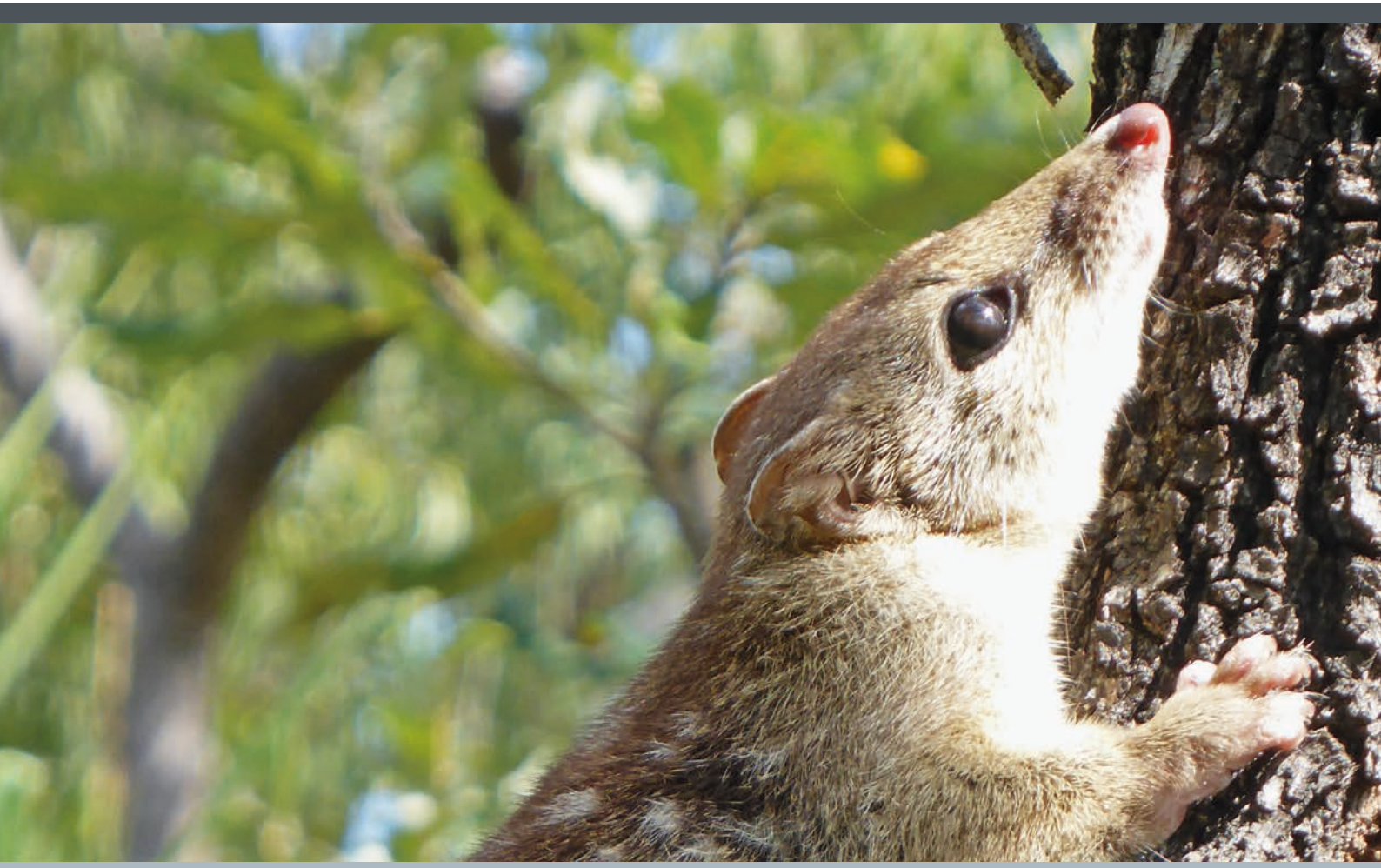
7 Terrestrial Ecology



CONTENTS

Tables

Figures

Plates

7 TERRESTRIAL ECOLOGY

7.1 INTRODUCTION

This section provides a summary of the key findings of the *Terrestrial Ecology Report* (Appendix C) prepared by Cumberland Ecology. This section also discusses issues related to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to the extent they are relevant to terrestrial ecology. An assessment of aquatic ecology is provided in Section 8 – Aquatic Ecology.

The Environmental Risk Assessment presented in Section 4 identifies all potential project risks in relation to terrestrial ecology and determines the consequence and likelihood of each risk, and the overall risk rating. Risk ratings are provided for the risk both with and without the application of mitigation measures. The risk assessment has concluded that, with the application of the proposed mitigation measures, the majority of risks associated with terrestrial ecology are low risk, and that there are no extreme risks. This section provides further detail on the impacts on terrestrial ecology that have been identified for the project, as well as the mitigation measures that will be applied.

7.2 OVERVIEW OF PROJECT SITE

The project site is characterised by areas of flat to undulating sand plains surrounded by low hills of outcropping quartzitic rock. The land within and surrounding the project site comprises natural bushland, and no farming or agricultural activities are undertaken in the vicinity of the project site. The primary activities currently undertaken within the project site, other than activities undertaken by the Traditional Owners, are related to exploration drilling, requiring minor clearance of vegetation for access tracks and drill pads.

The vegetation and habitats within the project site are almost pristine and are strongly influenced by topography and drainage. Eucalypt open forests and woodlands dominate the well-drained areas of the project site, with swampy and riparian areas dominated by Melaleucas. Fire also plays a significant role in determining vegetation composition and the majority of the site is regularly burnt by the Traditional Owners. The project site provides a range of forest, woodland and wetland habitat for fauna species and is contiguous with adjacent native vegetation.

The project site is located in the upper catchments of the Emerald, Amagula and Angurugu Rivers. The Emerald River and its tributaries drain the majority of the Northern Eastern Lease (Northern EL) and the western area of the Southern Eastern Lease (Southern EL). The Amagula River drains the eastern area of the Southern EL via two main tributaries. The north-eastern area of the Northern EL is within the catchment of the Angurugu River.

Groote Eylandt is considered to have a high conservation value due, in part, to the absence of many pest and feral animals that threaten native wildlife and habitats on the Australian mainland. Of particular significance, the Cane Toad (*Rhinella marina*), which poses a threat to many native animals on the mainland, is not present on the island.

7.3 OVERVIEW OF REGULATORY REQUIREMENTS

7.3.1 Key Regulatory Requirements of the Federal Government

EPBC Act

The EPBC Act prescribes the Federal Government's role in environmental assessment, biodiversity conservation and the management of protected Matters of National Environmental Significance (MNES). The Department of the Environment (DotE) is the administering authority for the EPBC Act.

The EPBC Act provides a mechanism for national environmental protection and biodiversity conservation. Biodiversity conservation is promoted by providing protection for MNES, including:

- Listed threatened species and communities, and migratory species;
- Protected areas (e.g. World Heritage properties, wetlands of international importance [Ramsar wetlands], conservation zones); and
- Indigenous heritage of the Federal Government.

Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES (including nationally threatened ecological communities and species, and listed migratory species) is termed a controlled action and is subject to assessment and approval under the EPBC Act.

Eastern Leases Project EPBC Act Status

The project was deemed a controlled action on 23 June 2014 with the controlling provisions for the project being listed threatened species and communities (Section 18 and 18A) and listed migratory species (Sections 20 and 20A). The project will be assessed through an accredited assessment process under the NT *Environmental Assessment Act* (EA Act), and DotE will use this EIS for its assessment under the EPBC Act.

EPBC Act Environmental Offsets Policy

Under the *EPBC Act Environmental Offsets Policy 2012* (EPBC Act Environmental Offsets Policy), environmental offsets are actions taken to counterbalance significant residual impacts on MNES. Offsets are used as a last resort in instances where an action will give rise to residual impacts, even after the application of management measures.

The EPBC Act Environmental Offsets Policy provides guidance on the role of offsets in environmental impact assessments and how DotE considers the suitability of a proposed offset package (SEWPaC, 2012). According to the policy, an offsets package is a "*suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project*" (SEWPaC, 2012). It can comprise a combination of:

- Direct offsets (e.g. restoring degraded land to provide habitat for an impacted species); and/or
- Other compensatory measures, which are also referred to as indirect offsets (e.g. contributing to research that benefits an impacted species).

Further information regarding the EPBC Act Environmental Offsets Policy is provided in the *Biodiversity Offsets Strategy* (Appendix E).

EPBC Act Guidance Materials

A variety of documents have been produced in accordance with the requirements of the EPBC Act to provide guidance on listed threatened species, key threatening processes that may impact those species, and survey techniques for the species. In addition, recovery plans and conservation advice are available for many species. These documents were consulted in planning field surveys, and assessing potential impacts on EPBC listed species (refer to the *Terrestrial Ecology Report,* Appendix C).

7.3.2 Key Northern Territory Legislation and Guidelines

Territory Parks and Wildlife Conservation Act

The *Territory Parks and Wildlife Conservation Act* (TPWC Act) is the principle legislation that provides for the protection and conservation of the NT's biodiversity. The TPWC Act classifies threatened flora and fauna into a number of conservation categories, including Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened and Least Concern. These categories are based on the recognition of how threatened a species is, and what action needs to be taken to protect it. The TPWC Act also provides for the classification and control of feral animals; permits for taking wildlife and entering land; designation and management of protected areas; and private sanctuaries.

The TPWC Act is administered by the Parks and Wildlife Commission NT.

No permits are required under this Act for clearing associated with the project, given that the project will be authorised under the NT *Mining Management Act*.

Weeds Management Act

The *Weeds Management Act* (WM Act), which is administered by the Department of Land Resource Management (DLRM) makes provision for the control and eradication of declared weeds in the NT. Weeds that have been identified to have an impact on the Territory's economic, environmental, cultural and social values are declared under the WM Act.

Northern Territory Guidance Documents

The NT Government has several guidance documents that were utilised for the ecology assessment, and these are discussed below.

Land Clearing Guidelines

The NT *Land Clearing Guidelines* (NRETAS, 2010), which are administered by DLRM, guide good land development practices in the NT through the establishment of standards for native vegetation clearing. The guidelines are formally recognised under the NT *Planning Act* and are referenced in the NT Planning Scheme.

Mining developments are regulated by the *Mining Management Act* rather than the *Planning Act*. Mining applications are, therefore, not required to formally consider the Land Clearing Guidelines. Nevertheless, there are sections of the guidelines that provide useful information regarding the assessment of sensitive or significant vegetation types. These sections of the guidelines were considered in the assessment of the environmental impacts of the project on sensitive vegetation communities.

Guidelines for Assessment of Impacts on Terrestrial Biodiversity

The *Guidelines for Assessment of Impacts on Terrestrial Biodiversity* (NT EPA, 2013) specify which information and assessments are required for vegetation communities, and flora and fauna species, and provide the terrestrial vertebrate survey methods used by DLRM. This guideline was used to inform the impact assessment and assessments of significance undertaken for the ecology study.

Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping

The *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst et al, 2007) describes the methods for collecting, describing, classifying and mapping vegetation in the NT, to ensure compliance with national standards of the National Vegetation Information System (NVIS) Framework. This guideline was used for field survey design for the terrestrial flora assessment.

Environmental Assessment Guidelines for the Northern Territory: Terrestrial Fauna Survey

The *Environmental Assessment Guidelines for the Northern Territory: Terrestrial Fauna Survey* (NRETAS, 2011) (NT Fauna Survey Guidelines) provides a framework and standards for terrestrial fauna surveys, interpretation and reporting for environmental impact assessments in the NT. This guideline was used for field survey design for the terrestrial fauna assessment.

Guidelines on Environmental Offsets and Associated Approval Conditions

The *Guidelines on Environmental Offsets and Associated Approval Conditions* (NT EPA, 2013) are designed to foster the coordination of offsets and the conditional approval requirements that may be imposed under Commonwealth and NT legislation. It should be noted that there is no formal offsetting policy under the EA Act and any offsets required for project-related impacts will be provided under the EPBC Act Environmental Offsets Policy (discussed further in the *Biodiversity Offsets Strategy* [Appendix E]).

7.4 METHODOLOGY

7.4.1 Desktop Assessment

A desktop assessment of the terrestrial ecology of Groote Eylandt and the project site was undertaken prior to the field surveys. This desktop assessment aimed to obtain background information on the historical and potential presence and distribution of species and ecological communities (particularly those listed under the EPBC Act and/or TPWC Act), and determine potential habitat values. The desktop study involved:

- Database searches including the EPBC Act Protected Matters Search Tool (PMST) and the NT NRM InfoNet database (InfoNet);
- Reviews of previous flora and fauna studies undertaken on Groote Eylandt, including key studies undertaken by Webb (1992), URS (2012), and Brocklehurst and Cowie (1992);
- Review and interpretation of recent high resolution aerial photography and topographic information;
- Review of published vegetation and geological mapping; and
- Review of the baseline soils assessment for the project (refer to the *Soils Report* [Appendix B]).

7.4.2 Field Surveys

Multi-season terrestrial flora and fauna surveys were conducted in accordance with the NT EPA flora and fauna survey requirements, and guidance published under the EPBC Act. The surveys were informed by the results of the desktop assessment, described in Section 7.4.1. Several members of the Anindilyakwa Land Council (ALC) Land & Sea Rangers participated in the October 2014 field surveys.

Survey Timing

The first survey was conducted between 20 May and 3 June 2014, immediately following the wet season, when natural resources for flora and fauna were expected to be at their peak due to the abundance of water. May was the earliest opportunity in that year to access the project site, given that it was inaccessible during the preceding months because of heavy rainfall.

The second survey was undertaken between 1 and 14 October 2014, when conditions were much drier in comparison to the first survey period. Surface water flows and water availability across the project site was far more limited during the October survey period, providing opportunities to observe and identify additional areas that were used as refugia.

Additional survey data was gathered from a network of infrared cameras (IR Cameras) located throughout the project site that were left recording (and baited weekly) for 15 weeks between the first and second survey periods.

Terrestrial Flora Survey

Flora surveys were conducted in accordance with the *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst et al., 2007). A total of 33 full characterisation sites were assessed (also referred to as “primary plots”) across the project site in the first survey period. A further 23 check sites (also referred to in this report as “secondary plots”) were surveyed in the second survey period. A cumulative total of 544 meander transect points and track notes were collected across both survey periods. All vascular flora species found were collected and identified to species level if possible. The presence and extent of any weeds or feral animals (as listed under the TPWC Act or WM Act) was recorded.

The locations of the flora survey sites are shown in Figure 7-1, and the survey effort is summarised in Table 7-1.

Vegetation Mapping

A preliminary vegetation map was developed prior to the commencement of field work, based on high resolution aerial photography and the existing mapping and vegetation community descriptions for the western portion of

Groote Eylandt (as detailed in URS 2012 and Webb 1992). The preliminary vegetation map was reviewed after the completion of field surveys, and adjusted based on meander and track notes, and plot data.

Vegetation Classification and Community Descriptions

Vegetation communities within the project site were classified in accordance with the vegetation communities, or "Map Units" (MUs), as described in Webb (1992). The classification into MU is based on the floristic and structural characteristics of the dominant vegetation type within each community. MUs that were not previously described by Webb (1992) were classified in accordance with the NVIS framework.

Significant or Sensitive Communities

There are five vegetation communities in the NT recognised as sensitive. They include monsoon rainforest and vine thickets, old growth forest, riparian vegetation, mangrove forest, and sand-sheet heath. The occurrences of any significant vegetation types were mapped in detail using high resolution aerial photography and ground-truthed using meander transect point and track notes as described above. The resultant information was used to inform impact assessment.

Terrestrial Fauna Survey

Fauna surveys were conducted in accordance with EPBC Act guidance, and the NT Fauna Survey Guidelines. Surveys included terrestrial trapping (Elliott and cage trapping), pitfall and funnel trapping, bird censuses, active searches, ultrasonic bat call detection, harp trapping, spotlighting, call playback and IR camera detection and incidental observations. The IR cameras were used specifically to target small, trap-shy, ground-dwelling fauna such as the Northern Hopping-mouse (*Notomys aquilo*) and Brush-tailed Rabbit-rat (*Conilurus penicillatus*).

A total of 18 fauna survey sites were established within the project site, with nine sites surveyed in each survey period. Fauna habitat assessments were undertaken at each survey site. Figure 7-2 shows the location of the fauna survey sites, and the survey effort is summarised in Table 7-1.

Terrestrial Ecology Survey Effort

A summary of the survey effort for the terrestrial flora and fauna surveys is provided in Table 7-1.

Table 7-1 Terrestrial Ecology Surveys – Survey Effort

SURVEY TECHNIQUE	SURVEY EFFORT
Flora Surveys	
Primary Plots	33 (20 m x 20 m) plots
Secondary Plots	23 plots
Meander Transect Points and Track Notes	544 data points, track notes recorded throughout survey period
Threatened Flora Searches	Undertaken throughout survey period
Fauna Surveys	
Elliot Trapping	1,080 trap nights
Cage Trapping	216 trap nights
Pitfall Trapping	216 trap nights
Funnel Trapping	216 trap nights
Bird Census (diurnal)	144 surveys
Bird Census (nocturnal)	36 surveys
Active Searches (diurnal)	54 surveys

SURVEY TECHNIQUE	SURVEY EFFORT
Active Searches (nocturnal)	36 surveys
Ultrasonic Call Detection	33 trap nights
Harp Trapping	8 trap nights
IR Camera Detection (Short-term Cameras)	94 trap nights
IR Camera Detection (Long-term Cameras)	719 trap nights
Incidental Observations	Undertaken throughout survey period
Habitat Assessment	18 sites

7.4.3 Additional Surveys

Additional surveys were undertaken, separate to the EIS surveys, to further inform the ecology impact assessment for the project. These included:

- A study on the potential impacts of dust on native vegetation at the existing mine; and
- A study of fauna species utilising areas of mature mine rehabilitation.

The full reports of these studies are provided in the *Terrestrial Ecology Report* (Appendix C), and the findings of these studies are applied to the impact assessment discussed in Section 7.6.

7.4.4 Likelihood of Occurrence Assessment

The likelihood of any threatened species identified in database searches being present on the project site was assessed based on the known habitat preferences of these species, the availability and condition of habitats within the project site, and results of the field surveys. The results of the assessment were used to inform the impact assessment and management measures that will be required for the project.

7.5 RESULTS

7.5.1 Vegetation Structure and Connectivity

There are seven broad habitat types across Groote Eylandt, comprising open forest (51%), sandstone woodland (24%), coastal complex/dunes (18%), closed forest (3%), riparian zones (2%), lakes (1%), and active mining and recent rehabilitation (1%). These broad habitats are shown on Figure 7-3. Within the project site, open forest, sandstone woodland and riparian habitat types are present.

The vegetation across the project site comprises remnant vegetation, and there has been no significant clearing of the site. Overall the vegetation is in very good condition and it is characterised by a high species and structural diversity, although the structure of the understorey and the condition of the ground layer has been modified by a regime of frequent fires. The project site is regularly burnt by the Traditional Owners, which has resulted in a reduction in the amount of woody debris, and is also likely to have affected the species composition and structure of the vegetation. Some species are highly sensitive to changes in fire regime, and it is likely that this may have influenced the suite of species that currently utilise the project site.

Very few weeds were recorded within the project site.

Habitat connectivity in the landscape is excellent and unbroken throughout the project site. The project site provides linkages with remnant vegetation on all sides that can be utilised by fauna species to connect to adjacent

areas of habitat. The project site provides a range of habitats for fauna species, including watercourses and wetlands, rocky outcrops and extensive areas of woodland.

7.5.2 Vegetation Communities

Mapping Units

Field surveys identified 13 MUs within the project site (Figure 7-4).

The most extensive vegetation community within the project site is MU4, which comprises open forests dominated by Darwin Stringybark (*Eucalyptus tetrodonta*) and Darwin Woollybutt (*Eucalyptus miniata*) that occur on gently undulating sandy soils. The next most dominant vegetation community is MU18, comprising Northern Cypress Pine (*Callitris intratropica*), Darwin Stringybark and Scarp Gum (*Eucalyptus kombolgiensis*). The remainder of the project site comprises a mix of low woodlands, swamp and sedgeland vegetation. A full list of the vegetation communities within the project site is contained in the *Terrestrial Ecology Report* (Appendix C).

Habitat Types

Field surveys identified several habitat types occurring within the project site, which provide a range of habitats for fauna species. Key habitats identified within the project site are summarised in Table 7-2, and are shown in Figure 7-5. Plates 6-1 to 6-6 provide representative photographs of each habitat type.

Table 7-2 Key Habitats within the Project Site

HABITAT TYPE	MAPPING UNIT	% OF PROJECT SITE
Open forest	MU4, MU5	69
Woodland / shrubland	MU16, MU17, MU31	13
Sandstone woodland and rock outcrops	MU18	12
Riparian / seasonal wetland / aquatic	MU11, MU20 / MU10a, MU10b, MU15a, MU24	6
Closed forest (rainforest)	MU3	<1

Open forest habitat, dominated by eucalypt species, was the dominant habitat on the project site. The extensive areas of open forest habitat provide numerous important habitat features that would be suitable for a suite of fauna species, including a number of the threatened fauna known or predicted to occur within the project site.

Features within the open forest habitats include a diversity of grasses for seed-eating species, a shrubby understorey for birds and taller eucalypt trees. Hollow-bearing trees of varying sizes are present in these areas, although are not abundant, likely due to the frequency of fire. The tree hollows and standing dead trees (stags) within the project site provide shelter, roosting and nesting habitat for a number of arboreal fauna species, including microbats and gliders, diurnal birds, owls and some reptiles. Terrestrial features such as fallen logs, debris and leaf litter provide shelter for many of the small to medium sized terrestrial fauna species on the project site. However, there is also a lack of coarse woody debris on the ground due to the frequency of fire.

The remaining terrestrial habitat types are described in detail in the *Terrestrial Ecology Report* (Appendix C). The aquatic habitats are described in the *Aquatic Ecology Report* (Appendix D).

Threatened Ecological Communities

EPBC Act Listed Communities

The EPBC Act PMST did not record any Threatened Ecological Communities (TECs) as occurring or potentially occurring within a 20 km radius of the project site, and none were found during the ecology field survey.

TPWC Act Listed Communities

The TPWC Act contains no listings for threatened ecological communities, as such no records are held within the InfoNet database.

Significant Ecological Communities

Of the five broad types of sensitive vegetation communities that may occur in the NT (refer to Section 7.4.2), three are considered to occur on the project site. These are Old-Growth Forests (represented by MU4 and MU5, equivalent to approximately 69% of the project site); Dry Monsoon Rainforests (represented by MU3, equivalent to less than 1% of the project site); and Riparian Vegetation (represented by MU11 and MU20, equivalent to less than 6% of the project site).

Seasonal Wetlands

A number of seasonal wetland vegetation types are present within the project site and generally occur in low-lying areas. They may be expressed as dry swamp woodlands during the dry season. They are represented by MU10a, MU10b, MU15a, and MU24.

Groundwater Dependent Ecosystems

There are areas of shallow groundwater in the south-western portion of the Northern EL and the central and western portion of the Southern EL. The presence of shallow groundwater has had a marked influence on vegetation structure and vegetation composition in these areas. Broad areas of stunted Darwin Stringybark (MU16) occur in areas with shallow groundwater, and there are also sizeable occurrences of other woodlands in which various paperbark species (*Melaleuca spp*.) and sedges are prominent (MU10a and MU31). Figure 7-4 shows the location of these MUs.

Groundwater flows appear to sustain the perennial reaches of some rivers (refer to Section 8 – Aquatic Ecology). Vegetation community MU11, tall swamp forest with rainforest elements, is associated with these areas.

There is a highly localised patch of dry sub-coastal monsoon rainforest (MU3) in the south of the Southern EL. This vegetation is surrounded by drier, regularly burnt woodland. The vegetation appears to be sustained by a highly localised occurrence of shallow groundwater that prevents it from succumbing to fire. This vegetation is likely to be located above a localised lens of perched groundwater.

7.5.3 Flora Species

A total of 249 flora species were recorded within the project site over the two seasons of survey. The dominant family groups exemplify the overall composition and condition of vegetation within the project site. These include Poaceae (grasses), Fabaceae – Faboideae (peas), Myrtaceae (Eucalyptus, Angophora and Melaleuca) and Cyperaceae (sedges). *Acacia* and *Eriachne* were the most dominant genera.

Threatened Species

EPBC Act Listed Flora Species

The EPBC Act PMST report generated for the project site indicates that no flora species listed under the EPBC Act or threatened flora species habitat are known, or considered likely to occur within a 20 km radius of the project site, and none were recorded during field surveys.

TPWC Act Listed Flora Species

The InfoNet database holds records for one threatened flora species on Groote Eylandt, namely the Lantern Tree (*Hernandia nymphaeifolia*), which is listed as Vulnerable under the TPWC Act. This species was recorded in 1988 on the eastern coast of Groote Eylandt. This species is not considered likely to occur within the project site as it is only known to occur in littoral rainforest and coastal swamps, and neither vegetation type is found within the project site. No TPWC Act listed flora species were recorded during the field surveys.

Declared Weeds

No declared weeds were recorded within the project site during the field surveys.

7.5.4 Fauna Species

A total of 116 fauna species were recorded within the project site over the two seasons of survey, comprising 54 birds, 6 amphibians, 31 reptiles and 25 mammals.

Threatened Species

EPBC Act Listed Terrestrial Fauna Species

Field surveys identified the following EPBC Act listed fauna species on the project site:

- Masked Owl (northern) (*Tyto novaehollandiae kimberli*) (EPBC Act status: Vulnerable; TPWC Act status: Vulnerable);
- Brush-tailed Rabbit-rat (*Conilurus penicillatus)* (EPBC Act status: Vulnerable; TPWC Act status: Endangered);
- Northern Quoll (*Dasyurus hallucatus*) (EPBC Act status: Endangered; TPWC Act status: Critically Endangered); and
- Northern Hopping-mouse (*Notomys aquilo*) (EPBC Act status: Vulnerable; TPWC Act status: Vulnerable).

The location that these species were found within the project site is shown in Figure 7-5, and their general habitat preferences are discussed in Section 7.5.5.

The results of the PMST database search indicated that a further three fauna species listed under the EPBC Act could potentially occur within the project site. A likelihood of occurrence assessment was undertaken as described in Section 7.4.4. These three species were assessed as having a low likelihood of occurring on the project site and are therefore not considered further in the assessment. Further detail on these species and the likelihood of occurrence assessment is provided in the *Terrestrial Ecology Report* (Appendix C).

EPBC Act Migratory Fauna Species

Field surveys identified the following EPBC Act migratory fauna species on the project site:

- Rainbow Bee-eater (*Merops ornatus*); and
- Salt-water Crocodile (*Crocodylus porosus*).

The location that these species were found within the project site is shown in Figure 7-5.

The results of the PMST database search indicated that a further nine migratory species listed under the EPBC Act could potentially occur within the project site. A likelihood of occurrence assessment was undertaken as described in Section 7.4.4. The following three migratory species were assessed as having a moderate likelihood of occurring on the project site:

- Fork-tailed Swift (*Apus pacificus*);
- White-bellied Sea-eagle (*Haliaeetus leucogaster*); and
- Rufous Fantail (*Rhipidura rufifrons*).

The vegetation communities within the project site are not considered to provide important habitat for any of the migratory species (as defined by *EPBC Act Policy Statement 1.1 Significant Impact Guidelines (2013)*. There is no evidence to suggest the project site supports an ecologically significant proportion of the population of any of these migratory species. Additional information regarding these species is provided in the *Terrestrial Ecology Report* (Appendix C).

The remaining six species from the PMST database search were assessed as having a low likelihood of occurring on the project site and are therefore not considered further in the assessment. Further detail on these species and the likelihood of occurrence assessment is provided in the *Terrestrial Ecology Report* (Appendix C).

TPWC Act Listed Fauna Species

The threatened species listed under the EPBC Act (described above) are also protected under the TPWC Act. The following additional TPWC Act listed fauna species were recorded from the project site during field surveys:

- Yellow-spotted Monitor (*Varanus panoptes*) (TPWC Act Status: Vulnerable); and
- Mertens' Water Monitor (*Varanus mertens*) (TPWC Act Status: Vulnerable).

The location that these species were found within the project site is shown in Figure 7-5, and their general habitat preferences are discussed in Section 7.5.5.

The results of the InfoNet database search indicated that a further eight fauna species listed under the TPWC Act could potentially occur within the project site. A likelihood of occurrence assessment was undertaken as described in Section 7.4.4, and these eight species were assessed as having a low likelihood of occurring on the project site and are therefore not considered further in the assessment. Further detail on these species and the likelihood of occurrence assessment is provided in the *Terrestrial Ecology Report* (Appendix C).

Exotic / Feral Species

Only a few exotic species were recorded during surveys of the project site, and sightings were infrequent. This included Domestic Dogs/Dingoes (*Canis familiaris/lupus*) and Feral Cats (*Felis catus*).

Feral cattle, horses, donkeys, pigs, goats, Water Buffalo, the Cane Toad, Rusa Deer and European Red Fox are notably absent from the project site and Groote Eylandt.

7.5.5 Habitat Preferences of Threatened Fauna Species

The habitat preferences for the threatened fauna species found on the project site during the EIS survey are summarised in Table 7-3.

Table 7-3 Habitat Preferences of Threatened Species Found on the Project Site

SPECIES	EPBC ACT STATUS	TPWC ACT STATUS	PRESENCE ON THE PROJECT SITE	HABITAT PREFERENCES
Masked Owl (northern)	Vulnerable	Vulnerable	The Masked Owl (northern) was recorded from four locations within the project site in open forest habitat (MU4), using call playback and spotlighting.	Habitat types in which the species is considered likely to occur within the project site are open forest (MU4, MU5), sandstone woodland and rock outcrops (MU18), and riparian habitats (specifically MU11, MU20).
Brush-tailed Rabbit-rat	Vulnerable	Endangered	The Brush-tailed Rabbit-rat was recorded from one location within the project site in open forest habitat (MU4), using an IR camera.	All fauna habitat types within the project site have the potential to provide habitat for this species.

SPECIES	EPBC ACT STATUS	TPWC ACT STATUS	PRESENCE ON THE PROJECT SITE	HABITAT PREFERENCES
Northern Quoll	Endangered	Critically Endangered	The Northern Quoll was recorded a total of 65 times from 22 locations within the project site. It was recorded using Elliott trapping, cage trapping, IR cameras and incidental spotlighting. This species was recorded in a suite of vegetation communities, including open forest habitats (MU4, MU5), seasonal wetlands (MU10a), riparian habitats (MU11, MU20), woodland / shrubland habitat (MU16, MU17), and sandstone woodland and rock outcrops (MU18). The Northern Quoll was also recorded within mine rehabilitation areas at the existing mine.	All fauna habitat types within the project site have the potential to provide habitat for this species.
Northern Hopping-mouse	Vulnerable	Vulnerable	The Northern Hopping-mouse was recorded from one location within the project site in open forest habitat (MU4), during incidental spotlighting searches.	Habitat types in which the species is considered likely to occur within the project site are restricted to open forest (MU4, MU5) and sandstone woodland and rock outcrops (MU18). A sandy substrate is also essential for this species for the creation of burrows, and therefore only areas within these MUs with suitable substrate would provide ideal habitat for this species.
Yellow-spotted Monitor	-	Vulnerable	The Yellow-spotted Monitor was recorded from three locations within the project site in open forest habitat (MU4) and riparian habitat (MU20), using cage traps and IR cameras. The Yellow-spotted Monitor was also recorded within mine rehabilitation areas at the existing mine.	All fauna habitat types within the project site have the potential to provide habitat for this species.
Mertens' Water Monitor	-	Vulnerable	Mertens' Water Monitor was recorded from a total of nine locations within the project site adjacent to watercourses in open forest habitat (MU4), and riparian habitat (MU11, MU20). The Mertens' Water Monitor was also recorded within mine rehabilitation areas at the existing mine.	Habitat types in which this species would occur within the project site include riparian (specifically MU11, MU20) and aquatic habitats.

7.6 IMPACT ASSESSMENT

7.6.1 Overview

Project activities have the potential to give rise to direct and indirect impacts on flora and fauna. These include:

- Direct impacts such as clearing of vegetation and habitat for open cut mining purposes, and the construction of infrastructure such as haul roads; and
- Indirect impacts such as habitat fragmentation, edge effects, the effects of noise and vibration, vehicle strikes, lighting, dust, erosion and the introduction of invasive species.

These impacts are described in the remainder of this section and mitigation measures for these impacts are discussed in Section 7.7.

7.6.2 Direct Impacts

Vegetation Clearing

The largest direct impact of the project is the removal of native vegetation communities that also provide habitat for a wide range of flora and fauna species. The project site covers an area of approximately 4,600 ha. The total disturbance footprint (i.e. the area of direct impact) is 1,525 ha and includes clearing for the open cut mining area and associated infrastructure. As shown in Table 7-4, the dominant vegetation community impacted by the project through clearing is the open forest habitat (represented by MU4), which occupies 73% of the disturbance footprint. Figure 7-6 shows the disturbance footprint for the project, and the mapping units that will be cleared as a result of the project. The vegetation communities occurring within the disturbance footprint are widespread on Groote Eylandt. Areas disturbed by mining will also be progressively rehabilitated to create open woodland vegetation.

Table 7-4 Key Habitats Cleared within the Project Disturbance Footprint

HABITAT TYPE	MAPPING UNIT	AREA WITHIN DISTURBANCE FOOTPRINT (ha)	% WITHIN THE DISTURBANCE FOOTPRINT
Open forest	MU4	1,119	73.4
Woodland / shrubland	MU16, MU17, MU31	290	19.0
Sandstone woodland and rock outcrops	MU18	6	0.4
Riparian / seasonal wetland / aquatic	MU10a, MU10b, MU15a, MU20, MU24	110	7.2
	Total Area	**1,525 ha**	**100%**

Note that the following mapping units are not located within the project disturbance footprint, and will therefore not be cleared:

- MU5 (which is a component of the Open Forest habitat);
- MU3 (Closed Forest (rainforest) habitat); and
- MU11 (which is a component of Riparian habitat).

Habitat Clearing

The vegetation communities within the project site support a range of habitat types for flora and fauna species, and specific habitat features provide foraging, shelter and breeding opportunities for fauna. They also provide

habitat for fauna listed as threatened or migratory. Within the project disturbance footprint, specific habitat features that will be removed include:

- Understorey vegetation that provides shelter and foraging habitat for amphibians, reptiles, small birds and terrestrial mammals;
- Fallen logs, debris and leaf litter that provides shelter habitat for amphibians, reptiles and terrestrial mammals;
- Rocky outcrops that provides shelter and breeding habitat for amphibians, reptiles and terrestrial mammals;
- Hollow-bearing living trees and standing dead trees (stags) that provides shelter and breeding habitat for a range of reptiles, birds, arboreal mammals and microbats;
- Nectar-producing trees and shrubs that provides foraging habitat for insects, blossom-dependent birds, arboreal mammals and megachiropteran bats;
- Feed trees, shrubs and grasses for a range of species that provides food for small birds, cockatoos and herbivorous mammals; and
- Seasonal wetlands that provide habitat for amphibians and waterbirds.

Despite the removal of these areas of habitat, extensive areas of land containing similar habitat occurs both within the project site and across Groote Eylandt. Table 7-5 summarises the broad habitat types that will be cleared within the project disturbance footprint, in relation to the available habitat across the remainder of the island.

Table 7-5 Available Habitat on Groote Eylandt

BROAD HABITAT TYPE	AREA OF HABITAT WITHIN DISTURBANCE FOOTPRINT (ha)	HABITAT AVAILABLE ON GROOTE EYLANDT (ha)	PROPORTION OF HABITAT ON GROOTE EYLANDT WITHIN THE DISTURBANCE FOOTPRINT
Open Forest^	1,514	118,071	1.28%
Sandstone Woodland	6	55,196	0.01%
Coastal Complex / Dunes	-	41,959	-
Closed Forest	-	6,145	-
Watercourse / Riparian Zone	5	4,180	0.12%
Lakes	-	2,317	-
Active Mining and Recent Rehabilitation	-	3,310	-
Total	**1,525 ha**	**231,178 ha**	**0.66%**

^ Note that the "Open Forest" broad habitat type for Groote Eylandt comprises the project site vegetation communities of Open Forest, Woodland / Shrubland, and Seasonal Wetlands.

As can be seen in Table 7-5, the clearing for the project will result in the removal of approximately 1.3% of the open forest habitat that occurs on Groote Eylandt. It is expected that the types of flora and fauna species utilising the habitat within the disturbance footprint will continue to persist in the other large areas of suitable habitat on the island.

It is also worth noting, that the direct clearing of habitat within the disturbance footprint will occur gradually over the 15-year life of the project. The habitats within the project site are well connected with similar habitats within the locality, and consequently the staging of impacts will allow for the relocation of many fauna species into these adjacent areas.

In addition, the rehabilitation of mined areas is proposed to occur progressively over the life of the project. As noted in Section 6 – Mine Rehabilitation and Closure, the proponent has extensive experience and success with mine rehabilitation, and has an established program of monitoring of the rehabilitation. The objective of the rehabilitation is to recreate and establish self-sustaining open woodland that resembles the pre-mining vegetation communities and is able to support a diverse range of viable flora and fauna populations. The progressive rehabilitation will also allow for the creation of habitat for numerous fauna species and the recolonisation of habitat by fauna.

Separate to the EIS studies, a study of the fauna species present within rehabilitated areas of the existing mine was conducted to inform the ecology assessment (the full study is presented in the *Terrestrial Ecology Report*, Appendix C). To date, the rehabilitation monitoring program for the existing mine, has largely focussed on flora and select fauna groups. In order to understand fauna usage of rehabilitation at the existing mine, a number of areas of mature mine rehabilitation were surveyed as part of the EIS field survey work. The field survey was undertaken in October 2014, and included trapping, bird surveys, active searches, bat surveys and a fauna habitat assessment. Long-term IR cameras were also utilised (operational from 25 May to 4 October 2014), specifically to detect small, trap-shy, ground-dwelling fauna species.

The survey identified 41 fauna species within the surveyed rehabilitation areas, including three threatened species, specifically the Northern Quoll, Mertens' Water Monitor, and Yellow-spotted Monitor.

The project site will be rehabilitated in accordance with the proponent's existing rehabilitation standards. Consequently it is anticipated that, over time, rehabilitated areas of the project site will also provide habitat for a range of flora and fauna species, including threatened fauna species. Progressive rehabilitation will serve to reduce the duration of the impact associated with habitat clearing, ensuring that (for most species) it is not a permanent impact.

7.6.3 Indirect Impacts

The project will have a range of indirect impacts on the ecological values of vegetation and habitat remaining within the project site, including fragmentation and edge effects, increased dust, noise, light and potentially erosion.

The indirect impacts relevant to the project are considered in more detail below.

Habitat Fragmentation

The project is likely to increase habitat fragmentation through the clearing of areas of open forest and woodland, which may impact less mobile species or species with small home ranges, such as small terrestrial mammals. Only one discrete patch of habitat will be temporarily isolated by mining within the Northern EL (Figure 7-6), where an area of vegetation will be surrounded on all sides by quarries and/or haul roads. Relatively narrow corridors of habitat will also be created by the project along some riparian areas, however these corridors will continue to be connected to remaining undisturbed habitat within the project site. The remaining vegetation within the project site will continue to be contiguous with the undisturbed vegetation around the project site, allowing opportunities for movement and dispersal.

Edge Effects

A further consequence of habitat fragmentation is that it produces "edge effects". Edge effects are impacts that occur at the interface between natural habitats (especially forests) and disturbed or developed land. When an edge is created between woodland and a cleared area, changes to light, temperature, humidity and wind at the edge, can impact ecological processes, and therefore potentially cause significant changes to the ecology at this interface (Lindenmayer, 2006). These changes can extend between 10 m and 100 m from the edge, and can include invasion by weeds, increase in feral animals, reduction in tree health, and barriers to dispersal or distribution. There is potential that indirect impacts of the mine may therefore extend beyond the areas that are being cleared and into the areas of adjacent habitat that fringe the mine disturbance footprint. However, the proponent will implement various management plans on the project site, including plans to control the spread of weeds and feral animals (discussed further in Section 7.7.2). The management strategies will aim to reduce the potential edge effects from the project.

Noise and Vibration

Noise and vibration will be generated by the project from various sources such as construction equipment, mining trucks, excavators, bulldozers and blasting, and this may affect native species and the value of the habitats that remain. However, the impacts from noise emissions are likely to be localised, close to the operational quarries and haul roads (up to 100 m) and are not likely to have a significant, long-term impact on wildlife populations. It should also be noted that the project will be mined on a campaign basis, and there may be extended periods where no mining occurs in any one year. This means that the impact from noise occurs periodically, rather than continuously. Noise impacts will also diminish within areas that are progressively rehabilitated and, in the long-term, noise levels will return to pre-mining levels following the cessation of mining and the completion of rehabilitation of the site.

Vehicle Strike

Impacts from vehicle strike are likely to occur due to haul trucks and other mine vehicles operating within the mining area or travelling between the project site and the existing mine. Although some mortality of animals as a result of vehicle strike is likely, it is not expected to be a significant impact. Speed limits along internal roads, appropriate signage and driving policies will increase driver awareness and decrease the risk of vehicles striking fauna. The risk of vehicle strike will diminish following cessation of mining.

Light

Although increased artificial light can impact wildlife, there are very limited sources of light proposed within the project site. Sources of light are restricted to vehicle headlights, lighting of the crib huts (small demountable buildings), as well as lighting of areas being mined at night. At any one time, only a small proportion of the project site would experience any impacts from lighting. The impacts from night light pollution are therefore likely to remain close to the light sources, with only a limited glow into the surrounding natural vegetation. It is likely that most fauna species would habituate to the levels of light sources or temporarily move away from areas of night lighting and return once the night lighting has ceased. Light is therefore unlikely to have a significant or long-term impact on any fauna species. Artificial light will not be required following the cessation of mining, and rehabilitation activities will take place during daylight hours.

Dust

Increased levels of dust could impact vegetation within adjacent woodland communities, potentially reducing the health of some species along the edge of mined areas and roads. It could also potentially impact upon foraging resources for wildlife. A separate dust investigation study was conducted to inform the ecology assessment to establish if there was any evidence that dust might be impacting native vegetation adjacent to the existing mine (the full study is presented in the *Terrestrial Ecology Report*, Appendix C). The survey was undertaken during the dry season, in October 2014, and a total of seven investigation locations were established across various sites anticipated to be affected by dust to varying degrees, and also at a control site, remote from any sources of dust. Refer to the *Terrestrial Ecology Report* (Appendix C) for further detail regarding site locations.

The study found that, although bands of dust are clearly discernible on the canopy of forest vegetation as seen from aerial photographs taken during the dry season, there was no evidence that dust is having a significant detrimental impact upon native vegetation. The vegetation survey found no evidence of crown dieback, or dieback of any of the open forest strata; no floristic difference between vegetation samples taken from areas exposed to dust and vegetation in the control site in a relatively dust-free area; and no evidence of additional weed species in areas where dust is prevalent.

In areas where dust is prevalent due to mining on Groote Eylandt, rain and fires are likely to naturally mitigate dust impacts on vegetation and fauna habitat. Heavy rains during the wet season wash dust from foliage and settle the dust raised from activities along haul roads and quarries. Fire removes old and dusty foliage and triggers renewed foliage growth, providing new surfaces for photosynthesis, and improving food for herbivores.

Despite this, standard dust minimisation strategies such as watering haul roads will be implemented to minimise the creation of dust from the project, particularly during the dry season.

Erosion and Sedimentation

Active mining areas and recently rehabilitated areas may be subject to erosion, potentially leading to runoff with elevated levels of suspended sediment. An Erosion and Sediment Control Plan will be developed prior to the commencement of construction to address erosion and the control of suspended sediment from these areas (discussed further in Section 10 – Surface Water). The Erosion and Sediment Control Plan will include a detailed description of the proposed drainage control measures for managing stormwater runoff and preventing gully and rill erosion, erosion control measures for the protection of exposed soils and surfaces and sediment control measures for containing and settling any entrained sediments in stormwater runoff or site drainage. The Erosion and Sediment Control Plan will include an inspection plan to ensure that sediment control structures are maintained and remain effective, and haul road crossings are stable and operating effectively (i.e. not causing sedimentation of watercourses). It is therefore unlikely that erosion or sedimentation will significantly affect the habitat of the project site or downstream areas, and is therefore unlikely to impact terrestrial species.

Feral Animals and Weeds

Feral animals can cause problems for native fauna species by preying upon them or by competing with them for food and resources. Currently the only feral animals recorded in the project site are the Dog and Feral Cat. The project has the potential to increase the numbers of these animals inhabiting the project site, due to the creation of transport vectors, such as tracks and haul roads.

Weeds have the potential to out-compete native plant species for resources such as nutrients, sunlight and space. Weeds are most likely to occur at disturbed locations where they can readily spread. The invasion of weeds within native vegetation can alter the diversity and functioning of vegetation communities. Although the project site is currently unaffected by weed species, there is a high potential for weeds to become established as project activities take place. Weed species known to occur in the existing mine are likely to have the highest potential to establish in the project site.

The proponent has existing management plans that address pests and weeds on its tenements. This includes the provision for the implementation of appropriate control measures including monitoring and population reduction. Furthermore, the proponent has strict quarantine procedures in place that provide guidance on the inspection of barges and their cargo, such as shipping containers, vehicles and equipment, to prevent unwanted pests and weeds arriving on Groote Eylandt. These procedures will remain in place and will be applicable for the project. The proponent will also implement feral animal control on the project site (i.e. cat trapping). With the implementation of these measures, it is unlikely that feral animals or weeds will have a significant impact on the ecology of the project site.

Cane Toad

The Cane Toad is currently absent from Groote Eylandt. The project is unlikely to exacerbate the risk of the introduction of this species to the island beyond current conditions, given that the project will not significantly increase transport vectors for the Cane Toad from the mainland to the island.

There are measures in place to prevent the introduction of the Cane Toad, including quarantine measures, an education campaign and an acoustic detection program. The ALC manages these programs, with involvement from the proponent, particularly in the inspection of barges. The proponent has a specific Cane Toad Management Plan which operates across all the proponent's tenements. The plan will continue to operate and will be applicable to the project site.

7.6.4 Impacts on Vegetation Communities

Threatened Ecological Communities

None of the vegetation communities occurring within the project site are listed as a TEC under the EPBC Act and no TECs are considered to occur within the surrounding areas. As such, no impacts to EPBC Act listed communities are anticipated.

The TPWC Act contains no listings for threatened ecological communities, and none of the vegetation communities occurring within the project site are listed under the TPWC Act.

Significant Ecological Communities

The Old Growth Forest significant ecological community, represented by MU4, will be impacted by the project. Note that MU5, which is also considered a component of old growth forest community, does not occur within the disturbance footprint, and will therefore not be impacted by the project. As shown in Table 7-4, approximately 1,120 ha of this old growth type will be cleared, which will remove older trees with hollows that provide habitat. Notwithstanding this, the total forest area to be cleared is relatively small when compared to areas that will remain on the island (approximately 118,000 ha), and rehabilitation activities will replant these areas with species common to the MU4 vegetation community. The proponent's existing rehabilitation has successfully regrown species from this vegetation community (such as Darwin Stringybark and Darwin Woollybutt) (refer to Section 6 – Mine Rehabilitation and Closure). For this reason, in the long term, it is predicted that tree hollow resources will be returned to the mined areas.

Although the majority of riparian vegetation will not be disturbed by the project, a small area of Riparian Vegetation (represented by MU20) is located within the disturbance footprint. The majority of this vegetation is associated with haul road crossings of watercourses (refer Section 8 – Aquatic Ecology). Approximately 5 ha of this riparian vegetation will be cleared (Table 7-5). Although this will remove some habitat and refuge for aquatic and woodland species, the area to be cleared is only 0.12% of the riparian vegetation habitat that will remain on the island.

The significant ecological community of Dry Monsoon Rainforests (represented by MU3) occurs outside the project disturbance footprint, and will therefore not be impacted by the project.

Groundwater Dependent Ecosystems

Groundwater drawdown has the potential to indirectly impact upon vegetation by increasing the depth of groundwater to a point where some groundwater dependent vegetation starts to change. However, drawdown due to the project will occur predominantly within the quarries, where vegetation will be cleared ahead of mining (as discussed in Section 9 – Groundwater). Although groundwater drawdown is predicted to occur in some areas beyond the quarries, the post-mining groundwater levels are predicted to rapidly recover following the completion of mining. Drawdown effects are therefore predicted to be temporary and are consequently unlikely to have a significant, residual effect on vegetation.

The majority of watercourses within the project site are dependent on surface water, and are consequently ephemeral. There are, however, a number of areas where watercourses receive groundwater inflows, leading to sections of the watercourses being perennial. There are patches of MU11 (tall swamp forest with rainforest elements) on the project site which grow alongside these perennial sections, and this vegetation community is predicted to be dependent on the groundwater source. A reduction in groundwater inflows could potentially impact this community. However, the 3D numerical groundwater modelling undertaken for the project (refer to the *Groundwater Report*, Appendix F) concluded that changes to groundwater inflows will be negligible in terms of total surface water flows, and any change in flow rate or stream level would be imperceptible at downstream locations. Therefore, no significant impacts to this vegetation community, or its habitat values are predicted as a result of the project.

As mentioned in Section 7.5.2, there is a highly localised patch of dry sub-coastal monsoon rainforest (MU3) which appears to be sustained by a shallow, localised lens of perched groundwater. The results of the *Groundwater Report* (Appendix F) indicate that this localised lens is hydraulically disconnected from the watertable, and therefore there is no mechanism by which drawdown of the watertable would affect the shallow overlying groundwater lens. Consequently, the localised patch of rainforest (MU3) is unlikely to experience any significant detrimental impacts from any groundwater drawdown from the project.

It is also noteworthy that there is no evidence that indirect impacts on vegetation due to groundwater drawdown have occurred around the existing mine on Groote Eylandt, despite 50 years of mining in an area with shallow groundwater. For these reasons, no significant impacts on vegetation are predicted as a result of groundwater drawdown.

7.6.5 Impacts to Threatened Flora Species

No threatened flora species listed under the EPBC Act or TPWC Act were found within the project site and none are predicted to occur. As such, no impacts to threatened flora species are anticipated.

7.6.6 Impacts to Threatened Fauna Species

A number of threatened fauna species listed under the EPBC Act and/or TPWC Act have been recorded within the project site (refer to Table 7-3), and the impacts to these species are discussed in the following sections.

EPBC Act Listed Terrestrial Fauna Species

Assessments of significance were conducted on the four threatened EPBC listed species in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (2013) (refer to the *Terrestrial Ecology Report*, Appendix C).

The assessments of significance identified that the project will not give rise to significant impacts on the Masked Owl (northern) or the Northern Quoll for the following reasons:

- Masked Owl (northern): Although some areas of habitat for the Masked Owl (northern) will be removed by the project, this species is highly mobile and is expected to occupy the large amount of suitable habitat that will remain across Groote Eylandt (refer to Table 7-5). Some indirect impacts from the project may have consequences on the preferred prey of the Masked Owl. However, its prey is known to occur in the rehabilitated areas of the existing mine (refer to the *Terrestrial Ecology Report*, Appendix C). The mined areas on the project site will be progressively rehabilitated with woodland and open forest habitat, which, over time, will provide suitable foraging habitat for this species.
- Northern Quoll: This species was recorded extensively throughout all habitat types on the project site, and it was also recorded within the rehabilitated areas of the existing mine. This species is known to occur in areas adjacent to main roads, and is assumed to have a relatively high tolerance of light and noise. It is therefore unlikely to be indirectly impacted by the project. This species is widely distributed across Groote Eylandt, and although the project will remove approximately 1,525 ha of potential habitat for this species, the amount of remaining habitat on the island is significant (refer to Table 7-5). The mined areas on the project site will be progressively rehabilitated with woodland and open forest habitat, which will provide suitable habitat for this species, and will assist the persistence of this species within the project site.

The assessments of significance identified that the project may potentially give rise to significant impacts on the Brush-tailed Rabbit-rat and the Northern Hopping-mouse, as discussed below:

- Brush-tailed Rabbit-rat: This species is likely to utilise areas within the project site for foraging and breeding. Key habitats that will be removed by the project include open forest habitats (represented by MU4). Additionally, habitat types such as closed forest (rainforest), sandstone woodland and rock outcrops, and riparian habitats would also be removed. Tree hollows, fallen hollow logs and Pandanus, which provide sheltering habitat for this species, will also be cleared within the project site. This species has not been recorded, to date, in mine rehabilitation.
- Northern Hopping-mouse: Key habitats that will be removed by the project include open forests with a grassy understorey which are considered to provide suitable habitat for the Northern Hopping-mouse, in particular areas with a sandy substrate and in proximity to white rock. This species has not been recorded, to date, in mine rehabilitation.

Impact avoidance and mitigation measures for these species are provided in Section 7.7, and offsets are proposed to compensate for impacts to the Brush-tailed Rabbit-rat and the Northern Hopping-mouse. The proposed offsets are discussed further in Section 7.7.3.

The assessments of significance undertaken on the remaining EPBC Act threatened / migratory species found within the project site and those with a moderate likelihood of being present, found no significant impact as a result of the project was likely (refer to the *Terrestrial Ecology Report*, Appendix C).

TPWC Act Listed Terrestrial Fauna Species

The TPWC Act threatened species found within the project site (further to those TPWC listed species that are also listed under the EPBC Act, and are discussed above) were assessed against the direct and indirect impacts of the project. The assessment identified that the project will not give rise to significant impacts on the Yellow-spotted Monitor or Mertens' Water Monitor for the following reasons:

- Yellow-spotted Monitor: This species is wide ranging, and has the potential to occur in all habitat types within the project site. It was also recorded within the rehabilitated areas of the existing mine. This species is known to occur in areas adjacent to main roads, and is assumed to have a relatively high tolerance of light and noise. It is therefore unlikely to be indirectly impacted by the project. Although the project will clear approximately 1,525 ha of potential habitat for this species, the amount of remaining habitat on the island is significant (refer to Table 7-5). The mined areas on the project site will be progressively rehabilitated with woodland and open forest habitat, which will provide suitable habitat for this species, and will assist the persistence of this species within the project site.
- Mertens' Water Monitor: This species was found in vegetated and rocky riparian areas within the project site. The project may also result in indirect impacts to this species through habitat fragmentation and edge effects, however, design principles were adopted during mine planning to restrict mining to areas beyond the watercourses (refer to Section 3 – Project Description). Consequently, large areas of known and suitable habitat for this species will be retained within the project site (refer to Table 7-5).

Impact avoidance and mitigation measures for these species are provided in Section 7.7.

7.7 IMPACT MITIGATION

Impact mitigation is typically centred on a hierarchy of impact reduction principles, namely avoidance, mitigation and compensation. These principles, and how they relate to the project, are discussed in this section.

7.7.1 Measures to Avoid Impacts

Open cut mining projects cannot readily avoid impacts to biodiversity where the target mineral resource is located beneath flora and fauna habitats. However, avoidance of impacts has been achieved for this project, to the extent possible, by modification of the mine plan to avoid natural habitats where feasible.

Manganese ore deposits occur throughout large parts of the project site, including beneath watercourses. Ore beneath the watercourses will not be mined, and the project has been designed to ensure that mining will not encroach on the Emerald River, Amagula River or their tributaries. Buffers have been defined around these watercourses and there will be no mining within the buffers despite the fact that a known mineral resource occurs within the majority of these areas. The watercourses on the project site provide important resources for many species, including terrestrial species. The undisturbed vegetation along watercourses will also provide a connection between areas disturbed by mining activities and undisturbed vegetation, ultimately allowing fauna to colonise rehabilitation. Section 3 – Project Description and Section 8 – Aquatic Ecology provide further detail on the buffers that will be left around watercourses, and Figure 7.3 shows the location of the buffers.

The haul road alignment has similarly been selected and designed based on a rigorous risk-based assessment process. The alignment was selected in order to avoid areas of known environmental sensitivity and to minimise the disturbance footprint of the haul road.

7.7.2 Measures to Mitigate Impacts

The proponent has a range of policies, plans and procedures for the existing mine that are relevant to flora and fauna and the *Terrestrial Ecology Report* (Appendix C) provides a summary of them. These policies, plans and procedures will be reviewed and revised prior to the commencement of the project to ensure that they address all activities proposed to be undertaken on the project site. They will include, as a minimum, the management measures described in the following sections.

Pre-Clearing Work

Clearing will be undertaken in accordance with the proponent's Permit to Clear process. As described below, this process includes specifications designed to limit the impact of the clearing activity itself. In addition to these specifications, the clearing process will be considered as an integral part of long term mine planning to allow clearing to be appropriately planned and staged. Undertaking the clearing progressively in a staged manner will:

- Maximise the potential for mobile species to move to adjacent areas;
- Provide an opportunity for the collection of seeds for use in rehabilitation. Seeds will be collected and stored in accordance with existing procedures; and
- Allow for a pre-clearing survey to be undertaken to identify any noxious weeds in the area so that clearing can be undertaken in a manner that avoids the spread of weeds as far as possible.

Clearing

The following procedures will be implemented as part of the proponent's Permit to Clear process (which includes a procedure and an associated form):

- The limits of clearing will be delineated prior to the commencement of any clearing and marked clearly on plans and on the ground;
- Clearing will be confined to the smallest practicable area required to safely perform the task;
- Clearing work will be planned in a manner that causes minimum disturbance to natural drainage patterns;
- Vegetation removal will be carried out using appropriate earthmoving equipment; and
- Disturbance of the topsoil will be kept to a minimum.

Rehabilitation

A high standard of mine rehabilitation is a key mitigation measure for the project. As noted in Section 6 – Mine Rehabilitation and Closure, the proponent has extensive experience and success with mine rehabilitation, and has an established program of monitoring of the rehabilitation. Rehabilitation is designed to restore mined land to a self-sustaining open woodland, similar to the pre-mining environment and the surrounding undisturbed land.

All areas disturbed by open cut mining activities will be progressively rehabilitated. A project-specific plan will be prepared to guide the staged rehabilitation of land within the disturbance footprint, as the mine progresses and areas become available for rehabilitation.

Rehabilitation within the project site will be guided by the proponent's rehabilitation procedures and manuals (discussed in Section 6 – Mine Rehabilitation and Closure). Further, the proponent has individual procedures relating to specific rehabilitation activities including topsoil management; topsoil ripping; seed collection; aerial seeding; sowing seed by hand; and weed management.

Rehabilitated areas will be monitored as part of the proponent's rehabilitation monitoring program. The success of rehabilitation works will be assessed against the completion criteria that have been developed by the proponent. As noted in Section 6 – Mine Rehabilitation and Closure these criteria will be reviewed for use in project rehabilitation. Completion criteria for the project will include criteria in relation to fauna colonisation.

Further detail on proposed mine rehabilitation is provided in Section 6 – Mine Rehabilitation and Closure.

Land Management

The entire project site, including the sections that will not be disturbed as part of the project, will be managed to conserve its conservation value. Land management measures for the project site will include weed and feral animal control (including feral cat control), and fire management. Fire management will include developing and implementing a fire regime on the project site to optimise biodiversity values, whilst also ensuring the risks to

human safety and property are managed. The proponent will continue to work with the Traditional Owners in relation to land management, particularly with respect to fire management.

The proponent has an existing Land and Biodiversity Management Plan, which provides an overall framework for land management and managing potential impacts to land and biodiversity. This plan will be updated to include the construction and operation of the project, and will include the measures described above.

The workforce will also be provided with information about threatened species, as part of their induction or through general environmental awareness programs.

Indirect Impacts

Table 7-6 provides a summary of management measures that will be adopted in relation to indirect impacts. In some instances these measures are described in further detail in other sections of the EIS, and section references are provided.

Table 7-6 Management of Indirect Impacts

INDIRECT IMPACT	MANAGEMENT
Vehicle Strike	A site traffic management plan will be developed for the project, which will include requirements for speed limits, safe driving practices and the installation of signage.
Light	There is very limited project lighting. However, any lighting will be designed to ensure that lighting is directed away from habitat areas, as far as possible.
Dust	Section 12 – Air Quality describes management measures, particularly watering of haul roads and progressive rehabilitation of disturbed areas.
Erosion and Sedimentation	An Erosion and Sedimentation Control Plan will be developed as described in Section 19 – Environmental Management Plan.
Weeds and Feral Animals	The proponent has existing procedures in relation to weed management, which will be reviewed and applied to project activities, and to the overall management of the project site. The revised manual will include measures for the control of existing weeds (which are very limited on the project site at present) and measures to prevent the introduction of weeds. Current mine procedures include weed mapping and spraying, and vehicle washdown procedures to prevent the spread of weeds. These procedures will be applied to the project. Given the low density of weeds within the project site, specific measures will be adopted to prevent the spread of weeds from the existing mine to the project site. The proponent also has a Cane Toad Management Plan and an associated quarantine procedure. The management plan includes monitoring, and reporting and disposal procedures in the event of a Cane Toad being found. This plan will be reviewed and revised to ensure that it is applicable to all project activities. The proponent undertakes Cane Toad inspections as part of a quarantine control function. However, the quarantine programs are not subject to a regular audit. As an additional management measure for this project, the proponent will undertake an annual audit of quarantine procedures to confirm their adequacy and make recommendations for their continuous improvement. The audits would be undertaken by trained and experienced quarantine officers. The proponent will extend its procedures to include feral animal control within the project site, specifically feral cat trapping.

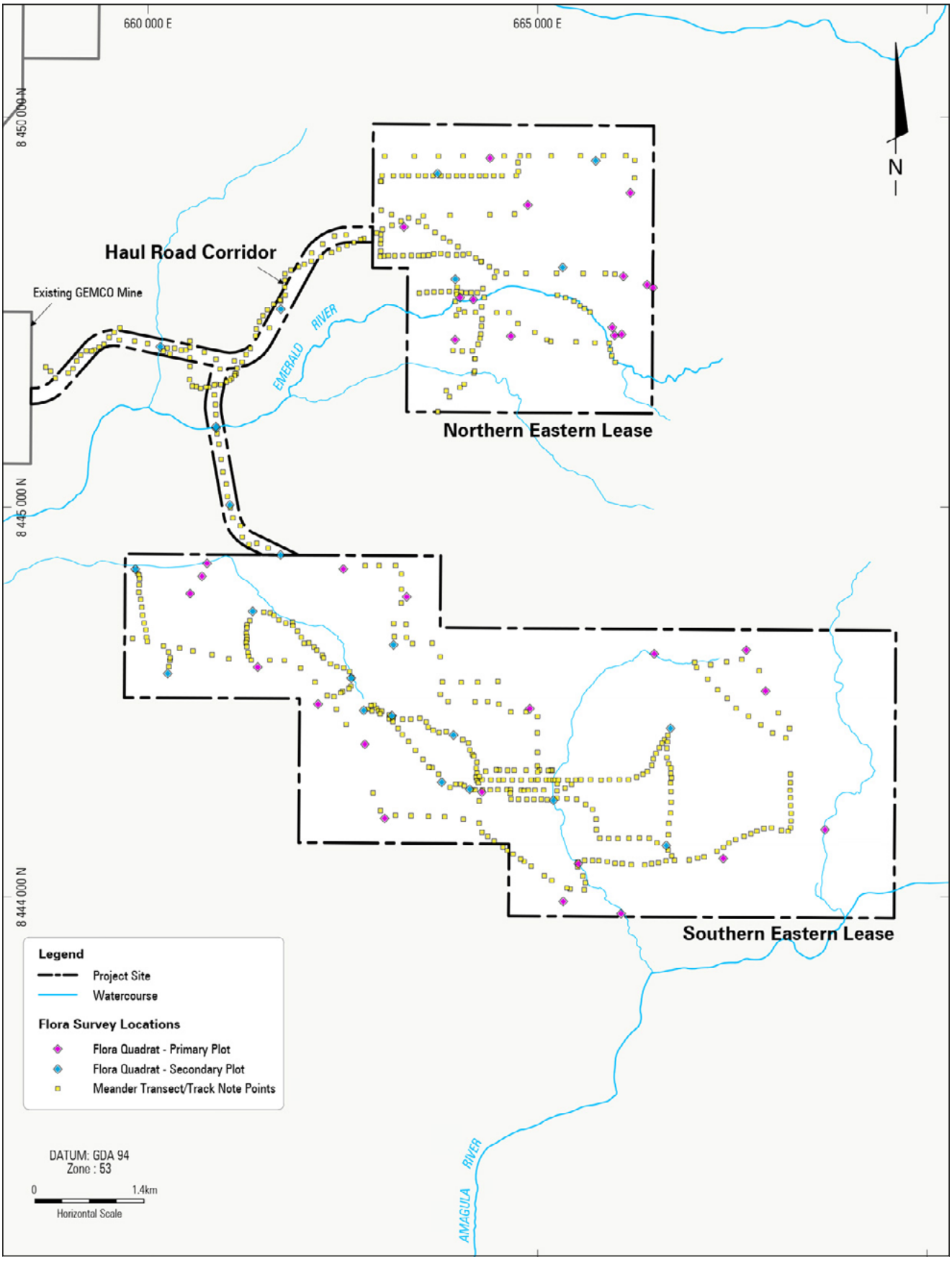
7.7.3 Offsets

In accordance with the EPBC Act Environmental Offsets Policy, biodiversity offsets are required to offset any significant, residual impacts. As discussed in Section 7.6.6, the project has the potential to give rise to significant, residual impacts on the Northern Hopping-mouse and the Brush-tailed Rabbit-rat. Offsets are proposed to be provided for these species. A *Biodiversity Offset Strategy* (Appendix E) has been prepared and provides detail regarding the proposed offsets for the project.

The Biodiversity Offset Strategy proposes the use of indirect offsets for the Northern Hopping-mouse and the Brush-tailed Rabbit-rat through sponsoring research on the threats to these species and/or the research priorities identified in the conservation advice for these species. Detailed plans for the offset programs will be developed prior to the commencement of the project, and provided to the DotE for approval.

Research programs undertaken as part of the Biodiversity Offset Strategy could include research into feral cat control (particularly using baits); research into the ecology of the Brush-tailed Rabbit-rat; and research into improving the value of mine rehabilitation as habitat for the Northern Hopping-mouse and Brush-tailed Rabbit-rat. These programs have the potential to provide a knowledge base that will allow for more effective management of these species and their threats. In this way the proposed offsets have the potential to provide wider benefits to the species, and potentially to a number of other native fauna species that are subject to the same threats. Further detail is provided in the *Biodiversity Offset Strategy* (Appendix E).

FIGURES

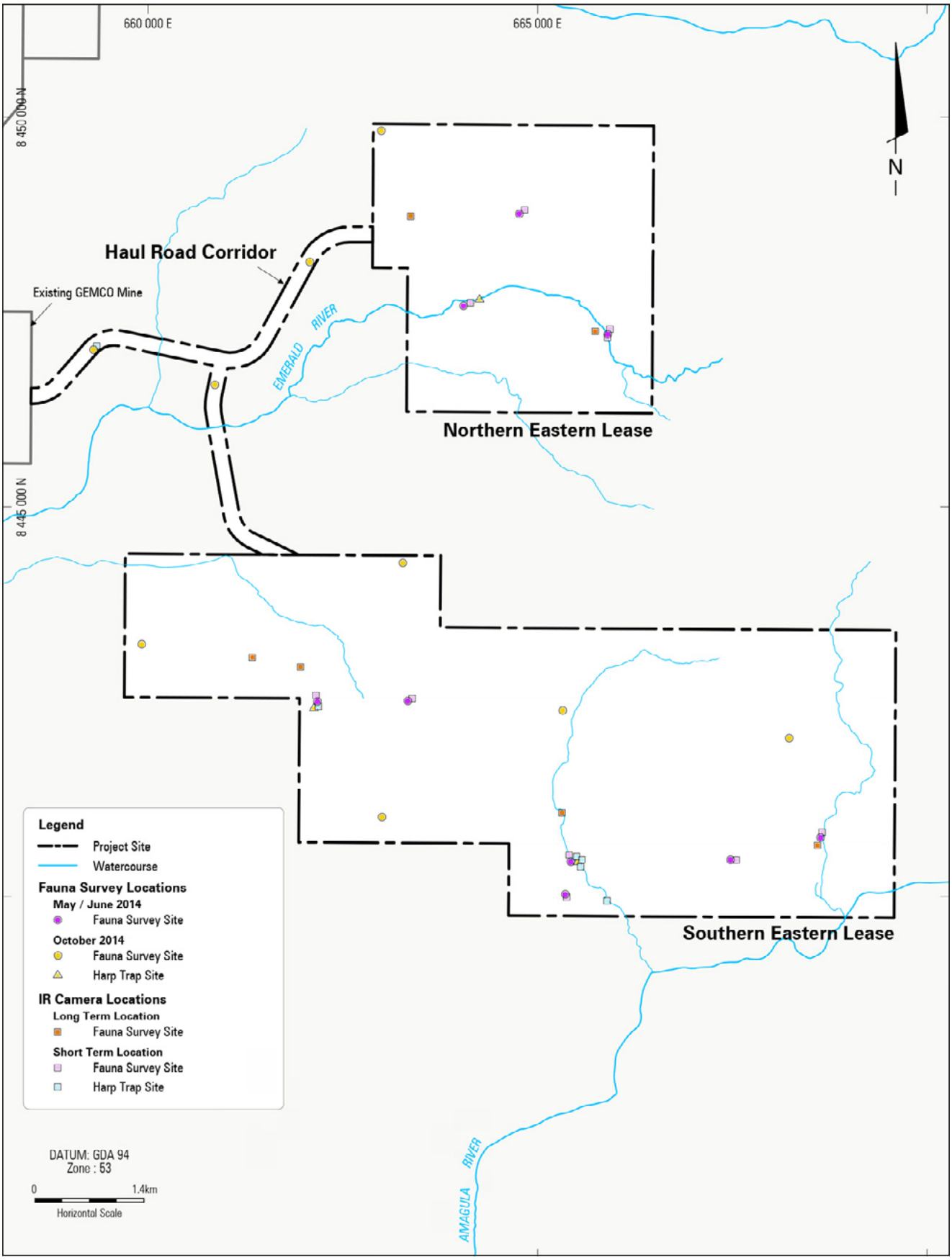


EASTERN LEASES PROJECT

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Terrestrial Flora Survey Sites

FIGURE 7-1

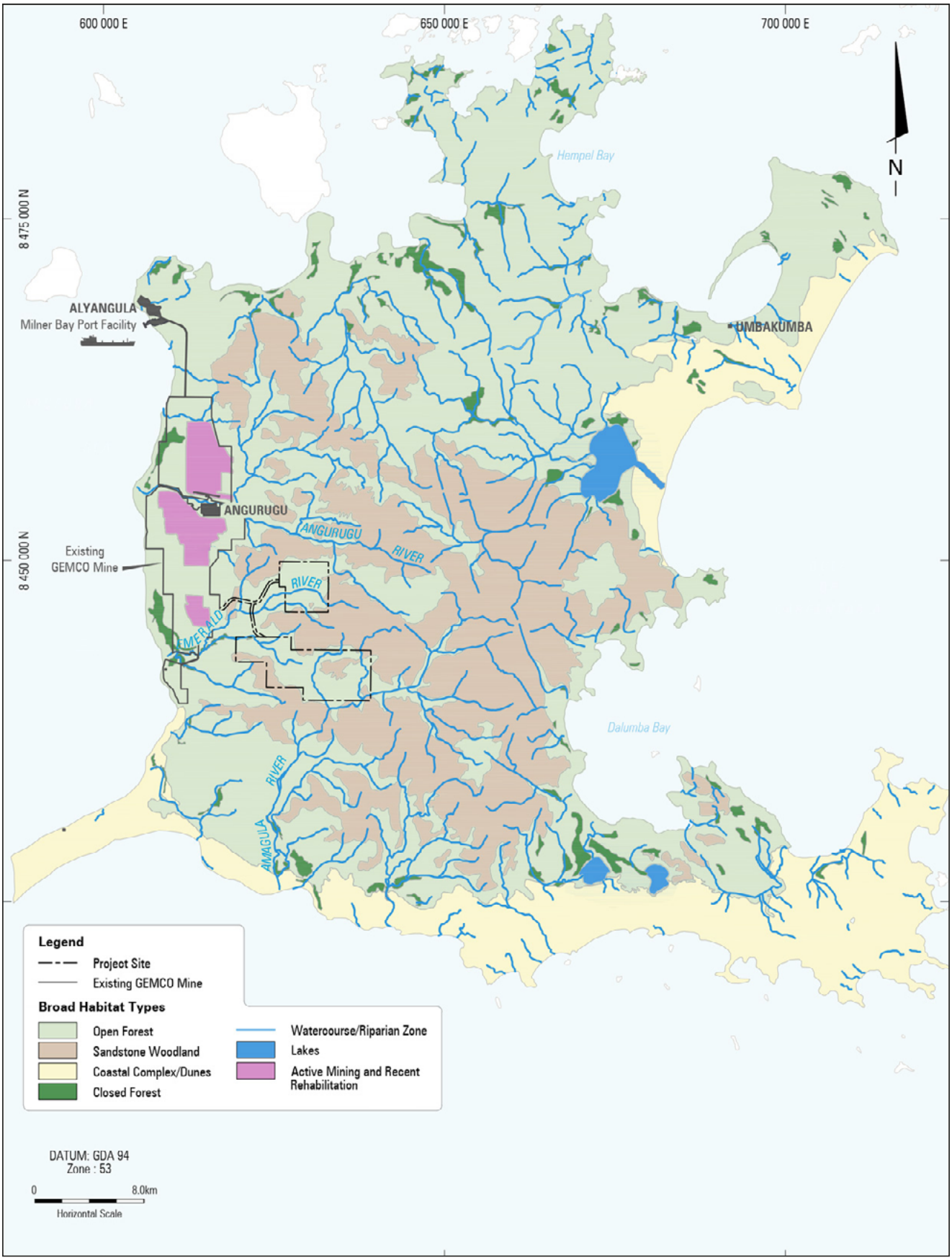


EASTERN LEASES PROJECT

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Terrestrial Fauna Survey Sites

FIGURE 7-2

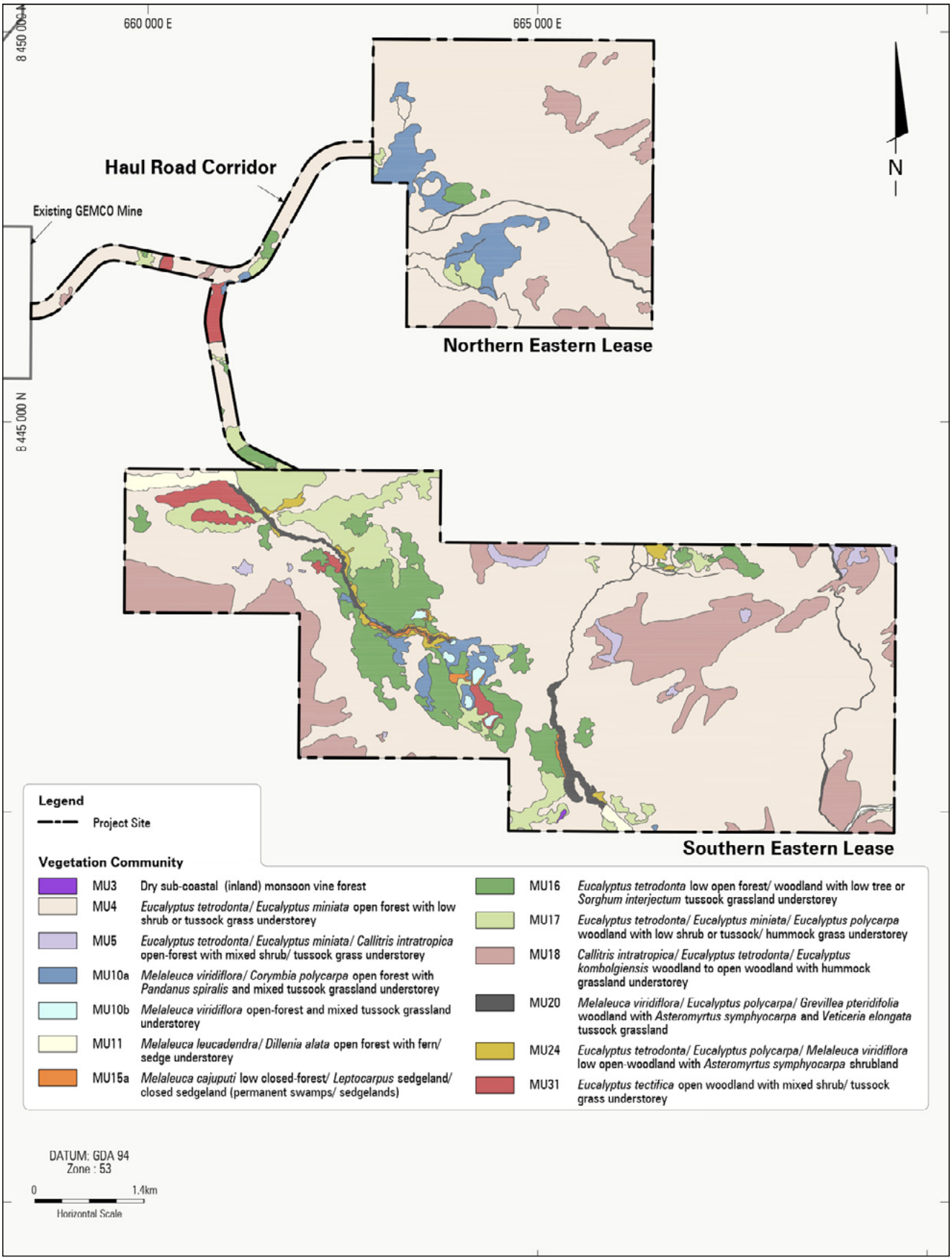


EASTERN LEASES PROJECT

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Broad Habitat Types on Groote Eylandt

FIGURE 7-3

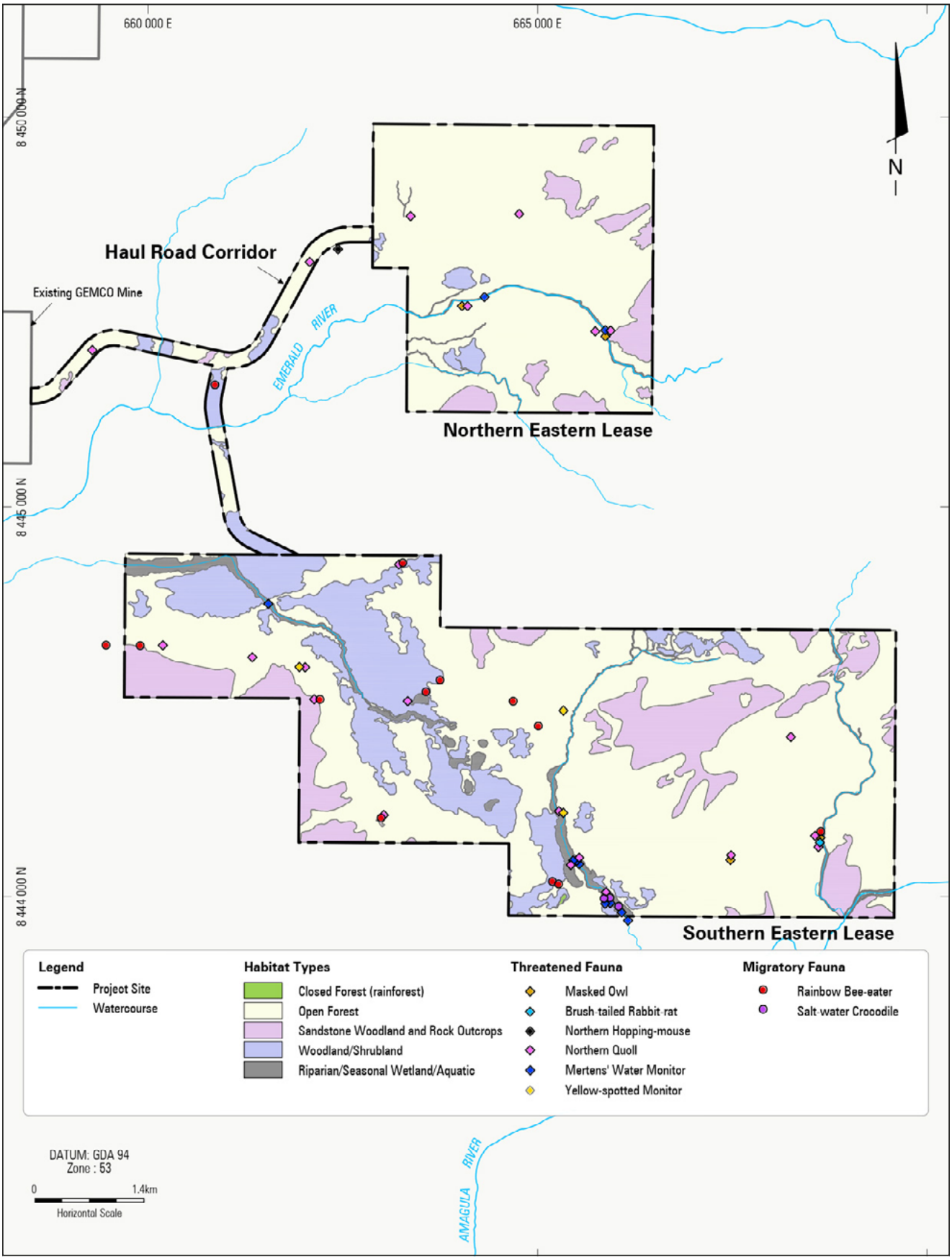


EASTERN LEASES PROJECT

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Vegetation Communities within the Project Site

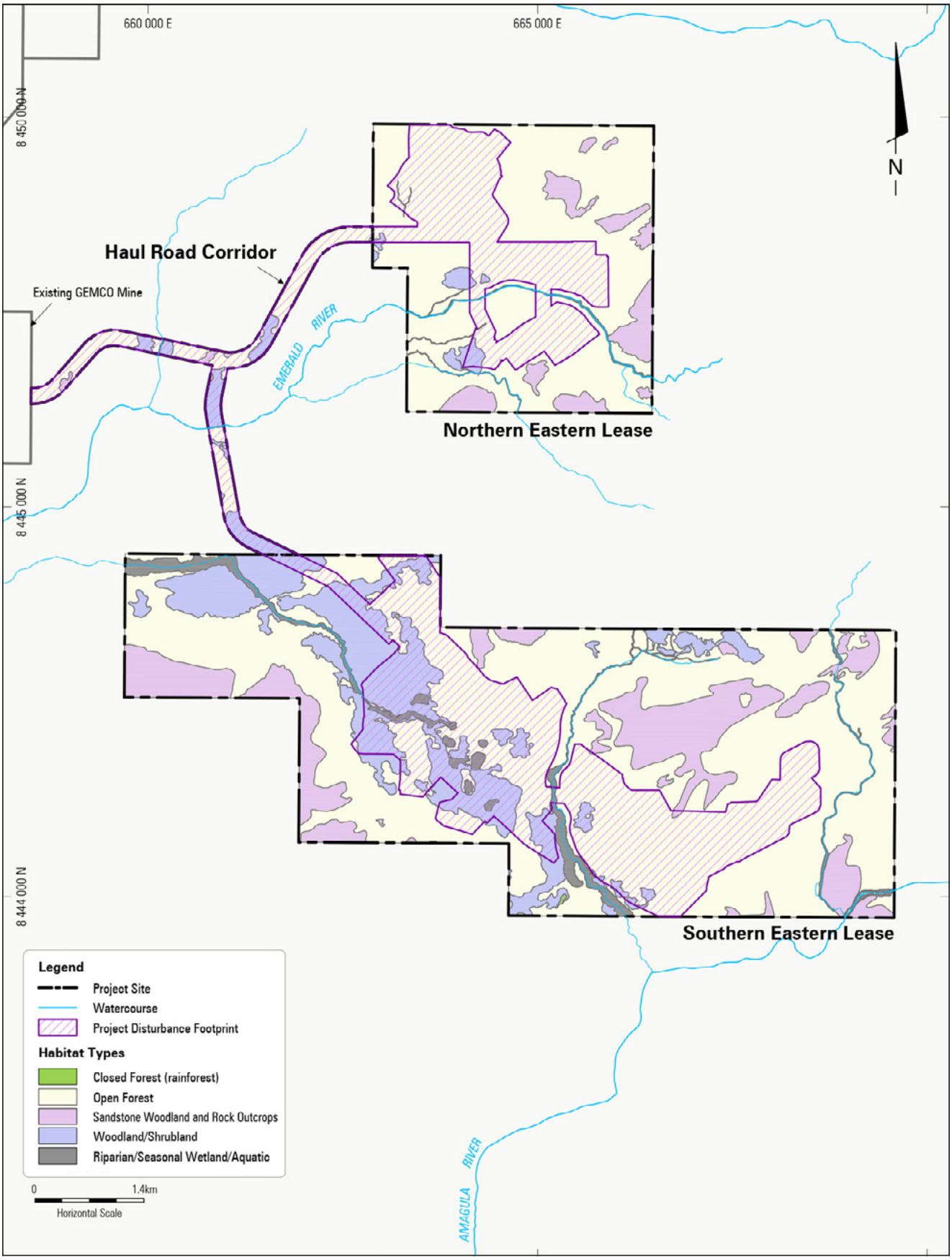
FIGURE 7-4



EASTERN LEASES PROJECT

Habitat Types and Threatened Fauna within the Project Site

FIGURE 7-5



EASTERN LEASES PROJECT

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Impacts on Habitat Types within the Project Site

FIGURE 7-6

PLATES

Plate 7-1 Example of Open Forest Habitat within the Project Site

Plate 7-2 Example of Woodland Habitat within the Project Site

Plate 7-3 Example of Shrubland Habitat within the Project Site

Plate 7-4 Example of Sandstone Woodland and Rock Outcrop Habitat within the Project Site

Plate 7-5 Example of Riparian Habitat within the Project Site

Plate 7-6 Example of Closed Forest (Rainforest) Habitat within the Project Site