

Sconi Battery Minerals Project  
Terrestrial Ecology Report

PREPARED FOR  
Australian Mines Limited

SEPTEMBER 2018



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## Document History and Status

Issue	Rev.	Issued To	Date	Reviewed
1	1	AARC	Sept 2018	JB
1	2	AARC	March 2023	IG

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**Name of Client:** Australian Mines Limited  
**Name of Project:** Sconi Battery Minerals Project  
**Title of Document:** Terrestrial Ecology Report  
**Document Version:** Final

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## LIST OF ABBREVIATIONS

°C	Degrees Celsius
%	Percent
AARC	AARC Environmental Solutions Pty Ltd
Australian Mines	Australian Mines Limited
BOM	Bureau of Meteorology
BPA	Biodiversity Planning Assessment
BVG	Broad Vegetation Group
C	Least Concern
CE	Critically Endangered
cm	centimetre(s)
DAF	Department of Agriculture and Fisheries
DoE	Department of Environment
DoEE	Department of Environment and Energy (Formerly DoE)
DES	Department of Environment and Science (Formerly EHP)
DSEWPAC	Department of Sustainability, Environment, Water, Population and Communities
E	Endangered
EA	Environmental Authority
EHP	Queensland Department of Environment and Heritage Protection
EPA	Environmental Protection Agency
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
ERE	Endangered Regional Ecosystem
FS	Fauna site
GDE	Groundwater Dependent Ecosystem
GIS	Geographical Information System
ha	hectares

km	kilometre(s)
km <sup>2</sup>	square kilometre(s)
m	metre(s)
Ma	Marine
Mi	Migratory
ML	Mining Lease
mm	millimetre(s)
MLES	Matters of Local Environmental Significance
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC	No concern at present
NC Act	<i>Nature Conservation Act 1992</i>
NCWR	<i>Nature Conservation (Wildlife) Regulation 2006</i>
NL	Not Listed
Nornico	Nornico Propriety Limited
RAD	Recovery Actions Database
ROM	Run of mine
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
SL	Special Least Concern
SPRAT	Species Profile and Threats Database
V	Vulnerable
VM	<i>Act Vegetation Management Act 1999</i>
VMR	<i>Vegetation Management Regulation 2000</i>
WoNS	Weeds of National Significance

## **AARC EXECUTIVE SUMMARY**

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AARC Environmental Solutions Pty Ltd was commissioned by Australian Mines Pty Ltd to conduct a terrestrial flora and fauna assessment for the Sconi Battery Minerals Project (the 'Project').

Nine flora and fauna surveys were conducted in the Project area. Dry season surveys were undertaken in August 2009, August 2010, May 2018 and June 2018 and wet season surveys were undertaken in April 2009, April 2011, March 2012, March 2013 and January 2013.

To assess the ecological values of flora and fauna communities on the Project site, AARC undertook the following scope of works:

- A desktop review of literature and database records to identify species of conservation significance known from the Project region. This enabled these species to be targeted during the field survey component of the study;
- Field surveys employing standard methodologies such as the *Terrestrial Vertebrate Fauna Survey Guidelines of Queensland* and *Queensland Herbarium Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* to identify terrestrial flora and fauna species inhabiting the Project site, particularly species of conservation significance; and
- The preparation of a report to Australian Mines describing the ecological features identified and outlining possible management strategies to reduce any foreseeable impacts associated with proposed mining/development activities.

### **SITE DESCRIPTION**

The Project area consists of three tenements: the Greenvale tenement, the Lucknow tenement and the Kokomo tenement. The Project is located in the Charters Towers region approximately 225 kilometres west-northwest of Townsville in North Queensland. The Greenvale tenement is situated approximately five kilometres west-northwest of the township of Greenvale. The Lucknow tenement is located approximately two kilometres west of Greenvale. The Kokomo tenement is located approximately 50 kilometres north-east of Greenvale. Access to all sites is off the Gregory Developmental Road.

The current land use at the Project location is low intensity cattle grazing with extensive exploratory drilling activities being carried out by Nornico Propriety Limited. The Greenvale tenement is the site of a historical nickel mine and has been cleared of vegetation previously.

### **FIELD SURVEY METHODS**

Scoping of the Project site was conducted using aerial photography (sourced from Google Earth and Queensland Globe) and broad ground truthing. Transects were located in areas representative of the Project site's vegetation types and habitats. In addition, habitats potentially inhabited by species of conservation significance were surveyed.

#### **Flora**

A number of Secondary transects were surveyed to obtain a detailed floristic inventory of the dominant woody plants within each vegetation type. In order to map and confirm the extent of the vegetation communities, Quaternary plots were used along the boundaries of the communities. The quality of communities was assessed with regard to their likely value and viability as a representative vegetation type.

## **Fauna**

The fauna survey methodology employed for the Project was originally based on standard survey techniques that are used to sample terrestrial vertebrate fauna and in more recent surveys it was based on the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al. 2014). The surveys were conducted in compliance with AARC's scientific purposes permit and animal ethics approval.

Survey methods for fauna included the establishment of survey transects in representative areas of habitat on the Project site. A range of trapping and survey techniques were employed along these transects including pitfall trapping, Elliott trapping, funnel trapping, cage trapping, camera trapping, bat recording device (Anabat), habitat searching, bird surveying, call playback and spotlighting. Fauna records obtained from these transects were combined with incidental records from other non-transect areas of the Project site to produce a comprehensive fauna species list. These methodologies and transect locations were replicated in field surveys where possible to investigate seasonal and temporal variation in species composition.

## **SURVEY RESULTS**

### **Flora**

A total of 425 flora species were recorded on the Project site, 41 of which are introduced species. No threatened flora species were recorded on the site.

124 species listed as threatened under Commonwealth and/or the Queensland legislation were identified in database searches as potentially inhabiting within the 100km buffer area of the Project site. Of those species, only 9 species were identified within a smaller buffer area of each of the tenements of the Project site. These species were not encountered during the field surveys despite targeted searches being undertaken where suitable habitat was found.

Fourteen distinct vegetation communities were identified on the Project site. Fourteen of these communities were classed as Remnant Vegetation as defined in the *Vegetation Management Act 1999*. None of these communities are classed as threatened ecological communities under Commonwealth legislation. All fourteen vegetation communities recorded during the survey were associated with fifteen Regional Ecosystems, one of which are listed as Of Concern under the *Vegetation Management Act 1999*. Six of the Regional Ecosystems on site are classified as Of Concern under the Department of Environment and Science's Biodiversity Status. The remaining 8 Regional Ecosystems have a Biodiversity Status of No Concern at Present.

### **Fauna**

A total of 231 vertebrate fauna species were recorded on the Project site during the surveys, comprising 13 amphibians, 39 reptiles, 44 mammals and 135 birds.

The Greater Large-eared Horseshoe bat (*Rhinolophus robertsi*) (NC Act Endangered and EPBC Act Vulnerable) was registered as possibly present in the Kokomo tenement at two sites with the bat recorded. The signals allocated to *R. robertsi* were very noisy and poorly-rendered in the spectrograms but fell within the relevant frequency range for the species (28-32 kHz) and appeared to represent the constant-frequency signals typical of horseshoe bats. It is, however, possible that these "calls" were from an unknown non-bat source (Balance Environmental 2018).

The Masked Owl (Northern subspecies) is listed as Vulnerable under the NC Act and EPBC Act and was recorded at the Kokomo tenement and is considered likely to occur across the Project area.

Six introduced species were observed on the Project site during the surveys. These were the Cane Toad (*Rhinella marina*), Black Rat (*Rattus rattus*), Feral Pig (*Sus scrofa*), Wild Dog (*Canis lupus dingo*), Feral Cat (*Felix catus*) and European Rabbit (*Oryctolagus cuniculus*). The Feral Pig, Wild Dog, Feral Cat and European Rabbit are listed as restricted invasive animal under the *Biosecurity Act 2014*.

110 species listed as threatened under Commonwealth and/or the Queensland legislation were identified in database searches as potentially inhabiting within the 100km buffer area of the Project site. Of those species, only 18 species were identified within a smaller buffer area of each of the tenements of the Project site. These species were not encountered during the field surveys despite targeted searches being undertaken where suitable habitat was found.

Twenty-six EPBC listed marine birds of which three are also EPBC listed migratory birds were identified on the Project site. The distribution of each listed migratory species identified is widespread throughout northern and eastern Australia and the local populations on the Project site are unlikely to constitute an ecologically significant proportion of the total population of these species. Furthermore, the Project site is not at the limit of these species' range, nor are these species considered to be declining within the region. Therefore, it is unlikely the Project will have a significant impact on the regional populations of these migratory species.

## **RECOMMENDATIONS**

### **Management of Native Flora and Fauna**

Proposed strategies to manage native fauna on the Project site include:

- Implementation of a formal permit system for clearing works on site;
- Reporting and incident management procedures for abandoned, injured, threatened or unusual fauna found on the Project site;
- Vegetation inspections for fauna prior to clearing works. If fauna species are encountered, works must cease until the fauna has vacated the area; and
- Environmental induction and training of Project staff and contractors.

### **Management of Introduced Flora and Fauna**

Proposed strategies to manage introduced fauna on the Project site include:

- Implementation of a Pest Control Program;
- Implementation of a Weed Management Plan;
- Provision of vehicle washdown bays to minimise weed and pathogen spread; and
- Environmental induction and training of Project staff and contractors.

### **Management of Threatened Species**

Further survey effort is recommended to determine the presence of species of conservation significance. The NC Act Endangered Greater Large-eared Horseshoe Bat was was inconclusively recorded on the Project site. Further bat detection acoustic survey effort is recommended to determine the presence of

the species on the Project site. The Masked Owl was recorded on the Kokomo tenement and further assessment of the occurrence of this species across the Project area tenements is recommended. The Greater Glider was not recorded in the Project area, however was recorded off site during the aquatic ecology surveys. Further survey effort within the Project area is recommended to determine conclusively its presence across the Project area.

## 1.0 INTRODUCTION

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AARC Environmental Solutions Pty Ltd (AARC) was commissioned by Australian Mines Limited (Australian Mines) to conduct a Terrestrial Flora and Fauna Assessment of the proposed Sconi Battery Minerals Project (the 'Project'). Australian Mines proposes to mine and process the nickel-cobalt (Ni-Co) and scandium (Sc) deposits found within the Project area.

The Project area is made up of three separate tenements:

- The Greenvale tenement;
- The Lucknow tenement; and
- The Kokomo tenement.

### 1.1 SCOPE OF STUDY

To assess the ecological values of flora and fauna communities on the Project site, the following scope of works was undertaken:

- A desktop review of literature and database records to identify species of conservation significance known from the Project region. This enabled these species to be targeted during the field survey component of the study;
- Field surveys employing standard methodologies such as the *Terrestrial Vertebrate Fauna Survey Guidelines of Queensland* and *Queensland Herbarium Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* to identify terrestrial flora and fauna species inhabiting the Project site, particularly species of conservation significance<sup>1</sup>; and
- The preparation of a report to Australian Mines describing the ecological features identified and outlining possible management strategies to reduce any foreseeable impacts associated with proposed mining/development activities.

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<sup>1</sup> 'Species of conservation significance' or 'threatened species' when referred to within this document are references to species listed as Near Threatened, Vulnerable or Endangered under the Queensland *Nature Conservation Wildlife Regulation 2006* or Vulnerable, Endangered or Critically Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999*.



## 2.0 PROJECT DESCRIPTION

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The Project site will comprise three mining leases (ML). Applications (MLA) will be lodged with the Queensland Government to increase the area of the currently approved MLs as follows:

- Mining Lease Application (MLA) 10368 (Greenvale) over 3,389 hectares (ha);
- MLA 10366 (Lucknow) over 302.6 ha; and
- MLA 10342 (Kokomo) over 2,087 ha.

The Project proposes to mine nickel, cobalt and scandium laterite at the former Greenvale nickel mine, as well as the Lucknow and Kokomo tenements. The Project will have a mine life of greater than 20 years and is intended to be staged, with mining at Lucknow and Greenvale first with a single processing area located at Greenvale. Kokomo is expected to be mined at a later date, commencing some 12 years later.

The Project is expected to process approximately 750,000 to 1,000,000 tonnes per annum (tpa) of ore through the High-Pressure Acid Leaching (HPAL) process plant, producing either a nickel-cobalt concentrate or metal ingots and scandium oxide.

The Project location for the HPAL process plant and infrastructure will be at the former Greenvale Nickel Mine. Ore will be mined and processed at Greenvale. Residue Storage Facilities (RSF) will be constructed at Greenvale adjacent to the HPAL process plant. Final infrastructure locations are yet to be confirmed through studies and site geotechnical investigations. Satellite ore bodies at Lucknow and Kokomo will be open-cut mined and the ore trucked to Greenvale for processing.

## 2.1 PROJECT LOCATION

The Project is located in the Charters Towers region approximately 225 kilometres (km) west-northwest of Townsville in North Queensland. The Project area consists of three separate tenements: the Greenvale tenement, the Lucknow tenement and the Kokomo tenement. The Greenvale tenement, which will hold the process plant is situated approximately 5 km west-northwest of the township of Greenvale. The Lucknow tenement is located approximately 2 km west of Greenvale and the Kokomo tenement is located approximately 50 km north-east of Greenvale. Access to all tenements is from the Gregory Developmental Road. The Greenvale tenement is accessed by travelling north off the Gregory Developmental Road along a minor road for approximately 2.5 km. The Lucknow tenement can be accessed directly off the Gregory Developmental Road to the south. Access to the Kokomo site is via the Greenvale Road to the Valley of Lagoons then onto the Lava Plains Mount Fox Road. Kokomo is located within the Valley of Lagoons between Lake Lucy and Kinrara National Park adjacent to the Burdekin River. Where not specified, references to the Project in this report refer to the three tenements of Greenvale, Lucknow and Kokomo.

Figure 1 shows the regional location of the Project area.

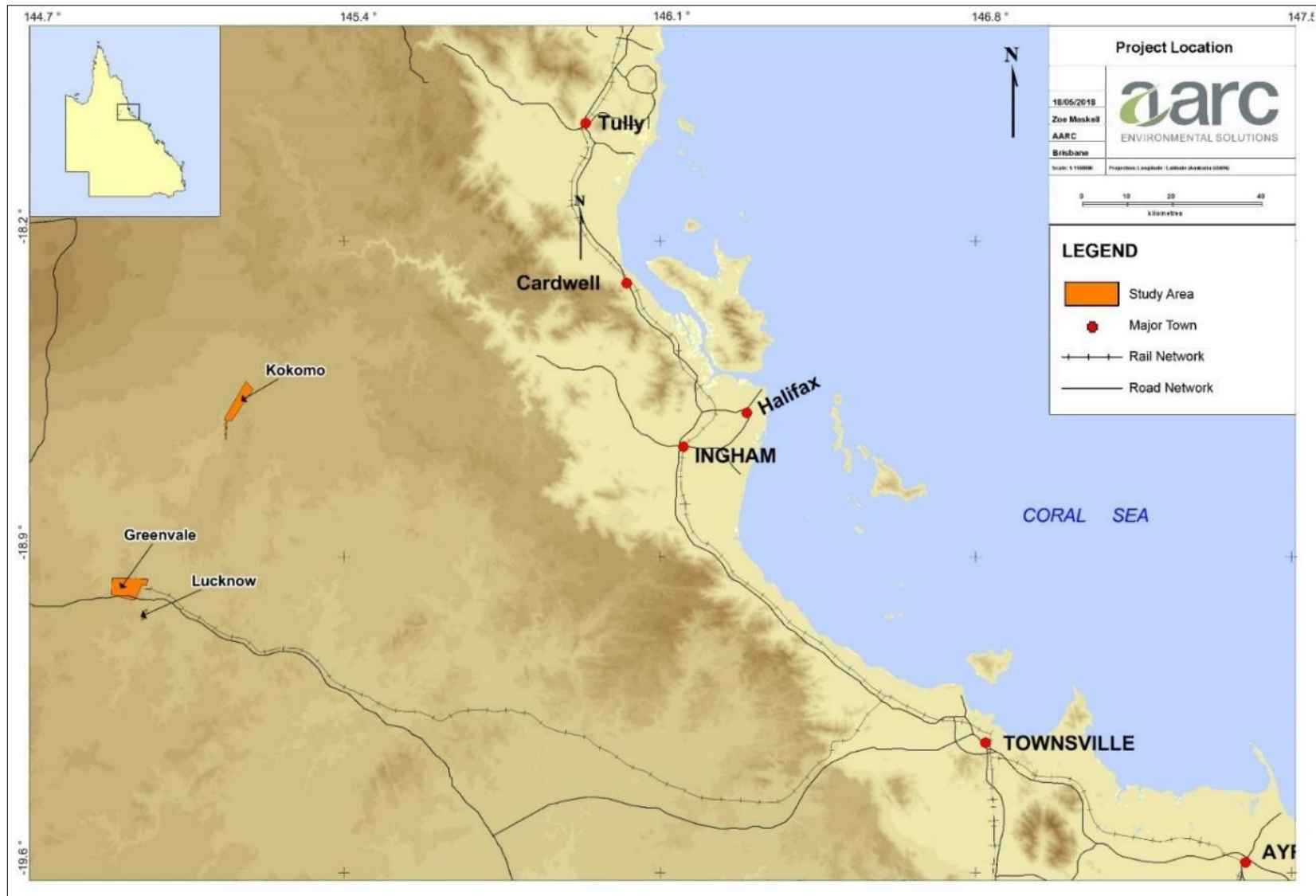


Figure 1 Project Location

## 2.2 BIOREGIONAL DESCRIPTION

The Project site is located in the northern section of the Burdekin River Basin within the Einasleigh Uplands Bioregion. The Einasleigh Uplands Bioregion is approximately 118,500 square kilometres (km<sup>2</sup>) in size and lies across the Great Dividing Range. It is dominated by Eucalypt woodlands and is used primarily for grazing, with mining, cropping and horticulture also considered significant land uses.

The Einasleigh Uplands are geologically rich, consisting of rugged hills and ranges; alluvial and sand plains and dissected plateaus. The geological diversity is also apparent over time, with the Einasleigh Uplands home to not only the youngest rocks, but also the oldest rocks in eastern Australia (Kutt et al., 2009). Unique to the area are historic basalt flows, creating lava tunnels, such as those found at Undara Volcanic National Park. Associated with these lava flows in the south of the bioregion are springs and spring fed wetlands, home to a diversity of flora and fauna.

Special values of the Einasleigh Uplands include endemic fauna, habitat for threatened and geographically restricted flora and for arboreal mammals. The bioregion contains the upper catchments of several significant river systems that drain north into the Gulf of Carpentaria, and south and east into the Pacific Ocean. The high sections of the Great Dividing Range form part of a mesotherm archipelago of uplands through Queensland that is significant for avifauna.

The Valley of Lagoons Fauna Sanctuary lies 10 km to the southwest of the Kokomo tenement and contains numerous wetland areas. The Burdekin River runs parallel with the Kokomo tenement approximately 500 metres (m) out of the Project boundary and then continues to flow south-east approximately 5 km from the Greenvale tenement and 9 km from the Lucknow tenement.

## 2.3 NATURAL RESOURCE MANAGEMENT REGION

The Natural Resource Management Region (NRM region) is a federal land management unit, based on catchments and bioregions designated for specialised state government programmes, funding and key issues plans. The Project is located within the Burdekin NRM region. The Burdekin NRM region covers 133,400km<sup>2</sup> and encompasses the Burdekin catchment including the Belyando and Burdekin rivers. The region is typified by a humid, tropical climate with pronounced wet and dry seasons.

## 2.4 SOILS AND GEOLOGY

### 2.4.1 Geology

The Project region has a unique geological history, with historic basalt flows creating springs and spring-fed wetlands. These basalt flows are particularly relevant to the aquatic ecology on and around the Project site as large basalt caves and crevices were found in the riparian area along the Burdekin River. These basalt flows also created the Valley of Lagoons, a series of lakes formed by the damming of the Burdekin River. The bioregion includes the following land zones:

- Drainage lines and floodplains;
- Sand plains;
- Escarpments;
- Basalt plains and hills;
- Sandstone ranges;

- Hills and lowlands on metamorphic rocks; and
- Hills and lowlands on granite rocks.

## 2.4.2 Soils

A variety of soil types exist on the Project site from recent Quaternary alluvial flats to hills and ranges formed by Proterozoic igneous rock. The majority of the site is described as undulating plains and rises. These areas are comprised of soils such as ferrosols, sodosols and Dermosols forming medium to heavy clays and sandy loams.

Alluvial flats are generally comprised of loam to fine sandy-loam surface soils grading into light clays/sandy clay-loams at variable depths. Other alluvial soil management units comprise a variety of medium to heavy, hard setting clays.

Lateritic scarps and plateaus formed vast ranges comprised of numerous soil types throughout the Project site. Hard-setting, red loams to medium-heavy clays and sharp gravels were recorded on escarpments at Kokomo and Lucknow. One small section at Kokomo comprised sandy clay loam on the surface with light clay sub-soils.

## 2.5 TOPOGRAPHY

Both Kokomo and Lucknow are located on mesa landforms. Lucknow has a maximum elevation of 540 metres (m) above sea level and Kokomo, 600m above sea level. The Greenvale site, at maximum, is less than 515m above sea level and has little variation in elevation across the site. The area is strongly influenced by the Burdekin River, its tributaries and floodplains.

## 2.6 CATCHMENT AREA

The Project lies within the Burdekin Basin which encompasses a large area of land including the Burdekin, Belyando and Suttor Rivers. The Burdekin catchment covers an area of 136,000km<sup>2</sup> (DNR 2002). The catchment is divided into four sub catchments, of which the Project lies within the Upper Burdekin sub catchment. The Upper Burdekin sub catchment encompasses the northern area of the Burdekin catchment and flows south into Lake Dalrymple.

## 2.7 LOCAL WATERCOURSES

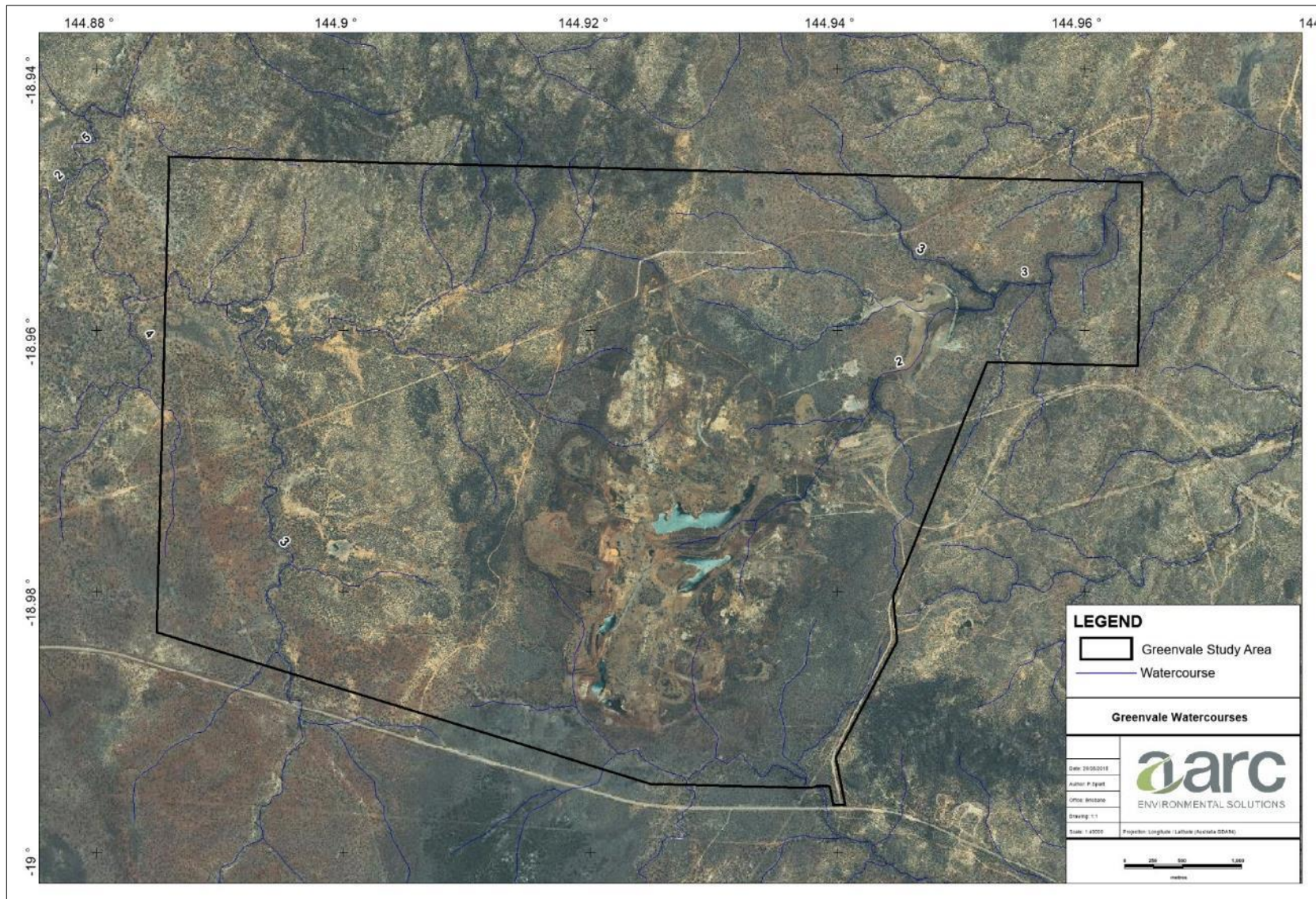
The Project region is located within the Burdekin River Basin, which flows in a south-easterly direction into the Pacific Ocean at Upstart Bay, approximately 90 km south-east of Townsville. Watercourses on the Project site are small, ephemeral creeks that drain into the Burdekin River. The watercourses are ephemeral due to the local topography. Flow is restricted to heavy rainfall events, which typically occur between the months of November and March (the wet season). See Figure 2, Figure 3 and Figure 4 for the local waterways in relation to the Project sites.

The Greenvale tenement has little variation in elevation across the site being, at maximum, less than 515 metres (m) above sea level. It features several small wetland areas created by flooding of disused mine voids. Surface water flow on the Greenvale tenement is restricted to small, ephemeral, first order watercourses. The only sources of permanent water on the Greenvale tenement are the flooded mine voids. These mine voids occupy large areas of land, holding ponded water up to 20 m deep.

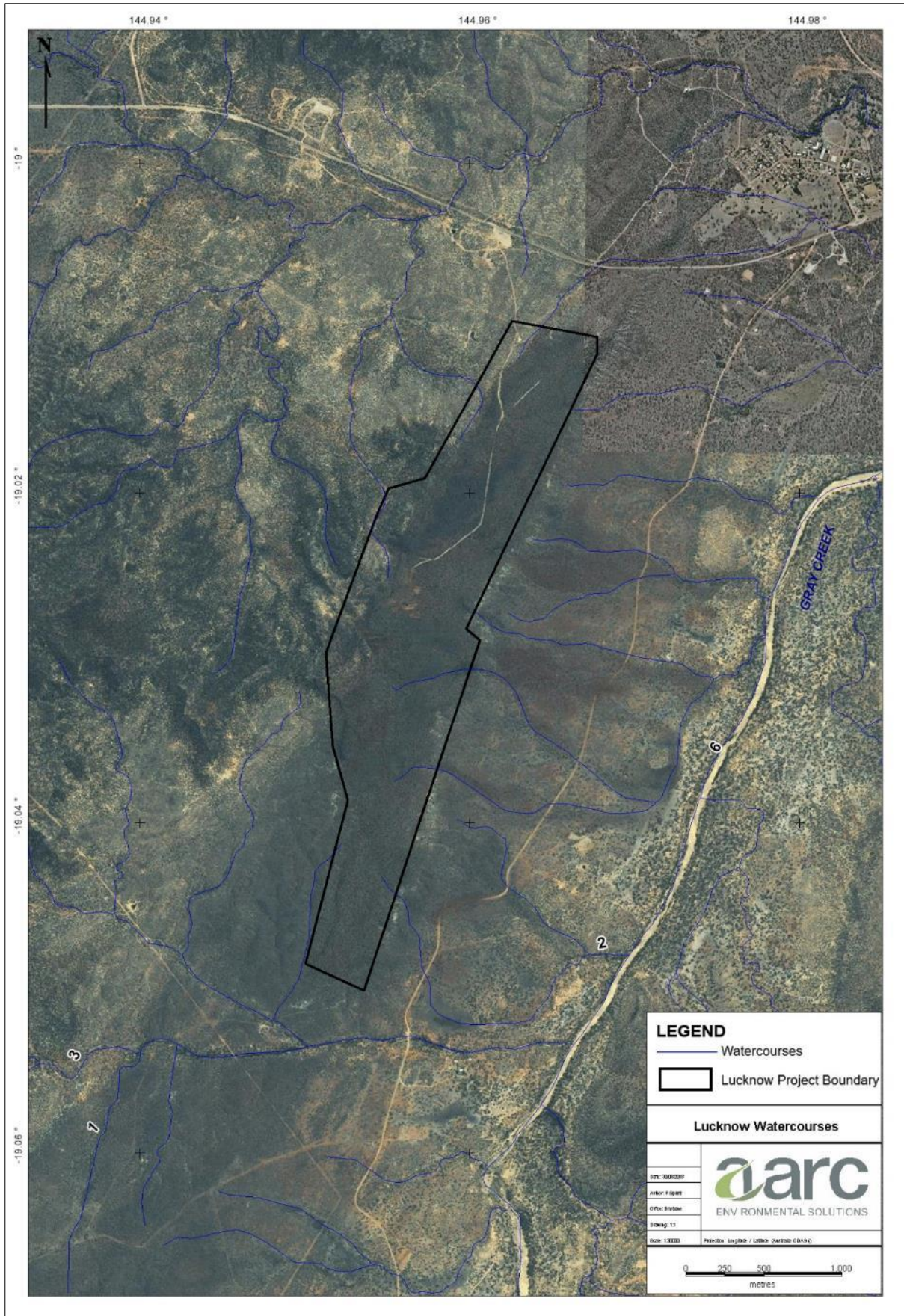
Lucknow is located on a mesa with a maximum elevation of 540 m above the sea level. Surface water following rainfall rapidly drains from the cliffs of the mesa into local creeks. The creek system on the western and north-western side flows into Redbank Creek (which also collects runoff from the southern

parts of Greenvale). This water eventually flows into the Burdekin River. Water flow from the eastern and southern side of the Lucknow tenement drains into Gray Creek. Gray Creek is ephemeral and eventually flows into the Burdekin River, approximately 17 km downstream of the Project site.

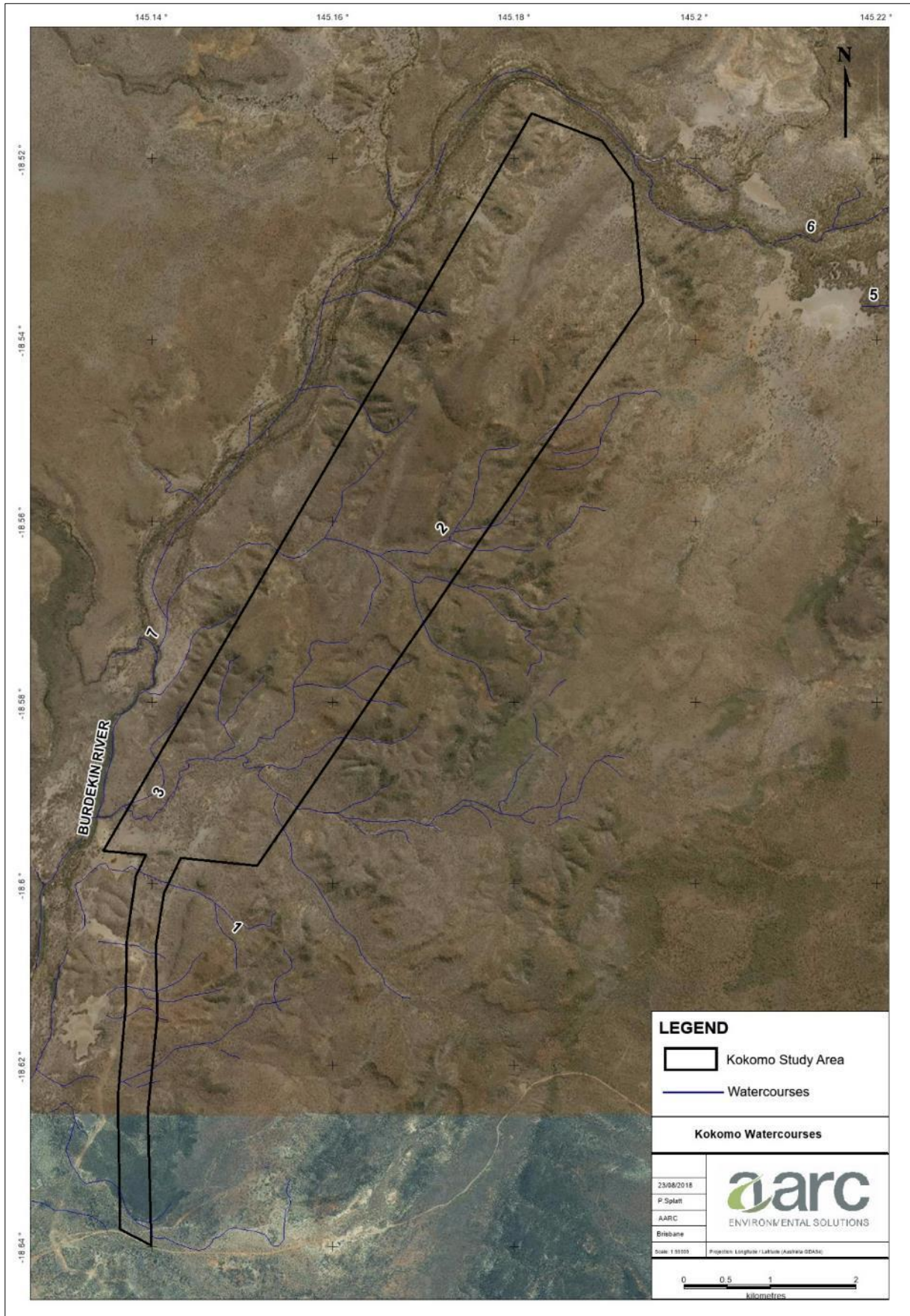
A series of small mesas cover the Kokomo tenement reaching 600m above the sea level. Following rainfall, surface water rapidly drains from the top of these mesas into local creeks that drain to the Burdekin River, located 1 km away. No significant sources of permanent water are available on the Kokomo tenement. Much of the site is composed of steep sided hills. Alluvial fans have also formed in several areas. Larger deposition areas are floodplain-like and incised channels are rare.



**Figure 2 Local waterways for the Greenvale Project Site**



**Figure 3 Local waterways for the Lucknow Project Site**



**Figure 4 Local waterways for the Kokomo Project Site**



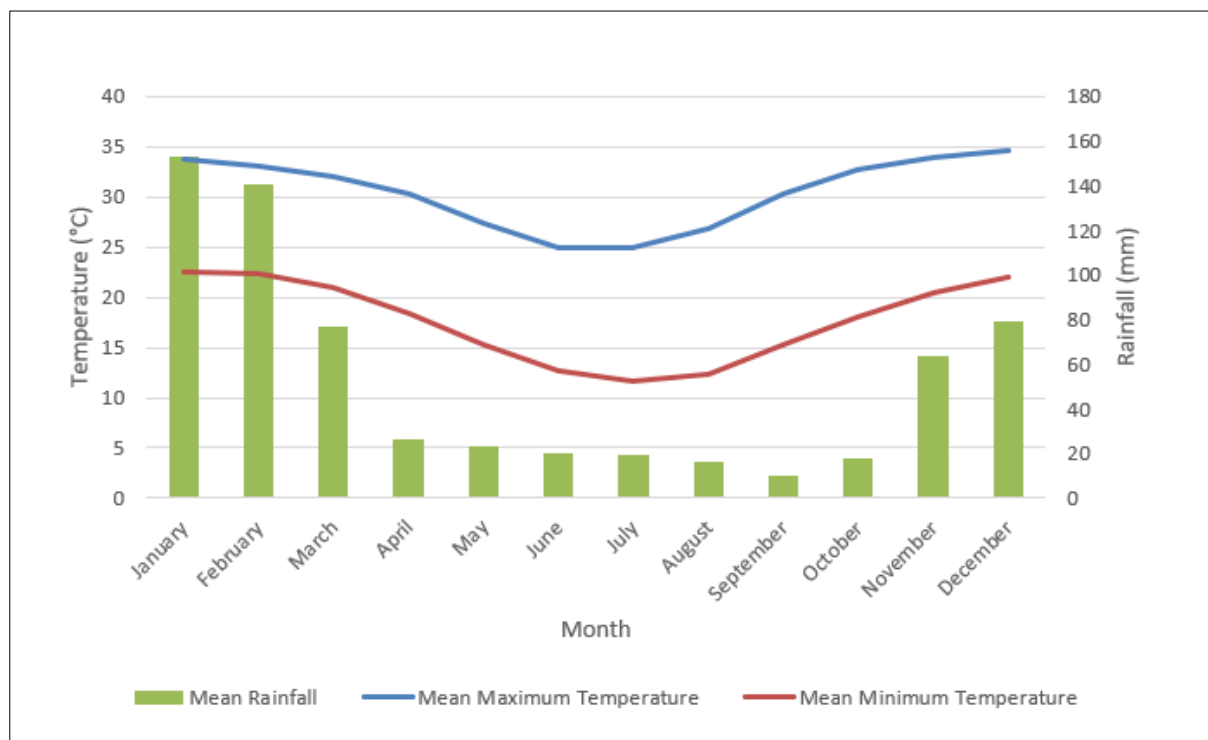
## 2.8 REGIONAL CLIMATE

The climate of the broader Project area is classified as semi-arid, with characteristic hot, dry summers and warm winters. The Project’s geographical proximity to the east coast of Australia and position west of the Great Dividing Range results in widely unpredictable weather conditions. Through the wet season, tropical rainfall events often inundate the Project’s waterways and severe storms with high winds are not uncommon. These events are juxtaposed by periods of prolonged drought and high diurnal temperatures, a result of the Project’s association to the semi-arid interior of Queensland. An overview of the regional climate statistics of the Project site is provided below.

Rainfall statistics for the Project area have been sourced from the Bureau of Meteorology (BoM) rainfall statistics for Lucky Springs which is located 20 kilometres (km) to the south west of the Project. The data indicates the annual average rainfall for the region to be approximately 686.4 millimetres (mm) with the majority falling from November to March.

Long term air temperature statistics were collected from the Mount Surprise Weather Station, located approximately 100km north west of Greenvale. Maximum daily temperatures in summer average between 35.1°C and 32.3°C with overnight minimums averaging between 20.9°C and 16.1°C. In winter, average maximum temperatures range between 28.5°C and 26.5°C with minimums averaging between 10.6°C and 9.6°C.

The mean annual rainfall for the region (based on data collected from the Charters Towers Airport Weather station, station no. 034084) between 1992 and 2018 is 643.4 mm. Mean monthly rainfall recorded at this weather station since 1992 is shown in Figure 5 along with the mean monthly minimum and maximum temperatures recorded. The highest mean maximum temperature is recorded in December (34.6 °C) while the mean minimum temperature for the region is recorded in July (11.6°C). This graph indicates the wet season occurs between November and March while dry season conditions occur between April and October.



**Figure 5 Mean Temperature and Rainfall Data from the Charters Towers Weather Station**

## **2.9 CURRENT LAND USE**

Land use at each site varies as exploratory activities, cropping and cattle grazing are known throughout the region. Each tenement is currently subject to moderate intensity cattle grazing with the construction of fences and paddocks throughout. An exploration drilling program is currently being undertaken throughout the Project with the construction of access tracks and drill pads. The Greenvale tenement has previously been mined and rehabilitated. Rehabilitation is generally poor, with efforts leading to a sparsely vegetated waste rock dump and open pit voids holding ponded water. Neither Kokomo or Lucknow have experienced operational mining activity and are currently in a heavily vegetated state with minimal clearing.

## **3.0 RELEVANT LEGISLATION, POLICY AND GUIDELINES**

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### **3.1 LEGISLATION & POLICY**

Commonwealth and State legislation relevant to the assessment of flora, fauna and biodiversity on the Project site is discussed below.

#### **3.1.1 *Commonwealth Environment Protection and Biodiversity Conservation Act 1999***

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action will require approval from the Federal Environment Minister if the action has, will have, or is likely to have a significant impact on a Matter of National Environmental Significance (MNES). MNES that are potentially relevant to the Project include:

- Listed threatened species and ecological communities;
- Migratory species protected under international agreements; and
- A water resource, in relation to a coal seam gas development or large coal mine.

Where the Project has the potential to significantly impact on a MNES, an EPBC Act referral may need to be prepared and submitted to the Commonwealth Department of the Environment and Energy (DoEE) for assessment.

A Referral was submitted to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) in February 2012, due to the scale of the Project and due to the potential presence of marine and migratory listed fauna and threatened flora and fauna species. The decision notice from the Minister of DSEWPAC was the proposed action is not a controlled action, therefore no further assessment and approval under the EPBC Act was required before the Project can proceed. Groundwater Dependant Ecosystems are considered as water resources that are a MNES. A separate study will be conducted to determine the Projects impact of this MNES.

#### **3.1.2 *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy***

The *EPBC Act environmental offsets policy* outlines the Australian Government's position on the use of environmental offsets under the EPBC Act. Environmental offsets can be used under the EPBC Act to maintain or enhance the health, diversity and productivity of the environment as it relates to matters protected by the EPBC Act. This policy only applies to Projects where a significant impact on a matter of national environmental significance is proposed.

Environmental offsets can be applied as an approval condition under the EPBC Act for developments that have undergone assessment. They may be used when a development will result in impacts on a matter protected by the EPBC Act. Environmental offsets are not applicable to all approvals under the EPBC Act. Offsets should not be applied where the impacts of a development are considered to be minor in nature or could reasonably be mitigated. In some circumstances suitable offsets may not be available to adequately compensate for the impacts of a development and a decision on the overall acceptability of the project will need to be made.

### 3.1.3 Queensland *Nature Conservation Act 1992*

The most relevant components of the *Nature Conservation Act 1992* (NC Act) to the Project are the sections which pertain to Wildlife Conservation. The classes of wildlife<sup>2</sup> to which the NC Act applies include protected wildlife, which is defined as:

- Extinct wildlife;
- Endangered wildlife;
- Vulnerable wildlife;
- Near Threatened wildlife; and
- Least Concern wildlife.

Species listed under the above classes are published in the associated *Nature Conservation (Wildlife) Regulation 2006* (NCWR).

The NC Act defines 'threatening processes' as any process that is capable of:

- a) Threatening the survival of any protected area, area of major interest, protected wildlife species, community of native wildlife or native wildlife habitat; or
- b) Affecting the capacity of any protected area, area of major interest, protected wildlife species, community of native wildlife or native wildlife habitat to sustain natural processes.

The NC Act is relevant to the Project site should any protected<sup>3</sup> flora or fauna species (as detailed in the NCWR) be found on the Project site.

#### 3.1.3.1 *Nature Conservation (Wildlife) Regulation 2006*

Species listed under the above threatened species classes are published in the associated *Nature Conservation (Wildlife) Regulation 2006* (NCWR). This report has considered the recent amendments made to listed threatened species in 2018.

### 3.1.4 Queensland *Vegetation Management Act 1999*

The *Vegetation Management Act 1999* (VM Act) is a part of a planning framework for the management of native vegetation across Queensland. The *Vegetation Management Regulation 2012* (VMR) prescribes the status of each of the Regional Ecosystems (REs) identified within Queensland.

Although the VM Act does not apply to the clearing of vegetation on the Project site, the scientific basis for biodiversity conservation is still valid and can be used to assess the conservation significance of the vegetation communities on the Project site. This includes the conservation status categories of each RE under the VM Act, which are listed below, as is the definition of Remnant Vegetation.

<sup>2</sup>Under the NC Act, wildlife is defined to be any taxon of an animal, plant, protist, prokaryote or virus.

<sup>3</sup> Under the *Nature Conservation Act 1992*, a protected plant is any threatened, near threatened or least concern wildlife. Similarly, protected fauna is defined as being any native wildlife prescribed under the Act.

Endangered Regional Ecosystems:

- <10% of pre-clearing extent remaining; and
- 10 - 30% of pre-clearing extent remaining and remnant <10,000 ha.

Of Concern Regional Ecosystems:

- 10 - 30% of pre-clearing distribution remains; and
- 30% of the pre-clearing extent remains and the remnant vegetation remaining is <10,000 ha.

Least Concern Regional Ecosystems:

- >30% of the pre-clearing distribution remains and remnant vegetation remaining is >10,000 ha.

Remnant Vegetation:

'Remnant Vegetation' for an area of Queensland for which there is no RE map or remnant vegetation map is any vegetation where the predominant canopy:

- covers more than 50% of the undisturbed predominant canopy;
- averages more than 70% of the vegetation's undisturbed height; and
- is composed of species characteristic of the vegetation's undisturbed dominant canopy.

### 3.1.5 Queensland *Biosecurity Act 2014*

The *Biosecurity Act 2014* provides comprehensive biosecurity measures to safeguard Queensland's economy, agricultural and tourism industries, environment and way of life, from:

- a) Pests;
- b) Diseases; and
- c) Contaminants.

Under the *Biosecurity Act 2014*, invasive plants and animals are classified as either prohibited or restricted matters. A Prohibited matter is a biosecurity matter not found in Queensland but would have a significant adverse impact on our health, way of life, the economy or the environment if it entered the state. Prohibited matters are listed in schedule 1 of the Biosecurity Act and include:

- Diseases, viruses or parasites;
- Invasive animals and plants (e.g. pest animal or weed);
- Exotic marine animals, plants or diseases;
- Noxious fish; and
- Insect pests.

A restricted matter is a biosecurity matter that is found in Queensland and has a significant impact on human health, social amenity, the economy or the environment. Restricted matters are listed in Schedule 2 of the Act and include:

- Diseases, viruses or parasites;
- Invasive animals and plants (e.g. pest animal or weed);
- Noxious fish; and
- Insect pests.

The Biosecurity Act is relevant to the Project site regarding the control and management of invasive plant and animal species.

### 3.1.6 Queensland Environmental Offsets 2014

The Queensland environmental offsets framework consists of the *Environmental Offsets Act 2014*, the *Environmental Offsets Regulation 2014* and the *Queensland Environmental Offsets Policy 2014* (DES, 2014). The offsets framework requires environmental offsets to be delivered where an activity is likely to result in a significant residual impact on a prescribed environmental matter. The *Significant Residual Impact Guideline* (DES, 2014a) is used to determine whether the residual impacts are considered to be significant.

Prescribed Environmental Matters include:

- Matters of National Environmental Significance (MNES);
- Matters of State Environmental Significance (MSES) (outlined below); and
- Matters of Local Environmental Significance (MLES).

MSES are defined in Schedule 2 of the *Environmental Offsets Regulation 2014*, and comprise:

- Regulated vegetation including:
  - i. Endangered and Of Concern regional ecosystems;
  - ii. Regional ecosystems that intersect areas shown as wetlands on the Vegetation Management Wetlands map;
  - iii. Regional ecosystems located within a prescribed distance from the defining banks of a watercourse; or
  - iv. Regional ecosystems mapped as essential habitat for endangered and vulnerable flora and fauna;
- Areas that provide connectivity and maintain ecosystem functioning;
- Mapped wetlands and watercourses including:
  - i. wetland protection areas, or areas of high ecological significance as shown on the Map of referable wetlands;

- ii. high ecological value waters (as defined under the Environmental Protection (Water) Policy 2009);
- Designated precincts in a strategic environmental area under the *Regional Planning Interests Regulation 2014*;
- Protected wildlife habitat, which includes;
  - High risk areas on the flora survey trigger map;
  - Areas that contain endangered or vulnerable plants;
  - Non-juvenile koala habitat trees in certain areas of south-east Queensland;
  - Habitat for endangered, vulnerable and special least concern animals;
- Protected areas and highly protected zones of State marine parks;
- Fish habitat areas;
- Waterways providing for fish passage;
- Marine plants; and
- Legally secured offsets.

Matters of Local Environmental Significance are set out in local planning instruments.

Offsets may be delivered as a financial settlement, Proponent-driven offset (i.e. a land-based offset or Direct Benefit Management Plan) or a combination of proponent-driven offset and financial settlement offset.

### **3.1.7 Planning Act 2016**

The purpose of the Planning Act 2016 is to establish a system of planning instruments and provides three main elements: plan making, development assessment and dispute resolution. This legislation is administered by state and local governments.

The system of instruments to facilitate the achievement of ecological sustainability includes:

- state planning policies
- regional plans
- planning schemes
- temporary local planning instruments
- planning scheme policies; and
- a development system, including the State Assessment and Referral Agency, for implementing planning policies and requirements about development.

Development of an ML are exempt from the requirement to obtain development permits under the Planning Act 2016 and the Planning Regulation 2017. Project activities that are located outside of an ML are subject to the Planning Act 2016, and for the Project, may include off-tenement accommodation and transport developments which may trigger assessment by the regional Charters Towers Regional Council.

### **3.1.8 Back on Track Species Prioritisation Framework**

The “Back on Track” (BoT) species prioritisation framework is a Queensland government initiative developed to:

- Prioritise Queensland's native species to guide conservation management and recovery;
- Enable the strategic allocation of limited conservation resources for achieving greatest biodiversity outcomes; and
- Increase the capacity of government, Natural Resource Management (NRM) bodies and communities to make informed decisions by making information widely accessible.

The framework prioritises all fauna and flora species irrespective of their classification under the NC Act or EPBC Act. A series of criteria are used to prioritise each species or taxon. This allows relevant parties to identify species that are at risk and species which have the greatest chance of recovery with available resources.

The framework also identifies actions and threats common to a range of species encouraging a multi-species or landscape approach to conservation.

A “Back on Track Actions for Biodiversity Document” has been produced to address priority species and associated impacts and actions for each NRM region. A list of priority species/taxa has been developed for each NRM region and a ‘Back on Track’ priority ranking has been given to each. A separate priority ranking for NRM region and state wide has been given to each species. The list of Priority Species for state and NRM region can be accessed from the Back on Track Actions for Biodiversity Document or by searching the Recovery Actions Database (RAD).



## 4.0 DATABASE SEARCH AND LITERATURE REVIEW

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Database searches gather information on flora and fauna species identified in the region from previous surveys, community records and other sources. A review of such databases facilitates the formulation of specific field survey techniques to target certain flora and fauna species known from the region. The results of these database searches revealed that several flora and fauna species of conservation significance are historically known to be present in the Project region.

The following database searches were conducted for the Project:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Search Tool – this search identifies flora and fauna species based on distribution and potential habitat. The database only pertains to species listed under the EPBC Act.
- Wildlife Online Database (Queensland Department of Environment and Heritage Protection (EHP)) – this database contains records of all flora and fauna collected from previous surveys, including Queensland Museum surveys as well as records from the public.

Searches were conducted using the central co-ordinates of each of the three tenements. A 100 km maximum buffer size was used for each search. Searches were also conducted with 5 km and 25 km buffers, in order to better gauge the likelihood of species occurring on or very close to the Project site.

A central coordinate for the Project was used to search the DES's protected plants flora survey trigger map. This map identifies high risk areas for protected plants and is used to help determine flora survey and clearing permit requirements for a particular location.

The DES's regulated vegetation management map and supporting map were reviewed in consultation with the Regional Ecosystem Description Database (REDD) to determine which remnant vegetation (category B), high-value regrowth vegetation (category C) and reef-regrowth watercourse vegetation (category R) communities were mapped on the Project site. The vegetation management supporting map also shows wetlands and watercourses and any mapped Essential Habitat for threatened species.

To identify any wetland values not shown on the vegetation management wetlands map, the Queensland Wetland Mapping Database was also searched. The DES's Map of Referable Wetlands was searched to identify any Wetland Protection Areas on the Project site or surrounding region.

The DES's Environmentally Sensitive Area (ESA) mapping was consulted to identify any ESAs on the Project site. ESAs include endangered REs, national parks, state forests, Ramsar wetlands and other protected areas.

Database searches have been carried out as part of the preparation for each survey conducted in the study area, however, for the purpose of this report only the most recent database searches have been included. These database searches are posterior to the latest amendments to the EPBC Act threatened species list on May 2018 and therefore up to date with the current species taxonomy and conservation status. Database search results are included in Appendix A and summarised below.

## **4.1 FLORA**

### **4.1.1 Flora Communities of Conservation Significance**

#### **4.1.1.1 Threatened Ecological Communities**

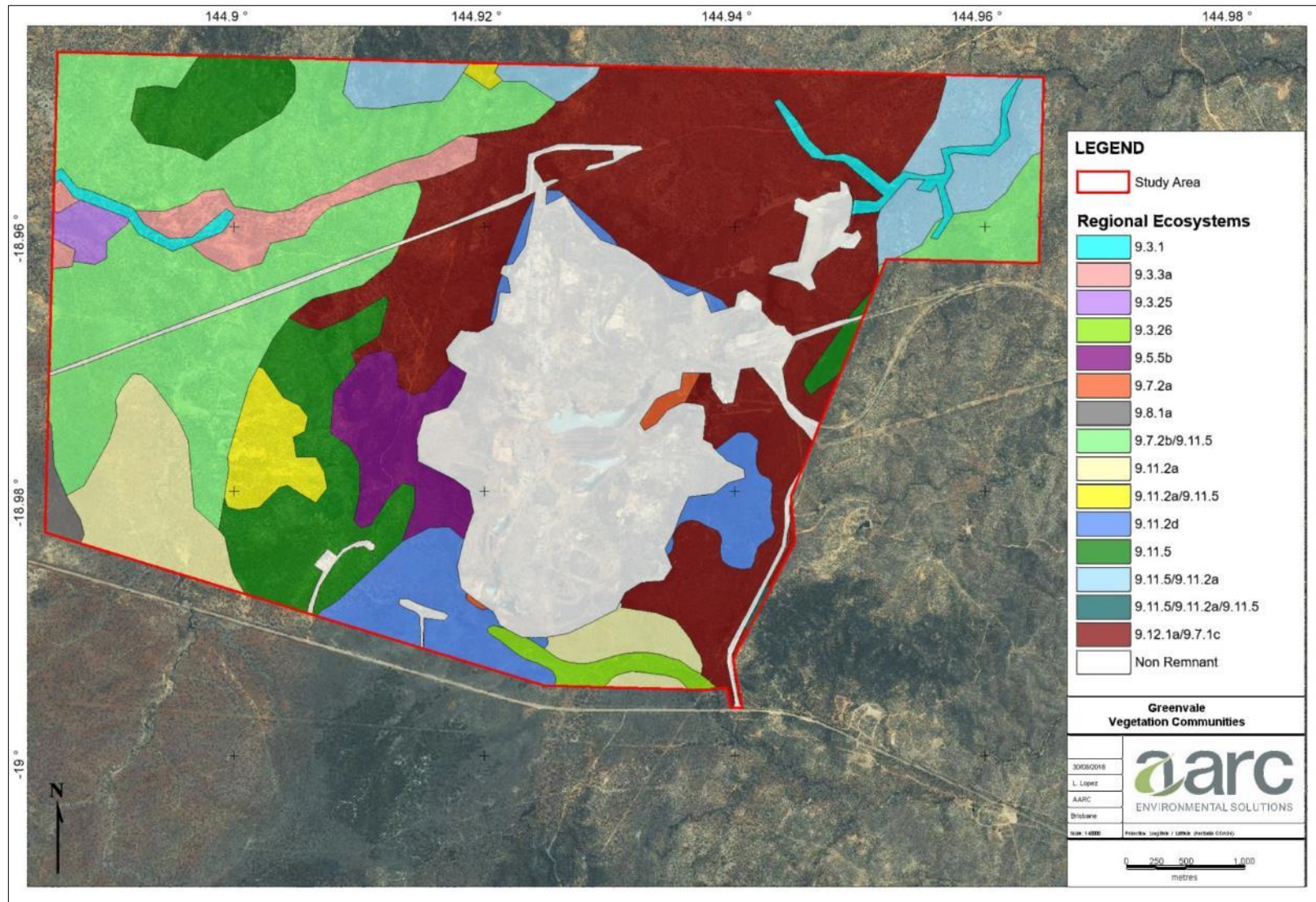
The Protected Matters Search Tool did not identify any Threatened Ecological Communities within 25 km of the Project area.

#### **4.1.1.2 Remnant Vegetation**

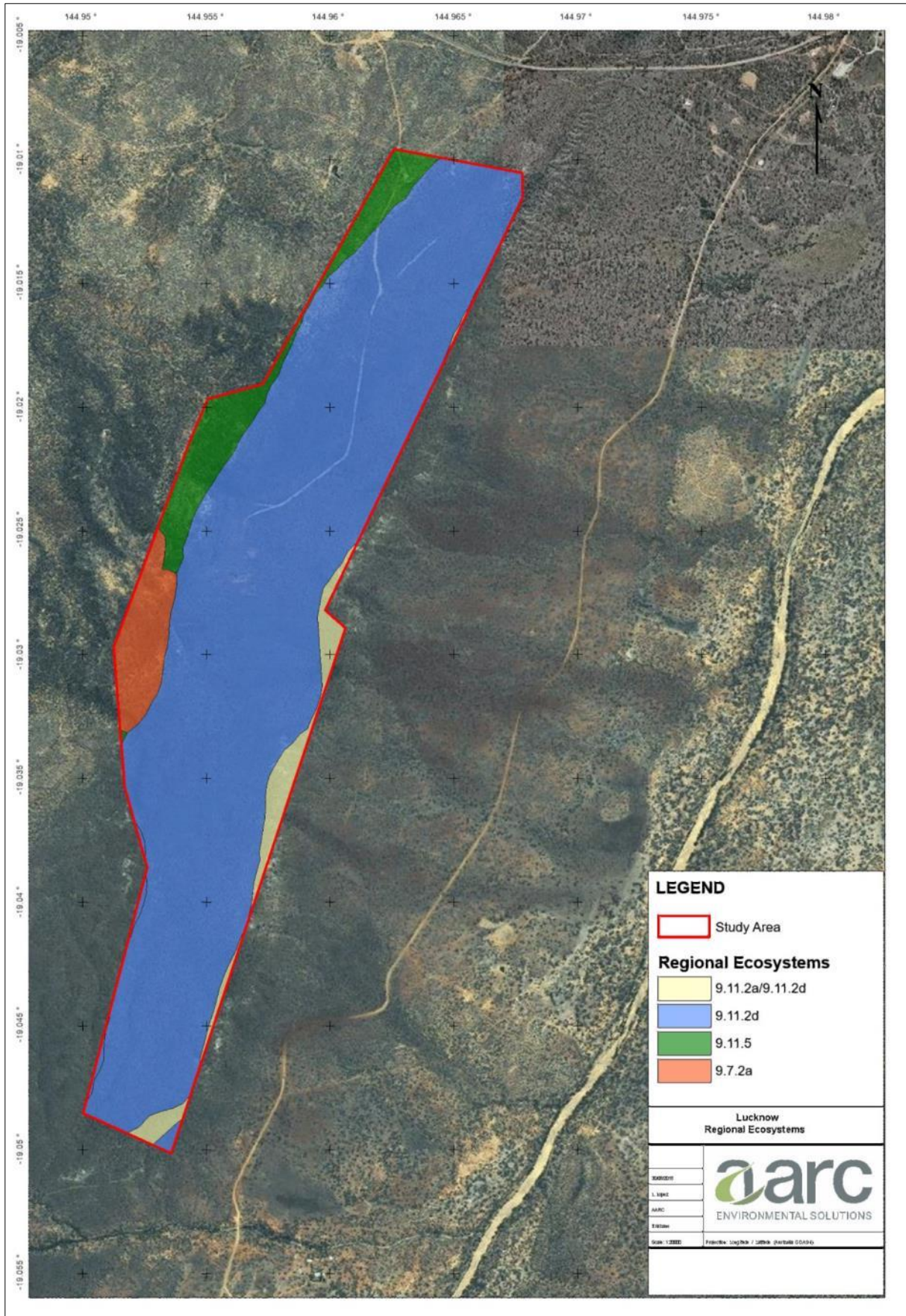
A review of the Queensland Government Regional Ecosystem (RE) mapping indicates the Project site contains 25 remnant REs, mapped as either whole or mixed polygons (e.g. 9.11.2a/9.11.5). All REs provided by this mapping are described in Table 1 below. Of the REs occurring on the Project site, two (RE 9.3.4 and 9.11.9) are listed under the VM Act and the Biodiversity Status as Of Concern. All REs present in landzone 3 and 5 (alluvium and old loamy and sandy plains respectively) except for RE 9.3.6a, are listed as Least Concern under the VM Act but Of Concern under the Biodiversity Status. The remaining REs are listed as Least Concern under the VM Act and No Concern at present under the Biodiversity Status. The RE map for the Project site is shown in Figure 6, Figure 7 and Figure 8.

**Table 1 Regional ecosystems mapped within the Project study area**

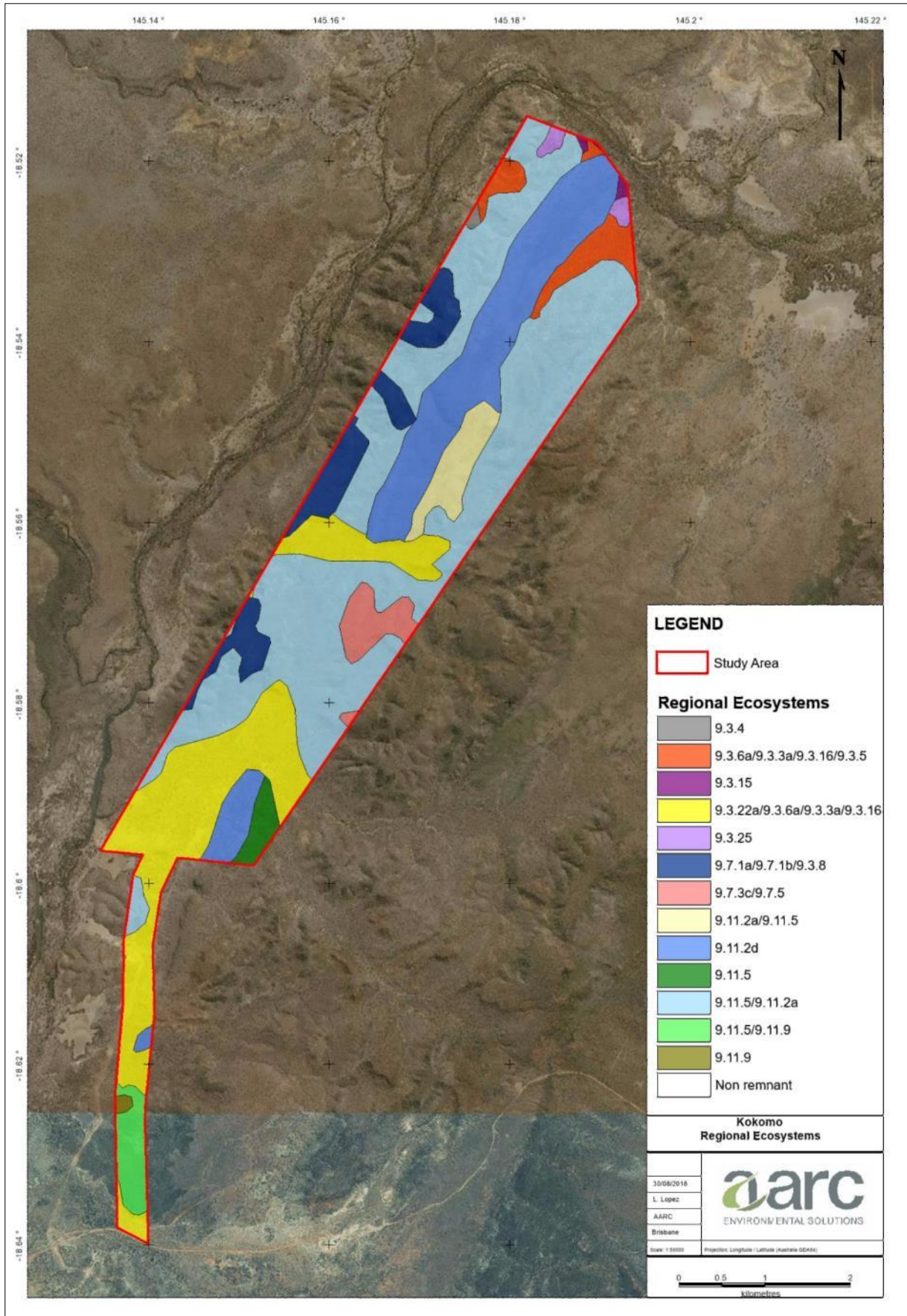
Regional Ecosystem	Description	VM Act Status	EHP Biodiversity Status
9.3.1	<i>Eucalyptus camaldulensis</i> and/or <i>E. tereticornis</i> +/- <i>Melaleuca</i> spp. +/- <i>Casuarina cunninghamiana</i> fringing woodland on channels and levees	Least Concern	Of Concern
9.3.3a	<i>Corymbia</i> spp. and <i>Eucalyptus</i> spp. dominated mixed woodland on alluvial flats, levees and plains	Least Concern	Of Concern
9.3.4	Permanent or seasonal wetlands frequently fringed by narrow bands of trees and shrubs including <i>Eucalyptus</i> spp. on alluvial plains	Of Concern	Of Concern
9.3.5	<i>Eucalyptus brownii</i> +/- <i>Eucalyptus</i> spp. +/- <i>Corymbia</i> spp. open woodland on alluvial plains	Least Concern	Of Concern
9.3.6a	<i>Eucalyptus platyphylla</i> +/- <i>Eucalyptus</i> spp. +/- <i>Corymbia</i> spp. woodland on alluvial plains	Least Concern	No concern at present
9.3.8	<i>Eucalyptus moluccana</i> woodland on alluvial deposits	Least Concern	Of Concern
9.3.15	<i>Eucalyptus tereticornis</i> +/- <i>Casuarina cunninghamiana</i> +/- <i>Melaleuca</i> spp. fringing woodland on channels and levees	Least Concern	Of Concern
9.3.16	<i>Eucalyptus tereticornis</i> and/or <i>E. platyphylla</i> and/or <i>Corymbia clarksoniana</i> woodland on alluvial flats, levees and plains	Least Concern	Of Concern
9.3.22a	<i>Eucalyptus crebra</i> or <i>E. cullenii</i> +/- <i>Corymbia</i> spp. open woodland on alluvial levees and terraces	Least Concern	Of Concern
9.3.25	<i>Dichanthium</i> spp., and/or <i>Astrebala</i> spp. +/- <i>Iseilema</i> spp. grassland on alluvial deposits derived from basalt soils	Least Concern	Of Concern
9.3.26	Mixed grassland to open grassland including <i>Eragrostis</i> sp., <i>Aristida</i> sp., <i>Enneapogon</i> sp., <i>Iseilema</i> sp., <i>Chloris</i> sp., or <i>Dichanthium</i> sp. on non-basalt derived alluvial deposits	Least Concern	Of Concern
9.5.5b	<i>Corymbia clarksoniana</i> , <i>Eucalyptus portuensis</i> , <i>E. crebra</i> and <i>C. citriodora</i> subsp. <i>citriodora</i> in mixed open forests on red kandosols on Tertiary surfaces	Least Concern	Of Concern
9.7.1a	<i>Eucalyptus persistens</i> woodland on lateritised and deeply weathered surfaces on undulating terrain	Least Concern	No concern at present
9.7.1b			
9.7.1c			
9.7.2a	<i>Acacia shirleyi</i> low woodland on mesas and lateritised surfaces	Least Concern	No concern at present
9.7.2b			
9.7.3c	<i>Eucalyptus crebra</i> or <i>E. portuensis</i> +/- <i>Corymbia clarksoniana</i> woodland on lateritised surfaces and edges of Tertiary surfaces	Least Concern	No concern at present
9.7.5	<i>Corymbia setosa</i> and/or <i>C. peltata</i> low open woodland on lateritised and deeply weathered surfaces	Least Concern	No concern at present
9.8.1a	<i>Eucalyptus crebra</i> +/- <i>Corymbia dallachiana</i> +/- <i>E. leptophleba</i> open woodland on plains and rocky rises of basalt geologies	Least Concern	No concern at present
9.11.2a	<i>Eucalyptus crebra</i> (or several other ironbark species) +/- <i>Corymbia</i> spp. woodland on shallow texture contrast soils on low metamorphic hills and lowlands	Least Concern	No concern at present
9.11.2d			
9.11.5	<i>Eucalyptus persistens</i> +/- <i>E. crebra</i> woodland on low metamorphic hills	Least Concern	No concern at present
9.11.9	Semi-deciduous vine thicket on metamorphic soils (not limestone)	Of Concern	Of Concern
9.12.1a	<i>Eucalyptus crebra</i> and/or <i>E. xanthoclada</i> and/or <i>E. drepanophylla</i> low open woodland on igneous rocks	Least Concern	No concern at present



**Figure 6 Greenvale Regional Ecosystem map**



**Figure 7 Lucknow Regional Ecosystem map**



**Figure 8 Kokomo Regional Ecosystem map**

#### **4.1.1.3 Regulated Vegetation Category C (high-value regrowth vegetation)**

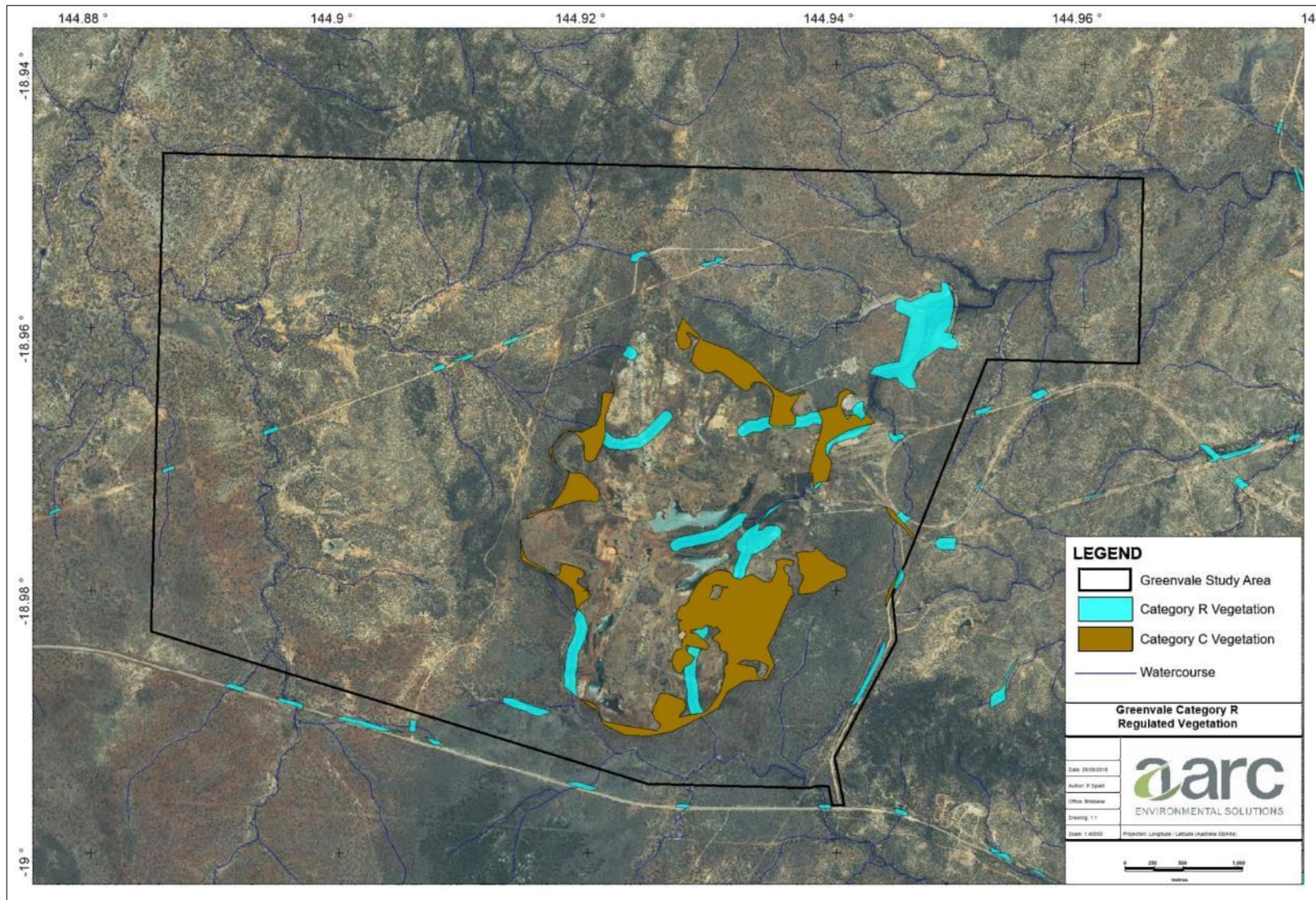
Category C area is an area which is high-value regrowth vegetation on freehold land, Indigenous land or land subject of a lease issued under the Land Act 1994 for agriculture or grazing purposes or an occupation licence under that Act in an area that has not been cleared in the last 15 years which is also an Endangered, of Concern or Least Concern regional ecosystem.

Desktop searches of the DES vegetation data revealed that there are areas of High-Value Regrowth Vegetation containing Least Concern Regional Ecosystems in Greenvale tenement, within the Project area.

#### **4.1.1.4 Regulated Vegetation Management Category R (reef-regrowth watercourse vegetation)**

Category R area is an area which is a regrowth watercourse and drainage feature area located within 50 metres (m) of a watercourse located in the Burdekin, Burnett-Mary, Eastern Cape York, Fitzroy, Mackay-Whitsunday or Wet Tropics catchments identified on the vegetation management watercourse and drainage feature map.

Desktop searches of the DES vegetation data revealed that there are small areas of Reed-Regrowth Watercourse containing Least Concern Regional Ecosystems in Greenvale tenement within the Project area.



**Figure 9 Category C and Category R Vegetation in Greenvale tenement**



### 4.1.2 Flora Species of Conservation Significance

The database searches (Appendix A) indicated that 101 flora species of conservation significance have been identified in the vicinity of the Project site. These species and their recorded occurrence within 5 km, 25 km and 100 km of the Greenvale, Lucknow and Kokomo tenements are shown in Appendix B. The majority of the species detected by the searches are rainforest species from the Wet Tropics region and are highly unlikely to occur within the Project site.

To ensure the survey team were familiar with these species of conservation significance, research into their growth form, ecology and appearance was undertaken prior to field surveys. The likelihood of these species occurring on the Project site is discussed in 6.3.

### 4.1.3 Back on Track Flora Species

The RAD search results indicate twenty-nine BoT priority flora species occur in the Burdekin NRM region. These species are listed in Table 2. This table identifies the BoT level of priority, NC Act and EPBC Act classifications for each species.

**Table 2 Back on Track Priority Flora Species for the Burdekin NRM Region**

Scientific Name	Common Name	NRM BoT Priority Ranking	State BoT Priority Ranking	NC Act Status	EPBC Act Status
<i>Acacia tingoorensis</i>		Critical	High	Vulnerable	Not Listed
<i>Aponogeton queenslandicus</i>		High	Medium	Least Concern	Not Listed
<i>Brunoniella spiciflora</i>		High	High	Least Concern	Not Listed
<i>Corchorus hygrophilus</i>		High	Medium	Vulnerable	Not Listed
<i>Cycas desolata</i>		High	Medium	Vulnerable	Not Listed
<i>Cycas platyphylla</i>		Critical	High	Vulnerable	Vulnerable
<i>Eriocaulon carsonii</i>	Salt Pipewort	Critical	High	Endangered	Endangered
<i>Eryngium fontanum</i>		Critical	High	Endangered	Endangered
<i>Eucalyptus raveretiana</i>	Black Ironbox	High	High	Least Concern	Vulnerable
<i>Glycyrrhiza acanthocarpa</i>		High	Medium	Least Concern	Not Listed
<i>Hemigenia sp. (Homestead E.J.Thompson+ CHA203)</i>		High	Medium	Least Concern	Not Listed
<i>Homoranthus porteri</i>		High	Medium	Vulnerable	Vulnerable
<i>Hydrocharis dubia</i>	Frogbit	High	Medium	Not Listed	Not Listed
<i>Hydrocotyle dippleura</i>		Critical	High	Vulnerable	Not Listed
<i>Ipomoea saintronanensis</i>		Critical	Critical	Vulnerable	Not Listed
<i>Lawrenzia buchananensis</i>		High	Medium	Vulnerable	Vulnerable
<i>Livistona drudei</i>	Halifax fan palm	High	Medium	Vulnerable	Not Listed
<i>Livistona lanuginosa</i>		Critical	Critical	Vulnerable	Vulnerable
<i>Marsdenia brevifolia</i>		High	High	Vulnerable	Vulnerable
<i>Myriophyllum artesium</i>		High	High	Endangered	Not Listed

Scientific Name	Common Name	NRM BoT Priority Ranking	State BoT Priority Ranking	NC Act Status	EPBC Act Status
<i>Myrmecodia beccarii</i>		Critical	High	Vulnerable	Vulnerable
<i>Pararistolochia praevenosa</i>		High	High	Near Threatened	Not Listed
<i>Pisonia grandis</i>		High	High	Least Concern	Not Listed
<i>Plectranthus graniticola</i>		Critical	High	Vulnerable	Not Listed
<i>Solanum adenophorum</i>		High	High	Endangered	Not Listed
<i>Solanum angustum</i>		High	Medium	Endangered	Not Listed
<i>Solanum graniticum</i>		High	Medium	Endangered	Not Listed
<i>Stephania bancroftii</i>		High	Medium	Least Concern	Not Listed
<i>Trioncinia retroflexa</i>		Critical	High	Endangered	Not Listed

## 4.2 FAUNA

### 4.2.1 Fauna Species of Conservation Significance

The database searches (Appendix A) indicated that 75 fauna species of conservation significance have been identified in the vicinity of the Project site. These species and their recorded occurrence within 5 km, 25 km and 100 km of the Greenvale, Lucknow and Kokomo tenements are shown in Appendix B. No Essential Habitat for threatened species was recorded on the Project site. The majority of the species detected by the searches are rainforest species from the Wet Tropics region and are highly unlikely to occur within the Project site.

The 100 km buffer Protected Matters search identified several marine species. As the Project area is not located in a marine area, marine species have been omitted from the search results presented below. The full desktop search results are presented in Appendix A.

To ensure the survey team were familiar with these species of conservation significance, research into their growth form, ecology and appearance was undertaken prior to field surveys. The likelihood of these species occurring on the Project site is discussed in 7.6.

### 4.2.2 Back on Track Fauna Species

The RAD search results indicate fifty-three BoT priority terrestrial fauna species occur in the Burdekin NRM region. These species are listed in Table 3. This table identifies the BoT level of priority, NC Act and EPBC Act classifications for each species. It should be noted that marine animals have been excluded from these results.

**Table 3 Back on Track Priority Fauna Species for the Burdekin NRM Region**

Scientific Name	Common Name	NRM BoT Priority Ranking	State BoT Priority Ranking	NC Act Status	EPBC Act Status
<b>Birds</b>					
<i>Artamus cinereus normani</i>	Black-faced Woodswallow (Cape York Peninsula)	Critical	High	Least Concern	Not Listed
<i>Casuarius casuarius johnsonii</i> (southern population)	Southern Cassowary (southern population)	Critical	Critical	Vulnerable	Endangered
<i>Erythrotriorchis radiatus</i>	Red Goshawk	High	High	Endangered	Vulnerable
<i>Esacus magnirostris</i>	Beach Stone-curlew	High	High	Vulnerable	Not Listed
<i>Grantiella picta</i>	Painted Honeyeater	High	High	Vulnerable	Vulnerable
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	High	High	Vulnerable	Not Listed
<b>Mammals</b>					
<i>Bettongia tropica</i>	Northern Bettong	Critical	Critical	Endangered	Endangered
<i>Dasyurus hallucatus</i>	Northern Quoll	High	Medium	Least Concern	Endangered
<i>Dasyurus maculatus gracilis</i>	Spotted-tailed Quoll (northern subspecies)	Critical	Critical	Endangered	Endangered
<i>Kerivoula papuensis</i>	Golden-tipped Bat	High	Medium	Least Concern	Not Listed
<i>Lasiorhinus krefftii</i>	Northern Hairy-nosed Wombat	Critical	Critical	Endangered	Critically Endangered
<i>Macroderma gigas</i>	Ghost Bat	Critical	Critical	Endangered	Vulnerable
<i>Macrotis lagotis</i>	Greater Bilby	Critical	Critical	Endangered	Vulnerable
<i>Murina florium</i>	Tube-nosed Insectivorous Bat	High	High	Vulnerable	Not Listed
<b>Reptiles</b>					
<i>Acanthophis antarcticus</i>	Common Death Adder	High	Medium	Vulnerable	Not Listed
<i>Anomalopus brevicollis</i>		High	High	Least Concern	Not Listed
<i>Delma labialis</i>	Striped-tailed Delma	High	Medium	Least Concern	Not Listed
<i>Denisonia maculata</i>	Ornamental Snake	High	Medium	Vulnerable	Vulnerable
<i>Egernia rugosa</i>	Yakka Skink	High	Medium	Vulnerable	Vulnerable
<i>Eseya irwini</i>	Irwin's turtle	High	High	Least Concern	Not Listed
<i>Lerista allanae</i>	Allan's Lerista	Critical	High	Endangered	Endangered
<b>Others</b>					
<i>Badamia exclamationis</i>	Narrow-winged Awl	High	Medium	Not Listed	Not Listed
<i>Bentosites hefferani</i>	Mount Inkerman Banded Snail	Critical	High	Not Listed	Not Listed

Scientific Name	Common Name	NRM BoT Priority Ranking	State BoT Priority Ranking	NC Act Status	EPBC Act Status
<i>Steorra estherlilleya</i>	Giant Paluma Banded Snail	Critical	Critical	Not Listed	Not Listed
<i>Hypochrysops apollo apollo</i>	Apollo jewel (Wet Tropics subspecies)	Critical	High	Not Listed	Not Listed
<i>Jalmenus eubulus</i>	Pale Imperial Hairstreak	High	Medium	Vulnerable	Not Listed

#### 4.2.3 Migratory Fauna Species

The EPBC Protected Matters search indicated 46 species of marine and/or migratory animals may potentially occur on the Project site. These species are listed in Table 4.

**Table 4 Marine and Migratory Animals identified near the Greenvale tenement from Desktop Searches**

Scientific Name	Common Name	EPBC status	Presence in Buffer Area		
			5 km	25 km	100 km
<b>Birds</b>					
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, Ma	x	x	x
<i>Anseranas semipalmata</i>	Magpie Goose	Ma	x	x	x
<i>Apus pacificus</i>	Fork-tailed Swift	Mi, Ma	x	x	x
<i>Ardea alba</i>	Great Egret	Ma	x	x	x
<i>Ardea ibis</i>	Cattle Egret	Ma	x	x	x
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, Ma	x	x	x
<i>Calidris ferruginea</i>	Curlew Sandpiper	Mi, Ma	x	x	x
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi, Ma	x	x	x
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo	Ma	x	x	x
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi	x	x	x
<i>Cuculus saturatus</i>	Oriental Cuckoo	Ma	x	x	x
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi, Ma	x	x	x
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Ma	x	x	x

Scientific Name	Common Name	EPBC status	Presence in Buffer Area		
			5 km	25 km	100 km
<i>Hirundapus caudacutus</i>	White-throated Needletail	Mi, Ma			x
<i>Hirundo rustica</i>	Barn Swallow	Mi, Ma	x	x	x
<i>Merops ornatus</i>	Rainbow Bee-eater	Ma	x	x	x
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi, Ma	x	x	x
<i>Monarcha trivirgatus</i>	Spectacled Monarch	Mi, Ma			x
<i>Motacilla cinerea</i>	Grey Wagtail	Mi, Ma	x	x	x
<i>Motacilla flava</i>	Yellow Wagtail	Mi, Ma	x	x	x
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi, Ma		x	x
<i>Numenius madagascariensis</i>	Eastern Curlew	Mi, Ma			x
<i>Pandion haliaetus</i>	Osprey	Mi, Ma	x	x	x
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi, Ma		x	x
<i>Rostratula benghalensis (sensu lato)</i>	Painted Snipe	Ma	x	x	x
<i>Tringa nebularia</i>	Common Greenshank	Mi, Ma		x	x
<b>Reptiles</b>					
<i>Crocodylus johnstoni</i>	Freshwater Crocodile	Ma		x	x
<i>Crocodylus porosus</i>	Salt-water Crocodile	Mi, Ma			x

EPBC – Environment Protection and Biodiversity Conservation Act 1999

Ma – Marine species

Mi – Migratory species

**Table 5 Marine and Migratory Animals identified near the Lucknow tenement from Desktop Searches**

Scientific Name	Common Name	EPBC status	Presence in Buffer Area		
			5 km	25 km	100 km
<b>Birds</b>					
<i>Anseranas semipalmata</i>	Magpie Goose	Ma	x	x	x
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, Ma	x	x	x
<i>Apus pacificus</i>	Fork-tailed Swift	Mi, Ma	x	x	x
<i>Ardea alba</i>	Great Egret	Ma	x	x	x
<i>Ardea ibis</i>	Cattle Egret	Ma	x	x	x
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, Ma	x	x	x
<i>Calidris ferruginea</i>	Curlew Sandpiper	Mi, Ma	x	x	x
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi, Ma	x	x	x
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo	Ma	x	x	x
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi	x	x	x
<i>Cuculus saturatus</i>	Oriental Cuckoo	Ma		x	x
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi, Ma	x	x	x
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Ma	x	x	x
<i>Hirundapus caudacutus</i>	White-throated Needletail	Mi, Ma			x
<i>Hirundo rustica</i>	Barn Swallow	Mi, Ma	x	x	x
<i>Merops ornatus</i>	Rainbow Bee-eater	Ma	x	x	x
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi, Ma	x	x	x
<i>Monarcha trivirgatus</i>	Spectacled Monarch	Mi, Ma			x
<i>Motacilla cinerea</i>	Grey Wagtail	Mi, Ma	x	x	x
<i>Motacilla flava</i>	Yellow Wagtail	Mi, Ma	x	x	x
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi, Ma	x	x	x

Scientific Name	Common Name	EPBC status	Presence in Buffer Area		
			5 km	25 km	100 km
<i>Numenius madagascariensis</i>	Eastern Curlew	Mi, Ma			x
<i>Pandion haliaetus</i>	Osprey	Mi, Ma	x	x	x
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi, Ma		x	x
<i>Rostratula benghalensis (sensu lato)</i>	Painted Snipe	Ma	x	x	x
<i>Tringa nebularia</i>	Common Greenshank	Mi, Ma		x	x
<b>Reptiles</b>					
<i>Crocodylus johnstoni</i>	Freshwater Crocodile	Ma		x	x
<i>Crocodylus porosus</i>	Salt-water Crocodile	Mi, Ma			x

EPBC – Environment Protection and Biodiversity Conservation Act 1999

Ma – Marine species

Mi – Migratory species

**Table 6 Marine and Migratory Animals identified near the Kokomo tenement from Desktop Searches**

Scientific Name	Common Name	EPBC status	Presence in Buffer Area		
			5 km	25 km	100 km
<b>Birds</b>					
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, Ma	x	x	x
<i>Anseranas semipalmata</i>	Magpie Goose	Ma	x	x	x
<i>Anous stolidus</i>	Common Noddy	Mi, Ma			x
<i>Apus pacificus</i>	Fork-tailed Swift	Mi, Ma	x	x	x
<i>Ardea alba</i>	Great Egret	Ma	x	x	x
<i>Ardea ibis</i>	Cattle Egret	Ma	x	x	x
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, Ma	x	x	x
<i>Calidris canutus</i>	Red Knot	Mi, Ma			x
<i>Calidris ferruginea</i>	Curlew Sandpiper	Mi, Ma	x	x	x
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi, Ma	x	x	x

Scientific Name	Common Name	EPBC status	Presence in Buffer Area		
			5 km	25 km	100 km
<i>Calidris ruficollis</i>	Red-necked Stint	Mi, Ma			x
<i>Calidris tenuirostris</i>	Great Knot	Mi, Ma			x
<i>Charadrius leschenaultii</i>	Greater Sand Plover	Mi, Ma			x
<i>Charadrius mongolus</i>	Lesser Sand Plover	Mi, Ma			x
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo	Ma	x	x	x
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi	x	x	x
<i>Cuculus saturatus</i>	Oriental Cuckoo	Ma	x	x	x
<i>Fregata ariel</i>	Lesser Frigabird	Mi, Ma			x
<i>Fregata minor</i>	Great Frigabird	Mi, Ma			x
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi, Ma	x	x	x
<i>Gallinago megala</i>	Swinhoe's Snipe	Mi, Ma			x
<i>Gallinago stenura</i>	Pin-tailed Snipe	Mi, Ma			x
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Ma	x	x	x
<i>Heteroscelus brevipes</i>	Grey-tailed Tattler	Mi, Ma			x
<i>Hirundapus caudacutus</i>	White-throated Needletail	Mi, Ma			x
<i>Hirundo rustica</i>	Barn Swallow	Mi, Ma	x	x	x
<i>Limosa lapponica</i>	Bar-tailed Godwit	Mi, Ma			x
<i>Merops ornatus</i>	Rainbow Bee-eater	Ma	x	x	x
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi, Ma	x	x	x
<i>Monarcha trivirgatus</i>	Spectacled Monarch	Mi, Ma			x
<i>Motacilla cinerea</i>	Grey Wagtail	Mi, Ma	x	x	x
<i>Motacilla flava</i>	Yellow Wagtail	Mi, Ma	x	x	x
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi, Ma	x	x	x
<i>Numenius madagascariensis</i>	Eastern Curlew	Mi, Ma		x	x
<i>Numenius minutus</i>	Little Curlew	Mi, Ma			x
<i>Numenius phaeopus</i>	Whimbrel	Mi, Ma			x
<i>Pandion haliaetus</i>	Osprey	Mi, Ma	x	x	x



Scientific Name	Common Name	EPBC status	Presence in Buffer Area		
			5 km	25 km	100 km
<i>Pluvialis squatarola</i>	Grey Plover	Mi, Ma			x
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi, Ma		x	x
<i>Rostratula benghalensis (sensu lato)</i>	Painted Snipe	Ma	x	x	x
<i>Sternula albifrons</i>	Little Tern	Mi, Ma			x
<i>Tringa brevipes</i>	Grey-tailed Tattler	Mi			x
<i>Tringa nebularia</i>	Common Greenshank	Mi, Ma	x	x	x
<i>Xenus cinereus</i>	Terek Sandpiper	Mi, Ma			x
<b>Reptiles</b>					
<i>Crocodylus johnstoni</i>	Freshwater Crocodile	Ma			x
<i>Crocodylus porosus</i>	Salt-water Crocodile	Mi, Ma			x

EPBC – Environment Protection and Biodiversity Conservation Act 1999  
 Ma – Marine species  
 Mi – Migratory species

### 4.3 ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Area (ESA) mapping presents Category A, B, and C areas of conservation significance, National Parks, Conservation Parks, Forest Reserves, Nature Refuges, Resource Refuges, Endangered Regional Ecosystems and areas listed under the Directory of Important Wetlands.

The ESA mapping for the Greenvale, Lucknow and Kokomo tenements is presented in Appendix A. No ESAs are present within the Project site. One wetland area associated with the Burdekin River is mapped 1 – 1.5 km east of the Kokomo tenement. This wetland is listed in the Directory of Important Wetlands in Australia managed by the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC).

### 4.4 FLORA TRIGGER MAP

A protected plants flora survey trigger map was generated using co-ordinates centred on each of the tenements of the Project site. This map is produced by generating a two-kilometre buffer around known locations of protected flora species. The search was undertaken to identify any areas at high risk of supporting protected flora species on the Project or surrounding lands. Areas shown on the map as high risk are subject to particular requirements under Queensland legislation. This search revealed there were no high-risk areas of possible protected flora species existing within the Project site. The Flora trigger mapping for the Greenvale, Lucknow and Kokomo tenements is presented in Appendix A.

## **4.5 WETLANDS**

### **4.5.1 Queensland Wetlands Program**

The Queensland Wetland Program wetland mapping provides detailed 1:50,000 (coastal) – 1:100,000 (inland) scale mapping of wetlands in Queensland.

The Queensland Wetland Map Version 4.0 map of the Project site shows three small palustrine systems in the north-west of the Kokomo tenement, all associated with a remnant Regional Ecosystem (RE) unit containing areas of wetland (9.3.25), and one palustrine wetland in the north-east of the Greenvale tenement (the Stenhouse dam). Several small creek channels, Policeman's Waterhole wetland and a significant riverine system (Burdekin River) are also located in close proximity to the Project. The Wetland mapping for the Greenvale, Lucknow and Kokomo tenements is presented in Appendix A.

Palustrine wetlands can provide nesting sites for birds, roosting sites for bats, food sources for migratory species, and filtration of the water moving through them by removing contaminants and nutrients. These wetlands were targeted for assessment of conservation values during the field surveys.

### **4.5.2 Referable Wetlands**

The Sustainable Planning Regulation 2009 defines a Referable Wetland as an area shown as a wetland on a 'Map of Referable Wetlands'.

The current map of Referable Wetlands in Queensland was derived from the RE mapping undertaken by the Queensland State government. The current map of Referable Wetlands includes areas dominated by wetlands and other areas where RE mapping indicates that the area may contain a minor proportion of wetlands. Wetlands mapping conducted as part of the Queensland Wetland Program (4.5.1) is considered to provide a more detailed and more accurate indication of wetlands over the Project site.

## 5.0 FIELD SURVEY METHODOLOGY

### 5.1 SURVEY TIMING

A total of nine ecological surveys were conducted in the Project area. Each tenement was surveyed in both the wet and dry seasons from 2009 to 2011 in order to capture seasonal variation in flora and fauna assemblages. Further surveys of each of the tenements were conducted in 2012, 2013 and 2018 in response to changes in the Project boundary. Table 7 shows the details of the surveys.

**Table 7 Ecology Survey Details**

Tenement	Survey Dates	Survey Type	Duration
Kokomo	August 5 – 11, 2009	Dry season	7 days
Kokomo	April 13 – 19, 2010	Wet season	7 days
Greenvale and Lucknow	September 7 – 13, 2010	Dry season	7 days
Greenvale and Lucknow	April 6 – 12, 2011	Wet season	7 days
Greenvale and Lucknow	March 9 – 14, 2012	Wet season	7 days
Greenvale and Lucknow	January 14 – 23, 2013	Wet Season	10 days
Kokomo	March 11 – 17, 2013	Wet Season	7 days
Kokomo	May 21 – June 1, 2018	Dry season	12 days
Greenvale and Lucknow	June 6 – 20, 2018	Dry season	14 days

### 5.2 INITIAL SITE SCOPING

Site scoping was conducted through the examination of aerial photography, satellite imagery and existing DES RE and Essential Habitat Mapping. This enabled the ecologists to gain an overall perspective of the vegetation distribution and landscape features on the Project site. Desktop analysis also allowed the survey team to predict the location of trapping efforts according to the basic understanding of REs and landforms from government maps.

Vehicle-based reconnaissance was carried out, where possible, to assist in locating suitable survey sites, maximising the representative vegetation and fauna habitat survey coverage. This also aided in targeting habitats potentially occupied by species of conservation significance. Areas of potential sensitivity (for example, creek lines and endangered communities) were surveyed on foot. This allowed further ecological familiarisation and comprehensive survey coverage.

### 5.3 FLORA SURVEY METHODOLOGY

The flora survey was designed and conducted in accordance with the current version at the time of the survey of *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner et al. 2017) in order to meet the following objectives:

- Obtain a detailed floristic summary of the Project site through the compilation of a flora species list;
- Define distinct vegetation communities and compile detailed descriptions of the floristic assemblages in each community;
- Identify threatened or conservation significant flora species and ecological communities; and
- Produce a comprehensive site vegetation map at a 1:10 000 scale to survey appropriate Quaternary and Secondary sites.

Neldner et al. (2017) describes four levels of sampling. Two of these sampling techniques (Secondary transects and Quaternary plots) were used in the flora assessment for the Project. Each survey technique was undertaken as follows:

- **Secondary Transect** – consist of a 10 m x 50 m transect, precisely marked using a Global Positioning System (GPS) and accurately measured with a marking tape. Data recorded at each Secondary site included a complete floral assemblage (all species observed from each vegetation layer). Species that fall outside the plot but are deemed typical of the community are also listed. Where a plant could not be positively identified to species level, a voucher specimen was collected for identification by the Queensland Herbarium. Relative abundance for individual woody species in each stratum, stem density, foliage projection cover and height of the tree and shrub layers was recorded. Percentage composition of each ground cover species was recorded in five 1 m x 1 m quadrats located at 10 m intervals along the transect line. A minimum of three representative Secondary transects were positioned in each of the REs throughout the ecology surveys. A total of 69 secondary transects were surveyed during the ecological survey.
- **Quaternary Plot** – These rapid vegetation surveys include marking the GPS location, recording the dominant species in the characteristic layers along with soil/landform and structural data. Recording soil and landform data is essential as many REs can only be differentiated by the land zone they occur on, due to their floristic assemblage descriptions being virtually identical. Quaternary plots are commonly used in the ground truthing of mapping previously completed for the local area. The plots are projected on a geographical information system and used in conjunction with local geological maps (which determine land zone) to effectively map the vegetation of the site. A total of 1214 Quaternary plots were surveyed within the Project area to ensure adequate site coverage and meet the minimum observation requirements for vegetation mapping at the 1:10 000 scale (i.e. 25 Observations/100ha).

Flora and habitat values identified in the desktop assessment and initial ground survey were targeted in the site selection process. Flora transects were sampled during all surveys to ensure sampling across a variety of seasonal conditions to obtain a comprehensive inventory of flora species on the Project site.

The condition and quality of vegetation at each survey site was assessed. Attention was paid to identifying the presence of weeds, and species of conservation significance or potential habitat for species of conservation significance.

The locations of the flora survey sites within the study are shown in Figure 10, Figure 11 and Figure 12.

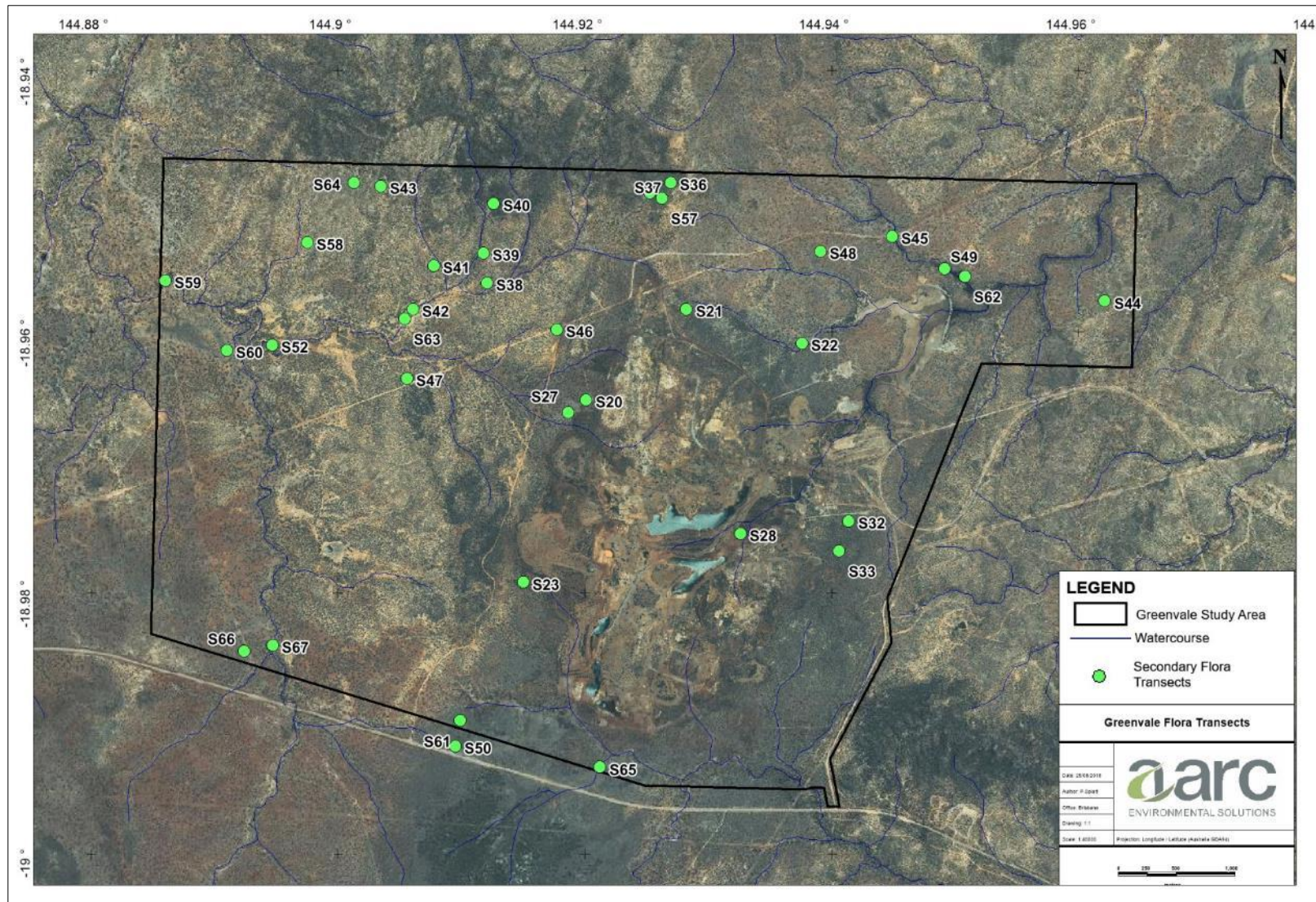
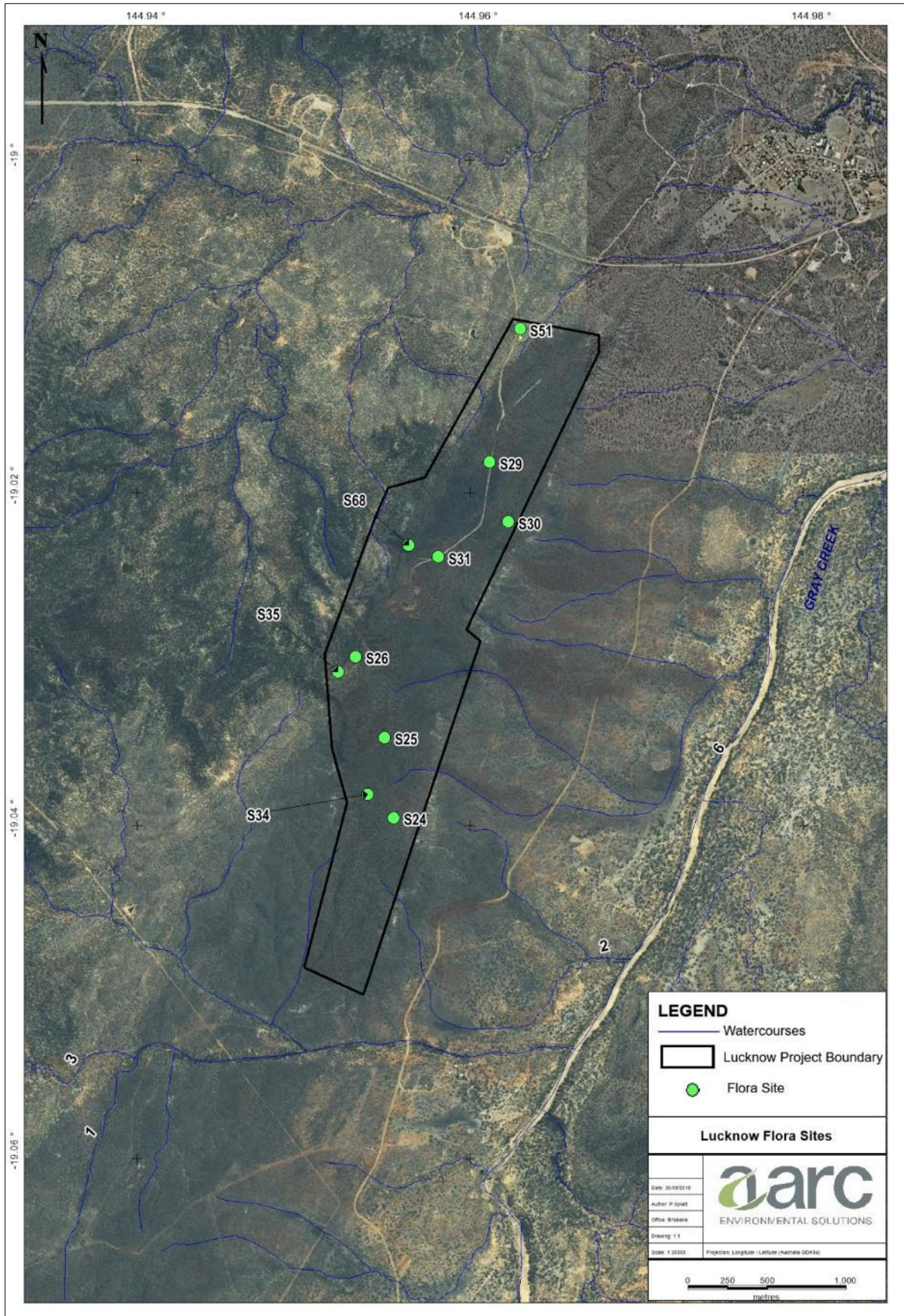
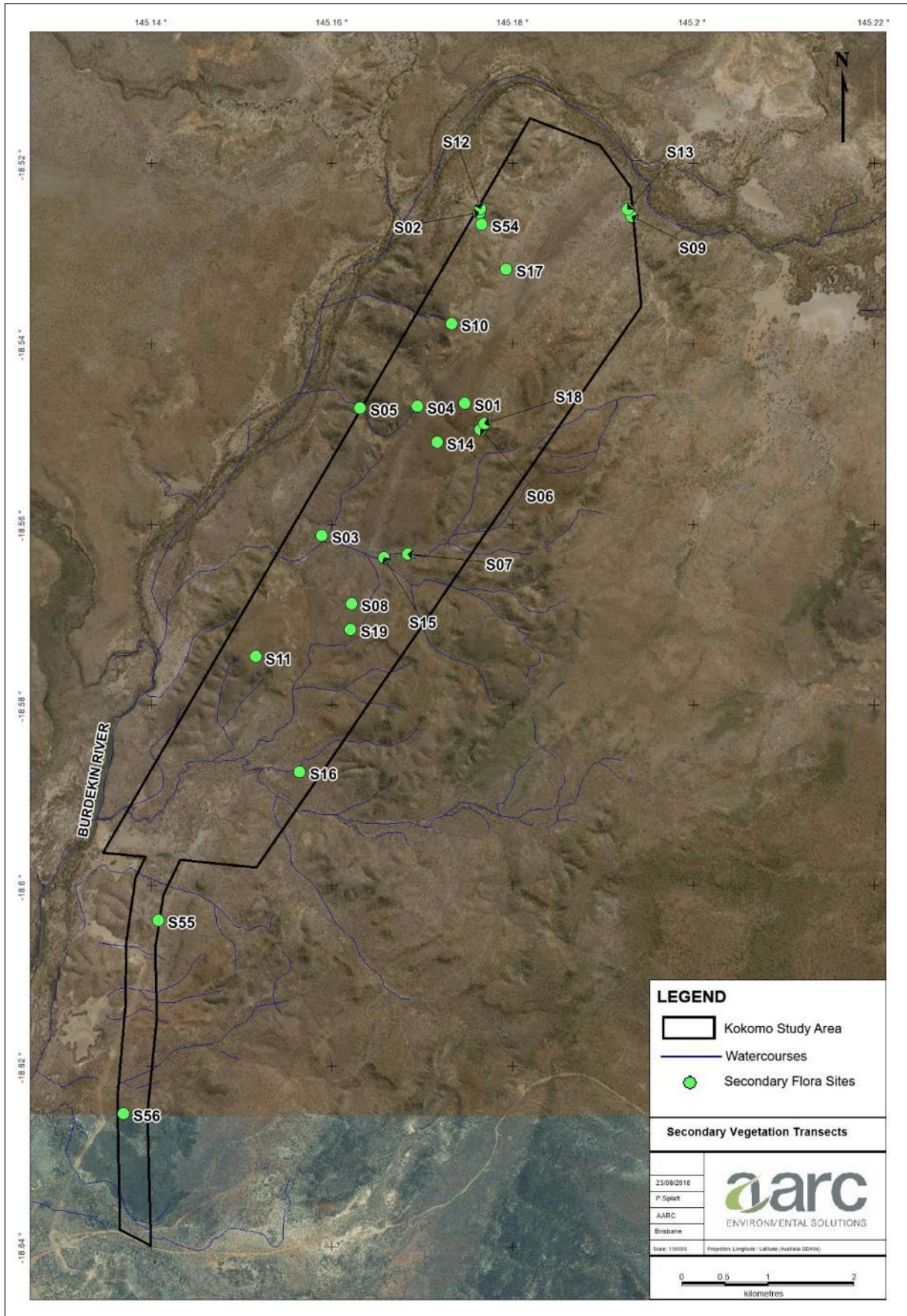


Figure 10 Greenvale Secondary Transect locations



**Figure 11 Lucknow Secondary Transect locations**



**Figure 12 Kokomo Secondary Transect locations**

### 5.3.1 Flora and Regional Ecosystem Identification

All plants encountered during the survey were identified by ecologists using a number of field guides and online resources. All REs were described and classified according to DES's Regional Ecosystem Descriptions Database (DES, 2016). For any flora species that could not be identified in the field, a voucher specimen was collected and sent to the Queensland Herbarium for identification.

Vegetation (RE) maps of the Project site were produced at a minimum scale of 1:10 000 following the completion of field surveys. The maps were developed based on secondary and quaternary data, satellite images, topographical and surface geological maps featuring the Project site. Where possible, each RE was mapped as a homogenous polygon wherever it occurs on the Project site. Occasionally vegetation patches occur that consist of more than one RE. When the least common RE in the remnant patch is smaller than the minimum mappable area defined in Neldner et al. (2017) or the structure of the vegetation does not allow clear delineation of each RE, all contributing REs may be mapped together as a "mixed polygon".

## 5.4 FAUNA SURVEY METHODOLOGY

The fauna survey methodology employed for the Project was originally based on standard survey techniques that are used to sample terrestrial vertebrate fauna and in more recent surveys it was based on the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al. 2014). The surveys were conducted in compliance with AARC's scientific purposes permit and animal ethics approval. All fauna trapping efforts were conducted over four consecutive nights (unless otherwise stated). To maximise species detection the fauna surveys were conducted in early dry and early wet seasons. During the early wet season vertebrate activity is high as animals start to move around with the building humidity (Eyre et al. 2014). Fauna survey methods undertaken during the survey are described in detail in Section 5.4.2.

Sampling of vertebrate fauna was conducted primarily at dedicated fauna sites established in each of the major habitat types. During all surveys, observations of species outside the specific fauna study locations were noted as incidental observations.

Many fauna species, notably frogs and reptiles, do not have widely accepted common names. Scientific names for species often change with taxonomic revisions. For the purpose of this report, all nomenclature used will follow that used in the DES WildNet Database.

### 5.4.1 Fauna Survey Sites

Fauna sampling was conducted amongst representative areas of the main habitat types on the Project site:

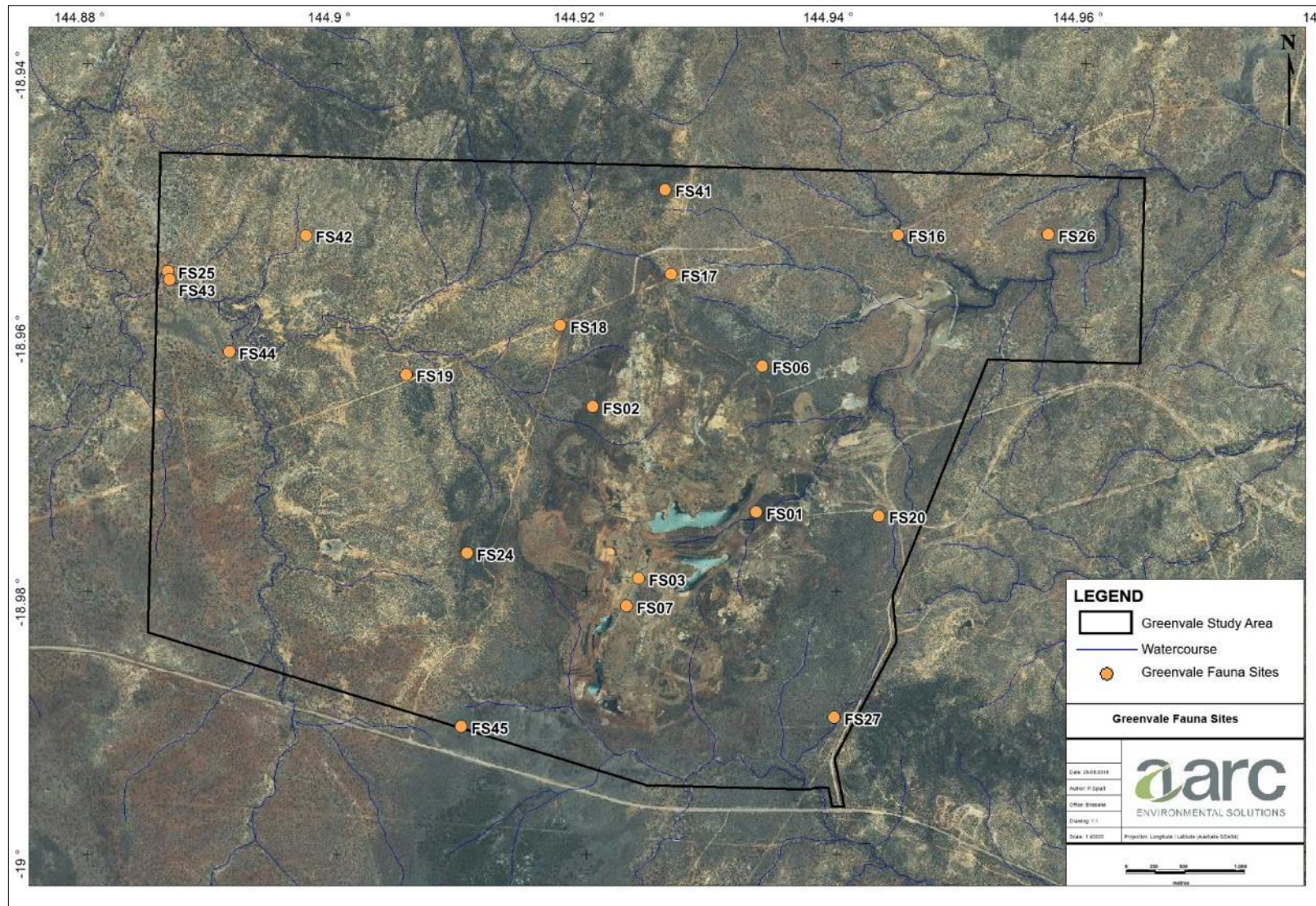
- Semi-deciduous vine thicket on metamorphic soils (not limestone);
- Moist to dry open forest to woodland dominated by *Eucalyptus portuensis*, *Corymbia intermedia* (pink bloodwood), *Eucalyptus* spp. on ranges;
- Creeks dominated by *Melaleuca bracteata*, and occasionally with *Casuarina cunninghamiana* and River Gums (*Eucalyptus camaldulensis* or *E. tereticornis*) and alluvial flats of *E. platyphylla* woodland and *Corymbia* spp.;
- Woodlands to open woodlands of *Eucalyptus crebra* (Ironbark) and *Corymbia* spp on metamorphic or igneous hills and slopes;



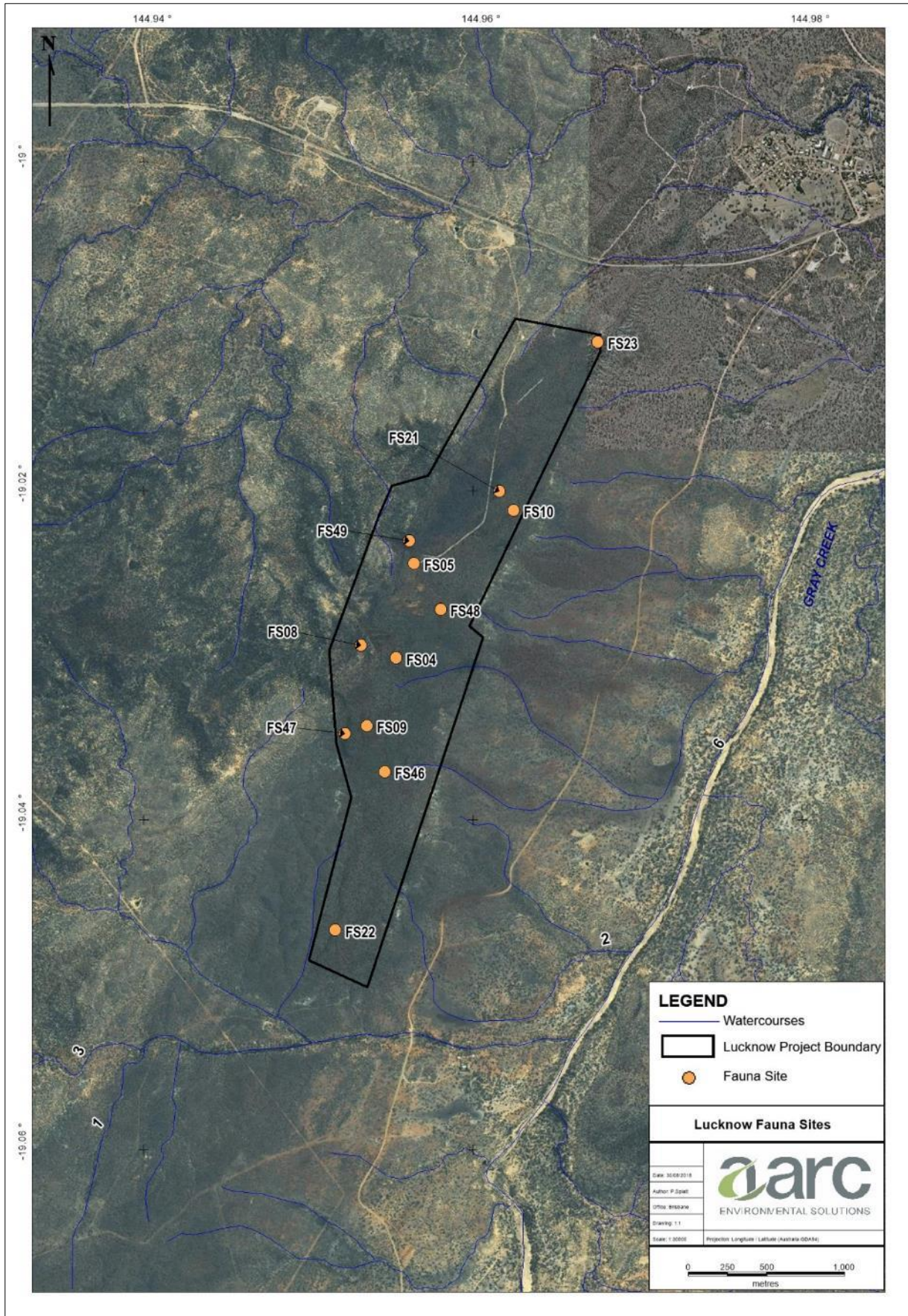
- Woodlands to open woodlands of *Eucalyptus persistens* on metamorphic hills and slopes;
- Woodlands to open woodlands dominated by *Eucalyptus melanophloia* (silver-leaved ironbark) on sand plains and footslopes of hills and ranges;
- Woodlands to open woodlands of *Acacia shirleyi* (Lancewood) on lateritic ridges; and
- Grasslands.

In total, 49 primary transects were established for terrestrial fauna monitoring across the several surveys carried out on the Project site throughout the several ecological surveys. Site descriptions of each survey site and photos are provided in Appendix C.

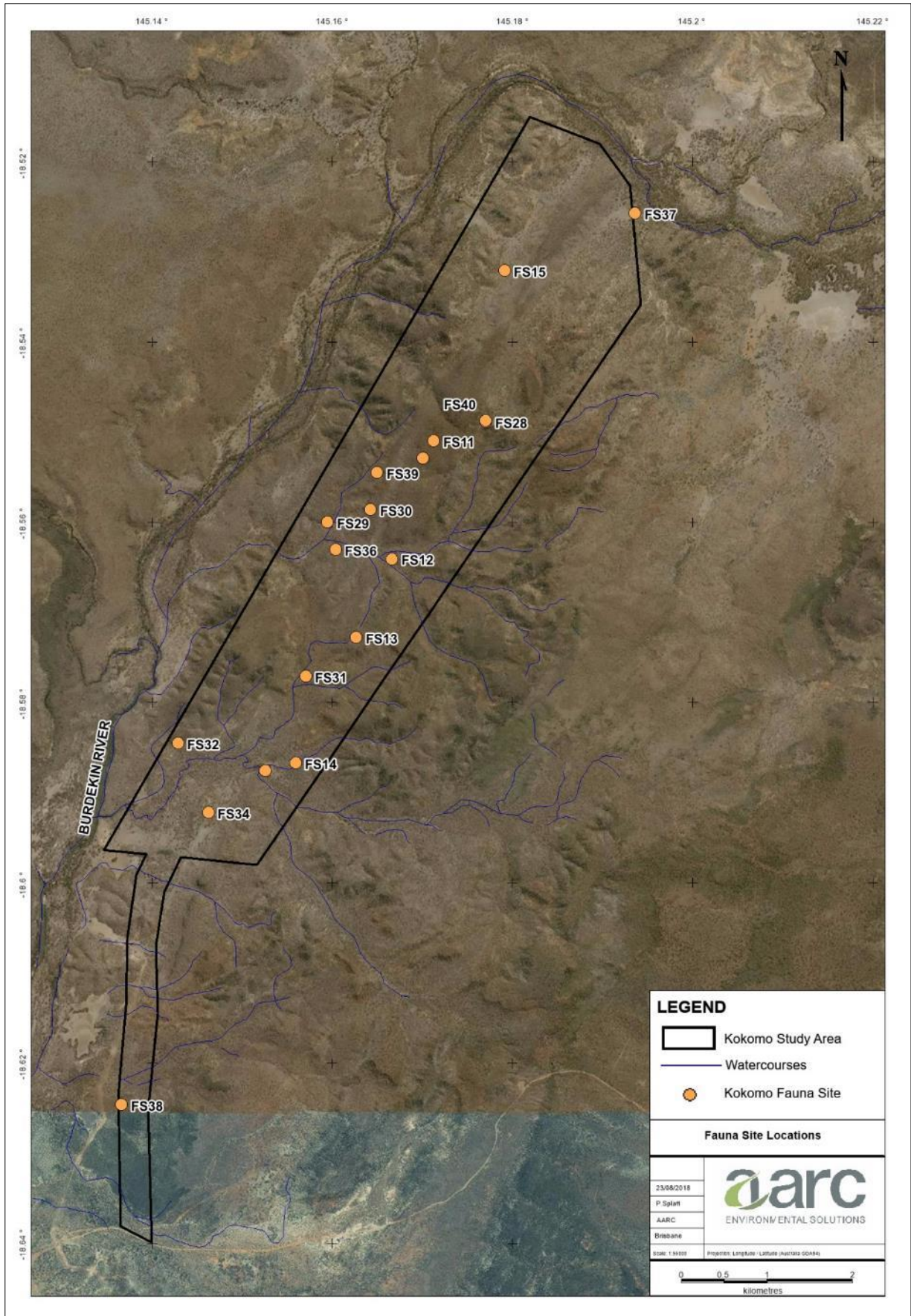
The locations of the fauna sites within the study are shown in Figure 13, Figure 14 and Figure 15.



**Figure 13 Greenvale Fauna Site locations**



**Figure 14 Lucknow Fauna Site locations**



**Figure 15 Kokomo Fauna Site locations**

## 5.4.2 Detection Methods

A description of the techniques employed to survey the fauna occurring on the Project site, unless otherwise stated in the site description in Appendix C, is provided below.

### 5.4.2.1 Elliott trapping

Elliott traps are aluminium boxes with doors triggered by a floor treadle that are used to target small ground-dwelling mammals inhabiting the Project site during the field survey period. Traps were baited with a mixture of oats, peanut butter, and vanilla essence (referred to here-in as 'mammal bait'). At each site, two parallel lines each with 10 Elliott traps were placed at 10 m intervals. Alternatively, where fauna sites were established in linear riparian habitats, traps were positioned at 10 m intervals along a single central transect. Traps were strategically positioned under shrubs or beside logs to reduce exposure of trapped animals to the sun, wind and rain and maximise trap success.

### 5.4.2.2 Automated camera trapping

Automated camera trapping is a less invasive method of surveying medium and large-sized nocturnal terrestrial species. Cameras are usually attached to a tree in a position that offers an unobstructed view over a track or clearing. A bait tube constructed with a PVC pipe and filled with bait (on this occasion chicken necks), is pegged to the ground and positioned in clear view of the camera. Motion-sensing technology in the camera picks up movement by target fauna which then triggers an automatic photographic response. This is a highly effective survey method and is now widely used (Eyre *et al.*, 2014).

### 5.4.2.3 Pitfall trapping

To target small ground-dwelling taxa (e.g. reptiles, mammals and amphibians), a pitfall trap line was established at all fauna sites. Each line consisted of a 30 centimetre (cm) tall drift fence running along the ground and crossing the middle of four 20 litre buckets buried flush with the soil surface. Each pitfall trapping line was constructed in a T-shape design with 45 m of drift fence and buckets placed at approximately 7.5 m intervals. The bottom edge of each drift fence was buried to guide target animals towards the buckets. A small amount of soil, vegetation litter, a damp sponge and a small plastic pipe were placed in the bottom of each bucket to provide shelter and moisture for captured wildlife.

### 5.4.2.4 Funnel trapping

Funnel traps are elongated box-shaped traps made of wire and fine mesh. Six funnel traps were positioned at each fauna site in order to catch medium and large-sized terrestrial reptiles, snakes and some species of medium-sized skinks, dragons and geckos. Funnel traps were also set with a damp sponge and covered with hessian bags to provide shelter and moisture for captured wildlife. Where pitfall trapping lines were established at a fauna site, funnel traps were placed at the end of each drift fence. In the absence of a pitfall line, funnel traps were placed in suitable habitat along fallen timber or rocky outcrops throughout the fauna site (100x100m plot).

### 5.4.2.5 Micro-bat surveying

Micro-bats (Microchiropterans) form an extremely diverse group of wildlife and the identification of individual species requires the use of specialised survey methods due to the superficial similarity of many species, their small size, and largely inaudible calls.

In order to navigate and hunt at night micro-bats use high frequency echolocation calls, most of which are above the frequency range audible to humans (i.e. ultrasound). These echolocation calls provide an opportunity to unobtrusively survey and identify micro-bats through the use of a specialised ultrasonic

recorders. During the survey event, bat call detection devices (i.e. Songmeter or ANABAT recorder) were strategically positioned to detect micro-bat calls at all fauna trapping sites. A bat call detector was left at each site for 3 nights.

#### 5.4.2.6 Bird surveying

A dedicated search for diurnal birds was conducted visually and aurally at each fauna site. A minimum of one hour of bird surveying was conducted in the early morning or late afternoon when bird activity was highest. In addition, opportunistic diurnal searches were also conducted on foot in areas considered likely to have high avian diversity (e.g. vegetated watercourses or dams), or likely to contain cryptic or threatened bird species.

#### 5.4.2.7 Spotlighting

Spotlighting was carried out at night in various sections of the Project site in order to observe nocturnal wildlife unlikely to be detected by other survey methods. Two spotlighting techniques were employed:

1. **Walk searches:** Areas within the Project site considered likely to contain cryptic or threatened species, or high fauna diversity were investigated on foot. These areas were randomly traversed by two ecologists equipped with spotlights and binoculars, and wherever possible, bark crevices and tree hollows were examined. A slow walking speed (approximately 1 km per hour) was maintained across the length of the survey area to fully facilitate intensive listening and thorough visual searching. While this technique improves the likelihood of detecting small cryptic species, it is a time consuming activity that does not permit the coverage of large areas.
2. **Vehicle searches:** Spotlighting was also conducted from a slow-moving vehicle where established roads/tracks permitted driving through areas considered likely to have high wildlife diversity or cryptic or threatened species. One 55-watt 12-volt spotlight was used to scan roadside vegetation for arboreal and ground-dwelling wildlife. An advantage of this survey technique is the efficiency with which large areas can be covered.

#### 5.4.2.8 Call playback

It consists in playing each call for three minutes, followed by a two-minute listening period. Calls need to be played loud enough so that the softest call can be heard 100-200 m away. Following the sequence of playback calls, listen for calls and spotlight the area for five minutes.

#### 5.4.2.9 Habitat searching

To further enhance the likelihood of detecting small cryptic species, opportunistic diurnal searches were conducted at each fauna site. In addition, notes were made on habitat features such as the presence of tree hollows and large stick nests. Observed animals were caught where possible to aid positive species identification. At each fauna site, a minimum of one hour of active habitat searching was conducted.

#### 5.4.2.10 Scat/track searching

At each survey site, a search of the immediate area was conducted for evidence of the presence of wildlife through the identification of obvious tracks, scats and other signs of occupation (e.g. tree trunk scratchings).

Scats were collected and sent to a scat analysis expert (i.e. Barbara Triggs) for identification of the species responsible for the scat and/or where possible, the identification of prey species material present in predator scats.

#### **5.4.2.11 Incidental recordings**

Throughout each survey, numerous fauna species were observed or heard on the Project site during routine activities (i.e. driving between sites, checking traps, vegetation surveys etc.). Where required, a closer inspection of detected wildlife was carried out to ensure positive species identification. All incidental observations were recorded.

## 6.0 FLORA RESULTS AND DISCUSSION

### 6.1 VEGETATION COMMUNITIES

A total of 425 flora species were identified in the Project site. A total of 41 introduced species were recorded on the Project site, of which four are listed as weed species. All four are listed as Class 2 weed species under the NC Act and only three of them are also classified as WoN (Weeds of National Significance) under the EPBC Act. No threatened flora species were observed on the Project site. A full flora list for the Project site is provided in **Error! Reference source not found.**

Fifteen distinct vegetation communities were identified on the Project site. Fourteen of these communities were classed as Remnant Vegetation as defined in the VM Act. Associations within the communities reflect different vegetation structures and compositions, which occur on different geophysical locations. The corresponding Queensland Herbarium RE classifications are noted for each of the described remnant vegetation communities. The vegetation communities observed on the Project site are described in detail in the following sections. A short description of the vegetation community as well as each representative RE is outlined in 6.1.1 to 6.1.15.

**Table 8 Vegetation Community Overview**

Vegetation Community	Regional Ecosystem	Community Description
Community 1	9.3.1	Creeks dominated by <i>Melaleuca bracteata</i> , and occasionally with <i>Casuarina cunninghamiana</i> and/or <i>Eucalyptus camaldulensis</i>
Community 2	9.3.3/9.3.3a	Alluvial flats of <i>Eucalyptus platyphylla</i> woodland
Community 3	9.3.15	<i>Eucalyptus tereticornis</i> +/- <i>Casuarina cunninghamiana</i> +/- <i>Melaleuca</i> spp. fringing woodland on channels and levees
Community 4	9.3.25	<i>Dichanthium</i> spp., and/or <i>Astrebla</i> spp. +/- <i>Iseilema</i> sp. grassland on alluvial deposits derived from basalt soils.
Community 5	9.3.26	Grassland of <i>Ophiuros exaltatus</i>
Community 6	9.7.1	<i>Eucalyptus persistens</i> woodland on laterised and deeply weathered surfaces on undulating terrain.
Community 7	9.7.2/9.7.2a	Lancewood ( <i>Acacia shirleyi</i> ) on lateritic ridges
Community 8	9.11.1	<i>Eucalyptus melanophloia</i> woodland metamorphic hills and slopes
Community 9	9.11.2a	<i>Eucalyptus crebra</i> and <i>Corymbia erythrophloia</i> woodland on metamorphic hills and slopes
Community 10	9.11.2d	<i>Eucalyptus crebra</i> and <i>Corymbia</i> spp open woodland on Serpentine
Community 11	9.11.5	<i>Eucalyptus persistens</i> +/- <i>E. crebra</i> woodland on low metamorphic hills
Community 12	9.11.9	Semi-deciduous vine thicket on metamorphic soils (not limestone)
Community 13	9.12.1a	<i>Eucalyptus crebra</i> woodland on hills and slopes of igneous rocks



Vegetation Community	Regional Ecosystem	Community Description
Community 14	9.12.2	<i>Eucalyptus portuensis</i> , <i>Corymbia citriodora</i> subsp. <i>citriodora</i> , <i>E. granitica</i> or <i>E. crebra</i> , <i>C. intermedia</i> or <i>C. clarksoniana</i> mixed woodland on steep hills and ranges on igneous hills close to Wet Tropics boundary
Community 15	Non Remnant	Non remnant vegetation

Figure 16, Figure 17 and Figure 18 show the distribution of vegetation communities on the Greenvale, Lucknow and Kokomo tenements respectively.

None of the vegetation communities on site are listed as threatened at the national level.

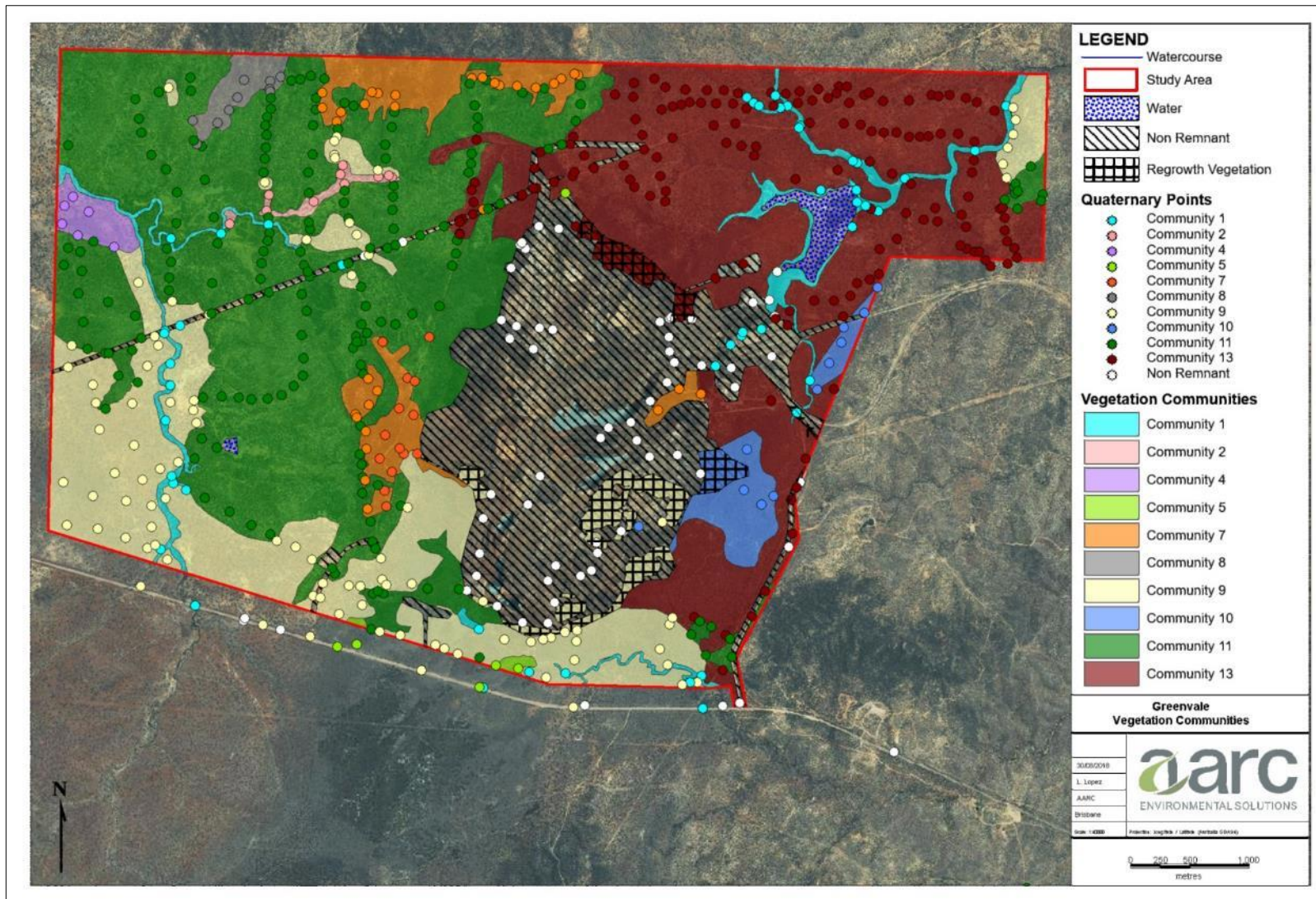
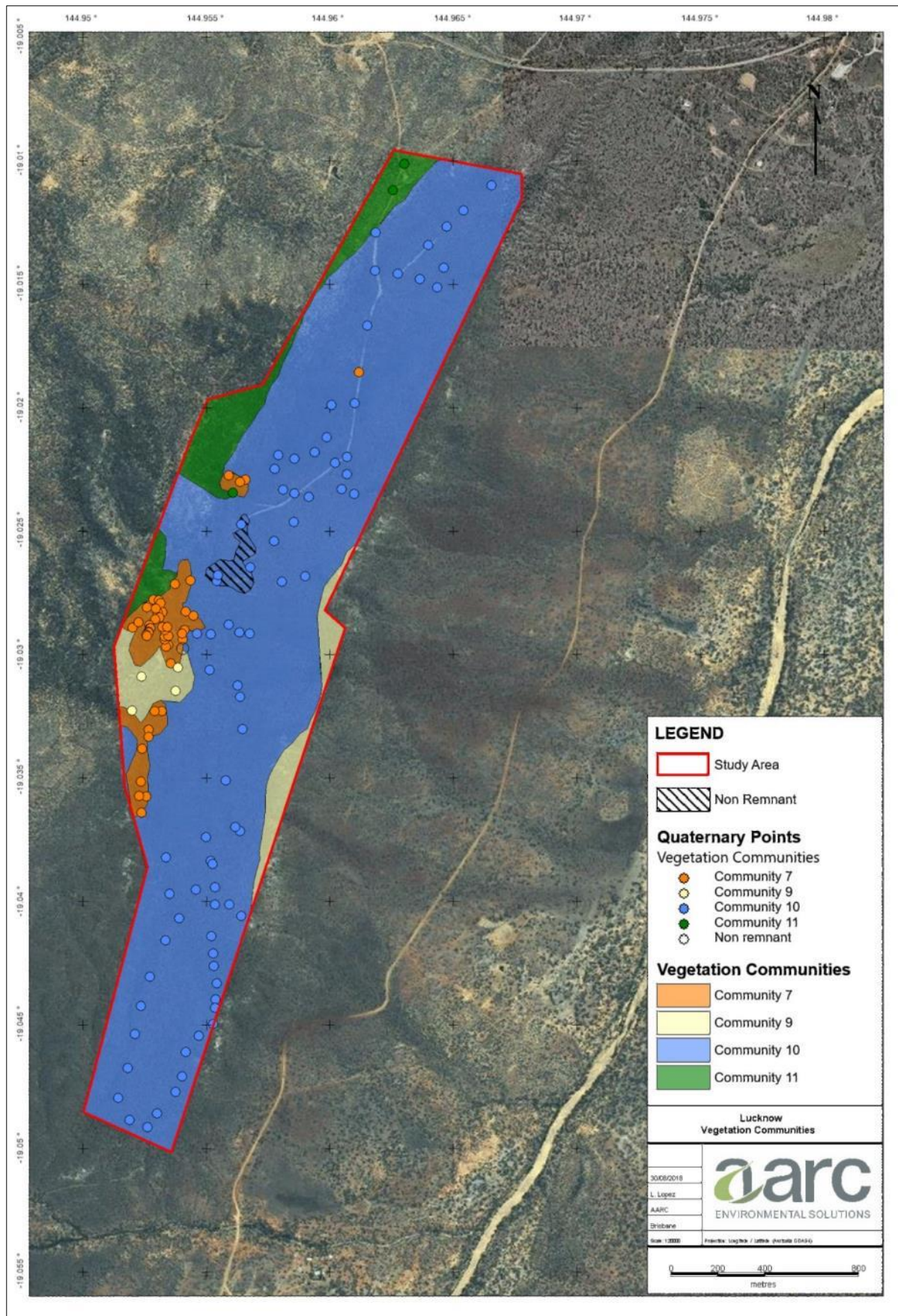
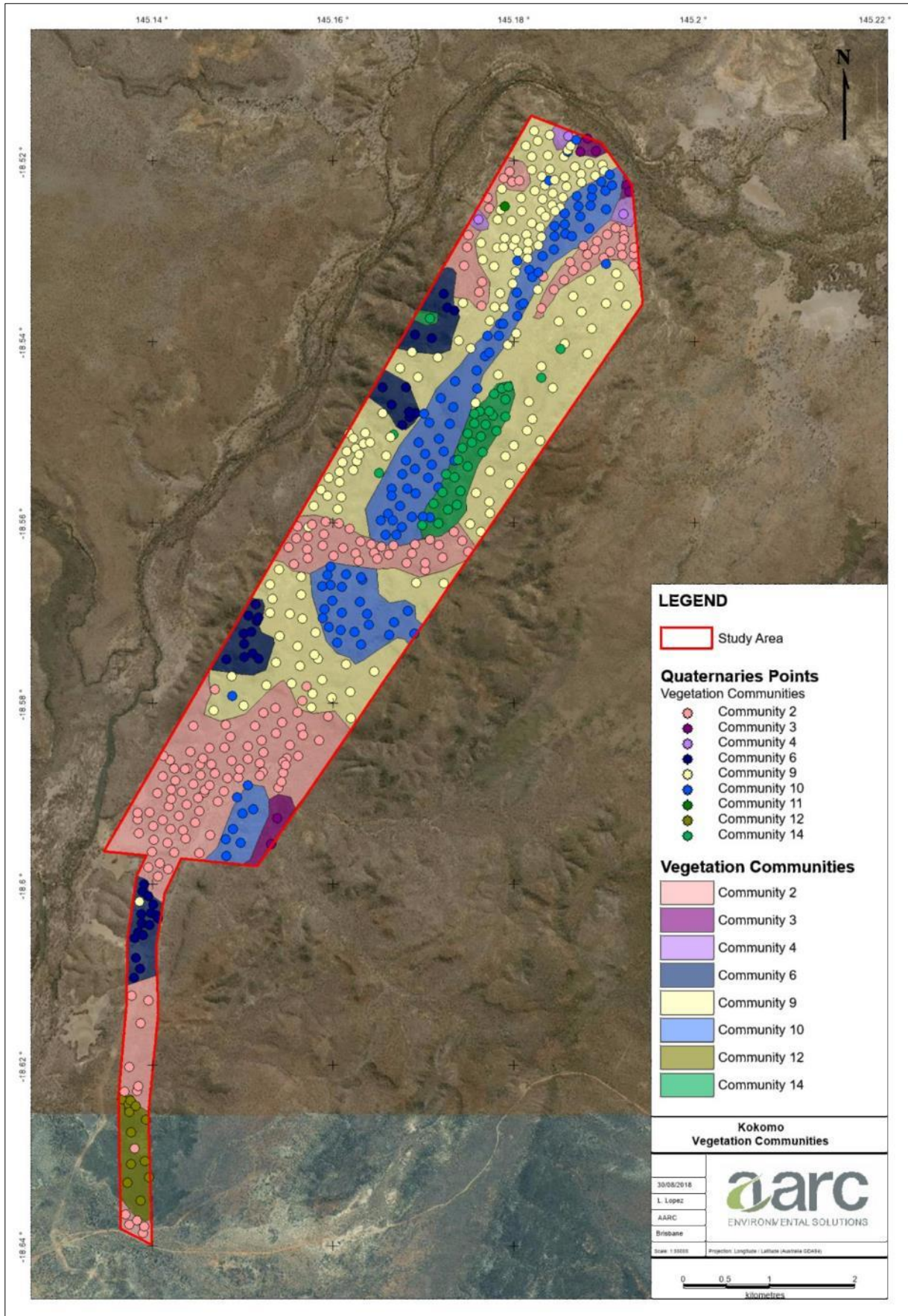


Figure 16 Greenvale Vegetation Map



**Figure 17 Lucknow Vegetation Map**



**Figure 18 Kokomo Vegetation Map**

## 6.1.1 Community 1

### 6.1.1.1 Community Description

Community 1 consists of creeks dominated by *Melaleuca bracteata*, and occasionally with *Casuarina cunninghamiana* or *Eucalyptus camaldulensis*. Community 1 occurs on creeks in the Greenvale tenement and covers approximately 77 ha (1.33%) of the Project site. It occurs on creek banks and levees. Table 9 provides a summary of community structure and corresponding conservation status.

**Table 9 Vegetation Community 1 Profile**

<b>Associated Regional Ecosystem</b>	9.3.1: <i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> +/- <i>Casuarina cunninghamiana</i> +/- <i>Melaleuca</i> spp. fringing woodland on channels and levees. Generally on eastern flowing rivers
<b>Extent within Project site</b>	77 ha
<b>Remnant Status</b>	Remnant
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	Of Concern
<b>Tree Layer</b>	<i>Melaleuca bracteata</i> and <i>Casuarina cunninghamiana</i> (15 – 20 m). Some narrower creeks only contain <i>Melaleuca bracteata</i> (12 m). Downstream, wider sections of the creeks also contain scattered <i>Eucalyptus camaldulensis</i> and/or <i>Melaleuca fluviatilis</i> . <i>Corymbia erythrophloia</i> , <i>Corymbia dallachiana</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus persistens</i> and <i>Hakea arborescens</i> are common trees on the edge on creeks, where the surrounding woodland intergrades with the creek
<b>Shrub Layer</b>	The 0.5 m to 3 m tall shrub layer is normally dominated by small <i>Melaleuca bracteata</i> plants and <i>Ficus opposita</i> .
<b>Groundcover</b>	The ground layer is typically dense on creek banks, dominated by <i>Dichanthium fecundum</i> , <i>Heteropogon contortus</i> and <i>Bothriochloa pertusa</i>
<b>Structure Category</b>	Sparse



**Photo Plate 1 Community 1 – RE 9.3.1**

#### **6.1.1.2 Conservation Value**

No species of conservation significance were recorded in this vegetation community. As the creeks are a relatively fertile ecosystem there are a number of weeds. Most significant are *Parthenium hysterophorus* (Parthenium), *Xanthium occidentale* (Noogoora Burr), and *Themeda quadrivalvis* (Grader Grass). *Navua Sedge* (*Cyperus aromaticus*) grows immediately downstream of the dam wall and *Bothriochloa pertusa* (Indian Couch) is common along many creeks.

RE 9.3.1 is vulnerable to the weeds *Lantana camara*, *Melinis repens* (Red Natal Grass), *Cryptostegia grandiflora* (Rubbervine), *Xanthium pungens* (Thornapple), *Sida rhombifolia* (Paddy's Lucerne), *Hyptis suaveolens*, *Stachytarpheta jamaicensis* (Snakeweed), *Bidens pilosa* (Cobbler's Pegs) and *Megathyrsus maximum* (Guinea Grass). It is also subject to the introduction of exotic pasture species such as *Cynodon dactylon* (Couch) for pasture improvement.

#### **6.1.1.3 Vegetation Condition and Habitat Value**

RE 9.3.1 generally occurs on eastern flowing rivers in the south of the Einasleigh Uplands bioregion. It is listed as Least Concern under the VM Act and Of Concern under the DES's Biodiversity Status. The extent of this community in reserve areas is low (REDD 2016).

### **6.1.2 Community 2**

#### **6.1.2.1 Community Description**

Community 2 is *Eucalyptus platyphylla* woodland on alluvial flats. Community 2 occurs in three small patches in the north-west of the Greenvale tenement and several of the flatter areas on the Kokomo tenement. It covers approximately 597.75 ha (10.34%) of the Project site. It occurs on sandy alluvial plains, terraces and levees. Table 10 provides a summary of conservation status and vegetative structure for Community 2.

**Table 10 Vegetation Community 2 Profile**

<b>Associated Regional Ecosystem</b>	9.3.3/9.3.3a: Mixed woodland dominated by <i>Corymbia</i> spp. and <i>Eucalyptus</i> spp. on alluvial flats, levees and plains
<b>Extent within the Project site</b>	597.75 ha
<b>Remnant Status</b>	Remnant
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	Of Concern
<b>Tree Layer</b>	<i>Eucalyptus platyphylla</i> (12 – 18 m), <i>Corymbia lignans</i> , <i>Eucalyptus leptophleba</i> (18-28 m), <i>Lophostemon grandiflorus</i> (15-20 m), <i>Eucalyptus crebra</i> (14 m), <i>Corymbia clarksoniana</i> , <i>Eucalyptus tereticornis</i> , <i>Corymbia erythrophloia</i> (9 m), <i>Corymbia dallachiana</i> , <i>Eucalyptus howittiana</i>
<b>Shrub Layer</b>	<i>Ficus opposita</i> , <i>Alphitonia excelsa</i> , <i>Breynia oblongifolia</i> , <i>Petalostigma pubescens</i> , <i>Acacia bidwillii</i> , <i>Lantana camara</i> *, <i>Melaleuca bracteata</i> , <i>Acacia decora</i> , <i>Carissa spinarum</i> , <i>Atalaya hemiglauca</i>
<b>Groundcover</b>	<i>Arundinella nepalensis</i> , <i>Dichanthium sericeum</i> and <i>Themeda triandra</i>
<b>Structure Category</b>	Mid-dense



**Photo Plate 2 Community 2 – RE 9.3.3**

### 6.1.2.2 Conservation Value

No species of conservation significance were identified in this community. The weed species *Lantana camara*, *Praxelis clematidea*, *Themeda quadrivalvis*, *Sida cordifolia*, *Sida spinosa*, and *Cirsium vulgare* were recorded in this community in the Kokomo tenement whilst only *Sporobolus jacquemontii* and *Malvastrum americanum* were recorded in the Greenvale tenement.

### 6.1.2.3 Vegetation Condition and Habitat Value

RE 9.3.3 occurs extensively throughout the Einasleigh Uplands bioregion. It is listed as Least Concern under the VM Act and Of Concern under DES's Biodiversity Status. The extent of this RE in reserves is low (REDD 2016).

## 6.1.3 Community 3

### 6.1.3.1 Community Description

This community is located in three patches in the Kokomo tenement, two small patches in the north of the tenement and one in the south-east. It covers approximately 6.5 ha. Community 3 occurs on alluvial plains. Table 11 provides a detailed description of Community 3.

**Table 11 Vegetation Community 3 Profile**

<b>Associated Regional Ecosystem</b>	9.3.15: <i>Eucalyptus tereticornis</i> +/- <i>Casuarina cunninghamiana</i> +/- <i>Melaleuca</i> spp. fringing woodland on channels and levees.
<b>Extent within Project site</b>	27.90 ha (0.48%)
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	Of Concern
<b>Tree Layer</b>	<i>Eucalyptus tereticornis</i> , <i>Casuarina cunninghamiana</i> , <i>Eucalyptus platyphylla</i> , <i>Eucalyptus crebra</i> , <i>Lophostemon grandiflorus riparius</i> ,
<b>Shrub Layer</b>	Absent
<b>Ground Layer</b>	<i>Dicanthium sericeum</i> , <i>Fimbristylis tetragona</i> , <i>Dicanthium fecundum</i> , <i>Lomandra multiflora</i> , <i>Ammania multiflora</i> , <i>Marsilea drummondii</i> , <i>Cyperus exaltatus</i> , <i>Eleocharis sphacelata</i> , <i>Euphorbia tannensis</i> subsp. <i>eremophila</i> , <i>Crotalaria verrucosa</i> , <i>Xanthium pungens</i> , <i>Aeschynomene indica</i> , <i>Sida cordifolia</i> , <i>Grewia retusifolia</i> , <i>Cirsium vulgare</i> *, <i>Rhynchosia minima</i> , <i>Alternanthera nodiflora</i> , <i>Chamaesyce drummondii</i> , <i>Eriochloa colona</i> , <i>Themeda quadrivalvis</i> , <i>Persicaria attenuate</i> , <i>Neptunia gracilis</i> , <i>Schoenoplectus praelongatus</i> , <i>Centipedia nidiformis</i> , <i>Polymeria ambigua</i> , <i>Lomandra laxa</i> , <i>Monochoria cyanea</i>



<b>Structure Category</b>	Very sparse
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**Photo Plate 3 Community 3 – RE 9.3.15**

#### **6.1.3.2 Conservation Value**

No species of conservation significance occurred within RE 9.3.15. The introduced *Cirsium vulgare* was recorded as present in this vegetation community.

#### **6.1.3.3 Vegetation Condition and Habitat Value**

RE 9.3.15 occurs in areas of higher rainfall in the central east of the bioregion and in areas close to the Wet Tropics bioregion with mesic species such as *Tristaniopsis* spp. and *Syzygium* spp. Subject to clearing, this RE is also prone to weed infestation by species such as *Lantana camara*, *Megathyrus maximus*, *Melinis repens*, *Passiflora* sp. and *Mesosphaerum suaveolens*. RE 9.3.15 provides significant habitat as drought refuge, wildlife corridors and for arboreal animals. It is classified as Least Concern under the VM Act and Of Concern under the DES's Biodiversity Status. The extent of RE 9.3.15 located in protected areas is classified as high (REDD 2016).

### **6.1.4 Community 4**

#### **6.1.4.1 Community Description**

This community is located in the north-eastern corner of the Kokomo tenement and one small patch in the north-west of the Greenvale tenement where the tree and shrub layers are more prominent. It covers approximately 41.60 ha (0.75%) of the Project site. Community 4 occurs on alluvial deposits derived from basalt soils. Table 12 provides a summary of conservation status and vegetative structure for Community 4.

**Table 12 Vegetation Community 4 Profile**

<b>Associated Regional Ecosystem</b>	9.3.25: <i>Dichanthium</i> spp., and/or <i>Astrelba</i> spp. +/- <i>Iseilema</i> sp. grassland on alluvial deposits derived from basalt soils.
<b>Extent within Project site</b>	41.60 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	Of Concern
<b>Tree Layer</b>	Tree layer absent or very sparse <i>Eucalyptus crebra</i> (10-12m), <i>Corymbia dallachiana</i> (10-12m), and trees on surrounding low hills and adjacent offsite areas include <i>Eucalyptus tereticornis</i> , <i>Eucalyptus crebra</i> , <i>Corymbia dallachiana</i> and <i>Eucalyptus persistens</i>
<b>Shrub Layer</b>	Occasional <i>Grewia retusifolia</i> , <i>Acacia victoriae</i> , <i>Carissa spinarum</i> and <i>Stylosanthes scabra</i>
<b>Ground Layer</b>	<i>Dichanthium sericeum</i> , <i>Fimbristylis tetragona</i> , <i>Dichanthium fecundum</i> , <i>Bothriochloa pertusa</i> , <i>Heteropogon contortus</i> , <i>Ammania multiflora</i> , <i>Marsilea drummondii</i> , <i>Cyperus exaltatus</i> , <i>Cyperus difformis</i> , <i>Cyperus polystachyos</i> , <i>Eleocharis sphacelata</i> , <i>Euphorbia tannensis</i> subsp. <i>eremophila</i> , <i>Crotalaria verrucosa</i> , <i>Xanthium pungens</i> *, <i>Aeschynomene indica</i> , <i>Sida cordifolia</i> *, <i>Parthenium hysterophorus</i> *, <i>Eragrostis schultzei</i> , <i>Indigofera linnaei</i> , <i>Grewia retusifolia</i> , <i>Cirsium vulgare</i> *, <i>Rhynchosia minima</i> , <i>Alternanthera nodiflora</i> , <i>Euphorbia drummondii</i> , <i>Eriochloa colona</i> , <i>Themeda quadrivalvis</i> *, <i>Vachellia farnesiana</i> , <i>Persicaria attenuata</i> , <i>Neptunia gracilis</i> , <i>Schoenoplectus praelongatus</i> , <i>Centipedia nidiformis</i> , <i>Polymeria ambigua</i> , <i>Lomandra laxa</i> , <i>Monochoria cyanea</i>
<b>Structure Category</b>	Grassland



**Photo Plate 4 Community 4 – RE 9.3.25**

#### **6.1.4.2 Conservation Value**

No species of conservation significance occurred within RE 9.3.25. Weed species including *Parthenium hysteroporus*, *Xanthium pungens*, *Sida cordifolia*, *Cirsium vulgare* and *Themeda quadrivalvis* were noted in this RE on the Project site.

Survey in Kokomo tenement confirmed the presence of a small palustrine system which has been categorised as a wetland of high ecological significance in the north-west of the tenement (see section 4.5.2). This wetland is associated with RE 9.3.25, and the wetland protection area extends also to sections of community 3 (RE 9.3.15) and community 9 (9.11.2a).

#### **6.1.4.3 Vegetation Condition and Habitat Value**

RE 9.3.25 occurs in patches throughout the central and southern bioregion. It is classified as Least Concern under the VM Act and Of Concern under EHP's Biodiversity Status. The extent of this RE in reserves is low.

### **6.1.5 Community 5**

#### **6.1.5.1 Community Description**

Community 5 is a grassland of *Ophiuros exaltatus*. Community 5 occurs in two small patches in the south of the Greenvale tenement and covers approximately 4.53 ha (0.08%) of the Project site. This RE occurs on alluvial deposits. Table 13 provides a summary of conservation status and vegetative structure for Community 5.

**Table 13 Vegetation Community 5 Profile**

<b>Associated Regional Ecosystem</b>	9.3.26: Mixed grassland to open grassland including <i>Eragrostis</i> sp., <i>Aristida</i> sp., <i>Enneapogon</i> sp., <i>Iseilema</i> sp., <i>Chloris</i> sp., or <i>Dichanthium</i> sp. on non-basalt derived alluvial deposits
<b>Extent within Project site</b>	4.53 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	Of Concern
<b>Tree Layer</b>	Scattered <i>Corymbia erythrophloia</i> (8 m)
<b>Shrub Layer</b>	<i>Grewia retusifolia</i>
<b>Groundcover</b>	<i>Ophiuros exaltatus</i> , <i>Heteropogon contortus</i> , <i>Dichanthium fecundum</i> , <i>Bothriochloa pertusa</i> , <i>Indigofera trita</i> , <i>Rhynchosia minima</i> , <i>Sida spinosa</i> , <i>Vachellia farnesiana</i> *, <i>Lobelia concolor</i> and <i>Polymeria ambigua</i>
<b>Structure Category</b>	Grassland



**Photo Plate 5 Community 5 – RE 9.3.26**

#### **6.1.5.2 Conservation Value**

No species of conservation significance were found in Community 5. The introduced species *Bothriochloa pertusa* is common in Community 5 and the weed species *Vachellia farnesiana* was also recorded in this community in Greenvale tenement.

### 6.1.5.3 Vegetation Condition and Habitat Value

RE 9.3.26 occurs in patches throughout the west and central bioregion. It is listed as Least Concern under the VM Act and Of Concern under DES's Biodiversity Status. The extent of this RE in reserves is high.

## 6.1.6 Community 6

### 6.1.6.1 Community Description

This community is situated on several sandstone hills on the western portion of the Kokomo tenement. These hills generally had steep rocky sides that were sparsely vegetated and flat plateau areas on top with open shrubby woodlands. Groundcover was sparse and grassy. This vegetation community covered 141.89 ha (2.46%) of the Project site. Community 6 occurs on laterised and deeply weathered surfaces on undulating terrain. Table 14 provides a summary of conservation status and vegetative structure for Community 6.

**Table 14 Vegetation Community 6 Profile**

<b>Associated Regional Ecosystem</b>	9.7.1: <i>Eucalyptus persistens</i> woodland on laterised and deeply weathered surfaces on undulating terrain.
<b>Extent within Project site</b>	141.89 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	No Concern at Present
<b>Tree Layer</b>	<i>Eucalyptus persistens</i> (14 m), <i>Lophostemon suavolens</i> (17 m), <i>Eucalyptus crebra</i> (14 m), <i>Corymbia setosa</i> (9 m) and occasional <i>Acacia shirleyi</i> .
<b>Shrub Layer</b>	<i>Acacia flavescens</i> , <i>Alphitonia excelsa</i> , <i>Petalostigma banksii</i> , <i>Terminalia playphylla</i> , <i>Persea falcata</i> , <i>Breynia oblongifolia</i> , <i>Ficus opposita</i> , <i>Acacia umbellata</i> , <i>Acacia simsii</i> , <i>Atalaya hemiglaucula</i> , <i>Hovea longipes</i> , <i>Eythroxylum austral</i> , <i>Diospyros humilis</i>
<b>Ground Layer</b>	<i>Aristida calycina</i> , <i>Scleria sphacelata</i> , <i>Eriachne mucronata</i> , <i>Pseuderanthemum variable</i> , <i>Panicum effusum</i> , <i>Themeda triandra</i> , <i>Pogonolobus reticulatus</i> , <i>Euphorbia tannensis</i> subsp. <i>eremophila</i> , <i>Digitaria fumida</i> , <i>Lomandra multiflora</i> subsp. <i>multiflora</i> , <i>Hybanthus aurantiacus</i> , <i>Cymbopogon refractus</i> , <i>Zornia prostrata</i> , <i>Crotalaria medicaginea</i> , <i>Praxelis clematidea</i> *, <i>Marsilea drummondii</i> , <i>Heteropogon contortus</i> , <i>Eulalia aurea</i> , <i>Aeschynomene micranthos</i> , <i>Polygala linariifolia</i> , <i>Cymbopogon ambiguus</i> , <i>Dianella nervosa</i> , <i>Scleria brownii</i> , <i>Eragrostis schultzei</i> , <i>Hibiscus meraukensis</i> , <i>Sida subspicata</i> , <i>Fimbristylis dichotoma</i> , <i>Jacquemontia paniculata</i> var. <i>tomentosa</i> , <i>Desmodium brachypodium</i>
<b>Structure</b>	Sparse



**Photo Plate 6 Community 6 – RE 9.7.1**

#### **6.1.6.2 Conservation Value**

No species of conservation significance occurred within RE 9.7.1a. The weed *Praxelis clematidea* was recorded growing in this RE. Weed diversity and abundance were low in this community.

#### **6.1.6.3 Vegetation Condition and Habitat Value**

RE 9.7.1 occurs extensively through the central and southern bioregion. It is classified as Least Concern under the VM Act and as No Concern at Present under the DES's Biodiversity Status. The extent of this RE in protected areas is classified as medium (REDD 2016).

### **6.1.7 Community 7**

#### **6.1.7.1 Community Description**

Community 7 occurred on the Greenvale and Lucknow tenements. It was noted in patches throughout the Greenvale tenement and it was recorded in the west and north-west of the Lucknow tenement. The total area of Community 7 is 141.36 ha (approximately 2.45%). This community occurs on lateritised mesa slopes, breakaways, scree slopes and remnant colluvium. A summary of Community 7 is presented below in Table 15.

**Table 15 Vegetation Community 7 Profile**

<b>Associated Regional Ecosystem</b>	9.7.2/9.7.2a <i>Acacia shirleyi</i> (Lancewood) low woodland on mesas and lateritised surfaces
<b>Extent within Project site</b>	141.36 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	No Concern at Present
<b>Tree Layer</b>	Emergent (sparse) <i>Eucalyptus crebra</i> , <i>Eucalyptus persistens</i> and dominant tree layer (mid-dense) of <i>Acacia shirleyi</i>
<b>Shrub Layer</b>	<i>Alphitonia excelsa</i> , <i>Margaritaria dubium-traceyi</i> , <i>Eremophila mitchellii</i> , <i>Gardenia wilhelmii</i> , <i>Eryroxylum austral</i> , <i>Stylosanthes scabra</i>
<b>Groundcover</b>	<i>Ancistrachne uncinulata</i> , <i>Paspalidium</i> sp., <i>Scleria sphacelata</i> , <i>Entolasia stricta</i> , <i>Jacquemontia paniculata</i> , <i>Melhania oblongifolia</i> , <i>Panicum effusum</i> , <i>Eragrostis schultzii</i>
<b>Structure Category</b>	Mid-dense



**Photo Plate 7      Community 7 – RE 9.7.2**

#### **6.1.7.2      Conservation Value**

No species of conservation significance were identified within Community 7. One non-native species was identified, Shrubby Stylo (*Stylosanthes scabra*). This species occurred in low density.

#### **6.1.7.3      Vegetation Condition and Habitat Value**

Community 7 is considered of high floristic and faunal value. Patches of this community occur within both the Greenvale and Lucknow tenements. These patches are often bordered by remnant vegetation and do not hold any stock watering points.

*Eucalyptus exilipes*, *Corymbia lamprophylla* and *Corymbia trachyphloia* are sometimes scattered on the edges of the lancewood forest.



RE 9.7.2/9.7.2a occurs mainly around Greenvale in the central part of the bioregion. It is listed as Least Concern under the VM Act and No Concern at Present under the DES's Biodiversity Status. The extent in reserves of RE 9.7.2 is considered low (REDD 2016).

## 6.1.8 Community 8

### 6.1.8.1 Community Description

Community 8 is composed of *Eucalyptus melanophloia* woodland on metamorphic hills and slopes. Community 8 occurs in the north-west of the Greenvale tenement and covers approximately 26.38 ha (0.46%) of the Project site. RE 9.11.1 occurs on skeletal soils on undulating rises and low metamorphic hills. The area inhabited by Community 8 was burnt in 2011, killing mature Acacia trees and promoting the growth of Acacia saplings. Table 16 presents a summary of Community 8.

**Table 16 Vegetation Community 8 Profile**

<b>Associated Regional Ecosystem</b>	9.11.1: <i>Eucalyptus melanophloia</i> +/- <i>E. persistens</i> +/- <i>E. crebra</i> (sens. lat.) +/- <i>Corymbia peltata</i> woodland to open woodland on skeletal soils on metamorphic hills
<b>Extent within Project site</b>	26.38 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	No Concern at Present
<b>Tree Layer</b>	<i>Eucalyptus melanophloia</i> (6 – 10 m)
<b>Shrub Layer</b>	<i>Acacia gonoclada</i> , <i>Acacia multisiliqua</i> , <i>Acacia leptostachya</i> , <i>Acacia lazaridis</i> , <i>Acacia umbellata</i> , <i>Petalostigma banksia</i> , <i>Dodonaea dodecandra</i> and <i>Pogonolobus reticulatus</i>
<b>Groundcover</b>	<i>Themeda triandra</i> , <i>Triodia pungens</i> , <i>Eriachne mucronata</i> , <i>Schizachyrium fragile</i> , <i>Olearia arguta</i> , <i>Eragrostis stultzii</i> and <i>Tephrosia juncea</i>
<b>Structure Category</b>	Sparse



**Photo Plate 8 Community 8 – RE 9.11.1**

#### **6.1.8.2 Conservation Value**

No introduced species or species of conservation significance occurred within Community 8.

#### **6.1.8.3 Vegetation Condition and Habitat Value**

RE 9.11.1 occurs from Greenvale to Charters Towers in the central and southern bioregion. It is classified as Least Concern under the VM Act and as No Concern at Present under the DES's Biodiversity Status. The extent of RE 9.11.1 in reserves is low (REDD 2016).

### **6.1.9 Community 9**

#### **6.1.9.1 Community Description**

Community 9 occurs in large patches across the Greenvale tenement, within a single small patch in the west of the Lucknow tenement and on red loamy soils on the main ridge line running north-south through the centre of the Kokomo tenement. Total Project area for Community 9 is 1,350.86 ha (approximately 23.4%). This community occurs on metamorphic hills and rises. The summarised profile for Community 9 is presented in Table 17.

**Table 17 Vegetation Community 9 Profile**

<b>Associated Regional Ecosystem</b>	9.11.2a: <i>Eucalyptus crebra</i> (or several other ironbark species) +/- <i>Corymbia</i> spp. woodland on shallow texture contrast soils on low metamorphic hills and lowlands.
<b>Extent within Project site</b>	1,350.86 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	No Concern at Present
<b>Tree Layer</b>	<i>Eucalyptus crebra</i> (14-24 m), <i>Corymbia erythrophloia</i> (9-16 m), <i>Corymba dallachiana</i> (9-14 m), <i>Corymbia citriodora</i> (17-26 m),
<b>Shrub Layer</b>	<i>Acacia bidwillii</i> , <i>Hakea arborescens</i> , <i>Alphitonia obtusifolia</i> , <i>Grevillea parallela</i> , <i>Bursaria incana</i> , <i>Maytenus cunninghamii</i> , <i>Breynia oblongifolia</i> , <i>Hovea longipes</i> , <i>Atalaya hemiglauca</i> , <i>Larsenaikia ochreatea</i> , <i>Grewia retusifolia</i>
<b>Groundcover</b>	<i>Heteropogon contortus</i> , <i>Themeda triandra</i> , <i>Bothriochloa pertusa</i> , <i>Bothriochloa decipiens</i> , <i>Dichanthium fecundum</i> , <i>Aristida calycina</i> , <i>Tephrosia hirusta</i> , <i>Bulbostylis barbata</i> , <i>Fimbristylis tetragona</i> , <i>Praxelis clematidea</i> *, <i>Themeda quadrivalvis</i> , <i>Eustrephus latifolius</i> , <i>Rostellularia adscendens</i> var. <i>clementii</i> , <i>Pterocaulon sphacelatum</i> , <i>Themeda triandra</i> , <i>Hybanthus enneaspermus</i> , <i>Crotalaria aridicola</i> , <i>Solanum ellipticum</i> , <i>Zornia muriculata</i> , <i>Sporobolus actinocladius</i> , <i>Glycine falcata</i> , <i>Heteropogon triticeus</i> , <i>Indigofera pratensis</i> , <i>Jacquemontia paniculata</i> , <i>Sida hackettiana</i> , <i>Melhaniania oblongifolia</i> and <i>Stylosanthes scabra</i> *.
<b>Structure Category</b>	Sparse to moderate



Photo Plate 9 Community 9 – RE 9.11.2a

### 6.1.9.2 Conservation Value

No species of conservation significance occurred within Community 9. Non-native species identified within Community 9 include the *Bothriochloa pertusa*, *Chamaecrista rotundifolia*, *Cucumis anguria*, *Monstera deliciosa*, *Cenchrus ciliaris*, *Praxelis clematidea* and *Stylosanthes scabra* and the weed *Praxelis clematidea*.

### 6.1.9.3 Vegetation Condition and Habitat Value

Overall, this community is in moderately healthy condition, however, there are small disconnected patches of regrowth within the old footprint of the mine in the Greenvale tenement. These patches are highly disturbed and traversed by old mine roads and exploration tracks. Woody weeds and *Bothriochloa pertusa* form a reasonable component of community composition.

RE 9.11.2a is listed as Least Concern under the VM Act and No Concern at Present under the DES's Biodiversity Status. This RE occurs throughout the central and southern parts of the Einasleigh Uplands bioregion. RE 9.11.2a is classed as retaining a low extent within reserves.

Because of its great extent within the Einasleigh Uplands, this land zone has a wide variety of fauna associated with it (Kutt et al., 2009). Characteristic mammals of this land zone are the Antilopine Wallaroo (*Macropus antilopinus*) and two species of "Rat-kangaroos" – the Rufous Bettong (*Aepyprymnus rufescens*) and Spectacled Hare-wallaby (*Lagorchestes conspicillatus*). Rock specialist animals (like the Allied Rock Wallaby of sandstone escarpments and granite country) are generally absent. The bird fauna is characterised by a large number of woodland species. Gleaners and Honeyeaters are common. Pied Butcherbirds and Australian Magpies dominate the raptorial avifauna, while Pale-headed Rosellas are the most common granivorous woodland parrots. Among the reptiles, the Zebra Skink (*Ctenotus zebrilla*) is common on this land zone as is the larger skink *Ctenotus*

*spaldingi*. *Carlia munda*, a small skink that generally increases abundance with disturbance, is also very common. The extensive Ironbark woodlands are primary habitat for the rarely seen, but common, Pale-headed Snake, (*Hoplocephalus bitorquatus*). These woodlands also harbour large numbers of the northern Velvet Gecko (*Oedura castelnaui*) and Zig-zag Gecko (*Oedura rhombifer*). Where small rock outcrops occur within this land zone, small populations of the Gecko *Gehyra nana* may occur (Kutt et al., 2009).

## 6.1.10 Community 10

### 6.1.10.1 Community Description

Community 10 spans over the majority of the Lucknow tenement, occurs in patches on ridges in the east of the Greenvale tenement and is located on red loamy soils on the main ridge line running north-south through the centre of the Kokomo tenement. Community 10 covers a total area of 679.36 ha (approximately 11.76% of the Project site). This community occurs on a wide variety of landforms, but predominantly undulating rises and hills generally on shallow loamy soils. It is restricted to Serpentinite geologies. Table 18 summarises Community 10 structure and conservation status.

**Table 18 Vegetation Community 10 Profile**

<b>Associated Regional Ecosystem</b>	9.11.2d: <i>Eucalyptus crebra</i> (or several other ironbark species) +/- <i>Corymbia</i> spp. woodland on shallow texture contrast soils on low metamorphic hills and lowlands. Restricted to Serpentinite geologies.
<b>Extent within Project site</b>	679.36 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	No Concern at Present
<b>Tree Layer</b>	<i>Eucalyptus crebra</i> (12-14 m), <i>Corymbia erythrophloia</i> (12-14 m), <i>Corymbia dallachiana</i> , <i>Eucalyptus persistens</i> , <i>Terminalia oblongata</i> var. <i>oblongata</i> , <i>Corymbia citriodora</i> and were also recorded on the Kokomo tenement
<b>Shrub Layer</b>	<i>Acacia flavescens</i> (6-14 m), <i>Hakea arborescens</i> (14 m), <i>Alphitonia obtusifolia</i> , <i>Grevillea parallela</i> (7-8 m), <i>Acacia leptostachya</i> (2-6 m), <i>Maytenus cunninghamii</i> , <i>Breynia oblongifolia</i> , <i>Hovea longipes</i> , <i>Atalaya hemiglauca</i> , <i>Grewia retusifolia</i>
<b>Groundcover</b>	<i>Heteropogon contortus</i> , <i>Bothriochloa pertusa</i> , <i>Aristida calycina</i> , <i>Fimbristylis tetragona</i> , <i>Heteropogon triticeus</i> , <i>Sarga plumosum</i> , <i>Praxelis clematidea</i> *, <i>Eustrephus latifolius</i> , <i>Rostellularia adscendens</i> var. <i>clementii</i> , <i>Pterocaulon sphacelatum</i> , <i>Themeda triandra</i> , <i>Hybanthus enneaspermus</i> , <i>Crotalaria aridicola</i> , <i>Solanum ellipticum</i> , <i>Zornia muriculata</i> , <i>Sporobolus actinocladus</i> , <i>Glycine falcata</i>
<b>Structure Category</b>	Sparse to medium



**Photo Plate 10 Community 10 – RE 9.11.2d**

#### **6.1.10.2 Conservation Value**

No species of conservation significance occurred within Community 10. Non-native species diversity and abundance within Community 10 was low. Weed species observed included *Chamaecrista rotundifolia*, *Monstera deliciosa*, *Sida cordifolia* and *Malvastrum americanum*.

#### **6.1.10.3 Vegetation Condition and Habitat Value**

Community 10 holds relatively high integrity, with a low occurrence of non-native flora species, a complex floristic structure and relatively large intact stands throughout the Project site. However, it is extensively traversed by old mining roads and drilling tracks, in particular in the Lucknow tenement.

In addition to the remnant vegetation, there are small patches of regrowth of Community 10 in the east of the old mine footprint in the Greenvale tenement.

RE 9.11.2d is listed as Least Concern under the VM Act and No Concern at Present under the DES's Biodiversity Status. It occurs throughout the central and southern parts of the bioregion. RE 9.11.2 is classed as retaining a low extent within reserves.

## 6.1.11 Community 11

### 6.1.11.1 Community Description

Community 11 covers most of the western portion of the Greenvale tenement and the north-west of the Lucknow tenement. Community 11 consists of *Eucalyptus persistens* woodland on metamorphic hills and slopes. This community covers approximately 1,068.21 ha (18.5%) of the Project site. Community 11 occurs on hills and undulating rises on a variety of soil types on metamorphic geologies. Table 19 summarises the details of this vegetation community.

**Table 19 Vegetation Community 11 Profile**

<b>Associated Regional Ecosystem</b>	9.11.5: <i>Eucalyptus persistens</i> +/- <i>E. crebra</i> woodland on low metamorphic hills
<b>Extent within Project site</b>	1,068.21 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	No Concern at Present
<b>Tree Layer</b>	<i>Eucalyptus persistens</i> (12 – 18 m), occasional <i>Eucalyptus crebra</i> and <i>Corymbia erythrophloia</i>
<b>Shrub Layer</b>	<i>Petalostigma banksii</i> , <i>Carissa ovata</i> , <i>Hakea arborescens</i> , <i>Bursaria incana</i> and <i>Acacia</i> spp. (e.g. <i>Acacia gonoclada</i> )
<b>Groundcover</b>	<i>Themeda triandra</i> , <i>Sarga plumosum</i> , <i>Chrysopogon fallax</i> , <i>Heteropogon triticeus</i> , <i>Brunoniella australis</i> , <i>Rhynchosia minima</i> and <i>Tephrosia juncea</i>
<b>Structure Category</b>	Sparse



**Photo Plate 11 Community 11 – RE 9.11.5**

#### **6.1.11.2 Conservation Value**

No species of conservation significance occurred within RE 9.11.5. The introduced species *Bothriochloa pertusa* is common in previously heavily disturbed areas.

#### **6.1.11.3 Vegetation Condition and Habitat Value**

RE 9.11.5 occurs extensively from Greenvale to north of Charters Towers in the south of the bioregion. It is classified as Least Concern under the VM Act and as No Concern at Present under the DES's Biodiversity Status. The extent of RE 9.11.5 in reserves is low. RE 9.11.5 is subject to degradation from high total grazing pressure.

### **6.1.12 Community 12**

#### **6.1.12.1 Community Description**

Community 12 covers a small portion at the south of the Kokomo tenement. Community 12 is *Eucalyptus persistens* woodland on metamorphic hills and slopes. This community covers approximately 49.31 ha (0.85%) of the Project site. RE 9.11.9 occurs on hills and undulating rises on a variety of soil types on metamorphic geologies. Table 19 summarises the details of this vegetation community.



**Table 20 Vegetation Community 12 Profile**

<b>Associated Regional Ecosystem</b>	9.11.9: Semi-deciduous vine thicket on metamorphic soils (not limestone)
<b>Extent within Project site</b>	49.31 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Of Concern
<b>Biodiversity Status</b>	Of Concern
<b>Tree Layer</b>	Tree layer absent except for scattered <i>Eucalyptus moluccana</i> (12 – 18 m)
<b>Shrub Layer</b>	<i>Terminalia oblongata</i> , <i>Bauhinia hookerii</i> , <i>Pittosporum spinescens</i> , <i>Carissa spinarum</i> , <i>Erythroxyleum austral</i> , <i>Croton phebalioides</i> , <i>Eremophila bianoniiflora</i> , <i>Geijera salicifolia</i> , <i>diospyros humilis</i> , <i>Alectryon oleifolius</i> , <i>Secamone elliptica</i> , <i>Grewia retusifolia</i> , <i>Capparis canescens</i>
<b>Groundcover</b>	<i>Cyperus gracilis</i> , <i>Malvastrum americanum*</i> , <i>Eragrostis parviflora</i> , <i>Eragrostis speciose</i> , <i>Cyperus polystachyos</i> , <i>Enneapogon truncates</i>
<b>Structure Category</b>	Sparse



**Photo Plate 12 Community 12 – RE 9.11.9**

### 6.1.12.2 Conservation Value

No species of conservation significance occurred within the Community 12 and its disturbance has been reported as minor.

### 6.1.12.3 Vegetation Condition and Habitat Value

RE 9.11.9 occurs in scattered patches throughout the central and northern region. It is classified as Of Concern under the VM Act and the DES's Biodiversity Status. The extent of RE 9.11.9 in reserves is low (REDD 2016).

## 6.1.13 Community 13

### 6.1.13.1 Community Description

Community 13 occurs throughout the eastern portion of the Greenvale tenement. It is a woodland of *Eucalyptus crebra* on hills and slopes of igneous rocks. Community 13 covers 774.74 ha (approximately 13.36%) of the Project site. It occurs on a variety of landforms, on granodiorites and granite hills. Table 21 provides a summary of community structure and corresponding conservation status.

**Table 21 Vegetation Community 13 Profile**

<b>Associated Regional Ecosystem</b>	9.12.1a: <i>Eucalyptus crebra</i> and/or <i>E. xanthoclada</i> and/or <i>E. drepanophylla</i> low open woodland on igneous rocks
<b>Extent within Project site</b>	771.74 ha
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Least Concern
<b>Biodiversity Status</b>	No Concern at Present
<b>Tree Layer</b>	<i>Eucalyptus crebra</i> , <i>Eucalyptus persistens</i> , <i>Corymbia erythrophloia</i> , <i>Corymbia setosa</i> , <i>Acacia flavescens</i>
<b>Shrub Layer</b>	<i>Alphitonia excelsa</i> , <i>Acacia leptostachya</i> , <i>Maytenus cunninghamii</i> , <i>Grevillea parallela</i> , <i>Hovea longipes</i> , <i>Hovea lanceolata</i>
<b>Groundcover</b>	<i>Themeda triandra</i> , <i>Heteropogon triticeus</i> , <i>Triodia mitchellii</i> , <i>Entolasia stricta</i> , <i>Indigofera pratensis</i> , <i>Jacquemontia paniculata</i>
<b>Structure Category</b>	Very sparse



**Photo Plate 13 Community 13 – RE 9.12.1a**

#### **6.1.13.2 Conservation Value**

No species of conservation significance occurred within this community. Non-native species identified within Community 13 included *Melinis repens*, *Passiflora foetida* and *Stylosanthes scabra*. The WoN species *Vachellia nilotica* has been recorded within this community in the east of the Greenvale tenement.

On a regional scale, RE 9.12.1a is prone to invasion by weeds, including *Cryptostegia grandiflorum*, *Ziziphus mauritiana*, *Melinis repens* and *Cenchrus ciliaris*.

#### **6.1.13.3 Vegetation Condition and Habitat Value**

Overall, the relative integrity of this community is high. Large stands of this community exist and weed diversity is comparatively low. Nevertheless, as occurred with Community 9, there are small disconnected patches of regrowth within the old footprint of the mine in the Greenvale tenement.

RE 9.12.1a occurs extensively throughout central and southern parts of the Einasleigh Uplands bioregion. RE 9.12.1 is listed as Least Concern under the VM Act and No Concern at Present under the DES's Biodiversity Status. Representation within reserves for RE 9.12.1 is classed as low.

The mammal fauna of Einasleigh Uplands land zone 12 is often similar to that of the land zone 5. Common Rock-rats (*Zyomys argurus*) are present where sufficient structural diversity occurs in the rocks to provide shelter, and the Common Wallaroo (*Macropus robustus*) tends to replace the other macropods. Bird fauna is dominated by widespread common species such as Weebills, Noisy Friarbirds

and Pied Butcherbirds. The reptile fauna is generally similar to that of the surrounding land zones (Kutt et al., 2009).

## 6.1.14 Community 14

### 6.1.14.1 Community Description

This community occurs in one location on the Project site, a hill abutting the main north-south running ridge line near the Kokomo tenement's eastern boundary. It covers approximately 75.77 ha (1.31%) of the Project site. Community 14 occurs on steep hills and ranges on acid and intermediate volcanics close to the Wet Tropics boundary. A summary of the information collected for this community is presented in Table 22.

**Table 22 Vegetation Community 14 Profile**

<b>Associated Regional Ecosystem</b>	9.12.2: <i>Eucalyptus portuensis</i> , <i>Corymbia citriodora</i> subsp. <i>citriodora</i> , <i>E. granitica</i> or <i>E. crebra</i> , <i>C. intermedia</i> or <i>C. clarksoniana</i> mixed woodland on steep hills and ranges on igneous hills close to Wet Tropics boundary.
<b>Extent within Project site</b>	75.77 ha
<b>Biodiversity Status</b>	No Concern at Present
<b>VM Act Status</b>	Least Concern
<b>EPBC Act</b>	Not listed
<b>Tree Layer</b>	<i>Corymbia citriodora</i> (15-22 m), <i>Eucalyptus persistens</i> (24 m), <i>Lophostemon suaveolens</i> (24 m), <i>Eucalyptus howittiana</i> (10 m)
<b>Shrub Layer</b>	<i>Acacia calyculata</i> (6 m), <i>Acacia flavescens</i> , <i>Persoonia falcata</i> , <i>Alphitonia excelsa</i> (3 m), <i>Petalostigma pubescens</i> , <i>Breynia oblongifolia</i> , <i>Hovea longipes</i> , <i>Maytenus disperma</i>
<b>Ground Layer</b>	<i>Aristida calycina</i> , <i>Scleria sphacelata</i> , <i>Eragrostis schultzei</i> , <i>Themeda triandra</i> , <i>Cymbopogon refractus</i> , <i>Cymbopogon bombycinus</i> , <i>Sida cordifolia</i> *, <i>Panicum effusum</i> , <i>Crotalaria aridicola</i> , <i>Zornia muriculata</i> , <i>Fimbristylis dichotoma</i> , <i>Bulbostylis barbata</i> , <i>Evolvulus alsinoides</i> , <i>Paspalidium</i> sp., <i>Marsilea drummondii</i> , <i>Cheilanthes sieberi</i> , <i>Rostellularia adscendens</i> var. <i>clementii</i> , <i>Solanum seaforthianum</i> *, <i>Solanum ellipticum</i> , <i>Phyllanthus carpentariae</i> , <i>Myrsine variabilis</i> , <i>Vigna radiata</i> subsp. <i>sublobata</i>
<b>Structure Category</b>	Mid-dense



**Photo Plate 14 Community 14 – RE 9.12.2**

#### **6.1.14.2 Conservation Value**

No species of conservation significance were recorded within RE 9.12.2. The weeds *Sida cordifolia* and *Solanum seaforthianum* were recorded in this community. RE 9.12.2 is vulnerable to invasion by the weeds *Praxelis clematidea* and *Melinis repens*.

#### **6.1.14.3 Vegetation Condition and Habitat Value**

RE 9.12.2 occurs adjacent to the Wet Tropics bioregion from Mareeba south. It is classified as Least Concern under the VM Act and as No Concern at Present under the DES's Biodiversity Status. The extent of RE 9.12.2 in protected areas is classified as high (REDD 2016).

### **6.1.15 Community 15 – Non-remnant Regrowth**

#### **6.1.15.1 Community Description**

Community 15 occurs over the south-east of the Greenvale tenement. Non-remnant regrowth occurs in areas that have been disturbed by historical human activities, such as mining. Table 23 summarises the community profile.

**Table 23 Vegetation Community 15 Profile**

<b>Associated Regional Ecosystem</b>	Non-remnant regrowth
<b>Extent within Project site</b>	Not applicable
<b>EPBC Act</b>	Not listed
<b>VM Act Status</b>	Not applicable
<b>Biodiversity Status</b>	Not applicable
<b>Tree Layer</b>	(very sparse) <i>Eucalyptus crebra</i> , <i>Acacia shirleyi</i>
<b>Shrub Layer</b>	(sparse) <i>Acacia salicina</i> , <i>Acacia farnesiana</i> *, <i>Acacia bivenosa</i> , <i>Calotropis procera</i> *
<b>Groundcover</b>	(sparse) <i>Cenchrus ciliaris</i> *, <i>Stylosanthes scabra</i> *, <i>Chamaecrista rotundifolia</i> *
<b>Structure Category</b>	Very sparse



**Photo Plate 15 Community 15 – Non-remnant Regrowth**

### 6.1.15.2 Conservation Value

No species of conservation significance occurred within the Non-remnant regrowth community.

Non-native species identified within Community 15 included the *Albizia lebbbeck*, *Vachellia farnesiana*, *Calotropis procera*, *Chamaecrista rotundifolia*, *Malvastrum americanum*, *Monstera deliciosa*, *Cenchrus ciliaris*, *Scoparia dulcis*, *Sida cordifolia*, *Stylosanthes scabra* and *Themeda quadrivalvis*.

### 6.1.15.3 Vegetation Condition and Habitat Value

Community 15 is in relatively unhealthy condition. It is dominated by the presence of woody weeds.

This community is not classed as remnant vegetation, therefore is not defined by an RE.

## 6.2 FLORA SPECIES AND VEGETATION COMMUNITIES OF CONSERVATION SIGNIFICANCE

### 6.2.1 Threatened Ecological Communities

No vegetation within the Project area met the conditions to be classified as threatened ecological communities.

### 6.2.2 Introduced Flora Species

Disturbances such as fire, change in river and stream flows, land clearing, and creation of new roads and tracks may influence the spread of weeds (Hamblin, 2001). For this reason, it is important to determine the species of weeds present in proposed disturbance areas, as well as the extent of infestations, and develop mitigation strategies to limit their spread and/or proliferation during construction activities. As land manager of the Project site, Australian Mines and their staff have the primary responsibility for the management of declared weed species.

41 introduced plant species were identified within the Project site, as shown in **Error! Reference source not found.** Four of these species, are declared restricted invasive plants under the *Biosecurity Act 2014* and/or listed as Weed of National Significance (WoNS) by the Australian Weeds Committee.

Species name	Common Name	Restricted invasive plant	WoN
<i>Lantana camara</i>	Lantana	Yes	Yes
<i>Parthenium hysterophorus</i>	Parthenium weed	Yes	Yes
<i>Vachellia nilotica</i>	Prickly Acacia	Yes	Yes
<i>Sporobolus jacquemontii</i>	American rat's tail grass	Yes	No

Appendix G provides Department of Agriculture, Fisheries (DAF) weed fact sheets for Prickly Acacia, Calotrope, Giants Rat's Tail Grass, Parthenium and Lantana. These species should be managed using strategies provided in Section 9.4.1.

The Project site lies within the Charters Towers Regional Council. Weed management must comply with published policies and management plans, including the *Charters Towers Regional Council Pest Management Plan 2013 – 2017*. Six of the weeds identified on the Project site (Prickly Acacia, Parthenium, Giant Rat’s Tail Grass, Lantana, Calotrope (Photo Plate 16), and Grader Grass) are listed as Council High Priority Weeds in the Charters Towers region.



**Photo Plate 16** Calotrope (*Calotropis procera*) growing in the Project area

### **6.3 SPECIES OF CONSERVATION SIGNIFICANCE IN REGIONAL AREA**

124 species listed as threatened under Queensland legislation were identified in database searches as potentially inhabiting within the 100km buffer area of the Project site. However, only 9 species were identified within a smaller buffer area of each of the tenements of the Project site. The habitat requirements of each species are described in Table 24 along with an assessment of their presence on the Project site. Only 4 of the 9 species were considered as possible to occur on the Project site. No plant species listed as threatened were observed on the Project site.



**Table 24 Threatened flora species of conservation significance not observed on the project site**

Scientific Name Common Name	Status		Species Habitat	Likelihood of Project Impact
	EPBC Act	NC Act		
<i>Acacia cromptonii</i> Pink Gidgee	V	V	Pink gidgee occurs on wooded downs (Silcock 2014) in woodland and open woodland often associated with gidgee ( <i>Acacia cambagei</i> ) and whitewood ( <i>Atalaya hemiglauca</i> ), on alluvial, sandstone and basalt derived soils. Potential habitats in the area include regional ecosystems (BAAM 2011): 9.8.5 and 9.8.6. Pink Gidgee is an uncommon species occurring in small, isolated populations (World Wide Wattle, 2005). This species occurs within the Burdekin, Desert Channels and Southern Gulf (Queensland) Natural Resource Management Regions. The distribution of this species overlaps with the “Community of native species dependent on natural discharge of groundwater from the Great Artesian Basin” EPBC Act-listed threatened ecological community.	<b>Unlikely:</b> The Project site is not within the species known distribution. Given the species has not been identified in targeted surveys and the absence of suitable habitat the Project is not expected to have a significant impact on the species.
<i>Cajanus mareebensis</i>	E	C	<i>Cajanus mareebensis</i> occurs in grassy woodlands of <i>Melaleuca-Acacia</i> , <i>Eucalyptus-Callitris</i> and <i>Eucalyptus-Corymbia</i> woodlands on sandy soils derived from granite with a lower horizon of impeded drainage. The Project site is located within the southern extent of this species’ range. Before 2002, it was known only from two sites, but it has recently been located at a further eight sites near Musgrave on Cape York Peninsula; at three sites from the Irvinebank to Petford area; and at one site south-west of Mt Garnet (DEWHA, 2008a).	<b>Possible:</b> Similar habitat exists within the Project site, although the Project site is not within known distributional locations. This species has a low to moderate potential to occur within the Project site. It is unlikely the Project will have a significant impact on this species.
<i>Cycas platyphylla</i> Cycad	V	V	The main population of <i>Cycas platyphylla</i> is known from the Petford district, west of the Atherton Tableland, Queensland. There are three smaller quite disjunct populations recorded from Taravale, Wandovale and the White Mountains, north of Torrens Creek. This species occurs in sparse <i>Eucalyptus sideroxylon</i> woodland with a grassy understorey, often on rocky slopes in shallow red stony loams (DEWHA, 2008b).	<b>Unlikely:</b> Although similar soils exist within the Project sites, this species known distribution is not within the Project area. This species has a low potential to occur within the Project site
<i>Dichanthium queenslandicum</i> King Blue Grass	E	V	This species occurs on black cracking clay in tussock grasslands mainly in association with other species of Bluegrasses. It is mostly confined to the natural Bluegrass grasslands of central and southern Queensland (DoE 2015).	<b>Unlikely:</b> This species known distribution is not within the Project area and it has not been identified in targeted surveys. The project is not expected to have a significant impact on the species.

<i>Dichanthium setosum</i> Bluegrass	V	C	Occurs in grassy woodland and open forests in inland Australia. Associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DoE 2015).	<b>Possible:</b> Suitable habitat for this species occurs throughout the Project site. Targeted searches were unable to identify this species on the Project site. It is unlikely the Project will have a significant impact on this species.
<i>Grevillea glossadenia</i>	V	V	<i>Grevillea glossadenia</i> is endemic to north-east Queensland. It is found west of Atherton Tablelands, mainly between Walkamin, Irvinebank, Herberton, and Watsonville. Localities include Mount Emerald, Mount Misery, Cooloomon Creek, Little Cooloomon Creek, Emu Creek, Granite Creek, and Barkerville. This species grows in Eucalypt woodland or low open forest, in shallow to skeletal granitic soils on rolling hills, gravel terraces near stream beds and along roadsides and mining tracks (DEWHA, 2008c).	<b>Possible:</b> The patchy distribution of this species is located within the regional vicinity of the Project site and preferred habitat for this species is present. There is a low to moderate potential for this species to occur within the Project site. It is unlikely the Project will have a significant impact on this species.
<i>Leptospermum pallidum</i>	NL	NT	There is limited information about the species habitat. The type specimen was recorded from Marble Creek mesa, SE of Greenvale. It was reported as growing at base of Cliff, with <i>Eucalyptus persistens</i> . This species was identified in the 25km database search but not in the 5k database search.	<b>Possible:</b> The patchy distribution of this species is located within the regional vicinity of the Project site. There is a low to moderate potential for this species to occur within the Project site. It is unlikely the Project will have a significant impact on this species.
<i>Lepturus minutus</i>	NL	V	There is limited information about the species habitat. The type specimen was described as common in understorey under rainforest canopy. This species was identified in the 25km database search but not in the 5k database search.	<b>Unlikely:</b> This species known distribution is not within the Project area and it has not been identified in targeted surveys. The project is not expected to have a significant impact on the species.
<i>Phalaenopsis rosenstromii</i>	E	E	<i>Phalaenopsis rosenstromii</i> occurs in north-east Queensland, sporadically from the Iron Range in the north and as far south as the Paluma Ranges. This species has been recorded in Daintree National Park, Iron Range National Park and Mt Spec National Park. It is known to grow in trees, rarely on rocks, in humid airy situations on sheltered slopes and in gullies, in deep gorges and close to streams in rainforests, at altitudes from 200–500 m. Population numbers and extent of occurrence are unknown (DoE, 2008).	<b>Unlikely:</b> This species' preferred habitat does not exist within or adjacent to the Project site, as no humid rainforest conditions are present. Therefore, it is highly unlikely to occur in the area. It is unlikely the Project will have a significant impact on this species.

EPBC – Environment Protection and Biodiversity Conservation Act 1999

NC Act – Nature Conservation Act 1992

C – Least Concern

CE – Critically Endangered

E – Endangered

NL – Not listed

NT – Near Threatened

V – Vulnerable

EW – Extinct in the Wild

## 7.0 FAUNA RESULTS AND DISCUSSION

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A total of 231 vertebrate species were positively identified on the Project site during the surveys, comprising 13 amphibians, 135 birds, 44 mammals and 39 reptiles. Six of these species are introduced. Twenty-six marine species were recorded during the survey, of which two are also listed as migratory species under the EPBC Act. Five threatened fauna species were observed on site, four species are listed as Special Least Concern under the NC Act and not listed under the EPBC Act and one bat species (which presence is only recorded as possible) is listed as Endangered under the NC Act and Vulnerable under the EPBC Act. A complete list of the fauna species recorded on the Project site is included in **Error! Reference source not found..**

Each of the major vertebrate groups observed on the Project site is discussed below in Sections 7.1 to 7.4. Pest species observed on the Project site are discussed in Section 7.5. Fauna species of conservation significance are discussed in Section 7.6.

### 7.1 AMPHIBIANS

Many of the amphibian species inhabiting Australia's drier regions are burrowing species capable of spending extensive periods underground awaiting heavy rain, after which they come to the surface to feed and breed. This behaviour is referred to as aestivation and assists in water preservation and survival during prolonged drought (Withers, 1995). Consequently, most amphibians from seasonally dry regions occur in areas where the ground becomes soft enough to allow burrowing during wet periods.

Non-burrowing amphibians also inhabit Australia's drier regions by adopting different survival strategies that include sheltering in deep tree hollows and rock crevices. These species are typically associated with permanent water sources.

#### 7.1.1 Observed Species

A total of 13 amphibian species were recorded during the surveys, comprising 12 native species and the introduced Cane Toad (*Rhinella marina*). This species observed include the Common Tree Frog (*Litoria caerulea*), Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Desert Tree Frog (*Litoria rubella*) (Photo Plate 17) and Striped Rocket Frog (*Litoria nasuta*). A full list of amphibian species observed on the Project site is presented in **Error! Reference source not found..**

All amphibian species observed have a big extent of occurrence (in every case bigger than 20,000 Km<sup>2</sup>) and don't present any decline.



**Photo Plate 17 Spotted Grassfrog (*Limnodynastes tasmaniensis*) in the Project area**

### **7.1.2 Amphibians of Conservation Significance**

No amphibian species of conservation significance were observed on the Project site during field surveys. No amphibians of conservation significance have previously been recorded within 25km of each of the three study areas. It is considered unlikely that any amphibian species of conservation significance will occur on the Project site.

## **7.2 BIRDS**

Avian assemblages are generally determined by factors such as food sources (e.g. fruit, nectar, seeds and insects), and habitat structures (such as grasses, thick understorey, midstorey and canopy vegetation). In general, greater numbers of food sources are generally reflected by higher avian diversity.

Food sources on the Project site are generally restricted to seeds, nectar, insects, and vertebrate prey items (or carrion). The Project site largely lacks a permanent or abundant supply of fruit producing plant species, therefore fructivorous bird species are less likely to be present.

### **7.2.1 Observed Species**

A total of 135 bird species were observed on the Project site. Most species observed were common species representative of the dry woodland habitat dominating the study area. The presence of permanent water in some portions of the Project site also provides habitat suitable for several wetland and migratory species. Photo Plate 18 depicts the Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* race *banksii*).

A full list of avian species observed on the Project site is presented in **Error! Reference source not found.**



**Photo Plate 18 Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* race *banksii*)**

## **7.2.2 Birds of Conservation Significance**

### **7.2.2.1 Threatened Species**

Four conservation significant bird species with threatened species listing under the NC Act or EPBC Act were observed on the Project site:

- The Masked Owl (*Tyto novaehollandiae Kimberli*) NC Act and EPBC Act listed Vulnerable;
- Fork-tailed Swift (*Apus pacificus*), NC Act Special Least Concern and EPBC Act Migratory and Marine;
- Sharp-tailed Sandpiper (*Calidris acuminata*), NC Act Special Least Concern and EPBC Act Migratory and Marine; and
- Barn Swallow (*Hirundo rustica*), NC Act Special Least Concern and EPBC Act Migratory and Marine.

The Masked Owl (Northern subspecies) is listed as Vulnerable under the NC Act and EPBC Act and was recorded at the Kokomo tenement at fauna site FS34 in Vegetation Community 2 (*Eucalyptus platyphylla* woodland on alluvial flats). The species is also considered likely to occur at the Greenvale and Lucknow tenements. Suitable habitat for the Masked Owl includes riparian forest, open forest, Melaleuca swamps and the edges of mangroves (DoEE 2018). The species occurs in low densities and requires an expansive area for hunting prey, with trees large enough to form appropriate hollows (DoEE

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2018). Their core area is approximately 155 ha, while their home range during the non-breeding season can extend as far as 1178ha.

The Fork-tailed Swift (*Apus pacificus*) is an EPBC Act listed migratory and marine species and was recorded at the Lucknow tenement. The Fork-tailed Swift is almost exclusively aerial species with a very broad range of preferred habitats, globally widespread and non-breeding visitor to all states and territories of Australia (Higgins 1999).

The Sharp-tailed Swift (*Calidris acuminata*) is an EPBC listed migratory and marine species and was recorded at the Greenvale tenement. The species prefers fresh or saltwater shallow wetlands with muddy edges with the presence of inundated or emergent sedges, grass, saltmarsh, or other low vegetation.

The Barn Swallow (*Hirundo rustica*) is an EPBC Act listed migratory and marine species. It is widespread in the northern hemisphere and winters in the southern hemisphere. It inhabits open country, agricultural land and urban areas.

The surveys and database searches identified nine bird species of conservation significance present or likely to occur within the Project region. An assessment of the likelihood of these species being significantly impacted by the Project is outlined in Table 26.

#### 7.2.2.2 EPBC Act Listed Marine and Migratory Species

The EPBC Act lists bird species that are classified as migratory and/or marine. Twenty-six migratory and/or marine birds were identified on the Project site. These species are listed in Table 25 and discussed in further detail below.

**Table 25 Migratory and Marine Bird Species found on the Project site**

Scientific Name	Common Name	Status
<i>Accipiter fasciatus</i>	Brown Goshawk	Marine
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	Marine
<i>Haliastur sphenurus</i>	Whistling Kite	Marine
<i>Todiramphus sanctus</i>	Sacred Kingfisher	Marine
<i>Apus pacificus</i>	Fork-tailed Swift	Marine, Migratory
<i>Ardea alba</i>	Great Egret	Marine
<i>Ardea ibis</i>	Cattle Egret	Marine
<i>Ardea intermedia</i>	Intermediate Egret	Marine
<i>Egretta garzetta</i>	Little Egret	Marine

Scientific Name	Common Name	Status
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Marine, Migratory
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	Marine
<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	Marine
<i>Coracina tenuirostris</i>	Cicadabird	Marine
<i>Eurystomus orientalis</i>	Dollarbird	Marine
<i>Chrysococcyx basalis</i>	Horsfields Bronze Cuckoo	Marine
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	Marine
<i>Dicrurus bracteatus</i>	Spangled Drongo	Marine
<i>Eurostopodus argus</i>	Spotted Nightjar	Marine
<i>Falco cenchroides</i>	Nankeen Kestrel	Marine
<i>Todiramphus macleayii</i>	Forest Kingfisher	Marine
<i>Hirundo rustica</i>	Barn Swallow	Marine, Migratory
<i>Merops ornatus</i>	Rainbow Bee-eater	Marine
<i>Grallina cyanoleuca</i>	Magpie Lark	Marine
<i>Pelecanus conspicillatus</i>	Australian Pelican	Marine
<i>Ninox boobook</i>	Southern Boobook	Marine
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	Marine
<i>Zosterops lateralis</i>	Silvereye	Marine

The distribution of the above-mentioned species is widespread in eastern Australia (Simpson and Day, 2010), and the local populations on the Project site are unlikely to constitute 'ecologically significant proportions' of the total population of each species. Furthermore, the Project site is not at the limit of these species' range, nor are these species considered to be declining within the region. Therefore, it is unlikely that the Project will have a significant impact on the regional populations of these species.

### 7.3 MAMMALS

The assemblage of mammal species recorded within the Project site varied greatly in morphology and habitat preferences. The ecology of each mammalian group recorded is equally variable as they are assessed separately in the following sections.

### ***Small Mammals***

Habitats suitable for small mammals include areas that provide plentiful food sources and suitable shelter sites. The highest density of small mammal species is usually associated with:

- Reliable rainfall, which is reflected in a reliable source of food; and
- Dense ground vegetation, particularly shrubs and grasses.

Small mammal diversity is often limited by unpredictable food supply and open ground vegetation. Consequently, small mammal populations can fluctuate dramatically in response to rain which increases seed production and insect abundance. During less favourable periods, small mammal populations can be very low.

The Project site offered moderate habitat value for small ground-dwelling mammals. Insufficient ground cover and grazing pressure reduced habitat appeal within the Greenvale tenement and parts of the Kokomo tenement. The Lucknow tenement provided much denser vegetation. Some shelter sites existed on rocky outcrops, in tree hollows and amongst fallen timber. Some drainage/floodplain areas contained significant groundcover into the dry season.

### ***Medium and Large Mammals***

Factors affecting the occurrence of medium and large sized mammals are varied. Important factors include land-clearing, feral animal predation and grazing pressures. Suitable habitat for medium and large mammals was common throughout the Project site, with grassy woodlands, rocky shelter and nearby sources of permanent water. This is reflected by the abundance of Wallabies and Wallaroos on the site. Currently, there is no suitable data to assess population changes in macropod species (SEWPAC, 2011) for the Einasleigh Uplands bioregion.

### ***Arboreal Mammals***

The majority of arboreal mammals that occur in Australia utilise tree hollows for nesting and shelter (Menkhorst and Knight, 2011). Shortages of nest hollows limit arboreal mammal populations (Smith and Lindenmayer, 1988).

The Project site was searched extensively for hollows. Spotlighting targeting arboreal mammals was undertaken in areas of potential habitat. The search revealed that only limited habitat for arboreal mammals is available on the Project site, hollow-bearing trees generally occur along creek-lines or in adjoining communities. Areas adjacent to the Project site, including creek lines with large hollow bearing trees, provide habitat for arboreal mammals.

### ***Bats***

The density and diversity of Australian bat species is determined primarily by the availability of suitable nesting and roosting sites. Roosting sites can include locations such as thick foliage, loose exfoliating bark, rock caves or cavities, tree hollows or even fabricated structures such as old buildings and culverts (Churchill, 1998).

Potential roosting habitat including rocky outcrops and drainage areas on the Project site were surveyed with an ANABAT echolocation call recorder. Riparian zones with large hollow bearing trees located adjacent to the Project site were also surveyed.



### 7.3.1 Observed Species

A total of 48 mammals were positively identified on the Project site, five of which are introduced species. Fourteen microbat species have been positively identified, plus inseparable species pairs (such as *Scotorepens greyii*/*S. sanborni*; *Myotis macropus*/*Nyctophilus* sp.) with 3 additional microbat species identified to genus level only. The presence of four additional species could not be confirmed. The most commonly recorded microbat species was the Northern Freetail Bat (*Chaerephon jobensis*), followed by the Mormopterus beccarii (*Beccari's Freetail Bat*). ANABAT results are presented in Appendix F.

Eleven medium and large mammal species were recorded on the Project site. Macropod abundance was high, with seven species observed on site. The seven species observed were the Spectacled Hare Wallaby (*Lagorchestes conspicillatus*), Black Striped Wallaby (*Macropus dorsalis*), Eastern Grey Kangaroo (*Macropus giganteus*), Whiptail Wallaby (*Macropus parryi*), Allied Rock-wallaby (*Petrogale assimilis*), Swamp Wallaby (*Wallabia bicolor*), Common Wallaroo (*Macropus robustus*) Northern Brown Bandicoot (*Isodon macrourus*) and the introduced Feral Cat (*Felis catus*).

Six small mammals were recorded on the Project site, including the Common Planigale (*Planigale maculata*) (Photo Plate 19), the Common Dunnart (*Sminthopsis murina*), the Northern Short-tailed mouse (*Leggadina lakedownensis*), the Rufous Bettong (*Aepyprymnus rufescens*), the introduced Black Rat (*Rattus rattus*) and the European Rabbit (*Oryctolagus cuniculus*).

One monotreme, the Echidna (*Tachyglossus aculeatus*), was recorded on site. Three arboreal mammals, the Brushtail Possum (*Trichosurus vulpecula*), the Squirrel Glider (*Petaurus norfolcensis*) and Sugar Glider (*Petaurus breviceps*), were identified on site.

A full list of species observed on site is presented in **Error! Reference source not found.**



**Photo Plate 19 Common Planigale (*Planigale maculata*) in the Project area**

### 7.3.2 Mammals of Conservation Significance

No mammal species of conservation significance were confirmed on the Project site. One NC Act Endangered and EPBC Act Vulnerable species, the Greater Large-eared Horseshoe bat (*Rhinolophus robertsi*) was registered as possibly present in the Kokomo tenement at two sites. The signals allocated to *R. robertsi* were very noisy and poorly-rendered in the spectrograms but fell within the relevant frequency range for the species (28-32 kHz) and appeared to represent the constant-frequency signals typical of horseshoe bats. It is, however, possible that these “calls” were from an unknown non-bat source (Balance Environmental 2018).

Surveys and database searches identified nine mammal species of conservation significance present in the Project area or likely to occur within the Project region. An assessment of the likelihood of these species being significantly impacted by the project is outlined in Table 26.

## 7.4 REPTILES

Australia’s environment supports an extremely diverse assemblage of reptile species, which exploit a wide array of micro-habitats (e.g. tree hollows, soil cracks) and food sources (e.g. succulent leaves, termites, grasshoppers, birds, and other reptiles) (Pianka, 1969). This diversity encompasses species of widely different body sizes (e.g. skinks versus monitors), and life history strategies (e.g. burrowing blind snakes versus arboreal geckos).

Reptile habitat on the Project site is quite diverse and generally representative of the surrounding region. Steep hill slopes with rocky outcrops and rocky surface cover provide protective cover to smaller reptile species. Timbered areas on the study area provided litter cover and some hollow forming trees were also observed, particularly in lower lying areas of the nearby Burdekin River and associated floodplain.

### 7.4.1 Observed Species

Thirty-nine reptile species were identified on the Project site. Reptiles from ten families were recorded. The highest species diversity was observed in the *Scincidae* family (19 species from six genera), followed by *Elapidae* (four species from three genera) and *Diplodactylidae* (four species from two genera). Three larger reptiles from the genus *Varanidae*, namely the Lace Monitor (*Varanus varius*), Storr’s Monitor (*Varanus storri storri*) and Black-tailed Monitor (*Varanus tristis*), were observed. Photo Plate 20 depicts the Spiny Knob-tailed Gecko (*Nephrurus asper*) and Photo Plate 21 shows an Eastern Stone Gecko (*Diplodactylus vittatus*).

A full list of reptile species observed on site is presented in **Error! Reference source not found..**



**Photo Plate 20** Spiny Knob-tailed Gecko (*Nephurus asper*) in the Project area



**Photo Plate 21** Eastern Stone Gecko (*Diplodactylus vittatus*) in the Project area

#### **7.4.2 Reptiles of Conservation Significance**

No reptiles of conservation significance were observed on the Project site during the survey period. Database searches identified one reptile species of conservation significance likely to occur within the

Project region. An assessment of the likelihood of this species being significantly impacted by the project is outlined in Table 26.

## 7.5 INTRODUCED FAUNA SPECIES

Field surveys positively identified 6 introduced and/or pest fauna species as having a presence within the Project area. Introduced species were recorded through detection of scats, tracks or other traces (e.g. skulls), sensor camera detection and/or direct observation. The suite of introduced species present includes the Cane Toad (*Rhinella marina*), Feral Pig (*Sus scrofa*), Feral Cat (*Felis catus*), Rabbit (*Oryctolagus cuniculus*), Wild Dog/Dingo (*Canis lupus familiaris/dingo*) and Black Rat (*Rattus rattus*). The Wild Dog/Dingo, Rabbit, Feral Pig and Feral Cat are listed as restricted invasive animal under the *Biosecurity Act 2014*.

Cane Toads (*Rhinella marina*) are not a declared animal under the *Biosecurity Act 2014* but are a major pest species that compete for food, habitat and breeding areas with native frogs. They are also known to consume a wide variety of native animals including frogs, small reptiles, mammals and birds and to cause fatalities in predators that attempt to consume them due to their poisonous nature.

The introduced Feral Pig (*Sus scrofa*) was also abundant throughout the Project site (see Photo Plate 22). Feral pigs are omnivorous, opportunistic feeders that have a significant impact upon the Australian environment and economy. They trample and uproot the ground, damage pastures and crops, disturb sensitive riparian zones and wetlands, spread weed seeds, compete with native species, destroy habitat and prey on smaller animals. They are also known to carry diseases such as leptospirosis, Q fever and sparganosis. Feral Pig disturbance is often a hindrance to any re-vegetation/rehabilitation plans, as they will eat almost any available plant material. Riparian and floodplain disturbance from Pigs was noted both on and adjacent to the Project site.

Rabbits are considered a major agricultural and environmental pest and. This species significantly impacts on the environment by competing with native animals and causing significant soil erosion through foraging on vegetation. Rabbits also damage crops. They are highly adaptable animals and can establish populations in a wide variety of habitats. European Rabbits were observed in abundance throughout the Project site. Favourable habitat conditions and food availability are thought to be responsible for their prevalence on site.

The Feral Cat (*Felis catus*) is an opportunistic predator, and dietary studies have shown that small mammals, birds, reptiles, amphibians, insects and even fish can be taken as prey. Actual competition for prey can cause a decline in the numbers of native predatory species such as quolls, eagles, hawks and reptiles. Not only do native animals bear the brunt of predation, but they also suffer the effects of a parasite that reproduces only in the intestine of the cat. This disease (toxoplasmosis) is particularly harmful to marsupials, which may develop blindness, respiratory disorders, paralysis, and suffer the loss of offspring through abortion and stillbirths.

Another introduced mammalian species that was observed in high numbers on the Project site was the Wild Dog/Dingo (*Canis lupus familiaris/dingo*). Wild Dogs are also listed as restricted animals for the impacts they have upon livestock. Wild Dogs can also spread disease to domestic animals and humans. They are also known to attack pets and children.



**Photo Plate 22 Feral Pigs (*Sus scrofa*) observed on the Project site**

## **7.6 FAUNA SPECIES OF CONSERVATION SIGNIFICANCE KNOWN FROM THE REGION**

This section discusses species of conservation significance that are known from the broad region in which the Project is located. These species have been identified from database and scientific literature searches. Table 26 provides an assessment of the likelihood of these species utilising the Project site. The assessment is based on the knowledge and opinion of AARC staff, information obtained from the field surveys, previous surveys conducted on the Project site, scientific literature and communications with relevant experts or interest groups.

**Table 26 Threatened Fauna species of conservation significance recorded or known from the Project region**

Scientific Name Common Name	Status		Species Habitat	Likelihood of Project Impact
	EPBC Act	NC Act		
<b>Birds</b>				
<i>Calidris ferruginea</i> Curlew Sandpiper	CE	E	Inhabiting wetland environments, The Curlew Sandpiper is commonly found on sandy shores, lagoons, tidal mudflats, saltmarshes, swamps, lakes, and sewage farms (Pizzey and Knight, 2007). They forage at the edge of shallow pools and can wade through water 15-60 mm deep. Whilst small numbers have been recorded living inland around ephemeral and permanent lakes, dams and bores, the majority reside along the coast roosting on dry shingle, sand, or shell beaches (DoEE, 2018).	<b>Unlikely:</b> Potential and likely habitat for this species occurs within the Project area. Habitat within the Project site is low amenity for the species and this type of habitat is associated with very low occupancy for the species. No high amenity coastal wetland areas are present. Given the lack of high amenity habitat, the project is not likely to have an impact on this species.
<i>Erythrotriorchis radiatus</i> Red Goshawk	V	E	This species prefers forest and woodland with a mosaic of vegetation types, large prey populations (birds) and permanent water. The vegetation types include Eucalypt woodland, open forest, tall open forest, gallery rainforest, swamp sclerophyll forest, and rainforest margins. The Red Goshawk nests in large trees, within 1 km of permanent water (DoEE, 2018)	<b>Unlikely:</b> Open woodland habitat for this species does occur within the Project site. Due to the low population (less than 1000 individuals remain (DERM, 2011) and tendency to reside in coastal areas, it is unlikely the Red Goshawk would utilise the Project site. Given the highly mobile nature of the species and the continued presence of habitat on and around the Project site, the Project is not expected to have a significant impact on the Red Goshawk.

Scientific Name Common Name	Status		Species Habitat	Likelihood of Project Impact
	EPBC Act	NC Act		
<i>Erythrura gouldiae</i> Gouldian Finch	E	E	This species is widely distributed throughout northern Australia occurring most commonly in Western Australia and the Northern Territory. It prefers grassy tropical woodland usually in association with a water source. It can occasionally be observed in open grasslands (DoEE, 2018).	<b>Unlikely:</b> Potential habitat for this species may occur in the Project area but the species was not recorded. Given the high mobility of this species and the absence of records, the Project is not expected to have a significant impact on the Gouldian finch.
<i>Geophaps scripta scripta</i> Squatter Pigeon (southern)	V	V	The Squatter Pigeon (southern subsp.) typically occupies grassy woodlands and open forests, mostly on sandy sites near permanent water (Curtis <i>et al.</i> 2012).	<b>Possible:</b> Due to the wide range of habitat this species inhabits, it is possible this species would occur within the Project sites. Given that this species has not been recorded on site and suitable habitat occurs in abundance throughout the bioregion, the Project is not expected to have a significant impact on the species.
<i>Neochmia ruficauda ruficauda</i> Star Finch (eastern)	E	E	The Star Finch occurs in grasslands and grassy woodlands, near permanent water, and often in or near suburban areas (Curtis <i>et al.</i> 2012).	<b>Unlikely:</b> In view of limited recent observations (only four definite and six unconfirmed records since 1990) (QEPA, 2006a), in combination with restricted preferred habitat on Site, it is unlikely the species occurs or is likely to occur on the Project site. The Project is not expected to impact on this species given that it is highly mobile and is not known to have a presence on site.
<i>Pandion cristatus</i> * <i>Pandion haliaetus</i> (Osprey, Eastern Osprey)	Mi, M	SLC	The Osprey (Eastern Osprey) Predominantly occupies coastal and littoral habitats as well as terrestrial wetlands of tropical and temperate Australia and offshore islands. They visit a variety of wetland habitats (DoEE, 2018).	<b>Unlikely:</b> The Osprey is unlikely to occur in the Project area due to a lack of suitable habitat and therefore Project impacts to the species are considered unlikely to occur.

Scientific Name Common Name	Status		Species Habitat	Likelihood of Project Impact
	EPBC Act	NC Act		
<i>Poephila cincta cincta</i> Black-throated Finch (southern)	E	E	Inhabits open grassy woodlands and forests (Curtis <i>et al.</i> 2012), scrubby plains and Pandanus flats with deep cover of grasses. Its habitat is never far from water. It is known to occur south of Townsville, particularly around Townsville and Charters Towers (DoEE, 2018).	<b>Unlikely:</b> The Project site does provide areas of potential habitat. However, given that the species is highly mobile and not known to occur on the site, the Project is not likely to impact on the species.
<i>Rostratula australis</i> Australian Painted Snipe	E	V	Found in shallow inland wetlands, either freshwater or brackish, which are either permanently or temporarily filled, throughout many parts of Australia (DoEE, 2018).	<b>Unlikely:</b> Suitable habitat is limited to the pit voids at the Greenvale Nickel Mine site. Possible utilisation of the Project site is unlikely. The Project is not expected to have a significant impact on this species given that it is highly mobile and has not been identified during targeted searches on the Project site.
<i>Tyto novaehollandiae Kimberli</i> Masked Owl (northern subspecies)	V	V	The distribution of the Masked Owl (northern subspecies) is very poorly known (Woinarski 2004), and three subpopulations have been suggested: Kimberley, Northern Territory (NT) and Cape York (Garnett <i>et al.</i> 2011). In northern Australia, the Masked Owl has been recorded from riparian forest, rainforest, open forest, <i>Melaleuca</i> swamps and the edges of mangroves, as well as along the margins of sugar cane fields (Higgins 1999; Nielsen 1996; Storr 1977, 1980). The Masked Owl has a large home range, and preys on mammal species.	<b>Potential:</b> The species was recorded at the Kokomo tenement (fauna site FS34) in Vegetation Community 2 ( <i>Eucalyptus platyphylla</i> woodland on alluvial flats) and is considered likely to occur at the Greenvale and Lucknow tenements. The Project may potentially impact Masked Owl habitat.
<b>Mammals</b>				
<i>Dasyurus hallucatus</i> Northern Quoll	E	C	The Northern Quoll is most abundant in rocky Eucalypt woodland. It occurs in a range of vegetation types, mostly within 200 km of coast (Menkhorst and Knight, 2011).	<b>Unlikely:</b> The Project site lacks suitable habitat for this species and therefore is not likely to impact on the species.



Scientific Name Common Name	Status		Species Habitat	Likelihood of Project Impact
	EPBC Act	NC Act		
<i>Macroderma gigas</i> Ghost Bat	V	E	Ghost bats can be found in various habitats ranging from dry, arid regions of open woodlands through to wet rainforests and vine scrubs (Van Dyck et al. 2013). They occupy the northern tropical areas of Queensland, Northern Territory and Western Australia.	<b>Unlikely:</b> As this species is known to occupy a range of habitats, the Project is not expected to have a significant impact on this species given that it is highly mobile and has not been identified on the Project site.
<i>Mesembriomys gouldii rattoides</i> Black-footed Tree-rat (north Queensland)	V	C	This species mostly occurs in eucalypt forests and woodlands, especially where hollows are relatively plentiful. S. Legge (pers. Obs.) notes a record of denning in a hollow in a large rainforest tree near rainforest-eucalypt forest boundary at Iron Range.	<b>Unlikely:</b> The Project site is located South of the species known distribution. Given this species has not been recorded on the the Project is not expected to have a significant impact on the species.
<i>Petauroides Volans</i> Greater Glider	V	V	It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (Andrews et al., 1994; Smith et al., 1994, 1995; Kavanagh 2000; Eyre 2004; van der Ree et al., 2004; Vanderduys et al., 2012). The distribution may be patchy even in suitable habitat (Kavanagh 2000). The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (Kavanagh 1984).	<b>Unlikely:</b> The species was not detected on site during the terrestrial ecology surveys however was recorded aquatic ecology surveys at sites on the Burdekin River approximately 2 km to 5 km from the Greenvale tenement. Potential Greater Glider marginal quality habitat occurs in the Project area however the species was not observed within the Project area through targeted surveys. The Project is therefore considered unlikely to impact the Greater Glider

Scientific Name Common Name	Status		Species Habitat	Likelihood of Project Impact
	EPBC Act	NC Act		
<i>Phascolarctos cinereus</i> Koala	V	V	Inhabits Eucalypt forests and woodlands on the east coast of Australia (Curtis <i>et al.</i> 2012).	<b>Unlikely:</b> The species was not detected on site during the surveys and there are no records of this species within the local area. It is therefore considered unlikely to occur on the Project Site. Given the species has not been identified in targeted surveys and the absence of suitable habitat the Project is not expected to have a significant impact on the species.
<i>Pteropus conspicillatus</i> Spectacled Flying-fox	V	E	Coastal Queensland from Tully to tip of Cape York. Inhabits tall rainforest, gallery forest, mangroves or paperbark forests (Menkhorst and Knight 2001).	<b>Unlikely:</b> Limited habitat occurs on the Project site and there are no records of this species within the local area. It is therefore considered unlikely to occur on the Project sites. The Project is not expected to have a significant impact on this species given that it is highly mobile and has not been identified on the Project site.
<i>Saccolaimus saccolaimus nudicluniatus</i> Bare-rumped Sheathtail Bat	V	E	The Bare-rumped Sheathtail Bat occurs mostly in lowland areas, typically in a range of woodland, forest and open environments (Schulz & Thomson 2007; Reardon <i>et al.</i> 2010; Dennis 2012). The small number of confirmed roosts located in Australia have all been in tree hollows (Churchill 1998; Compton & Johnson 1983).	<b>Possible:</b> Based on the species accepted distribution (e.g. see Churchill 2008), and the wide range of habitat this species inhabits; the Project site may provide suitable habitat (Balance Environmental 2012). Given that this species has not been recorded on site and suitable habitat occurs in abundance throughout the bioregion, the Project is not expected to have a significant impact on the species.
<i>Rhinolophus robertsi</i> Greater Large-eared Horseshoe Bat	V	E	The Greater Large-eared Horseshoe Bat is found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, <i>Melaleuca</i> forest with rainforest understorey, open savannah woodland and tall riparian woodland of <i>Melaleuca</i> , Forest Red Gum ( <i>E. tereticornis</i> ) and Moreton Bay Ash ( <i>E. tessularis</i> ) (Churchill 2009; Pavey & Kutt 2008).	<b>Possible:</b> The Project site is located within the species distribution and may provide suitable habitat for the species. The species was not positively identified on the Project site however four potential calls were recorded. Given presence was not confirmed Project impacts are considered possible, and further survey effort will be necessary to determine the species presence and likelihood of impacts.
<b>Reptiles</b>				

Scientific Name Common Name	Status		Species Habitat	Likelihood of Project Impact
	EPBC Act	NC Act		
<i>Egernia rugosa</i> Yakka Skink	V	V	Inhabits dry open forests, woodlands and rocky areas in the Brigalow Belt, where it occurs in fallen timber, wood piles, uprooted trees, deep rock crevices, deeply eroded gullies or disused rabbit warrens (DoEE, 2018).	<b>Possible:</b> A low potential exists that this species may occur on Site however no individuals have been recorded in the surrounding region. Given this species has not been recorded on the Project site and suitable habitat will be retained, the Project is not expected to have a significant impact on the species.

EPBC – Environment Protection and Biodiversity Conservation Act 1999

NC Act – Nature Conservation Act 1992

C – Least Concern

CE – Critically Endangered

E – Endangered

NL – Not listed

NT – Near Threatened

V – Vulnerable

EW – Extinct in the Wild

MI – Migratory

M - Marine

## 8.0 POTENTIAL IMPACTS TO ENVIRONMENTAL VALUES

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This section provides a summary of the environmental values of the Project site. Suggested strategies to minimise Project impacts upon the local native flora and fauna, and recommendations regarding rehabilitation of the Project site are provided in Section 9.0.

### 8.1 SUMMARY OF ENVIRONMENTAL VALUES

The environmental values of the Project site have been impacted by previous mining activities, grazing, feral animals and weed infestations. Heavily disturbed areas of the Project site, such as the Greenvale Nickel Mine area, have limited environmental value.

As part of the Project, a haul road will be constructed from the Kokomo tenement to the Greenvale tenement. This haul road will utilise the existing road network which traverses land adjacent to the Valley of Lagoons. The Valley of Lagoons is listed on the Directory of Important Wetlands in Australia. It is a complex continuous aggregation of spring fed, permanent and seasonal riverine, lacustrine and palustrine wetlands at the headwaters of the Burdekin River. Assessment of impacts to the environmental values of the Valley of Lagoons is presented in the Aquatic Ecology Report.

Project development will involve the expansion of the Stenhouse Dam, a lacustrine wetland located on the Greenvale tenement. The Stenhouse Dam provides habitat for a diverse range of aquatic birds, including the Near Threatened Cotton Pygmy Goose (*Nettapus coromandelianus albipennis*). The Stenhouse Dam and Cotton Pygmy Goose are discussed in detail in the Aquatic Ecology Report.

#### 8.1.1 Flora Values

##### 8.1.1.1 Flora Species of Conservation Significance

No flora species of conservation significance were identified within the Project site.

##### 8.1.1.2 Weed Species of Management Concern

Three species recorded within the Project site were identified as WoNS Parthenium weed (*Parthenium hysterophorus*), Prickly Acacia (*Vachellia nilotica*) and Lantana (*Lantana camara*). All three species with the addition of American rat's tail grass (*Sporobolus jacquemontii*) are also listed as Class 2 under the NC Act.

##### 8.1.1.3 Vegetation Communities

Vegetation communities within the Project site are typical of remnant, arid-zone communities with minor disturbance from cattle grazing and exploration mining activities. All the vegetation communities described on site were associated with REs. No EREs were identified within the Project site. One RE out of fourteen described within the Project site has a Vegetation Management Act Class listing of 'Of Concern'. No EPBC Act listed TECs were identified within the Project site.

Vegetation communities on the Project site host a range of native flora species and provide habitat and food for native fauna species. The vegetation communities with low numbers of woody weeds (RE 9.3.3, RE 9.12.1a, 9.7.1a, RE 9.7.2, RE 9.11.2d) hold high biodiversity values for native flora and fauna. RE 9.3.25 contains wetland areas which provide water and habitat for a range of fauna species.

One of the present vegetation communities (Community 12 - RE 9.11.9) is also listed as Of Concern under the VM Act. Disturbance of this vegetation may result in a significant impact to a regulated vegetation under the Vegetation Management Act.

## 8.1.2 Fauna Values

### 8.1.2.1 Fauna Species of Conservation Significance

The Masked Owl is listed as Vulnerable under the NC Act and EPBC Act and has been recorded at the Kokomo tenement (fauna site FS34) in Vegetation Community 2 (*Eucalyptus platyphylla* woodland on alluvial flats) and is considered likely to occur at the Greenvale and Lucknow tenements. The Project has potential to impact Masked Owl habitat.

The Greater Large-eared Horseshoe Bat is listed as Endangered under the NC Act and Vulnerable under the EPBC Act. The species was un-conclusively identified from acoustic monitoring. Further survey effort should be applied to determine whether the species is present in the Project area. If confirmed, the Project has potential to impact Greater Large-eared Horseshoe Bat habitat.

Scats from the Short-beaked echidna (*Tachyglossus aculeatus*) were identified within the Project area indicating the presence of this species. The Short-beaked echidna is listed under the *Nature Conservation Act 1992* as Special Least Concern. This species is a habitat generalist as it is found across all of Australia (including Tasmania) in a wide variety of habitat types. Due to the wide distribution of this species and its capacity to occupy various habitat types, it is not expected that the Project will have a significant impact on this species.

### 8.1.2.2 Migratory Species

Three bird species listed as 'Migratory' under the EPBC Act were identified during field surveys within the Project site, *Apus pacificus* (Fork-tailed Swift), Sharp-tailed Sandpiper (*Calidris acuminata*) and *Hirundo rustica* (Barn Swallow).

The Fork-tailed Swift and Sharp-tailed Sandpiper have widespread distribution in Australia and breed in the northern hemisphere. The Project area does not provide breeding habitat, and suitable habitat for these two species is widespread in the region. The Barn Swallow is a habitat generalist and suitable habitat is widespread in the region and in broad areas across Australia. Given the mobility of these species and the availability of habitat in the region, the Project is not expected to have significant impacts in these migratory species.

### 8.1.2.3 Pest Species

Field surveys positively identified 6 introduced and/or pest fauna species as having a presence within the Project area. Introduced species were recorded through detection of scats, tracks or other traces (e.g. skulls), sensor camera detection and/or direct observation. The suite of introduced species present includes the Cane Toad (*Rhinella marina*), Feral Pig (*Sus scrofa*), Feral Cat (*Felis catus*), Rabbit (*Oryctolagus cuniculus*), Wild Dog/Dingo (*Canis lupus familiaris/dingo*) and Black Rat (*Rattus rattus*). The Wild Dog/Dingo, Rabbit, Feral Pig and Feral Cat are listed as restricted invasive animal under the *Biosecurity Act 2014*.

## 8.2 GENERAL POTENTIAL IMPACTS

Potential environmental impacts of the Project include habitat loss and fragmentation (principally on the Lucknow and Kokomo tenements), increased traffic, noise, dust and artificial lighting.

Land clearing for the Project will reduce the current extent of vegetation communities and associated faunal habitats on the site. Habitat such as hollow bearing trees, fallen timber and leaf litter will also be removed by land clearing. Loss of vegetation and habitat may cause fragmentation, reduction in biological diversity, genetic isolation or loss of individual species' local population. This may particularly affect smaller, less mobile species. However, as all species on the site are represented off-site, this impact will not be significant.

Land clearing activities associated with the Project may also increase soil erosion, inadvertently causing silting or sedimentation of riverine habitats and waterholes downstream. Soil erosion may also trigger a loss of nutrients to one area, causing a disruption of nutrient natural cycling.

Fauna injury or death may occur during the Project, with the greatest potential to occur during the construction phase.

The Project has the potential to cause impacts in relation to edge effects. Edge effects can include the establishment of weeds, alteration to microclimatic conditions (such as greater light intensity, more wind penetration, lower humidity) and a reduction in plant health through loss of photosynthetic potential (as a result of plants being covered by dust generated from vehicle movement on unsealed tracks).

Additional noise from mine site operations may disturb fauna or reduce available habitat for certain flora and fauna on the Project site. Noise effects can be highly species dependant and may vary widely. Impacts from noise will be concentrated around the process plant/open pits, leaving the majority of the Project site and associated habitat types unaffected.

Increased lighting around the process plant and accommodation camp area (to be located in the Greenvale township) may affect both nocturnal and diurnal fauna. The effects of artificial lighting will vary with different species. Additional lighting commonly attracts insects, which will result in a higher abundance of amphibians, microbats and reptiles ready to take advantage of concentrated prey.

Altered fire regimes may occur as a result of the Project, as the risk of fire is greater with anthropogenic presence. Fire frequency and intensity affect populations of native species in a variety of ways. The proposed Project is not expected to significantly impact upon current natural fire systems.

Processing and mining activities on the Project site may result in the release of contaminated water and sediment to downstream riverine habitats and waterholes. Ground and surface waters may potentially become contaminated with mine ore, hydrocarbons and other chemicals, particularly from any spills or leaks of hazardous substances at the HPAL plant and RSF. The potential for groundwater contamination is low, due to the lack of contiguous groundwater aquifers in the region in which the Project is located. Any contamination of surface waters in the Project area is likely to impact on the health of local flora and fauna, particularly aquatic species. Releases of pollutants to water can cause illness and mortalities of flora and fauna that live in or consume the water, due to either direct toxicity or changes to water quality. Water pollution can also result in smothering of aquatic plants and associated depletion of food sources for higher trophic level fauna.

Development of the Project may also lead to an increase of weed and pest species on the Project site. Land disturbance and provision of additional water sources during construction and operation may increase the suitability of the site to weeds and pest animals. The operation of vehicles and machinery on the site may lead to the introduction of additional weed species and spread of weeds on the Project site.

Construction and operation of the haul road from the Kokomo tenement may impact upon the Valley of Lagoons wetland area. Establishment of the haul road will require the clearing of vegetation and construction of creek crossings. These activities could potentially lead to contamination of surface

waters in the wetlands with dust, sediment and spilt hydrocarbons, with associated impacts upon the resident flora and fauna. The operation of the haul road may also impact upon native wildlife. There is the potential for vehicles travelling along the haul road to strike fauna crossing the road.

Key existing environmental issues in the Einasleigh Uplands bioregion, as defined by SEWPAC (2011), are:

- High pasture utilisation in some parts of the landscape in dry seasons;
- Increase in weeds of national and state significance, particularly woody species;
- Woodland thickening;
- Low fire frequency;
- Understorey species change from native perennial grasses to annual and exotic species; and
- Soil erosion in areas where groundcover has been reduced through excessive pasture utilisation.

The Greenvale tenement is highly disturbed and subject to all of the regional environmental issues listed above.

### 8.2.1 Potential Impacts from Feral Fauna

Native animals now have to compete with a range of introduced animals for habitat, food and shelter. Feral predators, such as Cats, Foxes and Pigs, have negatively impacted wildlife populations, and have been associated with numerous mammal extinctions. Feral species have three key impacts:

- Predation – feral predators such as cats and wild dogs eat native animals and historically have exacted a heavy toll on native species;
- Destruction of habitat – large numbers of feral herbivores (i.e. horses, cattle) cause the loss of ground cover and soil compaction. In times of drought, feral herbivores congregate around and degrade waterholes. Feral pigs destroy wetland vegetation through their digging; and
- Competition for food or habitat – introduced herbivores (e.g. rabbits, horses, goats) out-compete native herbivores (e.g. kangaroos, bettongs and seed eating birds) for food by overgrazing of native herbs, grasses, shrubs and trees. Similarly, feral cats use logs for shelter, which displaces native hollow-dwelling species.

Four mammal species are listed as restricted invasive animal under the *Biosecurity Act 2014* were recorded during the surveys:

- European Rabbit (*Oryctolagus cuniculus*);
- Wild Dog/Dingo (*Canis lupus familiaris/dingo*); and
- Feral Pig (*Sus scrofa*)
- Feral Cat (*Felis catus*).

The non-declared pest species Black Rat (*Rattus rattus*) and Cane Toad (*Rhinella marina*) were also observed on site. Potential impact from the feral fauna is described in detail in section 7.5



## **9.0 RECOMMENDED MITIGATION MEASURES**

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### **9.1 MANAGEMENT OF NATIVE FLORA AND FAUNA**

To maintain the integrity of vegetated land that is not cleared, appropriate erosion and sediment controls are recommended to prevent sediment deposition in remaining habitat. Such controls may include hessian fences, ground-cover mats or blankets and sand-bags. These controls are particularly important given the Project site's steep topography and the significant rainfall events common in the wet season. These controls will help maintain the ecological values of downstream areas.

To help maintain the viability of the seed bank in removed soil, topsoil should be stockpiled and planted with local species. Retaining areas of native vegetation will also provide an important source of seed stock for use in mine rehabilitation.

Native vegetation removal should be conducted only after:

- A permit to clear the vegetation has been issued by an Australian Mines supervisor;
- The areas to be cleared have been clearly delineated and identified to equipment operators and supervisors;
- Weed control measures such as vehicle wash downs have been implemented; and
- Appropriate erosion and sediment control structures are in place.

Measures should be taken to minimise harm to affected fauna communities by inspecting the vegetation to be disturbed prior to clearing to ascertain whether any fauna are present. Inspection of vegetation by on-site personnel should take place 100 m ahead of the clearing front at all times. If fauna is present, the Site Supervisor should be informed, and work ceased in the area to allow fauna to move on naturally before clearing recommences. Experienced fauna spotter-catchers can be used to relocate any animals that do not move on by themselves. The species and location of the fauna should be noted and added to existing flora and fauna records.

Clear trees with hollows in the following manner:

- Use the biggest bulldozer available – it needs to take the weight of a tree - tap the trunk with the blade a few times to wake up anything inside the tree, wait a few minutes and watch for anything to come out;
- Push the tree slowly from the side with the hollow – the hollow needs to be upwards, not crushed on the ground - with the base of the blade about one metre up to get leverage;
- As the tree starts to lean, lower the blade to the ground to catch the base/roots portion, and then lower the tree slowly by raising the blade;
- Salvage any good hollows for placement off site – wire them to other trees, pointing at the same compass aspect; and
- Relocate branches/roost trees to a non-impacted area in the immediate neighbourhood. Where relocation of whole trees is not feasible, the extent of the tree hollow can be estimated, and that section can be chain sawed out and fastened to nearby trees in a non-impacted area. Artificial nest boxes can also be installed within the non-impacted area.

By relocating hollows and branches, structural and micro-habitat diversity can be maintained. Termite mounds, leaf litter and stag trees are important as well, and should be left in place where possible.

A Traffic Management Plan should be developed to limit the potential for vehicle collisions with native fauna. This should address driving times as well as speed limits, particularly near the Valley of Lagoons Nature Refuge.

Design of the haul road should consider measures to protect native fauna. It is recommended that culverts and wildlife crossing points are included in the road design to minimise the potential for vehicle collisions with native fauna.

Ore will only be trucked from the Project site in the dry season. This will minimise the probability of any spilt ore being washed into waterways and fauna habitat.

In the event that abandoned, injured, rare or unusual fauna is found at any stage of the Project, the Site Supervisor and other relevant personnel should be notified, and the situation managed to prevent further injury. Local wildlife care groups or experts such as Queensland Parks and Wildlife should be informed, and arrangements made to care for the animal. The species and location of the fauna should be noted and include an account of the events preceding the incident.

Rehabilitation works will be undertaken progressively over the life of the Project. This will minimise the land area disturbed at each stage of the Project. It is recommended that the rehabilitation and revegetation work for the Project use the most appropriate locally occurring native species for the landscape elements of the site. Such methodologies should include habitat matching of species to ensure rehabilitation success and to encourage the return of native fauna. The most appropriate flora species for this rehabilitation are listed in the descriptions of each vegetation community in Section 6.1 of this report. Areas such as the waste rock dump should be planted with species that ensure both long-term stability and rehabilitation success.

The waste rock dump areas will be reshaped, rock mulched, topsoiled and progressively revegetated.

Where possible, the use of introduced pasture plants for rehabilitation works should be avoided. Exotic perennial grasses are not a replacement for native perennial grasses, as they deplete the diversity of native plants and animals, reduce soil fertility over time, promote fires and cause a decline in biodiversity. If exotic pastures are formed, ensure they do not become a monoculture.

It is recommended that recreated landforms are contoured to resemble the original local topography, including drainage patterns. This includes replicating any stony hillocks, riverine areas and flat sandy plains which may be disturbed.

A rehabilitation strategy will be required as part of the site Environmental Management Plan. This strategy should embody the concepts and recommendations presented above and include provision for monitoring of rehabilitation progress over the life of the operation. Degraded areas of the Greenvale tenement that fall outside the Project disturbance area should also be rehabilitated as part of the construction works, in order to improve the environmental value of the overall Project site.

Maintain cover and diversity of native perennial grasses as practicable, as the greater diversity of grasses leads to a greater diversity of food sources for fauna. Higher ground cover protects ground dwelling reptiles, birds and mammals from predation by fauna, as well as from drying out or overheating in the hot sun.

Avoid the creation of permanent, shallow water areas, such as septic and other tank overflows that form a permanent seep. These areas attract pest species such as Cane Toads (*Rhinella marina*) that are lethal to most snakes and other fauna species when ingested.

Chemicals and hazardous substances used during construction and operation should be stored in sealed, bunded areas in accordance with the Material Safety Data Sheet (MSDS) and applicable Australian Standards. A Spill Response Procedure should be developed to outline the response to any chemical spills. Spills must be promptly contained and cleaned up as they have the potential to contaminate soil, surface water and groundwater, leading to adverse impacts on flora and fauna. DES must be informed of spills into waterways.

To minimise contamination of ground and surface waters, ore stockpile areas will be compacted and bunded. Dust suppression and sediment catchment structures will be implemented around stockpile areas.

The Project is designed so that the supernatant water in the RSF will be reused in the process. Any contaminated water generated by Project activities will be retained on site for treatment, recycling or evaporation. These measures will be detailed in the Project's Water Management Plan.

Monitoring programs for groundwater, surface water and dust levels in the Project area should be implemented. Monitoring data will enable the detection of any seepage from the RSF or spillages into surface water, which may impact on the health of flora and fauna.

All vehicles, equipment and machinery used on the Project site should be fitted with adequate noise and dust suppression equipment in order to reduce the amount of noise and dust generated by Project activities. The design of the HPAL plant will include noise suppression strategies.

A segment of the Staff Induction Program should be allocated to informing staff of the conservation values on the Project site to increase staff awareness of the species present. This could include photographs, brief descriptions and management requirements of species of conservation significance known to inhabit the Project site and surrounding areas. Staff should also be informed of the Spill Response Procedure, vegetation clearing requirements, correct chemical handling and storage procedures and the importance of using and maintaining dust and noise controls on vehicles and equipment.

## **9.2 MANAGEMENT OF THREATENED SPECIES**

The Masked Owl (Northern subspecies) has been recorded at the Kokomo tenement and is considered likely to occur at the Greenvale and Lucknow tenements. Further assessment of the occurrence of the species and its suitable habitat is recommended.

The Greater Large-eared Horseshoe Bat (NC Act Endangered and EPBC Act Vulnerable) was recorded as possible on the Project site. Further surveys with bat detection acoustic surveys are recommended to determine the presence of the species in possible habitat on the Project site.

The Greater Glider was not recorded within the Project area. However, the species was recorded approximately 2 km northwest of the Greenvale tenement during the course of the aquatic ecology assessment. Additional survey effort across the Project area will be necessary to rule out the presence of this species.

### 9.3 MANAGEMENT OF SENSITIVE AREAS

Environmentally sensitive areas on the Project site include Community 12 (RE 9.11.9), Communities 3 and 4 (REs 9.3.15 and 9.3.25) which are both palustrine wetlands and the wetter drainage areas in Community 2 (RE 9.3.3a). Communities 3 and 4 are some distance from the proposed disturbance area and are unlikely to be directly impacted by mining operations, however, a pest control program targeting feral pigs will help environmental condition of these areas. Drainage lines within Community 2 are also subject to damage caused by feral pigs. Sediment controls will also be necessary to maintain the environmental values of Community 2 due to its proximity to disturbance areas.

The design, construction and operation of the haul road need to be managed in a way that minimise the potential for adverse impacts upon the Valley of Lagoons wetland area and the Community 12. Erosion, sedimentation and dust suppression measures should be implemented during construction of the haul road. Culverts and wildlife crossings should be installed to allow safe passage of fauna in the area. Speed limits should be restricted along the haul road, particularly at night time, to minimise the risk of vehicle collisions with native fauna.

### 9.4 MANagements of Introduced Flora and Fauna

Setting overall goals for managing natural resources on the Project site provides direction and assists in formulating management actions to control introduced flora and fauna species. Overall Project site goals should include:

- Preventing new pests from establishing;
- Eradicating high priority pests;
- Containing other priority pests to currently inhabited areas; and
- Keeping staff informed, knowledgeable and committed to the management of pest species.

#### 9.4.1 Weed Management Strategies

It is recommended that a Weed Management Plan be developed to limit the spread of weed species on the Project site. The Weed Management Plan should include the following requirements:

- Ongoing monitoring of the Project site by personnel for weeds of management concern;
- If increases in weed abundance or new weed species are identified on the Project site, they should be eradicated in accordance with local best management practice and/or DAF Pest Fact Sheets;
- Monitoring of treated areas to assess the success of any declared weed eradication;
- Inclusion of weed management in the Site Induction Program for the Project. Staff should be informed of the species of weed likely to be encountered on the Project site, the location of known weed infestations, and how to report the presence of new infestations;
- Remain on designated roads where practical;
- Stop water and fertilisers (when used) from running into bushland;
- Provide buffers or windbreaks around revegetated areas (when applicable);

- Washdown machinery prior to use on site; and
- Washdown and inspect vehicles (including visitor vehicles) prior to use on site and after off road travel on site.

Consult the Queensland Checklist for Cleandown Procedures (Department of Natural Resources, 2000) for guidance on effective washdown methods.

DAF Pest Fact Sheets of the weed species which were identified within each vegetation community detail the most effective methods of eradication. These Pest Fact Sheets should be consulted (Appendix G) when developing weed eradication/management strategies

#### **9.4.2 Management Strategies for Introduced Fauna Species**

Six introduced species were observed on the Project site, including four *Class 2 declared pest animals*. These were the *Feral Pig (Sus scrofa)*, *Wild Dog (Canis lupus dingo)*, *Feral Cat (Felix catus)* and *European Rabbit (Oryctolagus cuniculus)*.

Landowners must take reasonable steps to keep land free of these three species and are required to control any declared pests on their properties. It is recommended that a Pest Control Program be developed *to control these species and minimise their impacts on the local environment*. For further information about declared faunal pest species refer to Appendix H.

The non-declared amphibian pest, the *Cane Toad (Rhinella marina)*, is abundant on the Project site and control of the population of this species is recommended to minimise its impact on native fauna.

A Black Rat was also observed on the Project site. Black Rats are vermin and it is recommended that appropriate control strategies are put in place to minimise potential human health risks associated with Black Rats.

##### **9.4.2.1 Management of European Rabbit (*Oryctolagus cuniculus*)**

The DEEDI-QPIF (2010a) suggests a long-term strategy to effectively manage rabbits. The most effective method for long-term control is the destruction of source areas of rabbits. A source is an area with well-established warrens and sufficient resources for continual population growth, such as shelter and food. Warrens should be destroyed by ripping; rabbits alarmed by the ripping process take shelter in their warrens and are subsequently destroyed by the ripping tractor. If rabbits are found in shelters other than warrens, these shelters should be removed. For example, logs can be burned, and old machinery removed entirely.

Further approaches such as poison baiting, fumigation, trapping, exclusion fencing and biological control agents including Myxomatosis and Rabbit Haemorrhagic Disease might supplement the control strategy but are not effective stand-alone solutions to rabbit infestations.

##### **9.4.2.2 Management of Wild Dog (*Canis lupus familiaris/dingo*)**

Control methods for Wild Dogs include shooting, trapping, fencing and baiting combined with land management. Shooting is effective only for small populations or problem animals. Trapping is also used mainly to control small populations or problem animals, as it is both time-consuming and labour-intensive. Fencing is a very effective control method but is also very expensive to install and requires ongoing maintenance. Poisoning with 1080 baits (sodium monofluoroacetate) is recommended by DAF as the most economic, efficient, humane and effective method of controlling Wild Dogs. Baits can be quickly deployed in large numbers by hand, from vehicles or from aircraft. Baits should be buried in sand

or hidden to avoid killing non-target species. The baits will control the majority of Wild Dogs. Problem animals that avoid baits can then be trapped, shot or fenced-out.

#### **9.4.2.3 Management of Feral Pig (*Sus scrofa*)**

Due to their largely nocturnal habits, omnivorous dietary requirements and large home ranges, Feral Pigs are difficult to control. Management of Feral Pigs should integrate a combination of control methods. The most rapid and effective control method to reduce Pig populations is poisoning. However, great care must be taken to avoid detrimental impacts on non-target species. Before the baits are laid out, it is recommended to pre-feed the local population of Pigs for several days. Fermented grains are commonly used as an attractant; however, consideration must be given to any native species that exist in the area and may also be attracted to the bait. Monitoring of the pre-feed stations to see which animals are visiting them may aid in the selection of the most appropriate attractant. Bait can also be covered by soil since Pigs are known to dig up food. At present the most commonly used poison is sodium monofluoroacetate (1080), however personnel responsible for any baiting programs should keep abreast of ongoing research which is aimed at producing more species-specific, environmentally friendly poisons (Choquenot *et al.*, 1996; DEEDI-QPIF, 2004; DEEDI-QPIF, 2010b).

Live-trapping is a more humane and environmentally safe method than baiting but is effective only for small populations. It can be used as a supplementary measure to larger-scale baiting programs. Shooting of pigs by helicopter can be used in open areas. Fencing can be very successful in small areas but is considered to be the most expensive option and is therefore not recommended.

#### **9.4.2.4 Management of Feral Cat (*Felix catus*)**

The feral cat is most active at night, with peak hunting activity occurring soon after sunset and in the early hours before sunrise. At night the cat displays a distinctive green eyeshine under spotlight, making it easily distinguishable from other animals. Control methods for Feral Cats include shooting, trapping, fencing and baiting, all of them can be combined with lures. Fencing is the only feasible method of control when special areas need protection from cats but as mentioned above, it is very expensive to install and requires ongoing maintenance. Poisoning with 1080 baits (sodium monofluoroacetate) is recommended by DAF as the most economic, efficient, humane and effective method of controlling Feral Cats. Baits can be quickly deployed in large numbers by hand, from vehicles or from aircraft. Baits should be buried in sand or hidden to avoid killing non-target species. The baits will control the majority of Feral Cats. Problem animals that avoid baits can then be trapped, shot or fenced-out.

#### **9.4.2.5 Management of Cane Toad (*Rhinella marina*)**

Cane toads pose a significant environmental threat to Australia's ecosystems. They are highly toxic at almost all stages of their lives and are lethal to many predators that attempt to consume them. The biological impacts caused by Cane Toads are listed as a Key Threatening Process under the EPBC Act (Department of the Environment and Heritage, 2005).

No biological control measures are available for the management of Cane Toads. Mechanical control measures can aid in decreasing the local population of Cane Toads. Nocturnal collection of Cane Toads is followed by freezing the collected specimens (refer to Wetland Care Australia, 2006). Additionally, removal of eggs can support management of the species. Troughs, dams and other permanent water holding structures should be regularly checked for Cane Toads and their eggs. If possible, potential breeding sites should be eliminated.

#### **9.4.2.6 Management of Black Rat (*Rattus rattus*)**

Black Rats can spread disease to humans. Correct waste disposal, use of sealed waste receptacles and good housekeeping will help minimise the spread of this species on the Project site. Baiting may be required if the Rat population on site becomes problematic.

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