EcOz Environmental Services

WesternDesert RESOURCES

Chapter 4
Terrestrial Biodiversity

Western Desert Resources Limited
Roper Bar Iron Ore Project



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Prepared by:	Ann Grattidge, Tom Reilly and Glen Ewers
Position:	Environmental Scientists
Signed:	
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Approved by:	Ray Hall
Position:	Principal
Signed:	
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EcOz Pty Ltd

trading as EcOz Environmental Services
ACN: 143 989 039

Winlow House, 3rd Floor
75 Woods Street
DARWIN NT 0800
PO Box 381, Darwin NT 0800
Telephone: +61 8 8981 1100
Facsimile: +61 8 8981 1102
Email: ecoz@ecoz.com.au

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4.1 Introduction

The Project falls within both the Gulf Coastal and the Gulf Falls and Uplands bioregions. The vast majority of these bioregions regions comprise extensive areas of intact (uncleared) and relatively common land types. The extensive low undulating plains are interspersed with a number of major river systems, low to steep rocky hills, gorges, and freshwater wetlands. The coastal areas feature significant river mouths, tidal wetlands and mudflats. The less typical landscape features, particularly those associated with surface water flows' provide critical hotspots for the bioregions' biodiversity. Three of these are regarded as Sites of Conservation Significance (Figure 4-1). A number of large conservation areas are present and continue to be developed for the region. In particular, the MLA areas fall within the boundary of the recently declared Limmen National Park, and are also located within the Towns River catchment which flows into the proposed Limmen Bight Marine Park (Figure 4-1).

A number of notable plant and animal species are found within the Gulf region, including those which are rare, threatened, endemic, or occur only within a restricted range. Due to the remoteness of the region, the knowledge base for the biodiversity of the two Gulf bioregions is poorly developed. Few surveys have been conducted in the region and most have been concentrated in the vicinity of known areas of conservation significance or more accessible areas. There is still much room to discover some new species and, more likely, variations within known species (distribution, ecology and genetics).

The Gulf bioregions are considered to be in good condition. However, like much of Northern Australia, the quality and condition of the landscape is compromised, to varying degrees, by the pressures of introduced species (both plant and animal), grazing by domestic stock, and frequent hot fires. That said, the past few years have witnessed a gradual increase in the regions natural resource management capacity, with the reinforcement of indigenous ranger programs, destocking of some cattle stations, and the establishment of new conservation areas.

4.1.1 Scope of Chapter

This chapter outlines the steps taken to assess the biodiversity values of the Roper Iron Ore Project areas and their surrounds. These areas are examined with regard to their contribution to local, regional, national and international biodiversity values, and hence conservation significance. The character and typical range of terrestrial species (and freshwater fish) and ecosystems within the proposed development envelopes are described. Freshwater macro-invertebrates, however, are discussed in Chapter 6. A particular focus has been placed on identifying notable species and sensitive habitats, as these possess a high conservation value. The threats from project development activities detrimentally impacting on the identified biodiversity values are examined. Biodiversity values regarded as being at risk are referred to Chapter 9 and commitments are made to those requiring further study or ongoing monitoring.

No development can proceed without some loss to environmental value. This chapter concludes with a calculation of environmental loss – largely using vegetation type layers and impacts (direct and indirect) on vegetation and habitat. These losses are to be accounted for through WDRL's commitment to the Northern Territory Biodiversity Offsets Program (refer to Chapter 11).

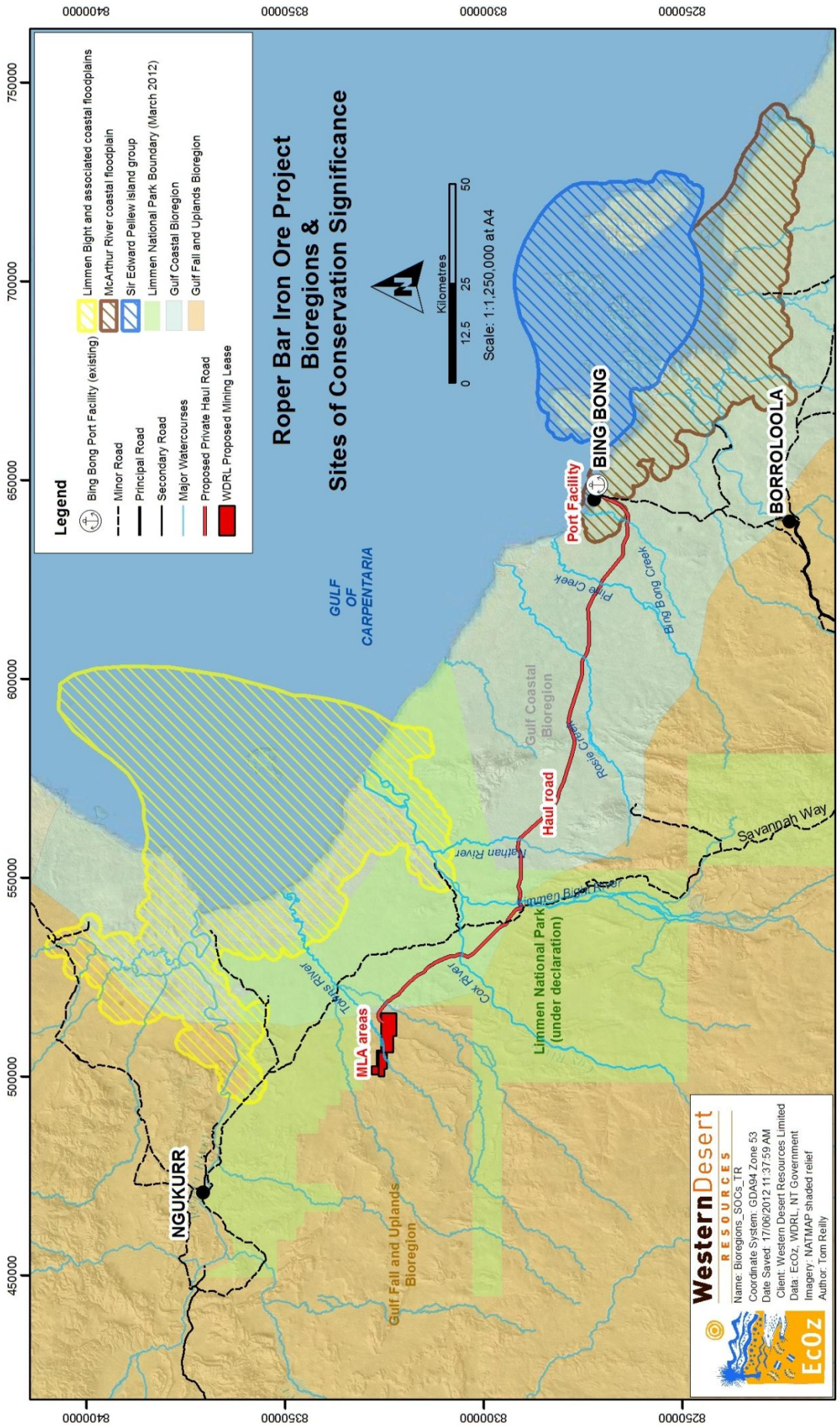


Figure 4-1: Location of the key components of the Roper Bar Iron Ore Project and regional Sites of Conservation Significance.

4.2 Assessment Methods

The biodiversity context, values and concerns for the Roper Bar Iron Ore Project have been assessed for the three key development components – the MLA areas, the haul road corridor, and the coastal port facilities – and their surrounds.

The key steps taken towards this assessment were:

A. Scoping the existing environment and biodiversity values through a combination of:
- **a.** A desktop review of existing data and information
- **b.** Field surveys, inclusive of
  - **i.** Vegetation surveys and mapping
  - **ii.** Specific habitat delineation
  - **iii.** Fauna surveys (largely terrestrial with some freshwater fish surveys)
  - **iv.** Targeted species surveys for a shortlist of species
  - **v.** Observations of critical ecological processes (e.g. surface drainage, presence of invasive species and the effects of fire)

B. Screening biodiversity values to identify priority species and sensitive habitats (based on distribution and habitat)

C. Assessing threats to these from the development

D. Referring to Chapter 9 any species or habitats that are identified as potentially being at risk from the development

4.2.1 Desktop review

The most up-to-date understanding of the ecological context for the project area was established through collating information from previous studies and existing dataset. The data enquiry included broad-scale reviews of climate data, geomorphology, land system and vegetation mapping. A review of flora and fauna species which are recorded to occur (or predicted to occur) within the proposed impact zones was compiled from a number of datasets and enquiry tools. This included known distributions and preferred habitats for flora and fauna species, as well as the current status of disturbance in the region.

Descriptions of the primary sources of information are presented in Appendix D.

4.2.2 Field Surveys

A number of vegetation and fauna surveys were conducted to supplement existing information, and to increase the level of knowledge of biodiversity values (e.g. habitats and species) within the vicinity of the proposed project. An indication of the areas surveyed is presented in Figure 4-2 and Figure 4-3 (more detail can be found in Appendix D).

The level of survey intensity, and any specific interrogations, varied with the degree of proposed disturbance within each of the three key development zones. Field assessments focused on providing baseline information such as vegetation maps and habitat characterisations, including discerning flora and fauna species association. The objective was to identify areas and/or species which may be sensitive to disturbance. As a consequence, surveys primarily targeted areas more likely to feature the greater range of species within the local area or to contain species and habitat which may be particularly 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. 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 surveys). The scope of field studies conducted for each of the proposed development zones are listed in Table 4-1.

In all cases vegetation and fauna assessments were carried out concurrently. Most of the biodiversity surveys have occurred during the 'build-up', or the early, mid and late Wet season. Only the MLA areas had

a repeat survey in the Dry season. Overall, the survey timing was highly successful in detecting ephemeral or seasonal species (both plants and animals). However, the diversity of reptile species dropped significantly with the onset of heavier rains associated with the surveys in early 2012.

Several attempts were made to engage the input of indigenous and local ecological knowledge, however, the input was much more limited than desired.

Table 4-1: A summary of terrestrial and freshwater fish ecological studies undertaken within each of the proposed development zones.

Project Area	Focus	Scope	Consultant & timing
MLA Areas	Reconnaissance survey	Helicopter survey – initial scoping of habitat and relation to proposed development zone.	Oct 2010
	Vegetation mapping	Preliminary vegetation mapping from aerial imagery and helicopter survey.	Oct 2010
		Refined vegetation descriptions and mapping to 1:25,000 scale.	May 2011
		Further refinement of vegetation mapping for rehabilitation targets and potential groundwater dependant ecosystems.	Jan 2012
	General terrestrial fauna survey	Fauna associated with habitats most likely to feature the more diverse range of fauna. Timing: Early Wet Season (build-up) & Dry Season.	Oct 2010 June 2011
	Targeted species survey	Bare-Rumped Sheath-Tailed Bat (study area covered a broader region inclusive of off-site). Early Wet Season.	Jan 2012
	Freshwater fish survey	Assessment of five sites for freshwater fish occupying permanent and semi-permanent freshwater systems. Timing: Late Dry season / Early build-up	Oct 2011
	Macro invertebrates	Studies of the regional aquatic systems to baseline water quality. See Chapter 6.	April 2012
	Groundwater Dependent Ecosystems	Estimation of likelihood of Groundwater Dependent Ecosystems through overlaying groundwater contours with Vegetation Mapping.	Jan 2012
Haul Road	Reconnaissance survey	Helicopter survey – scoping the preliminary path.	September 2011
	Sensitive land type mapping	Multiple criteria used to determine and delineate zones of higher value which warrant characterisation and avoidance. Timing: Early Wet Season	Feb 2012
	General terrestrial fauna survey	General fauna associated with habitats most likely to feature the more diverse range of fauna. Surveys were targeted to three primary high value landscapes /zones along the haul route, and two additional areas to assist with setting the general regional context. Timing: Early build-up & Early Wet Season	Oct Nov 2011 + Jan Feb 2012
	Macro-invertebrates	Studies of the regional aquatic systems to baseline water quality. See Chapter 6.	April 2012
	Weed survey	*Baseline assessment of weed infestations to underpin management planning. Target final haul road alignment, and up and downstream zones*	*EIS Commitment*
Coastal Port	Reconnaissance survey	Helicopter survey – scoping for general land types and higher value areas.	Nov 2011

Project Area	Focus	Scope	Consultant & timing
	Vegetation mapping	Helicopter survey, interpretation of aerial imagery and initial ground-truthing of dominant vegetation types. Timing: Mid/Early Wet Season	Feb/March 2012
	General terrestrial fauna survey	General fauna associated with habitats most likely to feature the more diverse range of fauna targeted to three primary land types. Timing: Early Wet Season	Feb 2012
	Shorebird potential	Reconnaissance survey – by helicopter for potential shorebird nesting and feeding areas. Timing: Early Wet Season	Feb 2012
	Weed survey	*Baseline assessment of weed infestations to underpin management planning.*	*EIS Commitment*

Vegetation Surveys and Mapping

The Roper Bar Iron Ore 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. The vegetation surveys carried out fit within three main assessment types:

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

The level of vegetation assessment applied to each of the three key development areas is presented in Appendix D.

Targeted Flora Surveys

While a number of plant species within the Gulf bioregions are rare, restricted in range, threatened or endemic, 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) of vegetation assessments for the MLA areas, is seen as sufficient to detect the presence of ephemeral and any rarer plant species within this zone. The potential haul road and coastal port are targeted for further future assessments to increase the probability of lesser known species being detected.

The haul road surveys focused on delineating and characterising notable habitats (or those preferably avoided) within a six kilometre wide corridor of the potential transport route. The notable habitats targeted were: rocky ridges, tributaries, water bodies and vegetation types inclusive of rainforest, monsoonal vine thicket, and riparian vegetation. These habitat types and land forms were chosen as they are more likely to either feature a diverse range of plant and animal species (or species assemblages which are less typical to the region), or are those prone to cause significant local management concerns and are therefore of particular concern for any level of disturbance.

The first round of fauna and habitat assessments resulted in relocating the potential haul road route to avoid the more sensitive areas in the landscape. The currently proposed corridor encompasses an area which has not yet been surveyed with an equivalent level of detail. Further assessments will be required to inform minimal impact recommendations for sources of rock and water required for construction purposes.

Standard Fauna Surveys

A series of fauna surveys were conducted for all three potential zones of impact: MLA areas, haul road route and coastal port (Figure 4-2). The aim of the fauna surveys was to scope the range of species potentially

inhabiting the proposed zones of impact, and to attempt to relate species presence with particular habitat types, thereby enabling assumptions about the likely diversity featuring in similar areas which have not been surveyed. Habitat types selected for surveying were targeted to those which are either common within the area, most likely to feature a diverse range of species, and/or likely to be targeted for disturbance.

Freshwater Fish

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 in order 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 (see, instead, Chapter 6 which covers surface water quality).

Targeted Fauna Surveys

Based on existing data and the quality of the habitat within the MLA areas, the Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*) – listed as Critically Endangered under the EPBC Act and Data Deficient under the TPWC Act – was subjected to a focused survey. This involved trapping, acoustic recording and roost searches conducted over five days in the early Wet season (January) of 2012 both within the MLA areas and at sites along Towns River and Little Towns River crossings on the Savannah Way.

This survey found no conclusive evidence for the presence of the Bare-Rumped Sheathtail Bat. Calls that can be identified as originating from a *Saccolaimus* species were recorded, but are likely to be from the more common species – the Yellow-Bellied Sheathtail Bat (*Saccolaimus flaviventris*).

Call playback was utilised within the MLA areas to detect the Masked Owl (northern subspecies) (*Tyto novaehollandiae kimberli*) listed nationally as Vulnerable, without any positive results.

Groundwater Dependent Ecosystems

Potential groundwater interaction and dependence for the vegetation types within the MLA areas is discussed in Appendix D. The method of assessing groundwater dependency involved overlaying modelled contours for an average groundwater level with the vegetation mapping. Vegetation types which intersect with the predicted groundwater level being within the root zone (set at 10m), and also with characters suggesting potential groundwater dependency, were interpreted to have a high potential for some level of groundwater dependency.

Ecological Processes & Resource Condition

Ecological processes which may be critical to sustaining the functioning, structure and diversity for the proposed development areas and their surrounds have been ascertained through field observations over a two year period. Weeds, fire and presence of feral animals have been recorded within all of the survey locations, with special attention being paid to road corridors, riparian zones and wetlands.

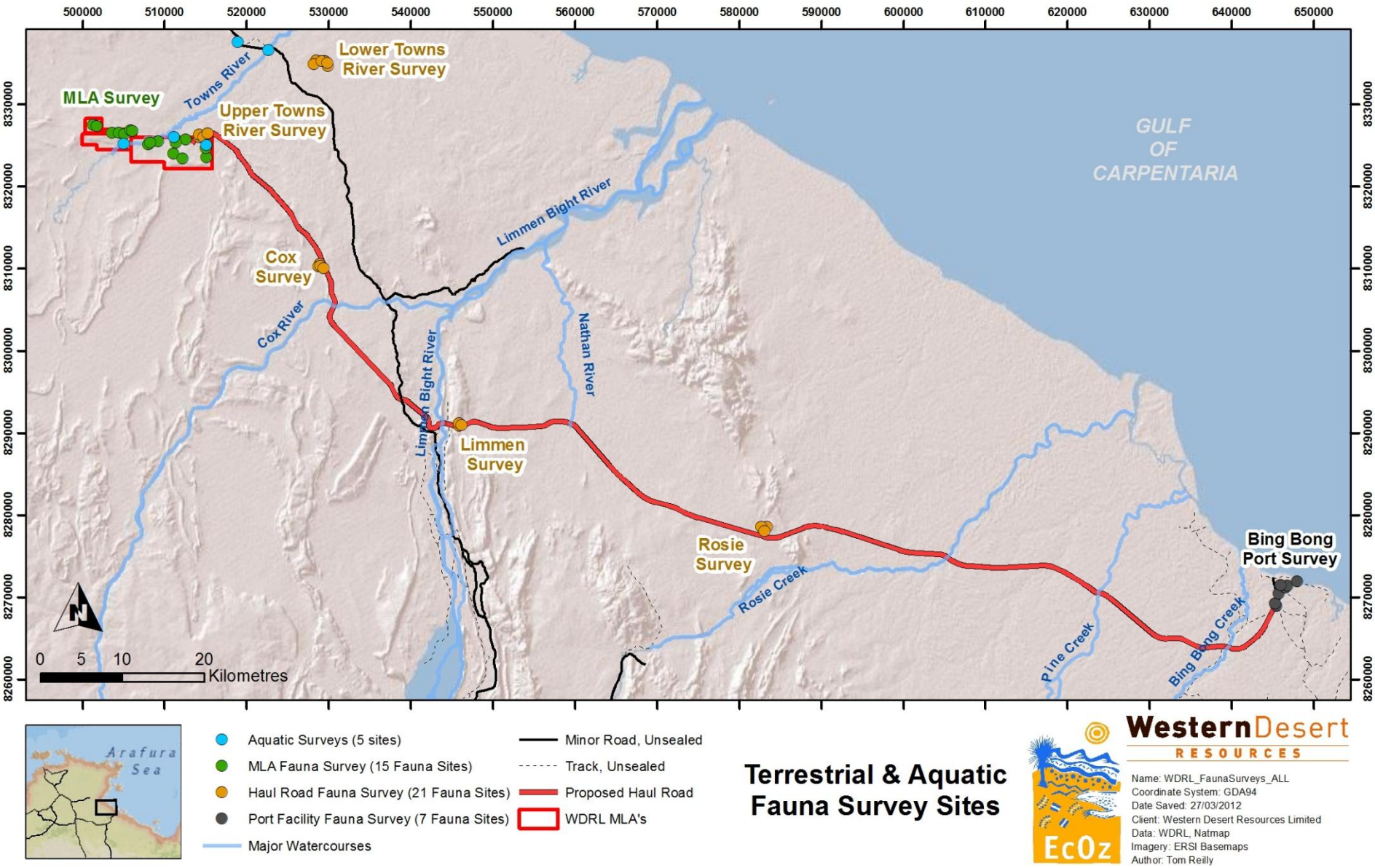


Figure 4-2: Summary map of baseline fauna surveys.

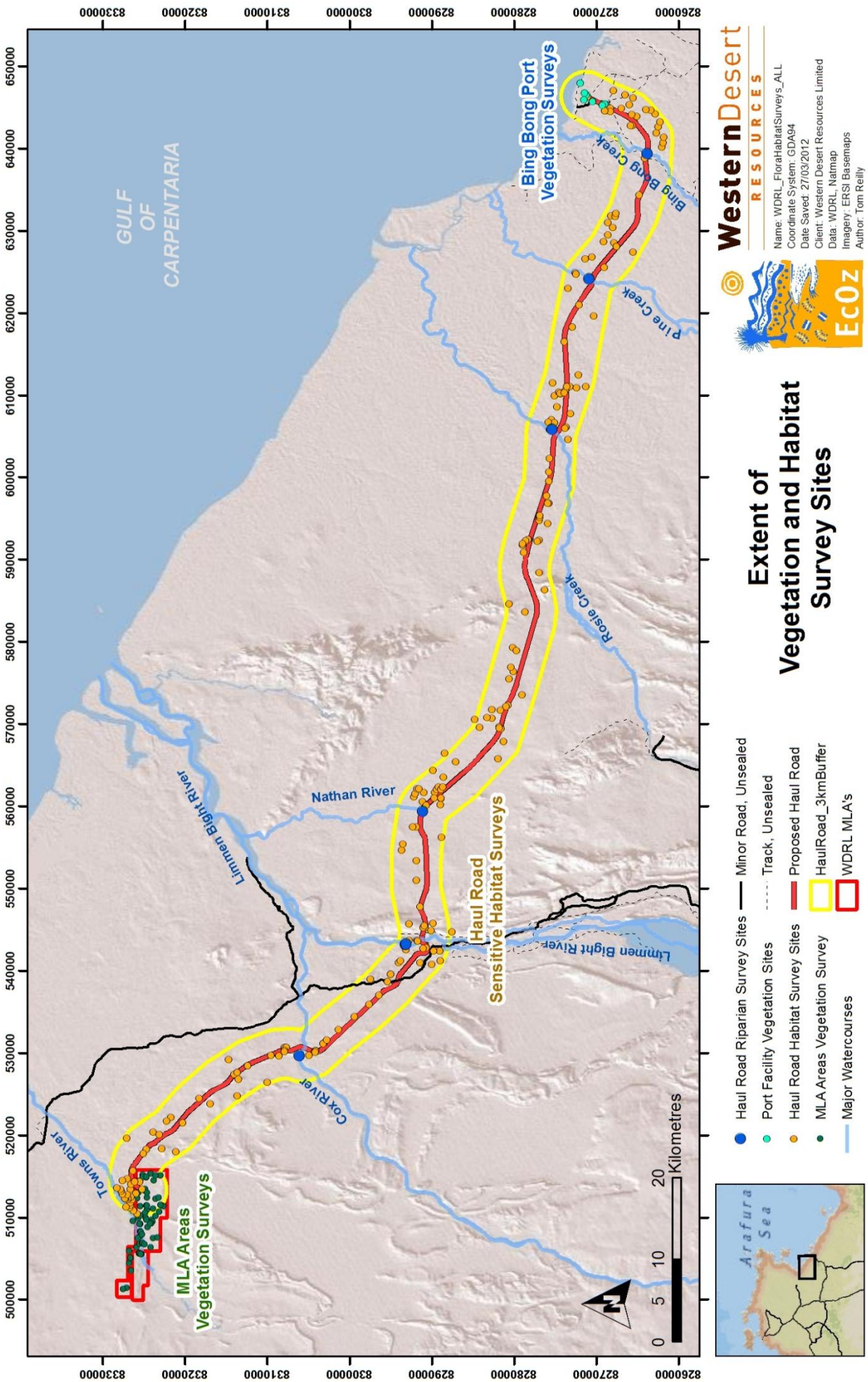


Figure 4-3: Vegetation and habitat survey sites.

4.2.3 Evaluating Notable Species and Sensitive Habitat

Defining Biodiversity

Biodiversity is defined (NBSRTG 2009) as comprising three levels:

- Ecosystems – the variety of habitats, biotic communities and ecological processes;
- Species – the variety of species; and
- Genes – variation within a species.

The overarching objectives for biodiversity associated with the Roper Bar Iron Ore Project are:

- To maintain the abundance, diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and the improvement in knowledge;
- To minimise threats of the project to notable habitats and species; and
- To ensure there is no net loss of biodiversity (as per the Territory 2030 Strategic Plan (NTG 2009)).

The assessment of biodiversity values and concerns for the project does not solely focus upon species and ecosystems recognised under international, national or Territory legislation. The need to maintain biodiversity resilience – the capacity for the landscape to maintain existing functionality, as well as the ability to evolve and adapt – over a range of scales and for the long term also needs to be kept in mind. However, a focus on notable species and sensitive habitats permits identifying and assessing broader biodiversity values, processes and concerns from a range of perspectives and scales (local, regional, national and international).

Identification of Notable Species

The term 'notable' is used in this assessment to denote species or habitat and ecological processes which 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 to define species risk of extinction (Figure 4-4).

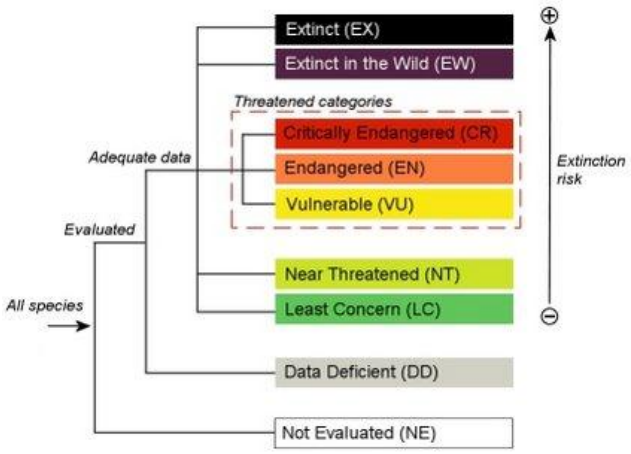


Figure 4-4: The IUCN Red List categories of risk for threatened species.

(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;
    - 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;
    - 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 Habitats

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 disjunct 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.

Given that the MLA areas are located within close proximity of the boundary of the proposed Limmen National Park, particular consideration has been given to factors which may contribute to maintaining ecological connectivity between the zone of disturbance (particular the mine site) and the surrounds.

Cultural Values for Biodiversity

The project areas fall within a broad region of value to indigenous land owners and native title holders. This assessment of biodiversity values and concerns therefore also considers species and habitat which may be of cultural significance to the regional population. These species and habitat are considered notable from a cultural perspective. Community consultations were conducted to determine the significance of cultural values of biodiversity that may be disturbed by the project. Refer to Appendix H in regards to community consultation approaches for this project.

4.2.4 Calculating Environmental Loss

Environmental losses can, in part, be offset or compensated for by investing in actions which bring about positive environmental consequences. These would not otherwise occur in the absence of the proposed loss or development. As used in other states of Australia, a metric for calculating the amount of offsets has involved an estimated area of clearing and a multiplier for habitat value. Where a notable species may be impacted, a more focused offset (which will aid the protection of this species nearby or elsewhere) is proposed.

Environmental loss was calculated by estimating direct impact on native vegetation within the project footprint. 'Direct impact' refers to locations that will be cleared for the mining activity. There will also be indirect impact on adjacent or downstream vegetation communities that will not be cleared, but will be altered in one way or another (i.e. increased noise activity, dust, sedimentation, localised fragmentation, altered surface drainage etc.). Indirect impacts have not been calculated as part of this assessment.

The area of each vegetation type that will be cleared for the development of the project was also calculated, with the aim of determining if sensitive habitat types will be impacted, and therefore require more rigorous management or offset considerations. This was possible at a scale 1:25,000 for the MLA and Port areas, and at a scale of 1:250,000 (land systems) for the haul road corridor.

4.3 Existing Environment

4.3.1 Bioregional Context

The Roper Bar Iron Ore Project lies within two bioregions (Figure 4-1):

- The **Gulf Fall and Uplands** bioregion is the second largest in the NT and stretches from the Arnhem Plateau into western Queensland. It comprises undulating terrain with scattered low, steep hills and rugged dissected plateaux. The most extensive vegetation is woodland dominated by Darwin Stringybark (*Eucalyptus tetrodonta*) and Variable barked Bloodwood (*Corymbia dichromophloia*) with spinifex understorey, and woodland dominated by Northern Box (*Eucalyptus tectifica*) with tussock grass understorey.
- The **Gulf Coastal** bioregion encompasses the lower reaches of many major rivers which originate in the Gulf Fall and Uplands Bioregion. Eucalyptus woodland with tussock or hummock grass understory dominates the bioregion, with significant areas of tidal flats, mangroves and littoral grassland.

Bioregional audits (NRETAS 2012a) indicate there is evidence of some broad-scale species declines for at least some mammals and birds species in both bioregions. As with most other bioregions in northern Australia, the major threatening processes to biodiversity include altered fire regimes, weeds, feral animals and grazing by livestock. All of these threatening processes operate on a broad-scale.

The Australian Collaborative Rangeland Information System, reporting change in the rangelands (Bastin and ACRIS 2008), indicated that land functionality for the Gulf Fall and Upland Bioregion for a number of locations showed declined condition (between the years of 1991 and 2005) despite good seasonal rains. This is generally indicative of land degradation from overgrazing. However, the extent of the cattle industry in the region seems to be progressively downscaling or diversifying into tourism and other nature-based enterprise.

Topography and Catchments

The vast majority of the landscape within both Gulf bioregions is a relatively low and undulating valley floors formed from more erodible siltstones, mudstones shales and carbonates (Refer to Chapter 3). These lower areas feature extensive *Eucalypt* and *Melaleuca* woodlands, ephemeral tributaries and strings of *Melaleuca* dominated billabongs. The extensive alluvial plains, particularly within the Gulf Fall and Uplands bioregion, are dissected with uplifted sandstone ridges running in an approximate north-south linear direction. These sandstone ridge formations are infrequent but significant features in the landscape, with a conglomerate of less typical habitats (inclusive of caves and springs). To the east of the Limmen River, the geology is

dominated by the sedimentary of the Roper Group which features more rolling hills. West of the Limmen the geology is much older and rugged and features the Yiyintyi ranges (near Rosie River), a unique and unusual formation with dissected plateaus.

The major river systems in the Northern Territory's Gulf country mostly originate approximately 60km inland from the coast in the uplifted, less erodible, sandstone plains and rises of the Gulf Fall and Uplands. These tributaries meander and break through the sandstone ridges creating river gorges before heading north-east towards the Gulf of Carpentaria coastline. The main rivers and creeks in order from west to east are the Roper River, Towns, Limmen, Cox, Nathan and Rosie Rivers, followed by the Pine, Bing Bong and Mule Creeks, and then the McArthur River. Most of the river systems in the Gulf region are ephemeral, by the end of the Dry season they cease to flow and dry to isolated water bodies (Zarr 2009). However, some localised areas flow all year round as they are supported by baseflow from groundwater aquifers, such as the upper reaches of the Rosie and MacArthur Rivers (Zarr 2009). Springs are also known to occur throughout the region. Rosie Creek, Limmen River and MacArthur River are known to have near-permanent flows in localised areas, for several kilometres, which are associated with fault springs (Zarr 2009).

The MLA areas are situated in the mid-level of the Towns River catchment. The haul road corridor traverses the Towns, Cox, Limmen, and Rosie Rivers as well as Pine Creek. It terminates at the Port of Bing Bong which is situated near the mouth of Mule Creek. Chapter 6 provides further details on the character of the surface waters for the greater region.

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 proposed haul road and coastal port facility fall within the northern tip of the McArthur River Coastal Floodplain SOCS (Figure 4-1).

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).

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 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: NRETAS 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).

Fire History

Fires are a regular occurrence in the bioregion and in the past five years a majority of the landscape has been burnt at least once (Figure 4-5). 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 port vicinity has been burnt recently. Coastal areas often contain 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. Most of the area containing the haul road corridor has experienced multiple late burns in recent times (see Appendix D).

NAILSMA supports two large projects focused on carbon emission reduction and biodiversity through managed early season burning to the north and south of the Limmen National Park. However, there is no equivalent fire management regime for the region immediately surrounding Limmen National Park.

Existing Species 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 area (see Figure 4-6 and Figure 4-7).

The two Gulf bioregions contain an abundance of flora species – as an indication, 1299 species alone are known to occur in the Limmen National Park (NT Herbarium Holtze Database). 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.

Few surveys have been conducted in the region and most have concentrated around accessible sections of the major tributaries and rocky ridges, and the two significant tidal systems. This pattern may be a reflection of ease of access, but it is also likely that these are the primary landscape elements which predispose the regions' biodiversity to be concentrated in particular areas. Within this context, therefore, there remains the potential to identify new species and, more likely, variations (distribution, ecology and genetics) within known species. This potential is illustrated by the results of field surveys conducted for this EIS which identified 21 fauna species not previously recorded for the greater search area. This included common birds such as Australasian Pipit (*Anthus novaeseelandiae*) and White-throated Needletail (*Hirundapus caudacutus*). More significantly, the record of Carpenter Frog (*Limnodynastes lignarius*) represents a ~400km range extension. Moreover, the observation of Long-footed Frog (*Litoria longipes*) in the port area places this species in the middle of a previously record-deficient region.

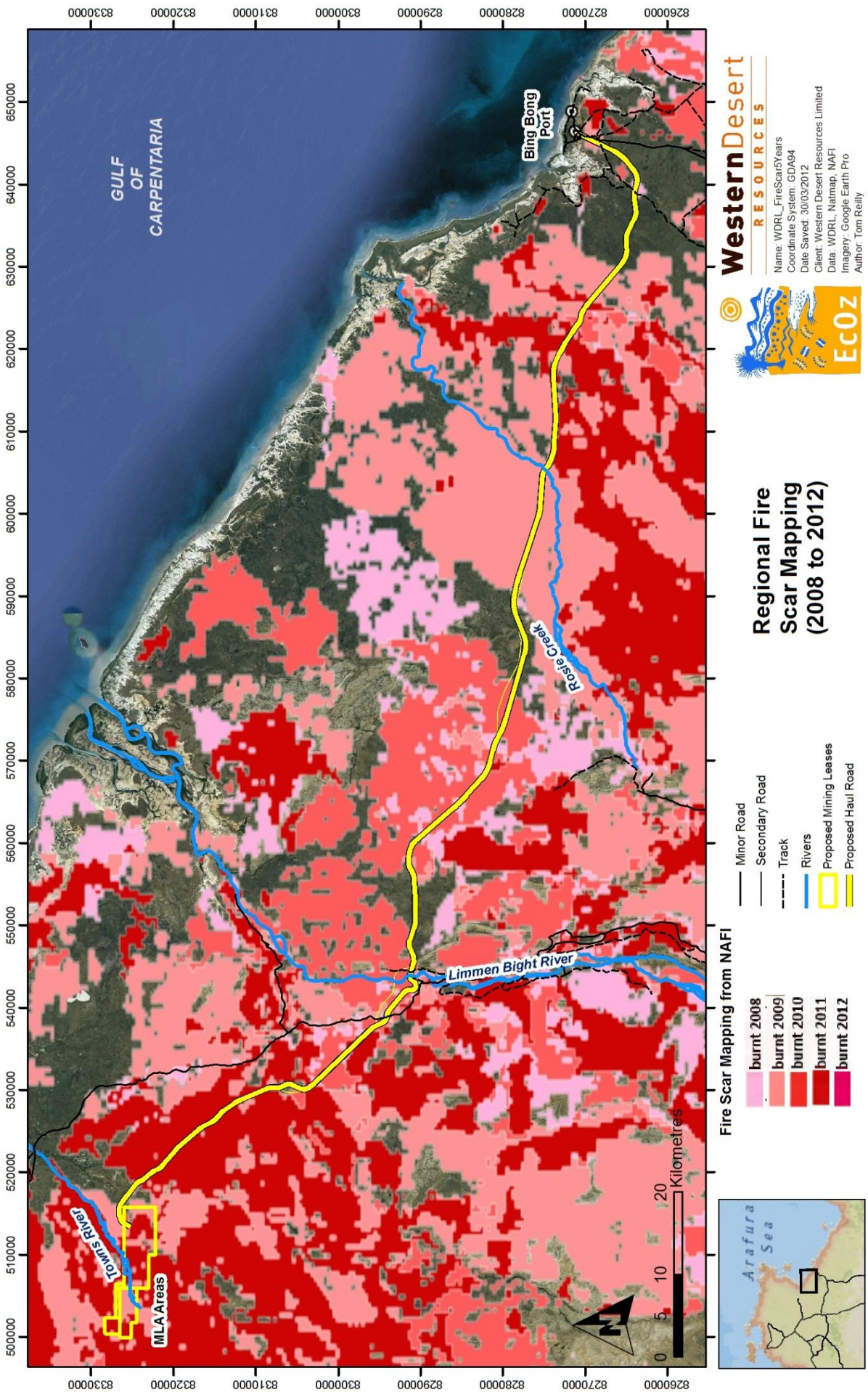


Figure 4-5: Regional five year fire scar map

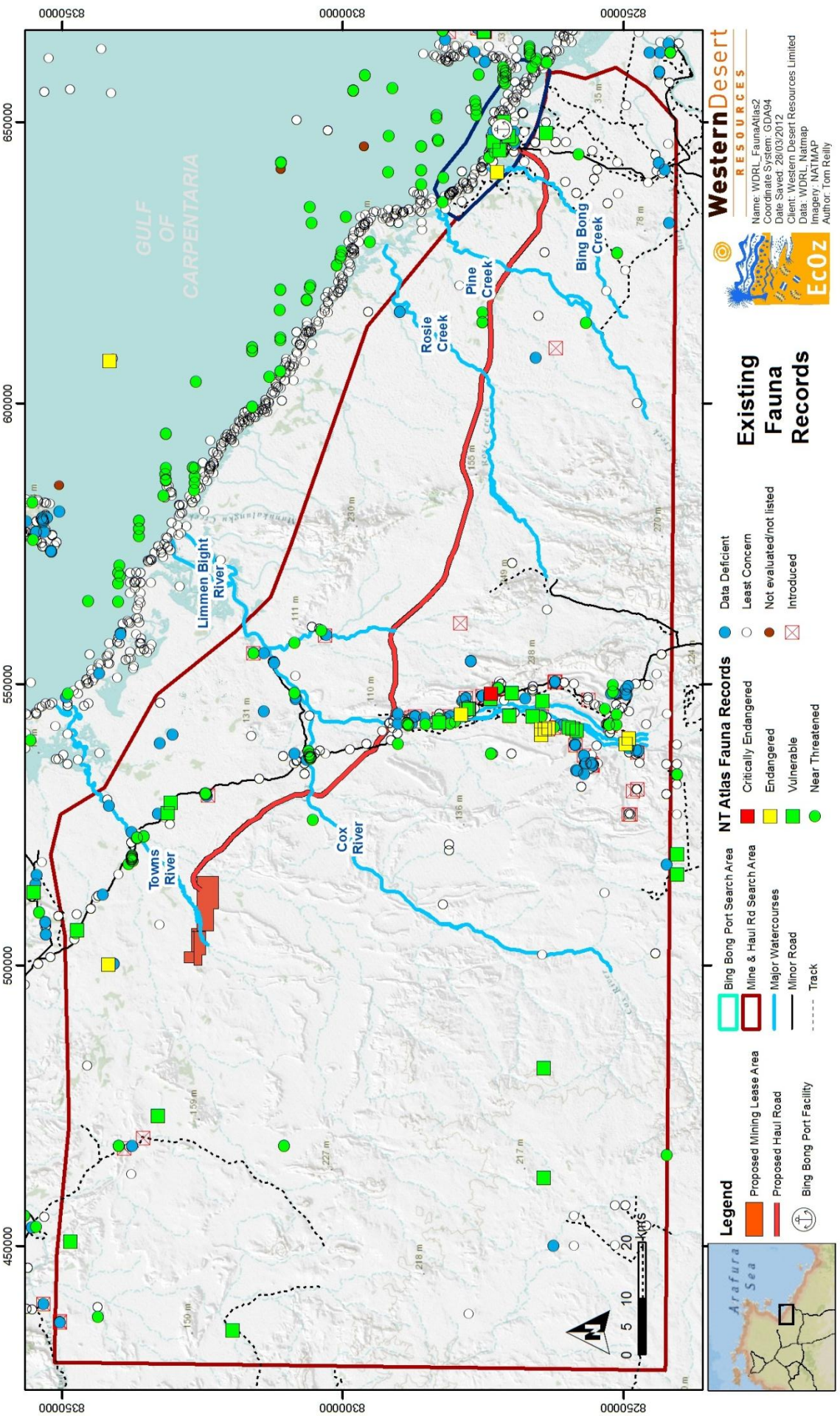


Figure 4-6: Fauna database search boundaries and significant records.

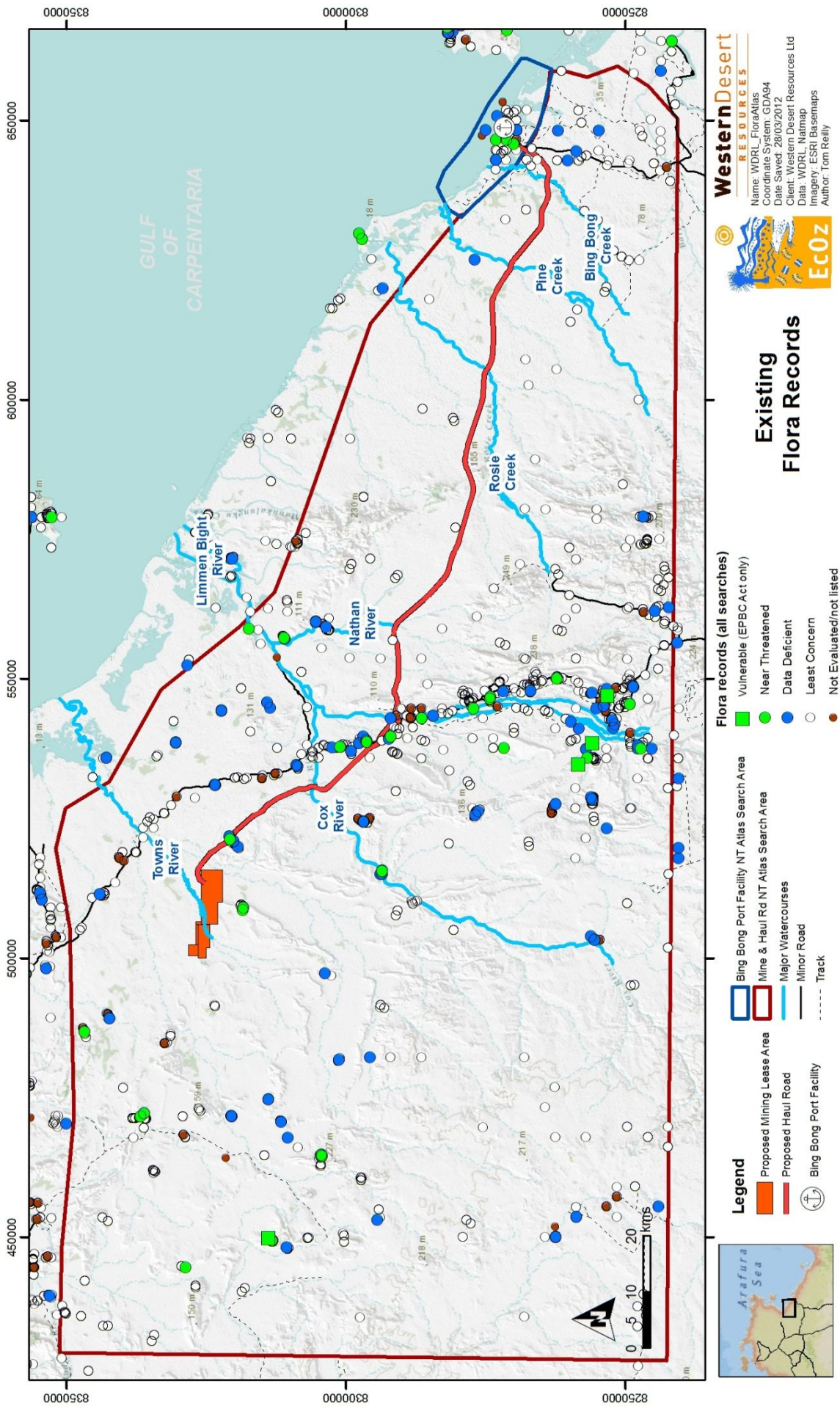


Figure 4-7: Flora database search boundaries and significant records

Introduced Species

The proposed project area contains several introduced fauna (pest species), including previous records of Cane Toad, Cattle, Swamp Buffalo, Donkey, Horse, and Pig – with Cat not recorded, but likely (see Appendix F). The highest number of records is concentrated primarily around Nathan River Station (likely reflecting survey efforts) with incidental occurrences of feral animals reported primarily around watercourses and linked with some degradation of riparian habitat.

A total of 75 weed species are known to exist or have the potential to invade into the environment of the project area (see Appendix F). Of these eight are recognised as high priority weeds (declared Class A under the *Weed Management Act 2001*) and 18 are recognised as being moderate priority weeds (declared Class B under the *Weed Management Act 2001*) (Figure 4-8). The greatest number of recorded weed species is along major roads traversing drainage lines or rivers, and within pastoral stations and areas containing settlements with relatively high levels of disturbance and vehicular traffic. It is unknown to what extent this is a real pattern or a sampling artifact.

Status of Conservation

In 2005, 10% of the Gulf Falls Uplands and 8% Gulf Coastal bioregions were identified as being within national conservation reserves – the proposed Limmen Bight National Park accounting for almost of all this (Baker *et al.* 2005). This proportion is augmented by some Indigenous Protected Areas (IPA's) – notably the Yanyuwa (Barni-Wardimantha Awara) Pellew Islands and the developing Marra Land Trust IPA. Other groups which actively undertake natural resource management in the region include Landcare groups and a number of indigenous ranger groups. Conservation areas in the vicinity of the project area are illustrated in Figure 4-9.

The Northern Territory Gulf country is important for linking the savanna from Queensland to Western Australia. The Kimberley to Cape Climate Change Corridor Project, driven by the North Australia Indigenous Land and Sea Management Alliance (NAILSMA), aims to facilitate a continuum of resource management activities supporting cultural, social and conservation connectivity objectives for the Northern Tropical Savannas (Whitten *et al.* 2011).

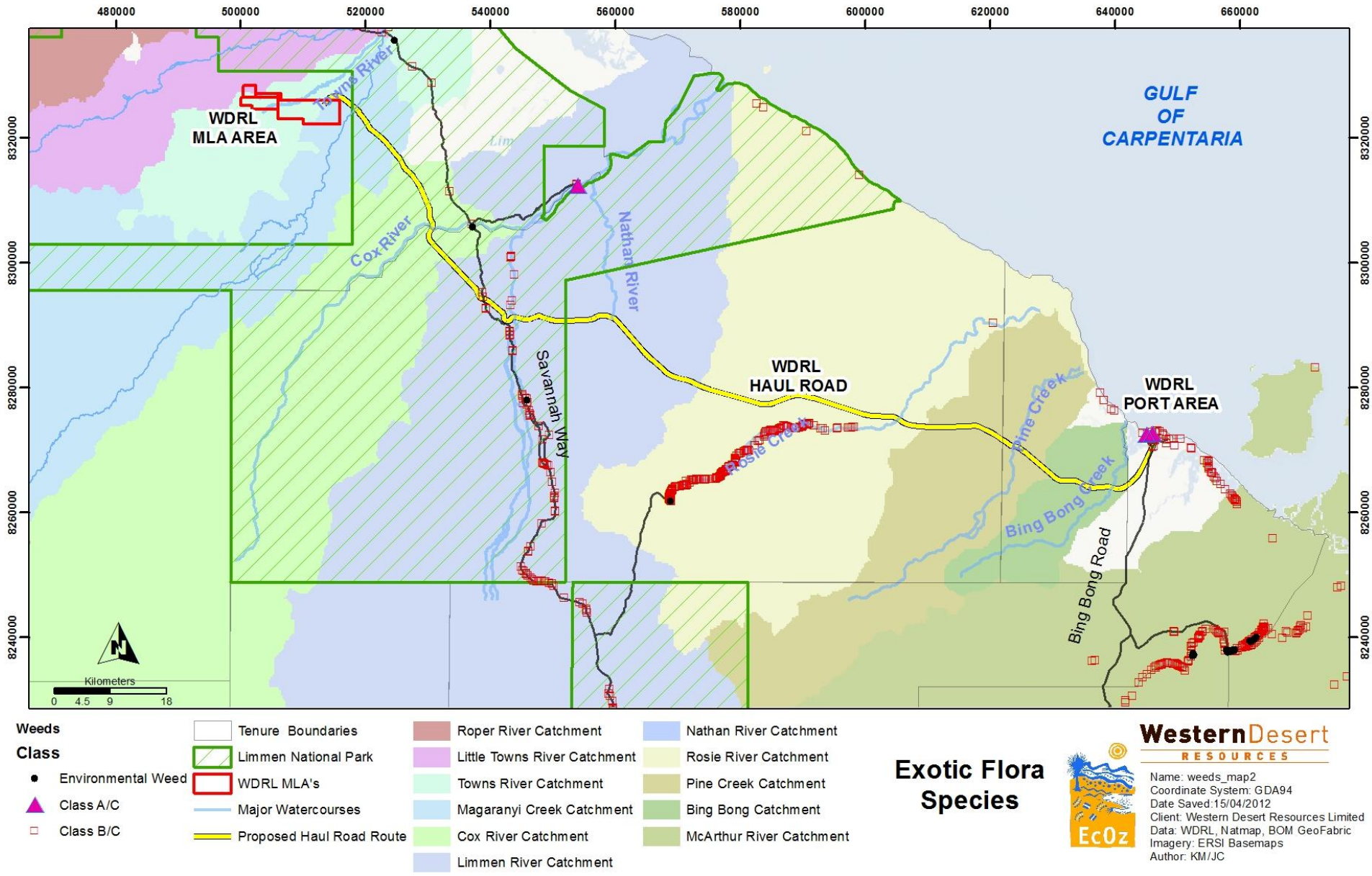


Figure 4-8: Existing weed records and surface water catchments in the vicinity of the project area.

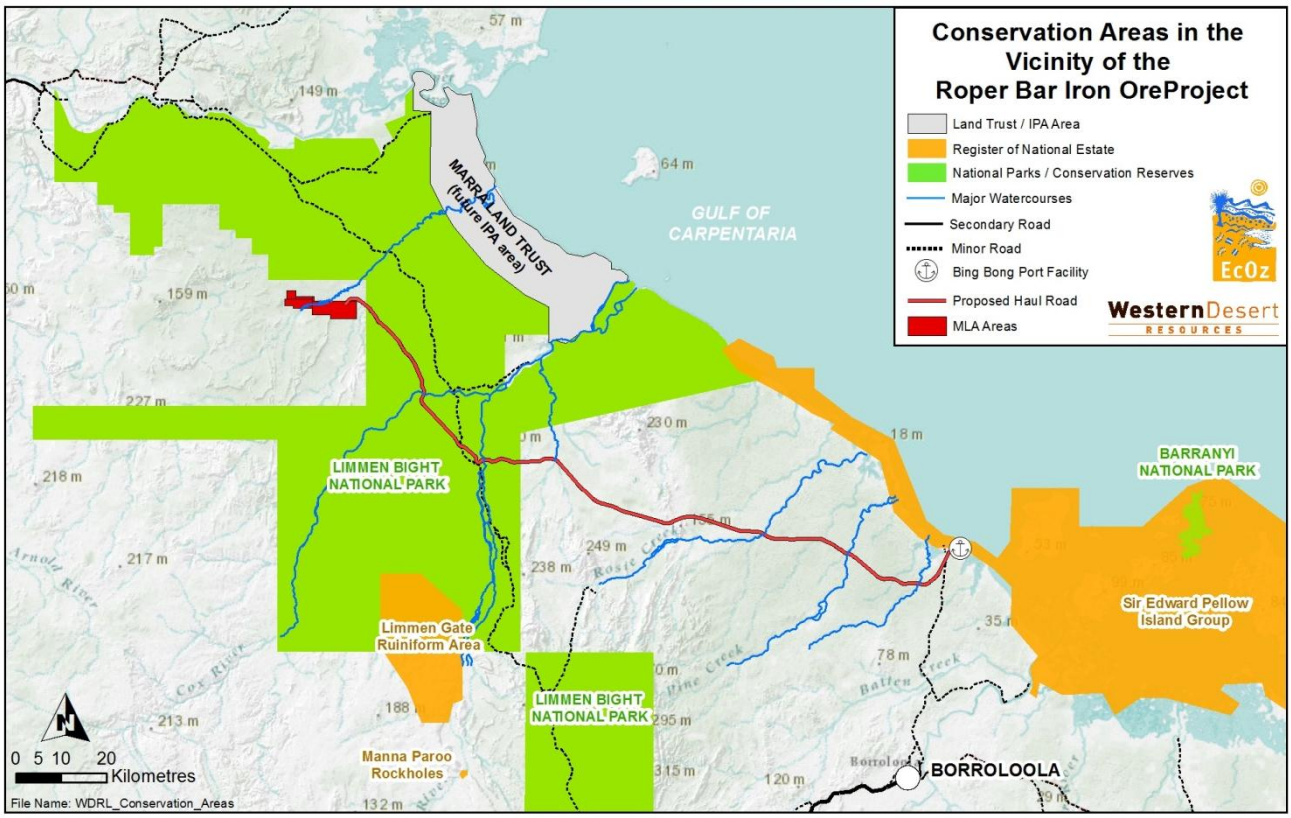


Figure 4-9: Conservation areas of varying status within the vicinity of the project area.

4.3.2 MLA Areas

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.

Vegetation Communities

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 4-2, depicted in Figure 4-10).

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 MLA areas the understorey is dominated by *Triodia* species or is a mosaic of either a Hummock grass or Tussock grass, whereas in the southern part the understory is dominated by heath (e.g. *Bossiaea* and *Jacksonia* species). Woodlands on the slight slopes transition into the other major habitat type *Melaleuca* open woodland.

Eucalyptus 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 4-3 and Figure 4-11). Detailed descriptions are provided in Appendix D.

Table 4-2: Five main vegetation and landform types present within the MLA areas

Broad Vegetation Types	Land form description	% of total survey area	Area (ha)
A. Acacia Woodlands			
	Rocky Ridges: Ironstone and white quartz sandstone, boulder dominated hills up to 30m high **Veg Units:** 1	4.6	164.2
B. Eucalyptus/Corymbia Woodlands over Hummock Grass			
	Undulating plains: Drier plains with a slight elevation and sandy loam soils and varying degree of clay subsoil **Veg Units:** 2, 3, 8	45.5	1628.9
C. Eucalyptus/Corymbia Woodlands over Tussock Grass			
	Low stony hills: Low rock and gravel covered hills **Veg Units:** 4, 6, 11, 12, 15	15.8	566.4
D. Melaleuca Woodlands			
	Inundated plains: Frequently inundated areas with sandy loam soils **Veg Units:** 5, 7, 9, 16, 20	31.6	1132.3
E. Wetlands and Riparian Woodlands			
	Stream channels: major and minor stream channels transitioning into billabongs **Veg Units:** 13, 14, 17, 18, 19, 21	2.6	91.5

Table 4-3: Summary of vegetation types found within the MLA areas

(note that Type 10 was merged into other types)

Veg Type 1. *Acacia shirleyi* Mid High Open Forest over

Veg Type 2. *Corymbia ferruginea +/- Eucalyptus tetrodonta, Eucalyptus phoenicea, Eucalyptus miniata* Mid Open Woodland

Veg Type 3. +/- *Corymbia ferruginea*, *Eucalyptus tetrodonta, Eucalyptus miniata* Low Open Woodland

Veg Type 4. *Eucalyptus pruinosa* and *Melaleuca citrolens +/- Atalaya hemiglauca*, *Corymbia confertiflora* Low Open Woodland

Veg Type 5. *Melaleuca citrolens, Hakea lorea +/- Corymbia polycarpa*, *Eucalyptus pruinosa* Low Open Woodland

Veg Type 6. *Corymbia polycarpa*, *Erythrophleum chlorostachys* +/- *Eucalyptus tetrodonta* Mid Woodland

Veg Type 7. *Melaleuca citrolens* +/- *Melaleuca viridiflora*, *Eucalyptus pruinosa* Mid Open Woodland

Veg Type 8. *Corymbia ferruginea, Eucalyptus tetrodonta* +/- *Eucalyptus miniata, Eucalyptus phoenicea* Mid Open Woodland

Veg Type 9. *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Grevillea striata*, *Bauhinia cunninghamii*, *Brachychiton diversifolius* Low Open Woodland

Veg Type 11. *Terminalia canescens*, *Terminalia bursarina*, *Hakea arborescens* Tall Sparse Shrubland

Veg Type 12. *Eucalyptus tectifica* Mid Open Woodland

Veg Type 13. *Excoecaria parvifolia, Melaleuca citrolens +/- Eucalyptus pruinosa*, *Terminalia bursarina* Low Woodland

Veg Type 14. *Eucalyptus camaldulensis, Corymbia polycarpa +/- Melaleuca nervosa*, *Melaleuca viridiflora* Low Open Woodland

Veg Type 15. *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys +/- Corymbia polycarpa*, *Corymbia ferruginea* Mid Open Woodland

Veg Type 16. *Melaleuca viridiflora*, *Terminalia canescens +/- Corymbia polycarpa*, *Eucalyptus pruinosa* Low Open Woodland

Veg Type 17. *Melaleuca viridiflora +/- Asteromyrtus symphyocarpa*, *Psydrax paludosa* Low Woodland

Veg Type 18. *Asteromyrtus symphyocarpa*, *Melaleuca viridiflora +/- Melaleuca citrolens*, *Corymbia polycarpa* Low Woodland

Veg Type 19. *Melaleuca viridiflora +/- Eucalyptus microtheca, Eucalyptus camaldulensis* Low Open Woodland

Veg Type 20. *Melaleuca nervosa*, *Melaleuca viridiflora +/- Corymbia polycarpa* Low Open Woodland

Veg Type 21. *Corymbia polycarpa*, *Erythrophleum chlorostachys* Mid Open Woodland

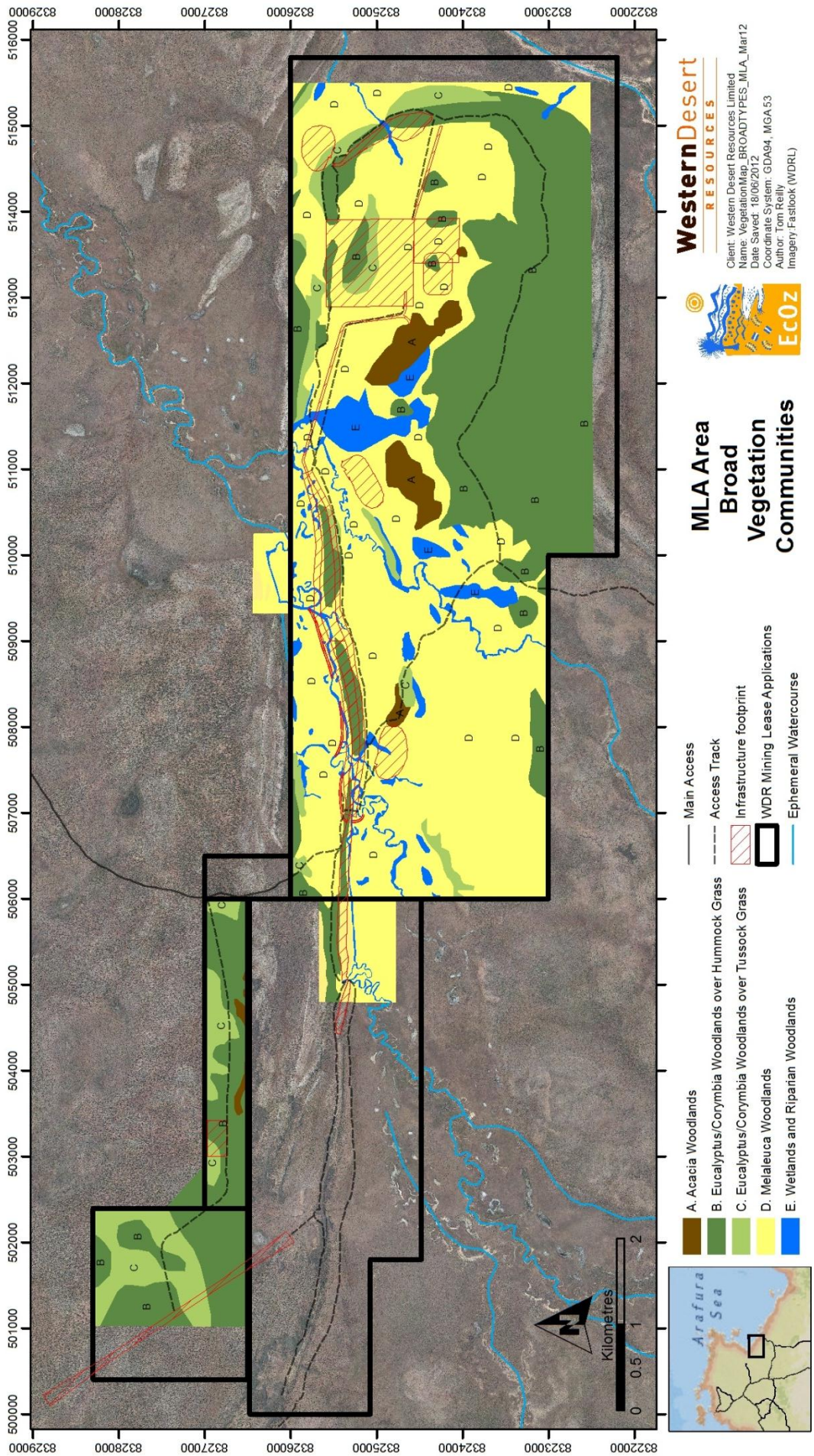


Figure 4-10: Five main vegetation types within the MLA areas

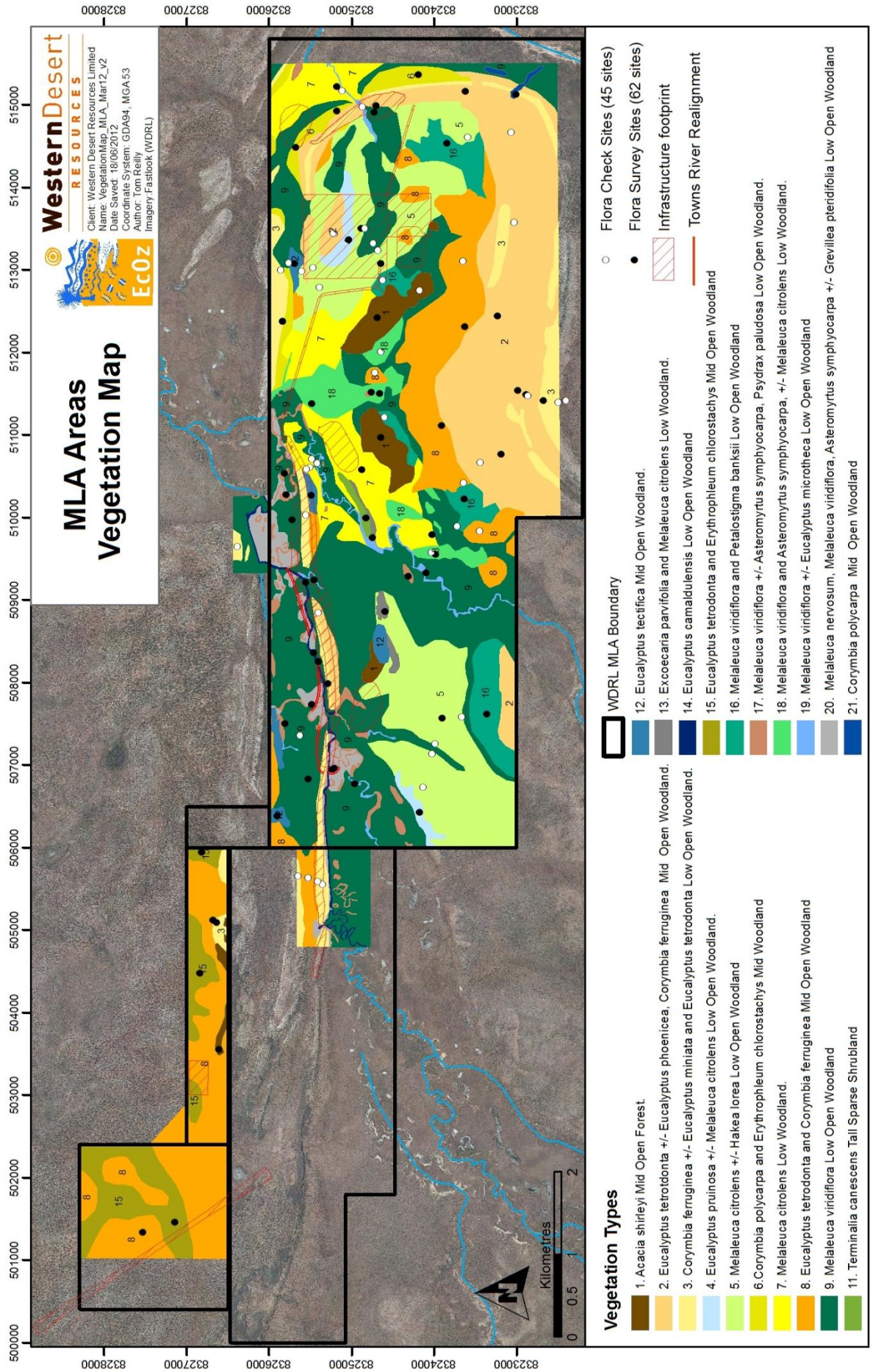


Figure 4-11: Detailed vegetation map of the MLA areas

Sensitive Habitat/Vegetation

None of the vegetation communities are listed under any legislation (TPWC or EPBC Acts) or were specifically regarded as being sensitive habitat. However, some vegetation 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 River catchment. The communities considered locally notable, and the justifications for this, are outlined below and shown in Figure 4-12.

Tall *Eucalyptus tetrodonta* 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* and *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 ($90m^2$) 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 River 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 groundwater 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).

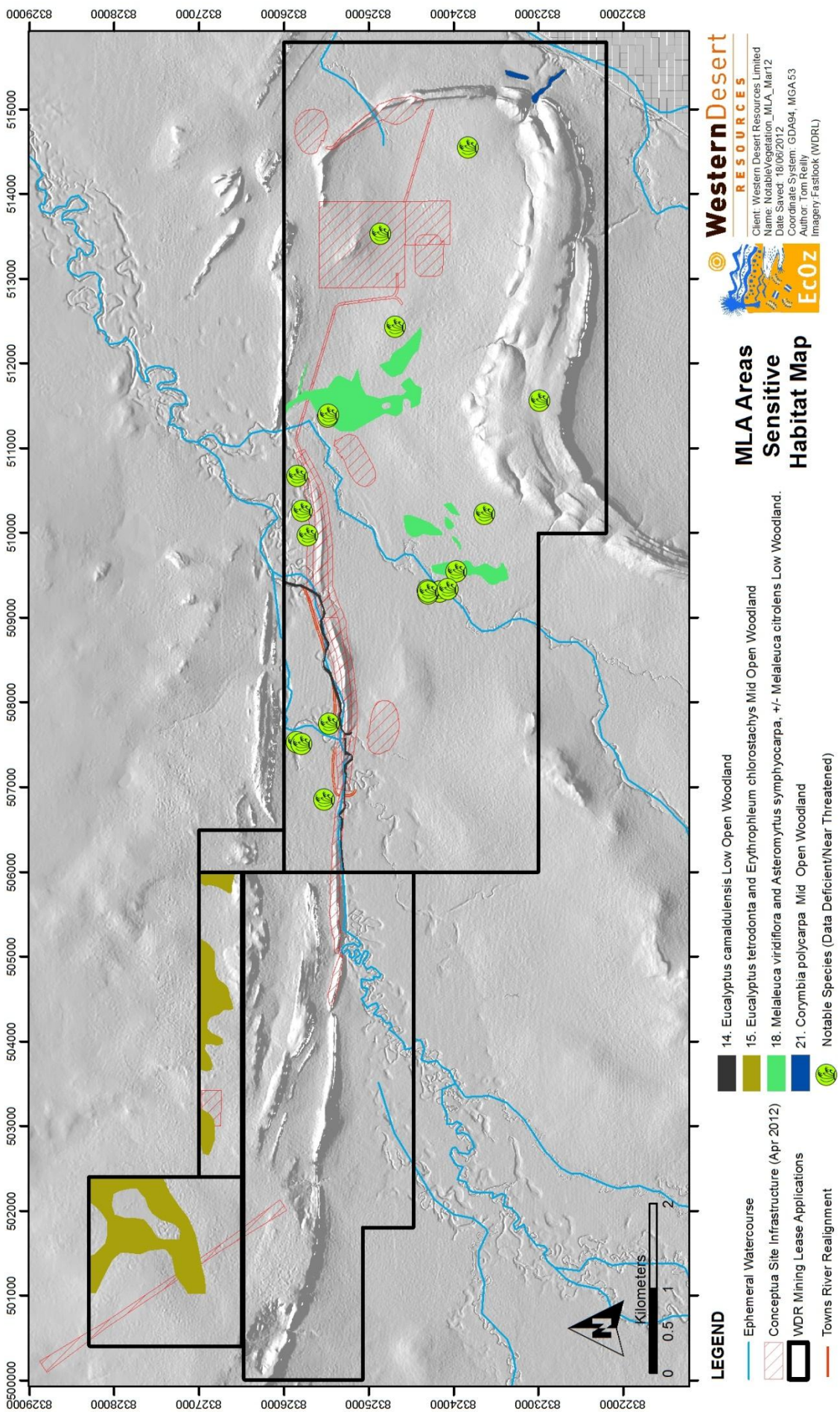


Figure 4-12: Notable Habitat within the MLA

Threatened and Notable Flora Species

A total of 302 flora species were identified within the surveyed MLA areas (compared to 1299 species being known to occur in the Limmen National Park, according to NT Herbarium Holtze Database).

Despite comprehensive survey efforts no threatened flora species were identified. Threatened flora species are unlikely to persist specifically in the MLA areas due to lack of unique habitat or landform types, and the fact that the surveys of Limmen National Park did not identify many threatened flora species.

However, field surveys did identify one Near Threatened species (*Ophioglossum gramineum* – fern) and seven Data Deficient species:

- *Psydrax paludosa* – shrub/tree;
- *Fimbristylis dolera* – sedge;
- *Hygrochloa cravenii* – aquatic grass;
- *Utricularia sp. affin fistulosa* – ephemeral herb;
- *Nymphoides exiliflora* – aquatic herb;
- *Fimbristylis subaristata* – sedge; and
- *Drosera fulva* – perennial herb.

These species are mainly in *Melaleuca*-dominated vegetation types which are seasonally inundated wetter vegetation communities (such as types 17-19). One of the Data Deficient species – *Psydrax paludosa* – is a woody tree. Trees are generally not missed in vegetation surveys and so it is possible this species is rare or uncommon.

Most records were outside of the zone of direct impact. It is likely that survey effort in similar vegetation types outside of the MLA areas would also support these species.

Refer to Appendix D for more detail on these species, and the potential impacts from the development on these local records/populations.

Groundwater Dependent 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 6.2.

Fauna Species

The field surveys of the MLA areas recorded a total of 150 fauna species, comprising of 13 amphibians, 34 reptiles, 91 birds, and 19 mammals. Field and desktop surveys identify a total of 460 fauna species that are found, or potentially occur, within the MLA areas (Table 4-4). This included a large search area around the MLA (Figure 4-6), as the immediate region contains very limited records which is not indicative of species diversity.

During the field surveys trap success was low for both reptiles and mammals, making the identification of key habitats for these difficult. Typically, though, rocky habitats provide optimum habitat for many reptiles, as well as the best refuges for mammals. Amphibian species favour damper habitats, especially those that are seasonally inundated. Birds and freshwater fish species are 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.

Refer to Appendix D for detailed information on MLA areas fauna surveys.

Table 4-4: Total fauna species within the MLA areas, haul road route, and surrounds – data from desktop and field surveys.

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

Bare-rumped Sheathtail Bat Surveys

The presence of *Saccolaimus 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. See Appendix D for more.

Threatened & Notable Fauna Species

Prior to the field surveys undertaken for this report there were no fauna records in the NT atlas for at least 15km from the MLA areas, and therefore there are no records of threatened fauna species. Threatened species that could be present are discussed in Appendix D, and those for which there is a plausible threat of impact from the project development are examined in Section 4.5 below.

No species listed as threatened under the EPBC Act were recorded during field surveys, even with targeted surveys for Bare-rumped Sheathtail bat (*Saccolaimus saccolaimus nudicluniatus*) and Masked Owl (*Tyto novaehollandiae kimberli*). Three threatened species as per the TPWC Act were noted:

- 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;
- 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 at 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.

In addition, during field surveys the lower, more estuarine reaches of the Towns River were judged to be likely habitat for freshwater sawfish (Dave Wilson pers. comm. 2011).

Although not a listed species, the Borroloola Dtella (*Gehyra borroloola*) is endemic to the bioregion and was recorded on the rocky ridges at Site 4 (which is within Area E) and Site 5, but not similar Site 3.

No species of particular cultural value (e.g. stable food or totem) were noted as present within the MLA areas. However, further liaison with custodians may alter this conclusion.

There is negligible suitable habitat within the MLAs for migratory shorebirds, however they have been recorded in significant numbers 40 km downstream of the Towns River, as detailed in Section 4.4.2.

Introduced Species

Despite considerable formal flora survey and vegetation mapping no weed species have been recorded within the MLA areas. There are ample signs of Pig, Water Buffalo (in low numbers), Donkeys and Cane Toads.

4.3.3 Haul Road

The haul road corridor crosses a number of major rivers and creeks, including the Limmen River, and traverses a variety of landforms including: alluvial floodplains, coastal dunes, lateritic plains, rugged quartz sandstone plateaux and hills, sandstone hills, sandstone plains and rises and tidal flats.

Vegetation Communities

The vegetation map presented in Figure 4-13 shows that the haul road route is set to traverse large sections of *Eucalyptus* woodland located on flat to undulating plains (Veg ID 570) east of the Limmen River and continuing through to the Bing Bong port facility. This vegetation type is dominated by *Eucalyptus tetrodonta*, *Corymbia ferruginea* and *Erythrophleum chlorostachys* in the upper stratum. Intersected by this section of the haul road are 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 tetrodonta* and *Corymbia ferruginea* located on well-draining upland plains (Veg ID 342) near the Limmen River and Rosie Creek crossings.

The section of haul road beginning at the mining area and continuing through to the Limmen River, fall almost entirely within *Eucalyptus* woodland (Veg ID 324) dominated by *Eucalyptus tectifica*, *Corymbia terminalis* and Erythrophleum *chlorostachys* located on flat to undulating plans. 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.

Detailed information including dominant species in the upper and ground stratums and general landform features are provided in Appendix D.

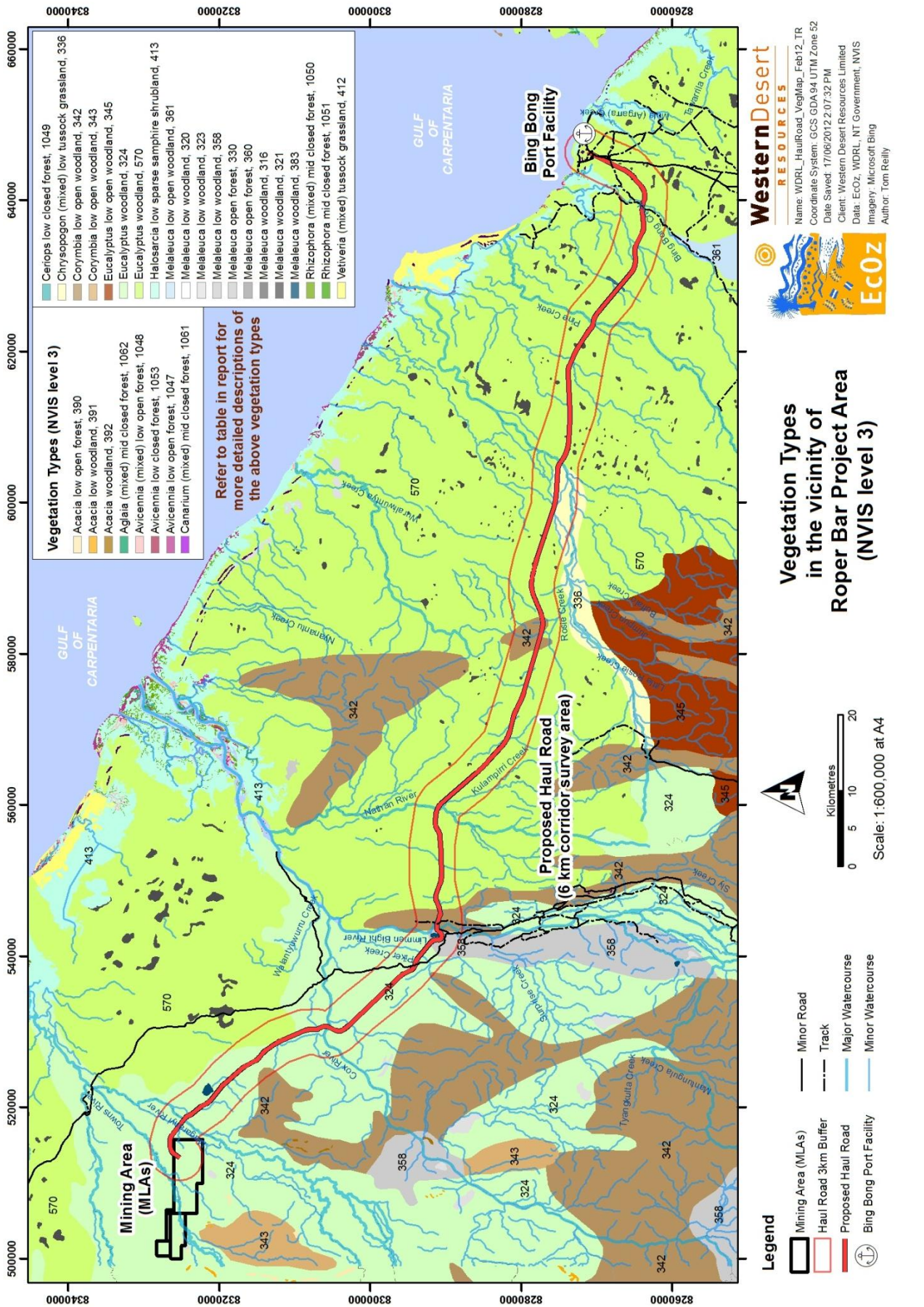


Figure 4-13: Vegetation communities within the vicinity of the proposed haul road (NVIS level 3)

Sensitive Habitat/Vegetation

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 the other higher priority vegetation types such as rainforest, monsoon vine thicket and monsoon forest, were found within the corridor. However, a number of localities which do present particular value for biodiversity on a regional scale were identified as being sensitive and are discussed below (see also Figure 4-14).

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*), Borroloola Dtella (*Gehyra borroloola*) 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 (labelled as R7, R115, and R116) 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). Refer to maps in Appendix D for location of these sites.

The Yiyintyi Ranges

The Yiyintyi ranges are an isolated entity of the Arnhem 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 Yiyintyi 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 (400 km) 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.

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

Waterbodies are to be avoided during construction of the haul road, with a minimum 50m buffer put in place around all waterbodies identified during the survey.

Road design adjacent to these areas should also minimise impacts from road drainage. A number of both high and low value waterbodies (SH1, W55, W117, W118, W120, W121 and W81) located nearby the current proposed route have been given recommendations to minimise impacts from road drainage. This can be achieved by directing road drainage towards overland flow so that runoff is filtered through ground vegetation prior to settling in waterbody depressions.

An approved Erosion and Sediment Control Plan of the haul road construction (see Appendix L) will also prevent erosion resulting in sedimentation of these high value habitat areas.

Minor Watercourse and Creek Crossings

The major rivers and creeks along the haul road route are associated with north-south linearly arranged sandstone landforms. The Limmen River, in particular, breaks through the tall sandstone escarpment at a location called the Limmens 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 freshwater fish 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 habitats (approx. 50km downstream of the proposed 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.

The presence of riparian vegetation is geographically restricted to the edge of waterways. This habitat provides refugia during fires and offers potential habitat for threatened and restricted species. The haul road corridor intersects with a number of rivers and creeks (Figure 4-14). Distinct riparian vegetation was not identified at the majority of these crossings.

Bridges or culverts will be constructed, depending on the width, depth and flow of the watercourse to be crossed. Where necessary, culverts will be put in place during construction of the haul road to minimise the disruption of surface water flows.

The choice of haul road route primarily reflected archeological concerns and road engineering considerations (Chapter 2.6). A consequence of these, however, is that the sensitive habitats described above 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.

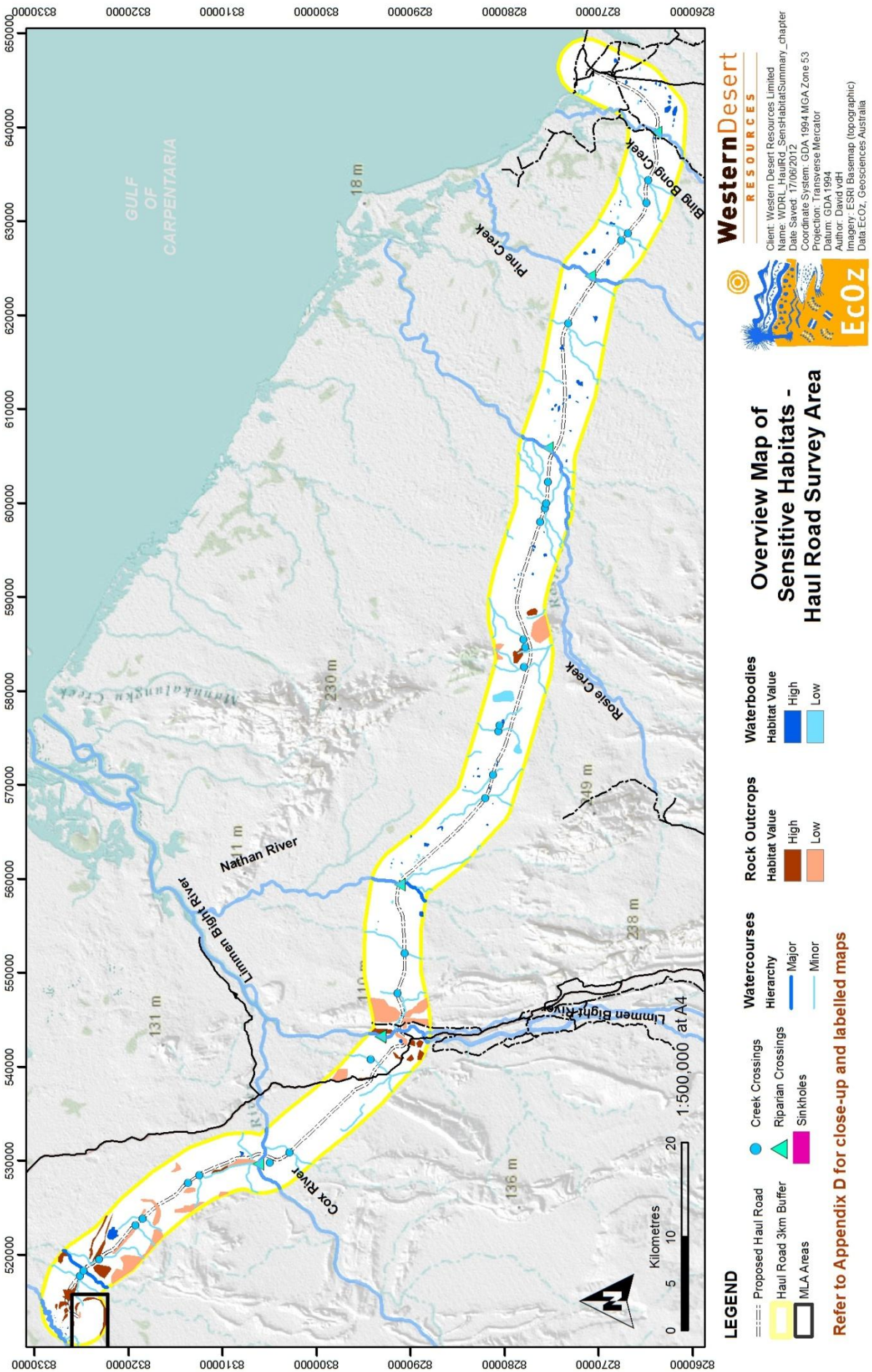


Figure 4-14: Sensitive habitat mapping along the haul road

Threatened & Notable Flora Species

Surveys conducted within the haul road corridor 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 have been previously recorded in the region, however many data deficient and near threatened species do exist. Also the possibility of described short range endemics is regarded as high (due to limited survey effort in the region). All potentially notable species highlighted by desktop research are provided in tables in Appendix D.

Fauna Species

The surveys recorded a total of 151 native fauna species, comprising of 15 amphibians, 29 reptiles, 92 birds, and 20 mammals. Field and desktop surveys identify a total of 460 fauna species that are found, or potentially occur, along the proposed haul road route (Table 4-5).

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 favour damper habitats, and bird diversity increases with proximity to water. More bat species were identified than in the MLA areas because of the cave habitats present.

Refer to Appendix D for detailed information on haul road fauna surveys.

Table 4-5: Total fauna species within the proposed haul road route – data from desktop and field surveys.

	Number of species
Amphibian	25
Reptile	93
Bird	209
Mammal	43
Freshwater Fish	46
TOTAL	**460**

Threatened & Notable Fauna Species

There are only records of one threatened species (as per the TPWC and EPBC Acts) occurring within the haul road corridor – Mertens' Water Monitor (*Varanus mertensi*) which is listed as Vulnerable. This was also the only threatened species recorded during WDRL surveys, being present at both Cox and Rosie sites in and along creeks. Other threatened species that could be present are discussed in Appendix D, and those for which there is a plausible threat of impact from the project development are examined in Section 4.4 below.

There was an unconfirmed, but highly likely, sighting of Ghost Bats *(Macroderma gigas*) at the Rosie River sandstone survey site (R3). While the Ghost Bat has been previously IUCN-listed as Vulnerable they are currently not EPBC or TPWC listed as threatened. The potential presence of the Ghost Bat it is of particular note as this species has experienced a significant range reduction over the last 200 years (EA 1999). Population studies of most of the main populations indicate that several population (particularly those which are geographically isolated) are genetically very distinct and therefore this species meets an IUCN threatened category (EA 1999 and McKenzie *et al.* 2008). While the Northern Territory populations are genetically distinct between each other and also distinct from other central distributions (e.g. the Kimberley's and Queensland) there may be at least some genetic flow between Northern Territory populations (McKenzie *et al.* 2008). The Northern Territory populations are considered to be stable. For the present, until further population and genetic studies are conducted, *Macroderma gigas* is treated as a single species and rated as Near Threatened under the TPWC Act (EA 1999).

Range extensions for two frog species also resulted from field surveys, see Section 4.3.1 above.

Introduced Species

All seven introduced fauna species mentioned in Section 4.3.1 have been recorded in the region containing the haul road corridor. Despite the remoteness of most of the haul road survey sites, introduced species

were detected and their impacts on habitat obvious. The four noted during field surveys were – Pig, Horse, Swamp Buffalo, and Cattle. Considerable damage to riparian habitat by Pigs feeding was evident at the Cox site.

Localised patches of weed infestations were found in the vicinity of river crossings traversing the proposed haul road corridor. A number of catchments including Pine Creek, Bing Bong Creek, Nathan River, Magarayngi Creek and Cox Stream upstream have no known weed records. Existing weed records within the Rosie Creek catchment show that Bellyache Bush (*Jatropha gossypiifolia*) (Class A) is also located upstream from the population surveyed at Rosie Creek. Riparian habitat assessment within the proposed haul road corridor identified three other exotic plants (*Passiflora foetida, Hyptis suaveolens* and *Sida acuta*).

4.3.4 Coastal Port

Vegetation Communities

The distribution and range of vegetation types within the port development area are depicted in Figure 4-15. 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 and Mule Creeks;
- **Low Coastal Plains**: Depressions and lowland flood-out areas, seasonally inundated, commonly with high clay content; and
- **Sandy Rises**: Slight sandy rises nested within coastal plains.

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. The coastal dunes transition into a series of older consolidated beach dunes that extend inland for just over one kilometre. 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 or 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.

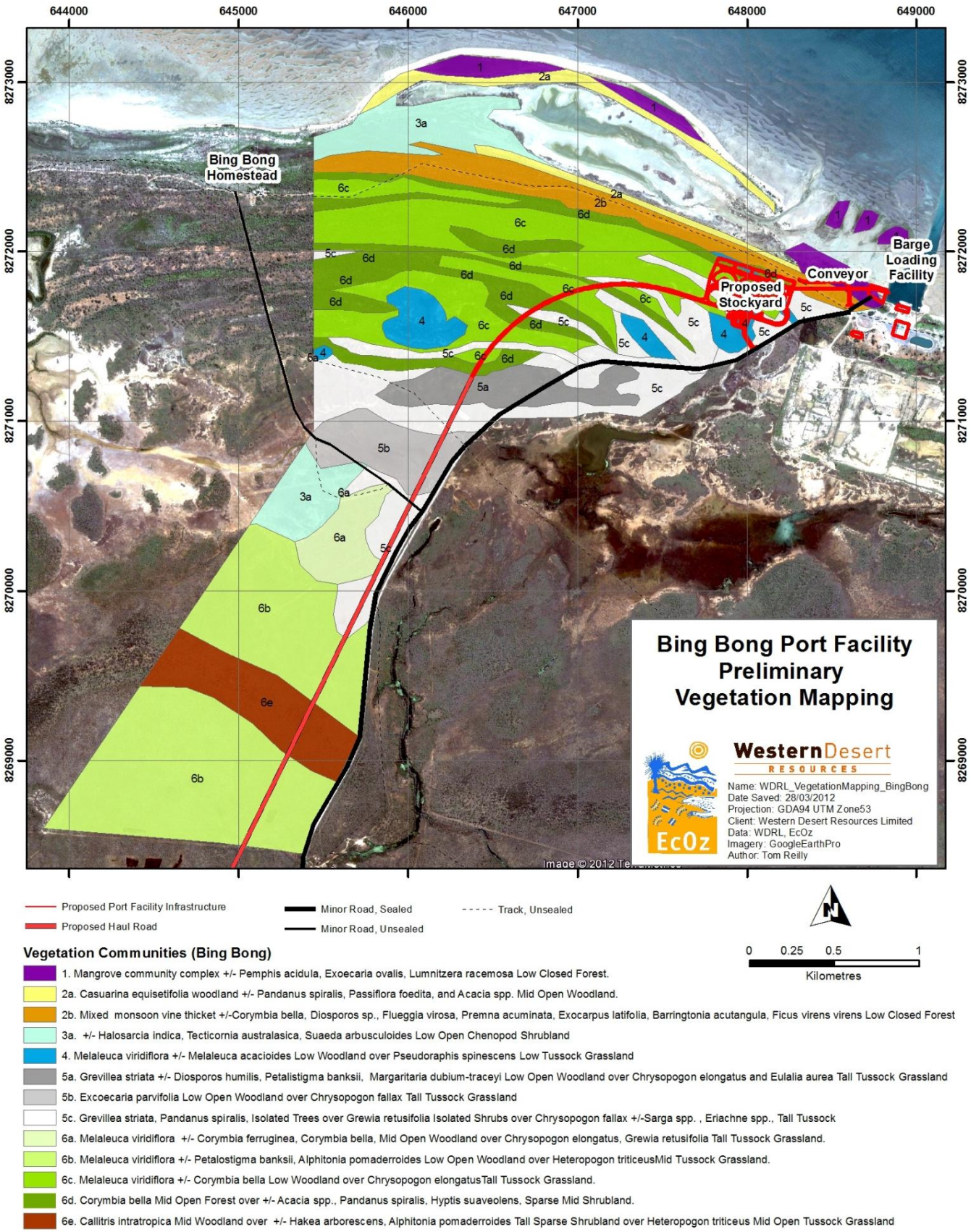


Figure 4-15: Preliminary vegetation map of the Bing Bong port

Sensitive Habitats

None of the vegetation communities associated with the Port of Bing Bong 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 notable, and the justifications, are outlined below.

Mangrove Community

A small coastal mangrove community is located within the project area, adjacent to the proposed Barge Loading Facility (Figure 4-16). 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).

WDRL will aim to reduce clearing of the small mangrove community at the site during the development of the Bing Bong Port Facility. The mangroves were infested with weeds including Parkinsonia (*Parkinsonia aculeata*), a Weed of National Significance, and Passion Vine (*Passiflora foetida*). WDRL will control Parkinsonia appropriately during the construction phase to ensure that the weed is not spread elsewhere within the project area.

Figure 4-16: Photo of mangroves that may be impacted by the conveyor belt and barge facility

Monsoon Vine Thicket Community

The monsoon vine thick community includes a series of beach ridges or cheniers composed of sand and shell deposits (see Figure 4-17). 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*).

The extent of vine thicket within the proposed development area that is proposed to be cleared is approximately less than 1 hectare.

Figure 4-17: Photo of coastal monsoon vine thicket adjacent to the proposed conveyor belt

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 (see Figure 4-18). The Cypress Pine stand is linear in shape, and is approximately 100m wide and a kilometre 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 4-18: Photo of Cypress Pine woodland close to the proposed port facility and haul road

***Melaleuca* Swamp**

This is a relatively large freshwater swamp supporting a shallow water body that has been highly impacted by weeds, cattle and pigs (see Figure 4-19). 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 aculeata)*, which is a Weed of National Significance that will need to be considered during construction and operation of WDRL operations.

This location will not be cleared or disturbed as part of the port development. The site is located downstream of the port facility so impact via erosion and sedimentation is possible (however, this will be mitigated via appropriate design and an Erosion and Sediment Control Plan – see Appendix L).

Figure 4-19: Photos of Paperbark swamp close to the proposed iron ore stockyard

Threatened and Notable Flora Species

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 Appendix D. The majority of the notable plant species that occur close to the Bing Bong port area are associated with aquatic freshwater habitats.

Fauna Species

The field surveys recorded a total of 115 fauna species, comprising of 8 amphibians, 16 reptiles, 81 birds, and 6 mammals. A combination of field and desktop surveys resulted in a total of 264 fauna species that are found within the vicinity of the port facility (Table 4-6).

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. Bat richness was relatively low compared to other sites (acoustic records available only), but further future effort might detect species that prefer mangal and other coastal habitats.

Refer to Appendix D for detailed information on MLA areas fauna surveys.

Table 4-6: Total fauna species within the coastal port facility (from desktop and field surveys)

	Number of species
Amphibian	9
Reptile	58
Bird	182
Mammal	15
Freshwater Fish	n/a
TOTAL	**264**

Threatened & Notable Fauna Species

Apart from marine species which are dealt with in Chapter 5, three threatened species as listed under the EPBC and/or TPWC Acts are recorded for the port area:

- Gouldian Finch (*Erythrura gouldiae*);
- Australian Painted Snipe (*Rostratula australis*); and
- Australian Bustard (*Ardeotis australis*).

In addition, one vulnerable species (TPWC Act) – Mertens' Water Monitor (*Varanus mertensi*), was recorded during field surveys on several occasions in man-made dams highly disturbed by feral animals (mainly Cattle and Pig) within the project area.

The observation of Long-footed Frog (*Litoria longipes*) at two sites represents a range extension for this species. Although found across sub-tropical and tropical Australia from the Kimberley, WA to the central Queensland coast, there is a dearth of records within the region of east Arnhemland through the Gulf coast and hinterlands, to near the Queensland border. The two records of Long-footed Frog from this survey place this species in the middle of this previously record-deficient region.

Migratory shorebirds inhabit the coastline and floodplains in the vicinity of Bing Bong, as detailed in Section 4.4.2.

Introduced Species

Only two introduced fauna species have been recorded within the port area – Cattle and Cane Toad. This no doubt reflects the small survey area.

Environmental assessments of the Bing Bong port, ore stock yards and loading facility have identified three declared weeds species:

- Parkinsonia (*Parkinsonia aculeata*) – a Weed of National Significance, 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
- Spinyhead 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 were present.

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

- Chinee Apple *(Ziziphus mauritiana)* (Class A); and
- Grader Grass (*Themeda quadrivalvis)* (Class B)

Other introduced weed species identified during the recent environmental assessment of the proposed port facility included:

- Buffel Grass (*Cenchrus ciliaris*) – Environmental Weed, but not a declared weed in the NT. Buffel Grass was located along some road sides in disturbed sand piles. There were scattered individuals and low infestation level;
- Passion Vine (*Passiflora foetida*) – Environmental Weed, but not a declared weed in the NT. There are widespread infestations of Passion Vine throughout the coast vine thicket vegetation; and

- 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;
- 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 were present.

Existing developmental impacts at the Port of Bing Bong has resulted in an incursion of weeds and subsequent records located in and around the proposed stockyard and loading facility. Two of these weeds (Chinee 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 Appendix F.

4.4 Priority Values and Concerns

This section summarises the priority biodiversity values and concerns for the project area. These will be the main focus for impact assessment, if necessary, and risk analysis.

4.4.1 Priority Species

Fauna

Existing data suggests that a total of 192 notable fauna species (as defined in Section 4.2.3) 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 – instead see Chapter 5. . 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 (see Table 4-7 and Figure 4-21).

For each of these priority species their distribution and ecology is summarised (with information from EPBC and NRETAS websites) in Table 4-7. In addition, an estimate of the likelihood of presence within each of the project's development areas is included, denoted by the following descriptors:

- **MAY** indicates a low probability the species occurs in the region;
- **LIKELY** indicates a moderate to high probability the species occurs in the region, although no records exist. Given that the region containing the Roper Bar Project Area has not been subject to

many surveys, distributional analysis suggests that many species not recorded are nonetheless likely to occur; and

- **KNOWN** recent records of occurrence exist.

These descriptors comply with those developed by SEWPaC when modelling distributions of threatened species and are based on such considerations as distribution, habitat, ecology and past records.

Each priority species has been assigned a preferred habitat category (see Table 4-7) in order to facilitate the collective assessment of the potential threats and impacts from the proposed development on each these habitats (and hence the species contained within), and their consequent management. The habitat categories used are:

- **Woodland**: Open woodland dominated either by *Eucalyptus sp.* and *Corymbia sp.* with a spinifex understorey or, in hillier areas, by *Eucalyptus sp.* with a tussock grass understorey. This is by far the main habitat in the proposed development area;
- **Sandstone**: This includes rugged rocky sandstone outcrops, hills, and ridges that have crevices and gullies, and are often protected from frequent fire events. Dominant vegetation is mid-high open woodland of *Eucalyptus sp.* and *Corymbia sp*;
- **Wetland**: Permanently or seasonally inundated billabongs, grasslands and swamps dominated by *Melaleuca*. This constitutes about 30% of the MLA areas and occurs patchily within the haul road corridor;
- **Riverine**: Woodland contiguous to rivers and streams, and riparian vegetation dominated by *Melaleuca* and *Pandanus*. The mine site is near the upper reaches of the Towns River (ephemeral section of the river), and also the Magarinyi River which is a tributary to the Towns River. The haul road crosses seven major rivers and many creeks/tributaries (lacking distinct riparian vegetation communities);
- **Coastal**: Mangroves, the inter-tidal zone to the low tide mark, sand dunes, mud flats, and contiguous samphire and salt-bush flats. Only the port facility is located in this habitat, although it also occurs downstream of the Towns River and all the rivers crossed by the haul road; and
- **Open Country**: Clay-based floodplains with closed grasslands and sparse tree cover, and dry open tussock grasslands. This habitat occupies a small proportion of the proposed haul road and none of the MLA areas.

An indicative map of the habitat categories list above is presented in Figure 4-20.

Table 4-7: Priority fauna within the project area

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

SCIENTIFIC NAME	COMMON NAME	STATUS		PREVIOUS RECORD		WDRL	DISTRIBUTION	ECOLOGY	THREATS	LIKELIHOOD			HABITAT
		Aus	NT	MLA/ Haul	Port	ECOZ surveys				MLA	Haul	Port	
BIRD													
Amytornis dorotheae	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	-	SANDSTONE
Ardeotis australis	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	WOODLAND OPEN COUNTRY
Botaurus poiciloptilus	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	WETLAND
Dromaius novaehollandiae	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	OPEN COUNTRY
Erythrotriorchis radiatus	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	RIVERINE
Erythrura gouldiae	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 *Sorghum*), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing *Eucalyptus* trees.	Changed fire regimes, grazing	known	known	may	WOODLAND
Falcunculus frontatus whitei	Crested Shrike-tit (northern)	VU	VU*	3	-	-	A narrow band between latitudes of 14°S and 17°S from the Kimberley, WA to	Eucalyptus open woodlands - especially with *Eucalyptus opaca*, not dominated by a thick shrub-	Changed fire regimes	likely	likely	may	WOODLAND

SCIENTIFIC NAME	COMMON NAME	STATUS		PREVIOUS RECORD		WDRL	DISTRIBUTION	ECOLOGY	THREATS	LIKELIHOOD			HABITAT
		Aus	NT	MLA/ Haul	Port	ECOZ surveys				MLA	Haul	Port	
							Borroloola, NT. Not recorded in the McArthur River-Borroloola area for over 80 years.	layer, and that are prone to being waterlogged seasonally. Proposed downgrade of status to Near Threatened.					
Rostratula australis	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	WETLAND
Tyto novaehollandiae kimberli	Masked Owl (northern)	VU	VU	3	3	-	Kimberley and Top End.	Eucalypt tall open forests (especially dominated by Eucalyptus miniata and Eucalyptus tetrodonta). Probably occupy large exclusive home ranges (~5-10 km2).	Changed fire regimes	likely	likely	likely	WOODLAND
FISH													
Pristis clavata	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	RIVERINE
Pristis microdon	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	RIVERINE, MARINE
Pristis zirjon	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	RIVERINE, MARINE
MAMMAL													
Conilurus penicillatus	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 *Pandanus* thickets.	Grazing, changed fire regimes, feral cats	may	may	may	WOODLAND
Dasyurus hallucatus	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	WOODLAND SANDSTONE

SCIENTIFIC NAME	COMMON NAME	STATUS		PREVIOUS RECORD		WDRL	DISTRIBUTION	ECOLOGY	THREATS	LIKELIHOOD			HABITAT
		Aus	NT	MLA/ Haul	Port	ECOZ surveys				MLA	Haul	Port	
Saccolaimus saccolaimus nudicluniatus	Bare-rumped Sheath-tailed Bat	CR	DD #	3	-	-	Few records for this sub-species - all from either Kakadu or Roper River mouth, NT.	Open *Pandanus* woodland fringing the sedgelands of rivers. Also recorded in *Eucalypt* tall open forests.	Habitat clearance	may	may	may	WOODLAND
Xeromys myoides	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	COASTAL
REPTILE													
Cryptoblepharus zoticus	Agile Snake-eyed Skink	-	NE	2	-	-	**Restricted range**: greater southern Gulf hinterlands	Sandstone escarpments, outcrops and ridges.	-	likely	likely	-	SANDSTONE
Ctenotus striaticeps	Carpentarian Ctenotus						**Restricted range**: greater southern Gulf hinterlands	Hard stony substrates with hummock grass understory.	-	likely	likely	may	WOODLAND
Elseya lavarackorum	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	RIVERINE
Gehyra borroloola	Borroloola Dtella						**Restricted range**: greater southern Gulf hinterlands	Sandstone escarpments, outcrops and ridges.	-	likely	likely	-	SANDSTONE
Varanus mertensi	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	RIVERINE
Varanus panoptes	Floodplain Monitor	-	VU	4	-	-	Tropics and sub-tropics from the Kimberley, NT to Brisbane, Qld.	Broad range of habitats.	Cane toads	likely	likely	likely	OPEN COUNTRY

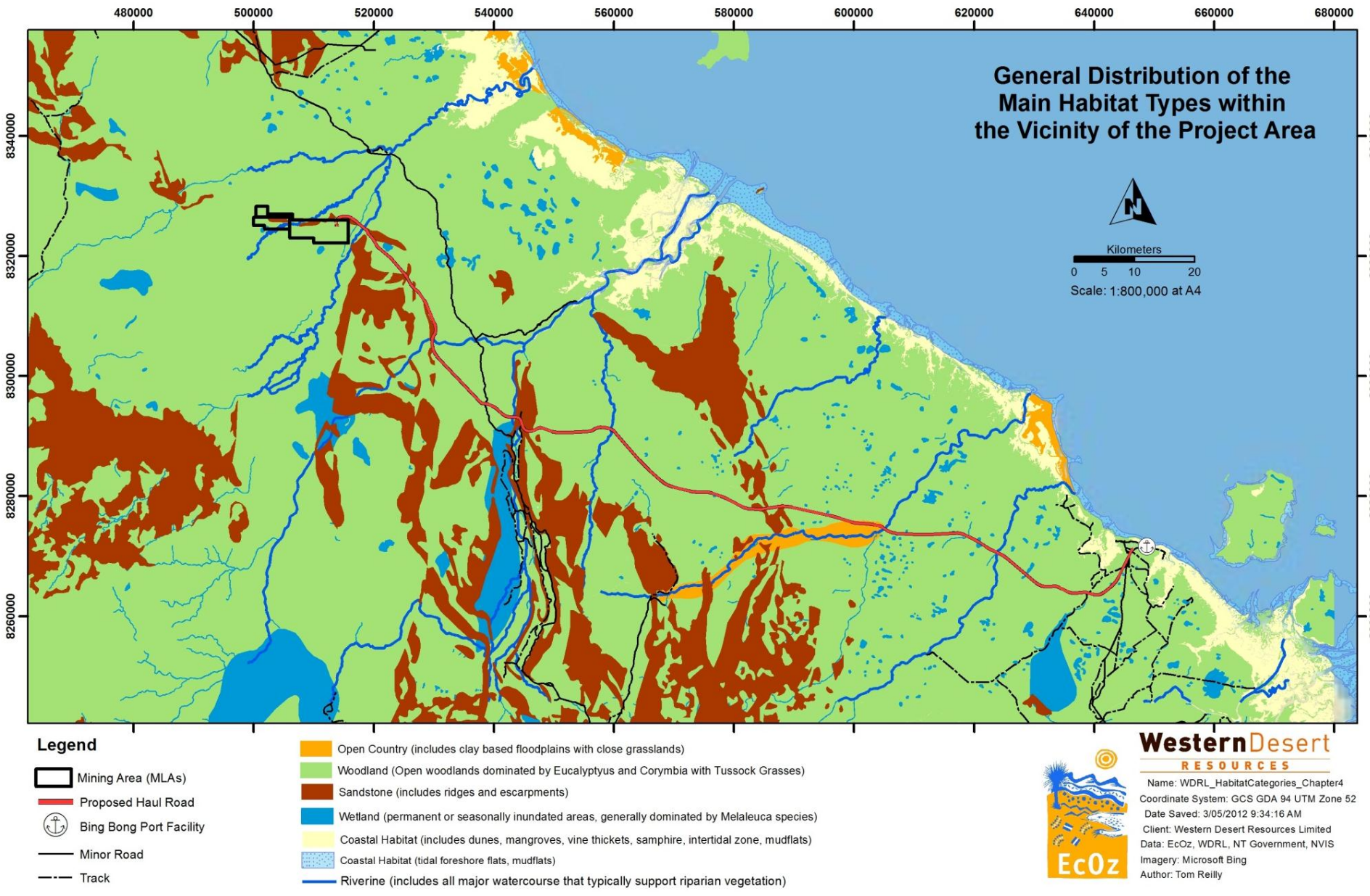
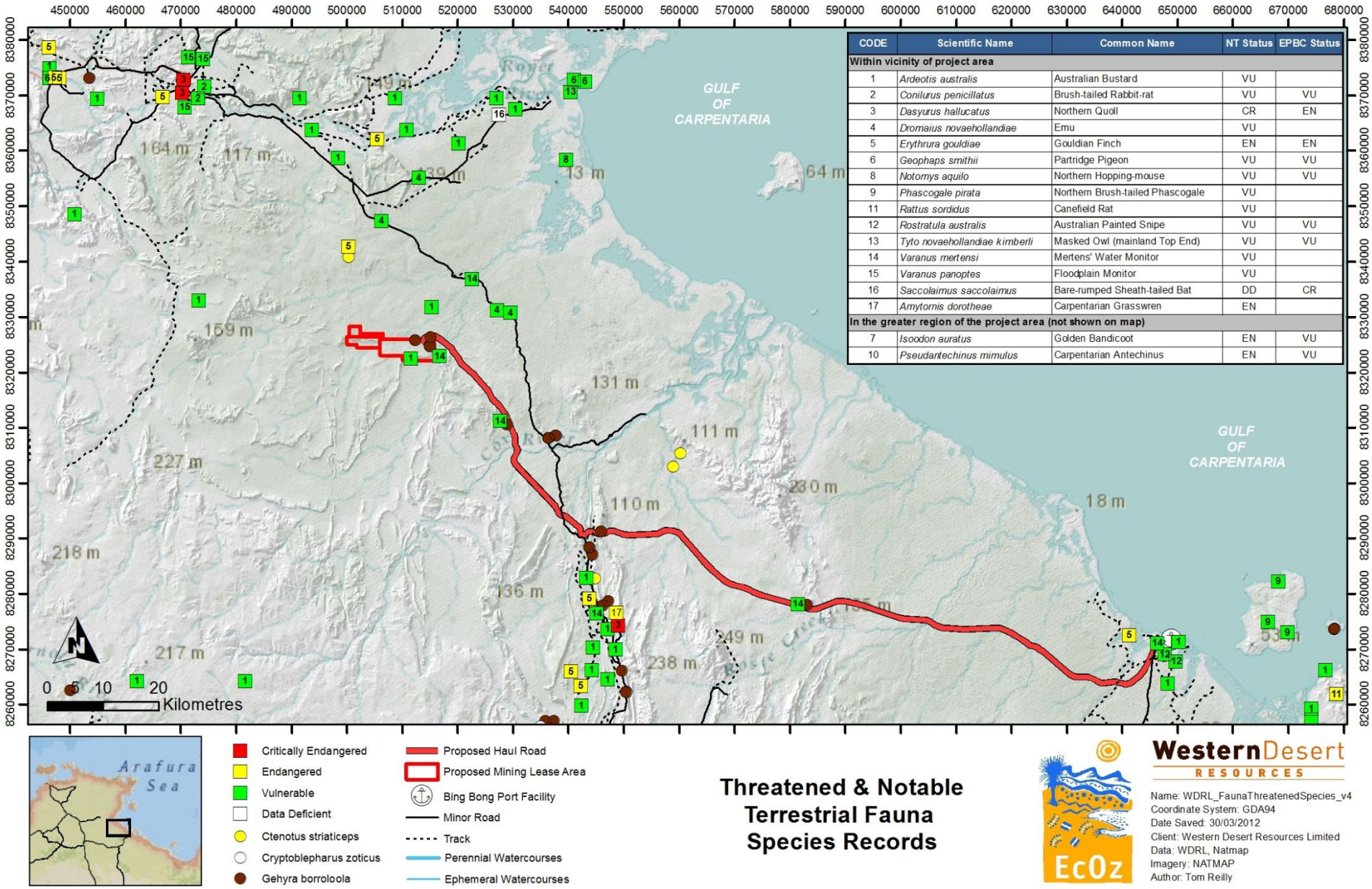


Figure 4-20: Priority Species habitat categories



CODE	Scientific Name	Common Name	NT Status	EPBC Status
Within vicinity of project area				
1	*Ardeotis australis*	Australian Bustard	VU	
2	*Conilurus penicillatus*	Brush-tailed Rabbit-rat	VU	VU
3	*Dasyurus hallucatus*	Northern Quoll	CR	EN
4	*Dromaius novaehollandiae*	Emu	VU	
5	*Erythrura gouldiae*	Gouldian Finch	EN	EN
6	*Geophaps smithii*	Partridge Pigeon	VU	VU
8	*Notomys aquilo*	Northern Hopping-mouse	VU	VU
9	*Phascogale pirata*	Northern Brush-tailed Phascogale	VU	
11	*Rattus sordidus*	Canefield Rat	VU	
12	*Rostratula australis*	Australian Painted Snipe	VU	VU
13	*Tyto novaehollandiae kimberli*	Masked Owl (mainland Top End)	VU	VU
14	*Varanus mertensi*	Mertens' Water Monitor	VU	
15	*Varanus panoptes*	Floodplain Monitor	VU	
16	*Saccolaimus saccolaimus*	Bare-rumped Sheath-tailed Bat	DD	CR
17	*Amytornis dorotheae*	Carpentarian Grasswren	EN	
In the greater region of the project area (not shown on map)				
7	*Isoodon auratus*	Golden Bandicoot	EN	VU
10	*Pseudantechinus mimulus*	Carpentarian Antechinus	EN	VU

Figure 4-21: Map of threatened and notable fauna species records within the project area and surrounds

Flora

Only one threatened species (under EPBC or TPWC Acts) was identified during desktop or field surveys of the project area (desktop searches included an extensive area surrounding the project area, see Section 3.7 for map of search area). This species – Thorny Solanum (*Solanum carduiforme*) – is discussed in section 4.5.2 below.

The proposed Limmen National Park is known to support a high number of data deficient species for the Northern Territory (NT Flora Atlas) – these are described in Appendix D.

4.4.2 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

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.

Limmen Bight

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.

4.4.3 Sensitive habitats

Whilst each project component contained notable habitats, only the haul road corridor contained sensitive habitat, as explained below.

MLA areas

None of the vegetation communities in the MLA areas 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. There are no habitats that were regarded as sensitive within the MLA areas. However, there were four communities considered locally notable which are listed below and described in Section 4.3.2:

- *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.

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 6km 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 if sensitive habitat was present, and also whether there are areas 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 4.3.3:

- 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 Cox River, Limmen River, Nathan River, Rosie Creek, Pine Creek, Bing Bong Creek, plus many small 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 are Limmen River crossing, and the ridges and rocky hills to the east of Limmen River and west of Rosie Creek crossing.

Port Facility

None of the vegetation communities associated with the Port of Bing Bong 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 notable are listed below and are outlined in Section 4.3.4:

- Mangroves;
- Monsoon Vine Thicket Community;
- Cypress Pine Woodland; and
- Melaleuca Swamp.

4.4.4 Culturally Significant Species

During the Environmental Impact Assessment process, WDRL worked closely with Traditional Owners, Elders and Indigenous groups to better understand and minimise potential project impacts on cultural heritage.

To date workshops and meetings have enabled the project team and participants to actively explore some of the identified impacts, and importantly, have encouraged participants to help develop mitigation measures that will be considered as part of the Roper Bar Iron Ore project's final design concept.

In February 2012, WDRL undertook an intensive two-week consultation period in the communities within the project's footprint – Borroloola, Minyerri, Ngukurr and Numbulwar – and spoke at length with Traditional Owners, Elders and Indigenous groups about potential impacts on matters of cultural heritage and the environment.

During this intensive consultation, culturally significant flora and fauna were not raised by Traditional Owners, Elders and Indigenous groups, as a potential impact. Rather, cultural heritage from both a preservation (through generations) and social perspective were the immediate concerns raised.

It was acknowledged that during this intensive consultation period, some Traditional Owners and Elders referred to the initial iron ore transport design put forward by WDRL in the feasibility stage that involved a slurry pipeline connecting Maria Island to the Mainland.

During the feasibility stage stakeholders were unsure of how the pipeline would impact the land and marine life, specifically the turtles and fish. Consultation confirmed many community members and groups still lived the traditional way, relying on flora and fauna for living (i.e. food) as well as business and tourism opportunities for economic and financial security. Their concern was centred on the perceived negative impact the proposed pipeline could have on this fragile country, and in turn, their livelihoods and way of life.

As a result of consultation with community members and stakeholders, WDRL undertook an investigation into the feasibility of an alternative transport option.

4.5 Threats and Impacts

The potential impacts to priority species due to this development include:

- Direct mortality;
- Loss of habitat (i.e. changes in habitat quantity);
- Changes in habitat quality, including:
    - Hydrological changes;
    - Dust;
    - Noise;
    - Weeds;
    - Spillages;
    - Erosion; and
- Alteration/loss of ecological processes such as ecological connectivity/fragmentation.

As mentioned in the Section 4.4, the threats these impacts pose to the majority of the priority species can be discussed collectively under preferred habitat categories (see also Figure 4-20).

4.5.1 Woodland species

Woodland is the most widespread habitat within the MLA areas and haul road (Figure 4-20). There are eight threatened or notable woodland species that may potentially fall within the impact area of the proposed mine (Table 4-7). All have broad distributions across tropical Australia; and the one restricted range species – *Ctenotus striaticeps* – is secure and locally common (although was not identified during fauna surveys conducted for the EIS). The main direct impact of this project on woodland will be clearing, which is focused within the MLA areas, haul road corridor and port area. The total area of woodland to be cleared for the developed is negligible in the regional context for this habitat type. Moreover, because of the contiguous nature of woodland in the area, habitat fragmentation and connectivity is unlikely to occur as a result of the development. Rehabilitation will be progressive but may result in some landforms and vegetation types which are different to those which presently exist.

4.5.2 Sandstone species

Sandstone ridges are considered as a sensitive habitat type within the project area. A number of restricted range species are confined to rocky elevated sandstone country. Most of these, however, are locally common and regarded as secure – e.g. Borroloola Dtella (*Gehyra borroloola*).

The threatened status, patchy distribution and specific habitat of three priority sandstone species – Thorny Solanum *(Solanum carduiforme)*, Northern Quoll (*Dasyurus hallucatus*) and Carpentarian Grasswren (*Amytornis dorotheae*) – mean they warrant additional examination and consideration during mine/haul road design, construction, and operation.

*Thorny Solanum (*Solanum carduiforme*)*

The plant Thorny Solanum is listed as 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 alignment. There is very little published information on this species (Woinarski 2007). This species is known to occur on conglomerate rock formations and larger sandstone ridges (George 1982). However, surveys in suitable sandstone ridges and hills (i.e. Limmen, Rosie, and Cox survey sites) did not identify the species.

Nonetheless, because of its restricted range and historical occurrence along the haul road route, this species is referred to the Risk Chapter (Chapter 9).

*Northern Quoll (*Dasyurus hallucatus*)*

Northern Quoll – listed as Endangered under the EPBC Act and Critically Endangered under the TPWC Act – formerly occurred in a broad and almost continuous band across northern Australia from the Pilbara to near Brisbane. Impacted in the past century by human persecution, habitat clearance and disease, the arrival of toxic Cane Toads initiated a dramatic population collapse (Van Dam *et al.* 2002).

Woinarski *et al.* (2008) identified Northern Quoll populations were more persistent in higher altitude sites with steeper slopes, shallower soils, and large rocks, boulders and outcrops. This may be due to these habitats being less disturbed by fires, as well as lower Cane Toad abundances in these drier habitats.

Searching for signs of the Northern Quoll (e.g. scats) were included within all survey locations which presented tree hollows, especially rocky ridges. No Northern Quolls were detected; however suitable habitat was identified in the MLA areas and the haul road corridor.

This species is therefore referred to the Risk Chapter (Chapter 9).

*Carpentarian Grasswren (*Amytornis dorotheae*)*

The Carpentarian Grasswren is a shy cryptic bird with a very restricted distribution and specific habitat requirements. The known distribution of Carpentarian Grasswren is limited to the Gulf of Carpentaria hinterland, between the Limmen River (Northern Territory) and Mount Isa (Queensland). Relatively secure in Queensland, the Northern Territory population is restricted to dissected, topographically complex, sandstone and conglomerate hills and plateaux.

The Carpentarian Grasswren is listed as Endangered under the TPWC because of population declines linked to changes in fire regimes. A recent survey of sites with historic records of this species – including Nathan River, which lies within the area of the proposed development – was unable to detect Carpentarian Grasswrens at seven of the eight sites (including Nathan River) (Perry 2011). The Carpentarian Grasswren has therefore only been observed at one site in the Northern Territory in the past 21 years.

The only site where a positive identification was recorded had been burnt only twice in the preceding 12 years. All other sites had been burnt between three and eight times. It is thought that adult Carpentarian Grasswrens rely on mature spinifex for nesting and protection against predators. Spinifex seeds may also be an important food source for the species. Contemporary fire regimes may reduce seed fertility, causing spinifex to be displaced by flora species that favour the modified fire regimes (Trainor 1996). Martin and McKean (1986) noted a likely relationship between spinifex maturity and height, and the presence of Carpentarian Grasswrens.

This all suggests that Carpentarian Grasswrens nowadays occur only in areas that afford some protection from fire and predation, provided by rockiness and topography of habitat. Particular fire regime requirements have therefore further limited distribution of this already restricted range species.

Within the MLA areas there are not likely to be any suitable habitat for Carpentarian Grasswren because of the lack of substantial hills and ridges. Along the proposed haul road route only the outcrops in the vicinity of the Rosie and Limmen survey sites contain potentially suitable habitat. Both of these sites appear to not have experienced many fires or late burns recently (see Figure 4-5) and so may contain Carpentarian Grasswren populations. However, these sites lie outside the haul road corridor and are not expected to be affected by the construction or presence of a road. Likewise the large area of sandstone country around Yiyintyi Range (nearest point is ~15 km to the north of the middle section of the haul road route) has escaped recent burns and certainly presents as suitable habitat.

This species is therefore not referred to the Risk Chapter (Chapter 9).

4.5.3 Wetland species

Wetlands are common within the MLA areas and along the haul road corridor. However, wetlands have been generally avoided by design because of the complications with construction in such a habitat.

The two wetland priority species are both highly nomadic birds. The wetlands habitat within the MLA areas is suitable habitat for these species, but is not critical habitat. This project will only directly impact (through clearing, dust, noise) on a negligible (in the regional context) area of this habitat. There is the potential for water quality to be affected in small areas (refer to Chapter 6), alteration to surface flows (refer to Chapter 6), sedimentation, and hydrocarbon spills.

4.5.4 Riverine species

From the proposed re-alignment of the Towns River there is the potential for riverine habitat to be effected by changes in water quality (refer to Chapter 6), alteration to surface flows (refer to Chapter 6), sedimentation, and hydrocarbon spills. Likewise for the construction of river crossings for the haul road. All five priority riverine species there warrant further examination.

Mertens' Water Monitor

Mertens' Water Monitor (*Varanus mertensi*) populations across tropical Australia have been severely diminished by toxic Cane Toads. Hearteningly, populations appear to be recovering after initial decimation, as evidenced by multiple observations of this species across the project area during field surveys. The minor localised impacts on riverine habitat in the construction of haul road river crossings are very unlikely to lead to any water monitor mortality. However, this species is known to occur on the Towns River within the MLA areas and so will be affected by the river re-alignment.

These species is therefore referred to the Risk Chapter (Chapter 9).

*Sawfish species (*Pristis sp.*)*

As a consequence of the stream realignment there may be some limitations to the movement of aquatic fauna from more permanent waters below the mine site (the lower parts of the Towns River), into the higher parts of the Towns River catchment, which might occur during very good Wet seasons. On the whole, the river and creek systems in the upper part of the Towns River are so ephemeral that this is not anticipated to have a significant impact on the diversity of aquatic species generally found upstream of the MLA areas. However, little is known about sawfishes' early stages of development.

The Gulf of Carpentaria is believed to be one of the last strongholds in the world for sawfish (Roelofs 2009). Three threatened species of sawfish may or are likely to occur in the area of all three components. All are listed as Vulnerable under both the TPWC and EPBC Acts:

- Freshwater Sawfish (*Pristis microdon*) are mainly confined to the main channels of large rivers (Larson *et al.* 2006; DSEWPC 2011a). This species spends its first three to four years in freshwater, with juveniles and sub-adults predominantly occurring in rivers and estuaries (Larson *et al.* 2006b; DSEWPC 2011a). Large mature animals occur more often in coastal and offshore waters up to 25m depth (DSEWPC 2011a). Freshwater Sawfish are known to occur in the lower reaches of the McArthur River, and the McArthur River Mine is actively monitoring the population, in order to detect any impact from the mines operations. A total of 28 records (including 19 captures) of Freshwater Sawfish have been collected over a five year period up to June 2011 (McArthur River Mine 2012).
- Green Sawfish (*Pristis zijsron*) is most commonly observed in the Gulf of Carpentaria in Queensland whereby it has been recorded in low numbers with a patchy distribution (Stirrat *et al*. 2006; DSEWPC 2011c). It is often found in shallow water; however it has been recorded offshore at depths over 70m (Stirrat *et al*. 2006; DSEWPC 2011c). *Pristis zijsron* is known to be responsive to tidal influence, occurring in muddy substrate, and has been reported to inhabit marine inshore waters, estuaries, lagoons and freshwater, although most records are from marine estuarine areas (Larson *et al.* 2006). This species has not been recorded from the south-western Gulf.
- Dwarf Sawfish (*Pristis clavata*) has only been recorded from the western Gulf of Carpentaria (DSEWPC 2011b) however suitable habitat for the species i.e. inshore marine waters, estuaries, river mouths, and in waters adjacent to sandy and muddy beaches, is present near the Port of Bing Bong. A number of authors have suggested that the Dwarf Sawfish is likely to be encountered in the same habitat as the Freshwater Sawfish and Green Sawfish (DSEWPC 2011b). It has not been recorded, however, in freshwater.

In general, little is known about how far upriver sawfish breed. With respect to the MLA areas, it seems that the nearest suitable habitat for sawfish in terms of permanency, depth and size of pools is more than 20 kilometres downstream in the Towns River. The haul road corridor, however, intersects a number of waterways at places that may contain suitable habitat.

These species is therefore referred to the Risk Chapter (Chapter 9).

*Gulf-snapping Turtle (*Elseya lavarackorum*)*

Very little is known about the Gulf Snapping Turtle. It is restricted to rivers draining into the Gulf of Carpentaria including the Limmen, Roper, Robinson and Nicholson Rivers. The Gulf Snapping Turtle is found in deeper permanent pools most often with muddy, sandy or rocky bottoms (Cogger 2000). Steep rocky gorges and river reaches with intact river banks seem to be preferred habitats for Gulf Snapping Turtles (Thomson *et al*. 1997).

Mainly herbivorous, this species relies on riparian trees for most of its dietary intake (Kennett & Tory 1996). A potential threat to this species, therefore, is land clearance or actions that have adverse effects on riparian forests (DSEWPAC 2012).

This species is therefore referred to the Risk Chapter (Chapter 9).

4.5.5 Open Country species

There is no open country in the MLA areas and very little intersecting the haul road corridor. Moreover, all of the priority open country species (3 species) have broad distributions across tropical Australia. Therefore, the project will not significantly affect any priority species that utilise and rely on these habitats.

4.5.6 Coastal species

The port development will only impact a small area of coastal habitat (less than 5ha cleared). The sole coastal priority species – Water Mouse (*Xeromys myoides*) – has a broad distribution and has not been recorded along the NT Gulf coastline. The coastal habitat that will be impacted upon by the development does not represent critical habitat for this species.

The coastal habitats downstream of the Towns River and other rivers crossed by the haul road are so distant that, short of a catastrophic pollution event, activities of the development will not impact on them. The measures that WDRL will employ to avoid such an event are addressed in Chapter 9.

4.5.7 Shorebirds

Port

Consultants acting on behalf of McArthur River Mine have undertaken annual 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). Notably, the surveys highlighted "*the importance of the Port McArthur area, east of Bing Bong, as a nationally and globally significant migratory bird staging area"* but also 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 Appendix D). 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). A helicopter survey disturbed only two flocks of a few hundred birds in each, and these were more than ten kilometres from the port.

In addition to the fact that the port located on the periphery of suitable shorebird habitat, the construction and operational footprint of the port facility will affect a negligible area of potential shorebird habitat.

MLA

Although significant numbers of shorebirds are known to occur on the floodplains into which the Towns River (amongst others) feeds, there are a number of factors indicating that the river re-alignment and activities on the MLA areas will not detrimentally impact them. Firstly, as explained in the Risk Chapter (Chapter 9), WDRL will undertake a range of preventative measures to mitigate the ecological impacts from re-aligning the upper Towns River. Secondly, the suitable shorebird habitat is approximately 40 km downstream from the realignment. Such a distance means that any change in water quality of the Towns River in the MLA areas would likely be diluted to the point of negligibility by the time it reached the floodplains. Increases in

turbidity because of the realignment are likely, but this is not something that negatively impacts on the already turbid inter-tidal and floodplain habitats preferred by shorebirds. Finally, no changes to water quantity are expected as a consequence of stream realignment and, if they were, this ephemeral tributary of the Towns River is one of many and so would have little effect on cumulative flows downstream.

However, as a catastrophic pollution event is possible and could have an impact on migratory shorebirds downstream of the Towns River, this suite of species is referred to the Risk Chapter (Chapter 9).

4.5.8 Weeds

Weeds can alter ecosystems and consequently reduce biodiversity by having the following impacts:

- Competition with native species for water and nutrients;
- Toxicity to native animals;
- Degradation of water quality (with soil erosion and aquatic weeds);
- Increased risk of fire; and
- Destabilisation of soil layer and increased erosion potential.

Weed infestations within the project area are concentrated around waterbodies. Unless weed hygiene protocols are incorporated into works activities, these infestations are likely to spread to relatively weed-free areas (including aquatic environments) during the construction stages of the project, as the result of significant disturbance from clearing and vehicular movement.

The construction stages of the proposal will involve significant ground disturbances potentially allowing for the establishment of weeds. The construction of the haul road could potentially increase the opportunity for weeds to spread along the route through the frequent movement of heavy machinery and vehicles within and adjacent to unknown infestation areas, as well as with road maintenance activities such as grading and slashing. In addition to ground disturbance, other factors such as uncontrolled waste (e.g. dumping of domestic refuse) and water (e.g. discharge of water) management may also increase the opportunity for these plants to become prolific by providing an additional resource supply.

During the operational phase the potential for weed dispersal for the haul road and port area will be relatively low as there will be little ground disturbance and haul vehicles will be travelling on a sealed road. Due to ongoing soil disturbance, weed risk at the mine site and subsequent rehabilitation activities will be relatively higher.

4.6 Calculated Environmental Loss

The total area of vegetation to be cleared has been estimated at 1193.6ha, which includes 356.4ha within the MLA areas, 820ha along the haul road (maximum scenario), and 17.1ha in the port area. The proportion of each vegetation type to be cleared has been calculated and is presented in (Table 4-8, Table 4-9 and Table 4-10).

Indirect loss has not been calculated as part of this assessment.

Table 4-8: Total area of each vegetation type that will be cleared as part of the mine development

Veg Type	Vegetation Description	Total Area (ha) within the MLA	Total Area (ha) and % of Veg Type Cleared within the MLA	
1	*Acacia shirleyi* Mid Open Forest	92.2	0.2	0.2
2	*Corymbia ferruginea* +/- *Eucalyptus tetrodonta, Eucalyptus phoenicea*, Mid Open Woodland.	585.1	55.2	9.4
3	+/- *Corymbia ferruginea Eucalyptus miniata* and *Eucalyptus tetrodonta* Low Open Woodland	149.6	31.2	20.9
4	*Eucalyptus pruinosa* +/- *Melaleuca citrolens* Low Open Woodland	29	14.2	49
5	*Melaleuca citrolens* +/- *Hakea lorea* Low Open Woodland	480.5	74.5	15.5
6	*Corymbia polycarpa* and *Erythrophleum chlorostachys* Mid Woodland	58.7	5.9	10
7	*Melaleuca citrolens* Low Woodland	227.7	19.2	8.4
8	*Eucalyptus tetrodonta* and *Corymbia ferruginea* Mid Open Woodland	554.9	17.2	3
9	*Melaleuca viridiflora* Low Open Woodland	867.7	128.2	14.8
11	*Terminalia canescens* Tall Sparse Shrubland	7.3	0	0
12	*Eucalyptus tectifica* Mid Open Woodland	28.8	2.5	8.7
13	*Excoecaria parvifolia* and *Melaleuca citrolens* Low Woodland	9.8	0	0
14	*Eucalyptus camaldulensis* Low Open Woodland	9.6	6.7	69.8
15	*Eucalyptus tetrodonta* and *Erythrophleum chlorostachys* Mid Open Woodland	145.5	2.1	1.4
16	*Melaleuca viridiflora* and *Petalostigma banksii* Low Open Woodland	128.4	1.5	1.2
17	*Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa*, *Psydrax paludosa* Low Open Woodland	44.8	7	15.6
18	*Melaleuca viridiflora* and *Asteromyrtus symphyocarpa* +/- *Melaleuca citrolens* Low Woodland	86.2	0.27	0.3
19	*Melaleuca viridiflora* +/- *Eucalyptus microtheca* Low Open Woodland	22.9	3.7	16.2
20	*Melaleuca nervosa*, *Melaleuca viridiflora*, *Asteromyrtus symphyocarpa* +/- *Grevillea pteridifolia* Low Open Woodland	50	9.1	18.2
21	*Corymbia polycarpa* Mid Open Woodland	4.4	0	0
Totals		**3583.1 ha**	**356.4 ha**	**9.9%**

Table 4-9: Total area of each land system that will be cleared as part of the haul road development

Land System		Landform	Vegetation	Distance & clearing area along Haul Rd	
				(km)	(ha)
Alh	Horse Creek	Gently undulating plains on sandstone with deep sandy soils and isolated swampy depressions	Tall open woodland of *E. tetrodonta, Callitris intratropica, E. miniata* and *C. ferruginea*. *Corymbia polycarpa* and *Melaleuca viridiflora* occur on wetter areas	26.7 km	133.5 ha
Alo	October	Very rocky gently undulating rises on massive sandstones	Mid-high open woodland of *C. dichromophloia*	1.3 km	6.5 ha
Als	Seigal	Gently undulating to undulating rises with abundant, often linear rocky outcrops and shallow sandy soils	Mid-high open woodland of *E. miniata, E. tetrodonta* and *C. ferruginea* with *C. dichromophloia* and *E. leucophloia*	13.2 km	66 ha
Alt	Tawarrila	Undulating rises to low hills with some rocky outcrops on sandstone	Mid-high open woodland of *C. phoenicea* with *C. polycarpa* on lower slopes	1.8 km	9 ha
Asb	Bukalara	Rugged rocky plateaux and steep, linear ridges on massive sandstones	Mid-high open woodland of *Corymbia dichromophloia* with *E. miniata, E. tetrodonta* and *E. leucophloia*	8.4 km	42 ha
Aso	O'Keefe	Broad breached anticlines and dissected structural plateaux on sub-horizontally bedded sandstones of the Roper Group with sandstone columns	Mid-high open woodland of *E. miniata, E. tetrodonta* and *C. ferruginea*	1.3 km	6.5 ha
Lwb	Bingbong	Incised, undulating rises flanking streams which are eroding into the laterite carapace of Lwf (Fletcher)	Mid-high open woodlands of *Eucalyptus tetrodonta* with *Callitris intratropica*	3.6 km	18 ha
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.	Tall open woodland of *E. tetrodonta* with *Melaleuca viridiflora, M. nervosa* and *Callitris intratropica*	23.1 km	115.5 ha
Lwr	Running	Gently undulating plains and rises on ferruginised, mainly arenaceous sediments	Tall open woodland of *E. tetrodonta* with *C. dichromophloia, C. ferruginea, E. miniata* and *C. phoenicea*	16.1 km	80.5 ha
Rle	Emmerugga	Undulating to rolling low hills on mainly argillaceous sediments	Mid-high open woodland of *E. leucophloia* with some *E. tectifica*, *C. terminalis*, and *Erythrophleum chlorostachys*	6.8 km	34 ha
Rlk	Kangaroo	Gently undulating to undulating rises on mainly argillaceous sediments	Mid-high open woodland of *E. tectifica*, *E. terminalis* and *Erythrophleum chlorostachys* with *Melaleuca viridiflora*, *Pandanus spiralis* and *C. polycarpa* on low lying areas	5.9 km	29.5 ha
Tac	Coolibah	Level to gently undulating plains on unconsolidated transported materials, rarely sedentary	Tall open grassland of *Chrysopogon fallax* and *Eulalia aurea* with some *E. microtheca* and *E. pruinosa*	6.5 km	32.5 ha
Taf	Frog	Broad sandy floodplains, terraces and lower colluvial slopes	Mid-high open woodland of *E. tectifica, C. terminalis* and *Erythrophleum chlorostachys* with some *C. bella* on sandy floodplains	6.2 km	31 ha

Land System		Landform	Vegetation	Distance & clearing area along Haul Rd	
				(km)	(ha)
Tam	McArthur	Broad or narrow fluvial corridors conducting regional drainage across various land systems towards the coast	Mid-high open woodland of *C. terminalis* and *E. microtheca* with some *C. bella* and *C. polycarpa*. Tall fringing riparian vegetation often includes *Melaleuca spp.*	15.6 km	78 ha
Tcn	Nathan	Pediments and side slopes of broad valleys on detritus and argillaceous sediments	Mid high open woodland of *C. terminalis* and *Erythrophleum chlorostachys* with some *Bauhinia cunninghamii* and *Melaleuca citrolens*	2 km	10 ha
Tcw	Wearyan	Gently undulating plains and pediplains on transported material or argillaceous sediments	Mid-high woodlands of *Melaleuca citrolens*	4.6 km	23 ha
Tol	Littoral	Tidal mud flats with channels and estuaries	Mostly bare areas with isolated clumps of *Melaleuca acacioides* and halophitic forbs with fringing mangroves along shoreline and tidal waterways	0.5 km	2.5 ha
Tor	Rosie	Almost level plains on old sea-floor deposits with regular dune swale systems or isolated sand dunes, in a sub-coastal orientation	Tall open woodland of *E. tetrodonta* with *Melaleuca viridiflora* and *Asteromyrtus symphyocarpa* on low lying areas	20.3 km	101.5 ha
Tos	Spillen	Coastal sand sheets, dunes and cheniers with minor intervening tidal flats	Tall grasslands of *Chrysopogon elongata* with some *Melaleuca viridiflora, M. nervosa, Pandanus spiralis* and *C. bella*	1.6 km	8 ha
Total					**820 ha**

Table 4-10: Total area of each vegetation type that will be cleared as part of the port development

Veg Type	Vegetation Description	Total Area of Veg Type Cleared within the Port Area
1a	**Mangrove Community -** +/- *Pemphis acidula, Excoecaria ovalis, Lumnitzera racemosa* Low Closed Forest.	0.47 ha
2b	**Coastal Dune -** Mixed monsoon vine thicket +/- *Corymbia bella, Diospyros* sp., *Flueggea virosa, Premna acuminata, Exocarpos latifolia, Barringtonia acutangula, Ficus virens* Low Closed	0.14 ha
4	**Swamps -** *Melaleuca viridiflora* +/- *Melaleuca acacioides* Low Woodland over *Pseudoraphis spinescens* Low Tussock Grassland	0.03 ha
5a	**Coastal Grasslands -** *Grevillea striata* +/- *Diospyros humilis*, *Petalostigma banksii*, *Margaritaria dubium-traceyi* Low Open Woodland over *Chrysopogon elongatus* and *Eulalia aurea* Tall Tussock Grassland	1.72 ha
5c	**Coastal Grasslands -** *Grevillea striata, Pandanus spiralis*, Isolated Trees over *Grewia retusifolia* Isolated Shrubs over *Chrysopogon fallax* +/- *Sarga* spp., *Eriachne* spp., Tall Tussock Closed Grassland.	5.16 ha
6c	**Coastal Woodlands -** *Melaleuca viridiflora* +/- *Corymbia bella* Low Woodland over *Chrysopogon elongatus* Tall Tussock Grassland	4.38 ha
6d	**Coastal Woodlands -** *Corymbia bella* Mid Open Forest over +/- *Acacia* spp., *Pandanus spiralis, Hyptis suaveolens,* Sparse Mid Shrubland	5.2 ha
Totals		**17.44 hectares**

Note: 0.34 ha is not included within the vegetation area as it represents the mudflat intertidal zone.

4.7 Findings and Conclusions

Prior to this EIS, few surveys have been conducted in the Gulf Falls Uplands and Gulf Coastal bioregions region due to their remoteness. As a consequence the knowledge base for the biodiversity of these regions is poor. This is evidenced by the number of species not previously recorded that were found in the field surveys for this EIS – some of which are common species that hadn't been encountered, and others representing significant range extensions. There is still much to discover from a biodiversity perspective.

The list of threatened species for the region (including the project area), their probability of occurrence and the impact that this development will have on those species is outlined in Sections 4.4 and 4.5. These sections conclude that most threatened species will not be affected because:

(i) No critical habitat is affected by the development;
(ii) Species are highly mobile;
(iii) These species are wide ranging – to the extent that the range of these species is much wider than the spatial extent of the development; and
(iv) Other processes such as the cane toad and habitat alteration due to changes of fire regime may have had a greater impact than this development.

There are six species that have the potential to be deleteriously threatened by this development. These are:

- Northern Quoll (*Dasyurus hallucatus*);
- Gulf Snapping Turtle (*Elseya lavarackorum*);
- Dwarf Sawfish (*Pristis clavata*);
- Freshwater Sawfish (*Pristis microdon*);
- Green Sawfish (*Pristis zirjon*); and
- Thorny Solanum (*Solanum carduiforme*).

There were three main sensitive habitat types identified within the project disturbance footprint that were considered to be at risk of impact, these included:

- Sandstone escarpments, hills, and ridges;
    - Deeply incised rocky hills close to Rosie Creek (isolated southern reaches of Yiyintyi Range);
    - Rocky ridges adjacent to Limmen Bight River;
- Wetlands;
    - Seasonally inundated *Melaleuca* swamps were common within the general project area;
- Riparian (major rivers and creeks);
    - Re-alignment of the upper reaches of Towns River; and
    - The many river and creek crossings along the haul road

No rainforest or monsoon forest patches were identified within or close to the project area.

To determine the degree of risk these species and sensitive habitats face from the development, and to identify potential mitigation and management actions, they have been referred to the formal risk assessment for the project (Chapter 9).

Weeds were not identified within the MLA areas, but were identified along the proposed haul road and port facility areas. Therefore, a strict weed quarantine program (see Appendix F) will be required to ensure that weeds are not spread by the mining operation.