	LIKELIHOOD		
		Aus	NT	Mig	Mar	Mine/ Haul	Port	Survey			Mine	Haul	Port
<i>Macroderma gigas</i>	Ghost Bat	-	NT	-	-	4	-	-	Top End above 800mm.	Broad range of habitats.	likely	likely	likely
<i>Onychogalea unguifera</i>	Northern Nailtail Wallaby	-	NT	-	-	2	-	M	Central and northern Northern Territory (between 400 and 1200mm).	Open woodlands with tussock grass understorey, particularly blacksoil plains.	known	known	likely
<i>Pseudomys laborifex</i>	Kimberley Mouse	-	NT	-	-	1	-	-	Subtropical centre of Northern Territory.	Wide range of habitats with shallow rocky soil. This species is likely con-specific with the widely distributed <i>Pseudomys johnstonii</i> . Range of habitats with dense undercover of tussock grasses. Often beneath Eucalypt woodland.	known	known	may
<i>Pseudomys nanus</i>	Western Chestnut Mouse	-	NT	-	-	2	2	H,M,P	Above 400mm.	Tall grassland, usually associated with small, seasonal watercourses.	likely	known	known
<i>Rattus tunneyi</i>	Pale Field-rat	-	NT #	-	-	2	-	-	Northern Top End and Gulf coast.	Broad range of habitats when irruptive.	known	known	likely
<i>Rattus villosissimus</i>	Long-haired Rat	-	NT	-	-	2	-	-	Irruptive - Barkly Tableland is Northern Territory stronghold.	Forages low in open country, roosts in deep, humid caves.	known	known	may
<i>Rhinonicteris aurantia</i>	Orange Leaf-nosed bat	-	NT	-	-	2	-	M	Top End above 600 mm.		known	known	likely
REPTILE													
<i>Acanthophis praelongus</i>	Northern Death Adder	-	NT	-	-	4	-	-	Top End above 600mm.	Grasslands, woodlands, and rocky ranges and outcrops.	likely	likely	likely
<i>Varanus primordius</i>	Northern Ridge-tailed Monitor	-	NT	-	-	1	-	-	Inland Top End.	Outcrops and rocky ranges.	may	may	may



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Appendix D-7 - Listed Migratory & Marine Species



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Table 7-1: Listed Migratory and Marine Species (EPBC Act)

Table Key	1 = Atlas of Living Australia 2 = NT Atlas (inc Museum) 3 = EPBC 4 = Distribution occurs within area 5 = WDRL geologist (birds)	* = proposed reduction of status # = proposed increase of status ¹ = Sight record – only identifiable at species level in the hand.	H = Haul Rd M = Mine P = Port	LC = Least Concern NE = Not Evaluated DD = Data Deficient

SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD			LIKELIHOOD		
		Aus	NT	Mig	Mar	Mine/Haul	Port	Survey	Mine	Haul	Port
ACCIPITRIDAE											
<i>Accipiter fasciatus</i>	Brown Goshawk	-	LC	-	x	1,2,5	1,2	H,M	known	known	known
<i>Circus approximans</i>	Swamp Harrier	-	LC	-	x	-	1,2	-	likely	likely	known
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	-	LC	x	x	2	1,2	H,M,P	known	known	known
<i>Haliastur indus</i>	Brahminy Kite	-	LC	-	x	1,2	1,2	-	known	known	known
<i>Haliastur sphenurus</i>	Whistling Kite	-	LC	-	x	1,2,5	1,2	H,M,P	known	known	known
<i>Pandion cristatus</i>	Eastern Osprey	-	LC	x	x	1,2	1,2	P	known	known	known
ANATIDAE											
<i>Dendrocygna arcuata</i>	Wandering Whistling-Duck	-	LC	-	x	1,2	1,2	H	known	known	known
<i>Nettapus pulchellus</i>	Green Pygmy-Goose	-	LC	-	x	1,2	1,2	P	known	known	known
<i>Tadorna radjah</i>	Radjah Shelduck	-	LC	-	x	1,2	-	P	known	known	known
ANSERANATIDAE											
<i>Anseranas semipalmata</i>	Magpie Goose	-	LC	-	x	1,2,3	1,2,3	M	known	known	known
APODIDAE											
<i>Apus pacificus</i>	Fork-tailed Swift	-	LC	x	x	-	1,2	-	likely	likely	known
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	NE	-	x	-	-	M	known	likely	likely
ARDEIDAE											
<i>Ardea ibis</i>	Cattle Egret	-	LC	x	x	1,2	-	-	known	known	may
<i>Ardea intermedia</i>	Intermediate Egret	-	LC	-	x	1,2,5	1,2	-	known	known	known
<i>Ardea modesta</i>	Eastern Great Egret	-	LC	x	x	1,2,5	1,2	M*	known	known	known
<i>Egretta garzetta</i>	Little Egret	-	LC	-	x	1,2	1,2	M,P	known	known	known
<i>Egretta sacra</i>	Eastern Reef Egret	-	LC	x	x	-	1,2	-	-	-	known
<i>Nycticorax caledonicus</i>	Nankeen Night Heron	-	LC	-	x	1,2,5	1,2	H,M	known	known	known
BURHINIDAE											
<i>Esacus magnirostris</i>	Beach Stone-curlew	-	LC	-	x	-	1,2	P	-	-	known



Scientific Name	Common Name	Status				Record			Likelihood		
		Aus	NT	Mig	Mar	Mine/Haul	Port	Survey	Mine	Haul	Port
CAMPEPHAGIDAE											
Coracina novaehollandiae	Black-faced Cuckoo-shrike	-	LC	-	x	1,2,5	1,2	H,M,P	known	known	known
Coracina papuensis	White-bellied Cuckoo-shrike	-	LC	-	x	1,2,5	1,2	H,M	known	known	known
Coracina tenuirostris	Cicadabird	-	LC	x	x	1	-	-	known	known	likely
CHARADRIIDAE											
Charadrius leschenaultii	Greater Sand Plover	-	LC	x	x	2	1,2	P	known	known	known
Charadrius mongolus	Lesser Sand Plover	-	LC	x	x	-	1,2	-	known	known	known
Pluvialis fulva	Pacific Golden Plover	-	LC	x	x	-	2	-	known	known	known
Pluvialis squatarola	Grey Plover	-	LC	x	x	-	1,2	P	known	known	known
Charadrius veredus	Oriental Plover	-	LC	x	x	2	-	-	known	likely	likely
COLUMBIDAE											
Ducula bicolor	Pied Imperial Pigeon	-	LC	-	x	1,2	1,2	P	known	known	known
CORACIIDAE											
Eurystomus orientalis	Dollarbird	-	LC	-	x	1,2,5	1,2	H,P	known	known	known
CUCULIDAE											
Cacomantis pallidus	Pallid Cuckoo	-	LC	-	x	1,2,5	1,2	H,M,P	known	known	known
Chalcites basalis	Horsfield's Bronze-Cuckoo	-	LC	-	x	1,2	1,2	H	known	known	known
Chalcites minutillus	Little Bronze-Cuckoo	-	LC	-	x	1,2	1,2	H	known	known	known
Chalcites osculans	Black-eared Cuckoo	-	LC	-	x	-	-	M	known	likely	likely
Eudynamys orientalis	Eastern Koel	-	LC	-	x	1,2,5	2	H,P	known	known	known
Scythrops novaehollandiae	Channel-billed Cuckoo	-	LC	-	x	1,2,5	1,2	H,P	known	known	known
EUROSTOPIDAE											
Eurostopodus argus	Spotted Nightjar	-	LC	-	x	1,2,5	1,2	H,M,P	known	known	known
FALCONIDAE											
Falco cenchroides	Nankeen Kestrel	-	LC	-	x	1,2	1,2	H	known	known	known
GLAREOLIDAE											
Glareola maldivarum	Oriental Pratincole	-	LC	x	x	1,2	-	-	known	known	likely
Stiltia isabella	Australian Pratincole	-	LC	-	x	1,2	1,2	-	known	known	known
HALCYONIDAE											
Todiramphus macleayii	Forest Kingfisher	-	LC	-	x	1,2	-	M	known	known	likely
Todiramphus sanctus	Sacred Kingfisher	-	LC	-	x	1,2,5	1,2	H,M,P	known	known	known
HIRUNDINIDAE											
Hirundo rustica	Barn Swallow	-	LC	x	x	3	3	-	may	may	may
Petrochelidon nigricans	Tree Martin	-	LC	-	x	1,2	1,2	-	known	known	known
LARIDAE											
Chlidonias leucopterus	White-winged Black Tern	-	LC	x	x	-	2	-	likely	likely	known



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD			LIKELIHOOD		
		Aus	NT	Mig	Mar	Mine/Haul	Port	Survey	Mine	Haul	Port
<i>Hydroprogne caspia</i>	Caspian Tern	-	LC	x	x	-	1,2	P	-	-	known
<i>Onychoprion anaethetus</i>	Bridled Tern	-	LC	x	x	-	-	-	-	-	likely
<i>Sterna dougallii</i>	Roseate Tern	-	LC	-	x	-	1	-	-	-	known
<i>Sterna hirundo</i>	Common Tern	-	LC	x	x	-	1,2	-	-	-	known
<i>Sternula albifrons</i>	Little Tern	-	LC	x	x	-	1,2	-	-	-	known
<i>Thalasseus bengalensis</i>	Lesser Crested Tern	-	LC	x	x	-	1,2	-	-	-	known
<i>Thalasseus bergii</i>	Crested Tern	-	LC	-	x	-	1,2	-	-	-	known
MEROPIDAE											
<i>Merops ornatus</i>	Rainbow Bee-eater	-	LC	x	x	1,2,5	1,2	H,M,P	known	known	known
MONARCHIDAE											
<i>Grallina cyanoleuca</i>	Magpie-lark	-	LC	-	x	1,2,5	1,2	M	known	known	known
MOTACILLIDAE											
<i>Anthus novaeseelandiae</i>	Australasian Pipit	-	LC	-	x	-	1,2	H	likely	known	likely
PELECANIDAE											
<i>Pelecanus conspicillatus</i>	Australian Pelican	-	LC	-	x	2	1,2	M	known	known	known
RALLIDAE											
<i>Gallirallus philippensis</i>	Buff-banded Rail	-	LC	-	x	5	-	M	known	known	likely
RECURVIROSTRIDAE											
<i>Himantopus himantopus</i>	Black-winged Stilt	-	LC	-	x	2	1,2	-	known	known	known
RHIPIDURIDAE											
<i>Rhipidura dryas</i>	Arafura Fantail	-	LC	-	x	1,2	-	-	known	known	likely
SCOLOPACIDAE											
<i>Actitis hypoleucos</i>	Common Sandpiper	-	LC	x	x	2	2	-	known	known	known
<i>Arenaria interpres</i>	Ruddy Turnstone	-	LC	x	x	2	1,2	P	known	known	known
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	LC	x	x	-	1,2	-	likely	likely	known
<i>Calidris alba</i>	Sanderling	-	LC	x	x	-	-	P	-	-	known
<i>Calidris canutus</i>	Red Knot	-	LC	x	x	2	1,2	-	known	known	known
<i>Calidris ferruginea</i>	Curlew Sandpiper	-	LC	x	x	-	1,2	-	may	may	known
<i>Calidris ruficollis</i>	Red-necked Stint	-	LC	x	x	2	1,2	-	known	known	known
<i>Calidris tenuirostris</i>	Great Knot	-	LC	x	x	2	1,2	-	known	known	known
<i>Gallinago sp.</i> ¹	Snipe species	-	DD	x	x	-	-	M	likely	likely	likely
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	-	NE	x	x	-	1,2	-	may	may	known
<i>Limosa lapponica</i>	Bar-tailed Godwit	-	LC	x	x	-	1,2	-	likely	likely	known



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD			LIKELIHOOD		
		Aus	NT	Mig	Mar	Mine/Haul	Port	Survey	Mine	Haul	Port
<i>Limosa limosa</i>	Black-tailed Godwit	-	LC	x	x	2	1,2	-	known	known	known
<i>Numenius madagascariensis</i>	Eastern Curlew	-	LC	x	x	-	1,2	P	may	may	known
<i>Numenius minutus</i>	Little Curlew	-	LC	x	x	1,2	1,2	-	known	known	known
<i>Numenius phaeopus</i>	Whimbrel	-	LC	x	x	1,2	1,2	P	known	known	known
<i>Tringa brevipes</i>	Grey-tailed Tattler	-	LC	x	x	2	1,2	P	known	known	known
<i>Tringa nebularia</i>	Common Greenshank	-	LC	x	x	2	1,2	P	likely	likely	known
<i>Tringa stagnatilis</i>	Marsh Sandpiper	-	LC	x	x	-	1,2	-	likely	likely	known
<i>Xenus cinereus</i>	Terek Sandpiper	-	LC	x	x	-	2	-	may	may	known
STRIGIDAE											
<i>Ninox novaeseelandiae</i>	Southern Boobook	-	LC	-	x	1,2,5	-	H,M,P	known	known	likely
THRESKIORNITHIDAE											
<i>Plegadis falcinellus</i>	Glossy Ibis	-	LC	x	x	1,2	1,2	P	known	known	known
<i>Threskiornis molucca</i>	Australian White Ibis	-	LC	-	x	1,2	1,2	M*	known	known	known
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	-	LC	-	x	1,2,5	1,2	H,M	known	known	known
MAMMAL											
BALAENOPTERIDAE											
<i>Balaenoptera edeni</i>	Bryde's Whale	-	DD	x	x	-	3	-	-	-	may
DELPHINIDAE											
<i>Delphinus delphis</i>	Short-beaked Common Dolphin	-	DD	-	x	-	3	-	-	-	may
<i>Grampus griseus</i>	Risso's Dolphin	-	DD	-	x	-	3	-	-	-	may
<i>Orcinus orca</i>	Killer Whale	-	DD	x	x	-	3	-	-	-	may
<i>Orcaella heinsohni</i>	Australian Snubfin Dolphin	-	LC	x	x	-	3	-	-	-	may
<i>Sousa chinensis</i>	Indo-Pacific Humpbacked Dolphin	-	LC	x	x	-	3	-	-	-	may
<i>Stenella attenuata</i>	Pantropical Spotted Dolphin	-	DD	x	x	-	3	-	-	-	may
<i>Tursiops aduncus</i>	Indo-Pacific Bottlenose Dolphin	-	NE	x	x	-	3	-	-	-	likely
REPTILE											
CHELONIIDAE											
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	-	DD	-	x	-	3	-	-	-	may
<i>Natator depressus</i>	Flatback Turtle	-	DD	-	x	-	3	-	-	-	may
CROCODYLIDAE											
<i>Crocodylus johnstoni</i>	Freshwater Crocodile	-	LC	x	x	1,2,3	-	H,M	known	known	likely
<i>Crocodylus porosus</i>	Saltwater Crocodile	-	LC	x	x	2,3	2	-	may	known	known
ELAPIDAE											



SCIENTIFIC NAME	COMMON NAME	STATUS				RECORD			LIKELIHOOD		
		Aus	NT	Mig	Mar	Mine/Haul	Port	Survey	Mine	Haul	Port
<i>Acalyptophis peronii</i>	Horned Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Aipysurus duboisii</i>	Dubois' Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Aipysurus eydouxii</i>	Spine-tailed Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Aipysurus laevis</i>	Golden Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Astrotia stokesii</i>	Stokes' Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Disteira kingii</i>	Spectacled Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Disteira major</i>	Olive-headed Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Emydocephalus annulatus</i>	Turtle-headed Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Enhydrina schistosa</i>	Beaked Sea Snake	-	DD	-	x	-	3	-	-	-	may
<i>Hydrelaps darwiniensis</i>	Black-ringed Mud Snake	-	LC	-	x	-	3	-	-	-	may
<i>Hydrophis atriceps</i>	Black-headed Sea Snake	-	DD	-	x	-	3	-	-	-	may
<i>Hydrophis czeblukovi</i>	Geometerical Sea Snake	-	DD	-	x	-	3	-	-	-	may
<i>Hydrophis elegans</i>	Bar-bellied Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Hydrophis inornatus</i>	Plain Sea Snake	-	DD	-	x	-	3	-	-	-	may
<i>Hydrophis mcdowelli</i>	Small-headed Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Hydrophis ornatus</i>	Plain Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Hydrophis pacificus</i>	Large-headed Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Lapemis curtus</i>	Short Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Parahydrophis mertonii</i>	Northern Mangrove Sea Snake	-	LC	-	x	-	3	-	-	-	may
<i>Pelamis platurus</i>	Yellow-bellied Sea Snake	-	LC	-	x	-	3	-	-	-	may



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Appendix D-8 – Total Flora Species Identified (MLA Surveys)



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Table 8-1: List of Flora Species found in the MLA Areas during field surveys

LC = Least Concern

NE = Not Evaluated

DD = Data Deficient

SCIENTIFIC NAME	NT STATUS
ACANTHACEAE	
<i>Hygrophila angustifolia</i>	LC
<i>Nelsonia campestris</i>	LC
<i>Rostellularia adscendens</i>	LC
AMARANTHACEAE	
<i>Alternanthera angustifolia</i>	LC
AMARYLLIDACEAE	
<i>Crinum uniflorum</i>	LC
ANACARDIACEAE	
<i>Buchanania obovata</i>	LC
APOCYNACEAE	
<i>Carissa lanceolata</i>	LC
<i>Marsdenia viridiflora subsp. tropica</i>	LC
<i>Sarcostemma viminale</i>	LC
<i>Wrightia saligna</i>	LC
APONOGETONACEAE	
<i>Potamogeton tepperi</i>	LC
ASPARAGACEAE	
<i>Thysanotus chinensis</i>	LC
BIGNONIACEAE	
<i>Dolichandrone heterophylla</i>	LC
BIXACEAE	
<i>Cochlospermum fraseri</i>	LC
<i>Cochlospermum gregorii</i>	LC
BORAGINACEAE	
<i>Ehretia saligna</i>	LC
CAPPARACEAE	
<i>Capparis umbonata</i>	LC
CARYOPHYLLACEAE	
<i>Polycarpaea spirostylis</i>	LC
CELASTRACEAE	
<i>Denhamia obscura</i>	LC
<i>Maytenus cunninghamii</i>	LC
<i>Stackhousia intermedia</i>	LC
CLEOMACEAE	



SCIENTIFIC NAME	NT STATUS
<i>Cleome viscosa</i>	LC
COMBRETACEAE	
<i>Terminalia bursarina</i>	LC
<i>Terminalia canescens</i>	LC
<i>Terminalia carpentariae</i>	LC
<i>Terminalia volucris</i>	LC
COMMELINACEAE	
<i>Cartonema trigonospermum</i>	LC
<i>Commelina agrostophylla</i>	LC
<i>Cyanotis axillaris</i>	LC
<i>Murdannia graminea</i>	LC
CONVOLVULACEAE	
<i>Bonamia media</i>	LC
<i>Bonamia pannosa</i>	LC
<i>Evolvulus alsinoides</i>	LC
<i>Ipomoea coptica</i>	LC
<i>Ipomoea eriocarpa</i>	LC
<i>Ipomoea gracilis</i>	LC
<i>Jacquemontia browniana</i>	LC
<i>Jacquemontia paniculata</i>	LC
<i>Merremia gemella</i>	LC
<i>Merremia incisa</i>	LC
<i>Polymeria ambigua</i>	LC
<i>Xenostegia tridentata</i>	LC
CUPRESSACEAE	
<i>Callitris intratropica</i>	LC
CYPERACEAE	
<i>Bulbostylis barbata</i>	LC
<i>Cyperus castaneus</i>	LC
<i>Cyperus holoschoenus</i>	LC
<i>Fimbristylis acuminata</i>	LC
<i>Fimbristylis cinnamometorum</i>	LC
<i>Fimbristylis depauperata</i>	LC
<i>Fimbristylis dichotoma</i>	LC
<i>Fimbristylis dictyocolea</i>	LC
<i>Fimbristylis dolera</i>	DD
<i>Fimbristylis littoralis</i>	LC
<i>Fimbristylis macassarensis</i>	LC
<i>Fimbristylis microcarya</i>	LC
<i>Fimbristylis miliacea</i>	LC
<i>Fimbristylis modesta</i>	LC
<i>Fimbristylis pachyptera</i>	LC
<i>Fimbristylis pallida</i>	LC



SCIENTIFIC NAME	NT STATUS
<i>Fimbristylis phaeoleuca</i>	LC
<i>Fimbristylis pterygosperma</i>	LC
<i>Fimbristylis simplex</i>	LC
<i>Fimbristylis</i> sp. Darwin A23005	LC
<i>Fimbristylis squarrulosa</i>	LC
<i>Fimbristylis subaristata</i>	DD
<i>Lipocarpa microcephala</i>	LC
<i>Rhynchospora leae</i>	LC
<i>Scleria brownii</i>	LC
<i>Scleria laxa</i>	LC
<i>Scleria rugosa</i>	LC
DILLENIACEAE	
<i>Hibbertia lepidota</i>	LC
DROSERACEAE	
<i>Drosera burmanni</i>	LC
<i>Drosera fulva</i>	DD
<i>Drosera indica</i>	LC
ERIOCAULACEAE	
<i>Eriocaulon fistulosum</i>	LC
<i>Eriocaulon spectabile</i>	LC
ERYTHROXYLACEAE	
<i>Erythroxylum ellipticum</i>	LC
EUPHORBIACEAE	
<i>Euphorbia vachellii</i>	LC
<i>Excoecaria parvifolia</i>	LC
<i>Microstachys chamaelea</i>	LC
FABACEAE	
<i>Acacia conspersa</i>	LC
<i>Acacia difficilis</i>	LC
<i>Acacia dimidiata</i>	LC
<i>Acacia drepanocarpa</i>	LC
<i>Acacia galioides</i> var. <i>galioides</i>	LC
<i>Acacia gonocarpa</i>	LC
<i>Acacia gonoclada</i>	LC
<i>Acacia holosericea</i>	LC
<i>Acacia humifusa</i>	LC
<i>Acacia multisiliqua</i>	LC
<i>Acacia platycarpa</i>	LC
<i>Acacia shirleyi</i>	LC
<i>Acacia subternata</i>	LC
<i>Acacia torulosa</i>	LC
<i>Acacia tropica</i>	LC
<i>Acacia umbellata</i>	LC



SCIENTIFIC NAME	NT STATUS
<i>Bauhinia cunninghamii</i>	LC
<i>Bossiaea bossiaeoides</i>	LC
<i>Cajanus geminatus</i>	LC
<i>Chamaecrista mimosoides</i>	LC
<i>Crotalaria brevis</i>	LC
<i>Crotalaria medicaginea</i>	LC
<i>Crotalaria montana</i> var. <i>indeterminate</i>	NE
<i>Daviesia reclinata</i>	LC
<i>Desmodium brownii</i>	LC
<i>Desmodium trichostachyum</i>	LC
<i>Dichrostachys spicata</i>	LC
<i>Erythrophleum chlorostachys</i>	LC
<i>Galactia tenuiflora</i>	LC
<i>Glycine tomentella</i>	LC
<i>Gompholobium subulatum</i>	LC
<i>Indigastrium parviflorum</i>	LC
<i>Indigofera linifolia</i>	LC
<i>Jacksonia dilatata</i>	LC
<i>Jacksonia odontoclada</i>	LC
<i>Mirbelia viminalis</i>	LC
<i>Neptunia dimorphantha</i>	LC
<i>Rhynchosia minima</i>	LC
<i>Senna oligoclada</i>	LC
<i>Tephrosia leptoclada</i>	LC
<i>Tephrosia simplicifolia</i>	LC
<i>Tephrosia</i> sp. <i>crowded pinnae</i>	NE
<i>Tephrosia spechtii</i>	LC
<i>Tephrosia virens</i>	LC
<i>Uraria lagopodioides</i>	LC
<i>Vigna lanceolata</i>	LC
<i>Zornia muriculata</i>	LC
<i>Zornia prostrata</i>	LC
GOODENIACEAE	
<i>Goodenia armstrongiana</i>	LC
<i>Goodenia coronopifolia</i>	LC
<i>Goodenia janamba</i>	LC
<i>Goodenia pilosa</i>	LC
<i>Lechenaultia filiformis</i>	LC
HALORAGACEAE	
<i>Gonocarpus leptothecus</i>	LC
HYDATELLACEAE	
<i>Trithuria lanterna</i>	LC
HYDROCHARITACEAE	



SCIENTIFIC NAME	NT STATUS
<i>Vallisneria rubra</i>	LC
HYDROLEACEAE	
<i>Hydrolea zeylanica</i>	LC
HYPOXIDACEAE	
<i>Hypoxis nervosa</i>	LC
LAMIACEAE	
<i>Clerodendrum floribundum</i>	LC
<i>Premna acuminata</i>	LC
<i>Vitex glabrata</i>	LC
LAURACEAE	
<i>Cassytha capillaris</i>	LC
<i>Cassytha filiformis</i>	LC
LENTIBULARIACEAE	
<i>Utricularia chrysantha</i>	LC
<i>Utricularia limosa</i>	LC
<i>Utricularia minutissima</i>	LC
<i>Utricularia sp. affin. fistulosa</i>	DD
LINDERNIACEAE	
<i>Lindernia lobelioides</i>	LC
<i>Lindernia subulata</i>	DD
LOGANIACEAE	
<i>Mitrasacme connata</i>	LC
<i>Strychnos lucida</i>	LC
LORANTHACEAE	
<i>Diplatia furcata</i>	LC
LYTHRACEAE	
<i>Ammannia multiflora</i>	LC
<i>Nesaea muelleri</i>	LC
<i>Rotala diandra</i>	LC
MALVACEAE	
<i>Abutilon leucopetalum</i>	LC
<i>Brachychiton paradoxus</i>	LC
<i>Corchorus sidoides</i>	LC
<i>Corchorus tridens</i>	LC
<i>Grewia retusifolia</i>	LC
<i>Helicteres cana</i>	LC
<i>Helicteres integrifolia subsp. indeterminate</i>	LC
<i>Hibiscus leptocladus</i>	LC
<i>Melhanian oblongifolia</i>	LC
<i>Melochia corchorifolia</i>	LC
<i>Melochia pyramidata</i>	LC
<i>Sida fibulifera</i>	LC
<i>Waltheria indica</i>	LC



SCIENTIFIC NAME	NT STATUS
MELIACEAE	
<i>Owenia vernicosa</i>	LC
MENISPERMACEAE	
<i>Tinospora smilacina</i>	LC
MENYANTHACEAE	
<i>Nymphoides exiliflora</i>	DD
MORACEAE	
<i>Ficus brachypoda</i>	LC
MYRTACEAE	
<i>Asteromyrtus symphyocarpa</i>	LC
<i>Calytrix brownii</i>	LC
<i>Calytrix exstipulata</i>	LC
<i>Corymbia aspera</i>	LC
<i>Corymbia confertiflora</i>	LC
<i>Corymbia ferruginea</i>	LC
<i>Corymbia grandifolia</i>	LC
<i>Corymbia polycarpa</i>	LC
<i>Eucalyptus camaldulensis</i>	LC
<i>Eucalyptus microtheca</i>	LC
<i>Eucalyptus miniata</i>	LC
<i>Eucalyptus phoenicea</i>	LC
<i>Eucalyptus pruinosa</i>	LC
<i>Eucalyptus tectifera</i>	LC
<i>Eucalyptus tetradonta</i>	LC
<i>Homalocalyx ericaeus</i>	LC
<i>Melaleuca citrolens</i>	LC
<i>Melaleuca nervosa</i>	LC
<i>Melaleuca viridiflora</i>	LC
NYMPHAEACEAE	
<i>Nymphaea violacea</i>	LC
OLEACEAE	
<i>Jasminum molle</i>	LC
ONAGRACEAE	
<i>Ludwigia octovalvis</i>	LC
OPHIOGLOSSACEAE	
<i>Ophioglossum costatum</i>	LC
<i>Ophioglossum gramineum</i>	LC
<i>Ophioglossum reticulatum</i>	LC
ORCHIDACEAE	
<i>Habenaria ochroleuca</i>	LC
OROBANCHACEAE	
<i>Buchnera linearis</i>	LC
PHILYDRACEAE	



SCIENTIFIC NAME	NT STATUS
<i>Philydrum lanuginosum</i>	LC
PHYLLANTHACEAE	
<i>Antidesma ghesaembilla</i>	LC
<i>Breynia cernua</i>	LC
<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>	LC
<i>Margaritaria dubium-traceyi</i>	LC
<i>Phyllanthus amarus</i>	LC
<i>Phyllanthus carpentariae</i>	LC
<i>Phyllanthus eutaxioides</i>	LC
<i>Phyllanthus exilis</i>	LC
<i>Phyllanthus virgatus</i>	LC
PICRODENDRACEAE	
<i>Petalostigma banksii</i>	LC
<i>Petalostigma pubescens</i>	LC
<i>Petalostigma quadriloculare</i>	LC
PLANTAGINACEAE	
<i>Stemodia lythrifolia</i>	LC
<i>Striga curviflora</i>	LC
POACEAE	
<i>Alloteropsis semialata</i>	LC
<i>Aristida holathera</i>	LC
<i>Aristida hygrometrica</i>	LC
<i>Aristida latifolia</i>	LC
<i>Brachyachne tenella</i>	LC
<i>Chrysopogon fallax</i>	LC
<i>Chrysopogon latifolius</i>	LC
<i>Cymbopogon procerus</i>	LC
<i>Digitaria ctenantha</i>	LC
<i>Dimeria ornithopoda</i>	LC
<i>Ectrosia scabrida</i>	LC
<i>Elytrophorus spicatus</i>	LC
<i>Eragrostis fallax</i>	LC
<i>Eragrostis tenellula</i>	LC
<i>Eriachne ciliata</i>	LC
<i>Eriachne obtusa</i>	LC
<i>Eriachne triodioides</i>	LC
<i>Eulalia aurea</i>	LC
<i>Germainia truncatiglumis</i>	LC
<i>Heteropogon contortus</i>	LC
<i>Hygrochloa cravenii</i>	DD
<i>Ischaemum australe</i> subsp. <i>Indeterminate</i>	LC
<i>Mnesithea formosa</i>	LC
<i>Panicum decompositum</i>	LC



SCIENTIFIC NAME	NT STATUS
<i>Panicum effusum</i>	LC
<i>Paspalidium rarum</i>	LC
<i>Paspalum scrobiculatum</i>	LC
<i>Pseudopogonatherum contortum</i>	LC
<i>Pseudoraphis spinescens</i>	LC
<i>Sacciolepis myosuroides</i>	LC
<i>Schizachyrium fragile</i>	LC
<i>Schizachyrium pseudeulalia</i>	LC
<i>Sehima nervosum</i>	LC
<i>Setaria apiculata</i>	LC
<i>Setaria surgens</i>	LC
<i>Sorghum plumosum</i> var. <i>plumosum</i>	LC
<i>Sorghum timorense</i>	LC
<i>Thaumastochloa major</i>	LC
<i>Thaumastochloa striata</i>	LC
<i>Themeda triandra</i>	LC
<i>Triodia bitextura</i>	LC
<i>Triodia procera</i>	LC
<i>Urochloa subquadripa</i>	LC
<i>Whiteochloa airoides</i>	LC
<i>Whiteochloa capillipes</i>	LC
<i>Yakirra majuscula</i>	LC
POLYGALACEAE	
<i>Polygala eriocephala</i>	LC
<i>Polygala longifolia</i>	LC
<i>Polygala</i> sp. Top End	LC
<i>Polygala stenoclada</i>	LC
PORTULACACEAE	
<i>Calandrinia gracilis</i>	LC
<i>Calandrinia uniflora</i>	LC
<i>Portulaca bicolor</i>	LC
<i>Portulaca filifolia</i>	LC
PROTEACEAE	
<i>Grevillea dryandri</i>	LC
<i>Grevillea heliosperma</i>	LC
<i>Grevillea parallela</i>	LC
<i>Grevillea pteridifolia</i>	LC
<i>Grevillea refracta</i> subsp. <i>indeterminate</i>	LC
<i>Grevillea striata</i>	LC
<i>Hakea arborescens</i>	LC
<i>Hakea lorea</i> subsp. <i>lorea</i>	LC
<i>Persoonia falcata</i>	LC
<i>Stenocarpus acacioides</i>	LC



SCIENTIFIC NAME	NT STATUS
PTERIDACEAE	
<i>Cheilanthes brownii</i>	LC
<i>Cheilanthes nitida</i>	LC
RHAMNACEAE	
<i>Alphitonia excelsa</i>	LC
<i>Alphitonia pomaderroides</i>	LC
RUBIACEAE	
<i>Gardenia fucata</i>	LC
<i>Oldenlandia galioides</i>	LC
<i>Oldenlandia mitrasacmoides subsp. indeterminate</i>	LC
<i>Pavetta brownii</i>	LC
<i>Psydrax paludosa</i>	DD
<i>Spermacoce stenophylla</i>	LC
RUTACEAE	
<i>Boronia lanuginosa</i>	LC
SANTALACEAE	
<i>Santalum lanceolatum</i>	LC
SAPINDACEAE	
<i>Atalaya hemiglauca</i>	LC
<i>Distichostemon hispidulus</i>	LC
<i>Dodonaea lanceolata</i>	LC
<i>Dodonaea physocarpa</i>	LC
TACCACEAE	
<i>Tacca leontopetaloides</i>	LC
THYMELAEACEAE	
<i>Thecanthes punicea</i>	LC
VIOLACEAE	
<i>Hybanthus enneaspermus</i>	LC
VITACEAE	
<i>Ampelocissus acetosa</i>	LC
<i>Cayratia trifolia</i>	LC
XYRIDACEAE	
<i>Xyris complanata</i>	LC
<i>Xyris indica</i>	LC
ZYGOPHYLLACEAE	
<i>Tribulopsis pentandra</i>	LC



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Appendix D-9 – Vegetation Descriptions (MLA)



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Vegetation Type 1

Short Description: *Acacia shirleyi* Mid Open Forest.

NVIS Code: T7c



Plate 1: Vegetation community site F7

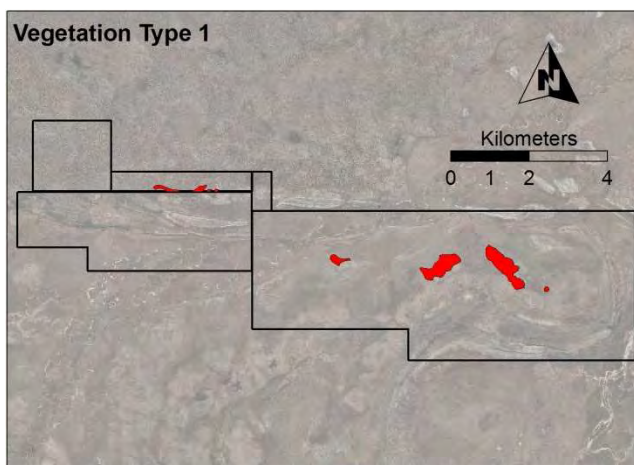


Plate 2: Distribution of the Vegetation Type

Area: 0.92 km² and 2.6% total surveyed area.

Survey Sites: F7 (check sites 50 & 49).

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	65 (30 - 85)	10.3 (8 - 12)	T7c
Mid	Shrub	6 (2 - 11)	3.7 (2 - 6)	S2c
Ground	Tussock Grass	44 (30 - 63)	0.3 (0 - 5)	G1i

NVIS Description: *Acacia shirleyi* Mid High Open Forest over *Acacia shirleyi* +/- *Melaleuca viridiflora*, *Corymbia ferruginea*, *Petalostigma banksii* Mid Sparse Shrubland over *Schizachyrium fragile* +/- *Eulalia aurea*, *Chrysopogon fallax* Low Open Tussock Grassland.

Upper: Mid high open forest dominated by *Acacia shirleyi* (fq 100%).

Mid: Mid sparse shrubland dominated by *Acacia shirleyi* (fq 100%) *Petalostigma banksii* (fq 100%), *Melaleuca viridiflora* (fq 66%).

Ground: Low open tussock grassland dominated by *Schizachyrium fragile* (fq 100%), *Waltheria indica* (fq 100%), *Marsdenia viridiflora* (fq 100%), *Goodenia pilosa* (frq 66%), *Stackhousia intermedia* (fq 66%), *Thecanthes punicea* (fq 66%).

Other species:

Upper: *Corymbia ferruginea* (fq 33%).

Mid: *Brachychiton paradoxus* (fq 66%), *Terminalia canescens* (fq 66%) *Bossiaea bossiaeioides* (fq 33%), *Brachychiton diversifolius* (fq 33%), *Callitris intratropica* (fq 33%), *Calytrix exstipulata* (fq 33%), *Carissa lanceolata* (fq 33%), *Distichostemon hispidulus* (fq 33%), *Hakea arborescens* (fq 33%), *Maytenus cunninghamii* (fq 33%), *Melaleuca citrolens* (fq 33%), *Mirbelia viminalis* (fq 33%), *Persoonia falcata* (fq 33%), *Premna acuminata* (fq 33%), *Wrightia saligna* (fq 33%).



Ground: *Alloteropsis semialata* (fq 66%), *Mitrasacme connata* (fq 66%), *Tephrosia leptoclada* (fq 66%), *Cheilanthes nitida* (fq 66%), *Chrysopogon fallax* (fq 66%), *Corchorus sidoides* (fq 66%), *Goodenia janamba* (fq 66%), *Goodenia pilosa* (fq 66%), *Habenaria ochroleuca* (fq 66%), *Helicteres cana* (fq 66%), *Hybanthus enneaspermus* (fq 66%), *Zornia muriculata* (fq 66%), *Bonamia pannosa* (fq 33%), *Cheilanthes brownii* (fq 33%), *Desmodium brownii* (fq 33%), *Drosera fulva* (fq 33%), *Drosera indica* (fq 33%), *Eulalia aurea* (fq 33%), *Evolvulus alsinoides* (fq 33%), *Gompholobium subulatum* (fq 33%), *Gonocarpus leptothecus* (fq 33%), *Goodenia armstrongiana* (fq 33%), *Goodenia coronopifolia* (fq 33%), *Grevillea dryandri* (fq 33%), *Hibbertia lepidota* (fq 33%), *Lindernia lobelioides* (fq 33%), *Murdannia graminea* (fq 33%), *Ophioglossum reticulatum* (fq 33%), *Paspalidium rarum* (fq 33%), *Phyllanthus exilis* (fq 33%), *Polygala eriocephala* (fq 33%), *Schizachyrium fragile* (fq 33%), *Senna oligoclada* (fq 33%), *Sorghum timorense* (fq 33%), *Stemodia lythrifolia* (fq 33%), *Tacca leontopetaloides* (fq 33%), *Thaumastochloa major* (fq 33%), *Triodia bitextura* (fq 33%), *Waltheria indica* (fq 33%), *Zornia muriculata* (fq 33%).

Landform: Lower hill slopes and plains. May be associated with the base of hills in some areas and slight rises adjacent to seasonally inundated *Melaleuca viridiflora* plains. *Acacia shirleyi* is often associated with fire shadows (parts of the landscape that experience a more infrequent fire regime than the landscape as a whole).

General Condition: The condition of lancewood forest in the lease area is generally good with large areas that have not experienced hot fires. Some areas adjacent to the airport road appear to have had recent crown scorch but this was not systematically assessed. *Callitris intratropica* was often present in and around the boundaries of the lancewood forest, although survey data does not necessarily reflect this. Feral animal disturbance was low and weeds were not present.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 2

Short Description: *Corymbia ferruginea* +/- *Eucalyptus tetrodonta*, *Eucalyptus phoenicea*, Mid Open Woodland.

NVIS Code: T7r



Plate 3: Vegetation community site V27

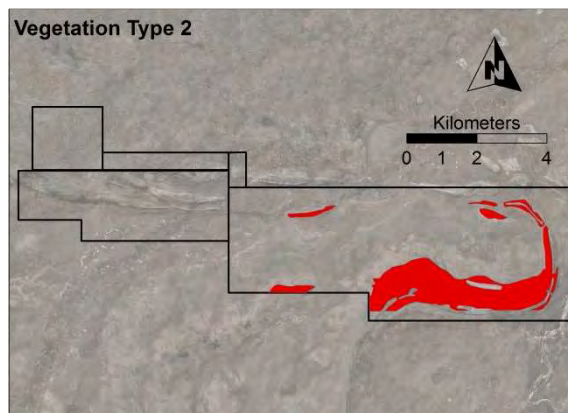


Plate 4. Distribution of the Vegetation Type

Area: 5.6 km² and 15% total surveyed area

Survey Sites: 106, 66, 118 & V27.

Strata	Modal growth form	Mean Cover %	Mean Height (m)	NVIS code
Upper	Tree	11 (5 - 20)	9.2 (6 - 14)	T7r
Mid	Shrub	22 (5 - 50)	2.8 (0.8 - 7)	S4r
Ground	Hummock Grass	45 (20 - 60)	0.5 (0 - 1)	H2i

NVIS Description: *Corymbia ferruginea* +/- *Eucalyptus tetrodonta*, *Eucalyptus phoenicea*, *Eucalyptus miniata* Mid Open Woodland over *Acacia galioides*, *Bossiaea bossiaeooides* +/- *Acacia gonocarpa*, *Jacksonia odontoclada*, *Petalostigma quadriloculare* Tall Sparse Shrubland over +/- *Triodia procera*, *Gompholobium subulatum*, *Eriachne ciliata*, *Bulbostylis barbata*, *Tephrosia leptoclada* Mid Open Hummock Grassland.

Upper: Mid open woodland dominated by *Corymbia ferruginea* (fq 100%), *Eucalyptus phoenicea* (fq 75%), *Eucalyptus tetrodonta* (fq 75%), *Eucalyptus miniata* (fq 25%).

Mid: Tall sparse shrubland of *Acacia galioides* (fq 100%), *Bossiaea bossiaeooides* (fq 100%), *Acacia gonocarpa* (fq 75%), *Jacksonia odontoclada* (fq 75%), *Petalostigma quadriloculare* (fq 75%).

Ground: Mid high open hummock grassland of *Triodia procera* (fq 75%), *Gompholobium subulatum* (fq 75%), *Bulbostylis barbata* (fq 75%), *Eriachne ciliata* (fq 75%), *Tephrosia leptoclada* (fq 75%).

Other species:

Upper: no additional species

Mid: *Grevillea refracta* (fq 50%), *Petalostigma banksii* (fq 50%), *Terminalia canescens* (fq 50%), *Tribulopsis angustifolia* (fq 50%), *Acacia conspersa* (fq 25%), *Brachychiton paradoxus* (fq 25%), *Buchanania obovata* (fq 25%), *Calytrix exstipulata* (fq 25%), *Clerodendrum floribundum* (fq 25%), *Daviesia reclinata* (fq 25%), *Dolichandrone heterophylla* (fq 25%), *Erythroxylum ellipticum* (fq 25%), *Grevillea heliosperma* (fq 25%), *Hibbertia lepidota* (fq 25%), *Persoonia falcata* (fq 25%), *Stenocarpus acacioides* (fq 25%), *Wrightia saligna* (fq 25%).



Ground: *Portulaca bicolor* (fq 75%), *Stackhousia intermedia* (fq 75%), *Corchorus sidoides* (fq 50%), *Eriachne obtusa* (fq 50%), *Gonocarpus leptothecus* (fq 50%), *Grevillea dryandri* (fq 50%), *Merremia incisa* (fq 50%), *Oldenlandia mitrasacmoides* (fq 50%), *Senna oligoclada* (fq 50%). *Cassytha filiformis* (fq 25%), *Evolvulus alsinoides* (fq 25%), *Fimbristylis pachyptera* (fq 25%), *Fimbristylis pterygosperma* (fq 25%), *Fimbristylis subaristata* (fq 25%), *Indigastrium parviflorum* (fq 25%), *Murdannia graminea* (fq 25%), *Panicum effusum* (fq 25%), *Phyllanthus carpentariae* (fq 25%), *Phyllanthus virgatus* (fq 25%), *Polymeria ambigua* (fq 25%), *Schizachyrium fragile* (fq 25%), *Tephrosia sp.crowded pinnae* (C.R.Dunlop 8202) (fq 25%), *Tribulopsis pentandra* (fq 25%), *Waltheria indica* (fq 25%).

Landform: Crests, mid-slopes and lower slopes. Gravelly substrates on gentle slopes are characteristic of this vegetation type.

General Condition: Condition in regard to feral animals and weeds was good to excellent with few alien species recorded. Condition in relation to fire impacts varied from long unburned to recently burnt. Fires were intense due to the hummock grass ground layer.

Species of Conservation Significance: *Fimbristylis subaristata* (Data Deficient), *Tephrosia sp. Crowded pinnae* (C.R. Dunlop 8202) (Not Evaluated)



Vegetation Type 3

Short Description: +/- *Corymbia ferruginea* *Eucalyptus miniata* and *Eucalyptus tetradonta* Low Open Woodland

NVIS Code: T6r



Plate 5: Vegetation community site F5a

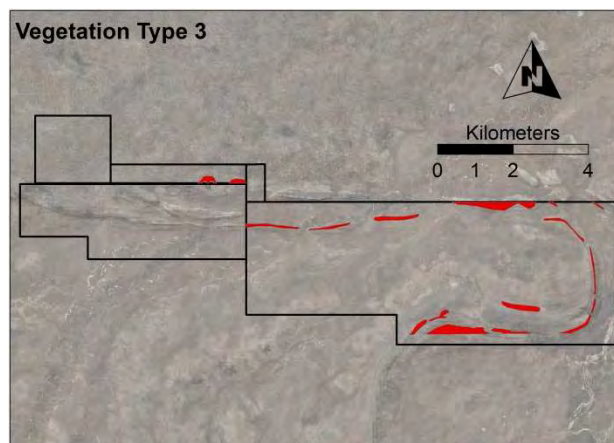


Plate 6. Distribution of the Vegetation Type



Plate 7: Vegetation community site F3

Area: 1.6 km² and 4.5% total surveyed area.

Survey Sites: F5a, F9, & F12b (Quartz sandstone reference sites) + F3 & F4 (ironstone reference sites).

Strata	Modal growth form	Mean Cover %	Mean Height (m)	NVIS Code
Upper	Tree	8 (5 - 10)	8.6 (4 - 12)	T6r
Mid	Shrub	9 (3 - 15)	2.2 (1 - 6)	S4r
Ground	Hummock Grass	31 (20 - 40)	0.5 (0 - 1)	H1i

NVIS Description: +/- *Corymbia ferruginea*, *Eucalyptus tetradonta*, *Eucalyptus miniata* Low Open Woodland over +/- *Acacia multisiliqua*, *Grevillea dryandra*, *Jacksonia odontoclada*, *Erythrophleum chlorostachys*, *Acacia conspersa* Tall Sparse Shrubland over +/- *Triodia procera*, *Acacia galioides*, *Eriachne ciliate*, *Gompholobium subulatum*, *Bulbostylis barbata* Low Open Hummock Grassland.



Upper: Low open woodland dominated by *Corymbia ferruginea* (fq 67%), *Eucalyptus tetrodonta* (fq 67%), *Eucalyptus miniata* (fq 50%), *Corymbia aspera* (fq 17%), *Corymbia grandifolia* (fq 17%).

Mid: Tall sparse shrubland of *Acacia multisiliqua* (fq 50%), *Grevillea dryandri* (fq 50%), *Jacksonia odontoclada* (fq 50%), *Erythrophleum chlorostachys* (fq 33%), *Acacia conspersa* (fq 33%).

Ground: Low open hummock grassland of *Triodia procera* (fq 83%), *Acacia galioides* (fq 67%), *Eriachne ciliata* (fq 67%), *Gompholobium subulatum* (fq 67%), *Bulbostylis barbata* (fq 50%).

Other species:

Upper: *Eucalyptus phoenicea* (fq 17%)

Mid: *Acacia dimidiata* (fq 33%), *Buchanania obovata* (fq 33%), *Corchorus sidoides* (fq 33%), *Gardenia fucata* (fq 33%), *Owenia vernicosa* (fq 33%), *Petalostigma quadriloculare* (fq 33%), *Tephrosia spechtii* (fq 33%), *Terminalia canescens* (fq 33%), *Acacia difficilis* (fq 17%), *Acacia drepanocarpa* (fq 17%), *Acacia gonocarpa* (fq 17%), *Acacia holosericea* (fq 17%), *Acacia humifusa* (fq 17%), *Acacia subternata* (fq 17%), *Alphitonia excelsa* (fq 17%), *Alphitonia pomaderroides* (fq 17%), *Antidesma ghesaembilla* (fq 17%), *Bossiaea bossiaeoidea* (fq 17%), *Calytrix brownii* (fq 17%), *Calytrix exstipulata* (fq 17%), *Ehretia saligna* (fq 17%), *Ficus brachypoda* (fq 17%), *Grevillea heliosperma* (fq 17%), *Grevillea refracta* (fq 17%), *Distichostemon hispidulus* (fq 17%), *Hibbertia lepidota* (fq 17%), *Homalocalyx eriaceus* (fq 17%), *Jacksonia dilatata* (fq 17%), *Mirbelia viminalis* (fq 17%), *Margaritara dubium-traceyi* (fq 17%), *Pavetta brownii* (fq 17%), *Petalostigma banksii* (fq 17%), *Petalostigma pubescens* (fq 17%), *Premna acuminata* (fq 17%).

Ground: *Aristida holathera* (fq 33%), *Stemodia lythrifolia* (fq 33%), *Sorghum timorense* (fq 33%), *Triodia bitextura* (fq 33%), *Uraria lagopodioides* (fq 33%), *Cassytha filiformis* (fq 17%), *Cheilanthes nitida* (fq 17%), *Cleome viscosa* (fq 17%), *Cymbopogon procera* (fq 17%), *Eriachne obtusa* (fq 17%), *Fimbristylis squarrulosa* (fq 17%), *Galactia tenuiflora* (fq 17%), *Hibbertia lepidota* (fq 17%), *Hibiscus leptocladus* (fq 17%), *Homalocalyx eriaceus* (fq 17%), *Indigofera linifolia* (fq 17%), *Hibiscus leptocladus* (fq 17%), *Lechenaultia filiformis* (fq 17%), *Indigofera linifolia* (fq 17%), *Lechenaultia filiformis* (fq 17%), *Marsdenia viridiflora* (fq 17%), *Microstachys chamaelea* (fq 17%), *Schizachyrium fragile* (fq 17%), *Schizachyrium pseudoeulalia* (fq 17%), *Setaria apiculata* (fq 17%), *Stackhousia intermedia* (fq 17%), *Tephrosia leptoclada* (fq 17%).

Landform: Ridges and upper slopes

General Condition: Vegetation type 3 was generally weed free and had few feral animal impacts. Fire had affected most sites recently or in the past although patches of very rocky habitat supported some dry monsoon thicket species and fire sensitive heath species such as *Calytrix*. Due to the cover of hummock grass, fires are likely to be intense in this vegetation type.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type



Vegetation Type 4

Short Description: *Eucalyptus pruinosa* +/- *Melaleuca citrolens* Low Open Woodland.

NVIS Code: T6r



Plate 8: Vegetation community site 98

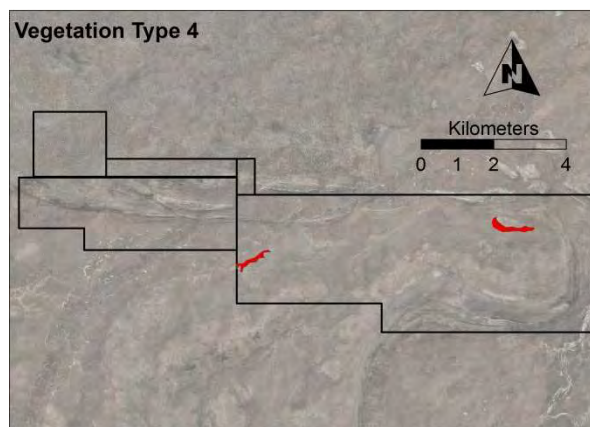


Plate 9. Distribution of the Vegetation Type

Area: 0.3km² and 0.8% total surveyed area

Survey Sites: 98, 48

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	12.5 (10 - 15)	5 (3 - 7)	T6r
Mid	Shrub	5.5 (5 - 6)	1.5 (0.5 - 5)	S3r
Ground	Tussock Grass	50(20 - 80)	0.5 (0 - 1.2)	G1i

NVIS Description: *Eucalyptus pruinosa* and *Melaleuca citrolens* +/- *Atalaya hemiglauc*a, *Corymbia confertiflora* Low Open Woodland over *Acacia galioides*, *Carissa lanceolata*, *Maytenus cunninghamii* +/- *Dolichandrone heterophylla*, *Dodonaea lanceolata* Mid Sparse Shrubland over *Bulbostylis barbata*, *Eulalia aurea*, *Evolvulus alsinoides*, *Indigastrium parviflorum* and *Triodia bitextura* Low Open Tussock Grassland.

Upper: Low open woodland of *Eucalyptus pruinosa* (fq 100%), *Melaleuca citrolens* (fq 100%), *Atalaya hemiglauc*a (fq 50%), *Corymbia confertiflora* (fq 50%).

Mid: Mid sparse shrubland of *Maytenus cunninghamii* (fq 100%), *Acacia galioides* (fq 100%), *Acacia gonoclada* (fq 50%), *Dodonaea lanceolata* (fq 50%), *Dolichandrone heterophylla* (fq 50%).

Ground: Low open tussock grassland of *Bulbostylis barbata* (fq 100%), *Eulalia aurea* (fq 100%), *Evolvulus alsinoides* (fq 100%), *Indigastrium parviflorum* (fq 100%), *Triodia bitextura* (fq 100%).

Other species:

Upper: *Wrightia saligna* (fq 50%).

Mid: *Ehretia saligna* (fq 50%), *Flueggea virosa* (fq 50%), *Hakea arborescens* (fq 50%), *Terminalia canescens* (fq 50%), *Tinospora smilacina* (fq 50%).

Ground: *Alloteropsis semialata* (fq 50%), *Aristida holathera* (fq 50%), *Bonamia pannosa* (fq 50%), *Brachyachne tenella* (fq 50%), *Calandrinia uniflora* (fq 50%), *Chrysopogon fallax* (fq 50%), *Chrysopogon latifolius* (fq 50%), *Corchorus sidoides* (fq 50), *Eriachne obtusa* (fq 50%), *Euphorbia* sp.(fq 50%), *Glycine tomentella* (fq 50%), *Hybanthus enneaspermus* (fq 50%), *Marsdenia viridiflora* (fq 50%), *Oldenlandia*



mitrasacmoides (fq 50%), *Panicum effusum* (fq 50%), *Phyllanthus exilis* (fq 50%), *Sehima nervosa* (fq 50%), *Senna oligoclada* (fq 50%), *Sorghum plumosum* (fq 50%), *Tephrosia leptoclada* (fq 50%), *Tephrosia simplicifolia* (fq 50%), *Tribulopsis angustifolia* (fq 50%), *Waltheria indica* (fq 50%).

Landform: Lower slopes and flats. Sometimes occurred as an ecotone between *Melaleuca viridiflora/citrolens* flats and Woodland on lower slopes.

General Condition: This vegetation type was weed free although the presence of feral animals was detected in low numbers (Donkeys and Pigs). Fire impacts were higher where the perennial grass layer was dense.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 5

Short Description: *Melaleuca citrolens* +/- *Hakea lorea* Low Open Woodland

NVIS Code: T6r



Plate 10: Vegetation community site 63

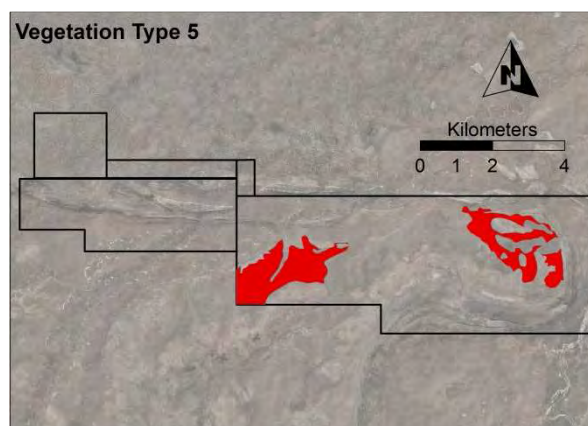


Plate 11. Distribution of the Vegetation Type

Area: 5 km² and 14% total surveyed area

Survey Sites: 63, 52 & 51(check sites)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	23 (20 - 30)	5.6 (3 - 8)	T6r
Mid	Shrub	8 (4 - 18)	2.1 (0.8 - 5)	S3r
Ground	Tussock Grass	90 (80 - 100)	0.5 (0.3 - 1)	G1d

NVIS Description: *Melaleuca citrolens*, *Hakea lorea* +/- *Corymbia polycarpa*, *Eucalyptus pruinosa* Low Open Woodland over *Melaleuca citrolens*, *Petalostigma banksii*, *Terminalia canescens*, *Wrightia saligna*, *Maytenus cunninghamii* Mid Sparse Shrubland over *Chrysopogon fallax*, *Eriachne obtusa*, *Evolvulus alsinoides*, *Glycine tomentella*, *Habenaria ochroleuca* Low Closed Tussock Grassland.

Upper: Low open woodland of *Melaleuca citrolens* (fq 100%), *Corymbia polycarpa* (fq 67%), *Eucalyptus pruinosa* (fq 67%).

Mid: Mid sparse shrubland of *Maytenus cunninghamii* (fq 100%), *Melaleuca citrolens* (fq 100%), *Petalostigma banksii* (fq 100%), *Terminalia canescens* (fq 100%), *Wrightia saligna* (fq 100%).

Ground: Low closed tussock grassland of *Chrysopogon fallax* (fq 100%), *Eriachne obtusa* (fq 100%), *Evolvulus alsinoides* (fq 100%), *Glycine tomentella* (fq 100%), *Habenaria ochroleuca* (fq 100%).

Other species:

Upper: *Melaleuca viridiflora* (fq 67%), *Corymbia confertiflora* (fq 33%), *Callitris intratropica* (fq 33%).

Mid: *Brachychiton paradoxus* (fq 67%), *Breynia cernua* (fq 67%), *Carissa lanceolata* (fq 67%), *Ehretia saligna* (fq 67%), *Flueggea virosa* (fq 67%), *Grewia retusifolia* (fq 67%), *Helicteres cana* (fq 67%), *Jasminum molle* (fq 67%), *Margaritaria dubium-traceyi* (fq 67%), *Marsdenia viridiflora* (fq 67%), *Premna acuminata* (fq 67%), *Terminalia volucris* (fq 67%), *Acacia umbellata* (fq 33%), *Clerodendrum floribundum* (fq 33%), *Cochlospermum gregorii* (fq 33%), *Dodonaea lanceolata* (fq 33%), *Dodonaea physocarpa* (fq 33%), *Dolichandrone heterophylla* (fq 33%), *Hakea arborescens* (fq 33%), *Strychnos lucida* (fq 33%).



Ground: *Murdannia graminea* (fq 100%), *Waltheria indica* (fq 100%), *Alloteropsis semialata* (fq 67%), *Desmodium brownii* (fq 67%), *Desmodium trichostachyum* (fq 67%), *Eulalia aurea* (fq 67%), *Ophioglossum reticulatum* (fq 67%), *Phyllanthus exilis* (fq 67%), *Sehima nervosa* (fq 67%), *Sorghum plumosum* (fq 67%), *Striga curviflora* (fq 67%), *Thecanthes punicea* (fq 67%), *Chrysopogon latifolius* (fq 33%), *Corchorus sidoides* (fq 33%), *Drosera fulva* (fq 33%), *Ectrosia scabrida* (fq 33%), *Euphorbia vachellii* (fq 33%), *Fimbristylis cinnamometorum* (fq 33%), *Hybanthus enneaspermus* (fq 33%), *Ipomoea gracilis* (fq 33%), *Merremia gemella* (fq 33%), *Panicum decompositum* (fq 33%), *Polygala eriocephala* (fq 33%), *Polygala longifolia* (fq 33%), *Scleria brownii* (fq 33%), *Setaria surgens* (fq 33%), *Sida fibulifera* (fq 33%), *Stackhousia intermedia* (fq 33%), *Tephrosia leptoclada* (fq 33%), *Uraria lagopodioides* (fq 33%), *Zornia muriculata* (fq 33%).

Landform: Flats and simple slopes. Heavier clay soils may differentiate where *Melaleuca viridiflora* and *Melaleuca citrolens* occur within the flatter plains of the survey area.

General Condition: This vegetation type was free of weeds although had some low level disturbance from Pigs and Donkeys. Fire impacts were high on some sites due to the thick grass layer. Dead *Callitris intratropica* trees indicate that at least in some areas, the current fire regime is too frequent or intense to allow the survival and regeneration of this long lived obligate seeder species.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 6

Short Description: *Corymbia polycarpa* and *Erythrophleum chlorostachys* Mid Woodland

NVIS Code: T7i



Plate 12: Vegetation community site 107

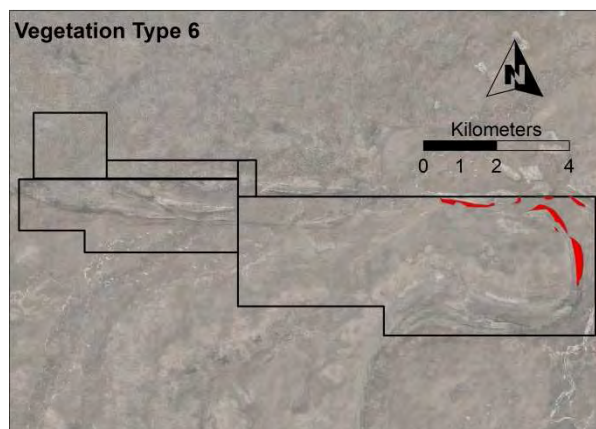


Plate 13. Distribution of the Vegetation Type

Area: 0.6 km² and 1.7% total surveyed area.

Survey Sites: F5b & CB4 (references sites) and 107 & 54 check sites

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	21 (15 - 35)	11 (8 - 14)	T7i
Mid	Shrub	6 (5 - 8)	2.7 (1 - 8)	S4r
Ground	Tussock Grass	71 (65 - 80)	0.5 (0 - 1)	G1c

NVIS Description: *Corymbia polycarpa*, *Erythrophleum chlorostachys* +/- *Eucalyptus tetradonta* Mid Woodland over *Alphitonia pomaderroides* +/- *Acacia torulosa*, *Wrightia saligna*, *Acacia platycarpa*, *Grevillea pteridifolia* Tall Sparse Shrubland over +/- *Senna oligoclada*, *Waltheria indica*, *Aristida holathera*, *Bonamia pannosa*, *Eriachne obtusa* Low Tussock Grassland.

Upper: Mid woodland of *Corymbia polycarpa* (fq 100%), *Erythrophleum chlorostachys* (fq 100%), *Eucalyptus tetradonta* (fq 75%).

Mid: Tall sparse shrubland of *Alphitonia pomaderroides* (fq 100%), *Acacia torulosa* (fq 75%), *Wrightia saligna* (fq 75%), *Acacia platycarpa* (fq 50%), *Grevillea pteridifolia* (fq 50%).

Ground: Low tussock grassland of *Senna oligoclada* (fq 75%), *Waltheria indica* (fq 75%), *Aristida holathera* (fq 50%), *Bonamia pannosa* (fq 50%), *Eriachne obtusa* (fq 50%).

Other species:

Upper: *Eucalyptus mininata* (fq 25%).

Mid: *Acacia platycarpa* (fq 50%), *Aristida holathera* (fq 50%), *Bonamia pannosa* (fq 50%), *Brachychiton paradoxus* (fq 50%), *Denhamia obscura* (fq 50%), *Melaleuca viridiflora* (fq 50%), *Persoonia falcata* (fq 50%), *Acacia difficilis* (fq 25%), *Acacia dimidiata* (fq 25%), *Acacia drepanocarpa* (fq 25%), *Antidesma ghesaembilla* (fq 25%), *Boronia lanuginosa* (fq 25%), *Bossiaea bossiaeoidea* (fq 25%), *Breynia cernua* (fq 25%), *Buchanania obovata* (fq 25%), *Distichostemon hispidulus* (fq 25%), *Grevillea heliosperma* (fq 25%).



25%), *Jacksonia odontoclada* (fq 25%), *Jasminum molle* (fq 25%), *Maytenus cunninghamii* (fq 25%), *Melaleuca nevosum* (fq 25%), *Petalostigma banksii* (fq 25%), *Premna acuminata* (fq 25%).

Ground: *Hibiscus leptocladus* (fq 50%), *Lechenaultia filiformis* (fq 50%), *Merremia incisa* (fq 50%), *Polygala coralliformis* (fq 50%), *Triodia bitextura* (fq 50%), *Zornia prostrata* (fq 50%), *Cassytha capillaris* (fq 25%), *Cassytha filiformis* (fq 25%), *Crotalaria medicaginea* (fq 25%), *Desmodium brownii* (fq 25%), *Eriachne triodioides* (fq 25%), *Evolvulus alsinoides* (fq 25%), *Fimbristylis acuminata* (fq 25%), *Fimbristylis squarrolosa* (fq 25%), *Gompholobium subulatum* (fq 25%), *Gonocarpus leptothecus* (fq 25%), *Goodenia pilosa* (fq 25%), *Hybanthus enneaspermus* (fq 25%), *Merremia gemella* (fq 25%), *Microstachys chamaelea* (fq 25%), *Mitrasacme connata* (fq 25%), *Murdannia graminea* (fq 25%), *Polygala stenoclada* (fq 25%), *Portulaca bicolor* (fq 25%), *Schizachyrium fragile* (fq 25%), *Schizachyrium pseudeulalia* (fq 25%), *Setaria apiculata* (fq 25%), *Sorghum timorense* (fq 25%), *Spermacoce stenophylla* (fq 25%), *Stackhousia intermedia* (fq 25%), *Tephrosia spechtii* (fq 25%), *Triodia procera* (fq 25%), *Whiteochloa arioides* (fq 25%).

Landform: Lower slopes.

General Condition: There were no weeds found in this vegetation type and few signs of feral animals. Although the ground layer does have a high cover, it lacks the high biomass of vegetation types with perennial tussock grasses and thus fires are less intense. The mid layer has many *Acacia* species and other shrub species due to less intense fires on this vegetation type. Despite this, *Callitris intratropica* has not been detected on this vegetation type.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 7

Short Description: *Melaleuca citrolens* Low Woodland.

NVIS Code: T6i



Plate 14: Vegetation community site CB3

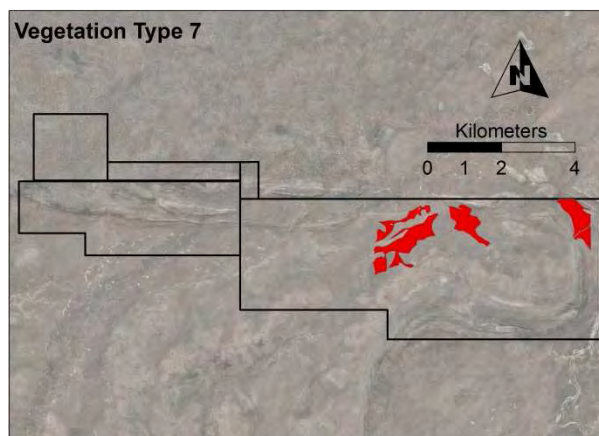


Plate 15. Distribution of the Vegetation Type

Area: 2.3 km² and 6% total surveyed area

Survey Sites: CB3 (reference site) & 104 & 55 check sites

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	21 (15 - 30)	5.5 (2 - 8)	T6i
Mid	Shrub	19 (3 - 50)	2.5 (1 - 5)	S4r
Ground	Tussock Grass	83 (80 - 90)	0.6 (0 - 1.5)	G2d

NVIS Description: *Melaleuca citrolens* +/- *Melaleuca viridiflora*, *Eucalyptus pruinosa* Mid Open Woodland over *Grevillea striata* +/- *Carissa lanceolata*, *Cochlospermum gregorii*, *Ehretia saligna*, *Flueggea virosa* Tall Sparse Shrubland over *Eulalia aurea* +/- *Alloterospis semialata*, *Murdannia graminea*, *Sorghum plumosum*, *Chrysopogon fallax* Mid Closed Tussock Grassland.

Upper: Low woodland with *Melaleuca citrolens* (fq 100%), *Melaleuca viridiflora* (fq 67%) and *Eucalyptus pruinosa* (fq 33%).

Mid: Tall sparse shrubland of *Grevillea striata* (fq 100%), *Carissa lanceolata* (fq 67%), *Cochlospermum gregorii* (fq 67%), *Ehretia saligna* (fq 67%), *Flueggea virosa* (fq 67%).

Ground: Mid closed tussock grassland of *Eulalia aurea* (fq 100%), *Alloterospis semialata* (fq 67%), *Murdannia graminea* (fq 67%), *Sorghum plumosum* (fq 67%), *Chrysopogon fallax* (fq 33%).

Other species:

Upper: no additional species.

Mid: *Petalostigma banksii* (fq 67%), *Terminalia canescens* (fq 67%), *Brachychiton diversifolius* (fq 33%), *Breynia cernua* (fq 33%), *Dodonaea physocarpa* (fq 33%), *Dolichandrone heterophylla* (fq 33%), *Terminalia volucris* (fq 33%).



Ground: *Crotalaria montana* (fq 33%), *Desmodium brownii* (fq 33%), *Desmodium trichostachyum* (fq 33%), *Eriachne obtusa* (fq 33%), *Sehima nervosa* (fq 33%), *Uraria lagopodioides* (fq 33%), *Waltheria indica* (fq 33%).

Landform: Flats and simple slopes

General Condition: Weeds were not found during surveys of this vegetation type while low impacts of Pigs and Donkeys were recorded. Fire impacts were variable but the potential for intense fires is great with the thick grass layer in this vegetation type. However the species within this vegetation type are somewhat resilient to disturbance from fire.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 8

Short Description: *Eucalyptus tetrodonta* and *Corymbia ferruginea* Mid Open Woodland

NVIS Code: T7r



Plate 16: Vegetation community site F8

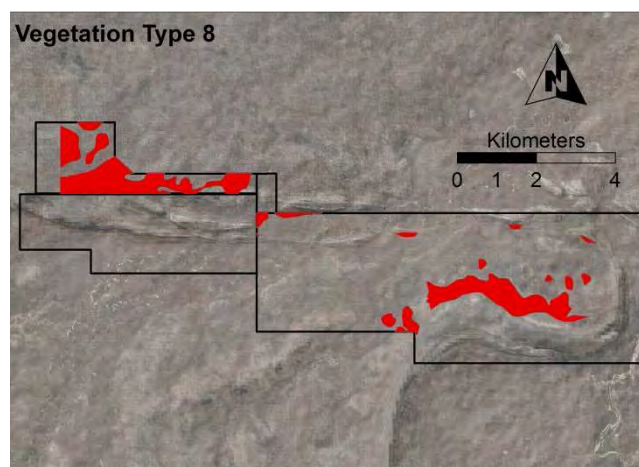


Plate 17. Distribution of the Vegetation Type

Area: 5 km² and 14% total surveyed area

Survey Sites: F8, F2, F12a & F1

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	18 (10 - 40)	12.5 (8 - 16)	T7r
Mid	Shrub	13 (5 - 35)	2 (0.5 - 4)	S4r
Ground	Hummock Grass	31 (15 - 50)	0.4 (0 - 0.5)	H1i

NVIS Description: *Corymbia ferruginea*, *Eucalyptus tetrodonta* +/- *Eucalyptus miniata*, *Eucalyptus phoenicea* Mid Open Woodland over *Distichostemon hispidulus* +/- *Acacia conspersa*, *Acacia galioides*, *Alphitonia pomaderroides*, *Boronia lanuginosa*, *Bossiaea bossiaeioides* Tall Sparse Shrubland over +/- *Triodia bitextura*, *Eriachne obtusa*, *Evolvulus alsinoides*, *Gompholobium subulatum* Low Open Hummock Grassland.

Upper: Mid open woodland of *Corymbia ferruginea* (fq 100%), *Eucalyptus tetrodonta* (fq 100%), *Eucalyptus miniata* (fq 50%), *Eucalyptus phoenicea* (fq 25%).

Mid: Tall sparse shrubland of *Distichostemon hispidulus* (fq 100%), *Acacia conspersa* (fq 75%), *Acacia galioides* (fq 75%), *Alphitonia pomaderroides* (fq 75%), *Boronia lanuginosa* (fq 75%).

Ground: Low open hummock grassland of *Aristida holathera* (fq 75%), *Triodia bitextura* (fq 75%), *Eriachne obtusa* (fq 50%), *Evolvulus alsinoides* (fq 50%), *Gompholobium subulatum* (fq 50%).

Other species:

Upper: no additional species

Mid: *Corchorus sidoides* (fq 75%), *Grevillea parallela* (fq 75%), *Maytenus cunninghamii* (fq 75%), *Acacia drepanocarpa* (fq 50%), *Brachychiton paradoxus* (fq 50%), *Erythrophleum chlorostachys* (fq 50%), *Hibbertia lepidota* (fq 50%), *Persoonia falcata* (fq 50%), *Petalostigma quadriloculare* (fq 50%), *Acacia dimidiata* (fq 25%), *Acacia gonocarpa* (fq 25%), *Acacia subternata* (fq 25%), *Breynia cernua* (fq 25%),



Carissa lanceolata (fq 25%), *Dolichandrone filiformis* (fq 25%), *Grevillea refracta* (fq 25%), *Helicteres cana* (fq 25%), *Jacksonia odontoclada* (fq 25%), *Stenocarpus acacioides* (fq 25%).

Ground: *Hibiscus leptocladus* (fq 50%), *Senna oligoclada* (fq 50%), *Whiteochloa arioides* (fq 50%), *Eulalia aurea* (fq 25%), *Fimbristylis squarrulosa* (fq 25%), *Grevillea dryandri* (fq 25%), *Hybanthus enneaspermus* (fq 25%), *Jacquemontia browniana* (fq 25%), *Jasminum molle* (fq 25%), *Oldenlandia mitrasacmoides* (fq 25%), *Polycarpaea spirostylis* (fq 25%), *Polymeria ambigua* (fq 25%), *Schizachyrium fragile* (fq 25%), *Sorghum plumosum* (fq 25%), *Tephrosia sp.crowded pinnae* (C.R.Dunlop 8202) (fq 25%), *Triodia procera* (fq 25%).

Landform: Simple slopes and flats

General Condition: There were no weed and few feral animal impacts detected during surveys in this vegetation type. This vegetation type seems to be subject to frequent fires of relatively high intensity. Most shrubs are either quick maturing obligate seeder species or they have a strong resprouting ability. It is likely that this vegetation type is adapted to a relatively high frequency of fires, but with longer time since fire the shrub layer increases in density and height.

Species of Conservation Significance: *Tephrosia sp. crowded pinnae* (C.R.Dunlop 8202)? (Not Evaluated).



Vegetation Type 9

Short Description: *Melaleuca viridiflora* Low Open Woodland

NVIS Code: T6r



Plate 18: Vegetation community site CB1

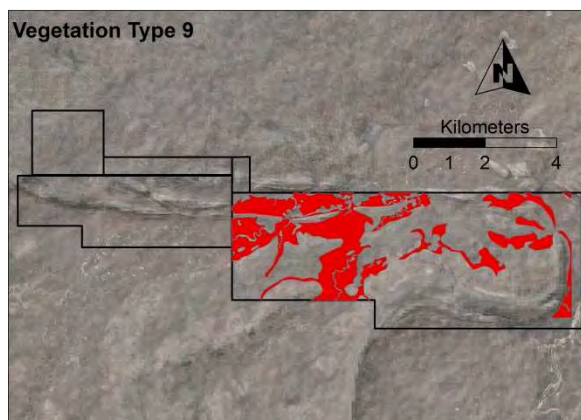


Plate 19. Distribution of the Vegetation Type

Area: 8.5 km² and 24% total surveyed area.

Survey Sites: CB1, 122 & 110

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	13 (5 - 20)	4.6 (2.5 - 7)	T6r
Mid	Shrub	21 (2 - 50)	2.5 (1 - 4)	S4i
Ground	Tussock Grass	70 (30 - 90)	0.5 (0 - 1)	G2c

NVIS Description: *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Grevillea striata*, *Bauhinia cunninghamii*, *Brachychiton diversifolius* Low Open Woodland over *Petalostigma banksii* +/- *Brachychiton paradoxus*, *Dolichandrone heterophylla*, *Hakea arborescens*, *Melaleuca citrolens* Tall Open Shrubland over *Alloteropsis semialata*, *Eulalia aurea*, *Chrysopogon fallax*, *Eriachne obtusa*, *Crinum uniflorum* Mid Tussock Grassland.

Upper: Low open woodland of *Melaleuca viridiflora* (fq 100%), *Asteromyrtus symphyocarpa* (fq 67%), *Grevillea striata* (fq 67%), *Bauhinia cunninghamii* (fq 33%), *Brachychiton diversifolius* (fq 33%).

Mid: Tall open shrubland of *Petalostigma banksii* (fq 100%), *Brachychiton paradoxus* (fq 33%), *Dolichandrone heterophylla* (fq 33%), *Hakea arborescens* (fq 33%), *Melaleuca citrolens* (fq 33%).

Ground: Mid tussock grassland of *Alloteropsis semialata* (fq 100%), *Eulalia aurea* (fq 100%), *Chrysopogon fallax* (fq 67%), *Eriachne obtusa* (fq 67%), *Crinum uniflorum* (fq 67%).

Other species:

Upper: no additional species

Mid: *Terminalia canescens* (fq 33%).

Ground: *Drosera fulva* (fq 67%), *Fimbristylis dichotoma* (fq 67%), *Polygala longifolia* (fq 67%), *Polygala sp.* (fq 67%), *Thecanthes punicea* (fq 67%), *Aristida hygrometrica* (fq 33%), *Bulbostylis barbata* (fq 33%), *Cartonema trigonospermum* (fq 33%), *Desmodium brownii* (fq 33%), *Desmodium trichostachyum* (fq 33%).



33%), *Dimeria ornithopoda* (fq 33%), *Drosera indica* (fq 33%), *Eriocaulon fistulosum* (fq 33%), *Evolvulus alsinoides* (fq 33%), *Fimbristylis pallida* (fq 33%), *Germainia truncatiglumis* (fq 33%), *Goodenia armstrongiana* (fq 33%), *Hybanthus enneaspermus* (fq 33%), *Lipocarpha microcephala* (fq 33%), *Murdannia graminea* (fq 33%), *Oldenlandia mitrasacmoides* (fq 33%), *Phyllanthus eutaxioides* (fq 33%), *Phyllanthus virgatus* (fq 33%), *Rhyncospora leae* (fq 33%), *Schizachyrium* sp.(fq 33%), *Scleria rugosa* (fq 33%), *Sorghum plumosum* (fq 33%), *Stackhousia intermedia* (fq 33%), *Utricularia chrysantha* (fq 33%), *Zornia muriculata* (fq 33%).

Landform: Flat and very gentle slopes.

General Condition: No weeds and very low signs of feral animals were detected in this vegetation type. Fire impacts were moderate to high due to the thick grass layer, although the dominant shrub and tree species are fire tolerant resprouters and are adapted to frequent fires.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.

Note: *Vegetation Type 10 was integrated into other types.*



Vegetation Type 11

Short Description: *Terminalia canescens* Tall Sparse Shrubland

NVIS Code: S4r



Plate 20: Vegetation community site V22b

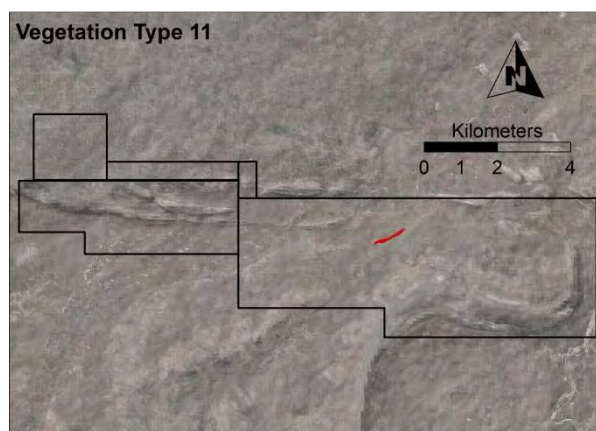


Plate 21. Distribution of the Vegetation Type

Area: 0.07 km² and 0.2% total surveyed area

Survey Sites: V22b

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Shrub	15 (15 - 15)	0.4 (0 - 0.5)	S4r
Mid	-	-	-	-
Ground	Tussock Grass	40 (40 - 40)	0.4 (0 - 0.5)	G1i

NVIS Description: *Terminalia canescens*, *Terminalia bursarina*, *Hakea arborescens* Tall Sparse Shrubland over *Alloteropsis semialata*, *Chrysopogon fallax*, *Pseudopogonatherum contortum*, *Schizachyrium fragile* Low Open Tussock Grassland.

Upper: Tall sparse shrubland of *Terminalia canescens* (fq 100%), *Eucalyptus pruinosa* (fq 100%), *Terminalia bursarina* (fq 100%), *Terminalia volucris* (fq 100%), *Hakea arborescens* (fq 100%), *Calytrix exstipulata* (fq 100%), *Dolichandrone filiformis* (fq 100%), *Flueggea virosa* (fq 100%).

Mid: The mid layer was indistinct and generally graded into the Upper.

Ground: Low open tussock grassland of *Alloteropsis semialata* (fq 100%), *Chrysopogon fallax* (fq 100%), *Pseudopogonatherum contortum* (fq 100%), *Schizachyrium fragile* (fq 100%), *Corchorus sidoides* (fq 100%).

Other Species:

Upper: no additional species.

Mid: *Helicteres cana* (fq 100%), *Margaritaria dubium-traceyi* (fq 100%), *Petalostigma banksii* (fq 100%), *Wrightia saligna* (fq 100%).

Ground: *Buchnera linearis* (fq 100%), *Evolvulus alsinoides* (fq 100%), *Hybanthus enneaspermus* (fq 100%), *Mnesithea formosa* (fq 100%), *Thaumastochloa striata* (fq 100%), *Thysanotus chinensis* (fq 100%), *Waltheria indica* (fq 100%), *Zornia muriculata* (fq 100%).



Landform: simple slope

General Condition: No weeds or feral animals were detected on the single site (V22b) for this vegetation type. Fire impacts were moderate.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 12

Short Description: *Eucalyptus tectifica* Mid Open Woodland.

NVIS Code: T7r



Plate 22: Vegetation community site CB7

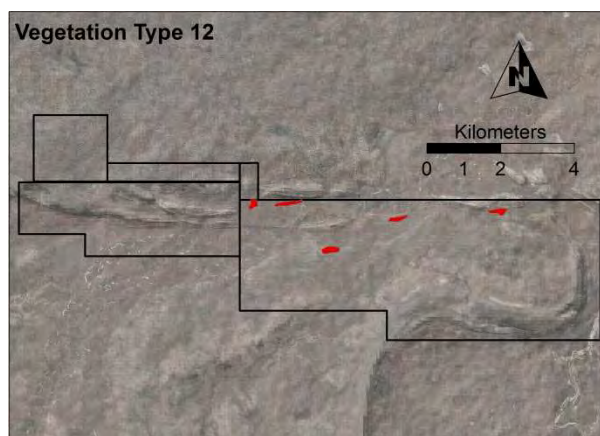


Plate 23. Distribution of the Vegetation Type

Area: 0.3 km² and 0.8% total surveyed area.

Survey Sites: CB7 (Reference site) & 108 & 109 (check sites)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	16 (15 - 18)	10 (6 - 14)	T7r
Mid	Shrub	1 (0 - 2)	1.1 (0 - 2)	S3r
Ground	Tussock Grass	86 (80 - 90)	0.7 (0.3 - 1)	G2d

NVIS Description: *Eucalyptus tectifica* Mid Open Woodland over *Carissa lanceolata* +/- *Flueggea virosa*, *Grewia retusifolia*, *Maytenus cunninghamii*, *Petalostigma banksii* Mid Isolated Shrubs over *Chrysopogon fallax*, *Eulalia aurea*, *Sorghum plumosum* +/- *Alloteropsis semialata*, *Fimbristylis dichotoma* Mid Closed Tussock Grassland.

Upper: Mid open woodland *Eucalyptus tectifica* (fq 100%).

Mid: Mid isolated shrubs of *Carissa lanceolata* (fq 100%), *Flueggea virosa* (fq 67%), *Grewia retusifolia* (fq 67%), *Maytenus cunninghamii* (fq 67%), *Petalostigma banksii* (fq 67%).

Ground: Mid closed tussock grassland *Chrysopogon fallax* (fq 100%), *Eulalia aurea* (fq 100%), *Sorghum plumosum* (fq 100%), *Alloteropsis semialata* (fq 67%), *Fimbristylis dichotoma* (fq 67%).

Other Species:

Upper: no additional species.

Mid: *Terminalia canescens* (fq 67%), *Hakea lorea* (fq 33%), *Acacia drepanocarpa* (fq 33%), *Acacia umbellata* (fq 33%), *Antidesma ghesaembilla* (fq 33%), *Breynia cernua* (fq 33%), *Dodonaea physocarpa* (fq 33%), *Dolichandrone heterophylla* (fq 33%), *Ehretia saligna* (fq 33%), *Grevillea striata* (fq 33%), *Hakea arborescens* (fq 33%), *Helicteres cana* (fq 33%), *Melaleuca viridiflora* (fq 33%), *Santalum lanceolatum* (fq 33%), *Wrightia saligna* (fq 33%).



Ground: *Polygala longifolia* (fq 67%), *Murdannia graminea* (fq 67%), *Aristida holathera* (fq 33%), *Calandrinia uniflora* (fq 33%), *Cyperus holoschoenus* (fq 33%), *Evolvulus alsinoides* (fq 33%), *Glycine tomentella* (fq 33%), *Heteropogon contortus* (fq 33%), *Hybanthus enneaspermus* (fq 33%), *Marsdenia viridiflora* (fq 33%), *Pseudopogonatherum contortum* (fq 33%), *Sehima nervosa* (fq 33%), *Striga curviflora* (fq 33%), *Themeda triandra* (fq 33%), *Uraria lagopodioides* (fq 33%), *Vigna lanceolata* (fq 33%).

Landform: Flats and simple slopes.

General Condition: There were few signs of feral animals and no weeds on this vegetation type. The thick grass layer ensures that the fire intensity is high in this vegetation type and the shrub cover is very low in response to this. The shrub species present are fire tolerant resprouters.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 13

Short Description: *Excoecaria parvifolia* and *Melaleuca citrolens* Low Woodland.

NVIS Code: T6i



Plate 24: Vegetation community site 22b

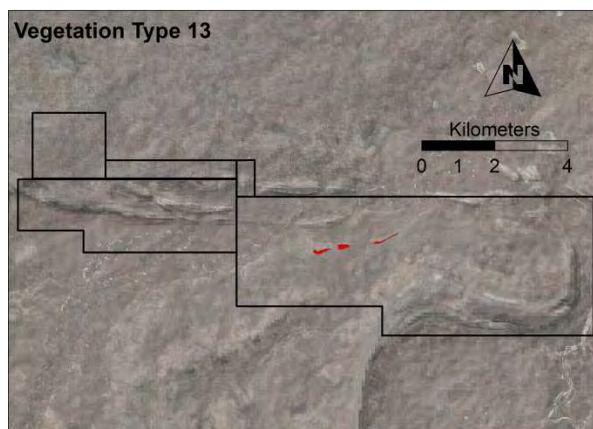


Plate 25. Distribution of the Vegetation Type

Area: 0.3 km² and 0.3% total surveyed area.

Survey Sites: V22a & 122

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	30 (20 - 40)	5.5 (4 - 7)	T6i
Mid	Shrub	13 (7 - 20)	2.5 (0.7 - 4)	S4r
Ground	Tussock Grass	67 (60 - 75)	0.6 (0 - 1)	G2c

NVIS Description: *Excoecaria parvifolia*, *Melaleuca citrolens* +/- *Eucalyptus pruinosa*, *Terminalia bursarina* Low Woodland over *Acacia umbellata* +/- *Sarcostemma viminale*, *Terminalia volucris*, *Acacia gonoclada*, *Carissa lanceolata* Tall Sparse Shrubland over *Eulalia aurea*, *Aristida latifolia*, *Chrysopogon fallax*, *Sorghum plumosum*, *Neptunia dimorphantha* Mid Tussock Grassland.

Upper: Low woodland of *Excoecaria parvifolia* (fq 100%), *Melaleuca citrolens* (fq 100%), *Eucalyptus pruinosa* (fq 50%), *Terminalia bursarina* (fq 50%).

Mid: Tall sparse shrubland of *Acacia umbellata* (fq 100%), *Terminalia volucris* (fq 50%), *Acacia gonoclada* (fq 50%), *Sarcostemma viminale* (fq 50%), *Carissa lanceolata* (fq 50%).

Ground: Mid tussock grassland of *Eulalia aurea* (fq 100%), *Aristida latifolia* (fq 100%), *Chrysopogon fallax* (fq 100%), *Sorghum plumosum* (fq 100%), *Neptunia dimorphantha* (fq 100%).

Other Species:

Upper: no additional species.

Mid: *Acacia galioides* (fq 50%), *Acacia shirleyi* (fq 50%), *Breynia cernua* (fq 50%), *Dichrostachys spicata* (fq 50%), *Dodonaea lanceolata* (fq 50%), *Dolichandrone heterophylla* (fq 50%), *Ehretia saligna* (fq 50%), *Flueggea virosa* (fq 50%), *Grewia retusifolia* (fq 50%), *Petalostigma banksii* (fq 50%), *Strychnos lucida* (fq 50%), *Terminalia canescens* (fq 50%), *Uraria lagopodioides* (fq 50%), *Waltheria indica* (fq 50%).



Ground: *Ammannia multiflora* (fq 100%) , *Corchorus sidoides* (fq 100%), *Rostellularia adscendens* (fq 100%), *Abutilon leucopetalum* (fq 50%), *Alternanthera angustifolia* (fq 50%), *Corchorus tridens* (fq 50%), *Cyanotis axillaris* (fq 50%), *Cyperus holoschoenus* (fq 50%), *Desmodium brownii* (fq 50%), *Digitaria ctenantha* (fq 50%), *Elytrophorus spicatus* (fq 50%), *Eragrostis tenellula* (fq 50%), *Fimbristylis microcarya* (fq 50%), *Fimbristylis phaeoleuca* (fq 50%), *Glycine tomentella* (fq 50%), *Hydrolea zeylanica* (fq 50%), *Hygrophila angustifolia* (fq 50%), *Ipomoea coptica* (fq 50%), *Jacquemontia paniculata* (fq 50%), *Melhania oblongifolia* (fq 50%), *Murdannia graminea* (fq 50%), *Oldenlandia galioides* (fq 50%), *Phyllanthus virgatus* (fq 50%), *Rhynchosia minima* (fq 50%), *Rotala diandra* (fq 50%), *Sehima nervosa* (fq 50%), *Uraria lagopodioides* (fq 50%), *Waltheria indica* (fq 50%).

Landform: Depressions adjacent to low rises.

General Condition: No weeds were present on this vegetation type but there were some low impacts from Donkeys. This vegetation type was adjacent to natural fire breaks or contained scattered rock piles. Consequently one of the sites had a relatively high cover of the fire sensitive shrub *Sarcostemma viminalis*. Observed fire impacts were low.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 14

Short Description: *Eucalyptus camaldulensis* Low Open Woodland

NVIS Code: T6r



Plate 26: Vegetation community site F10

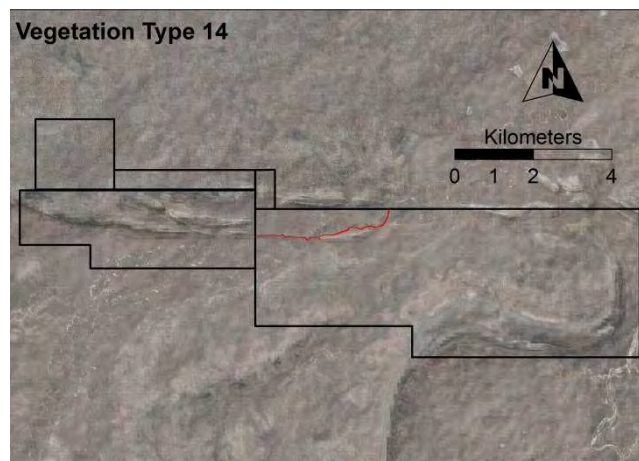


Plate 27. Distribution of the Vegetation Type

Area: 0.09km² and 0.3% total surveyed area.

Survey Sites: F11, F10 (reference sites) & 62 (check site)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	7 (5 - 10)	7 (5 - 10)	T6r
Mid	Shrub	4 (3 - 5)	1.6 (1 - 5)	S3r
Ground	Tussock Grass	30 (20 - 50)	0.3 (0 - 1)	G1i

NVIS Description: *Eucalyptus camaldulensis*, *Corymbia polycarpa* +/- *Melaleuca nervosa*, *Melaleuca viridiflora* Low Open Woodland over *Acacia holosericea*, *Acacia tropica*, *Asteromyrtus symphyocarpa*, *Grevillea pteridifolia* +/- *Acacia drepanocarpa* Mid Isolated Shrubs over *Chrysopogon fallax*, *Waltheria indica* +/- *Aristida holathera*, *Zornia prostrata*, *Pseudoraphis spinescens* Low Open Tussock Grassland.

Upper: Low open woodland of *Eucalyptus camaldulensis* (fq 100%), *Corymbia polycarpa* (fq 67%), *Melaleuca nervosa* (fq 67%), *Melaleuca viridiflora* (fq 67%).

Mid: Mid Isolated shrubs of *Acacia holosericea* (fq 100%), *Acacia tropica* (fq 100%), *Asteromyrtus symphyocarpa* (fq 100%), *Grevillea pteridifolia* (fq 100%), *Acacia drepanocarpa* (fq 67%).

Ground: Low open tussock grassland of *Chrysopogon fallax* (fq 100%), *Waltheria indica* (fq 100%), *Aristida holathera* (fq 67%), *Zornia prostrata* (fq 67%), *Pseudoraphis spinescens* (fq 33%).

Other Species:

Upper: no additional species.

Mid: *Acacia platycarpa* (fq 67%), *Brachychiton paradoxus* (fq 67%), *Antidesma ghesaembilla* (fq 33%), *Breynia cernua* (fq 33%), *Cayratia trifolia* (fq 33%), *Ehretia saligna* (fq 33%), *Marsdenia viridiflora* (fq 33%), *Petalostigma banksii* (fq 33%), *Premna acuminata* (fq 33%), *Santalum lanceolatum* (fq 33%), *Terminalia volucris* (fq 33%), *Tinospora smilacina* (fq 33%), *Wrightia saligna* (fq 33%).



Ground: *Alloteropsis semialata* (fq 33%), *Bonamia media* (fq 33%), *Cassytha filiformis* (fq 33%), *Chamaecrista mimosoides* (fq 33%), *Crotalaria montana* (fq 33%), *Desmodium brownii* (fq 33%), *Eriachne obtusa* (fq 33%), *Eulalia aurea* (fq 33%), *Fimbristylis squarrosa* (fq 33%), *Hybanthus enneaspermus* (fq 33%), *Ipomoea eriocarpa* (fq 33%), *Jasminum molle* (fq 33%), *Lechenaultia filiformis* (fq 33%), *Melochia corchorifolia* (fq 33%), *Mnesithea formosa* (fq 33%), *Paspalum scrobiculatum* (fq 33%), *Polygala stenoclada* (fq 33%), *Pseudoraphis spinescens* (fq 33%), *Spermacoce stenophylla* (fq 33%), *Thaumastochloa major* (fq 33%), *Whiteochloa capillipes* (fq 33%).

Landform: Drainage systems usually adjacent to alluvial flats. The creeks are often very steep-sided.

General Condition: The Impacts of Pigs and Donkeys on this vegetation type were low to moderate in some cases. Weeds were absent. Fire impacts were variable and often only affected part of the riparian zone. Shrub and ground cover were lower than might be expected due to the creek channels being bare or having open water. Erosion was often quite active on the banks of these creeks, which were often sheer.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 15

Short Description: *Eucalyptus tetrodonta* and *Erythrophleum chlorostachys* Mid Open Woodland

NVIS Code: T7r



Plate 28: Vegetation community site F14

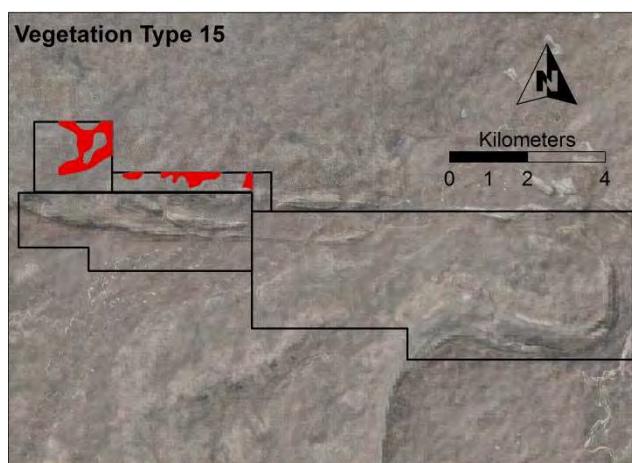


Plate 29. Distribution of the Vegetation Type

Area: 1.4 km² and 4% total surveyed area.

Survey Sites: F14 (reference) (68 & 67 check sites)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	22 (15 - 35)	11.8 (8 - 18)	T7r
Mid	Shrub	6 (2 - 13)	2.7 (1.5 - 10)	S4r
Ground	Tussock Grass	47 (30 - 63)	0.5 (0.3 - 1.1)	G2i

NVIS Description: *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* +/- *Corymbia polycarpa*, *Corymbia ferruginea* Mid Open Woodland over *Erythrophleum chlorostachys*, *Eucalyptus tetrodonta*, *Alphitonia pomaderroides*, *Dolichandrone heterophylla*, *Ehretia saligna* Tall Sparse Shrubland over *Sorghum plumosum*, *Eriachne obtusa*, *Whiteochloa arioides*, *Corchorus sidoides*, *Evolvulus alsinoides*, *Glycine tomentella* Mid Open Tussock Grassland.

Upper: Mid open woodland of *Eucalyptus tetrodonta* (fq 100%), *Erythrophleum chlorostachys* (fq 100%), *Corymbia polycarpa* (fq 50%), *Corymbia ferruginea* (fq 33%).

Mid: Tall sparse shrubland of *Erythrophleum chlorostachys* (fq 100%), *Eucalyptus tetrodonta* (fq 100%), *Alphitonia pomaderroides* (fq 100%), *Dolichandrone heterophylla* (fq 100%), *Ehretia saligna* (fq 100%).

Ground: Mid open tussock grassland of *Sorghum plumosum* (fq 100%), *Eriachne obtusa* (fq 100%), *Whiteochloa arioides* (fq 100%), *Corchorus sidoides* (fq 100%), *Evolvulus alsinoides* (fq 100%), *Glycine tomentella* (fq 100%).

Other Species:

Upper: no additional species.

Mid: *Premna acuminata* (fq 100%), *Acacia conspersa* (fq 67%), *Acacia galioides* (fq 67%), *Brachychiton paradoxus* (fq 67%), *Clerodendrum floribundum* (fq 67%), *Grewia retusifolia* (fq 67%), *Maytenus*



cunninghamii (fq 67%), *Grevillea parallela* (fq 33%), *Grevillea refracta* (fq 33%), *Helicteres integrifolia* (fq 33%), *Margaritaria dubium-traceyi* (fq 33%), *Petalostigma banksii* (fq 33%), *Wrightia saligna* (fq 33%).

Ground: *Jasminum molle* (fq 100%), *Aristida holathera* (fq 67%), *Hibiscus leptocladus* (fq 67%), *Hybanthus enneaspermus* (fq 67%), *Phyllanthus carpentariae* (fq 67%), *Scleria brownii* (fq 67%), *Senna oligoclada* (fq 67%), *Tephrosia leptoclada* (fq 67%), *Tribulopsis pentandra* (fq 67%), *Uraria lagopodioides* (fq 67%), *Vigna lanceolata* (fq 67%), *Crotalaria brevis* (fq 50%), *Diplatia furcata* (fq 50%), *Distichostemon hispidulus* (fq 50%), *Acacia difficilis* (fq 33%), *Acacia drepanocarpa* (fq 33%), *Boronia lanuginosa* (fq 33%), *Brachychiton diversifolius* (fq 33%), *Breynia cernua* (fq 33%), *Cajanus geminatus* (fq 33%), *Cassytha filiformis* (fq 33%), *Heteropogon contortus* (fq 33%), *Hibbertia lepidota* (fq 33%), *Jacquemontia browniana* (fq 33%), *Murdannia graminea* (fq 33%), *Phyllanthus exilis* (fq 33%), *Polygala stenoclada* (fq 33%), *Polymeria ambigua* (fq 33%), *Stackhousia intermedia* (fq 33%), *Striga curviflora* (fq 33%), *Triodia bitextura* (fq 33%), *Waltheria indica* (fq 33%), *Yakirra majuscula* (fq 33%), *Zornia muriculata* (fq 33%).

Landform: Flats and slight depressions on gently undulating plains.

General Condition: The impact of feral animals was low to absent and weeds were absent on this vegetation type. Fire impacts were low in intensity but affected all of the quadrat area. Shrub species were confined to resprouters or fast growing obligate seeders like *Acacia galioides*. This vegetation type lacks the heath species which can be found on the surrounding Vegetation type 8 which may be due to more fertile soils or a higher fire frequency associated with the thick perennial grass cover.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 16

Short Description: *Melaleuca viridiflora* and *Petalostigma banksii* Low Open Woodland

NVIS Code: T6r



Plate 30: Vegetation community site 56

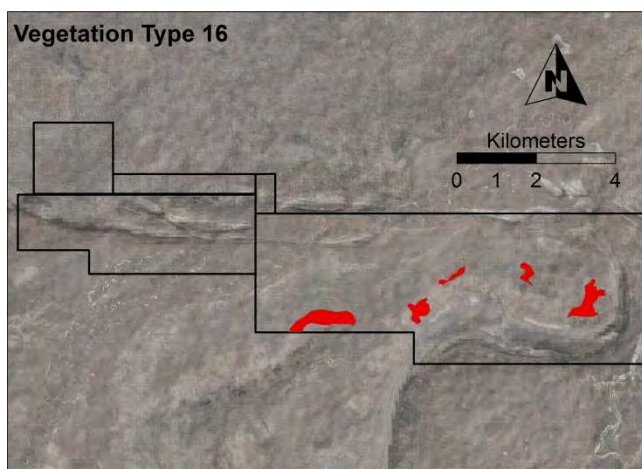


Plate 31. Distribution of the Vegetation Type

Area: 1.3 km² and 3.5% total surveyed area.

Survey Sites: 56, 64 & 119 (Check sites)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	5 (5 - 5)	5 (3 - 6)	T6r
Mid	Shrub	12 (2 - 20)	2.4 (1 - 6)	S4r
Ground	Hummock Grass	36 (15 - 65)	0.5 (0 - 1)	H2i

NVIS Description: *Melaleuca viridiflora*, *Terminalia canescens* +/- *Corymbia polycarpa*, *Eucalyptus pruinosa* Low Open Woodland over *Petalostigma banksii*, *Helicteres cana* +/- *Acacia galioides*, *Melaleuca citrolens*, *Acacia conspersa* Tall Isolated Shrubs over *Alloteropsis semialata*, *Grevillea dryandri*, *Merremia incisa*, *Oldenlandia mitrasacmoides* +/- *Triodia procera* Mid Open Hummock Grassland.

Upper: Low open woodland *Melaleuca viridiflora* (fq 100%), *Terminalia canescens* (fq 100%), *Corymbia polycarpa* (fq 33%), *Eucalyptus pruinosa* (fq 33%).

Mid: Tall isolated shrubs of *Petalostigma banksii* (fq 100%), *Helicteres cana* (fq 100%), *Acacia galioides* (fq 67%), *Melaleuca citrolens* (fq 67%), *Acacia conspersa* (fq 33%).

Ground: Mid open hummock grassland *Alloteropsis semialata* (fq 100%), *Grevillea dryandri* (fq 100%), *Merremia incisa* (fq 100%), *Oldenlandia mitrasacmoides* (fq 100%), *Triodia procera* (fq 67%).

Other Species:

Upper: no additional species.

Mid: *Eulalia aurea* (fq 67%), *Brachychiton diversifolius* (fq 33%), *Capparis umbonata* (fq 33%), *Cochlospermum gregorii* (fq 33%), *Grevillea parallela* (fq 33%), *Hibbertia lepidota* (fq 33%), *Jacksonia odontoclada* (fq 33%), *Maytenus cunninghamii* (fq 33%), *Mirbelia viminalis* (fq 33%), *Wrightia saligna* (fq 33%).



Ground: *Bulbostylis barbata* (fq 67%), *Cheilanthes nitida* (fq 67%), *Corchorus sidoides* (fq 67%), *Drosera fulva* (fq 67%), *Heliotropium* sp.(fq 67%), *Murdannia graminea* (fq 67%), *Stackhousia intermedia* (fq 67%), *Eriachne ciliata* (fq 33%), *Fimbristylis dichotoma* (fq 33%), *Fimbristylis modesta* (fq 33%), *Gonocarpus leptothecus* (fq 33%), *Goodenia armstrongiana* (fq 33%), *Hibiscus leptocladus* (fq 33%), *Hybanthus enneaspermus* (fq 33%), *Indigastrium parviflorum* (fq 33%), *Ipomoea eriocarpa* (fq 33%), *Mitrasacme connata* (fq 33%), *Polygala longifolia* (fq 33%), *Polymeria ambigua* (fq 33%), *Scleria brownii* (fq 33%), *Sorghum plumosum* (fq 33%), *Tephrosia leptoclada* (fq 33%), *Triodia bitextura* (fq 33%).

Landform: Simple slopes and very low rises adjacent to wetter *Melaleuca viridiflora* plains.

General Condition: Weeds and feral animals were not detected in this vegetation type. Impact of fire was moderate to high due to the hummock grass ground layer which gives rise to intense fires.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 17

Short Description: *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Psydrax paludosa* Low Open Woodland

NVIS Code: T6r



Plate 32: Vegetation community site 45

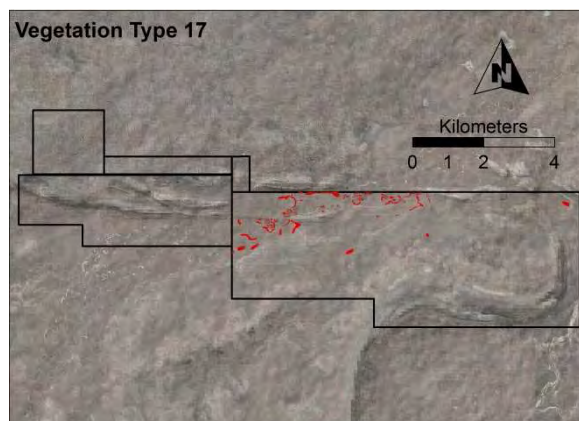


Plate 33. Distribution of the Vegetation Type

Area: 0.45km² and 1.3% total surveyed area.

Survey Sites: 37, 45, 57, 112 & 116 check sites

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	12 (10 - 15)	6.2 (2 - 14)	T6r
Mid	Shrub	21 (15 - 30)	2.2 (1 - 4)	S4c
Ground	Tussock Grass	55 (10 - 105)	0.5 (0 - 1.3)	G1c

NVIS Description: *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Psydrax paludosa* Low Woodland over *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Psydrax paludosa* Tall Shrubland over +/- *Cyperus holoschoenus*, *Pseudoraphis spinescens*, *Commelina agrostophylla*, *Eragrostis fallax*, *Eulalia aurea* Low Tussock Grassland.

Upper: Low open woodland *Melaleuca viridiflora* (fq 100%), *Asteromyrtus symphyocarpa* (fq 60%), *Psydrax paludosa* (fq 60%).

Mid: Tall shrubland of *Melaleuca viridiflora* (fq 100%), *Asteromyrtus symphyocarpa* (fq 60%), *Psydrax paludosa* (fq 60%).

Ground: Low tussock grassland *Cyperus holoschoenus* (fq 80%), *Pseudoraphis spinescens* (fq 80%), *Commelina agrostophylla* (fq 40%), *Eragrostis fallax* (fq 40%), *Eulalia aurea* (fq 40%).

Other Species:

Upper: *Corymbia polycarpa* (fq 20%), *Eucalyptus camaldulensis* (fq 20%), *Eucalyptus microtheca* (fq 20%).

Mid: *Acacia holosericea* (fq 20%), *Antidesma ghesaembilla* (fq 20%).

Ground: *Fimbristylis sp. Darwin A23005* (fq 40%), *Myriophyllum sp.* (fq 40%), *Nelsonia campestris* (fq 40%), *Chamaecrista mimosoides* (fq 20%), *Chrysopogon fallax* (fq 20%), *Crotalaria montana* (fq 20%),



Desmodium brownii (fq 20%), *Desmodium trichostachyum*, *Fimbristylis dolera* (fq 20%), *Fimbristylis macassarensis* (fq 20%), *Fimbristylis miliacea* (fq 20%), *Fimbristylis simplex* (fq 20%), *Drosera burmanni* (fq 20%), *Drosera indica* (fq 20%), *Hygrochloa cravennii* (fq 20%), *Ischaemum australe* (fq 20%), *Lipocarpa microcephala* (fq 20%), *Melochia corchorifolia* (fq 20%), *Nymphaea violacea* (fq 20%), *Ophioglossum costatum* (fq 20%), *Potamogeton tricarinatus* (fq 20%), *Vallisneria rubra* (fq 20%).

Landform: Depressions on alluvial plains and adjacent to drainage systems.

General Condition: Feral animal impacts were low to absent and weeds were absent. Fire impacts were generally low due to the lack of fuel in most swamps and billabongs when they dried out. However sites with *Ischaemum australe* (a native grass with high biomass) had high impacts with crown scorch and reduced canopy and shrub layer.

Species of Conservation Significance: *Fimbristylis dolera* (Data Deficient) and *Psydrax Paludosa* (Data Deficient).



Vegetation Type 18

Short Description: *Melaleuca viridiflora* and *Asteromyrtus symphyocarpa* +/- *Melaleuca citrolens* Low Woodland

NVIS Code: T6i



Plate 34: Vegetation community site F6

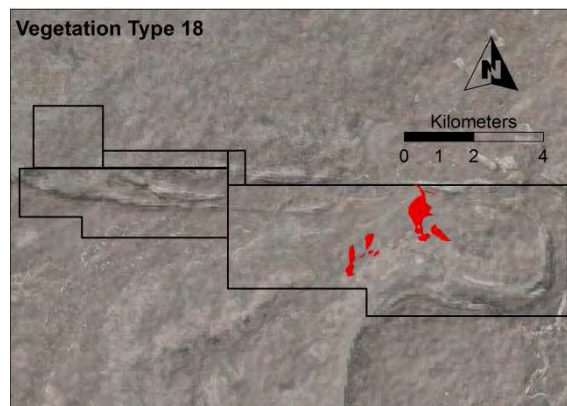


Plate 35. Distribution of the Vegetation Type

Area: 0.75km² and 2% total surveyed area.

Survey Sites: F6 (reference site) & 120 & 96 (check sites)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	21 (10 - 30)	5.3 (4 - 10)	T6i
Mid	Shrub	7 (3 - 10)	3 (1 - 5)	S4r
Ground	Tussock Grass	84 (80 - 90)	0.4 (0 - 1)	G1d

NVIS Description: *Asteromyrtus symphyocarpa*, *Melaleuca viridiflora* +/- *Melaleuca citrolens*, *Corymbia polycarpa* Low Woodland over *Petalostigma banksii* +/- *Acacia holosericea*, *Cochlospermum fraseri* Tall Sparse Shrubland over +/- *Alloteropsis semialata*, *Chrysopogon fallax*, *Fimbristylis simplex*, *Drosera indica*, *Eriachne obtusa* Low Closed Tussock Grassland.

Upper: *Asteromyrtus symphyocarpa* (fq 100%), *Melaleuca viridiflora* (fq 100%), *Melaleuca citrolens* (fq 67%), *Corymbia polycarpa* (fq 33%).

Mid: *Petalostigma banksii* (fq 100%), *Acacia holosericea* (fq 33%), *Cochlospermum fraseri* (fq 33%).

Ground: *Alloteropsis semialata* (fq 67%), *Chrysopogon fallax* (fq 67%), *Fimbristylis simplex* (fq 67%), *Drosera indica* (fq 67%), *Eriachne obtusa* (fq 67%).

Other Species:

Upper: no additional species.

Mid: no additional species.

Ground: *Fimbristylis macassarensis* (fq 67%), *Utricularia limosa* (fq 67%), *Cartonema trigonospermum* (fq 33%), *Cyperus castaneus* (fq 33%), *Desmodium trichostachyum* (fq 33%), *Drosera fulva* (fq 33%), *Ectrosia sp.* (fq 33%), *Eriocaulon fistulosum* (fq 33%), *Eriocaulon spectabile* (fq 33%), *Fimbristylis dictyocolea* (fq 33%), *Fimbristylis dolera* (fq 33%), *Fimbristylis littoralis* (fq 33%), *Fimbristylis modesta* (fq 33%), *Hypoxis nervosa* (fq 33%), *Ischaemum australe* (fq 33%), *Lindernia subulata* (fq 33%), *Murdannia*



graminea (fq 33%), *Nesaea muelleri* (fq 33%), *Nymphoides exiliflora* (fq 33%), *Ophioglossum gramineum* (fq 33%), *Rhyncospora leae* (fq 33%), *Rotala diandra* (fq 33%), *Scleria laxa* (fq 33%), *Scleria rugosa* (fq 33%), *Trithuria lanterna* (fq 33%), *Utricularia chrysantha* (fq 33%), *Utricularia minutissima* (fq 33%), *Utricularia* sp.affin. *fistulosa* (fq 33%), *Xyris indica* (fq 33%).

Landform: Flats and slight depressions that are part of diffuse and shallow surface drainage systems.

General Condition: Weeds were absent from this vegetation type and impacts of feral animals were low. Fire impacts were low due to the sparse ground layer. One site (96) was possibly being affected by ground water discharge from a drilling hole (wetter than usual).

Species of Conservation Significance: *Ophioglossum gramineum* (Near Threatened), *Nymphoides exiliflora* (Data Deficient), *Fimbristylis dolera* (Data Deficient) and *Utricularia* sp.affin. *Fistulosa* (Data Deficient) – only one record for this undescribed species; probably a short range endemic (Cowie, pers comm.).



Vegetation Type 19

Short Description: *Melaleuca viridiflora* +/- *Eucalyptus microtheca* Low Open Woodland

NVIS Code: T6r



Plate 36: Vegetation community site 113

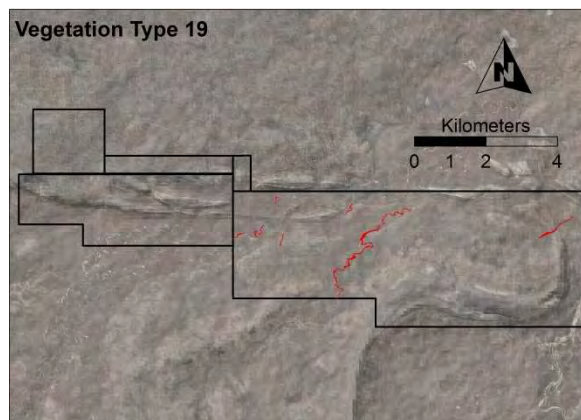


Plate 37. Distribution of the Vegetation Type

Area: 0.21km² and 0.6% total surveyed area.

Survey Sites: 42, 44 & 113 (check sites)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	9 (1 - 15)	6.5 (5 - 8)	T6r
Mid	Shrub	4 (3 - 5)	2.7 (1 - 5)	S4r
Ground	Tussock Grass	85 (65 - 100)	0.4 (0.2 - 1)	G1d

NVIS Description: *Melaleuca viridiflora* +/- *Eucalyptus microtheca*, *Eucalyptus camaldulensis* Low Open Woodland over +/- *Acacia holosericea*, *Asteromyrtus symphyocarpa*, *Melaleuca citrolens*, *Antidesma ghesaembilla*, *Breynia cernua* Tall isolated shrubs over *Chrysopogon fallax*, *Eulalia aurea*, *Melochia corchorifolia*, *Pseudoraphis spinescens* +/- *Commelina agrostophylla* Low Closed Tussock Grassland.

Upper: Low open woodland *Melaleuca viridiflora* (fq 100%), *Eucalyptus microtheca* (fq 67%), *Eucalyptus camaldulensis* (fq 33%).

Mid: Tall isolated shrubs *Acacia holosericea* (fq 67%), *Asteromyrtus symphyocarpa* (fq 67%) *Melaleuca citrolens* (fq 67%), *Antidesma ghesaembilla* (fq 33%), *Breynia cernua* (fq 33%).

Ground: Low closed tussock grassland *Chrysopogon fallax* (fq 100%), *Eulalia aurea* (fq 100%), *Melochia corchorifolia* (fq 100%), *Pseudoraphis spinescens* (fq 100%), *Commelina agrostophylla* (fq 67%).

Other Species:

Upper: no additional species.

Mid: *Flueggea virosa* (fq 33%), *Grevillea striata* (fq 33%), *Petalostigma banksii* (fq 33%), *Psydrax paludosa* (fq 33%).

Ground: *Chamaecrista mimosoides* (fq 67%), *Crinum uniflorum* (fq 67%), *Crotalaria montana* (fq 67%), *Desmodium trichostachyum* (fq 67%), *Fimbristylis dichotoma* (fq 67%), *Lipocarpa microcephala* (fq 67%), *Phyllanthus amarus* (fq 67%), *Calandrinia gracilis* (fq 33%), *Cassytha capillaris* (fq 33%), *Cayratia*



trifolia (fq 33%), *Cyperus holoschoenus* (fq 33%), *Desmodium brownii* (fq 33%), *Eragrostis fallax* (fq 33%), *Eriachne obtusa* (fq 33%), *Evolvulus alsinoides* (fq 33%), *Fimbristylis cinnamometorum* (fq 33%), *Fimbristylis depauperata* (fq 33%), *Fimbristylis miliacea* (fq 33%), *Goodenia pilosa* (fq 33%), *Hybanthus enneaspermus* (fq 33%), *Hygrophila angustifolia* (fq 33%), *Ipomoea coptica* (fq 33%), *Ludwigia octalvis* (fq 33%), *Murdannia graminea* (fq 33%), *Nelsonia campestris* (fq 33%), *Nymphoides exiliflora* (fq 33%), *Ophioglossum reticulatum* (fq 33%), *Paspalidium rarum* (fq 33%), *Polygala longifolia* (fq 33%), *Portulaca filifolia* (fq 33%), *Scleria rugosa* (fq 33%), *Stackhousia intermedia* (fq 33%), *Urochloa subquadriparia* (fq 33%), *Vigna lanceolata* (fq 33%), *Waltheria indica* (fq 33%).

Landform: Minor drainage systems within alluvial plains.

General Condition: Weeds were absent and feral animal impacts were low to moderate with pig impacts being more common than donkey. Fire impacts varied from low to high.

Species of Conservation Significance: *Nymphoides exiliflora* (Data Deficient) and *Psydrax paludosa* (Data Deficient).



Vegetation Type 20

Short Description: *Melaleuca nervosa*, *Melaleuca viridiflora*, *Asteromyrtus symphyocarpa* +/- *Grevillea pteridifolia* Low Open Woodland.

NVIS Code: T6r



Plate 38: Vegetation community site 38

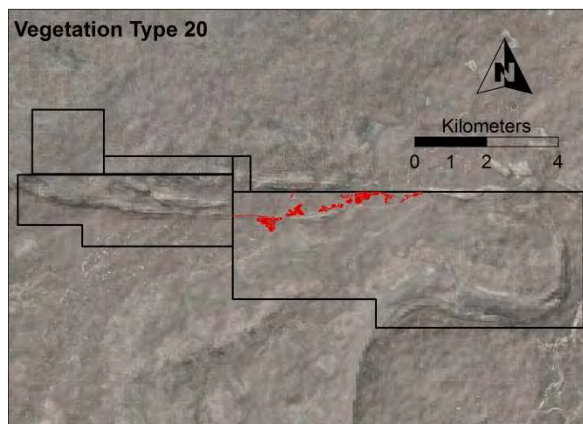


Plate 39. Distribution of the Vegetation Type

Area: 0.5 km² and 1.4% total surveyed area.

Survey Sites: 38,111 & 115 (check sites)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	11 (5 - 15)	6 (5 - 7)	T6r
Mid	Shrub	23 (4 - 55)	2.5 (1 - 5)	S4c
Ground	Tussock Grass	86 (80 - 100)	0.6 (0.3 - 1)	G2d

NVIS Description: *Melaleuca nervosa*, *Melaleuca viridiflora* +/- *Corymbia polycarpa* Low Open Woodland over *Acacia holosericea*, *Alphitonia pomaderroides*, *Asteromyrtus symphyocarpa* +/- *Acacia tropica*, *Grevillea pteridifolia* Tall Shrubland over *Eulalia aurea* +/- *Aristida holathera*, *Chrysopogon fallax*, *Chrysopogon latifolius*, *Desmodium brownii* Mid Closed Tussock Grassland.

Upper: Low open woodland of *Melaleuca nervosa* (fq 100%), *Melaleuca viridiflora* (fq 100%), *Corymbia polycarpa* (fq 67%).

Mid: Tall Shrubland of *Acacia holosericea* (fq 100%), *Alphitonia pomaderroides* (fq 100%), *Asteromyrtus symphyocarpa* (fq 100%), *Acacia tropica* (fq 67%), *Grevillea pteridifolia* (fq 67%).

Ground: Mid closed tussock grassland of *Eulalia aurea* (fq 100%), *Aristida holathera* (fq 67%), *Chrysopogon fallax* (fq 67%), *Chrysopogon latifolius* (fq 67%), *Desmodium brownii* (fq 67%).

Other Species:

Upper: no additional species.

Mid: *Cayratia trifolia* (fq 67%), *Antidesma ghesaembilla* (fq 33%), *Carissa lanceolata* (fq 33%), *Flueggea virosa* (fq 33%), *Margaritaria dubium-traceyi* (fq 33%), *Petalostigma banksii* (fq 33%).

Ground: *Crotalaria montana* (fq 67%), *Desmodium trichostachyum* (fq 67%), *Drosera fulva* (fq 67%), *Eriachne obtusa* (fq 67%), *Euphorbia vachellii* (fq 67%), *Evolvulus alsinoides* (fq 67%), *Lipocarpha*



microcephala (fq 67%), *Melochia corchorifolia* (fq 67%), *Murdannia graminea* (fq 67%), *Whiteochloa capillipes* (fq 67%), *Alloteropsis semialata* (fq 33%), *Bulbostylis barbata* (fq 33%), *Cassythra capillaris* (fq 33%), *Chamaecrista mimosoides* (fq 33%), *Crinum uniflorum* (fq 33%), *Digitaria ctenantha* (fq 33%), *Fimbristylis dichotoma* (fq 33%), *Gonocarpus leptothecus* (fq 33%), *Hybanthus enneaspermus* (fq 33%), *Ipomoea eriocarpa* (fq 33%), *Lechenaultia filiformis* (fq 33%), *Merremia incisa* (fq 33%), *Mnesithea formosa* (fq 33%), *Oldenlandia mitrasacmoides* (fq 33%), *Paspalidium rarum* (fq 33%), *Phyllanthus amarus* (fq 33%), *Polygala stenoclada* (fq 33%), *Setaria surgens* (fq 33%), *Stackhousia intermedia* (fq 33%), *Striga curviflora* (fq 33%), *Tribulopsis pentandra* (fq 33%), *Vigna lanceolata* (fq 33%), *Waltheria indica* (fq 33%), *Xenostegia tridentata* (fq 33%).

Landform: Alluvial flats and river levees.

General Condition: Feral animal impacts were low and weed impacts absent. Fire impacts were absent to high depending on the time since last fire. Recent fire removed much of the mid layer shrubs such as *Acacia tropica* and *Acacia holosericea*, which on unburned sites achieved a cover greater than 50%. Ground biomass was also much sparser following recent fires.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Vegetation Type 21

Short Description: *Corymbia polycarpa* Mid Open Woodland.

NVIS Code: T7r



Plate 40: Vegetation community site 46

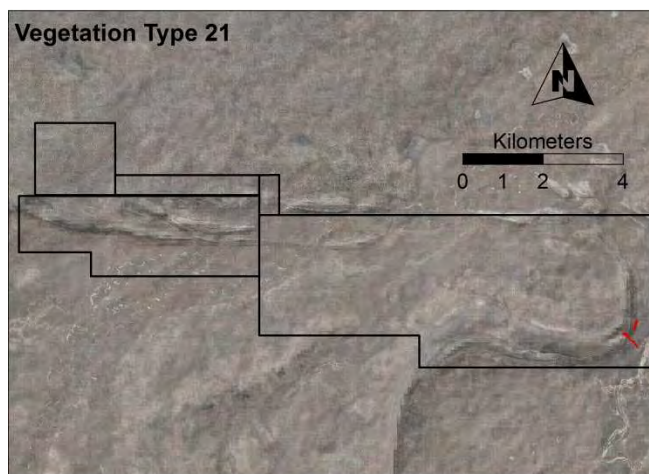


Plate 41. Distribution of the Vegetation Type

Area: 0.04 km² and 0.1% total surveyed area.

Survey Sites: 46 (check site)

Strata	Modal growth form	Mean Cover %	Mean height (m)	NVIS code
Upper	Tree	15 (15 - 15)	11 (8 - 12)	T7r
Mid	Shrub	80 (80 - 80)	2.2 (2 - 4)	S4c
Ground	Tussock Grass	95 (95 - 95)	0.8 (0.8 - 1.2)	G2d

NVIS Description: *Corymbia polycarpa*, *Erythrophleum chlorostachys* Mid Open Woodland over *Acacia tropica*, *Grevillea pteridifolia* Tall Shrubland over *Ischaemum australe*, *Triodia procera* Mid Closed Tussock Grassland.

Upper: Mid open woodland of *Corymbia polycarpa* (fq 100%), *Erythrophleum chlorostachys* (fq 100%), *Eucalyptus phoenicea* (fq 100%), *Eucalyptus tectifica* (fq 100%).

Mid: Tall shrubland of *Acacia tropica* (fq 100%), *Grevillea pteridifolia* (fq 100%), *Acacia platycarpa* (fq 100%), *Bossiaea bossiaeioides* (fq 100%), *Acacia multisiliqua* (fq 100%).

Ground: Mid closed tussock grassland of *Ischaemum australe* (fq 100%), *Triodia procera* (fq 100%).

Other species:

Upper: no additional species.

Mid: *Acacia conspersa* (fq 100%), *Acacia dimidiata* (fq 100%), *Alphitonia pomaderroides* (fq 100%), *Boronia lanuginosa* (fq 100%), *Buchanania obovata* (fq 100%), *Clerodendrum floribundum* (fq 100%), *Petalostigma banksii* (fq 100%), *Petalostigma quadriloculare* (fq 100%).

Ground: *Philydrum lanuginosum* (fq 100%), *Xyris complanata* (fq 100%), *Gonocarpus leptothecus* (fq 100%), *Cassytha capillaris* (fq 100%), *Microstachys chamaelea* (fq 100%).

Landform: drainage line in wide valley between low ridges.



General Condition: This single site had no signs of feral animals and no weeds. The site was long unburned and supported a dense shrub layer of *Acacia tropica*. However the very dense *Ischaemum australe* along the drainage line would be capable of supporting intense fires and there was evidence of past fires. The lack of monsoon vine thicket species was perhaps due to this high fire intensity, despite the site being moist for a large part of the year. Further down the creekline erosion was present although not on the survey site. Although the site appeared to be fed by seepage, this was presumed to be seasonal surface seepage rather than ground water due to the small number of aquatic macrophytes.

Species of Conservation Significance: No species of conservation significance were encountered for this vegetation type.



Appendix D-10 – Sensitive Habitat Surveys (Haul Road)



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Table 10-1: Sensitive Habitat Surveys (Haul Road) – Rock Outcrops

Site ID	Map	Easting	Northing	Description of Rock Outcrop	Habitat value	Recommendation
R1	1	513527	8325233	Flat white sandstone	Low	Minimise direct impacts
R2	1	513008	8326006	Rocky white sandstone ridge	High	Minimise impacts
R3	1	514437	8325572	Rocky brown sandstone ridge	High	Minimise impacts
R4	1	513485	8326651	Rocky white sandstone ridge	High	Minimise impacts
R5	1	514141	8326609	Rocky white sandstone ridge	High	Minimise impacts
R6	1	514416	8326175	Rocky white sandstone ridge	High	Minimise impacts
R7	1	514744	8327032	Rocky white sandstone ridge	High	Avoid direct impacts
R8	1	514532	8327667	Rocky white sandstone ridge	High	Minimise impacts
R9	1	515760	8326408	Rocky white sandstone ridge	High	Minimise direct impacts
R10	1	519729	8327127	Rocky white sandstone ridge	High	Minimise impacts
R11	1	520449	8323878	Rocky white sandstone	High	Minimise impacts
R12	1	520142	8323201	Rocky white sandstone ridge	High	Minimise impacts
R13	1	518448	8322862	Rocky white sandstone ridge	High	Minimise impacts
R14	1	518078	8321116	Flat white sandstone ridge	Low	Minimise impacts
R15	1	521539	8320301	Flat white sandstone ridge	Low	Minimise impacts
R16	1	539676	8295051	Rocky white sandstone hill	High	Minimise impacts
R16	1	524576	8318343	Flat white sandstone ridge	Low	Minimise impacts
R17	1	523899	8316999	Flat white sandstone ridge	Low	Minimise direct impacts
R18	1	524883	8313697	Rocky white sandstone hills	Low	Minimise impacts
R19	1	526883	8313549	Rocky white sandstone hills	Low	Minimise impacts
R20	1	529296	8314724	Rocky white sandstone hills	Low	Minimise impacts
R21	1	529042	8310395	Rocky white sandstone ridge	High	Minimise direct impacts
R22	2	526502	8310035	Rocky white sandstone hills	Low	Minimise impacts
R23	2	539022	8297484	Flat white sandstone ridge	Low	Minimise impacts
R24	2	541044	8291419	Rocky white sandstone ridge	High	Minimise impacts
R25	2	540874	8290022	Rocky white sandstone ridge	High	Minimise impacts
R26	2	541298	8288932	Rocky white sandstone ridge	High	Minimise impacts
R27	2	542451	8289017	Rocky white sandstone ridge	High	Minimise impacts
R28	2	542504	8289768	Rocky white sandstone ridge	High	Minimise impacts
R29	2	542842	8290702	Rocky white sandstone hills	Low	Minimise impacts
R30	2	543732	8292795	Rocky white sandstone ridge	High	Minimise direct impacts
R31	2	545796	8292763	Flat white sandstone hill with gullies	Low	Minimise impacts
R32	2	544917	8290117	Flat white sandstone hill with gullies	Low	Minimise impacts
R33	2	545849	8289895	Rocky white sandstone ridge	Low	Minimise impacts



Site ID	Map	Easting	Northing	Description of Rock Outcrop	Habitat value	Recommendation
R113	2	530262	8304241	Rocky white sandstone ridge	High	Minimise impacts
R114	2	530378	8304136	Rocky white sandstone ridge	High	Minimise impacts
R115	2	538731	8295402	Rocky white sandstone ridge	High	Avoid direct impacts
R116	2	539676	8295051	Rocky white sandstone ridge	High	Avoid direct impacts
R34	3	584711	8280614	Flat white sandstone hill	Low	Minimise impacts
R35	3	583695	8278677	Fractured brown sandstone hill	High	Minimise impacts
R36	3	586393	8276232	Flat white sandstone hill	Low	Minimise impacts
R37	3	588457	8276973	Rocky white sandstone hill	High	Minimise impacts



Table 10-2: Vegetation Assessment of Upper Towns Rocky Outcrops

Upper Towns Rocky Outcrops		
Date of Survey: 02/11/2011		Aspect Surveyed: South
Coordinate (UTM, GDA94, Zone 53): E515061 N8326333		Map Section: Proposed Haul Road Sensitive Habitats Map Section 1 of 4
		
Vegetation Description: Open woodland dominated by <i>Eucalyptus miniata</i> in the Upper, <i>E. tetradonta</i> with <i>Erythrophleum chlorostachys</i> in the Mid. Ground strongly dominated by <i>Triodia bitextura</i> .		
Weeds: None observed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 8% Height: 8 – 13m	Cover: 18% Height: 0.8 – 8m	Cover: 30% Height: 0 – 0.8m
Dominant species <i>Eucalyptus miniata</i>	Dominant species <i>Eucalyptus tetradonta</i> <i>Erythrophleum chlorostachys</i>	Dominant species <i>Triodia bitextura</i>
Other species <i>Corymbia ferruginea</i> <i>Eucalyptus tetradonta</i>	Other species <i>Eucalyptus miniata</i> <i>Corymbia ferruginea</i> <i>Acacia conspersa</i> <i>Acacia dimidiata</i> <i>Grevillea refracta</i> <i>Jacksonia odontoclada</i> <i>Buchanania obovata</i> <i>Terminalia carpentariae</i> <i>Melaleuca viridiflora</i> <i>Alphitonia excelsa</i>	Other species <i>Phyllanthus carpentariae</i> <i>Boronia lanuginosa</i> <i>Tephrosia spechtii</i> <i>Gomphrena flaccida</i> <i>Gompholobium subulatum</i> <i>Gardenia pyriformis</i>



Table 10-3: Vegetation Assessment of Rocky Outcrops in the vicinity of the Cox River

Cox Ridges		
Date of Survey: 01/02/2012		Aspect Surveyed: East
Coordinate (UTM, GDA94, Zone 53): E528950 N8310600		Map Section: Proposed Haul Road Sensitive Habitats Map Section 1 of 4
		
Vegetation Description: Open woodland dominated by <i>Petalostigma pubescens</i> , <i>Erythrophleum chlorostachys</i> and <i>Owenia vernicosa</i> in the Upper, with <i>Wrightia saligna</i> in the Mid. Ground dominated by <i>Tacca leontopetaloides</i> , <i>Bulbostylis barbata</i> , <i>Merremia incise</i> , <i>Spermacoce sp.</i> and <i>Glycine tomentella</i>		
Weeds: None observed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 10% Height: 8 – 10m	Cover: 5% Height: 1 – 8m	Cover: 40% Height: 0 – 1m
Dominant species <i>Petalostigma pubescens</i> <i>Erythrophleum chlorostachys</i> <i>Owenia vernicosa</i>	Dominant species <i>Wrightia saligna</i>	Dominant species <i>Tacca leontopetaloides</i> <i>Bulbostylis barbata</i> <i>Merremia incisa</i> <i>Spermacoce sp.</i> <i>Glycine tomentella</i>
Other species <i>Corymbia ferruginea</i> <i>Eucalyptus tetradonta</i> <i>Terminalia canescens</i>	Other species <i>Calytrix exstipulata</i>	Other species <i>Potulaca filifolia</i> <i>Corchorus sidoides</i> <i>Breynia cernua</i> <i>Bossiaea bossiaeooides</i>



Table 10-4: Vegetation Assessment of Rocky Outcrops in the vicinity of the Limmen River

Limmen Ridges		
Date of Survey: 01/02/2012		Aspect Surveyed: South
Coordinate (UTM, GDA94, Zone 53): E583083 N8278048		Map Section: Proposed Haul Road Sensitive Habitats Map Section 2 of 4
		
Vegetation Description: Open woodland dominated by <i>Buchanania obovata</i> , <i>Terminalia carpentariae</i> and <i>Owenia vernicosa</i> in the Upper with <i>Clerodendrum floribundum</i> and <i>Hibiscus sp.</i> in the Mid. Ground dominated by <i>Triodia bitextura</i> .		
Weeds: None observed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 10% Height: 4 – 6 m	Cover: 9% Height: 1 – 1.6m	Cover: 25% Height: 0.35 – 0.5m
Dominant species <i>Buchanania obovata</i> <i>Terminalia carpentariae</i> <i>Owenia vernicosa</i>	Dominant species <i>Clerodendrum floribundum</i>	Dominant species <i>Triodia bitextura</i>
Other species <i>Gardenia megasperma</i> <i>Acacia plectocarpa subsp. tanumbirinensis</i>	Other species <i>Hibiscus sp.</i>	Other species <i>Stemodia lythrifolia</i> <i>Solanum sp.</i> <i>Cheilanthes sp.</i>



Table 10-5: Vegetation Assessment of Rocky Outcrops in the vicinity of the Rosie Creek

Rosie Ridge		
Date of Survey: 26/02/2012		Aspect Surveyed: South West
Coordinate (UTM, GDA94, Zone 53): E545890 N8290882		Map Section: Proposed Haul Road Sensitive Habitats Map Section 3 of 4
		
Vegetation Description: Isolated <i>Eucalyptus tetradonta</i> trees with an open shrub land dominated by <i>Grevillea pteridifolia</i> , <i>Acacia latifolia</i> and <i>Jacksonia dilitata</i> in the Mid. Ground dominated by <i>Dapsilanthus spatheceus</i> and <i>Triodia sp.</i>		
Weeds: None observed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 5% Height: 6 – 8 m	Cover: 25% Height: 2 – 6m	Cover: 25% Height: <0.6m
Dominant species <i>Eucalyptus tetradonta</i>	Dominant species <i>Grevillea pteridifolia</i> <i>Acacia latifolia</i> <i>Jacksonia dilitata.</i>	Dominant species <i>Dapsilanthus spatheceus</i> <i>Triodia sp.</i>
Other species <i>Gardenia megasperma</i> <i>Acacia plectocarpa subsp. tanumbirinensis</i>	Other species <i>Melaleuca viridiflora</i> <i>Eucalyptus tetradonta</i> <i>Corymbia ferruginea</i> <i>Verticordia cunninghamii</i> <i>Owenia vernicosa</i> <i>Boronia lanceolata</i> <i>Disticostemon hispidulus</i>	Other species <i>Drosera indica</i> <i>Eriocaulon setaceum</i>



Table 10-6: Sensitive Habitat Surveys (Haul Road) – Waterbody Sites

Site ID	Map	Easting	Northing	Description of Waterbody	Habitat value	Recommendation
W38	1	522227	8321741	Water present	High	Minimise impacts
W117	1	530747	8307674	Water present	High	Minimise impacts from road drainage
W136	1	510505	8325861	Water present	High	Minimise impacts
W137	1	510898	8326292	Water present	High	Minimise impacts
W138	1	511268	8326764	Water present	High	Minimise impacts
W139	1	511580	8326697	Water present	High	Minimise impacts
W140	1	511853	8326667	Water present	High	Minimise impacts
W141	1	512261	8326435	Water present	High	Minimise impacts
W142	1	512519	8326570	Water present	High	Minimise impacts
W143	1	511370	8327170	Water present	High	Minimise impacts
W144	1	512275	8326990	Water present	High	Minimise impacts
W145	1	512410	8326975	Water present	High	Minimise impacts
W146	1	512282	8327239	Water present	High	Minimise impacts
W147	1	512384	8327341	Water present	High	Minimise impacts
W148	1	512802	8327077	Water present	High	Minimise impacts
W149	1	512921	8327666	Water present	High	Minimise impacts
W150	1	513287	8327790	Water present	High	Minimise impacts
W151	1	513539	8327881	Water present	High	Minimise impacts
W152	1	513686	8328333	Water present	High	Minimise impacts
W39	2	542748	8291070	Closed depression, no water present	High	Minimise impacts
W40	2	554751	8293637	Closed depression, no water present	Low	Minimise impacts
W41	2	555501	8293517	Water present	High	Minimise impacts
W42	2	557564	8291906	Closed depression, no water present	Low	Minimise impacts
W43	2	556294	8288826	Water present	High	Minimise impacts
W44	2	561207	8292165	Closed depression, no water present	Low	Minimise impacts
W45	2	561607	8292036	Water present	High	Minimise impacts
W46	2	562189	8291815	Closed depression, no water present	Low	Minimise impacts
W47	2	561776	8290998	Water present	High	Minimise impacts
W48	2	560611	8291124	Closed depression, no water present	Low	Minimise impacts
W49	2	561745	8289642	Closed depression, no water present	Low	Minimise impacts
W50	2	562155	8289441	Closed depression, no water present	Low	Minimise impacts
W51	2	562415	8289197	Closed depression, no water present	Low	Minimise impacts
W52	2	564427	8289879	Water present	High	Minimise impacts
W53	2	563637	8288576	Water present	High	Minimise impacts



Site ID	Map	Easting	Northing	Description of Waterbody	Habitat value	Recommendation
W54	2	562142	8288856	Close depression, no water present	Low	Minimise impacts
W55	2	562441	8288674	Close depression, no water present	Low	Minimise impacts from road drainage
W56	2	565465	8287127	Water present	High	Minimise impacts
W57	2	565853	8281924	Water present	High	Minimise impacts
W58	2	567983	8281291	Water present	High	Minimise impacts
W59	2	569549	8281584	Water present	High	Avoid direct impacts
W60	2	569688	8284149	Water present	High	Minimise impacts
W61	2	570770	8282693	Water present	High	Minimise impacts
W62	2	570854	8283325	Water present	High	Minimise impacts
W63	2	571829	8282712	Water present	High	Minimise impacts
W64	2	573598	8279000	Closed depression, no water present	Low	Minimise impacts
W65	2	576465	8280109	Water present	High	Avoid direct impacts
W118	2	545523	8290888	Gully with water present	High	Minimise impacts from road drainage
W119	2	561054	8288923	Closed depression, no water present	Low	Minimise impacts
W120	2	572186	8281000	Water present	High	Minimise impacts from road drainage
SH1	2	571720	8281632	Closed sinkhole	High	Minimise impacts from road drainage
W121	2	579022	8279728	Closed depression, no water present	Low	Minimise impacts from road drainage
W66	3	590968	8278778	Water present	High	Minimise impacts
W67	3	594486	8275896	Water present	High	Minimise impacts
W68	3	604673	8273442	Water present	High	Minimise impacts
W69	3	607081	8275445	Closed depression, no water present	Low	Minimise impacts
W70	3	607813	8273126	Water present	High	Minimise impacts
W71	3	608683	8274762	Closed depression, no water present	Low	Minimise impacts
W72	3	610004	8275094	Water present	High	Minimise impacts
W73	3	611571	8275263	Closed depression, no water present	Low	Minimise impacts
W74	3	610192	8274364	Water present	High	Minimise impacts
W75	3	611128	8273197	Water present	High	Minimise impacts
W76	3	610930	8272411	Water present	High	Minimise impacts
W77	3	611137	8271299	Water present	High	Minimise impacts
W78	3	612563	8272150	Water present	High	Minimise impacts
W79	3	616567	8273851	Water present	High	Avoid direct impacts
W80	3	619710	8270327	Water present	High	Minimise impacts
W81	3	621064	8272095	Closed depression, no water present	Low	Minimise impacts from road drainage
W122	3	591979	8278928	Water present	High	Minimise impacts



Site ID	Map	Easting	Northing	Description of Waterbody	Habitat value	Recommendation
W123	3	592384	8278592	Water present	High	Minimise impacts
W124	3	592539	8278277	Water present	High	Minimise impacts
W125	3	592312	8277157	Water present	High	Minimise impacts
W126	3	594827	8276951	Water present	High	Avoid direct impacts
W127	3	595394	8276840	Water present	High	Avoid direct impacts
W128	3	596920	8275888	Water present	High	Minimise impacts
W129	3	606036	8273822	Closed depression, no water present	Low	Minimise impacts
W130	3	610310	8274403	Water present	High	Minimise impacts
W131	3	610386	8273915	Water present	High	Avoid direct impacts
W132	3	611095	8273611	Water present	High	Avoid direct impacts
W82	4	623047	8273415	Water present	High	Minimise impacts
W83	4	625626	8269035	Water present	High	Minimise impacts from road drainage
W84	4	626843	8270507	Water present	High	Minimise impacts
W85	4	626610	8271353	Water present	High	Minimise impacts
W86	4	628759	8269099	Water present	High	Minimise impacts
W87	4	628621	8267840	Water present	High	Minimise impacts from road drainage
W88	4	627463	8265499	Water present	High	Minimise impacts
W89	4	629586	8268573	Water present	High	Minimise impacts from road drainage
W90	4	630420	8267945	Closed depression, no water present	Low	Minimise impacts
W91	4	631067	8268612	Water present	High	Minimise impacts
W92	4	631864	8268195	Water present	High	Minimise impacts
W93	4	631807	8267674	Water present	High	Minimise impacts
W94	4	632178	8267581	Water present	High	Minimise impacts
W95	4	640210	8261992	Water present	High	Minimise impacts
W96	4	640725	8261877	Water present	High	Minimise impacts
W97	4	641413	8261793	Water present	High	Minimise impacts
W98	4	641935	8262643	Water present	High	Minimise impacts
W99	4	642729	8262474	Water present	High	Minimise impacts
W100	4	643268	8262254	Water present	High	Minimise impacts
W101	4	644272	8262821	Water present	High	Minimise impacts
W102	4	644735	8263321	Water present	High	Minimise impacts
W103	4	644809	8263970	Water present	High	Minimise impacts
W104	4	643957	8265072	Water present	High	Minimise impacts
W105	4	642827	8265599	Water present	High	Minimise impacts from road drainage
W106	4	642836	8265794	Closed depression, no water present	Low	Minimise impacts
W107	4	644207	8265646	Water present	High	Minimise impacts
W108	4	646189	8265498	Closed depression, no water present	Low	Minimise impacts
W109	4	645420	8265970	Water present	High	Minimise impacts



Site ID	Map	Easting	Northing	Description of Waterbody	Habitat value	Recommendation
W110	4	644957	8266924	Water present	High	Minimise impacts from road drainage
W111	4	646587	8266488	Water present	High	Minimise impacts
W112	4	647096	8267905	Water present	High	Minimise impacts
W133	4	638898	8264092	Water present	High	Avoid direct impacts
W134	4	644663	8268921	Water present	High	Minimise impacts
W135	4	624487	8270853	Water present	High	Minimise impacts
W153	4	624946	8272519	Water present	High	Minimise impacts



Table 10-7: Sensitive Habitat Surveys (Haul Road) – Creek Crossings

Site ID	Map	Easting	Northing	Recommendation
CC1	1	517802	8325193	Creek crossing requiring culverts
CC2	1	518364	8324767	Creek crossing requiring culverts
CC3	1	519529	8323145	Creek crossing requiring culverts
CC4	1	523199	8319239	Creek crossing requiring culverts
CC5	1	523894	8318474	Creek crossing requiring culverts
CC6	1	527711	8313694	Creek crossing requiring culverts
CC7	1	528533	8312449	Creek crossing requiring culverts
CC8	1	529819	8304960	Creek crossing requiring culverts
CC9	1	530895	8302861	Creek crossing requiring culverts
CC10	2	540839	8294248	Creek crossing requiring culverts
CC11	2	547854	8291425	Creek crossing requiring culverts
CC12	2	552131	8290632	Creek crossing requiring culverts
CC13	2	568634	8282042	Creek crossing requiring culverts
CC14	2	571085	8281241	Creek crossing requiring culverts
CC15	2	575763	8280635	Creek crossing requiring culverts
CC16	2	576374	8280532	Creek crossing requiring culverts
CC17	3	582570	8277945	Creek crossing requiring culverts
CC18	3	584691	8277815	Creek crossing requiring culverts
CC19	3	585508	8278000	Creek crossing requiring culverts
CC20	3	598044	8276202	Creek crossing requiring culverts
CC21	3	599513	8275733	Creek crossing requiring culverts
CC22	3	600022	8275588	Creek crossing requiring culverts
CC23	3	602255	8275370	Creek crossing requiring culverts
CC24	3	619138	8273243	Creek crossing requiring culverts
CC25	4	627969	8267559	Creek crossing requiring culverts
CC26	4	628765	8266889	Creek crossing requiring culverts
CC27	4	632014	8264951	Creek crossing requiring culverts
CC28	4	634390	8264699	Creek crossing requiring culverts



Table 10-8: Riparian Vegetation Assessment – Cox River Crossing

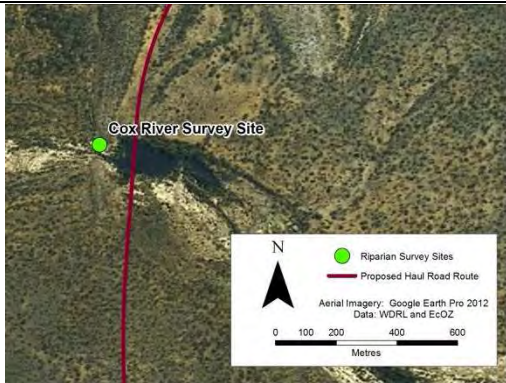
Cox River		
Date of Survey: 24/02/2012		Bank Surveyed: North
Coordinate (UTM, GDA94): Zone 53, 529692E 8306167N		Map Section: Proposed Haul Road Sensitive Habitats Map Section 1 of 4
 Aerial image of the survey location		 Photo from helicopter looking east
 Photo of north bank		 Photo of south bank
Extent and Width of Patch: Approximately 6m across River. 25m of sandy river bed on north bank, 5m of rock on south bank. Rocky ridge on northern and southern side of the crossing. Shallow river crossing.		
Vegetation Description: Riparian vegetation dominated by <i>Melaleuca argentea</i> growing throughout the sandy river bed in the Upper and <i>Asteromyrtus symphyocarpa</i> in the Mid. Seasonal flooding resulting in high impact on riparian vegetation.		
Weeds: None observed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 5% Height: 6 – 8 m	Cover: 15% Height: 1 – 6m	Cover: <1% Height: <1m
Dominant species <i>Melaleuca argentea</i> (4%) <i>Terminalia bursarina</i> (1%)	Dominant species <i>Asteromyrtus symphyocarpa</i> (8%) <i>Melaleuca argentea</i> (4%) <i>Barringtonia acutangula</i> (3%)	Dominant species NA



Table 10-9: Riparian Vegetation Assessment – Limmen River Crossing (west bank)

Limmen Bight River West Bank		
Date of Survey: 23/02/2012		Bank Surveyed: West
Coordinate (UTM, GDA94): Zone 53, 543205E, 8293244N		Map Section: Proposed Haul Road Sensitive Habitats Map Section 2 of 4
 Aerial image of the survey location		 Photo from helicopter looking north
 Photo Direction: East		 Photo Direction: West
Extent and Width of Patch: Approximately 80m across river. 30m wide riparian vegetation corridor on the west bank dissected by a backwater channel. Deep river crossing.		
Vegetation Description: River bank fringed by Upper <i>Melaleuca leucadendra</i> and <i>Casuarina cunninghamiana</i> . Backwater channel fringed by Mid <i>Melaleuca acaciodes</i> . River edge fringed by Mid <i>Melaleuca leucadendra</i> and <i>Casuarina cunninghamiana</i> . Ground strongly dominated by <i>Enteropogon minutus</i> . Seasonal flooding resulting in high impact on riparian vegetation.		
Weeds: None surveyed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 20% Height: 6 – 10 m	Cover: 40% Height: 0.3 – 5m	Cover: 80% Height: <0.3m
Dominant species <i>Melaleuca leucadendra</i> (10%) <i>Casuarina cunninghamiana</i> (10%)	Dominant species <i>Melaleuca acaciodes</i> (30%) <i>Casuarina cunninghamiana</i> (5%) <i>Cathormion umbellatum</i> (5%)	Dominant species <i>Enteropogon minutus</i> (75%) <i>Paspalidium rarum</i> (3%) <i>Chrysopogon elongates</i> (2%)



Table 10-10: Riparian Vegetation Assessment – Limmen River Crossing (east bank)

Limmen Bight River East Bank		
Date of Survey: 25/02/2012		Bank Surveyed: East
Coordinate (UTM, GDA94): Zone 53, 543335E 8293148N		Map Section: Proposed Haul Road Sensitive Habitats Map Section 2 of 4
 Aerial image of the survey location		 Photo from helicopter looking north
 Photo Direction: North		 Photo Direction: South
Extent and Width of Patch: Approximately 80m across river. 10m wide riparian vegetation corridor on the east bank. Bank approximately 5 m high. Deep river crossing.		
Vegetation Description: River edge fringed by Mid <i>Melaleuca leucadendra</i> backed by Upper <i>Melaleuca leucadendra</i> and <i>Casuarina cunninghamiana</i> . Ground dominated by <i>Paspalidium rarum</i> and <i>Chrysopogon elongatus</i> . Seasonal flooding resulting in high impact on riparian vegetation.		
Weeds: 30m x 30m <i>Hyptis suaveolens</i> nearby on river bank. <i>Passiflora foetida</i> in riparian zone.		
Vegetation Structure		
Upper	Mid	Lower
Cover: 70% Height: 8 – 14 m	Cover: 40% Height: 1 – 8 m	Cover: 60% Height: <1m
Dominant species <i>Melaleuca leucadendra</i> (40%) <i>Casuarina cunninghamiana</i> (10%) <i>Corymbia bella</i> (10%)	Dominant species <i>Melaleuca leucadendra</i> (35%)	Dominant species <i>Paspalidium rarum</i> (20%) <i>Chrysopogon elongatus</i> (15%)



Table 10-11: Riparian Vegetation Assessment – Limmen River Crossing (east bank)

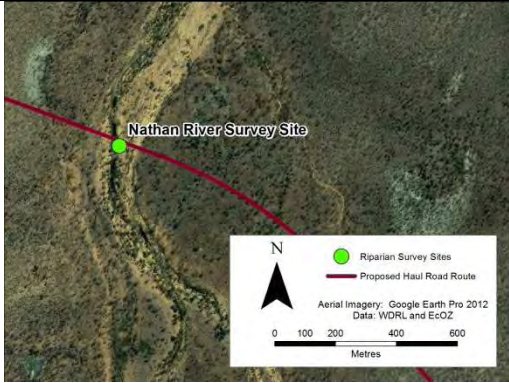
Nathan River		
Date of Survey: 24/02/2012		Bank Surveyed: West
Coordinate (UTM, GDA94): Zone 53, 559425E 8291153N		Map Section: Proposed Haul Road Sensitive Habitats Map Section 2 of 4
 Aerial image of the survey location		 Photo from helicopter looking north
 Photo Direction: North		 Photo Direction: East
Extent and Width of Patch: Approximately 6m across river. 6m wide riparian vegetation strip on west bank. 16m wide river bed supporting riparian vegetation with a 6m wide backwater channel on the east bank. Shallow river crossing.		
Vegetation Description: Riparian vegetation throughout sandy riverbed, dominated by <i>Eucalyptus camaldulensis</i> and <i>Lophostemon grandiflorus</i> in the Upper and <i>Terminalia bursarina</i> in the Mid. Ground dominated by <i>Chrysopogon elongatus</i>, present throughout riverbed. Seasonal flooding resulting in high impact on riparian vegetation.		
Weeds: 100m x 20m <i>Hyptis suaveolens</i> nearby on river bank. <i>Sida acuta</i> also present.		
Vegetation Structure		
Upper	Mid	Lower
Cover: 20% Height: 6 – 10 m	Cover: 40% Height: 1 – 6 m	Cover: 20% Height: <1m
Dominant species <i>Eucalyptus camaldulensis</i> (5%) <i>Lophostemon grandiflorus</i> (5%) <i>Vitex glabrata</i> (2%)	Dominant species <i>Terminalia bursarina</i> (20%) <i>Asteromyrtus symphyocarpa</i> (5%) <i>Antidesma ghesaembilla</i> (5%)	Dominant species <i>Chrysopogon elongatus</i> (15%) <i>Heteropogon contortus</i> (5%)



Table 10-12: Riparian Vegetation Assessment – Rosie Creek Crossing

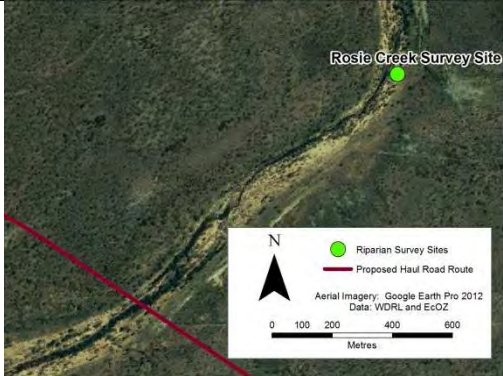
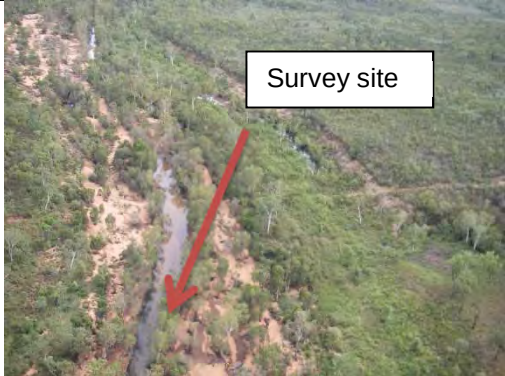
Rosie Creek		
Date of Survey: 25/02/2012		Bank Surveyed: East
Coordinate (UTM, GDA94): Zone 53, 605920E 8275394N		Map Section: Proposed Haul Road Sensitive Habitats Map Section 3 of 4
 Aerial image of survey location		 Photo from helicopter looking north
 Photo Direction: North		 Photo Direction: East
Extent and Width of Patch: Approximately 7m across creek. 10m wide riparian strip on west bank and 20m wide on east bank. 20m wide grassy patch adjacent to east bank riparian strip. Shallow creek crossing.		
Vegetation Description: Riparian vegetation throughout sandy riverbed, dominated by <i>Melaleuca argentea</i> and <i>Melaleuca leucadendra</i> in the upper and Mid. Ground dominated by <i>Chrysopogon elongatus</i>, present throughout riverbed. Grassy patch adjacent to east bank riparian strip dominated by <i>Mnethia rottboelliodes</i> and <i>Chrysopogon elongatus</i>. Seasonal flooding resulting in high impact on riparian vegetation.		
Weeds: 10m x 10m patch of <i>Jatropha gossypifolia</i> on river bank. <i>Hyptis suaveolens</i>		
Vegetation Structure		
Upper	Mid	Lower
Cover: 40% Height: 6 – 10 m	Cover: 10% Height: 1 – 6 m	Cover: 5% Height: <1m
Dominant species <i>Melaleuca argentea</i> (20%) <i>Melaleuca leucadendra</i> (10%) <i>Lophostemon grandiflorus</i> (2%)	Dominant species <i>Melaleuca leucadendra</i> (5%) <i>Melaleuca argentea</i> (2%) <i>Pandanus spiralis</i> (2%)	Dominant species <i>Chrysopogon elongatus</i> (5%)



Table 10-13: Riparian Vegetation Assessment – Pine Creek Crossing

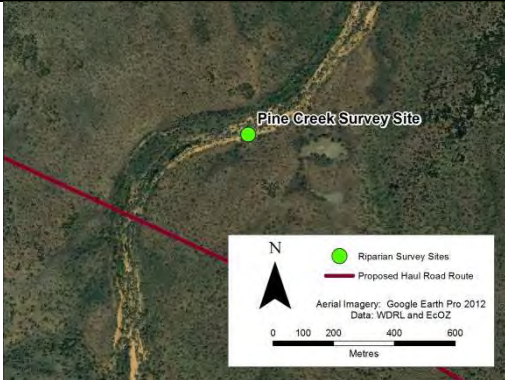
Pine Creek		
Date of Survey: 26/02/2012		Bank Surveyed: South
Coordinate (UTM, GDA94): Zone 53, 624160E, 8270918N		Map Section: Proposed Haul Road Sensitive Habitats Map Section 4 of 4
 Aerial image of the survey location		 Photo from helicopter looking east
 Photo Direction: North		 Photo Direction: East
Extent and Width of Patch: Approximately 6m across creek. 10m wide strip off riparian vegetation on both the west and east banks. Shallow creek crossing.		
Vegetation Description: Riparian vegetation throughout sandy riverbed, dominated by <i>Melaleuca argentea</i> in the Upper and <i>Acacia holosericea</i> in the Mid. Ground dominated by <i>Chrysopogon elongatus</i> . Seasonal flooding resulting in high impact on riparian vegetation.		
Weeds: None observed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 30% Height: 8 – 12 m	Cover: 20% Height: 1 – 8 m	Cover: 10% Height: <1m
Dominant species <i>Melaleuca argentea</i> (20%) <i>Melaleuca leucadendra</i> (5%) <i>Corymbia bella</i> (5%)	Dominant species <i>Acacia holosericea</i> (10%) <i>Melaleuca viridiflora</i> (2%) <i>Antidesma ghesaembilla</i> (2%)	Dominant species <i>Chrysopogon elongatus</i> (5%) <i>Pseudoraphis spinescens</i> (2%)



Table 10-14: Riparian Vegetation Assessment – Bing Bong Creek Crossing

Bing Bong Creek		
Date of Survey: 25/02/2012		Bank Surveyed: West
Coordinate (UTM, GDA94): Zone 53, 639450E, 8263826N		Map Section: Proposed Haul Road Sensitive Habitats Map Section 4 of 4
 Aerial image of the survey location		 Photo from helicopter looking north
 Photo Direction: East		 Photo Direction: South
Extent and Width of Patch: Approximately 8m across creek. Narrow strip of riparian vegetation 5m wide located on both the west and east banks. Shallow creek crossing.		
Vegetation Description: Tidal creek with mangrove species present. Narrow riparian vegetation strip on both banks, dominated by <i>Callitris intratropica</i> in the Upper and <i>Melaleuca acaciodes</i> and <i>Acacia leptocarpa</i> in the Mid. Ground dominated by <i>Themeda triandra</i> and <i>Sorghum plumosum</i> .		
Weeds: None observed		
Vegetation Structure		
Upper	Mid	Lower
Cover: 15% Height: 6 – 10 m	Cover: 30% Height: 1 – 6 m	Cover: 40% Height: <1m
Dominant species <i>Callitris intratropica</i> (8%) <i>Corymbia bella</i> (2%) <i>Corymbia polycarpa</i> (2%)	Dominant species <i>Melaleuca acaciodes</i> (10%) <i>Acacia leptocarpa</i> (10%)	Dominant species <i>Themeda triandra</i> (10%) <i>Sorghum plumosum</i> (10%)



Appendix D-11 –Vegetation Descriptions for Port Facility Area



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Table 11-1: Port Area. Vegetation Unit 2a – Coastal Vine Thicket

Vegetation Type 2a: Coastal Dry Monsoon Vine Thickets

Vegetation Description: Mixed monsoon vine thicket +/- *Corymbia bella*, *Diosporos* sp., *Flueggia virosa*, *Premna acuminata*, *Exocarpus latifolia*, *Barringtonia acutangula*, *Ficus virens virens* Low Closed Forest. Species supported are typical of coastal monsoon vine-thicket, however the chenier vine thicket community in the vicinity of the conveyor and stockyard rarely attains the dense closed-canopy structure typical of a monsoon vine thicket community.

Landform: Occurs on beach ridges or chenier's composed of sand and shell deposits. Some are interspersed with saline drainage floors or swales.

Date of Survey: 26/02/2012	Survey Sites: BB5, BB6
Coordinate (UTM, GDA94): Zone 53, E648030 N8271939 and E646828 N8271417	Map Code: 2a



Weeds: Relatively high impact mainly from well-established Passion Vine (*Passiflora foedita*) infestations. Declared weeds included Hyptis (*Hyptis suaveolens*) and Sida (*Sida acuta*), both Class B weeds under the NT Weeds Management Act. Other environmental weed species identified included Kapok Bush (*Aerva javanica*), Cobbler's Peg (*Bidens bipinnata*) and Buffel Grass (*Cenchrus ciliaris*).

Vegetation Structure		
Vegetation = 70%, Soil = 20%, Litter = 10%		
Upper	Mid	Lower
Cover: 15% Height: 7 – 12m	Cover: 45% Height: 1 – 5 m	Cover: 10% Height: 0 – 1 m
Dominant species <i>Alphitonia pomaderroides</i> <i>Petalostigma banksia</i>	Dominant species <i>Terminalia carpentaria</i> <i>Exocarpus latifolia</i>	Dominant species <i>Chrysopogon fallax</i>
Other species <i>Eucalyptus bella</i> <i>Ficus virens virens</i> <i>Premna acuminata</i>	Other species <i>Barringtonia acutangula</i> <i>Diosporos</i> sp. <i>Flueggia virosa</i> <i>Acacia hemsleyii</i> <i>Acacia leptocarpa</i> <i>Bridelia tomentosa</i> <i>Pandanus spiralis</i> <i>Melaleuca viridiflora</i>	Other species <i>Cleomi viscosa</i> <i>Indigofera</i> sp. <i>Spermacose</i> sp. <i>Hybiscus</i> sp. <i>Solanum echinatum</i> <i>Cayratia trifolia</i> <i>Abrus</i> sp.



Table 11-2: Port Area. Vegetation Unit 6b – Melaleuca Low Open Woodland

Vegetation Type 6b: Melaleuca Low Open Woodland over Tussock Grass		
Vegetation Description: <i>Melaleuca viridiflora</i> +/- <i>Petalostigma banksii</i>, <i>Alphitonia pomaderroides</i> Low Open Woodland over <i>Heteropogon triticeus</i> Mid Tussock Grassland. This vegetation community will not be disturbed as part of the port facility development, however the haul road traverse small patches.		
Landform: Low coastal plain subject to seasonal inundation. Soils were yellow brown sandy loams with some lateritic gravel.		
Date of Survey: 26/02/2012		Survey Sites: BB1
Coordinate (UTM, GDA94): Zone 53, E645432 N8268966		Map Code: 6b
		
Weeds: No weeds identified		
Vegetation Structure		
Vegetation = 95%, Soil = 5%, Litter = 5%		
Upper	Mid	Lower
Cover: 10% Height: 4 – 8 m	Cover: 5% Height: 1 – 3 m	Cover: 80% Height: 0 – 1 m
Dominant species <i>Melaleuca viridiflora</i>	Dominant species <i>Melaleuca viridiflora</i>	Dominant species <i>Heteropogon triticeus</i> <i>Cassytha filiformis</i>
Other species <i>Petalostigma banksii</i> <i>Alphitonia pomaderroides</i>	Other species <i>Alphitonia pomaderroides</i> <i>Grevillea decurrens</i> <i>Wrightia</i> sp. <i>Callytrix</i> sp.	Other species Unidentified sedges Sundew



Table 11-3: Port Area. Vegetation Unit 6a – Melaleuca Low Woodland

Vegetation Type 6a: Melaleuca Low Woodland		
Vegetation Description: <i>Melaleuca viridiflora</i> +/- <i>Corymbia ferruginea</i> , <i>Corymbia bella</i> , Mid Open Woodland over <i>Heteropogon contortus</i> , <i>Grewia retusifolia</i> Tall Tussock Grassland.		
Landform: This community occurs in poorly drained soils that do not result in water ponding or swamps.		
Date of Survey: 26/02/2012		Survey Site: BB3
Coordinate (UTM, GDA94): Zone 53, E645736 N8270449		Map Code: 6a
		
Weeds (or other impact): Potentially due to over grazing and high fire frequency. Close to McArthur River Station cattle stockyard that was overrun by many weed species (not surveyed).		
Vegetation Structure Vegetation = 100%, Soil = 0%, Litter = 10%		
Upper	Mid	Lower
Cover: 15% Height: 5 – 8m	Cover: <5% Height: 2 m	Cover: 95% Height: 0 – 1 m
Dominant species <i>Melaleuca viridiflora</i> <i>Corymbia ferruginea</i>	Dominant species -	Dominant species <i>Heteropogon contortus</i> <i>Grewia retusifolia</i>
Other species <i>Eucalyptus bella</i>	Other species <i>Acacia holosericea</i> <i>Ficus aculeata</i> var. <i>aculeata</i> <i>Ampelocissus acetosa</i>	Other species <i>Chrysopogon fallax</i>



Table 11-4: Port Area. Vegetation Unit 5a – Beefwood Open Woodland

Vegetation Type 5a: Beefwood Open Woodland		
Vegetation Description: <i>Grevillea striata</i> +/- <i>Diosporos humilis</i> , <i>Petalistigma banksii</i> , <i>Margaritaria dubium-traceyi</i> Low Open Woodland over <i>Chrysopogon elongatus</i> and <i>Eulalia aurea</i> Tall Tussock Grassland		
Landform: Occurs on poorly drained clay soils amongst the cheniers and saltflats of Bing Bong Creek.		
Date of Survey: 26/02/2012		Survey Sites: BB4
Coordinate (UTM, GDA94): Zone 53, E646573 N8271219		Map Code: 5a
		
Weeds: Weed species were present, with Passion Vine (<i>Passiflora foedita</i>) and Hyptis (<i>Hyptis suaveolens</i>) having the high impact. Other weeds at the site included <i>Chloris inflata</i> . Cattle and Feral Pigs were observed in the local area, however impact on the vegetation community was fairly low.		
Vegetation Structure Vegetation = 95%, Soil = 5%, Litter = 5%		
Upper	Mid	Lower
Cover: 10% Height: 4 – 7m	Cover: 5% Height: 1 – 4 m	Cover: 85% Height: 0 – 1 m
Dominant species <i>Grevillea striata</i>	Dominant species <i>Ficus aculeata</i> var. <i>aculeata</i> <i>Diosporos humilis</i>	Dominant species <i>Chrysopogon fallax</i> <i>Eulalia aurea</i>
Other species <i>Terminalia ferdinandiana</i>	Other species <i>Petalostigma banksia</i> <i>Acacia holosericea</i> <i>Margaritaria dubium-traceyi</i>	Other species <i>Panicum</i> sp. <i>Aristida</i> sp <i>Grewia retusifolia</i> <i>Corchorus</i> sp. <i>Uria logapodioides</i> <i>Digitaria</i> sp <i>Mnesithia rottboellioides</i> <i>Eriachne obtuse</i> <i>Eragrostis</i> sp <i>Cayratia trifolia</i> <i>Chloris inflata</i> <i>Hyptis suaveolens</i> <i>Passiflora foedita</i>



Table 11-5: Port Area. Vegetation Unit 6e – Cypress Pine Woodland

Vegetation Type 6e: Cypress Pine Stands		
Vegetation Description: <i>Callitris intratropica</i> Mid Woodland over +/- <i>Hakea arborescens</i>, <i>Alphitonia pomaderroides</i> Tall Sparse Shrubland over <i>Heteropogon triticeus</i> Mid Open Tussock Grassland Cypress Pine stands have a fairly restricted distribution in the region. Stands of Cypress Pine will aim to be avoided during the construction of the haul road.		
Landform: The Cypress Pine stand is linear in shape, and is approximately 100 m wide and a 1 km long.		
Date of Survey: 26/02/2012		Survey Sites: BB2
Coordinate (UTM, GDA94): Zone 53, E645303 N8269271		Map Code: 6e
		
Weeds: None recorded		
Vegetation Structure Vegetation = 80%, Soil = 10%, Litter = 10%		
Upper	Mid	Lower
Cover: 20% Height: 4 – 8 m	Cover: 5% Height: 1 – 2 m	Cover: 55% Height: 0 – 1 m
Dominant species <i>Callitris intratropica</i>	Dominant species <i>Bossia bossioides</i>	Dominant species <i>Heteropogon triticeus</i>
Other species <i>Hakea arborescens</i> <i>Melaleuca viridiflora</i> <i>Petalostigma sp.</i>	Other species <i>Grevillea pteridifolia</i> <i>Cochlospermum sp</i> <i>Brachychiton diversifolius</i> <i>Alphitonia pomaderroides</i>	Other species <i>Acacia nuparima</i> <i>Grewia retusifolia</i> <i>Ampelocissus acetosa</i> <i>Bossea bossioides</i>



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Appendix D-12 – Habitat Description Datasheet



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		Vegetation Quadrat Description Datasheet				Project:		Page 1 of 2	
Site Name				Waypoint		Date:		Recorder:	
Site description:									
Location Information									
Slope (°):		Photo numbers (take 4)		N E		Datum:		Zone:	
Aspect:		S W		Easting:		Northing:			
General Site Description									
Landform: Crest Hillock Ridge Simple slope Upper slope					Shape of Patch:				
Mid-slope Lower slope Flat Open depression (watercourse/gully) Closed depression (sinkhole/lake)					Patch size <0.4ha 0.04-1ha 1- 5 ha 5-100ha <100ha				
Soil Drainage Potential 1 = rapidly drained (steep slope/sandy soil) 2 = moderately well drained (occasional seasonal waterlogging) 3 = poorly drained (seasonally waterlogged most years) 4 = very poorly drained (seasonal waterlogging/inundation expected)					Drawing of Patch:				
Disturbance Information									
Disturbance 0=no visible impact -> 5= major impact affecting all of site					Weed density: absent scattered sparse common abundant dense				
Pig damage: 0 1 2 3 4 5			Cow/Horse/Donkey: 0 1 2 3 4 5			Weed extent:			
Other Disturbances:					Weed species:				
Erosion: Stabilised/ Absent Partly Stabilised Active		Erosion Extent: Type: wind scald water sheet rill gully tunnel streambank wave							
Fire impact: 0 1 2 3 4 (see defs)			Last fire:		very recent this year last year		2+ years unburnt		
Geology and Soils									
Rock Types		sandstone siltstone laterite limestone basalt granite quartz other							
Rock Size (cm) % area		s pebbles <0.6cm m pebbles 0.6-2cm lg pebbles 2-6cm cobbles 6-20cm stones 20-60cm boulders 60-200 lg boulders >200cm bedrock outcrop:							
Soil Depth		Deep Shallow Skeletal		Soil Type: Clay Loam Sand Organic Other:					
Soil Colour		Reddish Reddish Brown Brown Orange Black Yellow Yellowish brown Grayish Gray		Soil Photo:					
Vegetation Cover (%):		Litter Cover (%):		Bare Soil Cover (%):		Gravel Cover (%):		Rock Cover (%):	
Key Habitat Information									
Distance to Perm Water		<100m 100 - 300m 300 - 500m 500 - 1000m >1000m							
Tree Hollows		Absent (0) Scattered (1 - 5) Common (6 - 10) Abundant (>10) Living or Dead							
Fallen Logs (>50cm)		Absent (0) Scattered (1 - 5) Common (6 - 10) Abundant (>10)							
Mistletoe		Absent (0) Scattered (1 - 5) Common (6 - 10) Abundant (>10)							
Flowering Plants		Absent (0) Scattered (1 - 5) Common (6 - 10) Abundant (>10) Type							
Litter		Absent (0) Shallow Moderate Deep Estimated depth (mm)							
Density of termite mounds:		Odd Sparse Common Abundant		Max ht (m):		Profile: Tower Dome Magnetic			
Vegetation Structure									
Structural Formation (upper storey) (circle one)									
Crown Separation Ratio		Overlapping 0 - 0.25 0.25 - 1 1-20 >20							
foliage cover (NVIS)		70-100% 30-70% 10-30% <10% >0							
% cover (NVIS)		>80% 50-80% 20-50% 0.25-20% <0.25%							
Tree 10-30m (Mid High)		Closed Forest Open Forest Woodland Open Woodland Isolated trees							
Tree <11 m (Low)		Closed Forest (incl MVF) Open forest Woodland Open Woodland Isolated trees							
Shrub		Closed shrubland Shrubland Open shrubland Sparse shrubland Isolated shrubs							
Tussock Grassland		Closed T grassland T Grassland Open T grassland Sparse T grassland Isolated T grasses							
Hummock Grassland		Closed H grassland H Grassland Open H grassland Sparse H grassland Isolated H grasses							
Crown Density (%):		Stratum		U1 U2 M1 M2 G1 G2					
		% cover:							
		height range (m):							
		average height (m):							

Biodiversity Habitat Characterisation: dominant species Name or voucher number (>5% cover only)

Basal Density - Reference and Check sites - only one basal sweep is necessary

Total Basal Area (=sum total) x width of wedge hole used/no. of sweeps made =									

for flowers (FL): 0=no plants in flower (FL) or fruits (FR); 1=isolated plants with few flowers; 2=isolated plants with moderate no. of flowers or most plants with few flowers; 3=many plants with moderate no. flowers; 4=most plants with many flowers; 5=all plants with many flowers. Comparable score for fruit (FR)