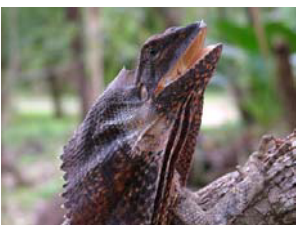
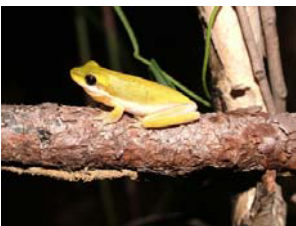
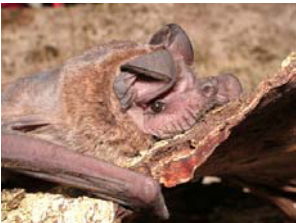
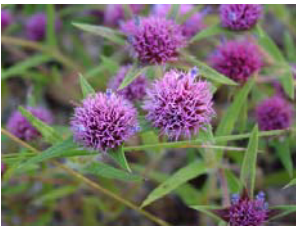


Appendix 4

Browns Oxide Project Fauna Report



BROWNS OXIDE PROJECT

Fauna Report

Prepared For
Enesar Consulting Pty Ltd &
Compass Resources NL

ECOLOGICAL MANAGEMENT
SERVICES PTY LTD

August 2005 FINAL



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Project: Browns Oxide Project, Batchelor NT
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Document Status: Final (Revision 1)

REVISION HISTORY/DOCUMENT STATUS

Version	Date of Issue	P. Barden	S. Hermon
Draft	23 June 2005		
Final	31 July 2005		
Revised	22 Aug 2005		

The authors gratefully acknowledge the provision of relevant information and assistance by the following:

- *John Earthrowl, Compass Resources NL: site liaison, soil and geological data;*
- *Paul Horner, Museum & Art Gallery of the Northern Territory: comments on Ramphotyphlops nema;*
- *Alaric Fisher, DIPE: liaison regarding the status of NT species and survey guidelines;*
- *Owen Price, DIPE: liaison regarding regional data;*
- *Kristin Metcalfe: vegetation maps and descriptions, cadastral base map and aerial photography;*
- *2002 BIITE students/field assistants: David Tapim, Lachlan Harrison, Johnny Sagenschnitter, Wayne Kroczeck, Joaquin Huddleston and Simon Ponto;*
- *Sonia Tidemann, BIITE: 2002 dry season bird survey and comments on avifauna of the wider study area; and*
- *Barbara Triggs: scat & hair analysis.*

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BROWNS OXIDE PROJECT

Fauna Report

Prepared For
Enesar Consulting Pty Ltd and
Compass Resources NL

1. INTRODUCTION

Ecological Management Services Pty Ltd has been commissioned by Enesar Consulting Pty Ltd to conduct a wet season (2005) fauna study of the 1.75 km² Browns Oxide Project Area. The Browns Oxide Project Area is located approximately 65 km south of Darwin and 7 km northwest of the Batchelor Township. The deposit has an east west orientation and is adjacent to the historic Rum Jungle Mine.

The report has been prepared in accordance with the brief provided by Enesar Consulting Pty Ltd (2005). The wet season fauna data presented in this report has been combined with the dry season fauna survey undertaken by Ecological Management Services in June 2002. The study area for the wet season survey was identified by Enesar Consulting Pty Ltd and included the Browns Oxide Project Area, which covers 12 mineral leases on the Browns Oxide deposit, but did not include the existing Rum Jungle mine area.

The dry season field survey included a wider study area (37.5 km²), which included sites in and surrounding the 1.75 km² Browns Oxide Project Area as well as the existing Rum Jungle mine. Survey sites that were sampled during the dry season survey that were located outside the Browns Oxide Project Area were not re-sampled during the wet season 2005. However, relevant dry season data has been retained in this report, as this information is relevant to the characterisation of the local and regional fauna.

In this report the "Browns Oxide Project Area" refers to the 1.75 km² area covered by the 12 mining leases covering the oxide ore body and immediately surrounding areas but not including the existing Rum Jungle Mine. The "wider study area" refers to the 37.5 km², area covered by the dry season 2002 survey (Figure 1).

During the 2005 wet season survey, three of the dry season sites in the vicinity of the Browns Oxide Project Area were re-sampled (sites 1, 2 and 8) and an additional site was selected to survey representative habitat within the Browns Oxide Project Area. The additional site was sampled in *Melaleuca* woodland south of the Browns Bulk Sample Pit (site 9). These four sites (1, 2, 8 and 9) are of most relevance in determining impacts within the Browns Oxide Project Area.

1.1 EXISTING ENVIRONMENT

1.1.1 Land Systems & Geology

The Rum Jungle region is in the north-western part of the Pine Creek Geosyncline where Lower Proterozoic sedimentary rocks were deposited over the Archaean Rum Jungle and Waterhouse granitic complexes (Davy 1975). The area is mainly a peneplain of gently undulating land interspaced by plains, with low rises and hills to around 150m above the surrounding drainage areas (Low 2001). Sedimentation occurred over the Tertiary and into the Quaternary and the sub-horizontal bedding of the sediments is a major factor influencing the topographic form (Low 2001). The Coomalie Dolomite forms the bed of the East Branch of the Finnis River below the Rum Jungle ore treatment area (Low 2001). The geology of the wider study area is described in detail by Low (2001).

Major landform groups represented in the wider study area include undulating lowlands (undulating lowlands and low rises of gravel and shallow lithosols over granite sub-outcrops), drainage floors and depressions (poorly drained areas subject to inundation and waterlogging during the wet season) and stream channels and levees.

Soils of the wider study area are poorly documented, however they are likely to be of low nutrient content except in the river valleys where they tend to be acidic (Low 2001). Low (2001) has indicated that a significant vegetation anomaly in the vicinity of the Browns Oxide deposit may result from soil or geochemical properties. Soils at survey sites within the Browns Oxide Project Area include moderate brown gravelly loam, moderate red brown silty sand, pale grey red gravelly sand, pale grey red gravelly sand in pisolitic laterite, pale yellowish-brown silt (J. Earthrowl pers comm.), as well as shallow lithosols associated with rock outcrops and textured 'acid' alluvial soils and heavy grey pedocals in the lowlands and floodplains.

1.1.2 Vegetation

In the absence of updated and specific vegetation and flora data for the Browns Oxide Project Area, data from Metcalfe (2002) from the wider study area has been used (refer to section 2.6). The vegetation in the study area has been described by Metcalfe (2002); Figure 1. The wider study area supports 10 major vegetation communities (Metcalfe 2002). The following major vegetation communities have been identified in the Browns Oxide Project Area and wider study area by Metcalfe (2002), including *Acacia auriculiformis*/regenerating monsoon vine-forest, *E. tetradonta/Eucalyptus miniata/Erythrophleum chlorostachys* tall open forest to woodland, *Eucalyptus phoenicea/Corymbia bleeseri* open woodland, *E. papuana/Corymbia foelscheana/Melaleuca* sp. open woodland to grassland, *E. tetradonta/Eucalyptus miniata* open woodland, *Lophostemon* communities open woodland to grassland, mixed Eucalypt woodland, paperbark communities woodland to open woodland, monsoon vine-forest closed forest to open forest and riparian woodland to open woodland. The project area also includes previously disturbed and modified habitats; in some cases these areas are dominated by weeds and introduced grasses.

1.1.3 Hydrology

The branches of the Finnis River are the main watercourses draining the wider study area. The channel of the Finnis River is generally broad and deeply cut, with steep banks 3 to 5m high including flood terraces flanked by sandy, heavily vegetated levees (Metcalfe 2002). During the dry season, the East Branch of the Finnis River and its associated creeks consist of a series of discontinuous permanent and semi-permanent waterholes.

Some of the smaller tributaries within the wider study area are spring-fed and flows are maintained throughout the dry season. Other minor tributaries and drainage lines are ephemeral, including those within the Browns Oxide Project Area. A number of mine pits adjacent to the project area support open water during the dry season. During the wet season open water in the Browns Oxide Project Area includes a number of small ephemeral streams, artificial dams and seasonally inundated swamp areas. The Browns Bulk Sample Pit is the largest permanent open body of water within the Browns Oxide Project Area. Areas surrounding the branches of the Finnis River consist of alluvial flats that become seasonally flooded.

1.1.4 Disturbance & Weeds

Disturbance and other impacts from past mining, clearing, fires, roads/tracks and the introduction of weeds and the feral pig have impacted on the condition and structure of remnant vegetation. Heavily

disturbed areas have been mapped by Metcalfe (2002) and are indicated in Figure 1 and disturbance at sites noted during the surveys are described in Appendix B.

During the 2002 dry season survey, many areas associated with open water and drainage channels displayed moderate to high levels of disturbance from the feral pig (*Sus scrofa*) in the wider study area. Bankside disturbance was noted in riparian vegetation and *Lophostemon* and *Melaleuca* woodland along Rum Jungle Creek and in vegetation along the East Branch of the Finnis River. During the 2005 wet season survey, the highest levels of disturbance from pigs in the Browns Oxide Project Area were noted at site 9 in *Melaleuca* woodland associated with low lying drainage areas and at site 1 in *Acacia auriculiformis*/recovering monsoon vine-forest.

A number of introduced plant species were identified in the wider study area, with the highest density noted primarily in disturbed areas (Metcalfe 2002). Several declared noxious weeds including *Mimosa pigra*, *Senna obtusifolia* and *Hyptis suaveolens* were recorded within the wider study area (Metcalfe 2002). A number of weed species were also recorded during the Rum Jungle rehabilitation and monitoring project (Rum Jungle Mine Area) including two class A noxious weeds listed under the *Weeds Management Act 2001*, grader grass (*Themeda quadrivalvis*) and mimosa (*Mimosa pigra*) (DIPE 2002). Of particular concern, is the distribution and density of the tall, introduced grasses *Pennisetum polystachion* (Mission Grass) and *Andropogon gayanus* (Gamba Grass) which have the potential to have a widespread and major impact on the fire ecology by changing vegetation structure and species composition (with associated reductions in savanna biodiversity) (Metcalfe 2002).

Legend

- 12 ML's Area (Browns Oxide Deposit)
- Browns Oxide Project Area (2005 Wet Season)
- Wider Study Area (2002 Dry Season)

Vegetation Communities (Metcalfe 2002)

Upland Eucalypt Communities

- 1. *Eucalyptus phoenicea*/ *C. bleeseri* Open Woodland
- 2. *E. tetradonta*/ *E. miniata* / *Erythrophloeum chlorostachys* Tall Open Forest to Woodland
- 3. *E. tetradonta*/ *E. miniata* Open Woodland
- 4. Mixed Eucalypt Woodland

Drainage Areas

- 5. Riparian corridor Woodland to Open Woodland
- 6. *Lophostemon* communities Open Woodland to Grassland
- 7. *Eucalyptus papuana*/ *C. foelschiana*/ *Melaleuca* sp. Open Woodland to grassland
- 8. Paperbark communities Woodland to open woodland

Monsoon Forest Communities

- 9. Monsoon vine-forest Closed forest to Open Forest
- 10. *Acacia auriculiformis* Regenerating vine forest communities Woodland to Open Forest

Other

- 11. Previous mining areas, disturbed sites & rehabilitation areas
- 12. Water bodies, mine pits

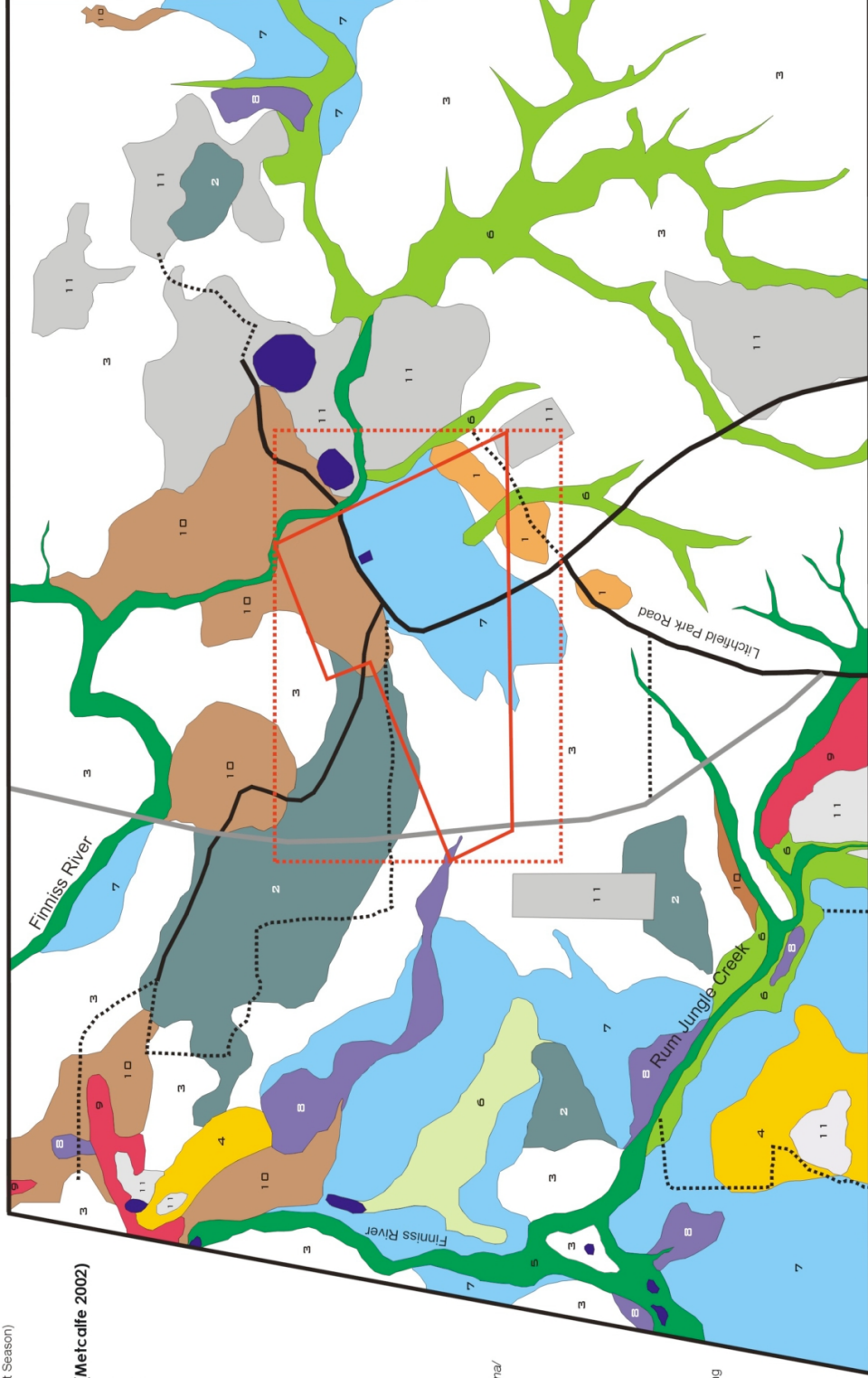
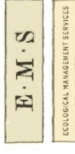


FIGURE 1.
Wider Study Area Location and
Vegetation Communities

BROWNS OXIDE PROJECT



Plan Note:
This map was prepared to accompany a preliminary ecological assessment of the Browns Oxide Project, Batchelor NT, and should not be used for any other purpose. While every care is taken to ensure the accuracy of this data, Ecological Management Services make no representations or warranties about its accuracy, reliability or completeness or suitability for any particular purpose and disclaim all responsibility and liability (including without limitation, liability in negligence) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
Base vegetation mapping provided by Metcalfe (2002).
Localities of vegetation association boundaries and study area boundary details displayed in this figure are indicative only and have not been surveyed by Ecological Management Services Pty Ltd.
This note is an integral part of this plan.

BASELINE

2. FAUNA ASSESSMENT

2.1 REVIEW OF EXISTING FAUNA DATA

2.1.1 Browns Oxide Project Area and Local Area

A detailed desktop review of existing biological data for the Browns Oxide Project Area and the wider study area has been prepared by Low (2001). Prior to the current and 2002 dry season surveys (EMS) the terrestrial and semi-aquatic fauna of the wider study area have not been systematically documented. Davy (1975) provides some general comments on the fauna of the Rum Jungle area, including vertebrate pest species. An extensive amount of monitoring and research has been undertaken on the Finniss River predominantly concentrating on freshwater macroinvertebrates and freshwater fishes (for example see Markich 2001; Jeffree & Twining 1998; Jeffree 2001), and some studies included crocodiles (Humphrey *et al.* 2001).

Low (2001) cites fauna studies in the Batchelor area, including surveys of the Woodcutters mine area (Van Groenou 1986), Cosmo Howley (Davison & Van Groenou 1986), Mt Bundy Station (Low 1986), Elizabeth Downs Station (Low *et al.* 1986a) and Tipperary Station (Low *et al.* 1986b). However Low (2001) found no fauna records held by the PWCNT Biological Records Scheme for the 20-minute square block centred on the Browns Oxide Project Area (Latitude 13° and Longitude 131°). Results of a search of a wider area from the Biological Records Scheme database (PWCNT 2002) conducted for this fauna assessment is included in Appendix A.

Additional data for the area has been compiled in Appendix A, including an impact assessment for the Winchester Magnesium Deposit EIS (Ecological Management Services 2001; URS 2001) and a list of mammal and significant bird species from the Mount Burton area to the north-west of the Browns Oxide Project Area (Tidemann unpublished data 2002).

2.1.2 Regional Fauna Records

Regional fauna records have been compiled in a number of databases, museum collections and survey reports, with surveys primarily located in the Litchfield and Adelaide River areas. A list of the

suite of fauna species present in the region based on these existing surveys and databases is included in Appendix A and includes the following sources.

Griffiths *et al.* (1997) provides a detailed summary of historical biological surveys in the region including Litchfield National Park. Terrestrial and aquatic fauna surveys that have been conducted within the Litchfield National Park include Parks & Wildlife Commission surveys by McKean & Martin (1984) and Griffiths *et al.* (1997). Griffiths *et al.* (1997) also provide regional records from various Museums including the Museum and Art Gallery of the Northern Territory, the Biological Records Scheme of the Northern Territory, bird records from the Royal Australian Ornithological Society database, fauna records from Petherick's rainforest, Daly River, Elizabeth Downs Station (Menkhorst & Woinarski 1992; Gambold & Woinarski 1993; Robinson & Woinarski unpubl. data), records from Petherick's rainforest (E.R. Petherick, in Griffiths *et al.* 1997) and the Union Reef Gold Mine EIS (ERA Environmental Services/NSR 1993). Records compiled from terrestrial vertebrate fauna monitoring in Litchfield National Park during 1995-96 and 2001-2002 (Woinarski *et al.* 2004) and a search of the Birds Australia (RAOU) bird atlas database (June 2005, one minute grid cell surrounding the project area) have also been included in Appendix A.

Regional records from the Natural Resource Strategy for Coomalie Sub-region have also been reviewed. This strategy provides a description of the fauna from the Coomalie Subregion from 35 sites, which have been formally surveyed for fauna (Price & Baker 2003). 290 species were recorded, comprising of 170 birds, 66 reptiles, 39 mammals, 15 frogs (Price & Baker 2003).

2.2 SELECTION OF FAUNA SAMPLING SITES

Terrestrial and aquatic habitats within the Browns Oxide Project Area were defined with reference to land systems, topography and vegetation communities. The distribution of fauna may also depend on other factors, such as the availability of open water, fire history and availability of microhabitat and other resources. These factors were considered when selecting representative survey sites within the wider study area and Browns Oxide Project Area. Some sites were selected to sample particular habitat features and topographic characteristics and additional sites were selected for the placement of specific sampling methods (such as harp trapping). While anthropogenic activities within the Browns Oxide Project Area have created a number of artificial habitats, including mine pits, tailings areas, plant areas and artificial dams, these disturbed areas were not sampled for fauna, other than incidental observations.

Terrestrial survey sites 1 - 8 were selected during the 2002 dry season survey to sample the main vegetation types listed in preliminary mapping provided by Metcalfe (2002) and also to provide a

representative sample of the land systems/vegetation within the wider study area. Sites were selected to sample the main vegetation/landform types within the wider study area including:

- Upland eucalypt communities on undulating rises and low hills;
- Monsoon vine-forest communities on scree and riverine flood terraces, narrow monsoon vine-forests on spring-fed tributaries;
- Open woodland and grassland communities in drainage areas;
- Rock outcrops and scree areas supporting dry open woodland vegetation; and
- Aquatic sites on minor and major tributaries within the wider study area.

Terrestrial survey sites 1, 2, 8 and 9 were selected during the 2005 wet season survey to sample the Browns Oxide Project Area. Sites 1, 2 and 8 from the dry season (2002) survey were re-sampled in order to provide comparative seasonal data. These sites included representative vegetation communities, including a Eucalypt tall open forest community, a monsoon vine-forest community and a rock outcrop, scree area supporting a Eucalypt/Corymbia open woodland vegetation community. An additional site was sampled (site 9) consisting of an additional representative vegetation type, *Melaleuca* woodland in a drainage area, located near the Browns Oxide deposit and the main impact area of the proposal.

Two aquatic sites were sampled in the 2005 wet season survey, including the east branch Finnis River adjacent to the Browns Oxide Project Area (Aq1) and an ephemeral creek south of the Browns Bulk Sample Pit (Aq9). The latter site was not sampled during the dry season, as there was no standing water at this site. Site data is included in Appendix B. Limitations associated with the siting of terrestrial sample sites are discussed in Section 2.6.

2.3 SURVEY SITES & EFFORT

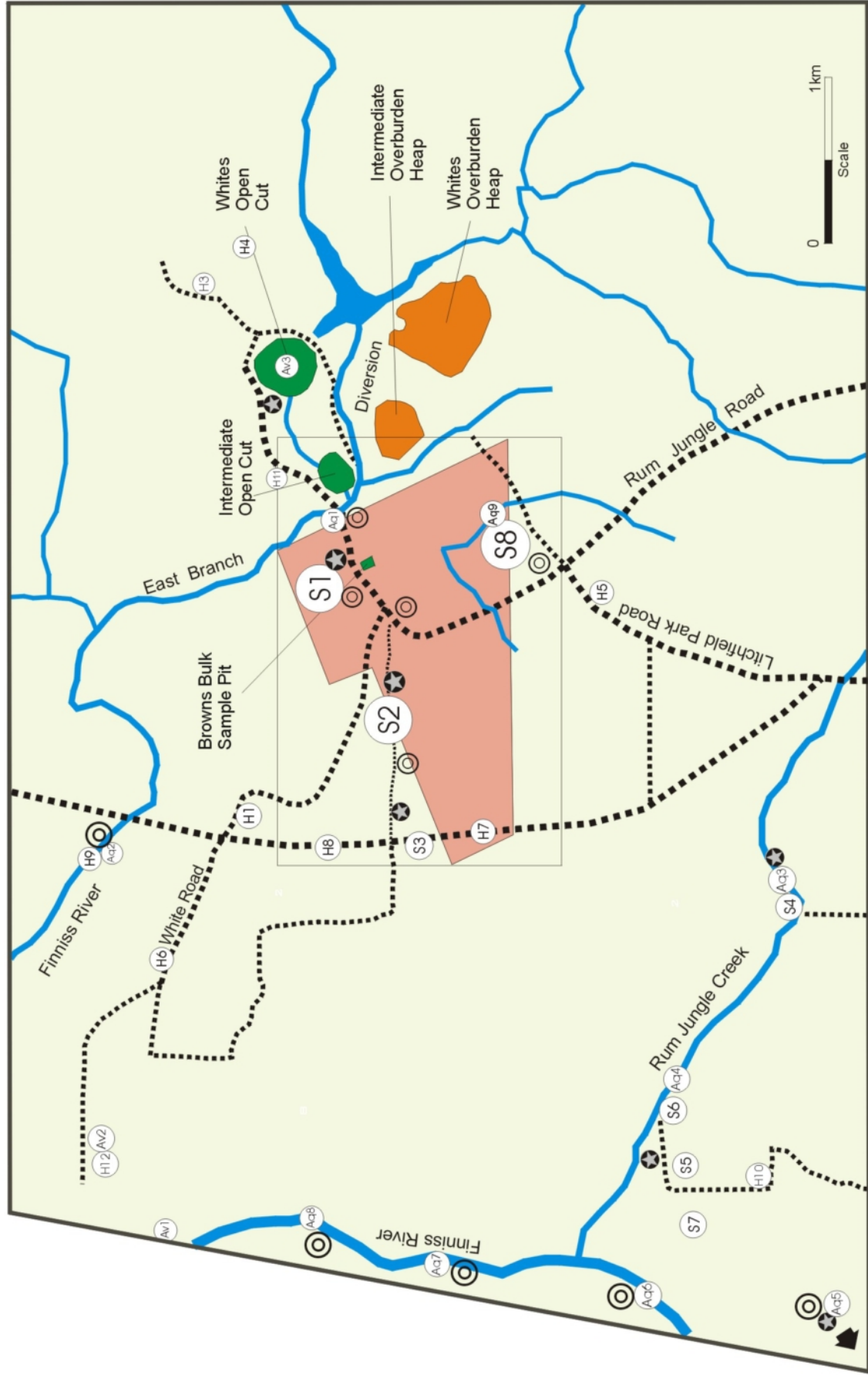
Eight terrestrial and eight aquatic survey sites were systematically sampled during the 2002 dry season survey (S1 - S8, Aq1 - Aq8 in Figure 2), with sampling undertaken between 18 June 2002 and 30 June 2002. Conditions during the dry season were generally clear and sunny with relatively cool overnight temperatures and no rainfall. Incidental observations from additional areas and the general study area were also compiled during the survey period. In addition to the terrestrial sites 1 - 8, Tidemann (2002) conducted bird surveys at two additional sites for birds (Av1 and Av2 in Figure 2). Bird observations from White's Pit within the existing Rum Jungle mine are also included (Site Av3). Twelve additional herpetofauna survey sites were selected to sample habitats away from the main

survey sites within the study area (H1 - H12 in Figure 2). Additional site surveys, such as harp trap localities and vehicle - spotlight transects are indicated in Figure 2.

Four terrestrial and two aquatic survey sites were systematically sampled during the 2005 wet season survey between 9 March 2005 and 20 March 2005 (S1, S2, S8, S9, Aq1 and Aq9 in Figure 3). Conditions during the wet season were generally warm/humid with frequent late gusty storms. A period of heavy rainfall associated with cyclone Ingrid occurred during the survey period. The smaller number of sites during the 2005 wet season is indicative of the reduced scope of the 2005 assessment, focussing on the Browns Oxide Project Area and surrounds. Wet season site methodologies conform to the methodology established during the dry season survey. The survey effort applied at each site is described in Table 2.1.

**TABLE 2.1 WET + DRY SEASON
SUMMARY OF FAUNA SURVEY SITE EFFORT**

Survey Site Type	2002 Dry Season Site No.	2005 Wet Survey Site Number	Survey Method	Survey Effort Per Site
Terrestrial Fauna Survey Site	S1 - S7	S1, S2, S8, S9	Hair Funnels	6 hair funnels (7 to 9 nights)
	S1 - S8	S1, S2, S8, S9	Tree Mounted Traps	4 tree trap nights
	S1 - S8	S1, S2, S8, S9	Elliott Type A Traps	42 trap nights
	S1 - S8	S1, S2, S8, S9	Elliott Type B Traps	3 large Elliott trap nights
	S1 - S8	S1, S2, S8, S9	Wire Cage Traps	3 wire cage trap nights
	S1 - S7	S1, S2, S8, S9	Pitfall Trap	8 pitfall trap nights
	S1 - S8	S1, S2, S8, S9	Timed area bird survey	3 x 20 min surveys, spotlight survey, broad surveys & incidental observations
	S1 - S8	S1, S2, S8, S9	Nocturnal Call Playback	Call playback of selected nocturnal birds & arboreal marsupials (40 minutes per site)
	S1 - S8	S1, S2, S8, S9	Timed Active Area Search (Diurnal)	3 x 20 minute timed area searches (1 person-hour per site)
	S1 - S8	S1, S2, S8, S9	Timed Active area Search (Nocturnal)	2 x 20 minute timed area searches (low watt light source) per site
	S1 - S8	S1, S2, S8, S9	Spotlight Survey	40 minutes spotlight survey (50 watt light source) per site
	S1 - S8/Aq1/ Aq2/ Aq5 - Aq8	S1, S2, S8, S9	Bat call detection fixed point	40 minutes fixed point sampling per site
Aquatic Fauna Survey Sites	Aq1 - Aq8	Aq1, Aq9	Semi-aquatic Vertebrates	Nocturnal spotlight survey (30 minutes per site), diurnal bankside observations, incidental observations
	Aq1 - Aq8		Turtle Trapping	10 trap hours per site
Additional Reptile Search Sites	H3 - H4 - H5 - H9		Timed Area Search Rock Outcrops	3 x 20 minute diurnal timed area search 2 x 20 minute nocturnal timed area search
	Aq6 - Aq7 - Aq8		Timed Area Search Riverine Habitat	3 x 20 minute diurnal timed area search 2 x 20 minute nocturnal timed area search
	H2 - H6 - H7		Timed Area Search Upland Eucalypt Habitat	3 x 20 minute diurnal timed area search 2 x 20 minute nocturnal timed area search
	H1 - H11 - H12		Timed Area Search Vine-forest Habitat	3 x 20 minute diurnal timed area search 2 x 20 minute nocturnal timed area search
Additional Avifauna Sites	Av1 + Av2		Timed area bird survey	3 x 20 min timed area surveys, spotlight survey, broad observational surveys & incidental records
Additional (Non-standard) Survey Methods	S1/S2/S4/S6/ Aq5	S1, S2, S8, S9	Harp Trap	12 harp trap nights per seasonal sample
			Vehicle spotlighting	90 minutes (Upland Eucalypt Communities) Dry Season
			Vehicle spotlighting	90 minutes (Riverine/Floodplain Communities) Dry Season
			Vehicle Spotlighting	90 Minutes (Browns Oxide Project Area) Wet Season
			Bat roost searches	Opportunistic
			Collection of scats/skeletal remains	Incidental



LEGEND

- S1 Fauna Survey Site
- Aq1 Aquatic Survey Site
- H1 Herpetile Search Site
- Bat Bat Echolocation Call Detection Site
- S12 Fauna Survey Site
- Aq12 Aquatic Survey Site
- H12 Herpetile Search Site
- S7 Fauna Survey Site
- Aq7 Aquatic Survey Site
- H7 Herpetile Search Site
- S8 Fauna Survey Site
- Aq8 Aquatic Survey Site
- H8 Herpetile Search Site
- S9 Fauna Survey Site
- Aq9 Aquatic Survey Site
- H9 Herpetile Search Site
- S10 Fauna Survey Site
- Aq10 Aquatic Survey Site
- H10 Herpetile Search Site
- S11 Fauna Survey Site
- Aq11 Aquatic Survey Site
- H11 Herpetile Search Site
- S12 Fauna Survey Site
- Aq12 Aquatic Survey Site
- H12 Herpetile Search Site

Note This map provides an indication of the general locality of sites.

Plan Note:

This plan was prepared to accompany a preliminary ecological assessment of the Browns Oxide Project, Batchelor NT, and should not be used for any other purpose. While every care is taken to ensure the accuracy of this data, Ecological Management Services make no representations or warranties about its accuracy, reliability or completeness or suitability for any particular purpose and disclaim all responsibility and liability (including without limitation, liability in negligence) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.

Localities of survey sites are based on field mapping only and have not been surveyed by Ecological Management Services. This map provides an indication of the general locality of sites.

This note is an integral part of this plan.



MGA 1984 ZONE 52

Date: 31 July 2005

FIGURE 2. Dry Season Fauna Survey Sites 2002

BROWNS OXIDE PROJECT

2.4 SURVEY METHODS

Small mammals and herpetofauna were surveyed using a number of live trapping methods, conducted under Parks and Wildlife Commission of the Northern Territory Permit Number 10907 (2002) and Permit Number 20347 (2005). Live capture/release methods included aluminium type A and B Elliott box traps for mammals, wire cage traps, tree mounted traps for arboreal small to medium sized mammals, harp traps for bats and pitfall traps with drift fences. Additional methods are also described below.

2.4.1 Elliot and Wire Cage Traps for Ground Mammals

Elliott Scientific aluminium Type A box traps for small mammals, Elliott Scientific aluminium Type B box traps for medium sized mammals and wire cage traps for medium sized ground mammals were used at each terrestrial fauna survey site. Elliott traps were placed at ten metre intervals along linear transects (~250 m long). One wire cage trap and one large Elliott trap (Type B) were placed at suitable sites on each transect. Traps were baited with a standard bait mix and operated over three nights. Trap nights for sites surveyed during the dry (2002) and wet season surveys (2005) were replicated in order to provide comparative data for a total of 48 trap nights per site, per season (42 Type A Elliott trap nights, 3 Type B Elliott and 3 wire cage trap nights).

2.4.2 Tree Mounted Traps for Arboreal/Scansorial Mammals

One tree-mounted trap for small arboreal/scansorial species was set at each terrestrial fauna survey site. Traps were baited with a standard bait mixture and operated over three nights, for a total of 3 trap nights per site, per season.

2.4.3 Pitfall Trapping

Pitfall traps were used to target herpetofauna and small mammals. Pitfall trap systems incorporated two 20 litre PVC buckets with a screen drift fence (12 m long x 0.4 m high). Pitfall traps were operated over four nights for a total of 8 pitfall trap nights at each site. Pitfall traps were cleared of captures in the morning and late afternoon.

2.4.4 Harp Trapping for Bats

Harp trapping for small bat species was undertaken at a number of suitable sites (12 harp trap nights per seasonal survey). Harp traps were used as a non-standard method with trapping localities selected on the basis of characteristics that were not available at all terrestrial survey sites. Sites for the placement of harp traps were situated along potential flyways, such as gaps or tracks through

open forest and riparian closed forest in the vicinity of creeks. Harp trapping locations are indicated in Figure 2 & Figure 3.

2.4.5 Semi-aquatic Vertebrate Survey & Turtle Trapping

Semi-aquatic vertebrates were sampled using spotlight survey, diurnal bankside observations and trapping. At each aquatic survey site (Aq1 - Aq9 in Figure 2) nocturnal spotlight survey using a 50-watt spotlight was conducted along a 200 m stream frontage (30 minutes per site). Each site was visited during the 30 minutes of bankside observations on the same reach as spotlight survey. Scats, tracks and skeletal remains were recorded or collected. Freshwater turtles were trapped using commercial bait traps. Traps were set at each aquatic survey site (Aq1 to Aq8 in Figure 2) for a total of 10 trap hours per site. During the dry season Aq9 could not be sampled, as there was no surface water present. During the wet season 2005 the reduced scope of the project area resulted in only two aquatic sites being sampled (Aq1 and Aq9).

2.4.6 Diurnal & Nocturnal Active Searches

Direct search for reptiles and amphibians was undertaken, including observational survey and removal of cover such as rocks, artificial material, fallen logs and peeling bark from trees. Three x 20-minute area searches were conducted within a 100 x 200 m² area at each site between 0900 and 1200 hours (total 60 minutes diurnal search per site per seasonal sample). New areas were searched for each 20-minute period. Searches were repeated at night using low watt headlamps (2 x 20 minute/100 x 200 m² area searches per site). During the dry season survey additional 20 minute timed area searches were conducted at additional herpetofauna search sites H1 - H12 (Table 2.1; Figure 2). Water bodies and drain margins were searched with a low watt torch for amphibian species.

Mammals were recorded when encountered during active searches. Observations made of wildlife recorded outside of the main sampling sites were noted according to the habitat in which they were observed.

2.4.7 Spotlight Survey

Spotlighting on foot was undertaken in representative habitat at each terrestrial survey site during the dry and wet season surveys. An area (~200 x 400 m²) was traversed on foot for 40 minutes using a 50-watt spotlight at each terrestrial survey site, to sample nocturnal mammals, birds, reptiles and frogs. Spotlighting was commenced at dusk and completed during the following 2 - 4 hours.

2.4.8 Diurnal Avifauna Surveys

Diurnal birds were recorded during timed searches in fixed areas as well as opportunistic observations. Searches involved identification of all bird species seen or heard within a 100 x 200m² area during three 20-minute search periods per site, on separate days, commencing before 0600 hours in the wet season and 0700 hours in the dry season and finishing by 0900 hours. The survey sites were chosen to represent specific habitat types. Records were also compiled during spotlighting surveys and opportunistic observations during the day both within the survey sites and outside but within the same habitat type. Where observations were not linked to a particular habitat, species are listed in the body of the report. The species of trees/shrubs flowering was noted for each habitat.

Tidemann (2002) conducted the survey of birds for the dry season (24 June to 7 July 2002). Bird surveys were repeated during the wet season at sites 1, 2, 8 and 9 within the Browns Oxide Project Area.

2.4.9 Call Playback and Spotlight Survey for Nocturnal Birds

Nocturnal birds were targeted during the dry and wet season spotlight surveys and the presence of nocturnal species was assessed by call playback of selected species following the methodology described by Debus (1995). This involves the broadcast of recorded calls of selected species for a standard period of time, followed by a period spent listening for calls of nocturnal birds and spotlighting in the immediate area. Nocturnal birds detected during vehicle spotlighting transects, spotlighting for other fauna groups and incidental records were also recorded.

During the dry season survey Tidemann (2002) recorded nocturnal bird species seen and heard during 30 minute spotlight surveys at Sites 1 - 8, Av1 and Av2. During the wet season survey nocturnal bird species seen and heard were recorded during 40-minute spotlight surveys at Sites 1, 2, 8 and 9.

2.4.10 Ultrasonic Bat Call Detection

Survey for microchiropteran bat species included the use of ultrasonic bat call detectors (AnaBat II, Titley Electronics). Timed fixed-point echolocation detection was conducted between dusk and 2200 hours at terrestrial survey sites to provide a comparison in bat activity and species between sites. During the dry season survey, fixed point sampling was undertaken at S1 - S8, Aq2, Aq5 and Aq8) and during the wet season survey at S1, S2, S8, S9). Species identifications were made using reference call material from the project area and Batchelor area (Ecological Management Services) and with reference to Milne (2002).

2.4.11 Hair Funnels

Hair funnels were baited and placed in trees and on the ground to target ground, scansorial and arboreal mammals. Four ground mounted hair funnels and two tree mounted hair funnels were placed at 20 metre intervals at survey sites. Baits included attractants for arboreal mammals and marsupial carnivores. Hair tubes were rebaited when necessary. Hair samples were analysed for species identifications.

During the dry season survey, hair funnels were set at 7 terrestrial survey sites (S1-S7) throughout the wider study area and were left on site for 7 nights. During the wet season survey, hair funnels were set at four terrestrial survey sites (S1, S2, S8, S9) throughout the Browns Oxide Project Area and were left on site for 9 nights.

2.5 ADDITIONAL SAMPLING METHODS

Additional survey methods were included in the survey to target specific sites or species and to incorporate surveys outside the representative survey sites.

2.5.1 Vehicle Spotlight Survey and Roadside Observations

Spotlighting was undertaken from a slow moving vehicle along roads and tracks within and on the margin of the wider study area and during movement between survey sites. During the dry season survey, 90 minutes was spent spotlighting in upland eucalypt communities and 90 minutes in floodplain/drainage areas across the wider study area. During the wet season survey 90 minutes was spent spotlighting along roads and tracks within and surrounding the Browns Oxide Project Area. Diurnal observations and incidental records were also collated for roadside areas.

2.5.2 Tracks & Signs

Fauna species identifications were compiled from evidence of fauna presence, including tracks, scats, skeletal remains and other signs.

2.5.3 Incidental Records

Incidental observations were compiled during time spent on-site. Any species observations made in the vicinity of a survey site or outside survey periods were noted as incidental observations. Microchiropteran bat surveys included opportunistic searches for roost sites.

2.6 SURVEY LIMITATIONS

In general, access was not available to all components of the wider study area and this limited the location of survey sites and prevented sampling of some preferred sites. Some areas, which may have represented the most suitable sites to survey due to suitable habitat features and habitat quality, were not accessible (for example due to the presence of sacred sites). These factors influenced the spread of sites across the wider study area. However in general there were fewer limitations related to site selection and access within the Browns Oxide Project Area than were encountered during the 2002 survey of the wider study area.

A number of the survey sites were located in components of the wider study area and Browns Oxide Project Area where there are ecotonal areas with intergrading vegetation types, particularly where floodplain vegetation includes a range of vegetation types associated with drainage/floodplain and riparian corridors. At these sites, mosaics of grassland, *Melaleuca* woodland, *Lophostemon* communities and other vegetation types are often present and many survey methods (eg. bat call detection) are likely to record fauna species that are utilising resources across all or a number of the vegetation types present.

Changes to the vegetation condition have occurred in the project area since 2002 including the effect of fire on some vegetation communities and an increase in weed invasion. It was recommended that vegetation mapping and communities should be refined, relevant species for the current Browns Oxide Project Area included, and information collected for the revised study area and scope of works associated with the PER guidelines. At the time of the fauna survey and report preparation this information was not available. In the absence of this data, the vegetation study prepared for the wider study area by Metcalfe (2002) has been used for site selection and has been referred to throughout the report. Flora information and vegetation communities may therefore be subject to change or refinement with further assessment.

Milne (2002) provides an explanation of the limitations of the anabat system. In particular it should be noted that reference calls of one critically endangered bat that occurs in the Top End, the bare-rumped sheath-tail bat (*Saccolaimus saccolaimus nudiclunatus*) are not available and consequently cannot be identified from call detection.

2.7 FAUNA SURVEY RESULTS

2.7.1 Amphibians

Seventeen native amphibian species were observed within the wider study area (Myobatrachidae and Hylidae) during the combined dry and wet season surveys (Appendix C; Table 2.2/2.3).

Dry Season 2002

During the 2002 dry season survey period, seven native amphibian species were observed within the Browns Oxide Project Area, with observations generally associated with the major river systems and spring-fed streams, including Rum Jungle Creek, the main Finniss River channel and on the banks and margins of the east branch of the Finniss River. The majority of amphibians were encountered during spotlight survey on creek and water body margins, with two species the bilingual frog (*Crinia bilingualis*) and Tornier's frog (*Litoria tornieri*) captured in pitfall traps on the margin of Rum Jungle Creek.

During the dry season survey the amphibian species richness and abundance was highest in riparian corridor habitat and amphibians were not recorded in any habitats away from streams and riparian areas. Amphibian species were not observed or recorded within the Browns Oxide Project Area. Most observations of amphibians in the wider study area were associated with the riparian areas of the Finniss River, east branch Finniss River well below the existing pit areas, and Rum Jungle Creek. These results are typical of dry season conditions in the Batchelor area. Patterns of amphibian diversity and abundance within the Browns Oxide Project Area are likely to be similar to that observed within adjacent areas of Litchfield NP, where streams and drainage depressions support a high proportion of the frog fauna (Griffiths *et al.* 1997).

The low numbers of amphibians and the limited number of habitats in which amphibians were located during the dry season survey is likely to be influenced by seasonal conditions. During the wet season survey, amphibians were found in greater abundance and diversity and in a greater variety of habitats.

TABLE 2.2 DRY SEASON

AMPHIBIAN SURVEY: RESULTS OF TIMED AREA SEARCHES

Mean frog abundance and species diversity for each site/habitat based on results of 3 x diurnal and 2 x nocturnal 20-minute area searches. Figures = number of individuals in 5 x 20min quadrat searches. S1-S8 = Terrestrial survey sites (Figure 2)

Additional site data derived from additional herpetofauna searches as indicated in Figure 2, where RO = Rock outcrops (H3, H4, H5 & H9); RIP = Riverine/riparian habitats (Aq6, Aq7 & Aq8 on the main Finniss River channel); UEF = Upland eucalypt forest (H6, H7 & H8); MVF = Monsoon vine-forest and *Acacia auriculiformis* regrowth (H1, H11, H12)

Common Name	Scientific Name	Dry Season Sites											
		S1	S2	S3	S4	S5	S6	S7	S8	RO	RIP	UEF	MVF
Bilingual Froglet	<i>Crinia bilingua</i>						2				5		
Bumpy Rocketfrog	<i>Litoria inermis</i>				1								
Javelin Frog	<i>Litoria microbelos</i>										1		
Tornier's Frog	<i>Litoria tornieri</i>						1						
Northern Laughing Treefrog	<i>Litoria rothii</i>						1				1		
Striped Rocketfrog	<i>Litoria nasuta</i>				1								
Giant Rocketfrog	<i>Litoria wotjulumensis</i>				1					1	1		
	Total individuals	0	0	0	3	0	4	0	0	1	8	0	0
	No. per 20 minute search	0	0	0	0.6	0	0.8	0	0	0.2	1.6	0	0
	Total species per site/habitat	0	0	0	3	0	3	0	0	1	4	0	0

Wet Season

During the 2005 wet season survey period seventeen native amphibian species were observed within the Browns Oxide Project Area and wider study area. The cane toad (*Bufo marinus*) was also present in low numbers, having arrived in the local area within a few weeks or months prior to this survey (J. Earthrowl pers comm. 2005).

Amphibian species are most active and conspicuous during the wet season and the majority of northern Australian species breed at the onset of the wet season (Tyler & Davies 1986). The surveys were conducted during the first period of heavy rainfall for the 2005 wet season, as well as heavy falls associated with cyclone Ingrid that crossed the Top End during the survey period. This period of rainfall induced the onset of amphibian breeding activity in suitable habitats throughout the Browns Oxide Project Area.

During the wet season survey, amphibians were found in a greater variety of habitats and thirteen native species were recorded within the Browns Oxide Project Area. A number of additional amphibian species, including *Notaden melanoscaphus*, *Litoria dahliei* and *Litoria microbelos*, were recorded in the wider study area. Most observations were of breeding individuals at ephemeral water-bodies and on

minor drainage lines/swampy areas to the south of the Browns bulk sample pit. A number of species were captured in pitfall traps in a variety of typically drier habitat types (including upland eucalypt forest, monsoon vine thicket and rocky habitats) during and following rainfall events. These species included *Limnodynastes ornatus*, *Litoria tornieri* and *Uperoleia inundata*. The highest number of amphibian species was recorded at Site 8 (12 species) and Site 9 (7 species). These areas supported a variety of breeding habitats including seasonally inundated woodland and swampland, drainage lines and artificial water-bodies in the area south of the Browns bulk sample pit and east of the Rum Jungle road. Few amphibians were observed adjacent to the Whites Pit, Intermediate Pit, Browns bulk sample pit or the main east Finniss River branch below the Intermediate Pit and no breeding was observed at these sites.

Amphibians recorded within the Browns Oxide Project Area are generally widespread and common in the Top End of the Northern Territory. The diversity of amphibian species recorded in the wider study area is comparative with the frog fauna known to occur in Litchfield NP. Seventeen species were recorded from the Browns Oxide Project Area compared to 22 species from a significantly larger area and greater diversity of habitats in Litchfield National Park (Woinarski *et al.* 2004).

TABLE 2.3 WET SEASON 2005
AMPHIBIAN SURVEY: RESULTS OF TIMED AREA SEARCHES

Mean amphibian abundance and species diversity for each site/habitat based on results of 3 x diurnal and 2 x nocturnal 20-minute timed/area searches. Figures = number of individuals located in 5 x 20min quadrat searches.

W-RIP = Wet season 2005 survey in riverine/riparian habitats on the East Branch Finniss River.

+ = Species recorded in the wider study area during the 2005 wet season survey.

Common Name	Scientific Name	Wet Season Sites				
		S1	S2	S8	S9	W-RIP
Bilingual Froglet	<i>Crinia bilingua</i>			5	10	
Marbled Frog	<i>Limnodynastes convexiusculus</i>	4		5	10	2
Ornate Burrowing Frog	<i>Limnodynastes ornatus</i>	5	1	3		
Brown Shovelfoot +	<i>Notaden melanoscaphus</i>					
Floodplain Gungan	<i>Uperoleia inundata</i>			4		
Stonemason Gungan	<i>Uperoleia lithomoda</i>			1		
Northern Snapping Frog	<i>Cyclorana australis</i>			1	2	
Common Treefrog	<i>Litoria caerulea</i>	1			1	
Northern Waterfrog +	<i>Litoria dahliei</i>					
Northern Sedgefrog	<i>Litoria bicolor</i>			2		
Bumpy Rocketfrog	<i>Litoria inermis</i>				2	1
Javelin Frog +	<i>Litoria microbelos</i>					
Tornier's Frog	<i>Litoria tornieri</i>		1	3		2
Northern Laughing Treefrog	<i>Litoria rothii</i>			2	6	2
Ruddy Treefrog	<i>Litoria rubella</i>				1	1
Striped Rocketfrog	<i>Litoria nasuta</i>				1	
Cane Toad	<i>Bufo marinus</i>			1	1	
	Total individuals	10	2	27	34	8
	No. per 20 minute search	2	0.4	5.4	6.8	1.6
	Total species per site/habitat	3	2	10	9	5

2.7.2 Reptiles

Dry Season

Thirty-two reptile species were identified during the dry season survey (Appendix C; Table 2.4). The majority of the reptiles were encountered during active searches of habitats during the day, during spotlight survey and incidentally within bushland areas and along roads.

Seven reptile species associated with freshwater habitats were detected within the wider study area. The northern yellow-faced turtle (*Emydura tanybaraga*) was observed and trapped at a number of sites on the main Finniss River but was not recorded on the east branch. The northern snake-necked turtle (*Chelodina rugosa*) was identified from shell remains on the margin of a floodplain billabong at Site Aq6 (main Finniss River floodplain). The estuarine crocodile (*Crocodylus porosus*) and freshwater crocodile (*Crocodylus johnstoni*) were present at sites on the main Finniss River channel during the survey period. Semi-aquatic reptiles associated with smaller streams within the wider study area included the Merten's water monitor (*Varanus mertensi*), Mitchell's water monitor (*Varanus mitchelli*) and Macleay's water snake (*Enhydryis polylepis*). None of these species were observed on the east branch below the historic Rum Jungle mine pits.

A number of reptile species, including the bar-shouldered ctenotus (*Ctenotus inornatus*, dark vertebral stripe form), northern spotted rock dtella (*Gehyra nana*) and olive python (*Liasis olivaceus*), were associated with rock outcrops and scree areas (Site 8). Reptiles commonly encountered during searches in open forest types included the prickly gecko (*Heteronotia binoei*), arboreal snake-eyed skink (*Cryptoblepharus plagiocephalus*), two-spined rainbow skink (*Carlia amax*), Top End dwarf skink (*Menetia alanae*), Douglas' skink (*Glaphyromorphus douglasi*) and the red-tailed snake-eyed skink (*Morethia ruficauda*). Poor returns were noted during reptile searches in *Acacia* regrowth/monsoon vine-forest habitat (vegetation types 9 & 10 in Metcalfe 2002) and open drainage areas (vegetation types 6, 7 and 8 in Metcalfe 2002).

Snake species recorded within the Browns Oxide Project Area include the carpet python (*Morelia spilota*), olive python (*Liasis olivaceus*), northern death adder (*Acanthophis praelongus*) and king brown snake (*Pseudechis australis*). Two species, the common tree snake (*Dendrelaphis punctulata*) and Macleay's water snake (*Enhydryis polylepis*) were associated with streams and riparian vegetation. The northern small-eyed snake (*Rhinoplocephalus pallidiceps*) was captured in a pitfall trap in vine-forest at Site 1. This species is not listed in regional fauna databases and has not been previously recorded in the local area, including Litchfield NP (Griffiths *et al.* 1997; Woinarski *et al.* 2004).

Reptile species richness was generally high in *Eucalypt/Corymbia* open woodland in rocky habitats (Site 8). Eucalypt open forest and woodland (vegetation types 2 & 3 in Metcalfe 2002) and riparian forest (vegetation type 5 in Metcalfe 2002) also supported relatively high reptile species richness. Numbers of reptiles encountered during searches were highest in riparian forest (vegetation type 5, Metcalfe 2002), largely due to the abundance of small litter dwelling skink species, particularly *Carlia gracilis* and *Carlia rufilatus*.

**TABLE 2.4 DRY SEASON
REPTILE SURVEY: RESULTS OF TIMED AREA SEARCHES**

Mean reptile abundance and species diversity for each site/habitat based on results of 3 x diurnal and 2 x nocturnal 20-minute area searches. Figures = number of individuals in 5 x 20min quadrat searches.

Additional site data derived from additional herpetofauna searches as indicated in Figure 2, where RO = Rock outcrops (H3, H4, H5 & H9); RIP = Riverine/riparian habitats (Aq6, Aq7 & Aq8 on the main Finniss River channel); UEF = Upland eucalypt forest (H6, H7 & H8); MVF = Monsoon vine-forest and *Acacia auriculiformis* regrowth (H1, H11, H12)

	Dry Season Sites											
Scientific Name	S1	S2	S3	S4	S5	S6	S7	S8	RO	RIP	UEF	MVF
<i>Crocodylus porosus</i>										1		
<i>Emydura tanybaraga</i>										3		
<i>Heteronotia binoei</i>		5	6		1			1	1		9	
<i>Gehyra nana</i>								8	5			
<i>Gehyra australis</i>	1							1				1
<i>Oedura rhombifer</i>			1									
<i>Lophognathus temporalis</i>				1		1				2		
<i>Lophognathus gilberti</i>			1									
<i>Diporiphora bilineata</i>								3	4			
<i>Varanus mitchelli</i>				1								
<i>Varanus mertensi</i>						10				1		
<i>Varanus panoptes</i>					1							
<i>Carlia amax</i>		6	2					4	16		7	
<i>Carlia rufilatus</i>				13		2	8			7		
<i>Carlia gracilis</i>	5			15		16				1		5
<i>Carlia triacantha</i>											1	
<i>Carlia munda</i>			3		6							
<i>Cryptoblepharus plagiocephalus</i>			1			1						1
<i>Ctenotus inornatus</i>								3	2			
<i>Glaphyromorphus douglasi</i>		1									1	
<i>Menetia alanae</i>		1									2	
<i>Morethia ruficauda</i>		1						2	3			
<i>Liasis olivaceus</i>								1				
<i>Dendrelaphis punctulata</i>				1								
<i>Enhydryis polylepis</i>				1								
<i>Pseudechis australis</i>							1					
Total individuals	6	14	14	32	8	30	9	23	31	15	20	7
No. per 20 minute search	1.2	2.8	2.8	6.4	1.6	6	1.8	4.6	6.2	3	4	1.4
Total species per site/habitat	2	5	6	6	3	5	2	8	6	6	5	3

Wet Season

The main variation between wet and dry season reptile surveys, was that in general, fewer specimens were located and observed during the wet season, possibly due to increased difficulties in locating and observing reptiles in the dense exotic and native grasses that dominate the landscape at this time. The frilled lizard (*Chlamydosaurus kingii*) was only recorded during the wet season surveys, as this species is largely inactive and difficult to locate during the dry season in the top end of the Northern Territory.

The 2005 wet season survey sampled fewer aquatic habitats/sites, limiting the number of semi-aquatic reptiles observed. Only one semi-aquatic vertebrate was recorded during the wet season survey. The freshwater crocodile was observed at a number of sites in and surrounding the Whites Open Pit and the Intermediate Open Pit, including the channel connecting the two pits. However none were observed in the east branch Finnis River below the Intermediate Open Pit.

A number of reptile species were added to the species list during wet season surveys, including the frilled lizard, robust ctenotus (*Ctenotus robustus*), ornate snake-eyed skink (*Notoscincus ornatus*) and slender blind snake (*Ramphotyphlops nema*).

A number of reptile species that have been identified by Parks & Wildlife Commission Northern Territory as being susceptible to impacts associated with the arrival of cane toads, were observed in the 2002 survey but not in the 2005 survey. These species included the northern death-adder and a number of varanid (goanna) species. However it is unclear whether this was indicative of a genuine decline of these species following the arrival of toads or due to these species being generally uncommon, or the influence of seasonality or a combination of factors. None of these species were recorded frequently during the 2002 survey. Other species that are considered potentially vulnerable to the cane toad, including the freshwater crocodile, were still present during the 2005 surveys.

**TABLE 2.5 WET SEASON
REPTILE SURVEY: RESULTS OF TIMED AREA SEARCHES**

Mean reptile abundance and species diversity for each site/habitat based on results of 3 x diurnal and 2 x nocturnal 20-minute area searches. Figures = number of individuals in 5 x 20min quadrat searches

S1-S2-S8-S9 = Terrestrial survey sites

W-Rip = Riverine/riparian

Common Name	Scientific Name	Wet Season Sites				
		S1	S2	S8	S9	W-Rip
Freshwater Crocodile	<i>Crocodylus johnstoni</i>					8
Prickly Gecko	<i>Heteronotia binoei</i>		6			
Northern Spotted Rock Dtella	<i>Gehyra nana</i>			3		
Northern Dtella	<i>Gehyra australis</i>	1	1		1	
Zig Zag Velvet Gecko	<i>Oedura rhombifer</i>	1				
Friiled Lizard	<i>Chlamydosaurus kingii</i>	1		1		
Gilbert's Lashtail	<i>Lophognathus temporalis</i>					
Two-lined Dragon	<i>Diporiphora bilineata</i>			1		
Two-spined Rainbow Skink	<i>Carlia amax</i>		1	1		
Red-sided Rainbow Skink	<i>Carlia rufilatus</i>	1		1	2	
Slender Rainbow Skink	<i>Carlia gracilis</i>	1		1	1	
Bar-shouldered Ctenotus	<i>Ctenotus inornatus</i>			1		
Robust Ctenotus	<i>Ctenotus robustus</i>	1			1	
Douglas' Skink	<i>Glaphyromorphus douglasi</i>	1	5			
Slender Blind Snake	<i>Ramphotyphlops nema</i>		1			
Carpet Python	<i>Morelia spilota variegata</i>			1		
	Total individuals	7	14	10	5	8
	No. per 20 minute search	1.4	2.8	2	1	1.6
	Total species per site/habitat	7	5	8	4	1

2.7.3 Birds

One hundred and twenty (120) bird species were observed within the Browns Oxide Project area and the wider study area during the dry and wet season survey periods (Appendix C).

Dry Season

Ninety-seven bird species were observed within the wider study area during the dry season survey period (Appendix C; Table 2.6). This represents about 61% of total birds recorded for the property of Mount Burton (Tidemann unpublished data) adjacent to the wider study area but only about 8% the size of the wider study area and about 53% of birds reported in Litchfield National Park within the same region (Griffiths *et al.* 1997). The majority of species (n~62) are widely distributed in open

forest/woodland habitats across northern Australia. The remaining species include birds usually associated with wetlands or freshwater habitats and a limited number that primarily occur in riparian forests or vine thickets.

The only species recorded in all habitat types was the rainbow lorikeet, however, in half of these habitats, the rainbow lorikeets were flying over and not using the habitats. Species (n=39) richness was highest in an additional riverine habitat on the Finniss River and lowest (n=16) in the *Lophostemon-Melaleuca-Pandanus* habitat. Of the remaining sites, the mixed eucalypt habitats contained more species than the monsoon vine-forest and drainage area sites (Table 2.6).

Plant species flowering within the wider study area included *Eucalyptus miniata*, *E. tetradonta*, *E. grandifolia*, *E. phoenicea*, *Xanthostemon paradoxus*, *Cochlospermum fraseri*, *Lophostemon grandiflorus* and *Grevillea longicuspis* (Tidemann 2002). The seasonal availability of nectar and pollen was seen to be of importance especially in the *E. miniata* and *E. phoenicea* sites with species eg. White-breasted woodswallow (*Artamus leucorhynchus*), yellow oriole (*Oriolus flavocinctus*), figbird (*Sphecotheres viridis*), weebill (*Smicrornis brevirostris*), mistletoebird (*Dicaeum hirundinaceum*), silver-backed butcherbird (*Cracticus argenteus*), other than honeyeaters utilising the flowers (Tidemann 2002). Birds not typical of monsoon thickets were recorded in the vine-thicket site because it had tall emergent trees, including *E. miniata*, rising above it (Tidemann 2002).

Amongst the nocturnal birds recorded, the southern boobook (*Ninox novaeseelandiae*) was observed preying on a sugar glider (*Petaurus breviceps*) (Tidemann 2002). A rufous owl (*Ninox rufa*) with a juvenile was observed at Site 2 in *Eucalyptus tetradonta*/*E. miniata*/*Erythrophloeum chlorostachys* open forest. Call playback induced responses of a number of nocturnal raptor species, including the rufous owl, southern boobook, barking owl (*Ninox connivens*) and barn owl (*Tyto alba*). The spotted nightjar (*Eurostopodus argus*) was observed during vehicle spotlight survey along roads and tracks, generally within tall upland eucalypt open forest/woodland (vegetation types 2 and 3 in Metcalfe 2002).

A significant number of the nocturnal birds detected by spotlighting and call playback methods were located in upland eucalypt communities and associated monsoon vine-forest and regrowth, particularly vegetation types 2, 3 and 10 in Metcalfe (2002). The rufous owl, boobook owl, barking owl, barn owl, spotted nightjar, Australian owlet nightjar (*Aegotheles cristatus*) and tawny frogmouth (*Podargus strigoides*) were all observed or were vocalising in these habitats. Only a single nocturnal bird species (spotted nightjar) was recorded in open woodland/grassland habitats in drainage areas and floodplains within the wider study area.

During the dry season surveys, waterbirds were poorly represented within the wider study area. A number of species, including the black-winged stilt (*Himantopus himantopus*), little pied cormorant (*Phalacrocorax melanoleucos*), white-faced heron (*Egretta novaehollandiae*) and intermediate egret (*Ardea intermedia*), were observed on mine pits at the historic Rum Jungle mine (White's Open Pit and Intermediate Open Pit) (Site Av3 in Figure 2). A number of additional species were observed on the main Finnis River channel on the western margin of the wider study area, with species including the black-necked stork (*Ephippiorhynchus asiaticus*), great-billed heron (*Ardea sumatrana*) and darter (*Anhinga melanogaster*).

TABLE 2.6 AVIFAUNA SURVEY RESULTS JUNE - JULY 2002
RESULTS OF TIMED AREA SEARCHES, SPOTLIGHT SURVEY AND INCIDENTAL OBSERVATIONS (TIDEMANN 2002)

S1 - S8 = sites vegetation categories 10, 2, 3, 6, 7, 8 & 1 respectively from Metcalfe (2002); Av1 (=S1X in Tidemann 2002) = extra site in S1-type vegetation; Av2 (=S6X in Tidemann 2002) = extra site in S6-type vegetation; Av3 = Incidental records from the Rum Jungle mine pit. Numbers = mean no. recorded in quadrat (3 x 20 min timed area search); * = flying through/over quadrat; + = Outside quadrat (same habitat); S = seen during spotlighting

Common Name	Dry Season Sites										
	S1	Av1	S2	S3	S4	S5	S6	Av2	S7	S8	Av3
Orange-footed Scrubfowl	0.3							0.7			
Brown Quail			2.7s						2.3		
Darter								+			
Little Pied Cormorant								+			+
Little Black Cormorant								+			
White-faced Heron								0.3	*		+
Great-billed Heron								0.3			
Intermediate Egret					*			*			+
Nankeen Night Heron					0.3			+			
Black-necked Stork								*			
Pacific Baza								0.3			
Black-breasted Buzzard				+							
Black Kite			+								
Whistling Kite								0.3			+
White-bellied Sea-Eagle								0.3			
Brown Goshawk		0.3						0.3			
Red Goshawk			0.3								
Wedge-tailed Eagle			+								
Swamp Harrier									+		
Brown Falcon						0.3				0.3	
Black-winged Stilt											+
Bush Stone-curlew										0.3	

	Dry Season Sites										
Common Name	S1	Av1	S2	S3	S4	S5	S6	Av2	S7	S8	Av3
Common Bronzewing										0.3	
Peaceful Dove			+	2							
Bar-shouldered Dove	1.3	3	0.7	1.3	2		1.7	2.3	21.3		
Rose-crowned Fruit-Dove	0.3										
Red-tailed Black-Cockatoo	*	*	0.7, +	3, *	*	*	*			0.7, *	
Galah					*						
Little Corella								3.1			
Sulphur-crested Cockatoo	*, +		*		*, +		*		0.7, +	0.3, *	
Red-collared Lorikeet	*	*	4.7, *	6.7, *	*	9.3, *	0.3, *	0.3	*	*	
Varied Lorikeet	*	*	2, *	2, *	*		*	0.3			
Red-winged Parrot			0.7	3.7, *		*		0.7, *		0.7, *	
Northern Rosella				3.3 *							
Brush Cuckoo	0.3										
Pheasant Coucal			0.3								
Rufous Owl			S	S							
Barking Owl	S			S				+			
Southern Boobook			0.3, S	S							
Barn Owl	S										
Tawny Frogmouth			+								
Spotted Nightjar			+	+		+			+		
Australian Owlet-nightjar				0.3							
Azure Kingfisher								0.7			
Little Kingfisher								0.3			
Blue-winged Kookaburra	+		0.3	0.3, S		0.3		1	0.7		
Forest Kingfisher	0.7		0.3				0.7				
Sacred Kingfisher	1	0.3	0.3					0.7			
Rainbow Bee-eater	1.3	0.7, *	0.3, +	0.3	*		*	2, *			
Rainbow Pitta	2	0.7					0.3	0.3			
Red-backed Fairy-wren		0.7				2.3			0.7	0.3	
Striated Pardalote										1.3	
Weebill				0.7						1.7	
Large-billed Gerygone	0.3	1			2		0.7	0.3			
Green-backed Gerygone	1.3	0.3			0.3		0.3	1.3			
Silver-crowned Friarbird						0.3	0.3		0.7	3.7	
Little Friarbird			1	3		2.3			0.3	5.3	
Blue-faced Honeyeater								*	0.7	0.7	
Yellow-throated Miner			2, +	2							
White-gaped Honeyeater	2.3	2	0.3		1.7		1.3	1.7			
White-throated Honeyeater		1.3	3	1	1.3	0.7	1.3	0.7	2.3	3	
Brown Honeyeater	0.3		2.7, +	1.3, *	2.7	3.7	0.7		1.3, +	4.7	
Bar-breasted Honeyeater								1.3			
Rufous-banded Honeyeater								0.7			
Dusky Honeyeater	0.7	1	0.7		0.7		2.3			1.3	

	Dry Season Sites										
Common Name	S1	Av1	S2	S3	S4	S5	S6	Av2	S7	S8	Av3
Lemon-bellied Flycatcher	1	0.7			1		2	0.7	1.3		
Grey-crowned Babbler				0.7				1.3		0.7	
Rufous Whistler	1.3				1	0.3				0.7	
Little Shrike-thrush	2	3.1			0.7		1.7	0.7			
Leaden Flycatcher	1	0.3		0.7			0.3				
Shining Flycatcher	1	1.7			1.3		1	1.3			
Restless Flycatcher		0.3	0.3								
Magpie-lark			+			0.3		*			
Rufous Fantail	2							1.3			
Northern Fantail		1	0.3	0.7	1		1.7	0.7			
Willie Wagtail				1	0.7	0.3	0.7	0.3	0.3		
Spangled Drongo	1.7		3.3			1.3	0.3	2.3	*		
Black-faced Cuckoo-shrike				0.3	*	0.3			1	0.3	
White-bellied Cuckoo-shrike	0.7		2.7	1		1		0.7, *	2, +		
White-winged Triller		0.3	1	1.3	*	1				0.3	
Varied Triller	1.7	1			*			0.7			
Yellow Oriole	1.3	1.7	3.3, *	1, +		0.7		1.3	1.3		
Olive-backed Oriole			0.3								
Figbird	1		1.3	1	*	0.7		2.7, *	*	1.3	
White-breasted Woodswallow			5.7, *	26.7, *	n *	*					
Little Woodswallow								1, *			
Silver-backed Butcherbird			2	0.3							
Pied Butcherbird				0.3		0.3	*			0.3	
Torresian Crow			0.3, +	0.7					0.3, *	0.7, *	
Great Bowerbird	0.3s			0.3				0.3		0.3	
Double-barred Finch					2						
Crimson Finch					3						
Chestnut-breasted Mannikin					*						
Mistletoebird			0.3			0.7		0.3			
Tree Martin				*		*					
Tawny Grassbird							*				
Golden-headed Cisticola						0.7			0.3		
Total spp seen in/around site	31	23	37	31	29	24	24	48	22	24	5
Total species using site	25	20	31	29	16	20	18	39	17	23	5

Wet Season

Ninety-six bird species were observed within the Brown's Oxide project area and adjacent areas during the wet season survey period (Appendix C; Table 2.7).

A number of species that were present during the dry season were recorded in a broader range of habitat types during the wet season survey, including the pheasant coucal (*Centropus phasianinus*)

and brush cuckoo (*Cacomantis variolosus*). Dense grasses present during the wet season also supported species that were not present at sites that had been recently burnt during the dry season, including the golden-headed cisticola (*Cisticola exilis*), masked finch (*Poephila personata*) and long-tailed finch (*Poephila acuticauda*). A number of typically migratory/nomadic species were present during the wet season survey, including the dollarbird (*Eurystomus orientalis*), common koel (*Eudynamys scolopacea*), channel-billed cuckoo (*Scythrops novaehollandiae*), fork-tailed swift (*Apus pacificus*), pied imperial pigeon (*Ducula bicolor*) and cicadabird (*Coracina tenuirostris*).

During the wet season surveys a number of water birds were observed at the White's Open Pit and Intermediate Open Pit and a number of species (including the black-necked stork and plumed whistling-duck) rested on the Browns bulk sample pit for short periods. No waterbirds were observed on the margins of the east branch of the Finniss River adjacent to the Browns Oxide Project Area.

Two significant bird species were recorded during the surveys. The vulnerable (*EPBC Act 1999*) partridge pigeon (*Geophaps smithii*) was not recorded during dry season 2002 surveys but was reported to occur in the local area by S. Tidemann (pers comm. 2002). This species was observed at a number of sites and locations in and around the Browns Oxide Project Area during wet season 2005 survey.

The vulnerable (*EPBC Act 1999*) red goshawk was observed at site 2 during timed/area bird surveys at that site during the dry season (Tidemann 2002). During the wet season 2005 survey a single red goshawk was observed in riparian vegetation dominated by *Melaleuca* sp along a small drainage line south of the Browns Bulk Sample Pit (between site 8 and 9). Both the wet and dry season observations were associated with flowering trees (*Eucalyptus miniata* in the dry season and *Melaleuca* sp in the wet season) that attracted a number of feeding birds.

TABLE 2.7 WET SEASON 2005
AVIFAUNA SURVEY: RESULTS OF TIMED AREA SEARCHES

W-pit = Incidental records from the Rum Jungle mine pits; Numbers = mean no. recorded in quadrat (3 x 20 min timed area search); * = flying through/over quadrat; + = Outside quadrat (same habitat); S = seen during spotlighting

Common Name	Wet Season Sites				
	S1	S2	S8	S9	W-pit
Orange-footed Scrubfowl	0.3				
Brown Quail		1.7			
Plumed Whistling-Duck					+
Darter					+
Little Black Cormorant					+

Common Name	Wet Season Sites				
	S1	S2	S8	S9	W-pit
Intermediate Egret					+
Nankeen Night Heron					+
Black-necked Stork					+
Whistling Kite				*	+
Red Goshawk			+		
Brown Falcon				0.7	
Black-winged Stilt					+
Partridge Pigeon			1		
Peaceful Dove	0.3		1	1	
Bar-shouldered Dove	2.3	1.3	1.3	1	
Emerald Dove	0.7				
Sulphur-crested Cockatoo	1.7	0.7	*	0.3, +	
Red-collared Lorikeet	*		0.3		
Varied Lorikeet		*			
Red-winged Parrot	*		*	0.3	
Brush Cuckoo	0.7		0.3, +	0.3	
Little Bronze-Cuckoo			0.3		
Pheasant Coucal	0.3	0.3, +	+	0.3	
Barking Owl	S		S	S	
Southern Boobook				S	
Tawny Frogmouth			0.3, S	S	
Large-tailed Nightjar				S	
Australian Owlet-nightjar		S	0.3, S	S	
Blue-winged Kookaburra	1	0.7			
Forest Kingfisher	0.3	1.3		0.3	
Sacred Kingfisher				0.3	
Rainbow Bee-eater	0.3		1.7		
Dollarbird				0.3	
Rainbow Pitta	1.3				
White-throated Needletail	*	*			
Fork-tailed Swift		*			
Red-backed Fairy-wren			1.7	1.3	
Striated Pardalote			0.3		
Weebill			0.3		
Silver-crowned Friarbird		0.3			
Little Friarbird			0.7	0.3	
Yellow-throated Miner		1.3			
White-gaped Honeyeater	1.7		0.3		

Common Name	Wet Season Sites				
	S1	S2	S8	S9	W-pit
White-throated Honeyeater	0.7	2.3	2	0.7	
Brown Honeyeater		0.7	1	0.7	
Bar-breasted Honeyeater			0.3		
Rufous-banded Honeyeater	0.3				
Banded Honeyeater			0.3		
Dusky Honeyeater	1		0.3		
Lemon-bellied Flycatcher	0.3		0.7	0.7	
Grey (Brown) Whistler	0.3				
Rufous Whistler		0.3			
Little Shrike-thrush	0.7				
Shining Flycatcher	0.7				
Magpie-lark			0.7		
Northern Fantail	0.7				
Spangled Drongo	1.7	0.7	+		
Black-faced Cuckoo-shrike			0.3		
White-bellied Cuckoo-shrike	0.7	0.7	1.3		
Varied Triller	1				
Cicadabird	0.7				
Yellow Oriole	1		0.3		
Olive-backed Oriole				0.3	
Silver-backed Butcherbird		1.3	+		
Great Bowerbird	0.3			0.3	
Double-barred Finch			2.7	1.7	
Crimson Finch				3.3	
Chestnut-breasted Mannikin				1.7	
Long-tailed Finch			2		
Masked Finch			0.7		
Golden-headed Cisticola	+		0.7	0.7	
Total spp seen in/around site	31	18	35	27	8
Total species using site	27	15	29	26	8

2.7.4 Mammals

Dry Season

Twenty-eight native mammal species were identified during the dry season survey (Appendix C; Table 2.8 - 2.10). Microchiropteran bats (eight species) and rodents (four species) were the most species rich mammal groups within the wider study area.

Seven mammal species were observed during vehicle spotlight survey, including the brush-tailed phascogale (*Phascogale tapoatafa pirata*), northern brushtail possum (*Trichosurus vulpecula arnhemensis*), antilopine wallaroo (*Macropus antilopinus*), agile wallaby (*Macropus agilis*), black-flying fox (*Pteropus alecto*), dingo (*Canis lupus*) and feral pig (*Sus scrofa*). Numbers of mammals and species richness observed during vehicle spotlight transects were highest in the upland eucalypt forest communities (vegetation types 2 & 3 in Metcalfe 2002) (16 individual mammals per vehicle-spotlight hour, 5 species), compared to open drainage and floodplain habitats (1.3 individual mammals per vehicle-spotlight hour, 2 species).

Three carnivorous marsupials, the northern quoll (*Dasyurus hallucatus*), fawn antechinus (*Antechinus bellus*) and brush-tailed phascogale (*Phascogale tapoatafa pirata*) were identified within the Browns Oxide Project Area. The fawn antechinus was captured in Elliott traps and identified from hair analysis in four habitats, including *Acacia auriculiformis* regrowth/monsoon vine-forest (Site 1), *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) and *E. miniata*/*E. tetradonta* woodland (Site 3). There were also 'probable' hair funnel results for the fawn antechinus from *Lophostemon* and *Melaleuca* woodland (Site 4) and *E. foelscheana*/*E. papuana* open woodland (Site 5). The northern quoll was captured in Elliott traps and identified from hair analysis in three habitats, including *E. miniata*/*E. tetradonta* woodland (Site 3), *Lophostemon* and *Melaleuca* woodland (Site 4) and *E. phoenicea*/*C. bleeseri* open woodland on rock outcrops (Site 8). The brush-tailed phascogale (*Phascogale tapoatafa*) was observed during spotlight surveys in *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) and *E. miniata*/*E. tetradonta* woodland (south of Site 3).

Northern brushtail possums (*Trichosurus vulpecula arnhemensis*) were commonly observed in vegetation types 2 & 3 (Metcalfe 2002) during the spotlight survey. The sugar glider (*Petaurus brevipes*) was observed as a prey item of a southern boobook in this habitat at Site 2 (Tidemann 2002).

Two macropod species were recorded within the wider study area. The agile wallaby (*Macropus agilis*) was recorded in a variety of *Eucalypt* open forest/woodland, *Melaleuca* woodland/open woodland habitats and monsoon vine-forest and *Acacia auriculiformis* regrowth vegetation (Sites 1, 2, 5 & 7). This species is likely to be widespread in the local area and tracks and scats indicated frequent utilisation of monsoon vine-forest, riverine habitat and upland eucalypt forest habitats. The antilopine wallaroo (*Macropus antilopinus*) was less common in the local area and was observed at a single site south-east of the Rum Jungle Road - Litchfield Park Road intersection in *E. tetradonta*/*E. miniata* woodland, during a spotlight survey.

Harp trapping for microchiropteran bats recorded four species, including the dusky leaf-nosed bat (*Hipposideros ater*), pygmy long-eared bat (*Nyctophilus walkeri*), Arnhem long-eared bat (*Nyctophilus arnhemensis*) and a broad-nosed bat (*Scotorepens* sp.) (Table 2.9). Two additional species, the northern freetail-bat (*Chaerephon jobensis*) and northern myotis (*Myotis moluccarum*), were captured at roost sites. Significant numbers of black flying-fox (*Pteropus alecto*) were observed feeding on flowering *E. miniata* canopy trees in upland eucalypt forest (vegetation types 2 & 3 in Metcalfe 2002). A seasonally occupied roost of this species is present on the Finniss River to the west of the Browns Oxide Project Area. Survey using bat echolocation call detection and analysis recorded seven species within the wider study area (Table 2.8).

Four rodent species were recorded within the wider study area. The grassland melomys (*Melomys burtoni*) was captured and recorded from hair analysis in two habitats in the wider study area including *Acacia auriculiformis* open forest (Site 1), and riparian closed forest along Rum Jungle Creek (Site 6). The black-footed tree rat (*Mesembriomys gouldi*) was captured in two habitat types within the Browns Oxide Project Area, including *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) and *E. phoenicea*/*C. bleeseri* open woodland (Site 8). The common rock-rat (*Zyzomys argurus*) was observed during spotlight survey on rock outcrops at Site 8 and H9. The water rat (*Hydromys chrysogaster*) was identified from characteristic tracks and feeding remains on the east branch of the Finniss River at Site Aq2. Burrow systems characteristic of the pale-field rat (*Rattus tunneyi*) were noted at some sites in upland eucalypt open forest (vegetation types 2 & 3 in Metcalfe 2002).

**TABLE 2.8 DRY SEASON
FIXED-POINT BAT ECHOLOCATION CALL DETECTION**

Results from 40 minutes fixed-point sampling at each site. Sequence files without identifiable calls not included in the analysis.

	Dry Season June 2002														
Scientific Name	S1 24/6/02	S2 23/6/02	S3 22/6/02	S4 24/6/02	S5 25/6/02	S6 25/6/02	S7 25/6/02	S8 29/6/02	Aq1 30/6/02	Aq2 23/6/02	Aq5 24/6/02	Aq6 30/6/02	Aq7 30/6/02	Aq8 30/6/02	Total
<i>Saccolaimus flaviventris</i>		2	2					1		6					11
<i>Chaerephon jobensis</i>		4	4	5	6	3	3	10	1	13	60	1			110
<i>Scotorepens</i> sp.			59		2					37					98
<i>Scotorepens</i> sp./ <i>Chalinolobus nigrogriseus</i>	11	11						5							27
<i>Miniopterus schreibersii</i> / <i>Pipistrellus</i> sp		2						6	5			2			15
<i>Nyctophilus</i> sp										4					4
<i>Nyctophilus walkeri</i>			1												1
<i>Myotis moluccarum</i>											6				6
Total No Seq Files w Identifiable Calls	11	19	66	5	8	3	3	22	6	60	66	3	0	0	272
No of Species/Call Types Detected	1	4	4	1	2	1	1	4	2	4	2	2	0	0	9

**TABLE 2.9 DRY SEASON
MICROCHIROPTERAN BAT TRAPPING RESULTS**

+ = Bats captured during roost searches.

* = *Scotorepens* sp that may be present in the wider study area can only be confidently identified at species level by protein electrophoresis (Churchill 1998).

		Dry Season Sites						
Common Name	Scientific Name	S1	S2	S3	S4	S6	Aq5	Total
Dusky Leaf-nosed Bat	<i>Hipposideros ater</i>	1	-	-	-	-	-	1
Northern Freetail-bat	<i>Chaerephon jobensis</i>	-	-	-	-	-	1+	1
Broad-nosed Bat	<i>Scotorepens</i> sp.*	-	6	-	-	-		6
Northern Myotis	<i>Myotis moluccarum</i>	-	-	-	-	-	4+	4
Pygmy Long-eared Bat	<i>Nyctophilus walkeri</i>	-	3	-	-	-	-	3
Arnhem Long-eared Bat	<i>Nyctophilus arnhemensis</i>	-	2	-	-	-	-	2
Total Harp Trap Nights		2	4	2	2	2	1	13
Total New Captures		1	11	0	0	0	5+	17
No. of Captures per Harp Trap Night		0.5	2.75	0	0	0	0	1.3
Number of Species		1	3	0	0	0	2	6

**TABLE 2.10 DRY SEASON
GROUND MAMMAL TRAPPING RESULTS**

E = Elliott trap; LE = Large Elliott trap; W = Wire cage trap; T = Tree mounted trap

Values = New Captures: Recaptures

Common Name	Scientific Name	S1	S2	S3	S4	S5	S6	S7	S8	Total
Fawn Antechinus	<i>Antechinus bellus</i>	1:0	1:1	1:0						3:1
Northern Quoll	<i>Dasyurus hallucatus</i>				2:0				2:0	4:0
Northern Brown Bandicoot	<i>Isoodon macrourus</i>	3:1					1:0			4:1
Grassland Melomys	<i>Melomys burtoni</i>	2:0					3:1			5:1
Black-footed Tree Rat	<i>Mesembriomys gouldi</i>		1:0						1:0	2:0
Total Trap Nights (E + LE + W + T)		51	51	51	51	51	51	51	51	408
Total New Captures		6	2	1	2	0	4	0	3	18
Total Recaptures		1	1	0	0	0	1	0	0	3
Trap Return (%)		11.8	3.9	2.0	3.9	0	7.8	0	5.9	4.4
Number of Species		3	2	1	2	0	2	0	2	5

Wet Season

Twenty-three native mammal species were identified during the wet season survey in the project area (Appendix C; Table 2.11 - 2.13).

Seven mammal species were observed during spotlight surveys, including the northern quoll (*Dasyurus hallucatus*), northern brown bandicoot (*Isoodon macrourus*), northern brushtail possum (*Trichosurus vulpecula arnhemensis*), antilopine wallaroo (*Macropus antilopinus*), black-flying fox (*Pteropus alecto*), feral cat (*Felis catus*) and the dingo (*Canis lupus*).

A single Arnhem Land pebblemound mouse (*Pseudomys calabyi*) was caught in a pitfall trap at site 8 in a gravel washout area adjacent to a rocky outcrop. This species has previously been recorded from a variety of habitats in Litchfield National Park to the south-west of the Browns Oxide Project Area (Griffiths *et al.* 1997), however there are no previous records from the Batchelor/Rum Jungle area. Four other rodent species were recorded within the Browns Oxide Project Area. Grassland melomys (*Melomys burtoni*) were captured in *Melaleuca* woodland (Site 9) and the black-footed tree rat was observed during spotlight survey at site 2. The pale-field rat (*Rattus tunneyi*) was captured in *Melaleuca* woodland (Site 9) and characteristic burrows and runs were noted throughout *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2). The dusky rat (*Rattus colletti*) was less common and appears to be restricted to floodplain areas dominated by grassy understorey and *Melaleuca* woodland (Site 9).

Two carnivorous marsupials, the northern quoll (*Dasyurus hallucatus*) and the fawn antechinus (*Antechinus bellus*) were present within the Browns Oxide Project Area during the 2005 survey. The northern quoll was identified during spotlighting and from hair analysis in only one habitat, *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2). The fawn antechinus was captured in Elliott traps in three habitats, including *Acacia auriculiformis* open forest/vine-forest (Site 1), *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) and *Melaleuca* woodland (Site 9).

Wet season harp trapping in the Browns Oxide Project Area recorded two species (*Nyctophilus walkeri* and *Nyctophilus arnhemensis*). All captures were from riparian sites and on the margin of a small monsoon vine-forest remnant at site 1. Fixed-point echolocation detection (AnaBat system) recorded nine species/groups. A small number of calls of the Arnhem sheath-tail bat (*Taphozous kapalgensis*) (Milne 2002) were recorded in *Melaleuca/Pandanus* forest to the south of the Browns Bulk Sample Pit. This species is relatively poorly known and there are no previous known records in the Batchelor area with the exception of one site to the east of the town on Coomalie Creek (Ecological Management Services unpublished records, 2001).

**TABLE 2.11 WET SEASON
 FIXED-POINT BAT ECHOLOCATION CALL DETECTION**

Results from 40 minutes fixed-point sampling at sites within the Browns Oxide Project Area. Sequence files without identifiable calls not included.

Common Name	Scientific Name	Wet Season March 2005				Total
		S1 13/03/05	S2 18/3/05	S8 11/3/05	S9 12/3/05	
Arnhem Sheath-tail Bat	<i>Taphozous kapalgensis</i>				2	2
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>		3	1	4	8
Beccari's Freetail Bat	<i>Mormopterus beccarii</i>	3			2	5
Northern Freetail Bat	<i>Chaerephon jobensis</i>	2	7		11	20
A broad-nosed bat	<i>Scotorepens</i> sp.			1	98	99
Broad-nosed bat/Hoary Wattled Bat	<i>Scotorepens</i> sp./ <i>Chalinolobus nigrogriseus</i>	5	43	6	24	78
Northern Bentwing Bat/Pipistrelle	<i>Miniopterus schreibersii</i> / <i>Pipistrellus</i> sp	1	41		2	44
A long-eared bat	<i>Nyctophilus</i> sp	2	9		11	22
Pygmy Long-eared Bat	<i>Nyctophilus walkeri</i>		1	8	30	39
	Total No Seq Files with Identifiable Calls	13	104	16	184	317
	No of Species/Call Types Detected	5	6	4	9	9

**TABLE 2.12 WET SEASON
MICROCHIROPTERAN BAT TRAPPING RESULTS**

		Wet Season Sites				
Common Name	Scientific Name	S1	S2	S8	S9	Total
Pygmy Long-eared Bat	<i>Nyctophilus walkeri</i>			2		2
Arnhem Long-eared Bat	<i>Nyctophilus arnhemensis</i>	3		1		4
Total Harp Trap Nights		3	3	3	3	12
Total New Captures		3	0	3	0	6
No. of Captures per Harp Trap Night		1	0	1	0	0.5
Number of Species		1	0	2	0	2

**TABLE 2.13 WET SEASON
GROUND MAMMAL TRAPPING RESULTS**

E = Elliott trap; LE = Large Elliott trap; W = Wire cage trap; T = Tree mounted trap
Values = New Captures: Recaptures

Common Name	Scientific Name	WS1	WS2	WS8	WS9	Total
Fawn Antechinus	<i>Antechinus bellus</i>	1:0	2:0		1:0	3:0
Grassland Melomys	<i>Melomys burtoni</i>				1:0	1:0
Dusky Rat	<i>Rattus colletti</i>				3:0	3:0
Pale Field Rat	<i>Rattus tunneyi</i>				6:1	6:1
Total Trap Nights (E + LE + W + T)		51	51	51	51	204
Total New Captures		1	2	0	10	13
Total Recaptures		0	0	0	1	1
Trap Return (%)		2	3.9	0	19.6	6.4
Number of Species		1	1	0	4	4

2.8 INTRODUCED SPECIES

Four introduced vertebrate fauna species were recorded during the 2002 and 2005 surveys. Two introduced vertebrate fauna species were observed within the wider study area during the dry season, the feral pig (*Sus scrofa*) and the domestic dog (*Canis lupus familiaris*). These introduced species were also recorded in the Browns Oxide Project Area during the wet season survey with two additional introduced species, the feral cat (*Felis catus*) and the cane toad (*Bufo marinus*) recorded within the Browns Oxide Project Area.

2.8.1 Feral Pig (*Sus scrofa*)

The feral pig (*Sus scrofa*) was observed during field surveys and recorded from tracks and other signs during both dry and wet season surveys. Feral pigs appear to be relatively common and are likely to be the most numerous and destructive introduced mammal species in the Browns Oxide Project Area and local area, however this may change with the expansion of the cane toad in the local area.

During the 2002 dry season survey, many areas associated with open water and drainage channels displayed moderate to high levels of disturbance from the feral pig. Bankside disturbance was noted in riparian vegetation and *Lophostemon* and *Melaleuca* woodland along Rum Jungle Creek and in vegetation along the East Branch of the Finnis River. Signs of disturbance caused by feral pigs, including diggings, mud wallows and bank damage at water access points at sites 4, 5, 6 and 7 during the dry season survey. These sites are associated with floodplain areas, permanent water and/or major drainage lines.

During the 2005 wet season survey, feral pigs were also recorded at sites 1, 8 and 9. The highest levels of disturbance from feral pigs in the Browns Oxide Project Area were noted at site 9 in *Melaleuca* woodland associated with low lying drainage areas and at site 1 in *Acacia auriculiformis* open forest/vine-forest.

2.8.2 Cane Toad (*Bufo marinus*)

Cane toads (*Bufo marinus*) were present within the Browns Oxide Project Area during the wet season 2005 surveys, having arrived in the local area in the weeks or months prior to March 2005 (J. Earthrowl pers comm. 2005). There is anecdotal evidence from local residents of declines of some fauna in the local area, including goannas and monitors (*Varanus* sp), elapid snakes and some mammals (including quolls). However these observations have not been systematic or based on survey data. Experimental data in Northern Territory on the impacts (toxic effects) of ingestion of the cane toad by native species is being collected. Studies have been, and are continuing to be, undertaken on the northern quoll, vertebrate fauna in Kakadu National Park, reptiles, snakes, and crocodiles to determine the impact of lethal toxic ingestion of the cane toad on these species (Department of Environment and Heritage, 2005). It is noteworthy that while a small number of large adult cane toads were observed along roads within the Browns Oxide Project Area during March 2005, few were encountered in bushland habitats and no egg masses, juveniles or immature cane toads were observed. However a small number of male cane toads were vocalising at ephemeral water-bodies following extended rainfall at this time, indicating that the first wave of large adult cane toad 'immigrants' had commenced breeding in the local area.

The next phase of cane toad colonisation, following the 2005 wet season breeding, is likely to result in large numbers of toads invading local habitats. It is known that in recently colonised populations (less than two years old) cane toad numbers rapidly increase to levels far in excess of those in older established populations (DEH 2005). Conditions for cane toads may be improved with the presence of:

- Artificial breeding sites in areas where water is collected in scrapes or any other water storage area;
- Artificial lighting that can attract large numbers of invertebrate prey items; and
- Artificial shelter such as discarded materials and debris.

2.8.3 Feral Cats (*Felis catus*)

Feral cats were present within the Browns Oxide Project Area during the wet season 2005 surveys in Eucalypt open woodland and disturbed mine areas at sites 8 and near site 9. It is possible that native fauna including reptiles, birds and small mammals may be impacted by cat predation. Feral cats have also affected re-introduction programs for endangered species in the arid and semi-arid zones of Western Australia and the Northern Territory (Johnson 1991; Gibson *et al.* 1994; Dickman 1996). For these reasons predation by the feral cat is listed as a Key Threatening Process under Commonwealth Government legislation. The threat relies upon:

- The behavioural, morphological and physiological characteristics of cats which enable them to be more efficient predators than native predators;
- Factors that make cats more abundant or persistent than native predators;
- The small size and isolation of populations of some threatened species;
- The vulnerability of native prey to cat predation; and
- The deleterious affect of parasites and diseases transmitted from cats (*Biodiversity Group Environment Australia, 1999*).

Observations of feral cat numbers indicate that they may be higher in the vicinity of an operational mine. Local cat numbers may be increased by the presence of human activity due to a variety of factors, including increased availability of water, additional food sources (waste) and feeding by staff. Feral cats have been recorded moving up to 48 km to feed around human habitation during drought conditions (Newsome 1995). Feral cats are known to switch between 'feral' and 'commensal' foraging opportunistically, with animals reverting to commensal living around human habitation and watering points during unfavourable conditions (Newsome 1995). This aspect of the biology of the feral cat has significant implications for levels of predation on native species, as numbers of cats are sustained at an artificially high level despite environmental conditions (Newsome 1995).

3. THREATENED FAUNA SPECIES

3.1 CONSERVATION STATUS DEFINITIONS

Relevant legislation includes the *Territory Parks and Wildlife Conservation Act 2000* and the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999*.

Under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* any action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- Extinct in the wild;
- Critically endangered;
- Endangered; or
- Vulnerable.

Under the *EPBC Act 1999 administrative guidelines on significance*, an action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- Lead to a long-term decrease in the size of a population; or
- Reduce the area of occupancy of the species; or
- Fragment an existing population into two or more populations; or
- Adversely affect habitat critical to the survival of a species; or
- Disrupt the breeding cycle of a population; or
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; or
- Interfere with the recovery of the species.

Under the *EPBC Act 1999 administrative guidelines on significance*, an action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- Lead to a long-term decrease in the size of an important population of a species; or
- Reduce the area of occupancy of an important population; or

- Fragment an existing important population into two or more populations; or
- Adversely affect habitat critical to the survival of a species; or
- Disrupt the breeding cycle of an important population; or
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or
- Result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat; or
- Interferes substantially with the recovery of the species.

Under the *EPBC Act 1999* administrative guidelines on significance an important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

Under the Northern Territory Act species that have been classified as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable are considered to be threatened wildlife. The *Territory Parks and Wildlife Conservation Act 2000* threatened species criteria are based on criteria developed by the IUCN (Red List Categories Version 3.1). Under the IUCN criteria a taxon is Vulnerable when the best available evidence indicates that it is considered to be facing a high risk of extinction in the wild and a taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat (IUCN Red List Categories Version 3.1).

Under the *Territory Parks and Wildlife Conservation Act 2000* threatened wildlife are automatically given protected wildlife status.

Fauna species listed as Endangered, Vulnerable, Near Threatened or Data Deficient in relevant Commonwealth and Northern Territory Acts are listed in Tables 3.1 & 3.2. Site record localities for these species within the Browns Oxide Project Area are displayed in Figures 4, 5 and 6.

TABLE 3.1
NATIONALLY THREATENED FAUNA SPECIES OCCURRING WITHIN THE BROWNS OXIDE PROJECT AREA
Environment Protection & Biodiversity Conservation Act 1999

Species Name	Common Name	Status	Broad Habitat (Metcalf 2002)	Site Records
Threatened Species EPBC Act 1999				
<i>Dasyurus hallucatus</i>	Northern Quoll	Endangered	Upland Eucalypt Woodland, Drainage areas, Rocky rises	S3, S4, S8 (Dry) S2 (Wet)
<i>Erythroriorchis radiatus</i>	Red Goshawk	Vulnerable	Upland Eucalypt Woodland, Riparian	S2 (Dry) S8 (Wet)
<i>Geophaps smithii</i>	Partridge Pigeon	Vulnerable	Upland Eucalypt Forest, Rocky rises	S2, S8, S9 (Wet)

TABLE 3.2
STATE-THREATENED FAUNA SPECIES OCCURRING WITHIN THE BROWNS OXIDE PROJECT AREA AND WIDER STUDY AREA
TERRITORY PARKS AND WILDLIFE CONSERVATION ACT 2000

Species Name	Common Name	Status	Broad Habitat (Metcalf 2002)	Site Records
Vulnerable Species TPWC Act 2000				
<i>Dasyurus hallucatus</i>	Northern Quoll	Vulnerable	Upland Eucalypt Woodland, Drainage areas, Rocky rises	S3, S4, S8 (Dry) S2 (Wet)
<i>Phascogale tapoatafa pirata</i>	Brush-tailed Phascogale	Vulnerable	Upland Eucalypt Woodland	S2 (Dry)
<i>Erythroriorchis radiatus</i>	Red Goshawk	Vulnerable	Upland Eucalypt Woodland, Riparian	S2 (Dry) S8 (Wet)
<i>Pingalla lorentzi</i>	Lorentz's Grunter	Vulnerable	Riverine	Finniss R below Rum Jungle Mine (Allen <i>et al.</i> 2002)
Near Threatened Species TPWC Act 2000				
<i>Burhinus grallarius</i>	Bush Stone-curlew	Near Threatened	Upland Eucalypt Forest, Rocky rises	S8 (Dry)
<i>Geophaps smithii</i>	Partridge Pigeon	Near Threatened	Upland Eucalypt Forest, Rocky rises	S2, S8, S9 (Wet)
<i>Mesembriomys gouldii</i>	Black-footed Tree-rat	Near Threatened	Upland Eucalypt Woodland, Rocky rises	S2, S8 (Dry) S2 (Wet)
<i>Pseudomys calabyi</i>	Arnhem Land pebblemound mouse	Near Threatened	Run-off areas associated with rocky rises	S8 (Wet)
<i>Rattus tunneyi</i>	Pale Field-rat	Near Threatened	Upland Eucalypt Woodland, Drainage areas (<i>Melaleuca</i> woodland)	S2, S9 (Wet)
<i>Taphozous kapalgensis</i>	Arnhem Sheath-tail Bat	Near Threatened	Drainage areas (Melal. /Pandanus woodland)	S9 (Wet)

Species Name	Common Name	Status	Broad Habitat (Metcalf 2002)	Site Records
<i>Acanthophis praelongus</i>	Northern Death Adder	Near Threatened	Upland Eucalypt Woodland	S2 (Dry)
<i>Varanus panoptes</i>	Yellow-spotted Monitor	Near Threatened	Drainage areas	S5 (Dry)
Data Deficient TPWC Act 2000				
<i>Cyclorana australis</i>	Northern Snapping Frog	Data Deficient	Drainage areas, riparian	S8, S9 (Wet)
<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog	Data Deficient	Upland Eucalypt Woodland, Monsoon vine-forest, drainage areas, riparian	S1, S2, S8 (Wet)
<i>Gallinago megala</i>	Swinhoe's Snipe	Data Deficient	Drainage areas	Aq5 Finnis River floodplain (Wet)
<i>Antechinus bellus</i>	Fawn Antechinus	Data Deficient	Upland Euc. Woodland, Monsoon vine-forest, drainage areas	S1, S2, S3 (Dry) S1, S2, S9 (Wet)
<i>Demansia olivacea</i>	Olive Whip Snake	Data Deficient	Litchfield Park Road adjacent to study area	No site records
<i>Dendrelaphis punctulata</i>	Common Tree Snake	Data Deficient	Riparian, drainage areas	S4
<i>Enhydryis polylepis</i>	Macleay's Water Snake	Data Deficient	Riparian	S4, S6 (Dry)
<i>Ramphotyphlops nema</i>	Slender Blind Snake	Data Deficient	Upland Eucalypt Woodland	S2 (Wet)
<i>Rhinoplocephalus pallidiceps</i>	Northern Small-eyed Snake	Data Deficient	Monsoon Vine-forest	S1 (Dry)
<i>Varanus mertensi</i>	Merten's Water Monitor	Data Deficient	Riparian	S6 (Dry)
<i>Varanus mitchelli</i>	Mitchell's Water Monitor	Data Deficient	Riparian	S4 (Dry)

3.2 THREATENED AMPHIBIANS

The amphibians recorded within the Browns Oxide Project Area are generally common and widespread throughout areas of the western Top End and have been recorded in conservation reserves in the region. None of the amphibian species recorded within the Browns Oxide Project Area are listed as threatened in relevant legislation (*TPWC Act 2000*; *EPBC Act 1999*).

Two amphibian species listed as data deficient (*Cyclorana australis* and *Limnodynastes ornatus*) in the *TPWC Act 2000* were recorded within the Browns Oxide Project Area. Both species are relatively common in the project area and have been listed as data deficient in the NT legislation. A number of

NT amphibian species have been listed as data deficient due to the potential impact of cane toads (DIPE A. Fisher pers comm. 2005)

3.3 THREATENED REPTILES

Habitats within the Browns Oxide Project Area support reptile species that are generally common in the region, and none of the taxa recorded are considered to be endangered or vulnerable by relevant conservation authorities (*TPWC Act 2000*; *EPBC Act 1999*).

Two species, the northern death-adder (*Acanthophis praelongus*) and yellow-spotted monitor (*Varanus panoptes*), have been listed as near threatened in the *TPWC Act 2000* due primarily to the threat posed to these species by lethal toxic ingestion caused by cane toads. Both of these species were not recorded within the project area following the arrival of cane toads in 2005, however there is insufficient data available to determine whether populations of these species persist in the local area. Five additional reptile species occurring in the project area and surrounding habitats, including the Mitchell's water monitor (*Varanus mitchelli*), Mertens Water Monitor (*Varanus mertensi*), Macleay's water snake (*Enhydryis polylepis*), northern small-eyed snake (*Rhinoplocephalus pallidiceps*) and the olive whip-snake (*Demansia olivacea*), have been listed as data deficient (*TPWC Act 2000*). Many reptiles have been listed as data deficient due to the potential impact of cane toads (DIPE A. Fisher pers comm.) and are therefore not discussed in detail below.



LEGEND

-  Northern Quoll Endangered EPBC Act 1999,
Vulnerable NT TPWC Act 2000
-  Partridge Pigeon Vulnerable EPBC Act 1999
-  Red Goshawk Vulnerable EPBC Act 1999
Vulnerable NT TPWC Act 2000

Plan Note:
This plan was prepared to accompany a preliminary ecological assessment of the Browns Oxide Project, Batchelor NT, and should not be used for any other purpose. While every care is taken to ensure the accuracy of this data, Ecological Management Services make no representations or warranties about its accuracy, reliability or completeness or suitability for any particular purpose and disclaim all responsibility and liability (including without limitation, liability in negligence) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.

Localities of significant fauna species are based on field mapping only and have not been surveyed by Ecological Management Services. This map provides an indication of the general locality of species observations.

This note is an integral part of this plan.



MGA 1994 ZONE 52

Date: 31 July 2005

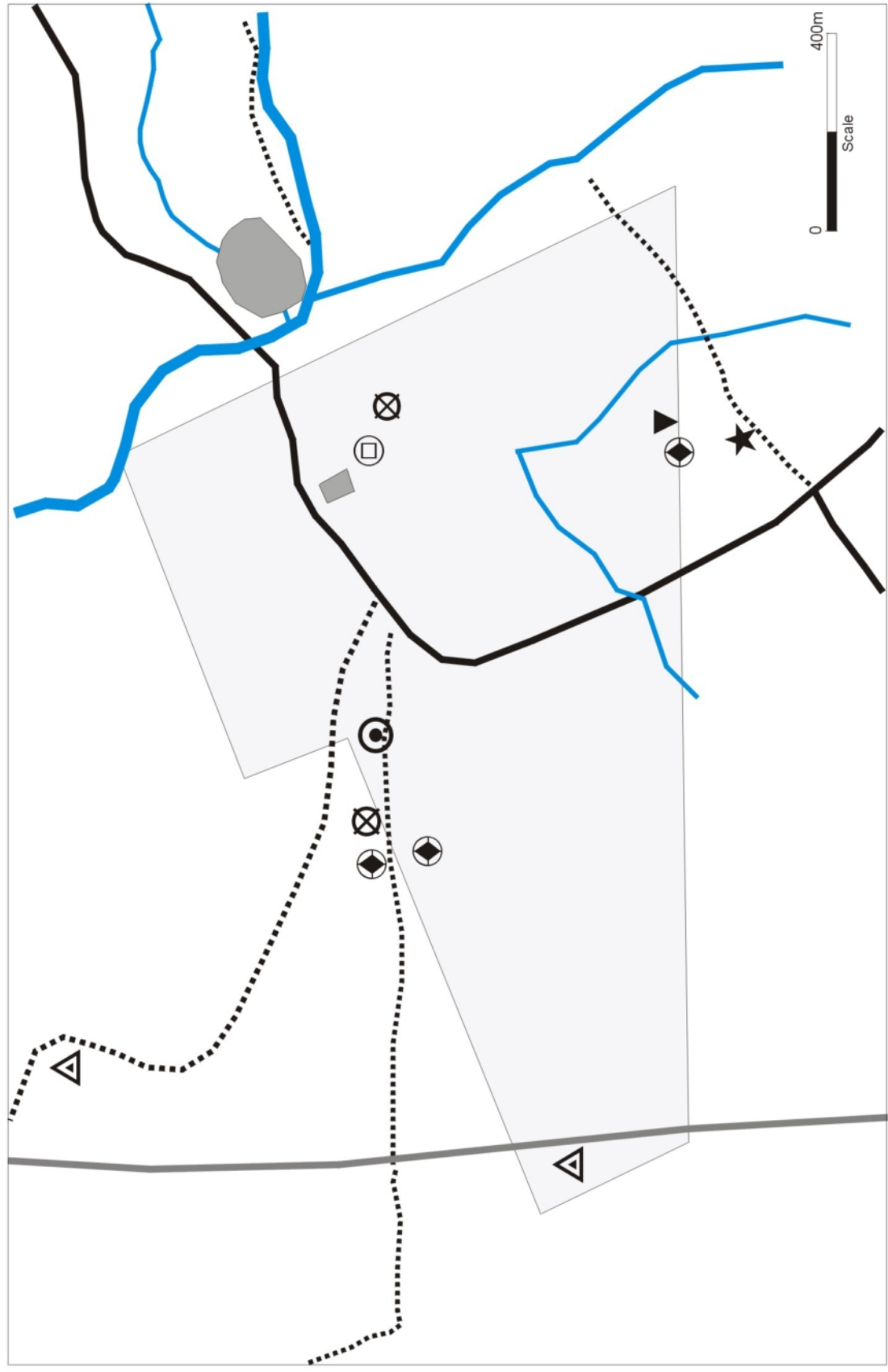
FIGURE 4. EPBC Act 1999 EV Fauna Site Records

BROWNS OXIDE PROJECT

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31 JULY 2005



LEGEND

- Northern Death Adder Near Threatened *TPWC Act 2000*
- Brush-tailed Phascogale Vulnerable *TPWC Act 2000*
- Arnhem Land Pebblemound Mouse Near Threatened *TPWC Act 2000*
- Arnhem Sheath-tail Bat Near Threatened *TPWC Act 2000*
- Black-footed Tree-rat Near Threatened *TPWC Act 2000*
- Pale Field-rat Near Threatened *TPWC Act 2000*
- Bush-stone Curlew Near Threatened *TPWC Act 2000*

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Localities of significant fauna species are based on field mapping only and have not been surveyed by Ecological Management Services. This map provides an indication of the general locality of species observations.

This map does not include species listed in the *TPWC Act 2000* that are also listed as Endangered or Vulnerable in the *EPBC Act 1999* (refer to Figure 4).

This note is an integral part of this plan.

**FIGURE 5. NT *TPWC Act 2000*
Listed Fauna Site Records
Vulnerable + Near Threatened**

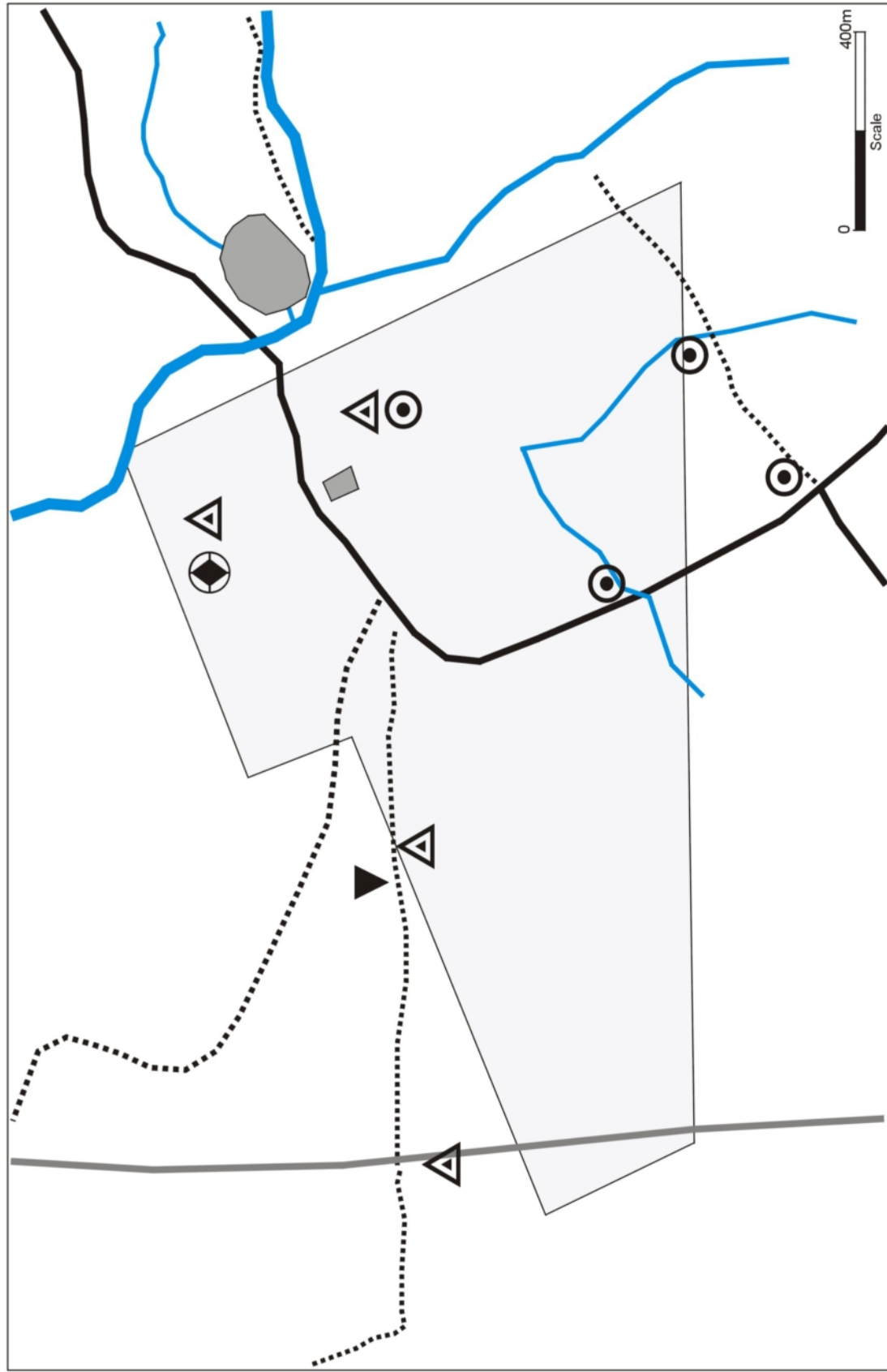
BROWNS OXIDE PROJECT

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Date: 31 July 2005



LEGEND

- Fawn Antechinus Data Deficient TPWC Act 2000
- Ramphotyphlops nema* Data Deficient TPWC Act 2000
- Northern Small-eyed Snake Data Deficient TPWC Act 2000
- Cyclorana australis* Data Deficient TPWC Act 2000

Plan Note:

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Localities of significant fauna species are based on field mapping only and have not been surveyed by Ecological Management Services. This map provides an indication of the general locality of species observations.

This map does not include some species listed in the TPWC Act 2000 that are also listed as Data Deficient in the TPWC Act 2000. This map provides a sample of some of the data deficient species records within the project area.

This note is an integral part of this plan.



MGA 1984 ZONE 52



Date: 31 July 2005

**FIGURE 6. NT TPWC Act 2000
Listed Fauna Site Records
Selected Data Deficient Species**

BROWNS OXIDE PROJECT

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ECOLOGICAL MANAGEMENT SERVICES

31 JULY 2005

3.3.1 Slender Blind Snake (*Ramphotyphlops nema*)

Conservation Status

Australia: Not listed under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Data deficient** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites

Dry Season: Nil

Wet Season: S2

Browns Oxide Project Area: S2

Distribution

All previously known specimens with locality data have been recorded from the Darwin metropolitan area and surrounds. The ecology and distribution of *Ramphotyphlops nema* remains poorly known, and the specimen from the Browns Oxide Project Area is only the seventh specimen collected and the fourth since 1965 (Shea & Horner 1996, P. Horner, Museum & Art Gallery of the Northern Territory, pers comm. 2005). Using criteria adopted by Cogger *et al.* (1993) for the Australian Reptile Action plan *Ramphotyphlops nema* would rate as being nationally "vulnerable", however this status is more likely to be related to its cryptic nature rather than genuine rarity (P. Horner pers comm. 2005). On the basis of current knowledge of the species *Ramphotyphlops nema* is currently listed as data deficient in the *TPWC Act 2000*.

Habitat

Habitat data is only available from the most recently collected Darwin specimens, both of which were collected in heavily vegetated backyards (Shea & Horner 1996). Within the project area a single specimen was collected in *E. miniata*, *E. chlorostachys*, *E. tetradonta* woodland (S2).

Threatening Processes

None documented, but land clearing is likely to impact populations. With the exception of the Browns Oxide Project Area specimen, all other specimens with collection data are from the Darwin area, indicating that development in and around the city may impact populations. This species is not known from any conservation reserves.

3.4 THREATENED AVIFAUNA

Two species that have been recorded within the project area are listed as endangered and vulnerable under the *EPBC Act 1999* and the *TPWC Act 2000*. One bird species, the bush stone-curlew (*Burhinus grallarius*), is listed as near threatened in the Northern Territory (*TPWC Act 2000*). A number of birds present in the Browns Oxide Project Area and local area are listed as migratory species under the *EPBC Act 1999*.

3.4.1 Red Goshawk (*Erythrotriorchis radiatus*)

Conservation Status

Australia: **Vulnerable** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Vulnerable** under the *Territory Parks and Wildlife Conservation Act 2000*. Current estimates on population size and structure and a continuing decline indicate that this species may qualify as endangered in the Northern Territory (Woinarski 2002a).

Survey Sites:

Dry season 2002: S2

Wet season 2005: S8/Riparian vegetation

Browns Oxide Project Area: S2, S8/Riparian vegetation

Distribution

The red goshawk occurs at very low densities across northern Australia. This species has been recorded in the local area in Litchfield NP (Woinarski 2002a). Griffiths *et al.* (1997) report a single historical record from the Walker Creek area and Tidemann (unpublished) has observed the red goshawk within the adjacent Mount Burton property. The red goshawk was also recorded at the Browns Oxide Project Area and adjacent areas during the dry season and wet season surveys.

Habitat

The red goshawk inhabits coastal and sub-coastal tall open forests and woodlands, tropical savannahs traversed by forested rivers and the margins of rainforest (Marchant & Higgins 1993). Home range may be up to 200 km² (Garnett & Crowley 2000). Within the Browns Oxide Project Area one individual was observed during an avifauna quadrat dry season survey (Tidemann 2002) in *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) and one individual was observed in a narrow riparian vegetation/paperbark strip near site 8 along a small drainage line south of the Browns Bulk Sample Pit (between site 8 and 9) during the wet season survey. It is likely to utilise other eucalypt forest types, open forests and woodlands in drainage areas and riverine forests in the wider project area. Both the wet and dry season observations were associated with flowering trees (*Eucalyptus miniata* in the dry season and *Melaleuca* sp in the wet season) that had attracted numbers of birds.

Threatening processes

Threatening processes under the *EPBC Act 1999* include land clearance. Other threatening processes include the impacts from fire, illegal egg collecting, shooting (Woinarski 2002a) and disturbance to nest sites (Garnett & Crowley 2000). It is likely to be most severely impacted by disturbance in the vicinity of nest sites, none of which have been identified in the Browns Oxide Project Area during surveys undertaken to date.

3.4.2 Partridge Pigeon (Eastern) (*Geophaps smithii smithii*)

Conservation Status

Australia: **Vulnerable** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Near threatened** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites:

Dry season 2002: Not recorded

Wet season 2005: S2, S8, S9

Browns Oxide Project Area: S2, S8, S9

Distribution

The current range of the partridge pigeon is restricted to sub-coastal areas of northern Northern Territory, principally from Kakadu and between Katherine and Darwin, and in the Daly and Finnis River catchments (Garnett & Crowley 2000). Three records are documented for the Coomalie sub-region by Price & Baker (2003). The partridge pigeon occurs in the local area with existing records from a number of sources including RAOU data (2005). This species has also been recorded in Litchfield NP (Woinarski 2004; Griffiths *et al.* 1997) and from the vicinity of the wider study area (historical record) (PWCNT 2002). Tidemann (unpublished data) has reported the partridge pigeon from the vicinity of the Browns Oxide Project Area and this species was recorded in the Browns Oxide Project Area and along the Litchfield Park Road to the south-west of the project area during the wet season survey.

Habitat

Habitat is mainly mixed eucalypt woodland and *E. tetradonta*/*E. miniata* woodland and forest with a structurally diverse understorey (Garnett & Crowley 2000). In Litchfield National Park it has been recorded in *Melaleuca* forests close to water and *E. miniata* open forest on undulating lowlands (Griffiths *et al.* 1997). Partridge pigeons feed by taking seeds from bare ground where there are sparse grasses and commonly where the ground layer has been removed by fire (Garnett & Crowley 2000).

The partridge pigeon was observed in the Browns Oxide Project Area in woodland and along tracks at site 8 during the 2005 wet season survey and in grassy areas on the road verges along Litchfield Park Road near site 8 in *E. tetradonta*/*E. miniata* open woodland. The partridge pigeon was also observed on the margin of the Rum Jungle mine access road north-west of the Browns Bulk Sample Pit (S9) and on the eastern end of White Road (S2) in *E. miniata*/*E. tetradonta* open woodland, and on Mount Burton (Tidemann pers obs.). This species was not recorded in the wider study area during the dry season yet was relatively frequently observed at certain sites during the wet season.

Threatening processes

Threatening processes under the *EPBC Act 1999* include 'land clearance' and 'predation by feral cats'. Impacts on water sources have also been proposed as a threatening process for this species, however it is thought that the major threat to the partridge pigeon is altered fire regimes (Garnett & Crowley 2000). Clearing of tall eucalypt open forest and changes in native grass and vegetation composition/structure including the invasion of exotic grasses and impacts of livestock and feral animals on habitat structure are also identified as threatening processes by Woinarski (2003). The known distribution of this species has contracted by more than 50% (Garnett & Crowley 2000). This species has disappeared from much of the lower rainfall parts of its range over the last century (Woinarski 2003). Its decline has been a response to widespread development of pastoralism and, in part concomitantly, changed fire regimes (Fraser 2000, cited in Tidemann 2002).

3.4.3 Bush Stone-curlew (*Burhinus grallarius*)

Conservation Status

Australia: **Not listed** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Near Threatened** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites:

Dry season 2002: S8

Wet season 2005: Dry season wider study area.

Browns Oxide Project Area: S8

Distribution

Recorded from all but the most arid areas of mainland Australia, remaining relatively common in northern Australia (Garnett & Crowley 2000). Five records are documented for the Coomalie sub-region by Price & Baker (2003). It is at times considered very common in Litchfield NP and has been recorded from Elizabeth Downs, Tipperary, Finniss River, Mount Bunday and Welltree Stations and Petherick's Rainforest (Griffiths *et al.* 1997) and in and around the Batchelor township. This species has also been recorded in the RAOU data search for the regional area (RAOU 2005) and in the Browns Oxide Project Area (Tidemann 2002).

Habitat

The bush stone-curlew occurs in sparsely grassed, lightly timbered open forest or woodland habitat, and in northern Australia this species persists where ground cover is relatively open (Garnett & Crowley 2000). Within the Browns Oxide Project Area it was recorded from open woodland habitat at Site 8 (Tidemann 2002).

Threatening Processes

In southern areas predation by foxes, land clearing and altered fire regimes represent threatening processes. However it remains relatively common in the local area and persists in modified areas such as pastures and township margins.

3.5 THREATENED MAMMALS

Two mammal species recorded within the wider study area and the Browns Oxide Project Area, are listed as endangered or vulnerable under relevant conservation legislation (*EPBC Act 1999*; *TPWC Act 2000*). The northern quoll (*Dasyurus hallucatus*) is listed as Endangered under the *Environment Protection & Biodiversity Conservation Act 1999*. The northern quoll has also been classified as Vulnerable under the *Territory Parks and Wildlife Conservation Act 2000*. The brush-tailed phascogale (*Phascogale tapoatafa pirata*) is listed as vulnerable (*TPWC Act 2000*). As the northern quoll and the brush-tailed phascogale are considered to be threatened wildlife under the NT Act they are automatically given protected wildlife status.

Three mammal species within the wider study area and the Browns Oxide Project Area, the black-footed tree rat (*Mesembriomys gouldi*), Arnhem Land pebblemound mouse (*Pseudomys calabyi*) and pale field-rat (*Rattus tunneyi*) are listed as near threatened in the *TPWC Act 2000*. One mammal, the fawn antechinus (*Antechinus bellus*), is listed as Data Deficient (*TPWC Act 2000*).

3.5.1 Northern Quoll (*Dasyurus hallucatus*)

Conservation Status

Australia: **Endangered** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Vulnerable** under the *Territory Parks and Wildlife Conservation Act 2000*.

The northern quoll has been classified as Vulnerable based on a population size reduction of >30%, within the next 10 years. However this may need review if cane toads impact on existing island populations (Woinarski 2003).

Survey Sites:

Dry season 2002: S3, S4, S8

Wet season 2005: S2

Browns Oxide Project Area: S2, S8

Distribution

Local records for the northern quoll indicate that this species was widespread in the region, with records from south-east of Batchelor (EMS 2001), Mount Burton (Tidemann unpublished), Litchfield

NP (Woinarski *et al.* 2004; Griffiths *et al.* 1997), Tipperary, Elizabeth Downs and Mt Bunday Stations, and Petherick's rainforest (Griffiths *et al.* 1997). Twenty records have also been recorded in the Coomalie sub-region (Price & Baker 2003). Although the northern quoll is considered common in Litchfield National Park and widespread throughout Litchfield (Woinarski 2003; Griffiths *et al.* 1997) and the local area, its distribution in northern Australia has been substantially reduced, and is becoming increasingly restricted and disjunct (Braithwaite & Griffiths 1994). Analysis of its distribution indicates a 75% range reduction in northern Australia and possible causes for decline and/or potential threats include impacts associated with grazing, the expansion of the cane toad and exotic disease (Braithwaite & Griffiths 1994). Research suggests that this substantial reduction in range is directly related to habitat disturbance, suggesting that this species cannot maintain populations in sub-optimal environments that have been disturbed (Griffiths *et al.* 1997).

Vulnerability to cane toad toxins has caused recent declines across the Top End in areas that correlate with the expansion of the cane toad. This species is the most at risk from the cane toad invasion, and is known to have suffered major decline and regional extinctions in Queensland and the NT immediately following the arrival of toads (DIPE 2005).

Habitat

The northern quoll was recorded in three habitat types during the dry season survey during 2002 including *E. miniata*/*E. tetradonta* woodland (Site 3), *Lophostemon* and *Melaleuca* woodland (Site 4) and *E. phoenicea*/*C. bleeseri* open woodland on rock outcrops (Site 8).

During the wet season survey in 2005, the northern quoll was only recorded in one habitat, *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2).

Threatening processes

Prior to the arrival of cane toads northern quolls appear to have been declining in the Northern Territory for at least several decades, possibly because of impacts from feral cats, disease or changed fire regimes (Woinarski 2003). 'Land clearance' and 'the biological effects, including lethal toxic ingestion, caused by cane toads (*Bufo marinus*)' and 'predation by feral cats' are threatening processes under the *EPBC Act 1999*. It is likely that the northern quoll population will be impacted by the recent invasion by cane toads (*Bufo marinus*) in the Batchelor area and within the Browns Oxide Project Area. Quolls appear to be particularly susceptible to the poison of cane toads, and are killed when they attempt to kill or consume the toads (Woinarski 2003). Although the exact extent of decline is difficult to estimate based on data obtained from only two surveys in the project area, these results indicate that the local population of the northern quoll may have already suffered a decline.

3.5.2 Brush-tailed Phascogale (Northern Mainland) (*Phascogale tapoatafa pirata*)

Conservation Status

Australia: **Not listed** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Vulnerable** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites:

Dry season 2002: S2, S3

Wet season 2005: Nil

Browns Oxide Project Area: S2

Distribution

The northern form of the brush-tailed phascogale (race *pirata*) occurs in suitable habitat across northern Australia, from the Kimberly region to the Gulf of Carpentaria (Strahan 1995), however it appears to be uncommon and patchily distributed (Maxwell *et al.* 1996). Recent documented records of this species from the Top End of the NT include Litchfield NP (Woinarski 2002b; Griffiths *et al.* 1997) and specimens collected from the Pellew Islands and Kakadu NP (Maxwell *et al.* 1996). This species was also recorded in the Darwin River Dam catchment by the DIPE in 2002 (Price & Baker 2003). The brush-tailed phascogale is uncommon in Litchfield National Park (Griffiths *et al.* 1997) and is likely to be uncommon in the local area.

Habitat

The brush-tailed phascogale was observed during the 2002 dry season spotlight surveys in *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) in the Browns Oxide Project Area and in *E. miniata*/*E. tetradonta* woodland (south of Site 3). This species was not recorded during the 2005 wet season survey within the Browns Oxide Project Area. The majority of recent records in the Top End are from tall open forest of Darwin woollybutt (*Eucalyptus tetradonta*) - Darwin stringybark (*Eucalyptus miniata*) (Woinarski 2002b; Maxwell *et al.* 1996). All sightings are from drier forest types although there are some records from riparian/woodland interface and deciduous vine thicket (Maxwell *et al.* 1996). Suitable habitat for this species occurs in a large percentage of the Browns Oxide Project Area, particularly in undisturbed forest to the west and south-west of the Browns Oxide Project Area. The typical home range for individuals of this species is large (up to 150 hectares for males), suggesting that a local population is likely to utilise large areas of open forest and woodland habitat within the wider study area.

Threatening processes

Potential threats include bushland clearance, changes to frequency and intensity of fires (Maxwell *et al.* 1996) and the impacts from either exotic predators (cats) or disease, vegetation change due to altered fire regimes and/or pastoralism and the impact of cane toads (Woinarski 2002b).

3.5.3 Black-footed Tree Rat (*Mesembriomys gouldi*)

Conservation Status

Australia: **Not listed** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Near Threatened** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites:

Dry season 2002: S2, S8

Wet season 2005: S2

Browns Oxide Project Area: S2, S8

Distribution

Local records for the black-footed tree rat include Mount Burton (Tidemann unpublished), Litchfield NP (Woinarski *et al.* 2004; Griffiths *et al.* 1997), Elizabeth Downs Station and Petherick's rainforest (Griffiths *et al.* 1997). Five sightings of this species have been recorded in the Coomalie sub-region (Price & Baker 2003). The distribution of this species is patchy and early distribution records indicate that its range has contracted from inland areas to northern or coastal areas of the Northern Territory, including Melville and Bathurst Islands (Lee 1995; Strahan 1995; Watts & Aslin 1981). Populations of the black-footed tree rat appear to be thinly spread and this species is probably not an abundant animal in most areas of its range (Strahan 1995; Watts & Aslin 1981).

Habitat

Suitable habitat generally includes eucalypt forest and woodland (*E. miniata*/*E. tetradonta*) on deep soils supporting a relatively dense understorey of small trees and shrubs (e.g. *Gardenia*, *Terminalia*, *Petalostigma* and *Pandanus* spp.) (Lee 1995). The black-footed tree rat was captured and/or observed in two habitat types in the Browns Oxide Project Area, including *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) and *E. phoenicea*/*C. bleeseri* open woodland on rock outcrops (Site 8).

Threatening processes

Grazing by introduced ungulates and changes in fire regimes since European settlement may have reduced the abundance of the understorey trees and shrubs that provide food for this species (Lee 1995). Research is needed to establish the role of fire in habitat management, and its effects on populations of the black-footed tree rat (Lee 1995).

3.5.4 Arnhem Land Pebblemound Mouse (*Pseudomys calabyi*)

Conservation Status

Australia: **Not listed** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Near Threatened** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites:

Dry season 2002: Nil

Wet season 2005: S8

Browns Oxide Project Area: S8

Distribution

Local records for the Arnhem Land pebblemound mouse include records from Litchfield NP (Woinarski *et al.* 2004; 2000; Griffiths *et al.* 1997). This species was also recorded in the Darwin River Dam catchment by the DIPE in 2002 (Price & Baker 2003) and occurs in Kakadu National Park (Woinarski 2000; Lee 1995). There are no previous records from the Batchelor/Rum Jungle area.

Habitat

Suitable habitat generally includes stony woodland, eucalypt woodland on stony hills with records from *E. tectifica* woodland, *E. miniata* forest, *E. tetradonta* forest and *Corymbia* woodland (Woinarski 2000; Griffiths *et al.* 1997). The Arnhem Land pebblemound mouse was captured in one habitat type in the Browns Oxide Project Area, *E. phoenicea*/C. *bleeseri* open woodland, with a tall grass understorey, adjacent to rock outcrops (Site 8). Suitable habitat with gravelly soils occurs in a band on the southern margin of the Browns Oxide Project Area from the Rum Jungle Road to the historic Rum Jungle Mine.

Threatening processes

Not known (Lee 1995; Woinarski 2000). Possibly land clearing and fire.

3.5.5 Pale Field-rat (*Rattus tunneyi*)

Conservation Status

Australia: **Not listed** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Near Threatened** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites:

Dry season 2002: Nil

Wet season 2005: S2, S9

Browns Oxide Project Area: S2, S9

Distribution

Six records have been recorded in the Coomalie sub-region (Price & Baker 2003) and it is known from at least six islands and six conservation reserves in the region (Woinarski 2000). Local records for the pale field-rat include records from south-east of Batchelor (EMS 2001), Litchfield NP (Woinarski *et al.* 2004; Griffiths *et al.* 1997), Tipperary, Elizabeth Downs Stations and Pethericks rainforest (Griffiths *et al.* 1997). Although the pale field-rat is locally common and widespread in the Litchfield area, Museum records indicate a contraction in its overall distribution in the last 100 years. A decline in distribution of

85% has reduced its distribution from a continental distribution to fragmented distribution, with the north-western and central east coast of Australia/southern Queensland coast, remaining as the most significant habitat and/or refuge habitat (Braithwaite & Griffiths 1996). It has declined in lower rainfall areas in the monsoon tropics of Northern Territory and it may be subject to an ongoing decline in Kakadu NP (Woinarski 2000).

Habitat

The pale field-rat was recorded in two habitat types in the Browns Oxide Project Area, *Melaleuca* woodland (Site 9) and in *E. miniata* open forest (site 2). Survey results and observations of characteristic burrows and runs indicate that this species is restricted to two particular habitats within the project area and is relatively common in *Melaleuca* woodland at site 9, south of the Browns Oxide deposit.

Threatening processes

Impacts primarily relate to habitat modification, loss of local refuges, loss of vegetation cover, and impacts associated with the low level of groundwater reducing the availability of refuge riparian habitat, and the additional impact of introduced mammals including grazing impacts and soil compaction (Braithwaite & Griffiths 1996; Watts & Aslin 1981).

3.5.6 Arnhem Sheathtail Bat (*Taphozous kapalgensis*)

Conservation Status

Australia: **Not listed** under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: **Near Threatened** under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites:

Dry season 2002: Nil

Wet season 2005: S9

Browns Oxide Project Area: S9

Distribution

Very few records have been documented for the Arnhem sheathtail bat since its description (11 specimens). The closest regional records include Muldiva Creek near the Daly River, coastal areas near Darwin (Woinarski & Milne 2002) and Point Ceylon at Bynoe Harbour (GHD 2003). Prior to the wet season survey this species was known from one other site, (which has since been cleared) in the Batchelor area, on Coomalie Creek to the east of the township (Ecological Management Services unpublished records, 2001).

Habitat

The Arnhem sheath-tail bat was recorded in one habitat type in the Browns Oxide Project Area *Melaleuca* woodland at Site 9. Known habitat for this species includes open woodland on the floodplain edge, dense paperbark forest and a mixture of sandstone woodlands and riparian areas (Woinarski & Milne 2002). The Arnhem sheath-tail bat may roost in trees, the base of *Pandanus* foliage or in caves and old mines (Woinarski & Milne 2002).

Threatening processes

Impacts may relate to clearing, hollow availability, habitat modification and invasion by exotic weeds (Woinarski & Milne 2002). The ecology of the Arnhem sheath-tail bat is poorly known, however given its foraging characteristics it is likely to be most vulnerable to disturbance and impacts at roost sites including *Pandanus* trees and forest habitats.

3.5.7 Fawn Antechinus (*Antechinus bellus*)

Conservation Status

Australia: Not listed.

Northern Territory: Data Deficient (*TPWC Act 2000*)

Dry season 2002: S1, S2, S3, S4, S5

Wet season 2005: S1, S2, S9

Browns Oxide Project Area: S1, S2, S9

Distribution

Three records have been recorded in the Coomalie sub-region (Price & Baker 2003) and this species has been recorded in Litchfield NP and Petherick's rainforest (Griffiths *et al.* 1997). The fawn antechinus is uncommon in Litchfield National Park (Griffiths *et al.* 1997) and it is likely to have a patchy distribution within its current range. It was recorded at six sites within the wider study area and three sites within the Browns Oxide Project Area.

Habitat

During the dry season 2002 survey the fawn antechinus was recorded in a range of habitats in the study area including *Acacia auriculiformis* open forest (Site 1), *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) and *E. miniata/E. tetradonta* woodland (Site 3). There were also 'probable' hair funnel records for the fawn antechinus from *Lophostemon* and *Melaleuca* woodland (Site 4) and *E. foelsheana/E. papuana* open woodland (Site 5). During the 2005 wet season the fawn antechinus was recorded at site 1, 2, and in *Melaleuca* woodland at site 9. Suitable habitats include patches of structurally diverse open-forest and vegetation communities with grassy open or shrubby understoreys that support abundant woody debris, hollow trunks and limbs.

Threatening processes: Clearing of habitat including patches of structurally diverse open-forest may affect the survival of local populations. Impacts including environmental fluctuations and a decrease in resource availability are likely to be significant.

3.6 THREATENED FRESHWATER FISHES

3.6.1 Lorentz's Grunter (*Pingalla lorentzi*)

Australia: Not listed under the *Environment Protection & Biodiversity Conservation Act 1999*.

Northern Territory: Vulnerable under the *Territory Parks and Wildlife Conservation Act 2000*.

Survey Sites: Recorded in the east branch of the Finnis River below the historic Rum Jungle Mine (Allen *et al.* 2002; Stirrat 2002).

Distribution: Lorentz's grunter is more common and widespread in Papua New Guinea however it is only known from two areas in Australia, northern Cape York and the Northern Territory. In the Northern Territory it is known only from the Finnis River near the Rum Jungle mine site (Allen *et al.* 2002; Stirrat 2002).

Habitat: Lorentz's grunter occurs in small and large pools with rock and sand substrates, usually in open unshaded sections of streams and in water temperatures between 25°C and 30°C (Allen *et al.* 2002).

Threatening processes: Stirrat (2002) identifies general threats to this species, including degradation of waterways and riparian areas due to mining activity, land clearing, altered fire regimes and weed infestation. Jeffree & Twining (1998) have identified toxic metal concentrations at low pH as the main factor in fish kills and the restricted fish abundance and diversity in the impact area on the east branch of the Finnis River below the historic Rum Jungle mine. Any mining activity that increases erosion, sedimentation, inflows of toxic metals and changes in pH (eg acid mine drainage) will have a potential impact on Lorentz's grunter populations.

3.7 THREATENED TERRESTRIAL INVERTEBRATES

A number of terrestrial invertebrate taxa are listed as endangered, vulnerable and data deficient in the *Territory Parks and Wildlife Conservation Act 2000* (Parks & Wildlife Commission of the Northern Territory 2000). Based on available information and ecological data it is unlikely that any of the species currently listed in this Act are likely to occur within the Browns Oxide Project Area.

4. MIGRATORY SPECIES COVERED BY PROVISIONS OF THE EPBC ACT 1999

Table 4.1

MIGRATORY SPECIES COVERED BY MIGRATORY PROVISIONS OF THE EPBC ACT 1999
 Based on EPBC Protected Matters Report for the Rum Jungle Area June 2005

Migratory species covered by migratory provisions of the EPBC Act 1999				
<i>Crocodylus porosus</i>	Estuarine Crocodile	Listed	Riverine	Finniss River main branch (Dry)
<i>Gallinago megala</i>	Swinhoe's Snipe	Listed	Drainage areas	Aq5 Finniss River floodplain (Wet)
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Listed	Riparian	Av2 (Wet)
<i>Hirundapus caudacutus</i>	White-throated Needletail	Listed	Aerial Feeder	S2 (Wet)
<i>Apus pacificus</i>	Fork-tailed Swift	Listed	Aerial Feeder	S1, S2, S8 (Wet)
<i>Merops ornatus</i>	Rainbow Bee-eater	Listed	Most forest types	S1, S2, S3, S4, S6, S7 (Dry) S1, S2, S8 (Wet)
<i>Rhipidura rufifrons</i>	Rufous Fantail	Listed	Riparian, Monsoon vine-forest	S1, Finniss River main branch (Dry)
<i>Coracina tenuirostris melvillensis</i>	Cicadabird	Listed	Upland Eucalypt Woodland, Monsoon vine-forest	S1, S2 (Wet)

4.1.1 Estuarine Crocodile (*Crocodylus porosus*)

Conservation Status

Australia: Listed as a migratory species under the *Environment Protection & Biodiversity Conservation Act 1999*.

Survey Sites:

Dry Season: Aq7

Wet Season: Not recorded

Browns Oxide Project Area: Not recorded

Distribution

Estuarine crocodiles have been reported from Elizabeth Downs and Finniss River stations and from the Reynolds River in Litchfield NP (Griffiths *et al.* 1997). Estuarine crocodiles were present on the main Finniss River on the western margin of the wider study area during the dry season survey and several large specimens have been reported from the vicinity of Site Av1 (S. Tidemann pers comm. 2002).

Habitat

Inhabits large rivers and streams, freshwater swamps, floodplain billabongs (Ehmann 1992). Estuarine crocodiles are likely to move into the lower reaches of the Finniss River and the east branch of the Finniss River during the wet season. However suitable habitat was not identified during the wet season survey within the Browns Oxide Project Area.

Threatening processes

Aquatic pollution, acid mine drainage.

4.1.2 Migratory Birds

A number of birds are listed as migratory species under the *EPBC Act 1999* Act were recorded within the Browns Oxide Project Area and wider study area (Table 4.1).

The rainbow bee-eater is generally a common and widespread species that has broad habitat requirements. It was present in the wider study area in a variety of habitats in both dry and wet seasons. The white-throated needletail and fork-tailed swift are aerial feeders that were not observed using terrestrial habitats within the study area. It is unlikely that the project would have a significant impact on these species. One migratory wetland bird, assumed to be a Swinhoe's snipe, was observed on the Finniss River floodplain outside the project area during the wet season survey. There are no major habitats for migratory wading birds within the Browns Oxide Project Area, however it is possible that small numbers of migrating water birds might use artificial water sources or flooded areas around the Rum Jungle mine area temporarily.

Top End populations of the rufous fantail (*Rhipidura rufifrons*) are present year round, and migratory movements in this species are mostly associated with east coast populations occurring south 25° latitude (Schodde & Tidemann 1988). Top End populations of the cicadabird (*Coracina tenuirostris melvillensis*) are seasonally nomadic rather than extralimital migrants, retreating to pockets of rainforest in the dry season. This species was not recorded during dry season surveys and was locally common during the wet season surveys.

5. SIGNIFICANT VEGETATION/HABITAT

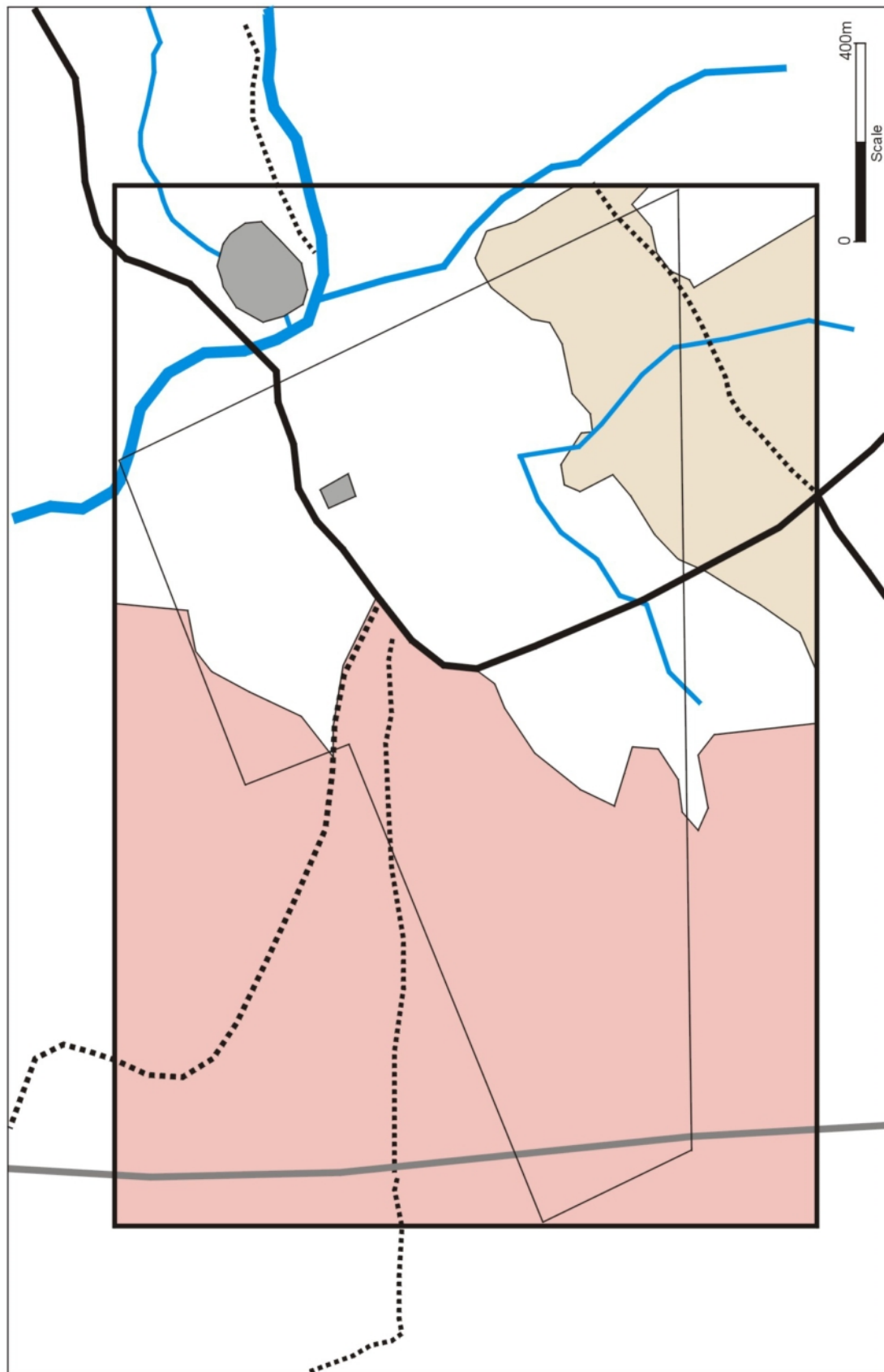
None of the habitats or ecosystems within or affected by the proposed project are listed as threatened ecological communities under the *EPBC Act 1999*. There are no World Heritage properties in close proximity to the project area and the nearest conservation reserve in the region is Litchfield National Park. This reserve is located about 15 km south-west of the project area.

Table 5.1 lists significant vegetation within the Browns Oxide Project Area, which includes habitat of vulnerable, endangered fauna and regionally restricted fauna. There are no major habitats for migratory wetland birds, ecologically outstanding areas or wetlands in the Browns Oxide Project Area. Figure 7 indicates broad habitat types supporting populations of endangered and vulnerable fauna under the Commonwealth *EPBC Act 1999*.

TABLE 5.1
SIGNIFICANT VEGETATION
THREATENED & REGIONALLY RESTRICTED FAUNA SPECIES OR HABITATS

Site/Significant Vegetation (Habitat of Threatened Fauna)	Vegetation Type (Metcalf 2002)	National Conservation Status <i>EPBC 1999 Act</i>	NT Conservation Status <i>TPWC Act 2000</i>	Regionally Restricted Species	Diversity
Site 1. <i>Acacia auriculiformis</i> / Regenerating vine-forest	10			Northern Small-eyed Snake (Data Deficient) Fawn Antechinus (Data Deficient)	
Site 2. <i>E. miniata</i> , <i>E. chlorostachys</i> , <i>E. tetradonta</i> open forest	2, 3	Northern Quoll (Endangered) Red Goshawk (Vulnerable) Partridge Pigeon (Vulnerable)	Northern Quoll (Vulnerable) Red Goshawk (Vulnerable) Partridge Pigeon (Near threatened) Brush-tailed Phascogale (Vulnerable)	Slender Blind Snake (Data Deficient) Northern Death adder (Near Threatened) Pale Field Rat (Near Threatened) Fawn Antechinus (Data Deficient) Black-footed Tree Rat (Near Threatened)	Highest species diversity during the 2002 dry season survey (site 2).
Site 8. <i>E. phoenicea</i> /C. <i>bleeseri</i> open woodland on rocky outcrops +/- riparian vegetation	1	Northern Quoll (Endangered) Red Goshawk (Vulnerable) Partridge Pigeon (Vulnerable)	Northern Quoll (Vulnerable) Red Goshawk (Vulnerable) Partridge Pigeon (Near threatened)	Arnhem land Pebble-mound mouse (Near Threatened) Black-footed Tree Rat (Near Threatened)	Highest species diversity during the 2005 wet season survey.

Site/Significant Vegetation (Habitat of Threatened Fauna)	Vegetation Type (Metcalfe 2002)	National Conservation Status <i>EPBC 1999 Act</i>	NT Conservation Status <i>TPWC Act 2000</i>	Regionally Restricted Species	Diversity
Site 9. Melaleuca woodland	7			Arnhem Sheathail Bat (Near Threatened) Pale Field Rat (Near Threatened) Fawn Antechinus (Data Deficient)	



LEGEND

- Veg types 2 & 3 in Metcalfe 2002, Eucalypt Open Forest/Woodland, Site records of Red Goshawk, Northern Quoll & Partridge Pigeon, Brush-tailed Phascogale (Vu TPWCA 2000)
- Veg types 1, 3 & 6 in Metcalfe 2002, Eucalypt open woodland, Riparian vegetation, rock and scree areas and drainage areas, Site records of Red Goshawk, Northern Quoll, Partridge Pigeon

Plan Note:
This plan was prepared to accompany a preliminary ecological assessment of the Browns Oxide Project, Batchelor NT, and should not be used for any other purpose. While every care is taken to ensure the accuracy of this data, Ecological Management Services make no representations or warranties about its accuracy, reliability or completeness or suitability for any particular purpose and disclaim all responsibility and liability (including without limitation, liability in negligence) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
Localities of significant fauna habitats are based on field mapping and vegetation mapping provided by Metcalfe 2002 and have not been surveyed by Ecological Management Services. This map provides an indication of the general locality of habitat boundaries.
This note is an integral part of this plan.



MGA 1984 ZONE 52

Date: 31 July 2005

FIGURE 7. Habitats Supporting Species Listed as Endangered or Vulnerable, EPBC Act 1999

BROWNS OXIDE PROJECT

E. M. S.

ECOLOGICAL MANAGEMENT SERVICES

31 JULY 2005

IMPACT

6. IMPACTS ON THREATENED FAUNA & HABITATS

The following impact and management sections are based on the assumption that vegetation clearing and associated impacts will occur in areas defined by the proposed Browns Oxide infrastructure layout (Compass Resources NL July 2005). This will include most of the site within the 12 mining leases, with the exception of the south-east corner.

The primary impacts on fauna and significant fauna habitats relate to the proposed vegetation clearing and the proposed infrastructure layout. General impacts include the habitat loss, modification and disturbance to two fauna habitat types associated with and surrounding the Browns Oxide Project pit, new haul road, ROM pad, crushing pad, process plant and office. The proposed infrastructure will impact on the habitat availability, structure and condition of *E. miniata* and *E. tetradonta* +/- *E. chlorostachys* open forest/woodland and vine forest in the Browns Oxide Project Area. The potential impacts are outlined below.

6.1 IMPACTS ON THREATENED FAUNA SPECIES

The primary impacts include vegetation clearing, modification or disturbance to habitats that support three fauna species of national and Territorial significance. This habitat consists of *E. miniata* and *E. tetradonta* +/- *E. chlorostachys* open forest to woodland (site 2). The northern quoll, partridge pigeon and red goshawk are listed under the *EPBC Act 1999* as endangered and vulnerable and are also listed as vulnerable in the *Territory Parks and Wildlife Conservation Act 2000*. The Brush-tailed Phascogale is also listed as vulnerable in the *Territory Parks and Wildlife Conservation Act 2000*.

Five species of regional significance were also recorded in this habitat including the, slender blind snake (Data Deficient), northern death adder (Near Threatened), fawn antechinus (Data Deficient), pale field-rat (Near Threatened), black-footed tree rat (Near Threatened). The presence of these species is indicative of the significance of this habitat within the project area, as most of these species tend to be patchily distributed, with only a few records from the Coomalie sub-region or the local area, including Litchfield NP.

6.1.1 Northern Quoll

Endangered in the *Environment Protection & Biodiversity Conservation Act 1999*.

Vulnerable in the *Territory Parks and Wildlife Conservation Act 2000*.

Habitats: The northern quoll was recorded in three habitat types during the dry season survey during 2002 including *E. miniata*/*E. tetradonta* woodland (Site 3), *Lophostemon* and *Melaleuca* woodland (Site 4) and *E. phoenicea*/*C. bleeseri* open woodland on rock outcrops (Site 8). During the wet season survey in 2005, the northern quoll was only recorded in one habitat, *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2).

Significant habitats in the Browns project area for the northern quoll include *Eucalyptus tetradonta* - *Eucalyptus miniata* open forest/woodland and Eucalypt/Corymbia open woodland at site 8. Eucalypt/Corymbia woodland at site 8 (south-east corner of the Browns Oxide Project Area) is not proposed to be disturbed (Compass Resources NL July 2005).

Impacts of proposal/proposed vegetation clearing: the proposed development and associated habitat disturbance to *Eucalyptus miniata* open forest/woodland communities, is likely to have an impact on the habitat quality, population and distribution of the northern quoll within the Browns Oxide Project Area. The potential impacts of the proposal include fragmentation of open forest and woodland habitats and altered fire regimes. Any activities that increase numbers of feral cats and cane toads will also have a potential impact on this species.

Ability of fauna to withstand any increased pressure resulting from the proposal: The northern quoll cannot maintain populations in sub-optimal environments that have been disturbed. Research by the DIPE, when applied to a local landscape (4km radius circle), found that the northern quoll will probably be lost in a landscape with 30% vegetation retention (Price & Baker 2003).

Pest species: Construction and operation conditions may improve conditions for feral cats and cane toads. Quolls appear to be particularly susceptible to the poison of cane toads, and are killed when they attempt to kill or consume the toads (Woinarski 2003).

Proposed mitigation measures: Consideration should be given to minimising clearing of *Eucalyptus miniata*/*E. tetradonta* open forest/woodland communities in the design stage of this proposal and alternatives to the location of infrastructure in this habitat should be investigated.

6.1.2 Red Goshawk

Vulnerable in the *EPBC Act 1999*.

Vulnerable in the *Territory Parks and Wildlife Conservation Act 2000*.

Habitats: This species was recorded at site 2 in *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest during the dry season survey and in riparian vegetation near site 8 during the wet season

survey. This species is likely to utilise a variety of habitats from upland tall eucalypt forests to floodplain and riverine vegetation.

Significant habitats in the Browns project area for the red goshawk include *E. miniata*, *E. tetradonta* +/- *E. chlorostachys* open forest/woodland and riparian vegetation forest near site 8. The proposed layout indicates that riparian vegetation near site 8 is not proposed to be disturbed (Compass Resources NL July 2005).

Impacts of proposal/proposed vegetation clearing: The potential impacts of the proposal relate to clearing of preferred habitat, *E. miniata*, *E. tetradonta* +/- *E. chlorostachys* open forest/woodland and other open forest/woodland woodland communities and fire management practices.

Ability of fauna to withstand any increased pressure resulting from the proposal: The proposed layout does not impact on habitat at site 8 near the creekline (Compass Resources NL July 2005) and this habitat and riparian vegetation may contribute to the maintenance of preferred habitat in the project area. Land clearing in the region may have an impact on this species, however it is likely to be most severely impacted by disturbance in the vicinity of nest sites, none of which have been identified in the project area during surveys undertaken to date.

Pest species: Not applicable.

Proposed mitigation measures: Consideration should be given to minimising clearing of *E. miniata*, *E. tetradonta* +/- *E. chlorostachys* open forest/woodland communities in the design stage of this proposal and alternatives to the location of infrastructure in this habitat should be investigated. Consideration should be given to the maintenance of preferred red goshawk habitats when designing fire management practices in the Browns Oxide Project Area and wider study area, in particular, the maintenance of riparian vegetation/paperbark communities near site 8 and *E. miniata*, *E. tetradonta* +/- *E. chlorostachys* open forest/woodland and other open forest/woodland.

6.1.3 Brush-tailed Phascogale

Not listed under the *Environment Protection & Biodiversity Conservation Act 1999*.

Vulnerable in the *Territory Parks and Wildlife Conservation Act 2000*.

Habitats

The brush-tailed phascogale was observed during the 2002 dry season spotlight surveys in *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest (Site 2) in the Browns Oxide Project Area and in *E. miniata*/*E. tetradonta* woodland (south of Site 3). This species was not recorded during the 2005 wet season survey within the Browns Oxide Project Area.

Significant habitats in the Browns project area for the brush-tailed phascogale include *Eucalyptus tetradonta* - *Eucalyptus miniata* open forest/woodland. The majority of recent records in the Top End

are from tall open forest of Darwin woollybutt (*Eucalyptus tetradonta*) - Darwin stringybark (*Eucalyptus miniata*) (Woinarski 2002b; Maxwell *et al.* 1996).

Impacts of proposal/proposed vegetation clearing: Suitable habitat for this species occurs in a large percentage of the Browns Oxide Project Area, particularly in undisturbed forest to the west and south-west of the Browns Oxide deposit. The proposed development and associated habitat disturbance to *Eucalyptus miniata/tetradonta* open forest/woodland, is likely to have an impact on the habitat quality and distribution of the brush-tailed phascogale within the Browns Oxide Project Area. The principal potential impacts of the proposal include a reduced habitat area, fragmentation of open forest and woodland habitats and possibly altered fire regimes and invasion of weeds.

Ability of fauna to withstand any increased pressure resulting from the proposal: The brush-tailed phascogale appears to be uncommon and patchily distributed (Maxwell *et al.* 1996), is uncommon in Litchfield National Park (Griffiths *et al.* 1997) and is likely to be uncommon in the wider study area. The typical home range for individuals of this species is large (up to 150 hectares for males), suggesting that a local population is likely to utilise large areas of open forest and woodland habitat within the wider study area, including habitat in the Browns Oxide Project Area. This species is likely to be susceptible to the loss of preferred *Eucalyptus miniata/tetradonta* open forest/woodland habitat in the Browns Oxide Project Area and vegetation change due to altered fire regimes (frequency and intensity of fires). The brush-tailed phascogale is also likely to be susceptible to increased pressure from cat predation and the impact of cane toads (Woinarski 2002b).

Although sightings are from drier forest types there are some records from riparian/woodland interface and deciduous vine thicket (Maxwell *et al.* 1996) and these habitats may contribute to refuge habitat in the project area.

Pest species: As a result of construction and operation, conditions may improve for feral cats and cane toads, as these species may benefit from artificial water sources or waste.

Proposed mitigation measures: Consideration should be given to minimising clearing of *Eucalyptus miniata/E. tetradonta* open forest/woodland communities in the design stage of this proposal and alternatives to the location of infrastructure in this habitat should be investigated.

6.1.4 Partridge Pigeon

Vulnerable in the EPBC Act 1999.

Near threatened in the Territory Parks and Wildlife Conservation Act 2000.

Habitats: The partridge pigeon was observed in the project area in open areas/tracks at site 8 during the 2005 wet season survey and in grassy areas on the road verges along Litchfield Park Road. The partridge pigeon was also observed on the margin of the Rum Jungle mine access road north-west of the Browns Bulk Sample Pit (near S9) and on the eastern end of White Road (S2) in *E. miniata* - *E.*

tetrodonta open woodland. It has also been reported from Mount Burton to the north-east of the project area (Tidemann pers comm. 2002). Habitat is mainly mixed eucalypt woodland and *E. tetrodonta*/*E. miniata* woodland and forest with a structurally diverse understorey (Garnett & Crowley 2000). This species may occur in eucalypt forest and vegetation in drainage areas, including recently burnt habitats.

Impacts of proposal/proposed vegetation clearing: The potential impacts of the proposal relate to clearing of tall eucalypt open forest and changes in native grass and vegetation composition/structure (including the invasion of exotic grasses) clearing of preferred habitat and fire management practices. Threatening processes include the predation by feral cats and altered fire regimes (Woinarski 2003). The current proposal includes some proposed infrastructure that will remove habitat where this species was recorded during the wet season survey. Other areas where partridge pigeons were regularly seen (eg site 8) are not proposed to be disturbed (Compass Resources NL July 2005). The seasonal movements of this species in the local area may require further investigation.

Ability of fauna to withstand any increased pressure resulting from the proposal:

Partridge pigeons were recorded on two occasions in a previously disturbed area near White Road and frequently in intact habitat at site 8. Previously disturbed areas in the project area are proposed to be cleared and modified while the main habitat in the project area is proposed to be retained (based on proposed infrastructure layout Compass Resources NL July 2005). Issues that will potentially have a significant impact on the ongoing maintenance of the local population include the management of fire in the local area. Additional issues include the control of feral animals, particularly cats, and potential road kill through increased traffic volumes.

Proposed Mitigation Measures: Impacts on this species will potentially be minimised by the preservation of preferred habitat, particularly the southeastern component of the project area associated with site 8. The implementation of an appropriate fire management plan and control of feral cats in the project area may also benefit this species.

6.2 IMPACTS ON FAUNA HABITATS

The primary impacts include vegetation clearing, modification or disturbance to habitats that support fauna species of national and NT significance and habitats that supports a significant diversity of fauna within the project area.

6.2.1 *Eucalyptus miniata* and *E. tetrodonta* open forest/woodland

This habitat supported the highest species diversity during the 2002 dry season survey in the project area. Fauna species listed as endangered and vulnerable under relevant legislation include the northern quoll, red goshawk, brush-tailed phascogale and the partridge pigeon. Five species of

regional significance were also recorded in this habitat including the slender blind snake (Data Deficient), Northern death adder (Near Threatened), fawn antechinus (Data Deficient), pale field-rat (Near Threatened) and the black-footed tree rat (Near Threatened).

The proposed layout consists of a new haul road, ROM pad, crushing pad, process plant and office/admin located in this habitat. The primary impact of the proposed development includes loss of habitat, clearing, modification and disturbance to *Eucalyptus miniata* and *E. tetradonta* +/- *E. chlorostachys* open forest to woodland. Associated impacts may also occur on the habitat quality, condition and the availability of habitat that supports a significant diversity of fauna within the project area.

6.2.2 *Acacia auriculiformis* woodland to open forest/Regenerating Vine-forest

Vine-forests comprise a small percentage of vegetation within the project area. A small area remains north of the Browns Oxide deposit, where it is surrounded by *Acacia auriculiformis* woodland to open forest. However severe fires in late 2002 (J. Earthrowl pers comm.) have added pressure on these vegetation communities, burning into vine-forest areas, and degrading the condition of this community. Weeds and introduced grasses were noted in the wet season 2005 to be more prolific on disturbed edges.

Fauna species listed under Territory and Commonwealth legislation were not recorded in this habitat during surveys. Two species of regional significance were recorded in this habitat including the northern small-eyed snake (Data Deficient) and the fawn antechinus (Data Deficient). Although vine-forests are ecologically important areas at a local scale, they do not have any declared conservation status.

The small vine-forest present within the Browns Oxide Project Area continues to support a number of fauna species restricted to vine-forests, including the rainbow pitta, rose-crowned fruit dove and emerald dove. However the area of this vegetation has been greatly reduced by fire and remaining areas have been impacted by feral pigs, fire and weed invasion. The area, distribution and condition of remnant vine-forest remaining within the project area needs to be confirmed by an updated flora assessment.

6.2.3 Eucalypt Open Woodland on Rocky Rises/Riparian Vegetation

This habitat supported the highest fauna species diversity during the 2005 wet season survey. Fauna species listed as endangered and vulnerable under relevant legislation include the northern quoll, red

goshawk and the partridge pigeon. Species of regional significance were also recorded in this habitat including the Arnhem Land pebble-mound mouse (Near Threatened) and the black-footed tree rat (Near Threatened).

The proposed Browns infrastructure layout does not have a direct impact on open woodland/riparian vegetation at site 8 (Compass Resources NL July 2005).

6.2.4 Melaleuca Woodland

Species of regional significance were recorded in this habitat including the Arnhem sheath-tail bat (Near Threatened), pale field-rat (Near Threatened) and fawn antechinus (Data Deficient).

The proposed Browns infrastructure layout (Compass Resources NL July 2005) does not have a direct impact on Melaleuca woodland at site 9. Indirect impacts may be associated with surface water quality and ground water levels.

6.3 GENERAL IMPACTS

6.3.1 Fire

Many of the threatened and significant fauna species detected within the project area are negatively impacted by specific fire regimes. There is a possibility that increased activity in the local area associated with construction and operation could result in an increase in unplanned fires. Impacts may affect the fauna biodiversity and habitat for threatened fauna in the project area. However implementation of an ecologically based fire management plan will potentially mitigate any negative impacts. The presence and spread of exotic grasses (including gamba grass) can also influence the intensity and distribution of fires, and active control of these weeds in areas surrounding the proposed mine would benefit the local ecology.

6.3.2 Pests & Weeds

Feral pigs appear to be relatively common in riparian and other habitats in the wider study area. The disturbance caused by pigs may also result in an increase in the spread of weeds.

A number of the fauna species within the project area, including the northern quoll, brush-tailed phascogale, several goannas, snakes and frogs are likely to be negatively impacted by the recent arrival of cane toads in the Rum Jungle area. The impact of cane toads will be an issue for future

impact assessment and monitoring within the Browns Oxide Project Area, particularly in relation to determining project related impacts.

A number of feral cats are present in the vicinity of the Rum Jungle mine and in the Browns Oxide Project Area. Feral cats were observed relatively frequently throughout the project area at most sites. Feral cats may represent a risk to some of the significant fauna species that occur in the local area (eg partridge pigeon).

A number of significant weed species currently occur within the project area and have invaded additional areas between the 2002 and 2005 surveys. Construction and operational activities at the project area may result in further introductions from off-site and the spread of weeds within the site. Invasive weeds may impact on the structure and condition of fauna habitat and alter the frequency and intensity of fires.

6.3.3 Acid Mine Drainage

Jeffree & Twining (1998) have identified toxic metal concentrations at low pH as the main factor in fish kills and the restricted fish abundance and diversity in the impact area on the east branch of the Finnis River below the historic Rum Jungle Mine. Acid mine drainage has been a contributing factor, in combination with inflows of toxic metals. Reductions in acid mine drainage by liming has potentially reduced impacts on fish in the east branch by increasing the concentration of Ca which consequently reduces the toxicity of metals including Cu and Zinc (Jeffree & Twining 1998). Reductions in the overall load of Cu, Mn and Zn have also contributed to the recovery of fish populations in the east branch (Jeffree & Twining 1998). Any mining activity that increases erosion, sedimentation, inflows of toxic metals and changes in pH (eg acid mine drainage) will have a potential impact on Lorentz's grunter populations in the east branch of the Finnis River. Smaller local tributaries and seasonally inundated swamp areas may also be impacted.

Compass Resources NL (2004) state that mine waste products will be encapsulated in tailings areas or other suitable areas and that no acid generation or acid drainage is envisaged from the tailings area.

6.3.4 Mine Dewatering and Water Table Changes

Mine dewatering and other hydrological changes may impact habitats and associated fauna species in the area surrounding the proposed mine pit. Two potentially vulnerable habitats occur adjacent to the mine pit, including Melaleuca woodland and monsoon vine-forest.

6.3.5 Traffic

Some threatened species, particularly the partridge pigeon, were frequently observed on roadside verges within and adjacent to the Browns Oxide Project Area. This species has been recorded as road kill and increased traffic movements may have an impact on local populations. Common fauna may also be subject to road kill associated with the proposed new haul road and road upgrade in the project area.

6.4 SUMMARY OF SIGNIFICANCE OF POTENTIAL IMPACTS

- The overall proposed impact area is relatively small (1.75 km²) when compared to the potential impacts of other activities in the local area eg. the broad scale clearing of vegetation for grazing or tree plantations.
- A component of the Browns Oxide Project Area has been previously disturbed and degraded by past mining activities, and supports some areas of poor vegetation condition and/or areas dominated by weeds.
- Local impacts may be minimised if other freehold lands in Compass ownership are to be managed and maintained for conservation purposes, potentially offsetting losses in the 1.75 km² area.
- The primary issue of significance is the potential impact on species that have been recorded in the project area and are listed nationally as endangered or vulnerable under the *EPBC Act 1999* and vulnerable in the Northern Territory under the *TPWC Act 2000*. Impacts may be minimised with the retention of habitat for nationally/NT threatened species, particularly in the southeast component of the project area.
- The red goshawk has a large home range, of which the study area may represent a small component. Both observations of this species were on the margins or outside the proposed impact area (12 mining leases). It is unlikely that the project would have a significant impact on this species. However any raptor nests subsequently located in the project area should be investigated and identified prior to any disturbance in the vicinity of the nest.
- The partridge pigeon was observed in habitat at site 8 and disturbed areas within the mine area (eg. on the edge of White Road). The main concentration of sightings of this species is within the southeast section of the project area (S8) and this habitat should be maintained in its natural state. Based on known records, including historical records, the partridge pigeon does not appear to be locally or regionally common and is listed as nationally vulnerable. The

individuals recorded in the project area are likely to be significant as they contribute to the local population.

- Based on known partridge pigeon records it is likely that clearing of the 12 mining leases and potential operational impacts will have a impact on the local population. It is not possible to determine the significance of the impact on the local population without more detailed data on the local population (eg. breeding sites, habitats or areas outside the project area and seasonal movements) and the effect of the operational impacts (eg. fire management, feral animal management, increased activity and traffic and potential road kill). If the southeast component of the project area is retained and fire is managed appropriately then the potential impact on this species will be minimised.
- The northern quoll was present within the Browns Oxide Project Area during both survey periods. The major threat to this species is the recent invasion by cane toads and studies conducted in Northern Territory and Queensland suggest that the northern quoll is likely to suffer a major decline and/or regional extinction. In the short term clearing of habitat is also likely to increase pressure on this species.
- Management measures designed to minimise potential impacts on these species, NT threatened species and general ecological management recommendations, are included in Sections 6 and 7.

MANAGEMENT

7. POTENTIAL MANAGEMENT ISSUES RELATED TO FAUNA

In general the fauna of the project area is relatively diverse when compared to other similar habitats sampled within the Batchelor area (for example Ecological Management Services 2001). Management recommendations for fauna have been prepared, based on a dry season and wet season survey and relate to the potential impacts of the preliminary proposal (Compass Resources NL June/July 2005). Other recommendations relate to the management of significant fauna habitats and feral animals.

7.1 THREATENED FAUNA LISTED UNDER TERRITORY AND COMMONWEALTH LEGISLATION

Existing fauna habitat should be retained where possible and the area of the development footprint should be minimised during the design stage.

- Consideration should be given to minimising clearing of *Eucalyptus miniata*/*E. tetradonta* +/- *E. chlorostachys* open forest/woodland communities in the design stage and alternatives to the location of infrastructure in this habitat should be investigated.
- The design should minimise the overall area of disturbance and reduce clearing for infrastructure associated with the project by careful planning of road networks, equipment and waste rock dumps, tailings dams, associated works and operational areas.
- Impacts on the habitat value and condition should be minimised in the design stage by preventing indirect impacts associated with drainage, waste contamination and the spread of weeds.

During the construction and operational phases of the project, habitat should be protected from disturbance associated with surrounding areas of the Browns Oxide pit, new haul road, ROM pad, crushing pad, process plant and office.

- Vegetation disturbance associated with the proposed infrastructure should be minimised to prevent changes in structure and condition of *E. miniata* and *E. tetradonta* +/- *E. chlorostachys* open forest/woodland and smaller remnants of vine-forest.
- Temporary fencing should be erected around areas proposed to be cleared to limit construction impacts.

7.2 FAUNA HABITATS

Major impacts associated with this proposal include the loss of habitat, direct impact on habitat quality, condition and the availability of habitat that supports a significant diversity of fauna within the project area.

- The proposed layout, construction and operational phases of the project should aim to minimise habitat disturbance, the loss of vegetation cover and habitat modification.
- Design infrastructure placement to minimise habitat fragmentation and avoid severing riparian corridors.
- Where possible previously disturbed and modified areas should be utilised in preference to intact habitats.
- Areas to be disturbed should be clearly defined and disturbance outside these areas avoided during the construction and operational phases.

7.2.1 *Eucalyptus miniata* and *E. tetradonta* open forest/woodland

The proposed layout consists of a new haul road, ROM pad, crushing pad, process plant, office/admin located in *Eucalyptus miniata* and *E. tetradonta* +/- *E. chlorostachys* open forest to woodland. This habitat supports significant species diversity in the Browns Oxide Project Area and a number of species listed as threatened under the EPBC Act 1999.

- Consideration should be given to avoiding or minimising clearing modification or disturbance of *Eucalyptus miniata*/*E. tetradonta* open forest/woodland communities in the design stage.
- Alternatives to the location of infrastructure in this habitat should be investigated.

7.2.2 *Acacia auriculiformis*/Regenerating Vine-forest

This vegetation provides habitat for regionally significant fauna and may provide refuge habitat during fires. Management recommendations are outlined below:

- Protect any remnant vine-forest patches from direct disturbance, including clearing for infrastructure.
- Continue on-site fire management initiatives aimed at protecting these fire sensitive habitats and develop formal fire management strategies that will protect and enhance these habitats.
- Monitor vine-forest remnants to the north of the Browns Oxide deposit to assess potential impacts of mine de-watering, changes to ground water tables, fire and surface water issues.

7.2.3 Eucalypt open woodland/riparian vegetation

The proposed Browns Oxide Project infrastructure layout (Compass Resources NL July 2005) does not impact on Eucalypt open woodland/riparian vegetation on the un-named creek at site 8. Riparian vegetation at site 8 was one of two site records for the vulnerable red goshawk within the Browns Oxide Project Area. Management recommendations are outlined below:

- This riparian habitat should not be disturbed during the construction and operational stages.
- Habitat connectivity along this creek should be maintained and enhanced where possible. Canopy breaks and disturbance during the construction and operational stages along this riparian corridor should be prevented.
- The dumping of soil, construction materials, rubbish and landscaping and other stockpiles should not be allowed in this area.

Other Eucalypt/Corymbia open woodland habitat on rocky rises that occur in a band along the southeastern portion of the 12 mining leases supported the only known population of the regionally significant Arnhem Land pebblemound mouse (*Pseudomys calabyi*) within the local area. The vulnerable partridge pigeon were also frequently observed in this area. The current layout does not require modification of this area and it is recommended that any additional infrastructure should avoid these habitats.

7.2.4 Melaleuca Woodland

The current proposal (Compass Resources NL July 2005) does not have a direct impact on Melaleuca woodland at site 9. Management recommendations are outlined below:

- This habitat should not be disturbed during the construction and operational stages.
- The dumping of soil, construction materials, rubbish and waste-rock and other stockpiles should be confined to previously disturbed areas and should not be allowed in this habitat.
- Weed invasion presents an ongoing impact on this habitat and control measures should be implemented.
- Monitoring of vegetation to the south of the oxide deposit is recommended to assess potential impacts of mine de-watering, changes to ground water tables, fire and surface water issues.

7.3 GENERAL RECOMMENDATIONS

7.3.1 Fire

Planning and management of fire within the Browns Oxide Project Area and wider study area will be a significant issue in relation to managing impacts on rare and threatened species and fauna biodiversity in remnant habitat. Management recommendations are outlined below:

- Develop a formal fire management plan to address wildlife and habitat issues and ecological management objectives (eg. maintenance of specific habitat and habitat structure, refuge habitat, biodiversity and the consideration of threatened fauna species eg. partridge pigeon.).
- This should include an appropriate fire regime and sequence for the protection and maintenance of open forest, vine-forest, riparian forest and *Melaleuca* woodland communities.
- The fire management plan should consider the requirements of fauna species that are favoured by early dry season low intensity fires and should consider the habitat requirements for listed threatened fauna species known to occur in the local area.
- A mosaic of vegetation and habitats should be maintained with small scale fires and variation in fire intensities and seasons.
- Fire intervals and the structural development and spatial diversity of vegetation should also be considered in the plan.
- Implement measures and systems designed to control and regulate potential unplanned fires.
- Control the spread of weeds in the Browns Oxide Project Area, as they may affect the intensity and distribution of fires.

7.3.2 Pests & Weeds

A management program for the control of feral pigs and feral cats should be considered. Cane toad control is likely to be difficult and if implemented, appropriate measures should be developed in consultation with the Parks and Wildlife Service, Coomalie Council and Frogwatch. Reducing artificial breeding sites may reduce local recruitment. Recommendations include:

- Control of feral species in the vicinity of the mine area.
- Design of refuse disposal areas and other infrastructure in a manner that will not encourage feral animals associated with increased availability of food sources.

- Management of weeds is necessary to prevent further degradation of remnant habitats in the local area and they also have implications for ecological fire management.
- Implement control and management of weed species, including measures to minimise introductions from off-site (eg on machinery entering the site) and movement of weeds within the site.

7.3.3 Acid Mine Drainage

- Compass Resources NL (2004) state that mine waste products will be encapsulated in tailings areas or other suitable areas and that no acid generation or acid drainage is envisaged from the tailings area. Monitoring should be undertaken to ensure that these conditions are present and maintained and to ensure that there is no acid mine drainage or outputs of toxic metals.
- Management measures should include the ongoing monitoring of the tailings area, waste rock stockpiles and other waste storage areas. Ensure that bunds and tailings areas are appropriately designed and managed to avoid adverse impacts on downstream sites, particularly during high rainfall events.

7.3.4 Mine Dewatering and Water Table Levels

- Ongoing monitoring of habitats surrounding the mine pit, particularly Melaleuca woodland and monsoon vine-forest to determine potential impacts of mine dewatering and/or alteration of ground water levels.

7.3.5 Sedimentation and Water Quality

- Installation of sediment traps and other measure to reduce erosion and sedimentation, particularly during the construction phase.
- Ongoing monitoring of operation areas, tailings area, waste rock stockpiles and other waste storage areas to ensure that there is no acid mine drainage, outputs of toxic metals or other pollutants and minimisation of sedimentation.
- Ensure that bunds and tailings areas are appropriately designed to minimise downstream impacts, particularly during wet season events.
- Dust suppression measures on roads and mine areas.

7.3.6 Traffic

- Implement speed limits and traffic controls in areas where partridge pigeons and other threatened wildlife occur (eg Rum Jungle Road, White Road).

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APPENDIX A

Review Of Existing Data

Appendix A

Regional Terrestrial Vertebrate Fauna Species List: Existing Data

Data Sources

1. NT Parks & Wildlife Data Search 2002 (Includes NT Museum records and records from surveys between 1913 and 1988)
2. Litchfield NP (Griffiths *et al.* 1997), Litchfield NP (McKean & Martin 1984), Petherick's Rainforest (Griffiths *et al.* 1997; Gambold & Woinarski 1993), Union Reef EIS (ERA/NSR 1993), RAOU Records (cited in Griffiths *et al.* 1997)
3. Winchester Magnesium Deposit, Batchelor (Ecological Mangement Services 2001)
4. Mount Burton (Tidemann unpublished data 2002)
5. Litchfield National Park (Woinarski *et al.* 2004)
6. RAOU Data Base Search 2005

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
AMPHIBIANS							
Family Myobatrachidae							
Bilingual Froglet	<i>Crinia bilinea</i>		X	X		X	
Marbled Frog	<i>Limnodynastes convexiusculus</i>		X			X	
Ornate Burrowing Frog	<i>Limnodynastes ornatus</i>		X			X	
Northern Spadefoot Toad	<i>Notaden melanoscaphus</i>		X				
Floodplain Toadlet	<i>Uperoleia inundata</i>		X			X	
Stonemason Toadlet	<i>Uperoleia lithomoda</i>		X			X	
Family Hylidae							
Giant Frog	<i>Cyclorana australis</i>		X				
Long-footed Frog	<i>Cyclorana longipes</i>		X				
Northern Dwarf Tree Frog	<i>Litoria bicolor</i>		X			X	
Green Tree Frog	<i>Litoria caerulea</i>		X				
Saxicoline Tree Frog	<i>Litoria coplandi</i>		X				
Dahl's Aquatic Frog	<i>Litoria dahlia</i>		X				
Peter's Frog	<i>Litoria inermis</i>		X	X			
Rockhole Frog	<i>Litoria meiriana</i>		X				
Dwarf Rocketfrog	<i>Litoria microbelos</i>		X	X			
Striped Rocketfrog	<i>Litoria nasuta</i>		X	X		X	
Pale Frog	<i>Litoria pallida</i>		X				
Roth's Tree Frog	<i>Litoria rothii</i>		X			X	
Purple Tree Frog	<i>Litoria rubella</i>		X				
Tornier's Frog	<i>Litoria tornieri</i>		X	X		X	
Wotjulum Frog	<i>Litoria wotjulumensis</i>		X	X			
Family Microhylidae							
Northern Territory Frog	<i>Sphenophryne adelphe</i>					X	
REPTILES							
Family Crocodylidae							
Freshwater Crocodile	<i>Crocodylus johnstoni</i>		X	X			
Estuarine Crocodile	<i>Crocodylus porosus</i>		X				
Family Chelidae							
Northern Longneck Turtle	<i>Chelodina rugosa</i>		X				
Snapping Turtle	<i>Elseya dentata</i>		X				
Northern Yellow-faced Turtle	<i>Emydura tanybaraga</i>		X				
Family Gekkonidae							
Spiny-tailed Gecko	<i>Diplodactylus ciliaris</i>		X				
Crowned Gecko	<i>Diplodactylus stenodactylus</i>		X				
Northern Dtella	<i>Gehyra australis</i>		X	X		X	
Northern Spotted Rock Dtella	<i>Gehyra nana</i>	X	X	X		X	
House Gecko	<i>Hemidactylus frenatus</i>		X				
Prickly (Bynoe's) Gecko	<i>Heteronotia binoei</i>	X	X	X		X	
Gecko	<i>Heteronotia planiceps</i>		X				
Marbled Velvet Gecko	<i>Oedura marmorata</i>		X				
Zigzag Velvet Gecko	<i>Oedura rhombifer</i>		X	X		X	
Family Pygopodidae							
Rusty-topped Delma	<i>Delma borea</i>		X			X	
Burton's Snake-lizard	<i>Lialis burtonis</i>		X				

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
Family Agamidae							
Friilled Lizard	<i>Chlamydosaurus kingii</i>		X			X	
Ring-tailed Dragon	<i>Ctenophorus caudicinctus</i>		X				
White-lipped Two-line Dragon	<i>Diporiphora albilabris</i>	X	X	X		X	
Robust Two-line Dragon	<i>Diporiphora bennettii</i>		X				
Two-lined Dragon	<i>Diporiphora bilineata</i>	X	X	X		X	
Gilbert's Lashtail	<i>Lophognathus gilberti</i>		X			X	
Swamplands Lashtail	<i>Lophognathus temporalis</i>		X	X			
Family Varanidae							
Black-spotted Ridge-tailed Monitor	<i>Varanus baritji</i>		X				
Long-tailed Rock Monitor	<i>Varanus glebopalma</i>		X				
Sand Monitor	<i>Varanus gouldii</i>		X				
Mitchell's Water Monitor	<i>Varanus mitchelli</i>		X	X			
Mertens' Water Monitor	<i>Varanus mertensi</i>		X	X			
Yellow-spotted Monitor	<i>Varanus panoptes</i>		X	X			
Spotted Tree Monitor	<i>Varanus scalaris</i>		X				
Black-tailed Monitor	<i>Varanus tristis</i>		X				
Timor's Varanus	<i>Varanus timoriensis</i>					X	
Family Scincidae							
Two-spined Rainbow Skink	<i>Carlia amax</i>	X	X			X	
Slender Rainbow Skink	<i>Carlia gracilis</i>		X	X		X	
Striped Rainbow Skink	<i>Carlia munda</i>		X			X	
Red-sided Rainbow Skink	<i>Carlia rufilatus</i>	X	X	X		X	
Three-spined rainbow Skink	<i>Carlia triacantha</i>		X			X	
Arboreal Snake-eyed Skink	<i>Cryptoblepharus plagiocephalus</i>		X	X		X	
Northern Ctenotus	<i>Ctenotus borealis</i>		X				
Ten-lined Ctenotus	<i>Ctenotus decaneurus</i>		X				
Port Essington Ctenotus	<i>Ctenotus essingtoni</i>		X			X	
Top-end Lowlands Ctenotus	<i>Ctenotus hilli</i>		X				
Bar-shouldered Ctenotus	<i>Ctenotus inornatus</i>	X	X	X		X	
Robust Ctenotus	<i>Ctenotus robustus</i>		X			X	
Storr's Ctenotus	<i>Ctenotus storri</i>		X			X	
Northern Mulch-skink	<i>Glaphyromorphus darwiniensis</i>		X	X		X	
Douglas' Skink	<i>Glaphyromorphus douglasi</i>		X	X		X	
Smooth-scaled Skink	<i>Glaphyromorphus isolepis</i>		X	X		X	
Eastern Lerista	<i>Lerista orientalis</i>		X				
Top End Dwarf Skink	<i>Menetia alanae</i>		X			X	
Common Dwarf Skink	<i>Menetia greyii</i>		X	X			
Northern Dwarf Skink	<i>Menetia maini</i>		X				
Red-tailed Snake-eyed Skink	<i>Morethia ruficauda</i>		X			X	
Storr's Snake-eyed Skink	<i>Morethia storri</i>		X			X	
Ornate Snake-eyed Skink	<i>Notoscincus ornatus</i>		X			X	
Slender Snake-eyed Skink	<i>Proablepharus tenuis</i>		X				
Common Blue-tongue Lizard	<i>Tiliqua scincoides</i>		X				
Family Typhlopidae							
Kimberley Shallow-soil Blind Snake	<i>Ramphotyphlops kimberleyensis</i>		X				
Family Boidae							
Black-headed Python	<i>Aspidites melanocephalus</i>		X				
Children's Python	<i>Liasis childreni</i>		X				
Water Python	<i>Liasis fuscus</i>		X				
Olive Python	<i>Liasis olivaceus</i>		X	X			
Carpet Python	<i>Morelia spilota</i>		X				
Family Acrochordidae							
Arafura File Snake	<i>Acrochordus arafurae</i>		X				
Family Colubridae							
Brown Tree Snake	<i>Boiga irregularis</i>		X				
Common Tree Snake	<i>Dendrelaphis punctulata</i>		X				
Macleay's Water Snake	<i>Enhydryis polylepis</i>		X				

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
Slate-grey Snake	<i>Stegonotus cucullatus</i>		X				
Keelback	<i>Topidonophis mairii</i>		X				
Family Elapidae							
Northern Death Adder	<i>Acanthophis praelongus</i>		X				
Black Whip Snake	<i>Demansia atra</i>		X				
Olive Whip Snake	<i>Demansia olivacea</i>		X				
Papuan Whip Snake	<i>Demansia papuensis</i>		X				
Taipan	<i>Oxyuranus scutellatus</i>		X				
Mulga (King Brown) Snake	<i>Pseudechis australis</i>		X	X			
Western Brown Snake	<i>Pseudonaja nuchalis</i>		X				
Half-girdled Snake	<i>Simoselaps semifasciatus</i>		X				
Little Spotted Snake	<i>Suta punctata</i>		X				
BIRDS							
Family Dromaiidae							
Emu	<i>Dromaius novaehollandiae</i>		X				
Family Megapodiidae							
Orange-footed Scrubfowl	<i>Megapodius reinwardt</i>		X				X
Family Phasianidae							
Brown Quail	<i>Coturnix ypsilophora</i>		X			X	X
King Quail	<i>Coturnix chinensis</i>		X				
Family Anseranatidae							
Magpie Goose	<i>Anseranas semipalmata</i>	X	X				X
Family Anatidae							
Plumed Whistling-Duck	<i>Dendrocygna eytoni</i>		X	X			X
Wandering Whistling-Duck	<i>Dendrocygna arcuata</i>		X				X
Radjah Shelduck	<i>Tadorna radjah</i>		X	X			X
Green Pygmy-goose	<i>Nettapus pulchellus</i>		X				X
Pacific Black Duck	<i>Anas superciliosa</i>		X				X
Hardhead	<i>Aythya australis</i>		X				
Grey Teal	<i>Anas gracilis</i>						X
Pink-eared duck	<i>Malacorhynchus membranaceus</i>						X
Family Podicipedidae							
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>		X				X
Family Anhingidae							
Darter	<i>Anhinga melanogaster</i>		X	X			X
Family Phalacrocoracidae							
Little Pied Cormorant	<i>Phalacrocorax melanoleucas</i>		X	X			X
Pied Cormorant	<i>Phalacrocorax varius</i>		X				X
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>		X				X
Great Cormorant	<i>Phalacrocorax carbo</i>						X
Family Pelecanidae							
Australian Pelican	<i>Pelicanus conspicillatus</i>		X				X
Family Ardeidae							
White-faced Heron	<i>Egretta novaehollandiae</i>		X	X			X
Little Egret	<i>Egretta garzetta</i>		X				X
White-necked Heron	<i>Ardea pacifica</i>		X	X			X
Great-billed Heron	<i>Ardea sumatrana</i>		X				
Pied Heron	<i>Ardea picata</i>		X				X
Great Egret	<i>Ardea alba</i>		X				X
Intermediate Egret	<i>Ardea intermedia</i>		X				X
Cattle Egret	<i>Ardea ibis</i>		X				X
Nankeen Night Heron	<i>Nycticorax caledonicus</i>		X	X			X
Black Bittern	<i>Ixobrychus flavicollis</i>		X				X
Family Threskiornithidae							
Glossy Ibis	<i>Plegadis falcinellus</i>		X				X
Australian White Ibis	<i>Threskiornis molucca</i>		X	X			X
Straw-necked Ibis	<i>Threskiornis spinicollis</i>		X	X			X
Royal Spoonbill	<i>Platalea regia</i>		X				X
Yellow-billed Spoonbill	<i>Platalea flavipes</i>		X				

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
Family Ciconiidae							
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>		X				X
Family Accipitridae							
Pacific Baza	<i>Aviceda subcristata</i>		X				X
Black-shouldered Kite	<i>Elanus axillaris</i>						X
Square-tailed Kite	<i>Lophoictinia isura</i>		X				
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>		X	X			X
Black Kite	<i>Milvus migrans</i>		X	X			X
Whistling Kite	<i>Haliastur sphenurus</i>	X	X	X		X	X
Brahminy Kite	<i>Haliastur indus</i>		X				
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>		X				X
Spotted Harrier	<i>Circus assimilis</i>		X				X
Marsh Harrier	<i>Circus approximans</i>		X				
Brown Goshawk	<i>Accipiter fasciatus</i>		X	X			X
Grey Goshawk	<i>Accipiter novaehollandiae</i>		X				X
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>		X				X
Red Goshawk	<i>Erythrorhynchus radiatus</i>		X		X		
Wedge-tailed Eagle	<i>Aquila audax</i>		X	X			X
Little Eagle	<i>Hieraaetus morphoides</i>		X				X
Osprey	<i>Pandion haliaetus</i>						X
Family Falconidae							
Brown Falcon	<i>Falco berigora</i>		X	X			X
Australian Hobby	<i>Falco longipennis</i>		X				X
Black Falcon	<i>Falco subniger</i>		X				X
Peregrine Falcon	<i>Falco peregrinus</i>		X				
Nankeen Kestrel	<i>Falco cenchroides</i>		X				X
Family Gruidae							
Brolga	<i>Grus rubicunda</i>		X				X
Family Rallidae							
Buff-banded Rail	<i>Gallirallus philippensis</i>		X				
Bush Hen	<i>Amauornis olivaceus</i>		X				
Spotless Crake	<i>Porzana tabuensis</i>		X				
White-browed Crake	<i>Porzana cinerea</i>		X				
Purple Swampphen	<i>Porphyrio porphyrio</i>		X				X
Eurasian Coot	<i>Fulica atra</i>		X				
Family Otidae							
Australian Bustard	<i>Ardeotis australis</i>		X				X
Family Turnicidae							
Red-backed Button-quail	<i>Turnix maculosa</i>		X	X			
Red-chested Button-quail	<i>Turnix pyrrhothorax</i>		X				
Family Scolopacidae							
Little Curlew	<i>Numenius minutus</i>		X				X
Whimbrel	<i>Numenius phaeopus</i>		X				
Marsh Sandpiper	<i>Tringa stagnatilis</i>		X				
Common Greenshank	<i>Tringa nebularia</i>		X				
Common Sandpiper	<i>Actitis hypoleucos</i>						X
Family Jacanidae							
Comb-crested Jacana	<i>Irediparra galliacea</i>		X				X
Family Burhinidae							
Bush Stone-curlew	<i>Burhinus grallarius</i>		X				X
Family Recurvirostridae							
Black-winged Stilt	<i>Himantopus himantopus</i>		X				X
Family Charadriidae							
Red-capped Plover	<i>Charadrius ruficapillus</i>		X				
Black-fronted Dotterel	<i>Elsayornis melanops</i>		X				X
Red-kneed Dotterel	<i>Erythronyx cinctus</i>		X				X
Masked Lapwing	<i>Vanellus miles</i>	X	X	X			X
Family Glareolidae							
Oriental Pratincole	<i>Glareola maldivarum</i>		X				X
Australian Pratincole	<i>Stiltia isabella</i>		X				X

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
Family Laridae							
Whiskered Tern	<i>Chlidonias hybridus</i>		X				
Family Columbidae							
Emerald Dove	<i>Calcophaps indica</i>		X				X
Common Bronzewing	<i>Phaps chalcoptera</i>	X	X				X
Crested Pigeon	<i>Ochyphaps lophotes</i>		X				X
Partridge Pigeon	<i>Geophaps smithii</i>	X	X		X	X	X
Diamond Dove	<i>Geopelia cuneata</i>		X				X
Peaceful Dove	<i>Geopelia striata</i>	X	X	X		X	X
Bar-shouldered Dove	<i>Geopelia humeralis</i>	X	X	X		X	X
Rose-crowned Fruit-dove	<i>Ptilinopus regina</i>		X				X
Pied Imperial-Pigeon	<i>Ducula bicolor</i>		X				X
Family Cacatuidae							
Red-tailed Black-Cockatoo	<i>Calyptorhynchus banksii</i>	X	X	X			X
Galah	<i>Cacatua roseicapilla</i>		X	X		X	X
Little Corella	<i>Cacatua sanguinea</i>		X	X			X
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	X	X	X		X	X
Cockatiel	<i>Nymphicus hollandicus</i>		X				X
Family Psittacidae							
Red-collared Lorikeet	<i>Trichoglossus rubritorquatus</i>	X	X			X	X
Varied Lorikeet	<i>Psitteuteles versicolor</i>		X				X
Red-winged Parrot	<i>Aprosmictus erythropterus</i>	X	X	X		X	X
Northern Rosella	<i>Platycerus venustus</i>		X	X		X	X
Hooded Parrot	<i>Psephotus dissimilis</i>		X				X
Budgerigar	<i>Melopsittacus undulatus</i>		X				
Family Cuculidae							
Pallid Cuckoo	<i>Cuculus pallidus</i>		X				X
Brush Cuckoo	<i>Cacomantis variolosus</i>	X	X	X		X	X
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>		X				X
Little Bronze-Cuckoo	<i>Chrysococcyx minutillus</i>		X			X	X
Common Koel	<i>Eudynamys scolopacea</i>		X				X
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>		X				
Black-eared Cuckoo	<i>Chalcites osculans</i>						X
Family Centropodidae							
Pheasant Coucal	<i>Centropus phasianinus</i>		X	X		X	X
Family Strigidae							
Rufous Owl	<i>Ninox rufa</i>		X				X
Barking Owl	<i>Ninox connivens</i>		X	X			
Southern Boobook	<i>Ninox novaeseelandiae</i>		X	X			X
Family Tytonidae							
Masked Owl	<i>Tyto novaehollandiae kimberli</i>		X				
Barn Owl	<i>Tyto alba</i>		X				X
Grass Owl	<i>Tyto capensis</i>		X				
Family Podargidae							
Tawny Frogmouth	<i>Podargus strigoides</i>		X	X			X
Family Caprimulgidae							
Spotted Nightjar	<i>Eurostopodus argus</i>		X				X
Large-tailed Nightjar	<i>Caprimulgus macrurus</i>		X				X
Family Aegothelidae							
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>		X				X
Family Apodidae							
Fork-tailed Swift	<i>Apus pacificus</i>		X				X
Family Alcedinidae							
Azure Kingfisher	<i>Alcedo azurea</i>		X	X			X
Little Kingfisher	<i>Alcedo pusilla</i>		X				
Blue-winged Kookaburra	<i>Dacelo leachii</i>	X	X	X		X	X
Forest Kingfisher	<i>Todiramphus macleayi</i>		X			X	X
Red-backed Kingfisher	<i>Todiramphus pyrrhopygia</i>		X				X
Sacred Kingfisher	<i>Todiramphus sanctus</i>	X	X	X			X

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
Family Meropidae							
Rainbow Bee-eater	<i>Merops ornatus</i>	X	X	X		X	X
Family Coraciidae							
Dollarbird	<i>Eurystomus orientalis</i>	X	X			X	X
Family Pittidae							
Rainbow Pitta	<i>Pitta iris</i>		X				X
Family Climacteridae							
Black-tailed Treecreeper	<i>Climacteris melanura</i>		X	X			X
Family Maluridae							
Variegated Fairy-wren	<i>Malurus lamberti</i>		X				X
Red-backed Fairy-wren	<i>Malurus melanocephalus</i>		X	X		X	X
Family Pardalotidae							
Red-browed Pardalote	<i>Pardolotus rubricatus</i>		X				X
Striated Pardalote	<i>Pardolotus striatus</i>	X	X	X		X	X
Weebill	<i>Smicromis brevirostris</i>		X	X		X	X
Large-billed Gerygone	<i>Gerygone magnirostris</i>		X				X
Green-backed Gerygone	<i>Gerygone chloronotus</i>		X				X
White-throated Gerygone	<i>Gerygone olivacea</i>		X				X
Family Meliphagidae							
Helmeted Friarbird	<i>Philemon buceroides</i>		X				
Silver-crowned Friarbird	<i>Philemon argenticeps</i>	X	X	X		X	X
Little Friarbird	<i>Philemon citreogularis</i>	X	X	X		X	X
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>		X	X		X	X
Yellow-throated Miner	<i>Manorina flavigula</i>		X	X		X	X
Singing Honeyeater	<i>Lichenostomus virescens</i>		X				X
White-gaped Honeyeater	<i>Lichenostomus unicolor</i>		X	X		X	X
Grey-headed Honeyeater	<i>Lichenostomus keartlandi</i>		X				
Yellow-tinted Honeyeater	<i>Lichenostomus flavescens</i>						X
Black-chinned Honeyeater	<i>Melithreptus gularis</i>		X				X
White-throated Honeyeater	<i>Melithreptus albogularis</i>	X	X	X		X	X
Brown Honeyeater	<i>Lichmera indistincta</i>	X	X	X		X	X
Rufous-banded Honeyeater	<i>Conopophila albogularis</i>			X			X
Dusky Honeyeater	<i>Myzomela obscura</i>			X		X	X
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>						X
Banded Honeyeater	<i>Certhionyx pectoralis</i>						X
Family Petroicidae							
Lemon-bellied Flycatcher	<i>Microeca flavigaster</i>	X		X		X	X
Jacky Winter	<i>Microeca fascinans</i>						X
Hooded Robin	<i>Melanodryas cucullata</i>						X
White-browed Robin	<i>Poecilodryas superciliosa</i>						X
Family Pomatostomidae							
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>					X	X
Family Neosittidae							
Varied Sittela	<i>Daphoenositta chrysoptera</i>		X				X
Family Pachycephalidae							
Mangrove Golden Whistler	<i>Pachycephala melanura</i>		X				
Grey Whistler	<i>Pachycephala simplex</i>		X				X
Rufous Whistler	<i>Pachycephala rufiventris</i>	X	X	X		X	X
Little Shrike-thrush	<i>Colluricincla megarrhyncha</i>		X				X
Sandstone Shrike-thrush	<i>Colluricincla woodwardi</i>		X				X
Grey Shrike-thrush	<i>Colluricincla harmonica</i>		X				X
Family Dicruridae							
Broad-billed Flycatcher	<i>Myiagra ruficollis</i>		X				X
Leadon Flycatcher	<i>Myiagra rubecula</i>		X	X		X	X
Shining Flycatcher	<i>Myiagra alecto</i>		X	X			X
Restless Flycatcher	<i>Myiagra inquieta</i>	X	X	X			X
Australian Magpie-lark	<i>Grallina cyanoleuca</i>		X	X		X	X
Rufous Fantail	<i>Rhipidura rufifrons</i>		X				X
Grey Fantail	<i>Rhipidura fuliginosa</i>		X	X			X
Northern Fantail	<i>Rhipidura rufiventris</i>	X	X	X		X	X

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
Willie Wagtail	<i>Rhipidura leucophrys</i>	X	X	X			X
Spangled Drongo	<i>Dicrurus bracteatus</i>		X	X			X
Family Campephagidae							
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		X	X		X	X
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	X	X			X	
Cicadabird	<i>Coracina tenuirostris melvillensis</i>		X	X			X
White-winged Triller	<i>Lalage sueurii</i>	X	X	X			X
Varied Triller	<i>Lalage leucomela</i>		X	X			X
Family Oriolidae							
Yellow Oriole	<i>Oriolus flavocinctus</i>		X	X		X	X
Olive-backed Oriole	<i>Oriolus sagittatus</i>	X	X	X		X	X
Figbird	<i>Sphecotheres viridus</i>	X	X	X			X
Family Artamidae							
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>		X				X
Masked Woodswallow	<i>Artamus personatus</i>		X				X
Black-faced Woodswallow	<i>Artamus cinereus</i>		X	X			X
Little Woodswallow	<i>Artamus minor</i>		X	X			X
Silver-backed Butcherbird	<i>Cracticus argenteus</i>		X	X			
Pied Butcherbird	<i>Cracticus nigrogularis</i>	X	X	X		X	X
Grey Butcherbird	<i>Cracticus torquatus</i>					X	X
Family Corvidae							
Torresian Crow	<i>Corvus orru</i>	X	X	X		X	X
Family Ptilonorhynchidae							
Great Bowerbird	<i>Chlamydera nuchalis</i>	X	X	X		X	X
Family Alaudidae							
Singing Bushlark	<i>Mirafra javanica</i>		X				X
Richard's Pipit	<i>Anthus novaeseelandiae</i>						X
Family Passeridae							
Double-barred Finch	<i>Taeniopygia bichenovii</i>	X	X	X		X	X
Long-tailed Finch	<i>Poephila acuticauda</i>		X				X
Masked Finch	<i>Poephila personata</i>		X				X
Crimson Finch	<i>Neochmia phaeton</i>		X	X			X
Yellow-rumped Mannikin	<i>Lonchura flaviprymna</i>						X
Chestnut-breasted Mannikin	<i>Lonchura castaneothorax</i>		X				X
Pictorella Mannikin	<i>Heteromunia pectoralis</i>		X				
Gouldian Finch	<i>Erythrura gouldiae</i>		X		X		X
Family Dicaeidae							
Mistletoebird	<i>Dicaeum hirundinaceum</i>	X	X	X		X	X
Family Hirundinidae							
Tree Martin	<i>Hirundo nigricans</i>		X				X
Fairy Martin	<i>Hirundo ariel</i>		X				X
Family Sylviidae							
Tawny Grassbird	<i>Megalurus timoriensis</i>	X	X				X
Zitting Cisticola	<i>Cisticola juncidis</i>		X				X
Golden-headed Cisticola	<i>Cisticola exilis</i>		X	X			X
Rufous Songlark	<i>Cincloramphus cruralis</i>						X
MAMMALS							
Family Tachyglossidae							
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>		X	X	X		
Family Dasyuridae							
Northern Quoll	<i>Dasyurus hallucatus</i>		X	X	X	X	
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>		X				
Fawn Antechinus	<i>Antechinus bellus</i>		X				
Sandstone Antechinus	<i>Pseudantechinus bilarni</i>		X				
Common Planigale	<i>Planigale maculata</i>		X				
Red-cheeked Dunnart	<i>Sminthopsis virginiae</i>		X	X		X	
Family Peramelidae							
Northern Brown Bandicoot	<i>Isodon macrourus</i>		X	X	X	X	
Family Phalangeridae							
Northern Brushtail Possum	<i>Trichosurus vulpecula arnhemensis</i>		X		X		

Common Name	Scientific Name	Source					
		1	2	3	4	5	6
Family Petauridae							
Sugar Glider	<i>Petaurus breviceps</i>		X		X		
Family Macropodidae							
Short-eared Rock-wallaby	<i>Petrogale brachyotis</i>		X				
Agile Wallaby	<i>Macropus agilis</i>		X	X	X	X	
Euro	<i>Macropus robustus</i>		X		X		
Antilopine Wallaroo	<i>Macropus antilopinus</i>		X	X	X		
Family Pteropodidae							
Little Red Flying-fox	<i>Pteropus scapulatus</i>		X		X		
Black Flying-fox	<i>Pteropus alecto</i>		X	X	X		
Northern Blossom-bat	<i>Macroglossus minimus</i>						
Family Megadermatidae							
Ghost Bat	<i>Macroderma gigas</i>	X	X				
Family Rhinolophidae							
Dusky Leaf-nosed Bat	<i>Hipposideros ater</i>		X				
Unadorned Leaf-nosed Bat	<i>Hipposideros diadema inornatus</i>						
Orange Horseshoe-bat	<i>Rhinonictis aurantius</i>		X		X		
Family Emballonuridae							
Common Sheath-tail-bat	<i>Taphozous georgianus</i>		X				
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>			X			
Family Molossidae							
Northern Freetail-bat	<i>Chaerephon jobensis</i>			X			
Beccari's Freetail-bat	<i>Mormopterus beccarii</i>			X			
Family Vespertilionidae							
Northern Long-eared Bat	<i>Nyctophilus bifax</i>		X				
Arnhem Long-eared Bat	<i>Nyctophilus arnhemensis</i>		X				
Pygmy Long-eared Bat	<i>Nyctophilus walkeri</i>		X	X			
Northern Bentwing-bat	<i>Miniopterus schreibersii orianae</i>		X				
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		X	X			
Hoary Wattled Bat	<i>Chalinolobus nigrogriseus</i>		X	X			
Northern Myotis	<i>Myotis moluccarum</i>		X				
Little Broad-nosed Bat	<i>Scotorepens greyii</i>		X	X			
Cape York Pipistrelle	<i>Pipistrellus adamsi</i>		X				
Northern Cave Bat	<i>Vespadelus caurinus</i>		X				
Family Muridae							
Dusky Rat	<i>Rattus colletti</i>		X	X			
Pale Field-rat	<i>Rattus tunneyi</i>		X	X		X	
Water Rat	<i>Hydromys chrysogaster</i>		X	X			
Black-footed Tree Rat	<i>Mesembriomys gouldi</i>		X		X	X	
Common Rock Rat	<i>Zyzomys argurus</i>		X	X		X	
Lakeland Downs Mouse	<i>Leggadina lakedownensis</i>		X				
Arnhem Pebble-mound Mouse	<i>Pseudomys calabyi</i>		X			X	
Delicate Mouse	<i>Pseudomys delicatulus</i>		X		X	X	
Western Chestnut Mouse	<i>Pseudomys nanus</i>		X			X	
Grassland Melomys	<i>Melomys burtoni</i>		X	X	X	X	
Family Canidae							
Dingo	<i>Canis lupus dingo</i>		X	X	X		

APPENDIX B

Browns Oxide Project Fauna Survey *Site Habitat Data*

Appendix B

Browns Oxide Project Fauna Survey Site Data

Dry season sites refer to Figure 2; Wet season sites refer to Figure 3

Site	Locality/UTM	Major Land System	Habitat Type (Metcalfe 2002)	Habitat Characteristics	Surface Geology Soils/Substrate	Disturbance
Terrestrial Site 1 Wet/Dry Season	52 716567 E 85 63179 N	Drainage Floor/Undulating Lowlands	Monsoon Forest Communities <i>Acacia auriculiformis</i> regrowth	Regenerating monsoon vine-forest, disturbed areas and small patches of good vine-forest habitat adjacent to other forest types. 14% woody debris, 5% grass/ 40% bare ground, 40% leaf litter, 1% rocks 300m to Finniss River East Branch	Rocks <2% and rock size <0.6cm. Moderate brown gravelly loam.	Some evidence of old mining activity and disturbance. Snake weed and exotic grasses in disturbed areas surrounding remnant monsoon forest and on tracks. Feral Pig (<i>Sus scrofa</i>) damage. Fire in late 2002
Terrestrial Site 2 Wet/Dry Season	52 715898 E 85 62723 N	Undulating Lowlands	Upland Eucalypt Communities <i>E. miniata</i> , <i>chlorostachys</i> , <i>E. tetradonta</i> open forest.	Termite mounds. Many large to small tree hollows/fissures, tree bark. 40% Bare Ground, 30% grass, 20% logs, 10% leaf litter. High % spear grass noted in wet season. No nearby open water.	Rocks <2% and rock size <0.6cm. Moderate red-brown silty sand	Roads and patches of gamba grass and weeds near road edge. Regrowth of <i>E. miniata</i> in some areas. Last burnt 1 to 3 years ago.
Terrestrial Site 3 Dry Season	52 715056 E 85 62956 N	Undulating Lowlands	Upland Eucalypt Communities <i>E. miniata</i> and <i>E. tetradonta</i> woodland	Termite mounds, tree hollows and tree bark. 40% Bare Ground, 40% Grass, 5% grass, 5% logs/woody debris. No nearby open water.	Rocks 2 - 10% and rock size <0.6cm. Pale grey red gravelly sand in pisolitic laterite	Roads and old railway tracks.
Terrestrial Site 4 Dry Season	52 714664 E 85 60354 N	Drainage Floor/Stream Channel & Levee	Drainage Areas Riparian closed forest/ <i>Lophostemon</i> and <i>Melaleuca</i> woodland	Narrow closed forest on Rum Jungle Creek with adjacent grassland/ <i>Melaleuca</i> woodland. Flowing water present in creek.	'Acid' alluvial soils and heavy grey pedocals (Low 2001)	Excessive Feral Pig (<i>Sus scrofa</i>) damage.
Terrestrial Site 5 Dry Season	52 713 003 E 85 60675 N	Undulating Lowlands/Drainage Floor	Drainage Areas <i>E. foelscheana</i> / <i>E. papuana</i> open woodland	Termite mounds, some tree hollows and occasional dead stags. No nearby open water.	Pale yellowish - brown silt	Gamba Grass. Some evidence of Feral Pig (<i>Sus scrofa</i>) damage. Last burnt 1-3 years.

Appendix B

Site	Locality/UTM	Major Land System	Habitat Type (Metcalf 2002)	Habitat Characteristics	Surface Geology Soils/Substrate	Disturbance
Terrestrial Site 6 Dry Season	52 713374 E 85 61320 N	Drainage Floor/ Stream Channel & Levee	Drainage Areas Riparian closed forest/Adjacent <i>Lophostemon</i> and <i>Melaleuca</i> woodland	Narrow closed forest on Rum Jungle Creek with adjacent grassland/ <i>Melaleuca</i> woodland. Flowing water present in creek.	'Acid' alluvial soils and heavy grey pedocals (Low 2001)	Feral Pig (<i>Sus scrofa</i>) damage. Some Gamba Grass infestation.
Terrestrial Site 7 Dry Season	52 712742 E 85 61149 N	Drainage Floor	Drainage Areas <i>Melaleuca</i> woodland/open forest/Open grassland	~400m to Rum Jungle Creek and ~800m to the Finniss River South branch. Large areas of open grassland habitat.	'Acid' alluvial soils and heavy grey pedocals (Low 2001)	Last burnt 1-3 years. Feral Pig (<i>Sus scrofa</i>) damage.
Terrestrial Site 8 Wet/Dry Season	52 716971 E 85 62160 N	Undulating Hills/Rock Outcrops/Ephem eral Drainage Line	Upland Communities <i>Eucalyptus phoenicea</i> / <i>C. bleeseri</i> open woodland/ <i>Melaleuca</i> on drainage line	35% Grass, 30% Bare Ground, 20% rocks, 10% leaf litter, 5% logs. Grassy understorey. High % spear grass noted in wet season.	Rock outcrops along central ridge. Shallow lithosols.	Road tracks for access. Last burnt <1 year. Regrowth of canopy species post fire.
Terrestrial Site 9 Wet Season	52 716869 E 85 62794 N	Drainage Floor	Drainage Areas <i>Melaleuca</i> woodland/Open forest/Open grassland	Bare ground 5%, grass 89%, leaf litter 5%, logs and woody debris 1% Weed infestations in ground cover. Large areas inundated during wet season. Distance to permanent water: test pit, low lying swampy pools (wet season)	'Acid' alluvial soils and heavy grey pedocals (Low 2001)	Fire last burnt 2004 Feral Pig (<i>Sus scrofa</i>) damage Mining disturbance 90% weed species in ground cover
Aquatic Aq1 Dry Season/ Wet Season	52 717010 E 85 63089 N	Drainage Floor/ Stream Channel & Levee	Isolated pools on East Branch of the Finniss River, steep bank incline Max depth 1.8m Mean depth 0.5m	Bankside vegetation disturbed regrowth (<i>Acacia</i> , <i>Melaleuca</i> , <i>Lophostemon</i> , grasses). Some algal growth in pools. Isolated long pools, lentic.	Instream Substrate: Sand 30%/Gravel 30%/Rocks 30%/Litter - Woody Debris 5%/Mud - Silt 5%	Heavy historic mining disturbance upstream, evidence of acid mine drainage
Aquatic Aq2 Dry Season	52 715186 E 85 64349 N	Drainage Floor/ Stream Channel & Levee	Isolated pools on East Branch of the Finniss River, steep undercut bank Max depth 1.5m Mean depth 0.3m	Bankside vegetation generally open forest types, recently burnt. Some large rock outcrops in and adjacent to channel. No aquatic vegetation. Isolated long pools, lentic.	Instream Substrate: Sand 30%/Gravel 30%/Small Rocks 50%/Litter - Woody Debris 5%/Large Rocks 5%	Riparian vegetation narrow and recently burnt, evidence of acid mine drainage. Gamba grass infestation on southern bank.

Appendix B

Site	Locality/UTM	Major Land System	Habitat Type (Metcalf 2002)	Habitat Characteristics	Surface Geology Soils/Substrate	Disturbance
Aquatic Aq3 Dry Season	52 715186 E 85 64349 N	Drainage Floor/ Stream Channel & Levee	Rum Jungle Creek, shallow bank Max depth 0.8m Mean depth 0.15m	Bankside vegetation narrow band of riparian monsoon vine-forest, Lophostemon and Melaleuca forest with grassy understorey. Some attached aquatic plants. Long glydes and riffles, fast flowing (spring-fed)	Instream Substrate: Sand - Silt 30%/Mud 40%/Litter - Woody Debris 30%	Excessive Feral Pig (<i>Sus scrofa</i>) damage
Aquatic Aq4 Dry Season	52 713374 E 85 61320 N	Drainage Floor/ Stream Channel & Levee	Rum Jungle Creek, shallow bank Max depth 0.6m Mean depth 0.2m	Bankside vegetation narrow band of riparian monsoon vine-forest, Lophostemon and Melaleuca forest with grassy understorey. Some attached aquatic plants. Long glydes and riffles, fast flowing (spring-fed)	Instream Substrate: Sand - Silt 30%/Mud 40%/Litter - Woody Debris 30%	Feral Pig (<i>Sus scrofa</i>) damage
Aquatic Aq5 Dry Season	52 711667 E 85 59617 N	Drainage Floor/ Stream Channel & Levee	Main channel of the Finmiss River, steep bank incline Max depth ~3m Mean depth 0.8m	Bankside vegetation narrow band of riparian forest. Deep, long pool, glydes and riffles, flowing	Instream Substrate: Sand - Silt 50%/Cobble 20%/Litter - Woody Debris 30%	Roads and tracks
Aquatic Aq6 Dry Season	52 711966 E 85 61113 N	Drainage Floor/ Stream Channel & Levee	Main channel of the Finmiss River, steep bank incline Max depth ~3m Mean depth 0.8m	Bankside vegetation narrow band of riparian forest, dense bamboo clusters Deep, long pool and adjacent isolated floodplain billabong	Instream Substrate: Sand - Silt 50%/Mud 30%/Litter - Woody Debris 20%	Recent fires
Aquatic Aq7 Dry Season	52 712605 E 85 62267 N	Drainage Floor/ Stream Channel & Levee	Main channel of the Finmiss River, steep bank incline Max depth ~2m Mean depth 0.4m	Bankside vegetation narrow band of riparian forest, dense bamboo clusters Continuous channel	Instream Substrate: Sand - Silt 50%/Mud 30%/Litter - Woody Debris 20%	-
Aquatic Aq8 Dry Season	52 712876 E 85 63473 N	Drainage Floor/ Stream Channel & Levee	Main channel of the Finmiss River, steep bank incline Max depth ~1.5m Mean depth 0.3m	Bankside vegetation narrow band of riparian forest, monsoon vine-forest Long pool, glydes and riffles, flowing	Instream Substrate: Sand - Silt 30%/Mud 20%/Litter - Woody Debris 20%; Cobble 30%	-

Appendix B

Site	Locality/UTM	Major Land System	Habitat Type (Metcalf 2002)	Habitat Characteristics	Surface Geology Soils/Substrate	Disturbance
Aquatic Aq9 Dry Season	52 717017 E 85 62196 N	Drainage Floor/ Stream Channel & Levee	Un-named creek, shallow bank Max depth 0.6m (wet season) Mean depth 0.2m (wet season)	Bankside vegetation narrow band of melaleuca and pandanus with grassy understorey. Some attached aquatic plants. Long glydes and riffles, fast flowing (ephemeral, not flowing in dry season)	Instream Substrate: Sand - Silt 30%/Rocks 40%/Litter - Woody Debris 30%	Feral Pig (<i>Sus scrofa</i>) damage
Additional Avifauna Site Av1 Dry Season	52 712500 E 85 64350 N	Drainage Floor/ Stream Channel & Levee	Riparian monsoon vine-forest, main channel of the Finniss River (Av1 = S1x in Tidemann 2002)	Bankside vegetation narrow band of riparian forest, monsoon vine-forest	Unknown	-
Additional Avifauna Site Av2 Dry Season	52 713300 E 85 64470 N	Undulating Lowlands/ Drainage Floor	<i>Acacia auriculiformis</i> communities/Monsoon vine-forest/ Paperbark communities (Av2 = S6x in Tidemann 2002)	Monsoon vine-forest and regrowth intergrading with drainage area vegetation types (Metcalf 2002)	Unknown	-
Additional Herptile Site H1 Dry Season	52 715256 E 85 63020 N	Undulating lowlands/Low rises	Monsoon vine-forest on rock outcrops and scree, White Road	Monsoon vine-forest	Rock outcrops and scree	Road construction
Additional Herptile Site H2 Dry Season	52 715729 E 85 61002 N	Undulating lowlands	<i>Eucalyptus tetradonta</i> / <i>E. miniata</i> Open Woodland	Upland eucalypt forest	Pale grey red gravelly sand in pisolithic laterite	Tracks, recent fire
Additional Herptile Site H3 Dry Season	52 718396 E 85 63887 N	Low rises	Rock outcrops and scree with <i>Eucalyptus tetradonta</i> / <i>E. miniata</i> Open Woodland	Rock outcrop	Rock outcrops and scree	Mine infrastructure, tracks, recent fire
Additional Herptile Site H4 Dry Season	52 718497 E 85 63728 N	Low rises	Rock outcrops and scree with <i>Eucalyptus tetradonta</i> / <i>E. miniata</i> Open Woodland	Rock outcrop	Rock outcrops and scree	Mine infrastructure, tracks, recent fire

Appendix B

Site	Locality/UTM	Major Land System	Habitat Type (Metcalf 2002)	Habitat Characteristics	Surface Geology Soils/Substrate	Disturbance
Additional Herptile Site H5 Dry Season	52 718497 E 85 63728 N	Low rises	Rock outcrops and scree with <i>Eucalyptus phoenicea</i> /C. bleeseri Open Woodland	Rock outcrop	Rock outcrops and scree	Tracks, recent fire
Additional Herptile Site H6 Dry Season	52 714257 E 85 64128 N	Undulating lowlands	<i>Eucalyptus tetradonta</i> / <i>E. miniata</i> / <i>Erythrophleum chlorostachys</i> Tall Open Forest to Woodland	Upland eucalypt forest	Moderate red-brown silty sand	Tracks, recent fire
Additional Herptile Site H7 Dry Season	52 715101 E 85 62902 N	Undulating lowlands	<i>Eucalyptus tetradonta</i> / <i>E. miniata</i> Open Woodland	Upland eucalypt forest	Pale grey red gravelly sand in pisolitic laterite	Tracks, recent fire
Additional Herptile Site H8 Dry Season	52 715054 E 85 63229 N	Undulating lowlands	<i>Eucalyptus tetradonta</i> / <i>E. miniata</i> / <i>Erythrophleum chlorostachys</i> Tall Open Forest to Woodland	Upland eucalypt forest	Pale grey red gravelly sand in pisolitic laterite	Tracks
Additional Herptile Site H9 Dry Season	52 715102 E 85 64379 N	Undulating lowlands	Complex of granite outcrops with exfoliating slabs, surrounded by <i>Eucalyptus tetradonta</i> / <i>E. miniata</i> Open Woodland	Rock outcrop	Granite rock outcrops	Recent fire
Additional Herptile Site H10 Dry Season	52 713105 E 85 60512 N	Undulating lowlands	Mixed Eucalypt Woodland	Upland eucalypt forest	Pale yellowish - brown silt	-
Additional Herptile Site H11 Dry Season	52 717640 E 85 63321 N	Undulating lowlands	<i>Acacia auriculiformis</i> communities/Monsoon vine-forest	Monsoon vine-forest	Moderate brown gravelly loam	Mine infrastructure, past clearing, tracks
Additional Herptile Site H12 Dry Season	52 713310 E 85 64485 N	Undulating lowlands	<i>Acacia auriculiformis</i> communities/Monsoon vine-forest	Monsoon vine-forest	Moderate brown gravelly loam	-

APPENDIX C

Browns Oxide Project Area

Fauna Species List

Appendix C

Browns Oxide Project Fauna Species List

Terrestrial Fauna Survey Sites Browns Oxide Project Area (S1, S2, S8, S9) Sampled Dry 2002 & Wet 2005

S1 = *Acacia auriculiformis* open forest/MVF; S2 = *E. miniata*, *E. chlorostachys*, *E. tetradonta* open forest; S8 = *E. phoenicea* open woodland on rock outcrops/Riparian vegetation

S9 = Melaleuca woodland with grassy lower stratum, disturbed mining areas

WSA = wet season records in the wider study area/records in the Browns Oxide Project Area which are not related to specific survey sites.

Dry Season 2002 Additional Terrestrial Fauna Survey Sites (S1, S2, S3, S4, S5, S6, S7, S8) Sampled Dry 2002

S3 = *E. miniata*/E. tetradonta woodland; S4 = *Lophostemon* and *Melaleuca* woodland; S5 = *Eucalyptus papuana*/Eucalyptus foelschiana open woodland; S6 = Riparian corridor closed forest;

S7 = Melaleuca woodland with grassy lower stratum

AAS = Additional Avifauna Sites Wider Study Area (Av1 - Av2) Dry 2002

Av1 (=S1X in Tidemann 2002) = extra avifauna site in Monsoon Vine Forest, Finnis River

Av2 (=S6X in Tidemann 2002) = extra site riparian corridor closed forest

PIT

Av3 = Whites/Intermediate Mine Pit (Incidental Waterbird & Other Fauna Species Records)

2002 Dry Additional Herpetofauna Survey Sites (H1 - H12, Aq6 - Aq8)

RO (Rock outcrops) = H3, H4, H5 & H9: Rock outcrops with dry open woodland and forest vegetation;

RIP (Riparian closed forest) = Aq6, Aq7 & Aq8: Riparian closed forest on the main Finnis River channel

UEF (Upland Eucalypt Forest) = H2, H6, H7, H8 & H10: Open forest in undulating lowlands (upland eucalypt communities);

MVF (Monsoon Vine Forest) = H1, H11, H12: Monsoon vine forest and *Acacia auriculiformis* regrowth.

2002 Dry Aquatic Survey Sites (Aq1 - Aq8)

Aq1 - Aq2 = Finniss River East Branch (Main Channel); Aq3 - Aq4 = Rum Jungle Creek; Aq5 - Aq8 = Finniss River Main Channel.

Method/Record Type

O = Observed; X = Observed at site; SL = Spot light record; pF = Pitfall trap capture; E = Elliot trap capture; HF = Hair funnel (probable species ID); W = Wire trap capture; pF = Pitfall trap capture; E = Elliot trap capture; HF = Hair funnel (probable species ID);

SK = Skeletal remains; S = Scat; TR = Tracks; V = Vocalisation; CB = vocal response or approach during call playback; HC = Hand capture; RK = Road kill

A = AnaBat ultrasonic bat call Detection; HT = Harp trap capture; HC = Hand Capture.

Superscripts

* = Calls from Top End populations of *Chalinolobus nigrogriseus* and *Scotorepens greyi* and *Pipistrellus westralis*/*Miniopterus schreibersii* cannot be confidently separated

Status

En = Endangered; Vu = Vulnerable (EPBC Act 1999), IMSA = Iaxa listed in International Migratory Species Agreements (JAMBA, CAMBA, Bonn Convention)

V = Vulnerable, NI = Lower risk - near threatened; DD = Data Deficient (*territory Parks & Wildlife Conservation Act 2000*)

EX = Exotic (introduced) taxa; Feral = Feral animals or N

Common Name	Scientific Name	Cons Status		Method	Fauna Survey Sites WET 05								Fauna Survey Sites DRY 02								AAS			Additional Reptile Sites			Dry Season Aquatic Survey Sites							
		EPBC	TPWC		WS1	WS2	WS8	WS9	WSA	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	AV1	AV2	AV3	Pit	RO	RIP	UEF	MVF	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	
AMPHIBIANS																																		
Bilingual Froglet	<i>Crinia bilingua</i>			PF,V,O		X	X	X						PF (1)																				
Marbled Frog	<i>Limnodynastes convexiusculus</i>			V,O	X	X	X	X																	X			PF (1)						
Ornate Burrowing Frog	<i>Limnodynastes ornatus</i>		DD	V,O	PF	P/E	X	X																										
Brown Shovelfoot	<i>Notaden melanoscaphus</i>			V				X																										
Floodplain Gungan	<i>Uperoleia inurdata</i>			V,O				X																								X		
Stonemason Gungan	<i>Uperoleia lithomoda</i>			V,O		PF																												
Northern Snapping Frog	<i>Cyclorana australis</i>		DD	V,O	X	X	X																											
Northern Sedgefrog	<i>Litoria bicolor</i>			V,O	X	X	X												X															
Common Treefrog	<i>Litoria caerulea</i>			V,O		X																												
Northern Waterfrog	<i>Litoria dahlii</i>			SL		X		X																										
Bumpy Rocketfrog	<i>Litoria inermis</i>			V,O	X	X	X	X																										
Javelin Frog	<i>Litoria microbelos</i>			O,V				X																	X									
Ruddy Treefrog	<i>Litoria rubella</i>			O	X																													
Tornier's Frog	<i>Litoria tornieri</i>			PF,V,O		PF		X						PF (1)																				
Northern Laughing Treefrog	<i>Litoria rothii</i>			V,O		X	X	X	X		X		X						X						X									
Striped Rocketfrog	<i>Litoria nasuta</i>			V,O			X	X		X									X							X								
Giant Rocketfrog	<i>Litoria woljulumensis</i>			O																														
Cane Toad	<i>Bufo marinus</i>	Ext/c		V,O			X	X																		X								
n = 18					4	2	12	7	12	0	0	0	2	0	3	0	0	0	3	0	0	0	0	0	4	1	3	0	0	1	0			

Common Name	Scientific Name	Cons Status	EPBC	TPWC	Method	Fauna Survey Sites WET 05										Fauna Survey Sites DRY 02								Pit	Additional Reptile Sites					Dry Season Aquatic Survey Sites																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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