MIDDLEMOUNT COAL MINE

WESTERN EXTENSION PROJECT (EPBC 2017/8130)

EPBC Act Preliminary Assessment Documentation

Attachment C

Ecology Assessment

middlemount coal PTY LTD
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Biodiversity AUSTRALIA

Ecological Impact Assessment:

Project:

Western Extension Project,
Middlemount Coal Mine, Middlemount

Client:

Middlemount Coal Pty Ltd

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Executive Summary

Middlemount Coal Pty Ltd (MCPL) propose to seek Queensland Government and Commonwealth Government approval for changes to the approved Middlemount Coal Mine, herein referred to as the Western Extension Project (the Project).

The main activities associated with the Project are an extension of the open cut pit within ML 70379, expansion of the eastern dump, progressive development of haul roads, sediment dams and other associated infrastructure, and diversion of a drainage line around the mine extension footprint.

The primary outcomes of this study were to verify Regional Ecosystem mapping for the site; identify any threatened species under the *Nature Conservation Act 1992* (NC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act); identify and describe any Matters of State and National Environmental Significance; and identify proposed avoidance and mitigation measures to protect the natural values including consideration of biodiversity offset requirements.

The study area is divided into two separate study areas comprising the western study area, and the eastern study area. These study areas are characterised by a mix of remnant and non-remnant vegetation communities including eucalypt woodland and Brigalow. The landform is generally very flat with no significant geological features such as outcrops, cliff lines or major creeks. Two drainage lines run through the western study area, with one in the eastern study area.

The surrounding landuses are dominated by cattle grazing which have led to extensive clearing in the area and have introduced a number of threats to biodiversity such as weed invasion, feral species, edge effects, fragmentation and anthropogenic impacts such as dust. This is likely to have excluded many sensitive species from the area and reduced the value of the study area for flora and fauna, especially rare and threatened species.

No threatened flora species listed under the NC Act or EPBC Act were detected during the survey. Two Regional Ecosystems that occur in the study area (RE 11.3.1 and RE 11.4.9) consist of Brigalow forest and are listed as Endangered under the QLD *Vegetation Management Act*, *1999* (VM Act) and EPBC Act. Two Regional Ecosystems comprising Open Woodland on alluvial plains are listed as Of Concern under the VM Act (RE 11.3.2 and RE 11.3.4).

Three threatened fauna species were recorded during the field surveys, the Koala (*Phascolarctus cinereus*), Greater Glider (*Petauroides volans*) and Squatter Pigeon (Southern) (*Geophaps scripta scripta*). These species are listed as Vulnerable under the NC Act and EPBC Act. Two additional threatened fauna species, the Ornamental Snake (*Denisonia maculata*) and Powerful Owl (*Ninox strenua*), were considered potential occurrences in the study areas based on local records identified in the literature and database searches and presence of suitable habitat.

The Project is likely to result in a number of adverse impacts on biodiversity and contribute to threatening processes, however many of these are already acting in the study area due to the disturbance history and surrounding land uses. The assessment identified several Matters of State or Environmental Significance in the study area. These were regulated vegetation, connectivity areas, high ecological significance wetlands, protected wildlife habitat and legally secured offset areas. Assessment of these matters determined that the Project would result in significant residual impacts.

Assessment of nationally listed threatened species and ecological communities determined that the Project has the potential to result in a significant impact on the Greater Glider, Koala and *Brigalow (Acacia harpophylla dominant and co-dominant)* (Brigalow EEC) and therefore potential impacts on these entities would also be mitigated and offset. The Squatter Pigeon (Southern) and Ornamental Snake are not considered to be significantly impacted by the Project, but potential impacts on these species would also be mitigated and offset.

Mitigation measures for the Project are expected to be consistent with existing Environmental Authority conditions and MCPL plans (e.g. Erosion and Sediment Control Plan and Rehabilitation Management Plan). Specific measures to reduce impacts on biodiversity include marking clearing limits, pre-clearing surveys and clearing supervision, and reducing light spillage into adjacent retained habitat.

An extensive offset package will form part of the Project. This will dedicate 1,843 hectares of land to the west of the revised mine footprint area as conservation lands to offset the impacts of the Project. In July and November 2017, Biodiversity Australia undertook flora and fauna surveys in accordance with contemporary Qld and Commonwealth survey guidelines to assess the suitability of the proposed offset areas. The proposed offset areas provide a suitable offset for all Matters of State or Environmental Significance and Matters of National or Environmental Significance that are likely to be impacted by the Project.

1.0 Introduction

Middlemount Coal Pty Ltd (MCPL) has lodged an amendment application to the Middlemount Coal Mine Environmental Authority (EA) EPML00716913 in accordance with section 224 of the Queensland (Qld) *Environmental Protection Act 1994* (EP Act) to approve an extension of the Middlemount Coal Mine (Figure 1) (herein referred to as the Middlemount Coal Mine Western Extension Project [the Project]).

On 8 January 2018, the Project was referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) (2016/7649). On 8 February 2018, a delegate of the Commonwealth Minister for the Environment declared the Action to be a 'controlled action' for the purpose of the EPBC Act due to potential adverse impacts on the following controlling provisions under Part 3 of the EPBC Act:

- sections 18 and 18A of the EPBC Act (listed threatened species and communities); and
- sections 24D and 24E of the EPBC Act (a water resource, in relation to coal seam gas development and large coal mining development).

Biodiversity Australia Pty Ltd has been requested by MCPL to undertake an Ecological Impact Assessment for the Project.

1.1. Project Description

In May 2017, Mining Lease (ML) 70379 was extended to the north-west of currently approved operations at the Middlemount Coal Mine. The Project involves extension of operations within the recently acquired portion of ML 70379 and a ML for infrastructure to facilitate the extension of the East Dump (Figure 2).

The Project includes the following activities:

- extension of the open cut pit within ML 70379 to the north-west;
- continued extraction of run-of-mine (ROM) coal at up to 5.7 million tonnes per annum (Mtpa) using conventional open cut mining equipment;
- placement of waste rock in existing emplacements, expanded emplacements (Eastern Dump) and within the mined-out void;
- continued backfilling of coarse rejects into the pit within spoil, and temporary storage of fine rejects from coal crushing and washing in existing tailings storage facility cells for drying and reclaim for in-pit co-disposal;
- progressive development of sediment dams, pipelines and other water management equipment and structures (including levees and realignment of an existing diversion structure);
- progressive development of new haul roads and internal roads;
- continued development of soil stockpiles, laydown areas and borrow areas;

- continued use of existing and approved supporting mine infrastructure (including coal handling and preparation plant [CHPP] and ROM and product stockpiles);
- continued rail transport of coal products to the Dalrymple Bay Coal Terminal, Abbott Point Coal Terminal or Wiggins Island Coal Export Terminal for export;
- extension of the approved mine life by approximately six years (to 2037); and
- a change to the final landform at the Middlemount Coal Mine for the end of the mine life to include two final voids.

1.2. Study Objectives

The following lists the objectives of the Ecological Impact Assessment:

- Desktop literature review of relevant government databases and previous ecological assessments.
- Flora survey and field validation of Regional Ecosystems (RE) and habitat types within the Project area as per the *Methodology for Survey and Mapping of Regional Ecosystems and vegetation Communities in Queensland* (Nelder et al, 2017).
- Survey as per the requirements of *Guide to Determining Terrestrial Habitat Quality Version 1.2* (Department of Environment and Heritage Protection [DEHP] 2017a) to determine land-based offset requirements.
- Targeted surveys for threatened flora and fauna species listed under the *Nature Conservation Act 1994* (NC Act) and EPBC Act.
- Identification of any Matters of State Environmental Significance (MSES) and Matters of National Environmental Significance (MNES).
- Identification of avoidance and mitigation measures to protect the natural values, particularly threatened or near-threatened species, including consideration of biodiversity offset requirements in accordance with the *Queensland Environmental Offsets Policy* (DEHP 2017b).
- Assessment of the magnitude and duration of potential significant residual impacts and description of how the activity and any associated offset (if required) would be staged.

1.3. Project Location and Key Definitions

MCPL owns and operates the Middlemount Coal Mine, an existing open cut coal mine located approximately 3 kilometres (km) to the south-west of the Middlemount township (Figure 1) within the Isaac Regional Local Government Area. The Project occurs within the Isaac-Comet Downs subregion of the Brigalow Belt North Bioregion.

The Project area is defined as the actual area directly impacted by the proposed development including the mine pit, dump areas and infrastructure. This area totals approximately 571 hectares (ha).

The **eastern study area** is defined as the area to the east of the existing mining area.

The **western study area** is defined as the area to the west of the existing mining area.

The **study area** contains both the eastern and the western study areas.

The **locality** is defined as land within 10 km of the Project.

Figure 1: Location of the study areas

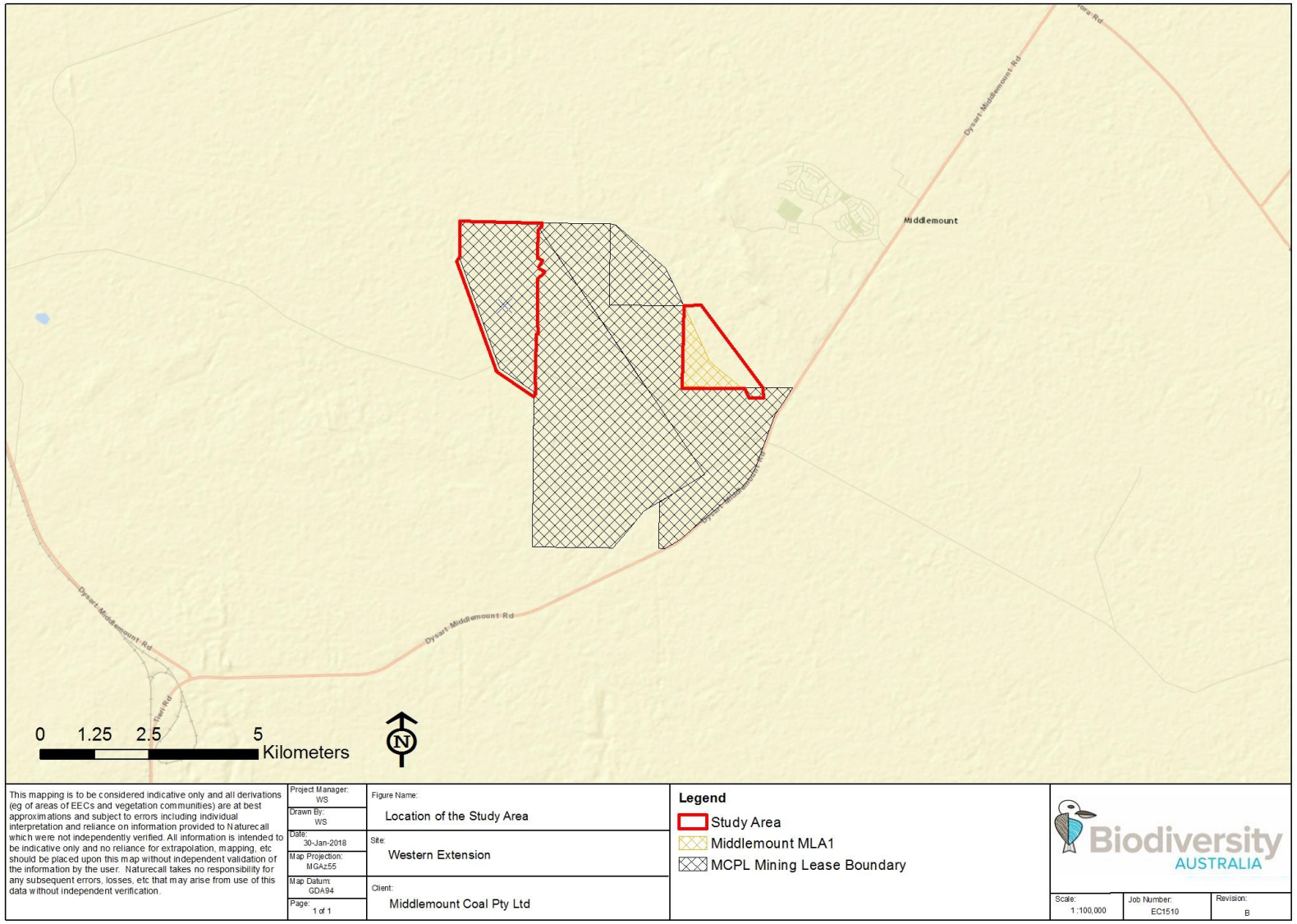
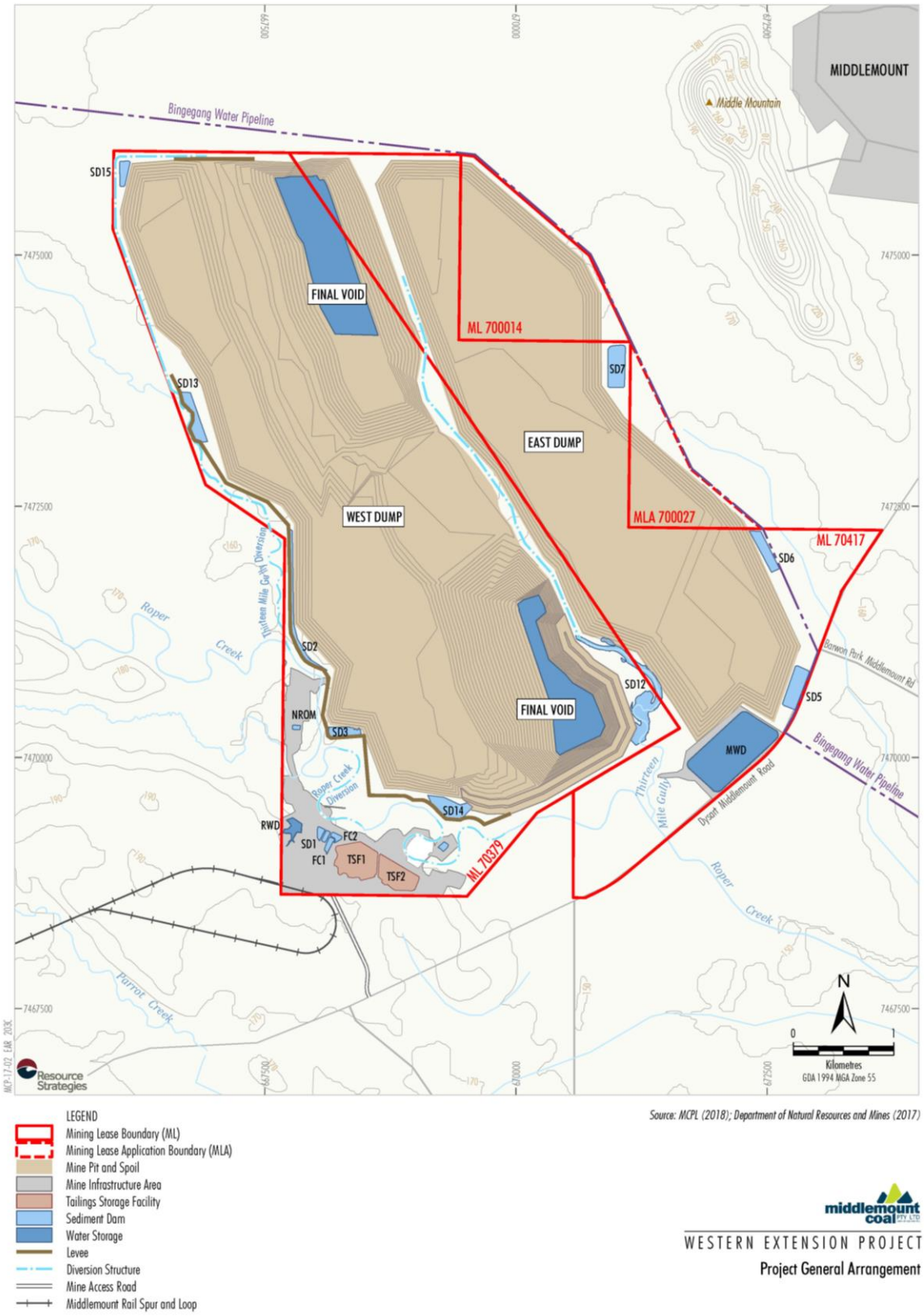


Figure 2: Proposed general arrangement



2.0 Background Information

2.1. Regional and Local Setting

The study area occurs within the Isaac-Comet Downs subregion of the Brigalow Belt North Bioregion, which falls with Isaac Regional Council. Surrounding landuses largely comprise open cut and underground coal mines and grazing land. The nearest protected area is Junee National Park which occurs 30 km to the east. Bundoora State Forest is located approximately 25 km to the south-west of the study area.

2.2. Soils, Topography and Geology

2.2.1. Western Study Area

The western study area is located on a relatively flat landform with elevation ranging from approximately 160-170 metres (m) Australian Height Datum (AHD). No distinct geological features such rocks outcrops, cliffs or escarpments occur on the study area (Figure 3).

The main topographic feature of the western study area is an ephemeral creek line which is referred to as Drainage Line 1. This runs west to east across the northern portion of the study area. A second drainage line, named Drainage Line 2, also traverses through the centre of the study area and feeds into Drainage Line 1 (Figure 4).

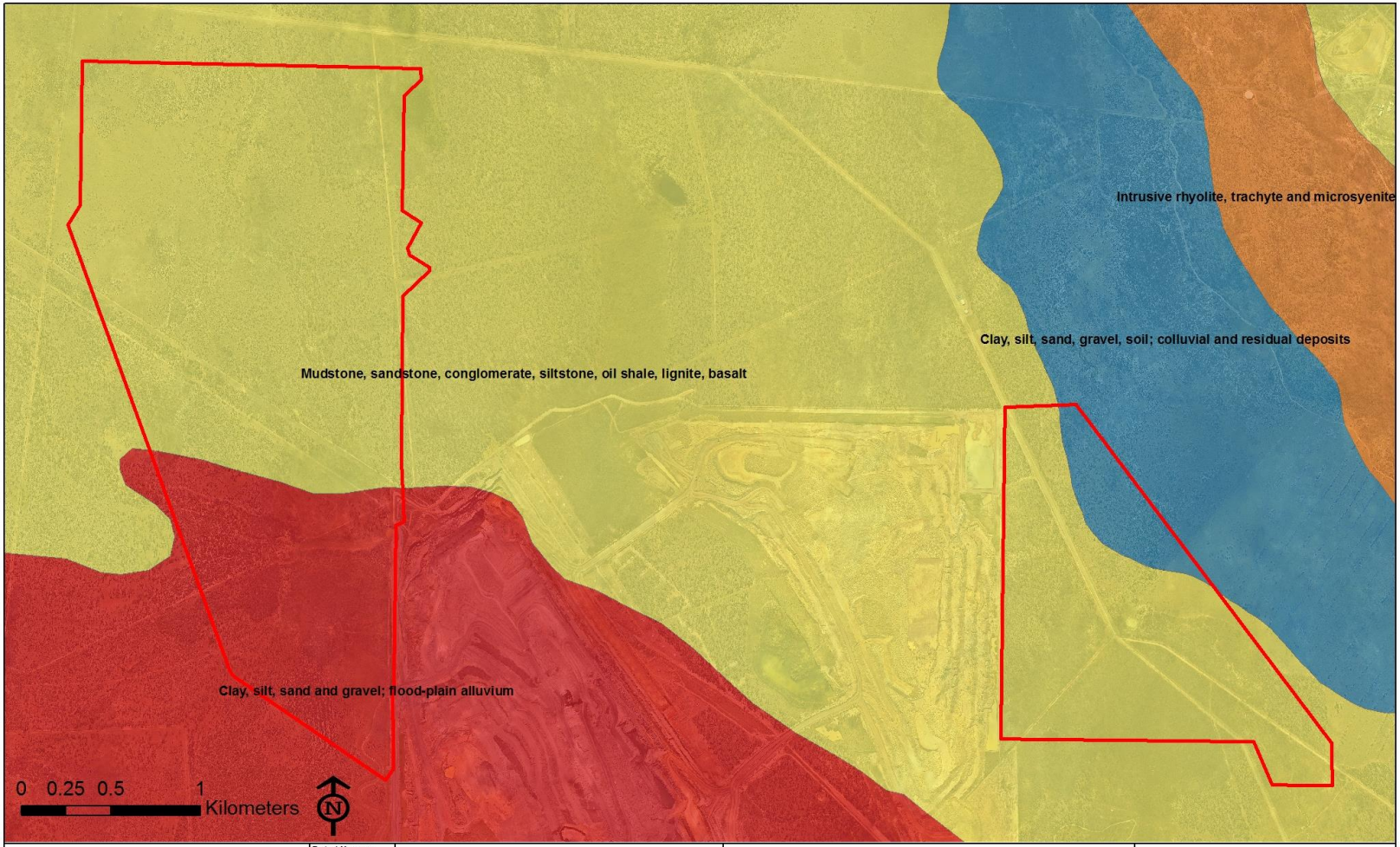
The study area contains three Land Zones as per Wilson and Taylor (2012). Alluvial formations associated with Drainage Line 1 and 2 fall in to Land Zone 3 which is defined as recent Quaternary alluvial systems. This zone typically comprises fertile alluvial soils including Vertosols and Sodosols. In the study area, this zone supports eucalypt woodland and Brigalow vegetation.

The study area contains areas of low lying clay plains which fall into Land Zone 4, described as Tertiary – early Quaternary clay plains. This zone largely comprises vertosols with gilgai microrelief. Soils encountered in this zone generally comprised deep clays and loams, sometimes with surface gravel present. Many of the gilgai contained water in the May 2017 field survey due to the preceding heavy rains. This land zone supports regrowth and remnant Brigalow vegetation in the study area.

The level sandy plains which cover the majority of the study area fall into Land Zone 5 which is described as Tertiary to early Quaternary loams and sandy plains and plateaus. In western QLD, this land zone typically contains sandy to loamy red Kandosols and Tenosols (Wilson and Taylor 2012). Soils encountered on the study area were well drained and contained a high sand content with a shallow organic layer. This zone typically supports Poplar Box woodland in the study area.

The western study area is underlain by the Burngrove Formation as part of the Bowen Basin. The dominant lithology of this formation is described as mudstone, siltstone, sandstone, coal and tuff (Department of Natural Resources and Mines [DNRM] 2015), as shown in Figure 3.

Figure 3: Geology of the study area



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	18-May-2017
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Geology of the Study Area
Site:	Western Lease Extension
Client:	Middlemount Coal Pty Ltd

Legend
- Study Area
- ALLUVIUM
- ARENITE-MUDROCK
- COLLUVIUM
- FELSITES (LAVAS, CLASTICS & HIGH-LEVEL INTRUSIVES)
- SEDIMENTARY ROCK

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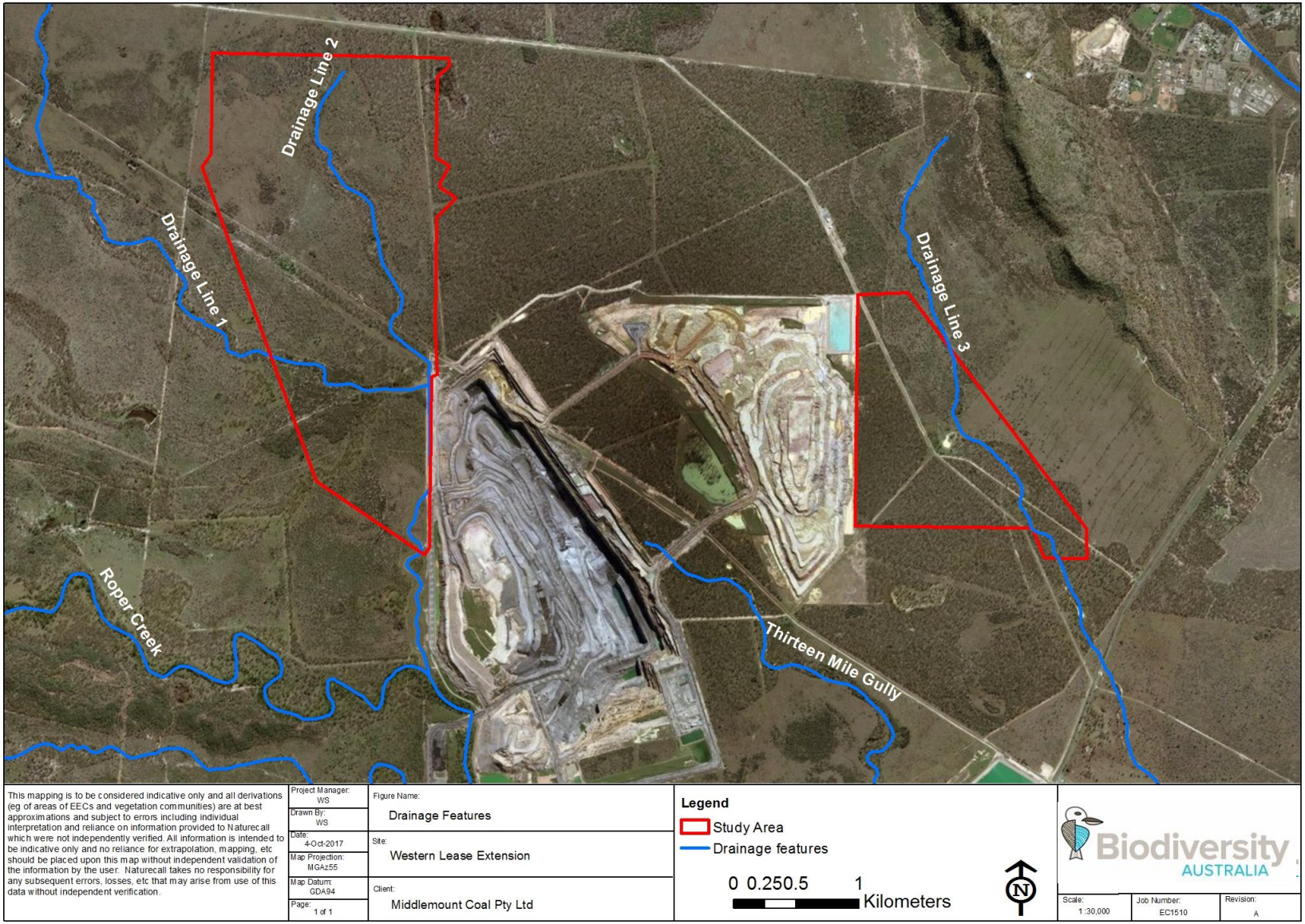
Scale:	Job Number:	Revision:
1:30,000	EC1510	A

Figure 4: Drainage features in the study area



2.2.2. Eastern Study Area

The eastern study area is located on a relatively flat sandplain with elevation ranging from approximately 160-170 m AHD. No distinct geological features such rocks outcrops, cliffs or escarpments occur on the study area.

The eastern study area falls into Land Zone 5 which is described as Tertiary to early Quaternary loams and sandy plains and plateaus. In western Qld, this land zone typically contains sandy to loamy red Kandosols and Tenosols (Wilson and Taylor 2012). Soils encountered on the study area were well drained and contained a high sand content with a shallow organic layer.

The eastern study area is underlain by the Burngrove Formation as part of the Bowen Basin. The dominant lithology of this formation is described as mudstone, siltstone, sandstone, coal and tuff (DNRM 2015), as shown in Figure 3.

2.3. Drainage Features

2.3.1. Western Study Area

The study area is located in the Roper Creek catchment within the Fitzroy River Basin, which drains an area of approximately 150 000 square kilometres (DNRM 2015).

The main drainage feature of the study area is Drainage Line 1 (formerly referred to as 13 Mile Gully) which is an ephemeral creek line (Photo 1). This is not defined as a watercourse under the Qld *Water Act 2000* (MCPL 2017). This runs west to east across the southern portion of the study area. As part of the Stage 2 Mine extension, this drainage line was diverted southwards to run into Roper Creek.

A second drainage line (Drainage Line 2) also traverses through the centre of the study area and feeds into Drainage Line 1 (Figure 4). A farm dam is located on this drainage line approximately 1km north of its intersection with Drainage Line 1 (Photo 2).

Both of these watercourses are ephemeral, and flow is restricted to periods of high rainfall. A number of pools were present in these watercourses during the May 2017 surveys.

Localised depressions occur within the patches of Brigalow which occur on Land Zone 4. These contain a shallow layer of clay and hold water after heavy rains. Standing water was present in many of these Brigalow patches during the May 2017 field surveys.

The edges of a palustrine wetland occur within the north-east corner of the western study area. This only holds water in the wet season after heavy rains and contains a number of aquatic flora species at these times.

Photo 1: Drainage Line 1

Photo 2: Farm dam on Drainage Line 2 in western study area

2.3.2. Eastern Study Area

One unnamed drainage line, referred to as Drainage Line 3, is mapped in the eastern study area as shown in Figure 4. This runs south, eventually meeting Roper Creek approximately 5 km south of the study area. Drainage Line 3 is not defined as a watercourse under the Qld *Water Act 2000* and did not contain any water during the surveys (Photo 3).

Due to the study area's highly permeable soils, water drainage would generally be through infiltration, with some localised overland flow expected during heavy rains. A few small depressions were encountered in the eastern study area which contained a shallow layer of clay. These areas would only hold water for short periods after heavy rains in the wet season, and would not support aquatic fauna or wetland plants.

A small farm dam is located in the centre of the eastern study area which generally holds water year-round. It does not contain any aquatic vegetation or habitat structures.

Photo 3: Drainage Line 3 in eastern study area

2.4. Landuse History

Pastoral properties dominate the local landuse along with a number of open cut and underground coal mines. No cropping or fruit growing areas are known to occur in the locality.

Clearing for cattle grazing in the region has been extensive, and both of the study areas contain cleared areas that are currently grazed or have been grazed in the past. Cattle grazing has also required the establishment of fences and stock dams on the study areas which has facilitated further clearing.

Cleared grazing lands also occur to the north of the western study area and to the east of the eastern study area. As a result of this clearing and grazing, vegetation in the region is highly fragmented and exists as a mosaic of remnant and regrowth woodland and derived pasture grassland.

2.5. Fire History

No recent fires are known to have occurred on the study areas. Charcoal was only noted on a few older dead trees indicating that a fire has not occurred within at least the past 15-20 years.

2.6. Previous Relevant Ecological Investigations

2.6.1. Biodiversity Australia (Naturecall)

2.6.1.1. Naturecall 2013-2017

Biodiversity Australia (formerly Naturecall) conducts annual monitoring of the Middlemount Coal Offset Areas comprising the Stage 2 Offset, Rail Loop and Spur, Parrot Quarry and 13 Mile Gully Diversion offset areas (Naturecall 2013, 2014a, 2015a, 2016a, 2017a). Monitoring is undertaken in accordance with the MCPL Offset Management Plan (MCPL 2012) and comprises annual Biocondition surveys as per Eyre et al. (2015) at 11 permanent transects, photo monitoring at 13 points as well as visual inspections and assessment of threats to the success of the Offset Areas. Three of the Biocondition survey points are located within the current Western Extension study area.

In accordance with the MCPL Offset Management Plan, dedicated fauna surveys were undertaken in the offset areas in May 2014 and May 2017. The following fauna survey techniques were employed:

- spotlighting;
- diurnal bird surveys;
- diurnal herpetofauna searches;
- installation of Passive Infrared (PIR) cameras;
- amphibian searches;
- opportunistic observations; and
- assessment of habitat features and complexity.

The fauna surveys have detected three conservation significant fauna species within the offset areas comprising the following:

- Koala (*Phascolarctos cinereus*) – Vulnerable NC Act and EPBC Act.
- Squatter Pigeon (southern) (*Geophaps scripta scripta*) - Vulnerable NC Act and EPBC Act.
- Greater Glider (*Petauroides volans*) – Vulnerable NC Act and EPBC Act.

2.6.1.2. Naturecall 2014a

Naturecall (2014b) prepared an ecological assessment report for the realignment of the Bingegang Pipeline which is located to the north and east of the Middlemount Coal Mine. A section of the realigned pipeline runs through the eastern study area.

The ecological survey was conducted in July 2014 and consisted of RE verification and mapping, passive fauna surveys along with habitat and weed mapping.

The RE mapping and field validation found the majority of vegetation along the realigned pipeline route consisted of Poplar Box Woodland analogous to RE 11.5.3. Small patches of a Brigalow community were detected along the realigned pipeline route which qualified as the State and Commonwealth listed Brigalow (*Acacia harpophylla* dominant and co-dominant [RE 11.5.16]) community, listed as Endangered under the NC Act and the EPBC Act. No threatened flora species were detected.

The fauna surveys detected a single threatened species – the Squatter Pigeon (southern) (*Geophaps scripta scripta*) which is listed as Vulnerable under the NC Act and the EPBC Act. This species was detected next to the small farm dam in the centre of the current eastern study area.

2.6.1.3. Naturecall 2015

Naturecall conducted field surveys and prepared a Terrestrial Ecological Impact Assessment for the North-eastern Extension project, located to the east and north of the current study areas. The surveys were undertaken over one week in October 2015. The field survey methodology comprised the following:

- *Flora and Habitat Quality Surveys* – RE verification and mapping, threatened flora transects, Terrestrial Habitat Quality Assessments.
- *Fauna Surveys* – Spotlighting, call playback, PIR cameras, diurnal bird surveys, herpetofauna searches, scat and track searches.

The flora and habitat quality surveys confirmed that the entire site comprised Poplar Box Woodland analogous to RE 11.5.3. Several small localized depressions were also recorded which were mapped as 11.5.3b. No threatened flora species were recorded during the surveys and none were considered potential occurrences.

The fauna survey only detected common fauna species.

The entire study area comprised one habitat type which was Eucalypt woodlands/forests. This was found to be in good remnant condition and contained several important habitat features such as hollow-bearing trees, coarse woody debris, flowering eucalypts and native grass dominated groundcover.

2.6.2. Ecology and Heritage Partners 2012

Ecology and Heritage Partners (EHP) (2012) conducted ecological investigations within the Offset Area for the Stage 2 Middlemount Coal Mine project. The scope of work for the investigations were to verify the REs and high value regrowth present within the Offset Area, quantify the area of each RE, identify the status of REs under the QLD *Vegetation Management Act*, *1999* (VM Act) conduct surveys for conservation significant flora and fauna species and conduct surveys for weeds and pest species.

2.6.2.1. Survey Methods

Field surveys were conducted by a team of four botanists from 10-14 July, 29 July-3 August and 13-17 August 2012. The main survey methodology employed was quaternary vegetation surveys as per Neldner et al. (2017). Targeted surveys for threatened flora species were undertaken via foot traverses along randomly 50m transects along with opportunistic searches in potential habitat. Fauna survey methods involved opportunistic surveys and habitat assessments.

2.6.2.2. Results

The Stage 2 Offset Area was found to contain 17 distinct REs. Approximately half of the Offset Area qualified as remnant vegetation with the remainder comprising non-remnant vegetation. The only endangered RE found in the Offset Areas was Brigalow EEC, which is also listed as Endangered under the EPBC Act.

Two threatened flora species listed under the VM Act were detected during the surveys comprising *Desmodium macrocparum* (no longer listed as a threatened species) and *Cerbera dumicola*. Two threatened fauna species listed under the NC Act were detected comprising the Koala and Squatter Pigeon (southern). These species are now both listed as Vulnerable under the EPBC Act. The Koala was found in the southwest of the Offset Area (over 4 km from the current western study area) while the Squatter Pigeon (southern) was recorded in roughly the centre of the Offset Area (approximately 1.5km west of the current western study area) and also in the south of the Offset Area.

Four vertebrate pest species were recorded comprising the Pig, Dog, Rabbit and Cat. Three weed species listed under the former *Land Protection (Pest and Stock Route Management) Act, 2002* were recorded comprising the Harissia Cactus, Velvety Tree Pear and Parthenium Weed.

2.6.3. Parsons Brinckerhoff 2010

Parsons Brinckerhoff Pty Ltd (PB) (2010) undertook the Environmental Impact Statement for the Middlemount Coal Mine Stage 1 and 2 areas. Part of their area of investigation extended onto the current study areas.

The field survey methodology employed by PB involved a comprehensive terrestrial flora and fauna survey. A brief outline of the methods and major findings of this study are described below.

2.6.3.1. Flora Survey

A flora survey was undertaken based on the methods described in Neldner et al (2017) in November 2009 and February/March 2010. A combination of secondary, tertiary and quaternary survey sites were used to sample vegetation and validate RE mapping. Targeted searches for threatened flora were also undertaken.

This resulted in the validation and mapping of 15 REs in the Stage 2 mine area. Three of these communities are listed as Endangered under the VM Act and the EPBC Act, with a further two listed as 'Of Concern'.

Two threatened flora species listed as 'Near Threatened' under the NC Act were detected in the project area, these being *Desmodium macrocarpum* and *Cerbera dumicola*. *Desmodium macrocarpum* has since been de-listed.

2.6.3.2. Fauna Survey

PB's (2010) fauna survey used a range of survey techniques to sample fauna species and their habitats in the project area. These included habitat classification and assessment, bird census, herpetofauna searches, spotlighting, live animal trapping and ultrasonic bat call detection. These were undertaken over two survey periods in November 2009 and February/March 2010.

The PB (2010) fauna survey detected 165 species of vertebrate animal, including eight introduced species. Three threatened species were detected; these being the Squatter Pigeon (southern), Ornamental Snake (*Denisonia maculata*) and the Little Pied Bat (*Chalinobolus picatus*). The Little Pied Bat has since been de-listed under the NC Act.

2.6.4. FRC Environmental 2010

2.6.4.1. General

An Aquatic Ecology Assessment Report was developed by FRC Environmental (FRC) in October of 2010. The report was prepared for PB to inform the *Middlemount Coal Project Stage 2 Environmental Impact Statement* (MCLP 2011)

The scope of the study included an assessment of aquatic habitat, aquatic flora and fauna distribution and biological values of the waterways. The assessment was confined to Roper Creek and Thirteen Mile Gully which were found to be the only major waterways that occur within the study area.

2.6.4.2. Survey Methods

Aquatic habitat, flora and fauna was assessed over two field surveys; one which occurred in early wet season of 2009, from the 7th to the 9th of December and another which occurred during mid wet season of 2010, from 22nd to the 26th of February.

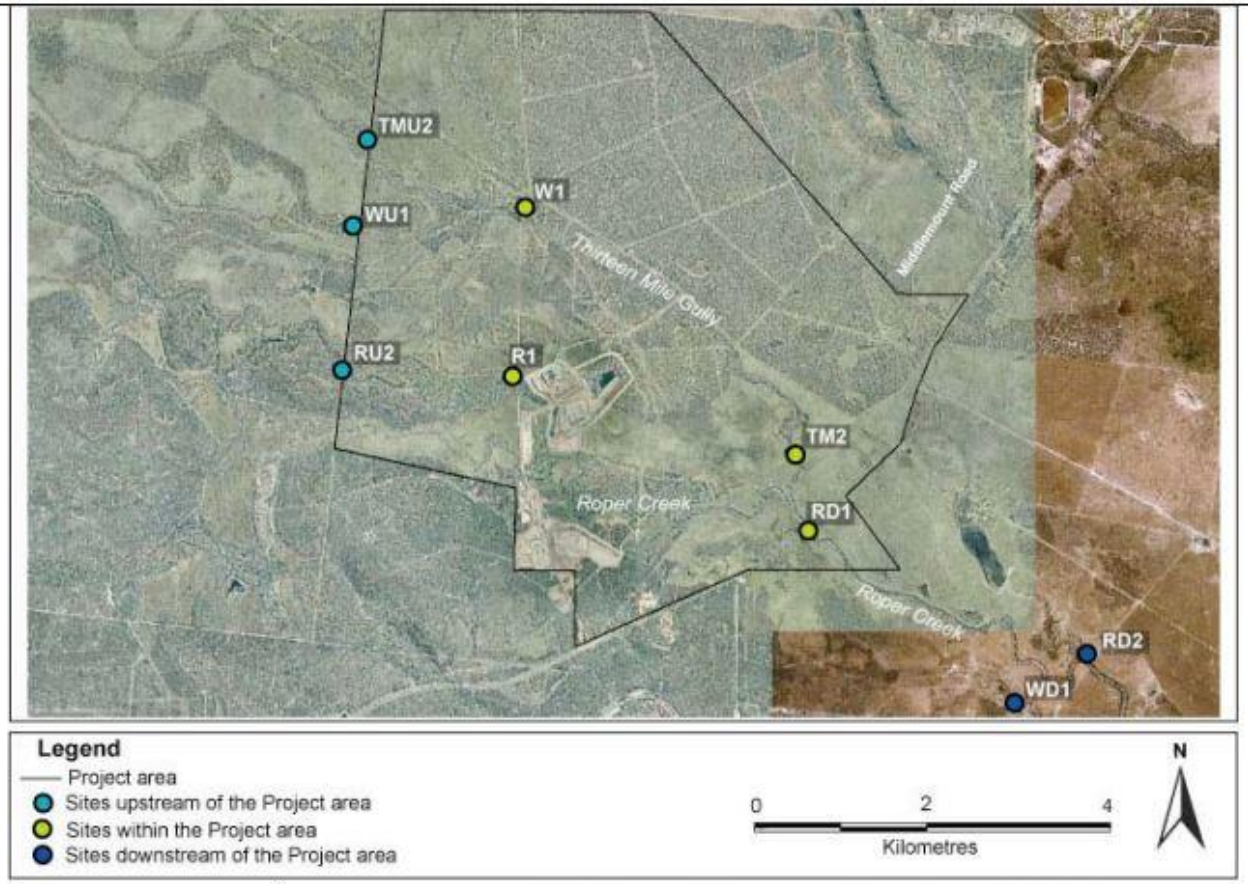
A total of nine sites were surveyed including sites upstream, within and downstream of the mine (Table 1 and Figure 5). These sites included palustrine and lacustrine wetlands mapped upstream, within and downstream of the mine as per Department of Environmental Resource Management (DERM) wetland mapping at the time of survey.

All habitat was surveyed using standardised Australian River Assessment System (AusRivAs) protocols, including survey of both the physical and biotic environments.

Table 1: Aquatic ecology survey locations

Site	Location (Figure 5)
RU2	Roper Creek
TMU2	Thirteen Mile Gully
WU1	Palustrine wetland
R1	Roper Creek
RD1	Roper Creek
TM2	Thirteen Mile Gully
W1	Lacustrine wetland
RD2	Roper Creek
WD1	Lacustrine wetland

Figure 5: Aquatic survey sites



frc environmental AQUATIC ECOLOGISTS deep thinking.science.	Middlemount Coal Project EIS, Stage 2: Aquatic Ecology	
	Figure 2.1 Location of survey sites.	
	Google Earth (2010)	October 2010

Aquatic Habitat

Aquatic habitat of the study area was assessed during both the December 2009 and February 2010 surveys at all nine locations presented within Table 1 and Figure 5.

Habitat assessment was undertaken in accordance with the *Qld AusRivAS Sampling and Processing Manual* (DNRM 2001). Visual assessment was undertaken at the time of survey using the following attributes:

- the type and condition of riparian vegetation;
- habitats;
- mean water depth;
- substrate and the presence of bars;
- bed and bank stability;
- the presence of snags, overhangs, undercuts, and other forms of shelter, and
- the presence of any physical barriers of fish passage.

River Bioassessment habitat assessment score datasheets (DNRM 2001) were also completed in the field. The assessment of aquatic habitat described above was used to numerically assess nine criteria, and design them to one of four categories; excellent, good, moderate and poor. These numeric values were combined to produce an overall River Bioassessment Program (RBP) habitat assessment score which is categorised into one of the following categories: excellent > 100; good 75 – 100; fair 39 – 74; and poor < 38.

Water Quality was undertaken at each site via the use of a Hydrolab QUANTA water quality meter. The following parameters were measured:

- Water Temperature (°C).
- Conductivity (µS/cm).
- pH.
- Dissolved oxygen (DO) (% saturation).
- Turbidity (NTU).

These parameters were compared to the *Qld Water Quality Guidelines (DEHP 2009)* (QWQG) values for lowland streams in central QLD. It must be noted that the results for DO were not compared with QWQG, as the DO guidelines should only be applied to flowing streams and not stagnant pools (DERM 2009). There was no flow in the December 2009 survey and sites RU2, TMU2 and R1 were dry. Flow occurred during the February 2010 survey, however equipment issues occurred during the field survey and data was not considered to be reliable.

Aquatic Flora

Aquatic flora of the study area was assessed during both the December 2009 and February 2010 surveys at all nine locations presented within Table 1 and Figure 5. Macrophytes were surveyed in a 100m section at each site. The following attributes were recorded:

- The presence of all native and exotic macrophytes.
- The percent coverage of each species at each site.
- The percent coverage of submerged, floating (free-floating or rooted) and emergent macrophytes.

Percentage cover was calculated by the percentage of substrate covered by vegetation. The methodology utilised, noted that due to the overlap of emergent, floating and submerged growth forms, the total percentage cover can exceed 100%. Identification was undertaken via photograph's taken in-situ and in the field where practicable. The DERM list of hydrophytes was used to classify macrophytes as native or exotic Environmental Protection Agency [EPA] (EPA 2008)

Aquatic Macroinvertebrates

The chosen methodology and potential species occurrence of aquatic macroinvertebrate communities was informed by a literature review of aquatic macroinvertebrate studies across the Fitzroy Basin. This included review of DERM macroinvertebrate surveys near the study area. Study sites included; Roper Creek at Wilpeena (Site 1301025), the Mackenzie River at Tartrus Weir Headwater (Site 130109A) and the Mackenzie River at Bedford Weir Tailwater (Site 13011A).

Communities were surveyed at all nine sites described within Table 1 and Figure 5. During the December 2009 survey three sites; TMU2, RU2 and R1 were not surveyed due to them being dry at that time.

Sampling methodology followed the procedures in the *Qld AusRivAS Sampling and Processing Manual* (DNRM 2001). Macroinvertebrate sample was collected at each site from both edge and bed habitats using a standard triangular framed, cone shaped net with 250 micrometre (µm) mesh. Samples were frozen and returned to the FRC laboratory for identification and analysis to identify and quantify macroinvertebrates to the lowest taxonomic level as per AusRivAS standards.

Aquatic Vertebrates

Aquatic vertebrate surveys were undertaken during both the December 2009 and February 2010 surveys at all nine locations presented within Table 1 and Figure 5. In December 2009, only five sites were surveyed due to the lack of water and time constraints.

Fish communities were surveyed using a combination of backpack and boat electrofishing, baited traps and seine nets. Electrofishing was the favoured survey technique and was attempted at all sites. Electrofishing was undertaken via a Smith-Root LR-24 backpack electro fisher when in shallow water and via a Smith-Root boat 2.5GPP electrofishing system in deep water in accordance with the *Australian Code of Electrofishing Practice, 1997.*

2.6.4.3. Results

The Aquatic Ecology Assessment Report (FRC 2010) found that no threatened flora or fauna species listed under State or Federal legislation were recorded, or are likely to occur within the study area. There were also no wetlands of regional, State or Federal significance in the study area. As such, the project concluded by stating that; "*The project is not likely to impact upon conservation-significant habitat, listed vulnerable or endangered species or on Matters of National Environmental Significance (MNES) with respect to aquatic ecology".*

The biological values of the aquatic ecosystems within the study area were found to be relatively low which is consistent with those of the wider catchment. The physical parameters of the waterways were dictated primarily by their ephemeral nature, with flow being largely dependent upon wet season rainfall. In addition to this, the 2010 FRC report did acknowledge that development and existing mining within the region has influenced water quality and the physical characteristics of aquatic habitat.

Creeks within the catchment were described as being in moderate condition. These waterways were described as being characterised by low habitat diversity, numerous access areas for cattle and road crossings, restricting passage for fish and other aquatic fauna and allowing the invasion of weed species.

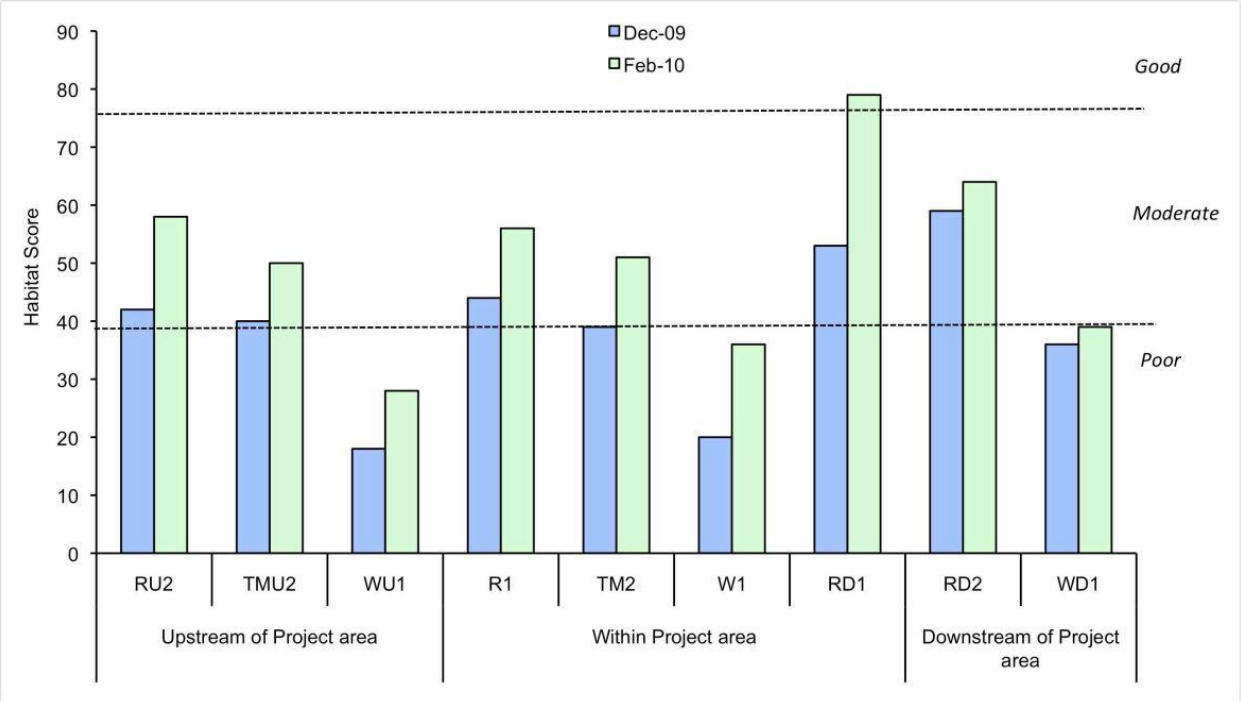
Physical parameters of water quality within the study area were identified as poor to moderate at the time of survey. Typically, the waterways within the study area were characterised by high turbidity and low DO levels. Despite this, the report acknowledged that the creeks within the study area provide upstream dispersal habitat for fish species and possible breading habitat for some of those which were recorded.

Aquatic Habitat

The aquatic habitat recorded within the FRC 2010 Aquatic Ecology assessment was considered unlikely to support any threatened fauna listed under either State or Federal legislation.

Most sites recorded moderate habitat assessment scores according to the RBP (Figure 6). This was attributed to low habitat diversity and channel alteration caused by the movement of fine sand and silt. Scores for wetlands (WU1, W1 and WD1) were poor, however it was also acknowledged that the RBP is primarily designed for use in streams and consequently wetlands habitats typically score poorly. RBP scores improved at all sites between December 2009 and February 2010, due to the higher water levels and flows in February of 2010.

Figure 6: RBP habitat assessment scores



The results of sites: TMU2 – Drainage Line 1, immediately upstream of the mine; WU1 – Wetland, immediately upstream of the mine and W1 – Wetland, within the mine, are all particularly relevant to the current assessment as they are located within, or in close proximity to the Project area. The descriptions of these sites are provided within Table 2.

Table 2: Aquatic habitat descriptions (FRC 2010)

Site	Description	Photographs
Upstream of Current Project Area		
MU2	In December 2009, this site was dry. In February 2010, the site was relatively shallow (0.3 m) and had low flow. The site had a wide (approximately 20 m) channel with sloping, and moderately stable banks. Instream habitat included woody debris and tree roots, trailing bank vegetation and undercut banks. The substrate was dominated by sand but also included silt / clay, gravel and pebbles. The riparian zone was wide (>30 m) and was dominated by grasses, shrubs and trees. There was a dirt ford crossing the creek approximately 30 m downstream of the site, which would impede fish passage during low flow, but have little impact to fish passage during moderate or high flows.	 Upstream December 2009.  Upstream, February 2010
WU1	This site was a large palustrine wetland which had similar characteristics in both surveys. The wetland was created by a dam on a small tributary of Thirteen Mile Gully. It was approximately 110 m wide and 1.2 m deep and there was no flow. The banks were sloping and had low stability due to cattle access and vegetation clearing. Instream habitat included woody debris, deep pools and trailing bank vegetation. A number of dead trees also provided instream habitat. The substrate was dominated by fine sediments (silt / clay and sand). The riparian zone was wide (>30 m) and was dominated by grasses, shrubs and trees.	 Channel, February 2010

Within Current Project Area		
W1	This site was a large lacustrine wetland created by a dam on Thirteen Mile Gully, and had similar characteristics in both surveys. The wetland was wide (approximately 80 m), and deep (4 m) with no flow. The banks were sloping and had low stability due to cattle accessing the area and vegetation clearing. Instream habitat included instream vegetation, floating vegetation and deep pools. The substrate was dominated by fine sediments (silt / clay and sand), but also included some gravel. The riparian zone was relatively wide (20 m) and was dominated by grasses, shrubs and trees.	 Channel, February 2010

Aquatic Flora

The aquatic flora assessment completed by FRC in 2010 as part of the Aquatic Ecology assessment for Stage 2 of the Middlemount Mine Extension Project, recorded no threatened aquatic flora listed under either State or Federal legislation and considered it unlikely that any such species would have potential to occur. Fifteen species of aquatic flora were recorded in the 2010 FRC Aquatic Ecology assessment, five with the December 2009 survey and 14 in February of 2010. A species list is provided within Table 3 below.

Table 3: Stage 2 - Aquatic Ecology - Aquatic flora list

Common Name	Scientific Name
Lesser Joyweed	*Alternanthera denticulata*
Dirty Dora	*Cyperus difformis*
Sharp Edge Sedge	*Cyperus haspan*
Bunchy Sedge	*Cyperus polystachyos*
-	*Cyperus sp.*
Common Water Hyacinth	*Eichhornia crassipes**
-	*Eleocharis sp.*
-	*Juncus sp.1*
Duckweed	*Lemna minor*
Green Mat-rush	*Lomandra hystrix*
Spiny-head Mat-rush	*Lomandra longifolia*
Monochoria	*Monochoria cyanea*
Water Snowflake	*Nymphoides indica*
Prince's Feather	*Persicaria orientalis*
-	*Schoenoplectus lateriflorus*

The February 2010 survey recorded greater species richness and cover due to the increased standing and flowing water. For example, site WD1 recorded the greatest macrophyte species richness and cover during the February 2010 survey, while in December of 2009 no macrophytes were recorded at this site.

Aquatic Macroinvertebrates

During the 2010 FRC Aquatic Ecology assessment, the macroinvertebrate communities within the study area were dominated by; Non-biting Midge larva, Water Boatmen, Common Dragonfly nymphs and Seed Shrimps. The distribution and richness of taxa was varied with the different aquatic habitats at each site.

Richness was higher in February 2010 when compared to December 2009 which was likely a result of increased water quality, greater water depth and availability of habitat features at this time. W1 and RD2 were exceptions to this, and showed a decline in richness, the reasons for which were unclear.

Macrocrustaceans were recorded throughout the survey periods through incidental observations during other surveys and targeted dip netting. Species recorded included: The River Prawn (*Macrobrachium sp.*), Freshwater Shrimp (*Paratya sp.*), Orange-fingered Yabby (*Cherax depressus*) and the Freshwater Crab (*Austrothelphusa sp.*). An estimated 757 macrocrusteceans were captured from both surveys and abundance was greatest at sites WU1 and TM2 in December 2009, indicating that these sites would likely provide refuge habitat for macrocrusteceans during prolonged dry periods. Whilst abundance was lower during the February surveys, records were more widespread which can be attributed to increased water flow and accessibility throughout the waterways of the study area.

Aquatic Vertebrates

The Aquatic Ecology assessment undertaken by FRC in 2010 did not record any threatened aquatic vertebrate species listed under state or federal legislation, in addition no threatened aquatic vertebrates were considered likely to occur within the study area. The survey did not record any exotic aquatic vertebrate species.

For each site, the taxonomic richness, total abundance, abundance of listed protected species and abundance of each life cycle stage was determined. Eight species of fish were recorded during the field surveys, these are presented in Table 4.

Table 4: Stage 2 - Aquatic Ecology - Recorded Fish Species

Common Name	Scientific Name
Agassiz's Glassfish	*Ambassis agassizii*
Fly-specked Hardyhead	*Craterocephalus stercusmuscarum*
Carp Gudgeon	*Hypseleotris sp.*
Spangled Perch	*Leiopotherapon unicolor*
Eastern Rainbowfish	*Melanotaenia s. splendida*
Purple-spotted Gudgeon	*Mogurnda adspersa*
Bony Bream	*Nematalosa erebi*
Hyrtl's Tandan	*Neosilurus hyrtlii*

Adults dominated the fish communities during both surveys. The number of juveniles decreased slightly between the December and February surveys while the number of intermediates increased. This has been attributed to the maturation of juveniles over this time period.

Krefft's River Turtle (*Emydura macquarii krefftii*) was recorded in the study area at sites WU1 and W1. Seven individuals were captured during the December 2009 survey and 24 were captured in February 2010.

3.0 Methodology

3.1. Desktop Study and Literature Review

A comprehensive desktop study was carried out prior to the field survey. The following databases and Geographic Information System (GIS) layers were searched/obtained:

- DNRM Regulated vegetation report (2017b).
- DEHP MSES, REs and terrestrial biodiversity and aquatic conservation values map and report with a 2km radius from the project area (2017c).
- DEHP Protected plants flora survey trigger map (2017d).
- Department of State Development, Infrastructure and Planning (2017). SPP Interactive Mapping System.
- Department of the Environment and Energy (DEE) Protected Matters Search Tool with a 10 km radius from the centre of the project area (2017a).
- Species Profile and Threats Database (DEE, 2018).
- DEHP Wildlife Online database with a 10 km radius from the centre of the project area (2017)
- Department of Science, Information, Technology and Innovation (DSITI) REs Mapping digital data layer (2017).
- Bureau of Meteorology (BoM) Groundwater Dependant Ecosystems (GDE) Map Report with a 5km radius from the centre of the project area (2017a).
- Atlas of Living Australia (ALA) database with a 10km radius from the centre of the project area (2017).
- Birdlife Australia Atlas of Australian Birds (AAB) database with a 10km radius from the centre of the project area (2017).

The results of these searches are presented in Section 4 and Appendices 5-11. In addition to the desktop searches, the following literature was reviewed:

- PB (2010). Middlemount Coal Project (Stage 2) Terrestrial Ecological Impact Assessment. In PB (2011) Middlemount Coal Project (Stage 2) Environmental Impact Statement.
- FRC (2010). Middlemount Coal Project EIS, Stage 2: Aquatic Ecology. In PB (2011) Middlemount Coal Project (Stage 2) Environmental Impact Statement.
- EHP. (2012). Ecological Investigations within the Offset Area for Stage 2 of the Middlemount Coal Mine, Qld.
- MCPL. (2013). Middlemount Coal Mine Offset Management Plan/Vegetation Management Plan.
- Naturecall (2014b). Ecological Assessment Report for Bingegang Pipeline Relocation, Middlemount Coal Mine. Naturecall (2014b). Ecological Monitoring for Offset Area: Annual Report.

- Naturecall (2015b). Terrestrial Ecology Impact Assessment: North-eastern Extension of Middlemount Coal Mine, Middlemount QLD. Unpublished Report to MCPL.
- Naturecall (2015a). Ecological Monitoring for Offset Area: Annual Report.
- Naturecall (2016a). Ecological Monitoring for Offset Area: Annual Report.
- Naturecall (2017a). Ecological Monitoring for Offset Area: Annual Report.
- Naturecall (2017b). Baseline Ecological Assessment for North-eastern Extension Offset Area.

3.2. Flora Surveys

Field surveys for these assessments were undertaken by two ecologists over two survey periods. Field surveys dates were 2-6th May 2017 for the western study area and 22-24th July for the eastern study area.

The primary aims of the field survey were to verify DEHP RE mapping for the study areas; refine previous RE mapping by PB (2010) and EHP (2012); identify and describe MSES and MNES (e.g. threatened flora species, REs and Commonwealth listed threatened ecological communities [TEC]); and collect sufficient data to conduct a terrestrial habitat quality assessment in accordance with the Guidelines (DEHP 2017a). Details of the flora and habitat quality surveys are provided in the following sections.

3.2.1. Flora Sampling and Vegetation Mapping

REs on the study areas were surveyed and field verified as per the *Methodology for Survey and Mapping of REs and Vegetation Communities in Qld* (Neldner et al. 2017). This consisted of both secondary and quaternary flora survey methods.

Five secondary sites and ten quaternary sites were undertaken over the two study areas. The location of these is shown in Figure 7.

Changes to RE mapping were made in the field using a tablet loaded with GIS Kit Pro (Garafa Inc.). This allowed highly accurate mapping of vegetation boundaries live in the field. This was followed by desktop mapping using ArcGIS 10.2 for Windows and recent satellite imagery (June 2017) supplied by MCPL.

3.2.2. Targeted Searches for Threatened Flora Species

The DEHP *Flora Survey Guidelines - Protected Plants* (DEHP 2014a) states that threatened flora surveys are required if the site falls within a high risk area (as defined by an online mapping tool) or if a threatened species is known to occur within the impact area. The study areas does not fall within a high risk area (see map in Appendix 9) and no threatened flora species are known to occur in the impact area.

However, given nearby records of *Cerbera dumicola* (near threatened) (PB 2010), and that only part of the study areas have been previously surveyed for threatened flora by PB (2010) and Naturecall (2014c); searches for threatened flora were carried out to increase confidence of the presence/absence of threatened flora.

This was achieved via conducting walking transects across the study areas, along with opportunistic searches during other activities.

3.2.3. Threatened Ecological Community Identification

Vegetation communities identified during the surveys were assessed for their conservation status under the EPBC Act, VM Act and DEHP Biodiversity Status. Brigalow communities were also assessed according to the Approved conservation advice for the Brigalow EEC (Department of the, Environment, [DofE] 2013) and the Species Profile and Threats Database (DEE, 2018).

3.2.4. Habitat Quality Assessment

The survey methodology outlined in the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a) was used to collect field attributes and determine a terrestrial habitat quality score for the study areas. This methodology uses BioCondition plots to collect field data (Eyre et al 2015).

A total of 16 site condition assessments (plots and transects) were undertaken on the western study area with six on the eastern study area. The location of these plots is shown in Figure 8. Site selection was based on ground-truthed RE mapping and analysis of high resolution satellite imagery, and aimed to sample a representative coverage of the site vegetation.

The following information was recorded at each of the field sampling sites:

- Observer, location and date.
- RE map unit.
- Photographic record of vegetation.
- Habitat description.
- Tree canopy and subcanopy height.
- Native plant species richness in each layer.
- Number of large trees.
- Recruitment.
- Course woody debris.
- Non-native plant cover.
- Percent cover of each layer.

The data collected was also used to determine a terrestrial habitat quality score for the study area, in accordance with the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a) and to assist in determining offset requirements for the Project.

Figure 7: Location of secondary and quaternary survey sites

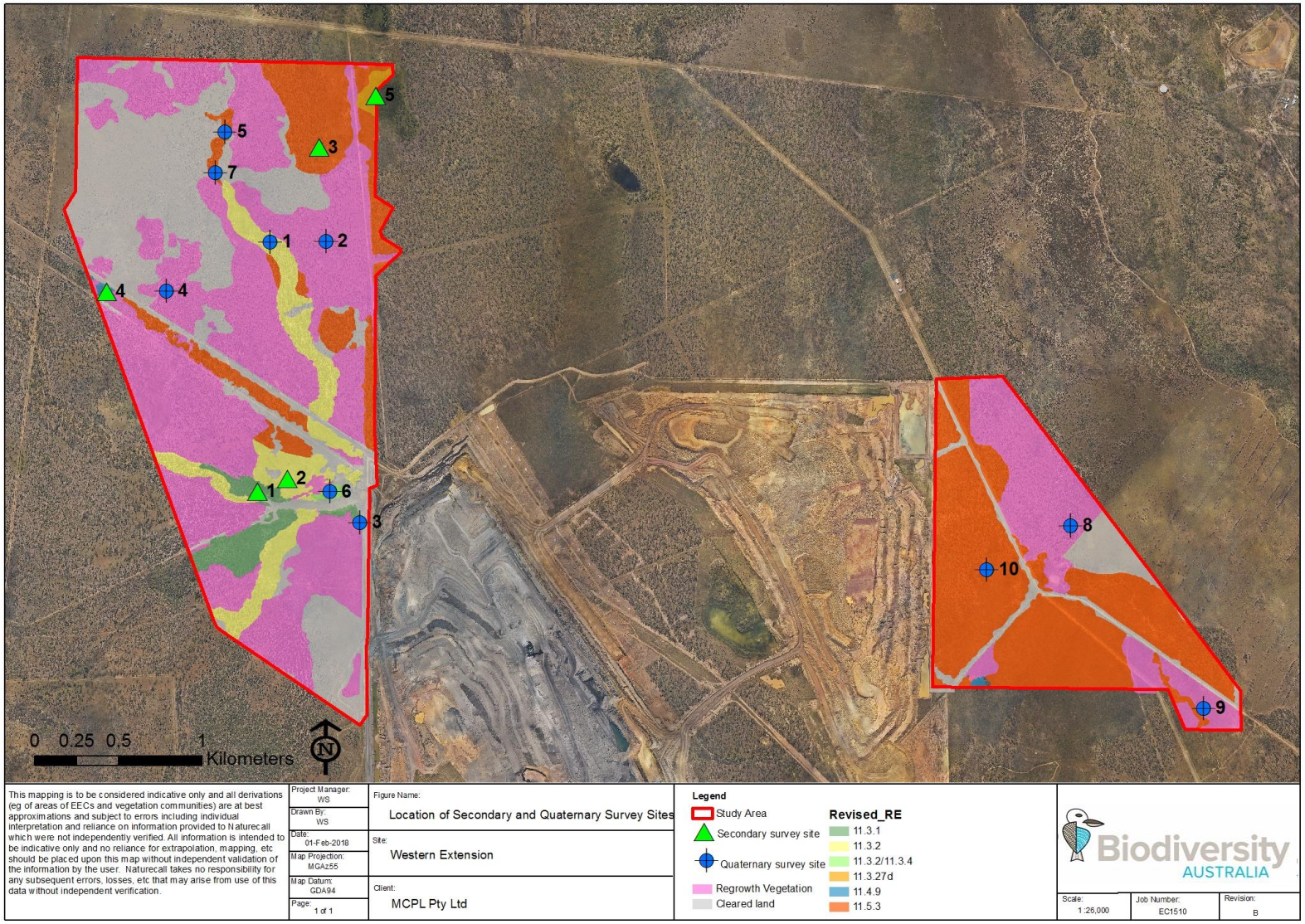
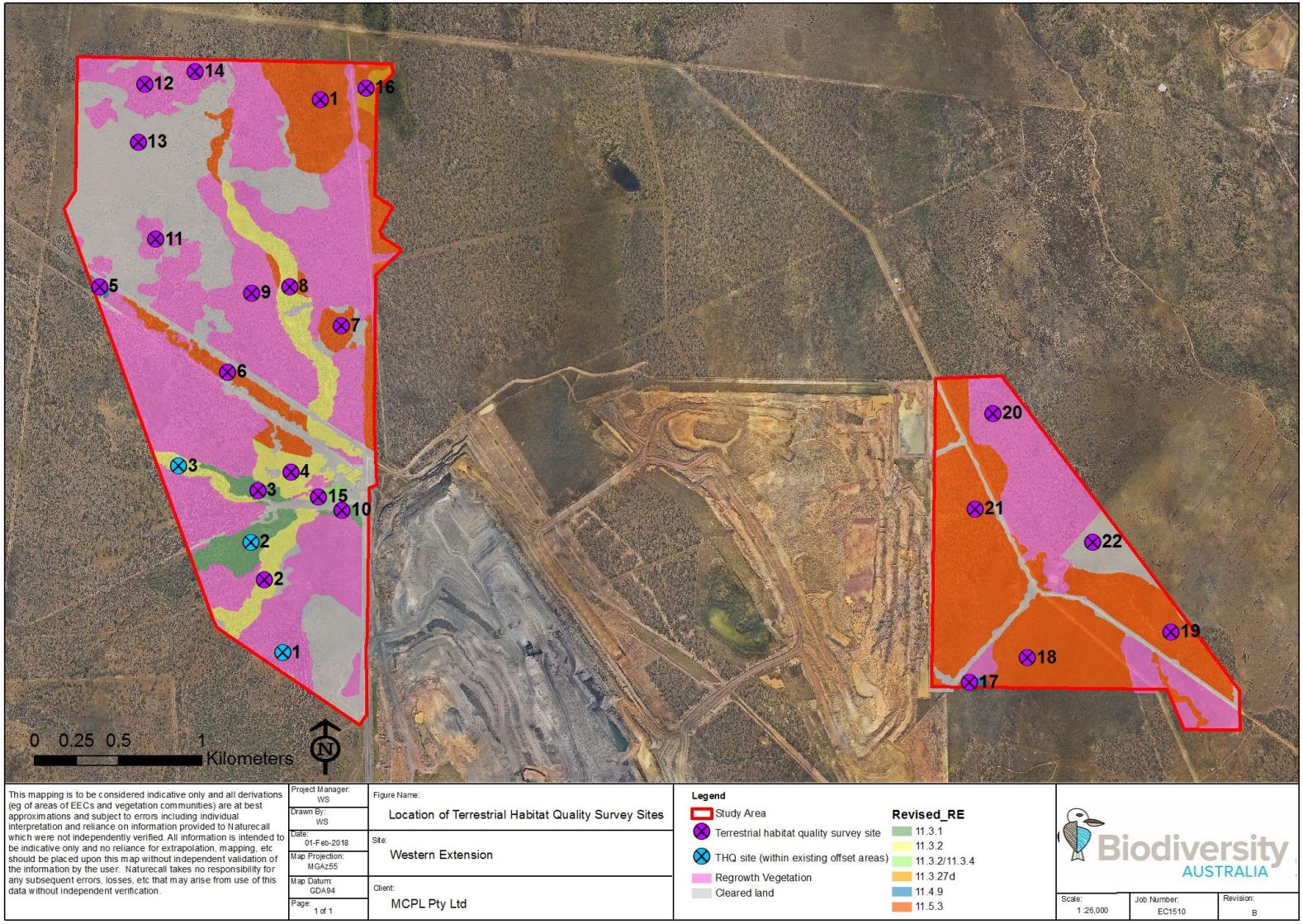


Figure 8: Location of terrestrial habitat quality survey sites



3.3. Fauna Surveys

3.3.1. General

Fauna surveys were undertaken over the study areas by two ecologists over four survey periods. The western study area was surveyed from 2-6 May 2017 and 14-18 September 2017. The eastern study area was subject to a preliminary survey from 22-24 July 2017 and a full fauna survey from 14-18 September 2017.

The first survey occurred in the autumn/winter survey period, with the second survey taking place in the spring/summer period to account for seasonal variation in fauna usage and abundance. Weather conditions for the survey periods are detailed in Section 4.3.4.

Fauna surveys were conducted in accordance with the following guidelines:

- *Terrestrial Vertebrate Fauna Survey Guidelines for Qld* (Eyre et al, 2014)
- *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPC 2011a).
- *Survey Guidelines for Australia's Threatened Mammals* (DSEWPC 2011b).
- *Survey Guidelines for Australia's Threatened Birds* (Department of the Environment, Water, Heritage and the Arts [DEWHA] 2010a).
- *Survey Guidelines for Australia's Threatened Bats* (DEWHA 2010b).
- *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, NSW and the Australian Capital Territory)* (DofE 2014).
- *EPBC Act Draft Referral Guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC 2011c).*
- Species Profile and Threats Database (DEE, 2018).

3.3.2. Fauna Sampling

Fauna surveys targeted threatened species listed under the NC Act and EPBC Act, as well as pest species, however common species were also surveyed. The following fauna surveys methods were utilised:

- Terrestrial and aquatic habitat assessments.
- Spotlighting.
- Call playback.
- Microbat call recording and analysis
- Harp traps.
- Herpetofauna surveys.
- Diurnal bird surveys.
- PIR camera stations.
- Koala SAT surveys
- Scat, track and secondary evidence searches.

These survey methods are described in detail in the following sections.

3.3.2.1. Terrestrial Habitat Assessment

Habitat assessments were undertaken across the study areas at the terrestrial habitat quality survey plots (Figure 8) and during foot traverses over the Study areas.

Habitats were defined according to parameters such as:

- Structural and floristic characteristics of the vegetation (e.g. understorey type and development, crown depth, groundcover density, etc.).
- Degree and extent of disturbance (e.g. fire, logging, weed invasion, modification to structure and diversity, etc.).
- Presence of water in any form (e.g. dams, creeks, drainage lines, soaks).
- Size and abundance of hollows and fallen timber.
- Availability of shelter (e.g. rocks, logs, hollows, undergrowth).
- Wildlife corridors, refuges and proximate habitat types (i.e. connectivity between suitable habitats).
- Presence of resources (e.g. mistletoe, nectar, gum, seed, sap, etc.).

This information, along with information obtained from the desktop assessment was used to formulate a list of potentially occurring threatened fauna species for the Study areas.

3.3.2.2. Aquatic Habitat Assessment

Assessments were undertaken at each ephemeral drainage line in the Study areas during the September survey period. This involved recording physical characteristics of the ephemeral drainage lines, their current condition and assessing their suitability to support aquatic fauna.

3.3.2.3. Spotlighting

Spotlighting was conducted for 1.5-2 hours per night for eight nights over the western Study area and four nights over the eastern Study area.

This involved driving transects from a vehicle moving at walking pace along roads and tracks and walking transects using hand-held spotlights through both vegetated areas and along tracks. The location of spotlight transects is shown on Figures 9 and 11.

All habitat components (i.e. understorey/canopy trees for arboreal fauna), the ground and terrestrial strata (e.g. logs, areas with good leaf litter accumulations, etc.) were searched for terrestrial fauna.

Spotlighting was conducted approximately one hour after dusk. Conditions varied between clear and overcast, and wind ranged from placid to moderate.

3.3.2.4. Call Playback

Call playback was carried out for eight nights over the western Study area and for four nights over the eastern Study area. The location of call playback points is shown on Figures 9 and 11.

Recorded calls of the threatened Powerful Owl (*Ninox strenua*), Squirrel Glider (*Petaurus norfolcensis*) and Koala (*Phascolarctos cinereus*) along with common species such as the Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*), Bush-stone Curlew (*Burhinus grallarius*) and Sugar Glider (*Petaurus breviceps*) were broadcast during call playback surveys.

Calls were played through a portable MP3 player via a 30W PA system from the rear of a utility at a level approximating natural intensities of the species. The general methodology involved an initial period of listening and spotlighting; followed by playback of the calls simulating a natural pattern. This was followed by 10 minutes of listening and 15-20 minutes spotlighting for fauna attracted by the calls (but not responding vocally), within a 100m radius of the playback point.

Calls were generally played soon after dusk, when such calls are normally heard.

3.3.2.5. Microbat Call Recording and Analysis

Microbat call detection was undertaken over both Study areas using two Anabat Express units (Titley Scientific). The units were deployed overnight at various locations including roads/tracks, ephemeral drainage lines and forested areas (see Figure 9 and 11). Nine nights of recording was conducted at the western Study area and four nights at the eastern Study area. This resulted in >130 hours of recording over both areas.

The recordings were forwarded to Greg Ford of Balance! Environmental, a bat call identification consultant, for identification of the bat species.

3.3.2.6. Harp Trapping

A harp trap was set at each study area during the September survey period targeting the South-eastern Long-eared Bat (*Nyctophilus corbeni*). These were set along ephemeral drainage lines which could potentially be used as flyways by Microbats (Photo 4, Figure 12). The traps were checked each night during spotlighting and within one hour of dawn each morning. Any bats captured were kept in an air-conditioned office during the day and released near the point of capture after dark.

Photo 4: Harp trap at eastern Study area

3.3.2.7. Herpetofauna Searches

Searches primarily targeting the Ornamental Snake, Yakka Skink (*Egernia rugosa*), Brigalow Scaly-foot (*Paradelma orientalis*), Dunmall's Snake (*Furina dunmalli*), and Golden-tailed Gecko (*Strophurus taenicauda*) were undertaken within 50m x 50m quadrats. These were conducted at six locations within the western Study area (surveyed in May and September) and three locations in the eastern Study area (Figures 10 and 12).

Herpetofauna searches involved active diurnal lifting up and rolling of timber and debris, inspection of dense vegetation and leaf litter and observation of likely basking sites for a total of 60 person minutes per site. Nocturnal herpetofauna torch searches were carried out in suitable habitat in conjunction with walking spotlight transects.

3.3.2.8. Diurnal Bird Surveys

Birds were surveyed by detecting calls and searching using binoculars at point positions or along a walking transect within 2 hours of dawn when peak activity usually occurs.

Specific bird censuses were undertaken each morning during the survey periods for 30 minutes with two observers. A total of 11 bird surveys were carried out on the western Study area and four on the eastern Study area over both autumn/winter and spring/summer survey periods (Figure 10 and 12).

Incidental observations of birds were also recorded during other survey activities. This provided short-term seasonal data on bird occurrences in the area for the particular seasons.

3.3.2.9. Passive Infared Camera Stations

Six infra-red cameras were deployed at various locations over the western Study area (Photo 5) during the May surveys and four during the September surveys. Cameras were set for ten nights during the May surveys and five nights during the September survey. Four infrared cameras were set over the eastern Study area for five nights during the September survey period (Figures 9 and 11).

The cameras were set either in forested areas or facing a road/track and were baited with either a mixture of oats, peanut butter and apple, or a meat bait consisting of chicken necks and tinned cat food.

Target species were the Northern Quoll (*Dasyurus hallucatus*), arboreal mammals, raptors and feral species such as European Red Foxes (*Vulpes vulpes*), dogs/dingoes (*Canis* sp.), feral cats (*Felis catus*) and pigs (*Sus scrofa*).

Photo 5: Anabat and PIR camera set at western Study area

3.3.2.10. Koala SAT Surveys

Three Koala Spot Assessment Technique (SAT) surveys were undertaken at the western Study area and two at the eastern Study area. The location of these is shown in Figures 10 and 12.

The SAT surveys consisted of checking the ground and leaf litter in a 1m radius around 30 trees for a period of two minutes per tree or until a scat was found. This technique is recognised as a very efficient method of detecting Koala presence, and in some instances, is a method used to identify areas of major Koala activity/significance e.g. Core Koala Habitat (Phillips and Callahan 1995).

The method is used by the Australian Koala Foundation primarily for mapping Koala habitat at a landscape scale (Phillips and Callahan 1995, 2011). The methodology uses a specific sampling technique to gauge the level of Koala activity at a sampling site, by the number of trees recording Koala scats divided by the total number of trees in the sampling area expressed as a percentage (Phillips and Callaghan 2011).

3.3.2.11. Track, Scat and Sign Searches

Searches for scats, tracks, feeding signs and scratch marks on trees were undertaken opportunistically along roads/tracks and within forested areas at the herpetofauna survey sites.

The sandy roads within and around the Study areas provided ideal locations for track searches, and any tracks found were photographed and identified using the methodology outlined in Triggs (1996). Predator scats were targeted for survey as remains can provide records of cryptic fauna.

Figure 9: Location of autumn/winter fauna survey sites part A

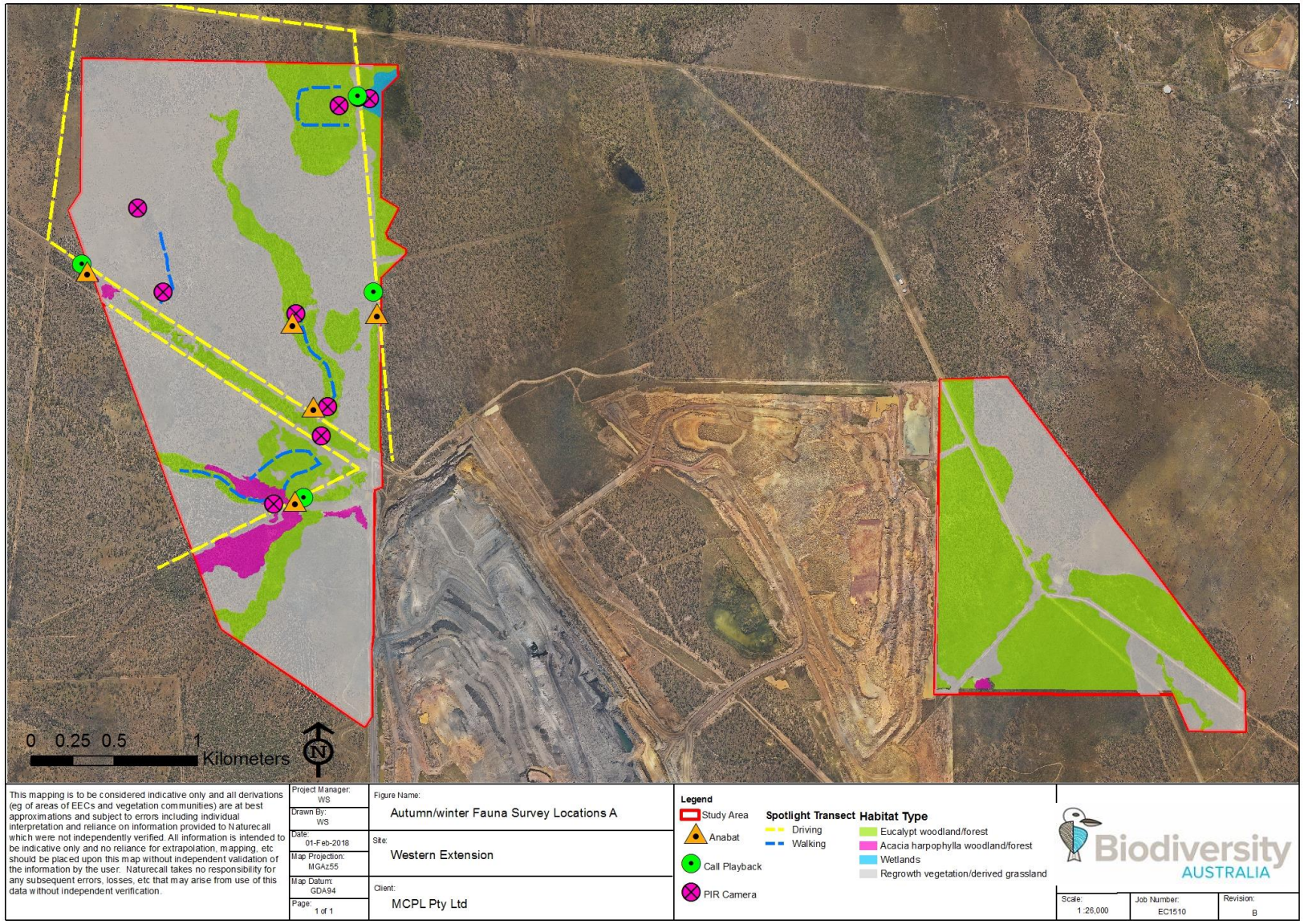
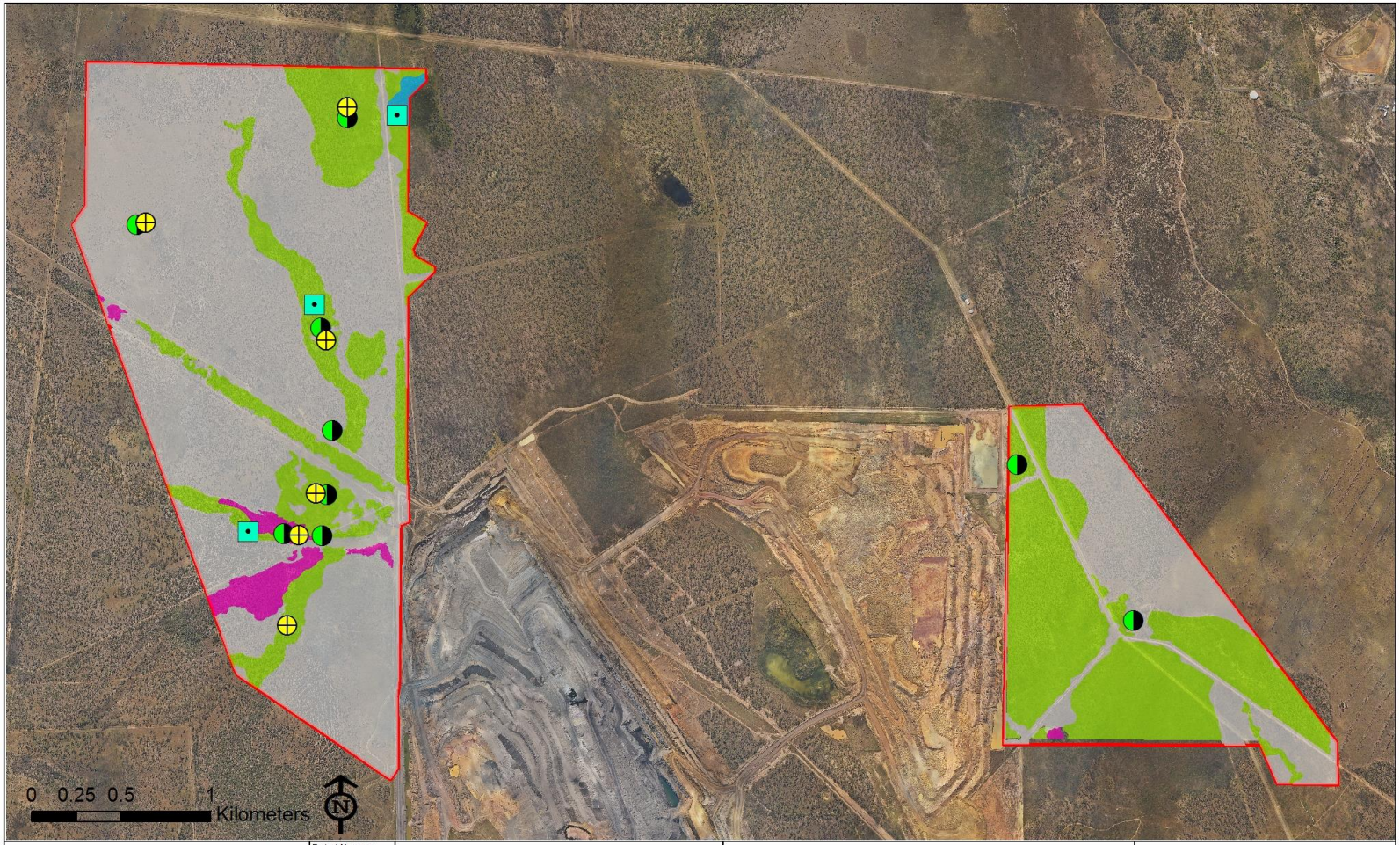


Figure 10: Location of autumn/winter fauna survey sites part B



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: WS
Drawn By: WS
Date: 01-Feb-2018
Map Projection: MGAz55
Map Datum: GDA94
Page: 1 of 1

Figure Name: Autumn/winter Fauna Survey Locations B
Site: Western Extension
Client: MCPL Pty Ltd

Legend
- Study Area
- Koala SAT
- Herpetofauna search
- Bird survey

Habitat Type
- Eucalypt woodland/forest
- Acacia harpophylla woodland/forest
- Wetlands
- Regrowth vegetation/derived grassland

Biodiversity AUSTRALIA

Scale: 1 :26,000
Job Number: EC1510
Revision: B

Figure 11: Location of spring/summer fauna survey sites part A

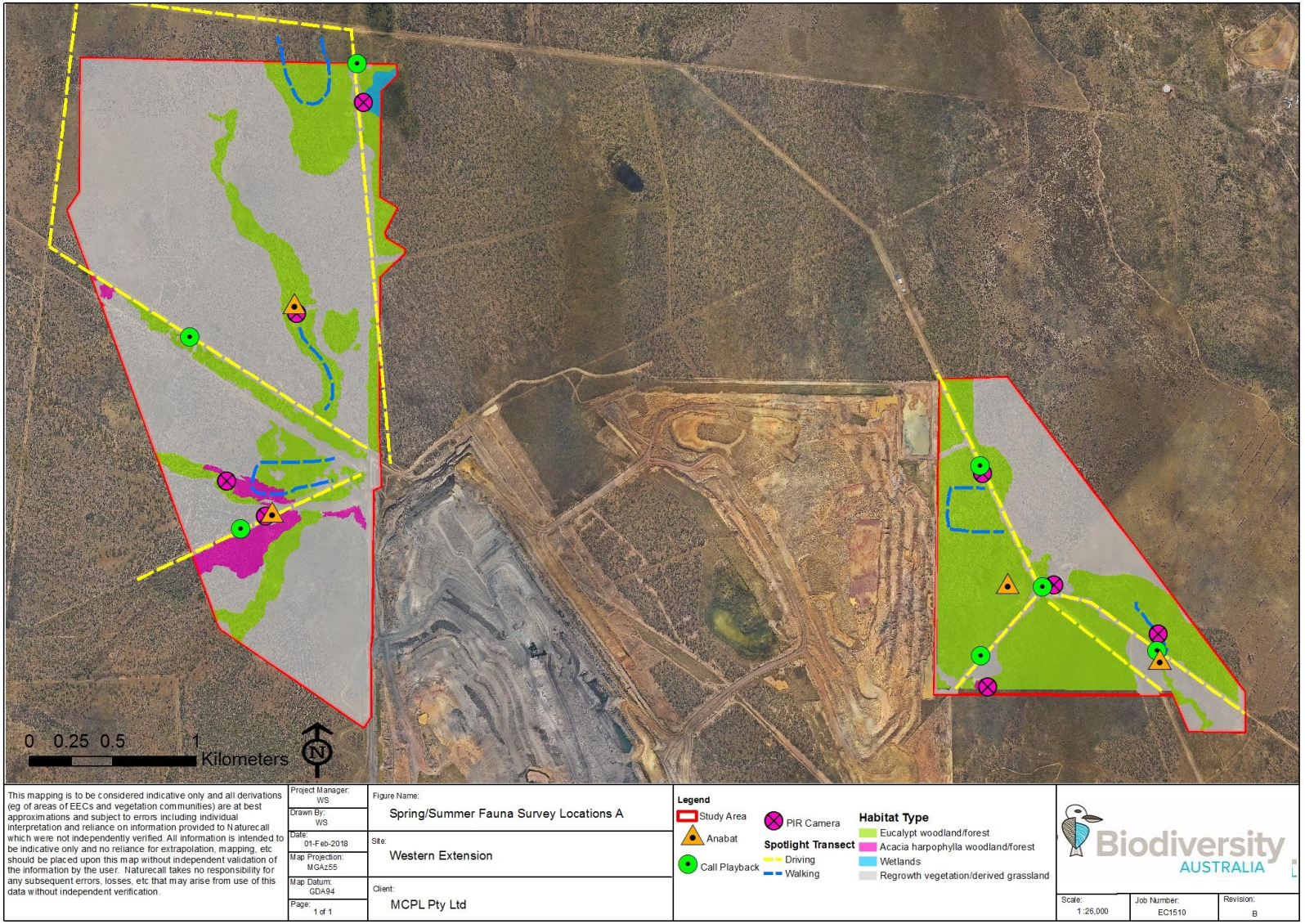
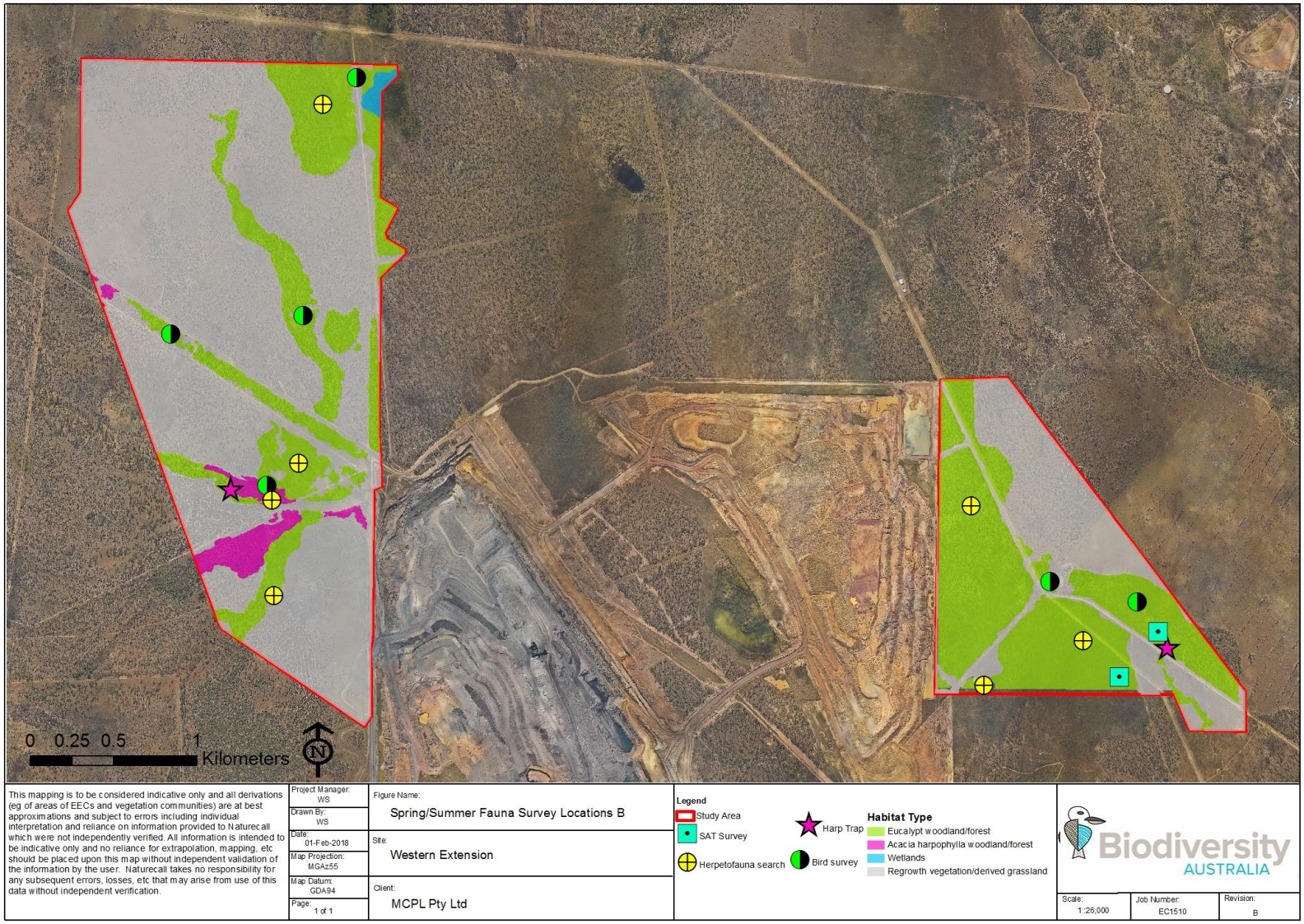


Figure 12: Location of spring/summer fauna survey sites part B



3.4. Weather Conditions During the Surveys

3.4.1. Survey Periods

3.4.1.1. May 2017 Survey

Weather conditions were generally fine and sunny with no rainfall recorded during the survey period. Winds ranged from nil to moderate. Minimum temperatures ranged from 8.3°C to 15°C with maximum temperatures ranging from 23.1°C to 28.5°C (BoM 2017 – nearest weather station at Emerald Airport, station 035264).

The moon phase ranged from new moon to first quarter.

Heavy rain and flooding preceded the survey. Middlemount Coal Mine recorded 342 millimetres (mm) of rainfall in March 2017.

3.4.1.2. September 2017 Survey

Weather conditions were fine, warm and sunny with no rainfall recorded during the survey period or the preceding month. Winds ranged from nil to moderate. Minimum temperatures ranged from 9.3°C to 17.9°C with maximum temperatures ranging from 26.8°C to 30.4°C (BoM 2017b – nearest weather station at Emerald Airport).

The moon phase ranged from half-moon to last quarter.

3.4.2. Limitations

3.4.2.1. Flora

The field surveys were undertaken over two different seasons in late autumn (post-wet season) and early spring (pre-wet season).

The post-wet season survey in May 2017 was preceded by heavy rains and flooding, and most grass species were in seed at this time making them easily detectable. Drier conditions were experienced during the July and September 2017 survey periods making grasses less detectable, however the warmer temperatures stimulated the flowering of many trees and shrubs. The seasonal variation in surveys allowed for a high rate of detection of flora species. Locally recorded threatened flora species would be easily detectable either year round (e.g. *Cerbera dumicola* – near threatened) or during either of the two survey periods.

3.4.2.2. Fauna

Fauna detectability is limited by seasonal, behavioral or lifecycle characteristics of each species (e.g. seasonal migrants), and by habitat variations (e.g. flowering and seeding periods), which can occur within a year, between years, decades, etc. (Eyre et al. 2014).

The fauna surveys were undertaken over two different seasons in late autumn/winter (post-wet season) and early spring (pre-wet season). While fauna activity may have been low or declining during the surveys in May and July, the Spring survey in September coincided with a period of high activity for many fauna groups due to increased temperatures, resource accessibility and lifecycle stages (e.g. arboreal mammals, Microchiropteran bats and reptiles).

Heavy rains preceded the May survey and standing water was still present in the creek lines, palustrine wetlands and gilgai. This allowed for high detection rates of amphibians (and species which prey on them) and water birds.

4.0 Results

4.1. Desktop Search Results

4.1.1. Threatened Species (NC Act)

Database and literature searches returned records of four fauna and one flora species within a 10 km radius of the study area as shown in Table 5 below. The complete online search results are provided in Appendix 5.

Table 5: Locally recorded threatened species

Common Name	Scientific Name	NC Act Status	EPBC Act Status	Source
Fauna				
Squatter Pigeon (southern)	*Geophaps scripta scripta*	V	V	EHP 2012, PB 2010, AAB 2017, Naturecall 2014b, Naturecall 2013-2017
Greater Glider	*Petauroides volans*	V	V	DEHP 2017e, Naturecall 2011-2017
Koala	*Phascolarctos cinereus*	V	V	EHP 2012, DEHP 2017e, Naturecall 2013-2017
Ornamental Snake	*Denisonia maculata*	V	V	DEHP 2017e, PB 2010
Flora				
NCN	*Cerbera dumicola*	NT	-	DEHP 2017e, ALA 2017, PB 2010

V – Vulnerable.

NT – Near Threatened.

4.1.2. Endangered and Of Concern Regional Ecosystems

The following threatened REs listed in Table 6 have been mapped on the western Study area:

Table 6: Locally recorded Endangered and Of Concern Regional Ecosystems

Regional Ecosystem	Code	VMA Status	Biodiversity Status	Source
Acacia harpophylla shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	11.4.9	Endangered	Endangered	DSITI 2017, PB 2010
Acacia harpophylla and/or *Casuarina cristata* open forest on alluvial plains	11.3.1	Endangered	Endangered	DSITI 2017, PB 2010
Eucalyptus populnea woodland on alluvial plains	11.3.2	Of concern	Of concern	DSITI 2017, PB 2010

4.1.3. Matters of State Environmental Significance

The results of the MSES search are provided in Table 7. The full report is provided in Appendix 6 and the search was undertaken using a 2 km search radius from the Study areas.

Table 7: Matters of State Environmental Significance search results

Category	Present on Site?	Description
Protected areas	No	-
Marine parks	No	-
Fish habitat areas	No	-
High ecological significance (HES) wetlands	Yes	Palustrine wetland in northeast of western study area
High ecological value wetlands	No	-
High ecological value waterways	No	-
Threatened species habitat (plants, animals and breeding places)	No	-
Regulated vegetation	Yes	Regulated vegetation occurs in the south and northeast of the western Study area
Legally secured offset areas	Yes	Not shown in search results, however the Stage 2 and Rail Loop & Spur Offset Areas occur within the western Study area.

4.1.4. Matters of National Environmental Significance

The results of the MNES search are provided in Table 8. The search was undertaken using a 10km search radius from the study area. See Appendix 10 for the full report.

Table 8: Matters of National Environmental Significance search results

Category	Result	Description
World Heritage Properties	No	-
National Heritage Places	No	-
Wetlands of International Importance	No	-
Great Barrier Reef Marine Park	No	-
Commonwealth Marine Area	No	-
Listed TECs	2	One listed TEC is known to occur within the area and one is likely to occur within the area.
Listed Threatened Species	21	Species or species habitat known/likely/may occur within the area.
Listed Migratory Species	12	Migratory wetland, terrestrial and marine species or species habitat known/likely/may occur within the area

4.1.5. Groundwater Dependant Ecosystems

A GDE is one in which the plant and/or animal community is dependent on the availability of groundwater to maintain its structure and function. Desktop mapping of potential GDEs through-out QLD (BoM 2017a) indicates that areas of with possible high, moderate and low potential for groundwater interaction occur within the Project locality. The desktop GDE mapping (BoM, 2017a) indicates:

- Terrestrial vegetation associated with watercourses (Roper Creek) and a drainage line (Drainage Line 1) is mapped as having a high potential to be associated with subsurface presence of groundwater.
- Aquatic habitat associated with watercourses (Roper Creek) and a drainage line (Drainage Line 1) is mapped as having a moderate potential to be reliant on surface expression of groundwater.
- Terrestrial vegetation and aquatic habitat associated with palustrine wetlands outside of ML 70417 and ML 70379 is mapped as having a high potential to be associated with subsurface presence of groundwater.

All other terrestrial vegetation (REs mapped by DSITI, 2017), is broadly mapped as having a low to moderate potential of being associated with subsurface presence of groundwater (BoM, 2017a).

The accuracy of the desktop GDE mapping (BoM 2017a) of the Project locality has been reviewed by AGE (2018) and Biodiversity Australia, with the following conclusions made in relation to the presence/absence of GDEs based on detailed site surveys and assessments:

- The majority of the terrestrial vegetation associated with Roper Creek and Drainage Line 1 is unlikely to be dependent on groundwater given the vegetation along these drainage features also occurs more widely across the landscape and is not restricted to areas where it could potentially access groundwater. There are small areas of RE 11.3.25 along Roper Creek which contains Qld Blue Gum (*Eucalyptus tereticornis*) and River Oak (*Casuarina cunninghamiana*) which are sometimes reliant on access to groundwater, however, the groundwater levels adjacent to Roper Creek range between 18.9 m below ground level (mbgl) and 22.7 mbgl (AGE 2018). Based on the depth to groundwater surrounding Roper Creek being around 20 mbgl it is unlikely that these communities would be reliant on access to groundwater.
- Aquatic habitat associated with Roper Creek and Drainage Line 1 is unlikely to be dependent on groundwater given the ephemeral nature of the drainage features (Plates 1 and 2).
- Terrestrial vegetation and aquatic habitat associated with palustrine wetlands north of ML 70417 and ML 70379 could potentially be reliant on groundwater given the RE mapped in these areas by DSITI (2017). DSITI (2017) has mapped these areas as RE 11.3.27, which contains River Red Gum (*Eucalyptus camaldulensis*) and Queensland Blue Gum, both species that could be reliant on subsurface expression of groundwater to some degree. However, given groundwater levels in this area have been identified as being in excess of 12 mbgl, it is likely that these communities would have limited reliance on groundwater.
- All other terrestrial vegetation is unlikely to be dependent on groundwater given that there is no evidence that any vegetation surrounding the Project area has experienced any impacts (i.e. dieback) from the existing operations.

The database map report is provided in Appendix 11.

4.2. Flora Survey Results

4.2.1. Floristics

The study areas were found to have reasonable floristic diversity, however exotic grasses and herbs have outcompeted native species over large areas of the study area, which has led to changes in forest structure and composition.

A total of 174 flora species were recorded during the survey (Appendix 2). Nineteen of these were introduced species with the remainder being native. The highest flora diversity was found in remnant communities which had an intact ground layer. No threatened flora species were recorded during the surveys. The flora list for the study areas is provided in Appendix 2.

RE descriptions are provided in the following Section.

4.2.2. Regional Ecosystems

Vegetation surveys ground-truthed six distinct RE's on the western Study area and two on the eastern Study area. Minor changes to existing RE mapping by PB (2010) and DSITI (2017) were made by the field validation process described in Section 3.2.1, by refining RE boundaries and separating out mixed RE's.

A description of the ground-truthed REs in the study area are provided in Tables 9 to 14. The communities are named as per the *Regional Ecosystem Description Database V10.0* (DSITI 2016). The DSITI RE mapping is shown in Figure 13 and a field verified RE map has been produced and is shown in Figure 14.

Photos 6-11 following the description illustrate the vegetation within the study areas.

A flora list for the study areas is provided in Appendix 2.

Table 9: Regional Ecosystem 11.5.3 description

RE Type	11.5.3: *Eucalyptus populnea* ± *E. melanophloia* ± *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces.
Extent on Site	Occurs as a several patches and linear stands in the western study area. Covers most of the eastern study area. The total area across both study areas is 154 ha (Photo 6).
General Description	**a) Canopy** Structure and species: The canopy consists of an open layer of generally even aged mature trees ranging from 15-20 m in height. Poplar Box (*Eucalyptus populnea*) is the dominant species. Common to occasional canopy associates include Clarkson's Bloodwood (*Corymbia clarksoniana*), Reid River Box (*Eucalyptus brownii*), Moreton Bay Ash (*C. tessellaris*) and Ghost Gum (*C. dallachiana*). **b) Subcanopy** Structure and species: The subcanopy generally consists of an open to sparse tall shrub/small tree layer from 4-10 m in height dominated by Leichardt Bean (*Cassia brewsteri*), Quinine Tree (*Petalostigma pubescens*), Ironwood (*Acacia excelsa*), Native Willow (*Acacia salicina*) and False Sandalwood (*Eremophila mitchellii*). Other less common species in this layer include Silver Oak (*Grevillea parallela*), Dead Finish (*Archidendropsis basaltica*), Bootlace Oak (*Hakea lorea*) and Red Ash (*Alphitonia excelsa*). **c) Shrub layer** Structure and species: A low shrub layer to 0.5 m in height is occasionally present and consists of patches of Currant Bush (*Carissa ovata*) along with other species such as Stylo (*Stylosanthes scabra**), Dysentery Bush (*Grewia latifolia*), *Sida filiformis* and *Sida cordifolia*. **d) Groundcover** Structure and species: The groundcover ranges from dense to open with height usually ranging from 0.1-0.5 m in height. Introduced grasses such as Buffel Grass (*Cenchrus ciliaris**), Sabi Grass (*Urochloa mosambicensis**) and Red Natal Grass (*Melinis repens**) are the dominant species overall, however less disturbed areas also existed that feature an open groundcover of native grasses such as Kangaroo Grass (*Themeda australis*), Black Speargrass (*Heteropogon contortus*), Native Millet (Panicum decompositum), Queendland Bluegrass (*Dichanthium sericeum*), and Forest Bluegrass (*Bothriochloa blahdii*).
Condition	Good condition overall with most areas featuring an intact canopy and understorey. Grazing has impacted the ground layers however via trampling and spreading exotic grasses. Weed cover is moderate to high but limited to exotic grass infestations in the ground layer and occasional Prickly Pear (opuntia stricta). Large non-remnant areas of this community also occur in the study area. These areas feature a regenerating layer of canopy trees to approximately 8 m height and a groundcover dominated by exotic pasture grasses.
Conservation Status	'Least Concern' under VM Act and 'Not of Concern' Biodiversity Status.

* Exotic species.

Photo 6: RE 11.5.3

Table 10: Regional Ecosystem 11.3.2 description

RE Type	11.3.2: *Eucalyptus populnea* woodland on alluvial plains
Extent on Site	Occurs in in the south and central parts of the western study area on floodplains associated with Drainage Line 1 and 2. Total area is 43.5 ha (Photo 7).
General Description	**a) Canopy** *Structure and species:* The canopy comprises an open tree layer which is dominated by Poplar Box. Other canopy associates include Moreton Bay Ash and Clarkson's Bloodwood. Height ranges from 17-20 m. **b) Subcanopy** *Structure and species:* A low tree layer ranging from 12-15 m in height is occasionally present. This consists of young Poplar Box and Moreton Bay Ash. **c) Shrub layer** *Structure and species*: This community features an open to mid-dense tall shrub layer ranging from 5-8 m in height. Commonly recorded species in this layer include False Sandalwood, Leichardt Bean, *Melaleuca nervosa,* and Ironwood. A low shrub layer is occasionally present and range from 1-2 m in height. Species recorded in this layer include *Grewia latifolia,* Coffee Bush (*Breynia oblongifolia*) and Western Boobialla (*Myoporum montanum*). **d) Groundcover** *Structure and species:* In most situations the groundcover is dense, however is sometimes open and patchy. Height ranges from 0.05-0.5 m. Dominant species recorded in this layer include Buffel Grass, Sabi Grass, *Chrysopogon fallax*, Black Speargrass, *Sida cordifolia* and Yellow Buttons.
Condition	Good remnant condition overall, with most disturbance occurring in the ground layer as a result of cattle grazing.
Conservation Status	'Of concern' under VM Act and 'Of concern' Biodiversity Status.

Photo 7: RE 11.3.2

Table 11: Regional Ecosystem 11.3.2/11.3.4 description

RE Type	11.3.2/11.3.4: *Eucalyptus populnea* woodland on alluvial plains / *Eucalyptus tereticornis* and/or Eucalyptus spp. woodland on alluvial plains.
Extent on Site	A single patch occurs in the south-east of the site adjacent to Drainage Line 1. Area is 1.5 ha (Photo 8).
General Description	**a) Canopy** *Structure and species:* The canopy is relatively dense (approx. 45% cover) and ranges in height from 17-23 m. It is dominated by Qld Blue Gum (*Eucalyptus tereticornis)* and Moreton Bay Ash. Poplar Box is an uncommon canopy associate. **b) Subcanopy** *Structure and species: A low tree layer to13 m in height is present and consists of a mid-dense layer of Melaleuca nervosa.* **c) Shrub layer** *Structure and species: Limited to juvenile Melaleuca and occasional Leichardt Bean.* **d) Groundcover** *Structure and species: Comprises a dense groundcover (almost 100% cover) of grass. The dominant species is Green Panic (Panicum maximum) and Buffel Grass is also common. Occasional sedges including Dirty Dora (Cyperus difformis) are also present.*
Condition	Fair condition, however very few native species are present in the groundcover. The dense layer of grasses has also suppressed regeneration of native forbs and shrubs.
Conservation Status	'Of concern' under VM Act and 'Of concern' Biodiversity Status.

Photo 8: RE 11.3.2/11.3.4

Table 12: Regional Ecosystem 11.3.27d description

RE Type	11.3.27d: *Eucalyptus camaldulensis* and/or *E. tereticornis* woodland
Extent on Site	A small extent of this RE occurs in the northeast of the western study area and forms the edge of larger patch. Area on site is 1.9 ha (Photo 9).
General Description	**a) Canopy** *Structure and species:* The canopy comprises an open tree layer which is dominated by Qld Blue Gum and Moreton Bay Ash with occasional Poplar Box located around the edges. Height ranges from 18-25m. **b) Subcanopy** *Structure and species:* A sparse lower tree layer ranging from 10-15 m in height occurs throughout. This consists of young Qld Blue Gum. **c) Shrub layer** *Structure and species*: Absent. **d) Groundcover** *Structure and species:* A low layer of sedges, forbs and grasses is present, with density changing throughout the year depending on the season. During the May survey the groundcover was very dense and lush with standing water present, however was largely comprised of bare ground and dead grass during the September survey. Height ranges from 0.01-1 m. Common to dominant species include *Cyperus exaltatus*, Nardoo (*Marsilea hirsuta*), *Eleocharis sphacelata*, Water Snowflake (*Nymphoides indica*) and Clustered Lovegrass (*Eragrostis elongata*).
Condition	Very good condition with little evidence of disturbance. Feral pigs were noted to have rooted up large areas of groundcover during the September survey. No weeds recorded.
Conservation Status	'Least concern' under VM Act and 'Of concern' Biodiversity Status.

Photo 9: RE 11.3.27d

Table 13: Regional Ecosystem 11.3.1 description

RE Type	11.3.1: *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
Extent on Site	Occurs as several patches in the south of the western study area adjacent to Drainage Line 1. Total area is 15 ha (Photo 10).
General Description	**a) Canopy** *Structure and species:* Consists of a mid-dense tree layer ranging from 10-15 m in height. Brigalow (*Acacia harpophylla*) is the dominant species. Uncommon canopy associates include Dawson's Gum (*Eucalyptus cambageana*) and Emu Apple (*Owenia acidula*), Bauhinia (*Lysiphyllum caronii*) and Yellow Wood (*Terminalia oblongata*). **b) Subcanopy** *Structure and species:* A low tree/tall shrub layer to 6 m in height is often present. Common to occasional species in this layer include juvenile Brigalow, False Sandalwood, Sandalwood (*Santalum lanceolatum*) and Whitewood (*Atalaya hemiglauca*). **c) Shrub layer** *Structure and species*: A patchy shrub layer to 1 m in height is sometimes present. Consists of Currant Bush, Nepine (*Capparis lasiantha*) and Dysentery Bush. **d) Groundcover** *Structure and species:* Groundcover is generally open with large patches of leaf litter and bare ground present. Grasses and forbs are dominant, and very few weed species occur. Species recorded include a range of grasses including *Chloris divaricata, Paspalidium distans, Panicum effusum, Enteropogon ascicularis*; and forbs such as Ruby Saltbush (*Enchylaena tomentosa*), Common Joyweed (*Alternanthera nodiflora*), *Phyllanthus sp. and Cyperus gracilis.*
Condition	Generally in good remnant condition with few disturbances noted. Weeds are uncommon and limited to occasional Buffel Grass and Harissia Cactus. Patches of non-remnant Brigalow also occur near Drainage Line 1. These areas feature a dense layer of young Brigalow to 6m in height and a sparse shrub and groundcover.
Conservation Status	'Endangered' under VM Act and 'Endangered' Biodiversity Status. Also listed as Endangered under the EPBC Act.

Photo 10: RE 11.3.1

Table 14: Regional Ecosystem 11.4.9 description

RE Type	11.4.9: *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
Extent on Site	A small remnant patch occurs in the central west of the western study area. A small patch also occurs in the southwest of the eastern study area. Area totals 1.5 ha (Photo 11).
General Description	**a) Canopy** *Structure and species:* Consists of a mid-dense tree layer ranging from 10-17 m in height. Brigalow (*Acacia harpophylla*) is the only canopy species present. **b) Subcanopy** *Structure and species:* A low tree/tall shrub layer to 8 m in height occurs throughout. This layer consists of regenerating Brigalow, Scrub Leopardwood (*Flindersia dissosperma*), Lime Bush (*Citrus glauca*), False Sandalwood, Vine Tree (*Ventilago viminalis),* Whitewood and Emu Apple. **c) Shrub layer** *Structure and species*: A patchy shrub layer to 3 m in height is sometimes present. Largely consists of Currant Bush and Nepine. **d) Groundcover** *Structure and species:* Groundcover is generally open with large patches of leaf litter and bare ground present. Grasses and forbs are dominant, and very few weed species occur. Species recorded include a range of grasses including *Chloris divaricata, Cymbopogon refractus, Bothriochloa ewartiana, Paspalidium distans, Panicum effusum and Enteropogon ascicularis*. Sedges and forbs including *Cyperus gracilis*, Ruby Saltbush and Potato Bush (*Solanum ellipticum*).
Condition	Generally in good remnant condition with few disturbances noted. Weeds are uncommon and limited to occasional Buffel Grass and Harissia Cactus.
Conservation Status	'Endangered' under VM Act and 'Endangered' Biodiversity Status. Also listed as Endangered under the EPBC Act.

Photo 11: RE 11.4.9

Figure 13: Mapped Regional Ecosystems

Source: DSITI 2017

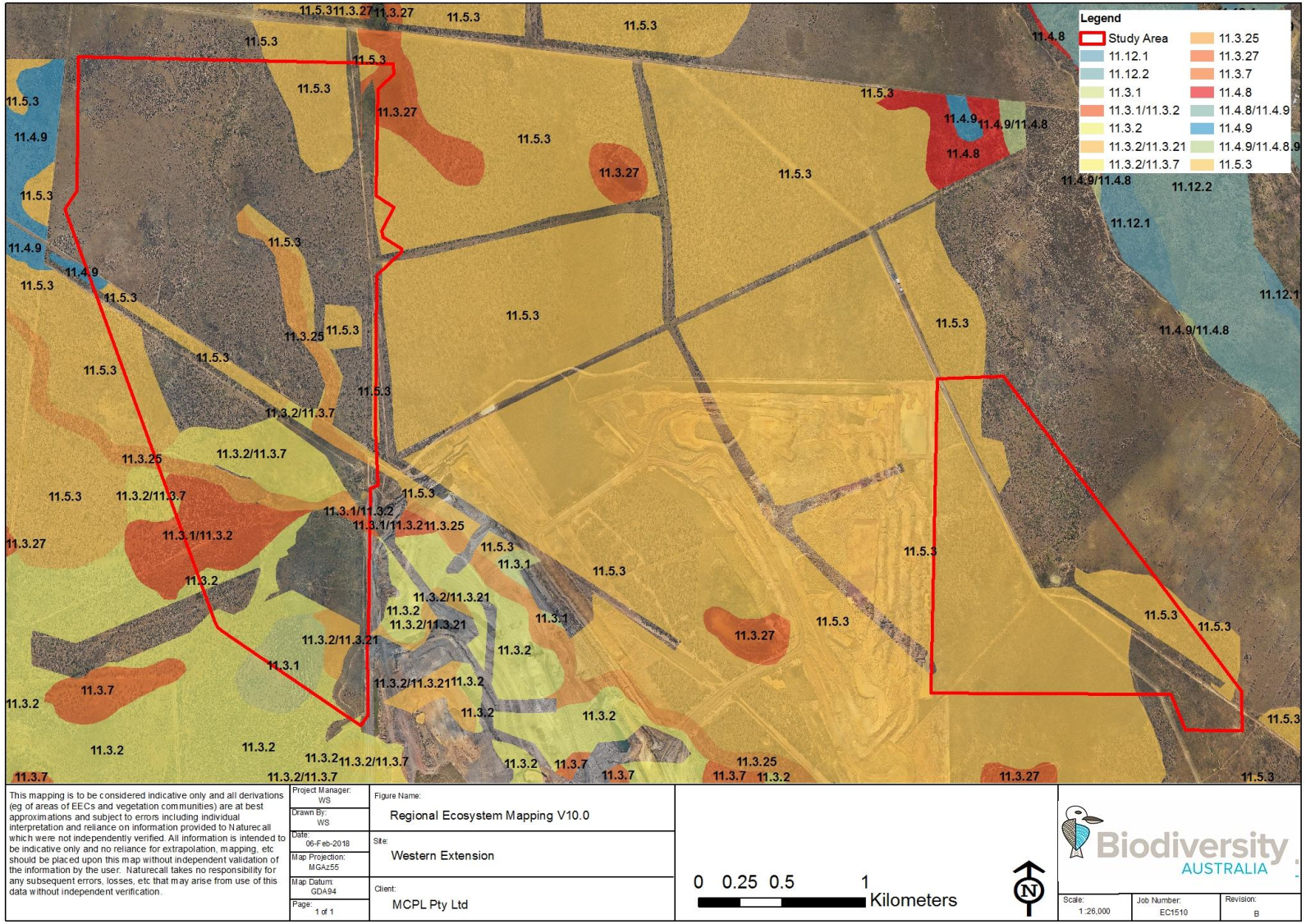
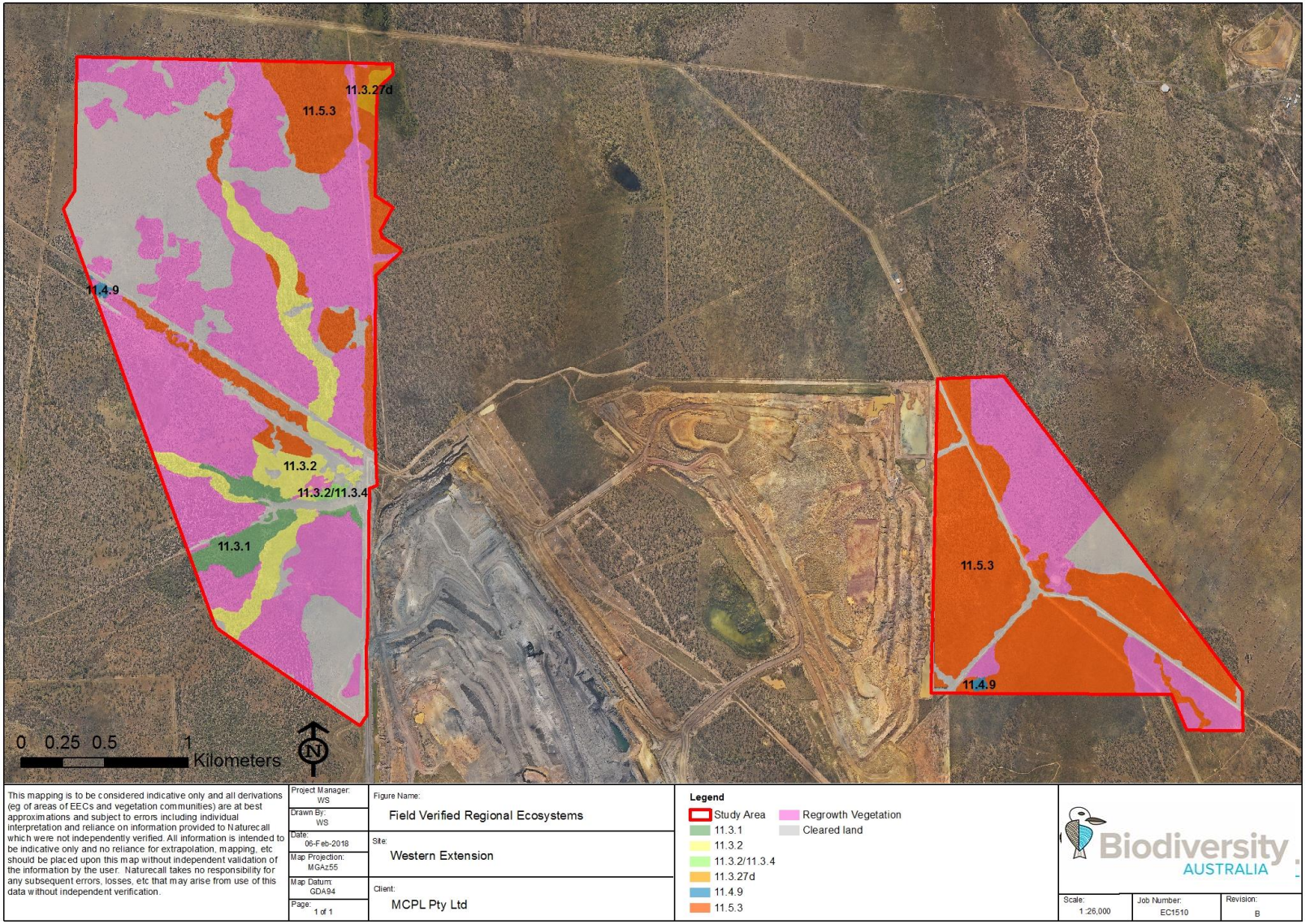


Figure 14: Field verified Regional Ecosystems



4.2.3. Endangered and Of Concern Regional Ecosystems

Four RE's listed as Endangered or Of Concern under the VM Act were recorded during the field surveys. The details of these are provided in Table 15. Figure 15 shows the location of these communities in the study areas. Section 4.2.2 provides a description of these communities.

All patches of Brigalow EEC in the Study areas were assessed to determine if they qualified as remnant vegetation using the criteria in Neldner et al. (2017).

Table 15: Endangered and Of Concern Regional Ecosystems recorded in the study area

Regional Ecosystem	Code	VMA Status	Area
Acacia harpophylla shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	11.4.9	Endangered	1.5 ha
Acacia harpophylla and/or *Casuarina cristata* open forest on alluvial plains	11.3.1	Endangered	15 ha
Eucalyptus populnea woodland on alluvial plains	11.3.2	Of concern	43.5 ha
Eucalyptus populnea woodland on alluvial plains / *Eucalyptus tereticornis* and/or Eucalyptus spp. woodland on alluvial plains	11.3.2/ 11.3.4	Of concern	1.5 ha

4.2.4. Threatened Ecological Communities

The Brigalow communities within the Study area have been assessed against the diagnostic and condition criteria listed in the approved conservation advice (DoE 2013) and the Species Profile and Threats Database (DEE, 2018). This is provided in Table 16:

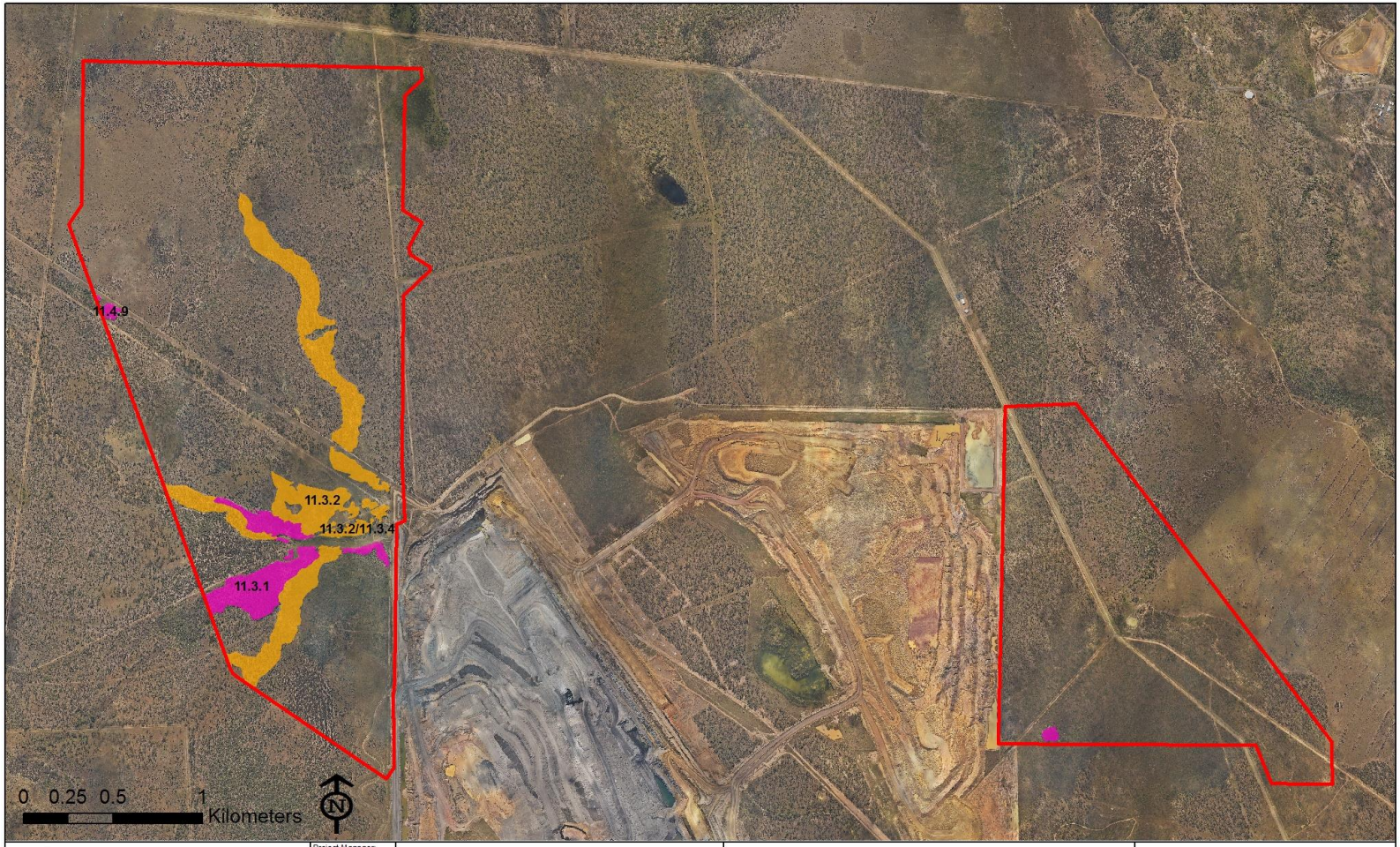
Table 16: Brigalow EEC assessment

Criteria	Result
1) The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch. *A. harpophylla* is either dominant in the tree layer, or co-dominant with other species (notably *Casuarina cristata*, other species of Acacia, or species of Eucalyptus).	Yes – Brigalow is dominant in the patches in the study area (see vegetation descriptions in Section 4.2.2 Table 13)
2a) In Qld - the patch is in one of the following Qld bioregions (including outliers) and it meets the description of one of 16 Qld REs determined at the time of the national listing of the Brigalow ecological community under the EPBC Act. The 16 REs are, as described by the Qld Herbarium (Wilson and Taylor 2013): In the Qld Brigalow Belt Bioregion – REs 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21.	Yes – Patches of Brigalow in the study area conform to 11.3.1 and 11.4.9.
2b) In NSW - the patch meets one of the following NSW Vegetation Classification and Assessment (VCA) community descriptions. The NSW VCA communities are: VCA IDs 29, 31 and 35; as described in Benson et al. (2006).	Not applicable

Criteria	Result
2c) The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Qld REs or NSW vegetation communities (although species density may be reduced). This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise.	Yes – All of the remnant patches and some non-remnant/regrowth patches of Brigalow meet this criteria. Some younger regrowth patches have been cleared within the last 15 years (determined through analysis is historic satellite imagery) and do not have typical structure and composition. These areas have been excluded.
3) The patch is 0.5 ha or more in size	Yes - Most patches of Brigalow in the study area are >0.5 ha in area. Some smaller patches did not meet the minimum size threshold and have been excluded.
4) Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.	Yes – exotic perennial plants comprised <50% cover in all Brigalow patches in the study area.
Result	All remnant and some non-remnant Brigalow communities in the study area qualify as Brigalow EEC.

The above assessment confirms that Brigalow communities in the Study areas qualify as the Brigalow EEC listed under the EPBC Act. The location of the TEC's in the Study areas is shown on Figure 16.

Figure 15: Endangered and Of Concern Regional Ecosystems



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	06-Feb-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Endangered and Of Concern Regional Ecosystems
Site:	Western Extension
Client:	MCPL Pty Ltd

Legend

Study Area

VMA Status

Endangered

Of Concern

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1 :26,000	EC1510	B

Figure 16: Threatened ecological communities

This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: WS
Drawn By: WS
Date: 24-Apr-2018
Map Projection: MGAz55
Map Datum: GDA94
Page: 1 of 1

Figure Name: Threatened Ecological Communities
Site: Western Extension
Client: MCPL Pty Ltd

Legend
Study Area
Acacia harpophylla (dominant and co-dominant) TEC
Remnant
Regrowth

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1:26,000	EC1510	C

4.2.5. Threatened Flora

No threatened flora species were recorded during the field surveys which were conducted over two separate survey periods to account for seasonal variations and detectability for threatened flora. There are no previous records of threatened flora species on either of the study areas. Neither study area occurs within a high risk trigger area (see report in Appendix 9).

Due to the disturbance history over most of the study areas (e.g. grazing, weed invasion), lack of local records and limited habitat types present, the potential for threatened flora to occur would be significantly reduced and no threatened flora species are considered potential occurrences.

4.2.6. Declared Weeds

As detailed in Section 4.2.1, a total of 19 exotic flora species were recorded within the study areas. Weed invasion is common throughout the study areas, especially in disturbed areas, however it is largely limited to the groundcover stratum. Naturalised introduced pasture species such as Buffel Grass (*Cenchrus ciliaris*), Sabi Grass (*Urochloa mosambicensis*) and Red Natal Grass (*Melinis repens*) along with herbs including *Sida spp*.. Cobblers Pegs (*Bidens pilosa*), Gomphrena Weed (*Gomphrena celosioides*) and Stylo (*Stylosanthes scabra*) were the main weeds encountered. These species dominated the ground layer in the derived grassland habitats, and incursion of these species into adjacent eucalypt woodlands was common.

Table 17 lists the noxious weeds declared under the *Biosecurity Act 2014* recorded within the study area. Prickly Pear (*Opuntia elata.*) and Harrisia Cactus (*Harissa martini*) were recorded. The distribution of these species was patchy and these species are unlikely to pose a significant risk to the ecological integrity of the study areas due to their low density.

Table 17: Noxious Weeds Recorded Within the study Area

Scientific Name	Common name	Biosecurity Act Category	Weed of National Significance	Abundance
Opuntia elata	Prickly Pear	Class 2,3,4,5	Yes	Low
Opuntia tomentosa	Velvety Tree Pear	Class 3	Yes	Low
Harrisia martini	Harrisia Cactus	Class 3	No	Low

4.3. Fauna Survey Results

4.3.1. Broad Fauna Habitats

Fauna habitats within the study area were categorised and mapped into four broad habitat types using the same classifications as PB (2010). The broad fauna habitat types present in the study area are:

- Eucalypt woodland/forest.
- Wetlands.
- *Acacia harpophylla* woodland/forest.
- Regrowth/derived grassland.

Table 18 details the REs which make up each broad fauna habitat type along with the area (in ha) of each.

Table 18: Broad Fauna Habitat Types

Broad Fauna Habitat Type	Regional Ecosystem	Field Verified Area (ha)
Eucalypt Woodland	11.3.2	43.5
	11.3.2/11.3.4	1.5
	11.5.3	154
Subtotal (Eucalypt Woodland)		199
Wetlands	11.3.27d	1.9
***Acacia harpophylla* woodland/forest**	11.3.1	15
	11.4.9	1.5
Subtotal (*Acacia harpophylla* woodland/forest)		18.4
Regrowth/derived grassland	-	249.5
Total		**467***

* Rounded number.

Table 19 describes the habitat values per category, with focus on habitat value and suitability for foraging, nesting, roosting, and breeding requirements for potentially occurring threatened species listed under the NC Act and EPBC Act. Selected habitat features located within the study areas are shown in Photos 12 and 13.

Table 19: Fauna habitat assessment

Habitat Attribute/ Category	Site Values			
	1. Eucalypt Woodland	2. Wetland habitat	3. *Acacia harpophylla* woodland/forest	4. Regrowth/derived grassland
Groundcover	Variable density and composition depending on disturbance history e.g. rotational grazing regime. Some areas feature a moderately dense cover of exotic grasses while some are more open and dominated by native grasses and shrubs. A number of native grass species provide a potential food resource for the Squatter Pigeon. Some areas also have a mosaic of open sandy areas and native grasses which is preferred habitat for this species.	Generally a good cover of native grasses, sedges and herbs. Aquatic species present during wet season.	Sparse to open ground cover of mostly native grasses, with areas of bare ground. Provides potential shelter and prey habitat for threatened reptiles.	Dominant ground cover composition of exotic grasses with native grasses and herbs being less common. Areas with a higher percentage of native grass species would provide food resources for the Squatter Pigeon. Squatter Pigeon recorded along a roadside on the eastern study area.
Leaf Litter	High under canopy trees, and scattered throughout the mixed grass undergrowth.	Generally thin leaf litter throughout due to open canopy.	Mature Brigalow habitats contained dense accumulations of leaf litter which would provide shelter and prey habitat for a range of small reptiles.	Sparse leaf litter.
Logs and Debris	Reasonable abundance of hollow logs and debris present due to the nature of Eucalyptus shedding limbs. Larger logs provide shelter and prey habitat for ground dwelling reptiles (Photo 12).	Some accumulations of coarse woody debris and logs under canopy trees. Marginal potential habitat values for threatened fauna overall.	High density of coarse woody debris, which is typical of this habitat type. Could provide potential shelter and prey habitat for the Ornamental Snake. Hollow logs are however rare.	Very few logs observed. Some log and debris piles as a result of past clearing occur.
Rocky outcrops	Only some small to medium surface rock present. No values to threatened species.	Absent	Absent	Absent
Aquatic habitat	Aquatic habitats in this habitat type are largely limited to small ephemeral creeks and soaks that would only hold water for short periods.	The wetland in the northeast comprises ephemeral aquatic habitat and contained water during the May survey. This would provide seasonal water sources for the Squatter Pigeon (southern).	Brigalow habitats contain gilgai that hold water during the wet season and provide habitat for amphibians. Water was present in gilgai during the May survey.	A few farm dams were located within non-remnant areas. One dam on the unnamed drainage line in the western study area contained established aquatic vegetation, while others were devoid of aquatic vegetation. Dams on site attracted a range of wetland birds and provided permanent water sources for a range of fauna including the Squatter Pigeon (southern).

Habitat Attribute/ Category	Site Values			
	1. Eucalypt Woodland	2. Wetland habitat	3. *Acacia harpophylla* woodland/forest	4. Regrowth/derived grassland
Hollows	Hollow-bearing trees and stags are common within this habitat type (Photo 13). A range of hollow-sizes are present i.e. <5 cm to >20 cm diameter cavities. Hollows provide nesting/denning/roosting habitat for a number of threatened fauna species such as the Corben's Long-eared bat and Greater Glider.	Hollow-bearing trees were generally uncommon in this habitat type and would largely be occupied by common birds such as Galahs and Lorikeets.	Low occurrence of tree hollows in occasional eucalyptus species present. Hollows that are present would provide potential roosting habitat for threatened bat species such as the South-eastern Long-eared Bat.	No live hollow bearing trees present due to previous clearing history. Occasional stags present which do contain small to medium hollows.
Nectar sources	Woodland habitats contain a range of nectar producing species e.g. eucalypts, acacias and grevilleas. Some Poplar Box were in flower during the survey. A range of shrubs and small trees were in flower during the September survey.	Nectar sources in riparian habitats include eucalypts and Melaleucas, some of which were flowering during the survey.	*Acacia harpophylla* is the primary nectar source and would provide foraging resources for fauna when in flower.	This habitat type does not provide a significant nectar source due to the lack of mature trees.
Koala food trees	Moreton Bay Ash, Reid River Box and Poplar Box are the main Koala browse species in this community (DofE 2014). Koala scats were recorded in this habitat type.	This community is dominated by Qld Blue Gum which is a preferred browse species for Koalas.	*Eucalyptus cambageana* is located within this habitat type and, although a less common food source for the Koala, meets the definition of a Koala food tree (DofE 2014).	Absent aside from occasional areas of regrowth *Eucalypts* and *Corymbia spp*.
Connectivity values	On the western study area, woodland communities are patchy and fragmented and do not provide strong connectivity across the site. Highly mobile species would easily move through this habitat type. Woodland is more contiguous on the eastern study area and provides connectivity, however is fragmented by several roads and fencelines. This habitat type would benefit the local movements of a range of fauna species, including arboreal species such as the Koala.	Only minor connectivity values.	The small patches of Brigalow habitats would contribute to the connectivity values of the other site habitats, however it is generally isolated, and would not provide any specific connectivity values for fauna.	Continued regeneration of non-remnant areas over time would help re-establish linkages for flora and fauna across the site and broader landscape.

Photo 12: Large hollow log in woodland

Photo 13: Large hollow-bearing tree in woodland

4.3.2. Aquatic Habitat Assessment

Aquatic habitat assessments were undertaken at the ephemeral drainage lines in the study area during the survey. This found that the ephemeral drainage lines were in a similar condition as was reported in FRC (2010) (see summary in Section 2.6.4). Given that there has been little change in the physical attributes of the drainage features in the study area, the conclusions of the FRC 2010 report remain valid and as such, the aquatic habitat on site would not be considered to be capable of supporting any threatened aquatic species.

During the May survey period, the drainage line contained standing water as shown in Photo 14. Brigalow habitats containing gilgai also contained standing water which provided habitat for a range of frog species (Photo 15).

All of the drainage lines in the study area were found to be dry during the September survey period as shown in Photo 16.

Some evidence of fish and aquatic invertebrates were found in the dry creek lines. These included Eel-tailed Catfish, Spangled Perch, Inland Freshwater Crab (Photo 17) and Freshwater Mussels.

Photo 14: Water in Drainage Line 1

Photo 17: Inland Freshwater Crab

Photo 15: Gilgai wetland in Brigalow

Photo 16: Drainage line 2 during the September survey

4.3.3. Field Survey Results

4.3.3.1. Observed and Detected Fauna

A total of 119 fauna species were detected during the survey either opportunistically or during specific survey methods. A list of fauna species detected is provided in Section 4.4 Appendix 3. Birds were the most common fauna group observed with a total of 68 species detected. Twenty nine mammals, 12 amphibians, eight reptiles and two fish were also detected. Photos 18-23 were taken during the surveys of the study areas.

The threatened species recorded during the surveys are discussed in Section 4.3.6.

Pest species comprising the wild pig, wild dog, feral cat, fox and rabbit were commonly detected in the study areas, mostly via numerous tracks along the sandy roads surrounding the site. Several feral cats were also observed during spotlighting.

Appendix 3 provides the total fauna list for the study area and the method of detection. Photographs of some of the species recorded are provided below and in Appendix 4.

Photo 15: Greater Glider near Drainage Line 1

Photo 16: Pair of Squatter Pigeons (southern) at the eastern study area

Photo 17: Jacky Lizard

Photo 18: Short-footed Frog

Photo 19: Gould's Long-eared Bat

Photo 20: Gould's Wattled Bat

4.3.4. Success and Limitations of Methodology

As evident in the survey results, a broad range of fauna species were detected during the survey, and the methods used are considered effective for detecting a range of threatened species in the region during the two seasonal surveys undertaken. Methods used were consistent with those recommended by DES and DEE (Section 3), and effort was consistent with or exceeding the specified minimum.

Surveys were undertaken in two different seasons to account for variations in fauna usage and availability of foraging resources. The heavy rainfall that preceded the first survey allowed detection of a range of amphibian and waterbird species. Although there were drier conditions in the September survey, the warmer temperatures were likely to have resulted in increased fauna activity, particularly arboreal mammals and microbats.

4.3.5. Assessment of Site Ecology

4.3.5.1. Fauna Assemblages

The fauna detected on the site generally consisted of common, generalist and wide ranging species capable of persisting in modified habitats. Native mammals were reasonably well represented in the survey results, especially microbats. A total of 14 microbat species were positively identified through the anabat analysis and four species were captured in the harp traps. The diverse range of habitats would provide a good foraging base and numerous hollows present in the Study area would provide a range of roosting and breeding opportunities for these species.

Only three arboreal mammals were detected and this is most likely to be a reflection of the extent of local fragmentation which may prevent some species from accessing the Study area and presence of feral predators such as the fox, feral cat and wild dog.

Bird diversity was high with a relatively diverse range of passerines detected across the Study area. Several raptor species were also detected which indicates the Study area has a reasonable prey base. The results are considered an indication of the range of foraging resources present (e.g. flowering canopy and understorey trees, fruiting species); and good understorey development in places providing shelter.

Ideal conditions for amphibian surveys were experienced in the May survey and numerous frog species were detected at this time. Very few amphibians were detected during the September survey which is a result of the dry conditions at this time. Amphibians would provide a good prey base for snakes.

Reptiles were poorly represented in the survey results considering the above average survey effort employed. This is likely to be an indication of the level of local habitat loss and fragmentation which may have historically excluded some species and lack of a habitat components such as rock outcrops and cracking clays (Wilson 2003). The presence of Cane Toads and other feral species (Cats, dogs foxes) is likely to have heavily impacted on reptile abundance. The limited detectability of many reptile species may also be a contributing factor (Wilson 2003).

4.3.5.2. Local Corridors and Habitat Linkages

Large areas of remnant vegetation occur in Junee National Park about 30km east of the site, however no vegetative link exists to here from the site due to fragmentation by cleared grazing land.

Remnant vegetation in the study area can be seen to be loosely connected to Bundoora State Forest, approxaimtely 15 km to the south-west. Some remnant vegetation fringing Drainage Line 1 adjoins the west of the Study area, and this would allow for movement of less mobile terrestrial fauna (e.g. amphibians, rodents, reptiles) or 'gap-shy' species. Most other adjoining vegetation comprises modified/regrowth habitats which would only be used by highly mobile fauna. Species such as the Koala and Greater Glider would be unlikely to move across these modified landscapes.

Regeneration of vegetation in the MCPL offset area to the west of the study areas will help improve connectivity between remnant habitats in the area.

4.3.6. Threatened Fauna Species

Three listed threatened fauna species were recorded during the field surveys. These are discussed in the following sections. Figure 17 shows the location of the recorded threatened fauna.

4.3.6.1. Ornamental Snake

Limited potential habitat for this species exists within the Project area, comprising a 0.5 ha patch of RE 11.4.9 (Brigalow) on the edge of the approved mine footprint and approximately 15 ha of RE 11.3.1 (Brigalow) in three patches (i.e. a total of approximately 15.5 ha in four patches).

The Species Profile and Threats Database (DEE, 2019) recognises RE 11.4.9 (Brigalow on gilgai soils) as habitat for this species but does not list RE 11.3.1 (Brigalow on alluvial soils). Given the Ornamental Snake was previously recorded in RE 11.3.1 (Brigalow) elsewhere in the mine site (Parsons Brinkerhoff, 2010a) and it provides suitable microhabitat for the species (e.g. woody debris, ground litter and gilgai), this RE is considered to provide potential habitat.

As shown in Figure 9 some of this habitat occurs along an ephemeral drainage line, which at times would provide preferred habitat for this species (i.e. habitat within, or close to, habitat that is favoured by its prey – frogs [DEE, 2019]). It is noted, however, that the Species Profile and Threats Database (DEE, 2019) states that: 'the species presumed preference for riparian areas is questionable.'

It is noted that this species often use gilgai or cracking soils on cleared land, however, the regrowth Brigalow TEC in the Project area (6.5 ha) does not provide habitat for the Ornamental Snake as it does not have gilgai or sufficient microhabitat requirements (e.g. fallen timber) for shelter and prey species. It is also located further away from the seasonal drainage line.

There is no preferred habitat within the Project area.

All of the potential habitat in the Project area (described above) is suitable habitat for this species.

No suitable habitat in the Project area is considered important as defined by the EPBC Act Draft Referral Guidelines for the Nationally listed Brigalow Belt Reptiles (DSEWPaC 2011c) as:

- The species has not been recorded in the habitat in the Project area, despite targeted surveys;
- The Project area is not near the limit of the species' known range (after DSEWPaC 2011c);
- The Project area does not contain large patches of contiguous, suitable habitat and viable landscape corridors as the habitat is instead small and fragmented (Figure 9); and/or
- The Project area does not contain a unique habitat type containing known records of the species.

4.3.6.2. Greater Glider

The Greater Glider occurs in forests and woodlands across eastern Australia where it forages on eucalypt leaves and occasionally flowers (Threatened Species Scientific Committee) [TSSC] 2016). It requires large tracks of remnant forests which contain old growth trees containing hollows which it uses for denning.

The Greater Glider was recorded on numerous occasions during spotlighting (Figure 16). This species is locally common and has also been recorded on numerous occasions within the wider locality (Naturecall, 2014; Parsons Brinkerhoff, 2010a).

Approximately 175 ha of known and potential habitat for the Greater Glider occurs in the Project area represented by all Eucalypt forests and woodlands present as these contain trees with hollows suitable for denning. Hollow-bearing trees and stags are common and a range of hollow-sizes are present i.e. <5 cm to >20 cm diameter cavities.

In the Project area, the Greater Glider was recorded within Poplar Box Woodland (RE 11.5.3 and RE 11.3.2). Previous observations of this species on MCPL owned-land have noted that it prefers Eucalypt woodlands and open forest associated with major creeks (which do not occur in the Project area) and drainage lines, equivalent to RE types 11.3.25, 11.3.2, 11.3.4 and 11.3.7. It has also been occasionally noted in Poplar Box woodland equivalent to RE 11.5.3. Based on these previous observations, preferred forage species appear to be Moreton Bay Ash (E. tessellaris), Silver-leaved Ironbark (E. melanophloia) and Poplar Box.

4.3.6.3. Koala

The Koala is an obligate folivore that predominantly feeds on leaves from Eucalyptus trees (DEE, 2017c). Koalas feed on a wide range of eucalypt species, however they have a small number of preferred food trees. These preferred tree species vary depending on location. A review of available literature and information from previous surveys within MCPL lands (see Section 3.1) have found that the following trees are preferred species in the area:

- Queensland Blue Gum (*Eucalyptus tereticornis*).

- Queensland Peppermint (*Eucalyptus exserta*).
- Moreton Bay Ash (*Corymbia tessilaris*).
- Narrow-leaved Ironbark (*Eucalyptus crebra*).
- Reid River Box (*Eucalyptus brownii*).

Queensland Blue Gum are scarce over the Study area and generally only occur in the wetland in the northeast of the western study area (RE 11.3.27d) and occasionally along drainage lines (RE 11.3.2). Moreton Bay Ash is occasionally present throughout Poplar Box woodland communities comprising RE 11.5.3 and more so RE 11.3.2. Reid River Box was an uncommon occurrence in RE 11.5.3.

Queensland Peppermint and Narrow-leaved Ironbark were not detected within the Study area, however are found on MCPL owned land further south in RE 11.5.9 and 11.7.2.

No Koalas were observed or heard calling during the survey despite targeted surveys. The five Koala SAT surveys undertaken also did not find Koala scats. Opportunistic scat searches did however detect Koala scats at the eastern study area in Poplar Box woodland under a Reid River Box. The age of the scats from visual identifiers was estimated at 3 months old. The scats were confirmed by scat analysis expert Luke Forster (Trace Ecology).

Individual Koalas, and Koala scats have been previously recorded in MCPL owned land. In 2012, EHP recorded an individual Koala in the south of the Stage 2 Offset Area and Biodiversity Australia recorded an individual adjacent to Parrot Quarry Road in 2014 (Naturecall 2014a). The record during the most recent survey is the first confirmed record of the Koala in the eastern part of MCPL lands. It is not known if the study area is part of the habitat for a resident Koala population or that the individual recorded via scats was merely a transient Koala moving through the area.

Given the survey results and sparse records in the area (despite numerous past surveys and ongoing offset monitoring/management), it appears that a very low density Koala population is present on MCPL lands and surrounds. Given the general low nutrient soils and scarcity of preferred foraging trees, Koala home ranges would be very large.

A large portion of the REs mapped within the study areas would provide potential foraging habitat for the Koala based on the occurrence of potential Koala food trees including preferred species described above (i.e. Blue Gum, Reid River Box and Moreton Bay Ash). This includes RE 11.3.2, RE 11.5.3, and RE 11.3.27d, equating to approximately 198ha of potential Koala habitat across both study areas. These areas would provide beneficial movement corridors (i.e. connectivity) for the Koala throughout the landscape, particularly areas of contiguous habitat and riparian corridors.

4.3.6.4. Squatter Pigeon (southern)

The Squatter Pigeon (southern) was recorded in the Project area by Naturcall (2017, 2014) and Parsons Brinkerhoff (2010a).

Habitat for the Squatter Pigeon (southern) in the Project area is considered to comprises all remnant and regrowth habitat with a suitable groundcover.

The Project area contains approximately 388.5 ha of potential habitat for the Squatter Pigeon (southern), comprising approximately 190.5 ha of woodland and 198 ha of vegetation in the early stage of regrowing from past clearance.

The habitat in the Project area is within 1 km of seasonal waterbodies (ephemeral unnamed drainage lines) and therefore all of the potential habitat mapped on Figure 11 is considered to be potentially used for breeding. Noting, however, this species has not been observed breeding in the Project area.

Some areas of vegetation in the early stage of regrowing from past clearance (approximately 198 ha) has been identified as suitable breeding habitat for the Squatter Pigeon (southern). These areas contain a high percentage of native grass species that would provide food resources for the Squatter Pigeon (southern).

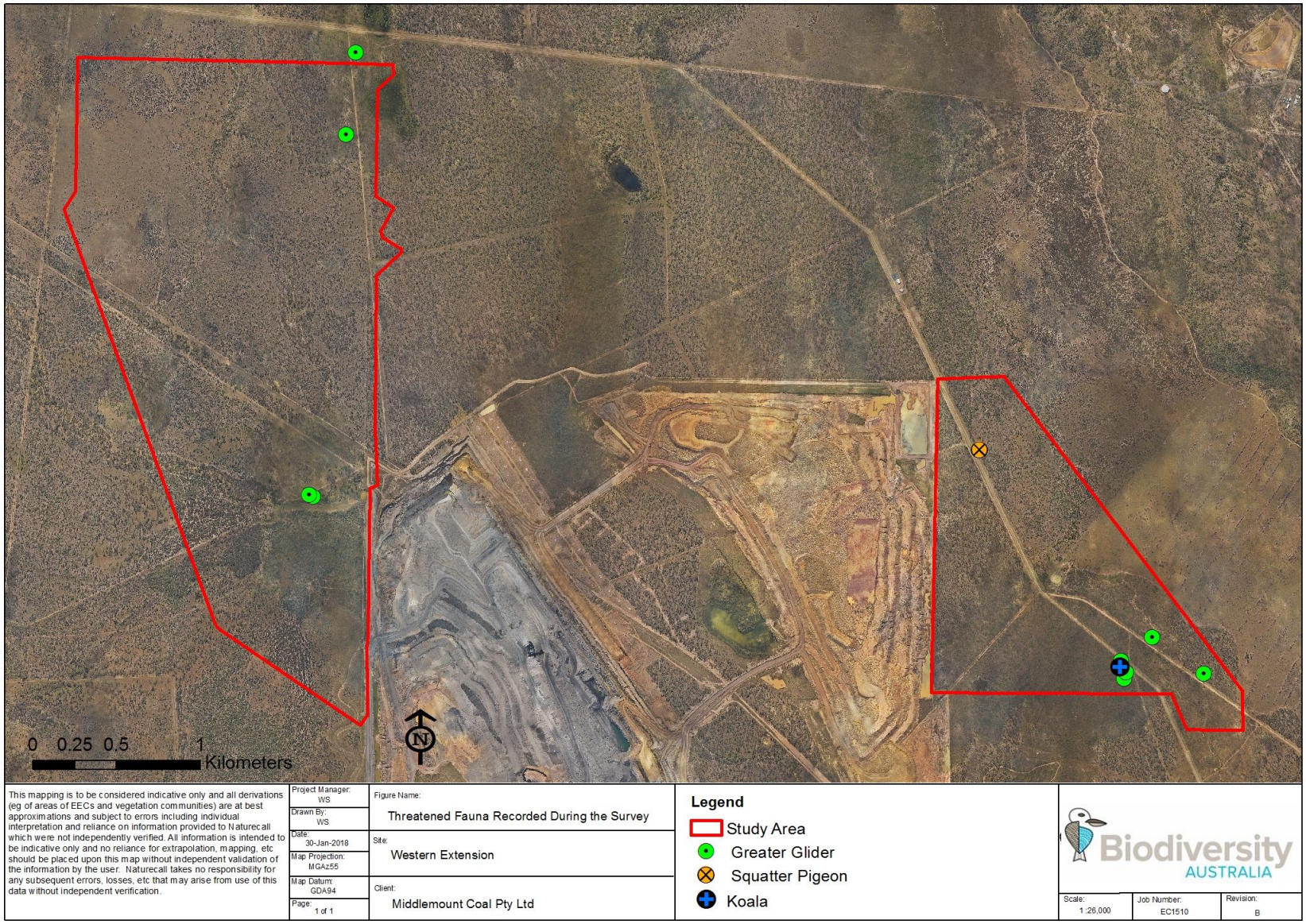
The remaining portion of the vegetation in the early stage of regrowing from past clearance (approximately 51.5 ha) is not considered potential habitat for this species because the dominant ground cover composition is exotic grasses with native grasses and herbs being less common.

The breeding habitat described above would also provide foraging resources and dispersal habitat for this species.

There are no additional areas of forest or woodland which would specifically aid the dispersal of the Squatter Pigeon (southern).

There are very small areas of cleared land between patches of habitat (less than 100 m apart). These largely comprise of cleared tracks and a pipeline easement. Hence, these areas are not considered ‘dispersal habitat’ for the species.

Figure 17: Location of recorded threatened species



4.4. Matters of State Environmental Significance

Table 20 defines the MSES that are relevant to the project. Figures showing the location of the matters in the study areas are provided within the table.

Table 20: Matters and State Environmental Significance

Prescribed Environmental Matter	Location of Impact	Maximum Extent of Impact
Regulated Vegetation		
RE 11.4.9 *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	Figure 18	0.5 ha
RE 11.3.1 *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Figure 18	15 ha
RE 11.3.2 *Eucalyptus populnea* woodland on alluvial plains	Figure 18	43.5 ha
RE 11.3.2/RE 11.3.4 *Eucalyptus populnea* woodland on alluvial plains / *Eucalyptus tereticornis* and/or Eucalyptus spp. woodland on alluvial plains	Figure 18	1.5 ha
Regional ecosystems (not within an urban area) that intersect a wetland on the vegetation management wetlands map RE11.3.27d	Figure 19	1.9 ha
Connectivity areas		
Connectivity area that is a regional ecosystem (not in urban area) The study area contains remnant vegetation that forms part of a corridor mapped as being of State biodiversity significance.	Figure 14	190.5 ha
Wetlands and watercourses		
A wetland of high ecological significance (HES) shown on the Map of referable wetlands	Figure 19	0.75 ha
Protected wildlife habitat		
Habitat for an animal that is vulnerable wildlife Ornamental Snake Greater Glider Koala Squatter Pigeon (southern)	Figure 21a Figure 21b Figure 21c	15.5 ha 175 ha 175 ha 388.5
Habitat for an animal that is Special Least Concern wildlife – Echidna		190.5 ha
Legally secured offset area		
Two legally secured offset areas are located within the western study area. These comprise of the: Stage 2 Offset Area Rail Loop and Spur Offset Area	Figure 20	32 ha 22 ha

4.4.1. Regulated Vegetation

Regulated vegetation mapped on the study area includes Endangered and Of Concern REs. These comprises RE's 11.3.1, 11.3.2, 11.3.2/11.3.4 and 11.4.9. Vegetation within 50 m of the banks of the wetland in the northeast of the western study area are also mapped as regulated vegetation.

This is shown in Figure 18.

4.4.2. Connectivity Areas

The landscape fragmentation and connectivity tool (DEHP, 2016) has been applied to the Project. The results are provided in Section 7.2.

4.4.3. Wetlands and Watercourses

The palustrine wetland in the northeast of the western study area is identified as a HES wetland. The location of this wetland is shown in Figure 19. Section 4.2.2 provides a floristic description of the wetland.

There are no watercourses defined under the *Water Management Act 2000* within the study area and no watercourses are mapped as high ecological value waters.

4.4.4. Protected Wildlife Habitat

The field surveys identified three species which are listed threatened species in Qld under the NC Act and qualify as MSES. These are the Squatter Pigeon, Greater Glider and Koala. The Echidna was also recorded which is a Special Least Concern species. These species are subject to the Significant Residual Impact Test in Section 7.

Based on local records and presence of suitable habitat on the site, two additional threatened fauna species listed under the NC Act are also considered potential occurrences, as shown in Table 21. The potential for these species to occur on the site is also reviewed in Appendix 1. These species are subject to the Significant Residual Impact Test in Section 7.

Table 21: Potentially occurring threatened species under the NC Act

Group	Species	Listing Status		Occurrence Likelihood
		NC Act	EPBC Act	
Reptiles	Ornamental Snake (*Denisonia maculata*)	V	V	Low chance of occurrence given disturbance history and lack of preferred habitat.
Birds	Powerful Owl (*Ninox strenua*)	V	-	Low chance of occurrence using study area as part of home range.

4.4.5. Legally Secured Offset Areas

Two legally secured offset areas are partly located within the western study area. These comprise the Stage 2 Offset Area and Rail Loop and Spur Offset Area secured via a Volunatary Declaration under the VM Act (Declared Area Map 2013/003919). Figure 20 shows the location of these offset areas relative to the study area.

4.4.6. Fish Habitat Areas and Waterway Providing for Fish Passage

No Fish Habitat Areas or waterways providing fish passage are declared in the study area.

Figure 18: Regulated vegetation

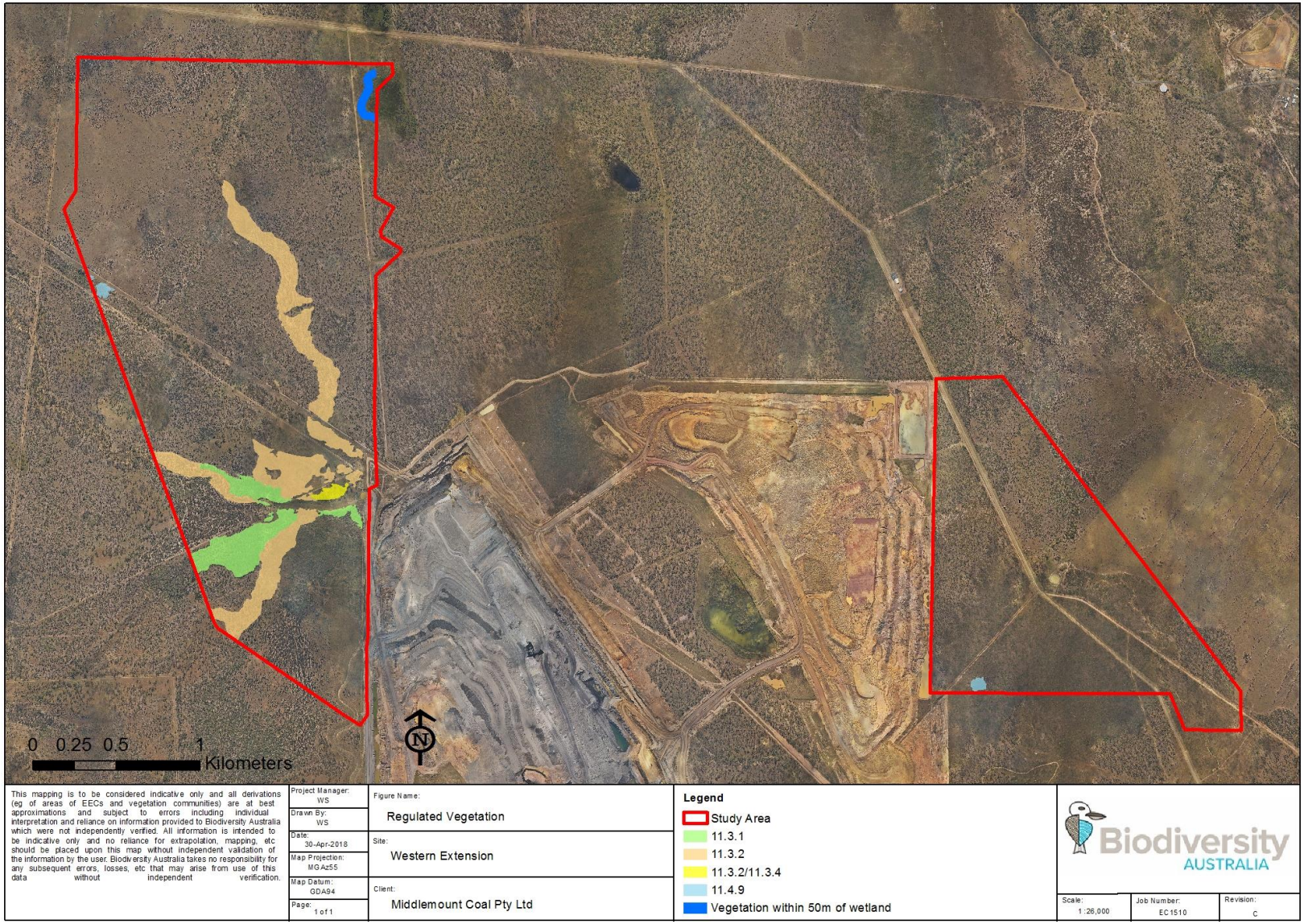


Figure 19: High ecological significance wetlands

This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Biodiversity Australia which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Biodiversity Australia takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: WS
Drawn By: WS
Date: 30-Apr-2018
Map Projection: MGAz55
Map Datum: GDA94
Page: 1 of 1

Figure Name: MSES High ecological significance wetlands
Site: Western Extension
Client: Middlemount Coal Pty Ltd

Legend
- Study Area
- MSES High ecological significance wetland

Biodiversity AUSTRALIA

Scale: 1 :26,000
Job Number: EC1510
Revision: C

Figure 20: Legally secured offset areas

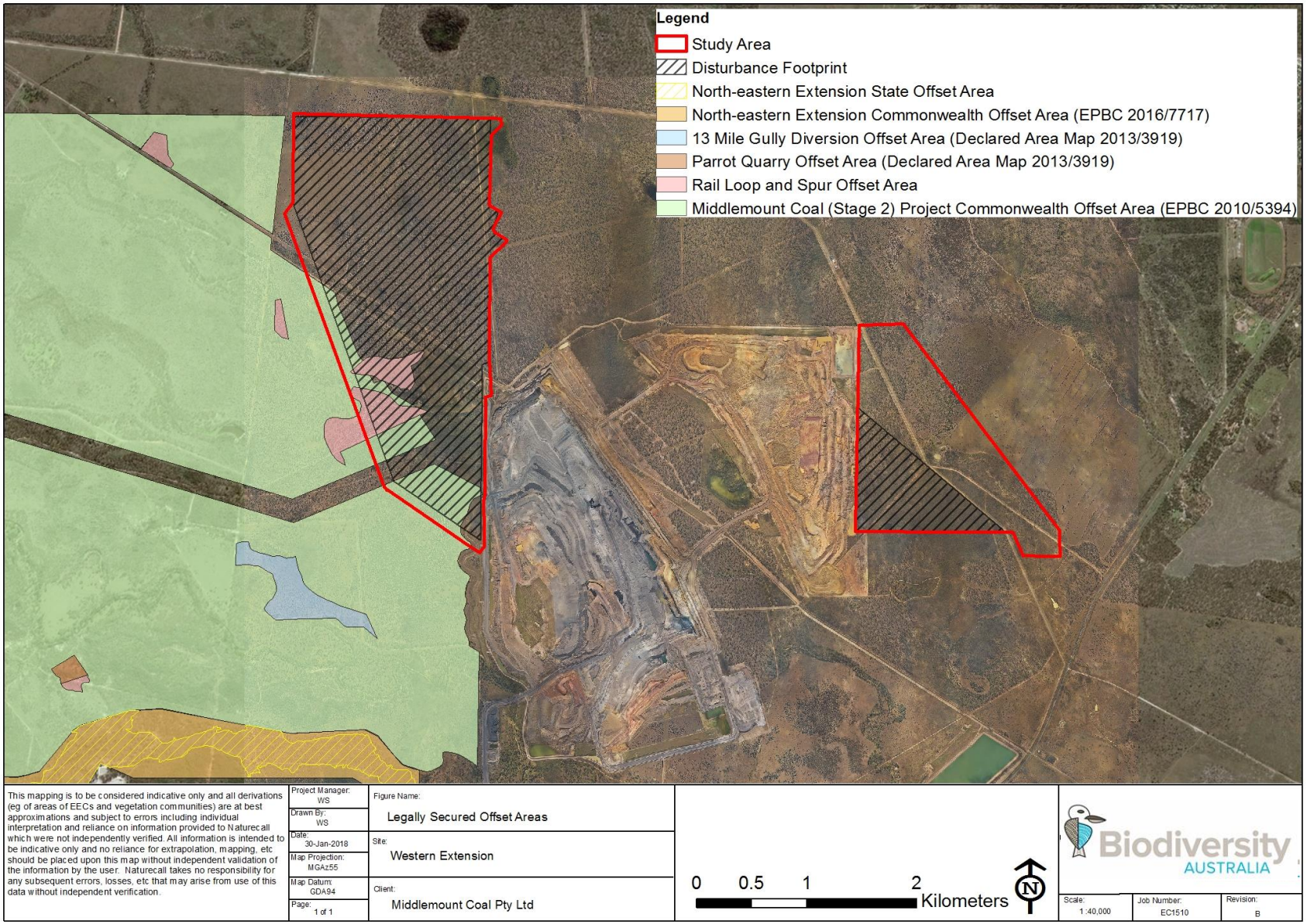


Figure 21a: Protected wildlife habitat – Ornamental Snake

This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	30-Jan-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1

Figure Name: Extent of Ornamental Snake Habitat in the Study Area

Site: Western Extension

Client: Middlemount Coal Pty Ltd

Legend

- Study Area
- Disturbance Footprint
- Ornamental Snake Habitat

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Scale:	Job Number:	Revision:
1:26,000	EC1510	A

Figure 21b: Protected wildlife habitat – Greater Glider

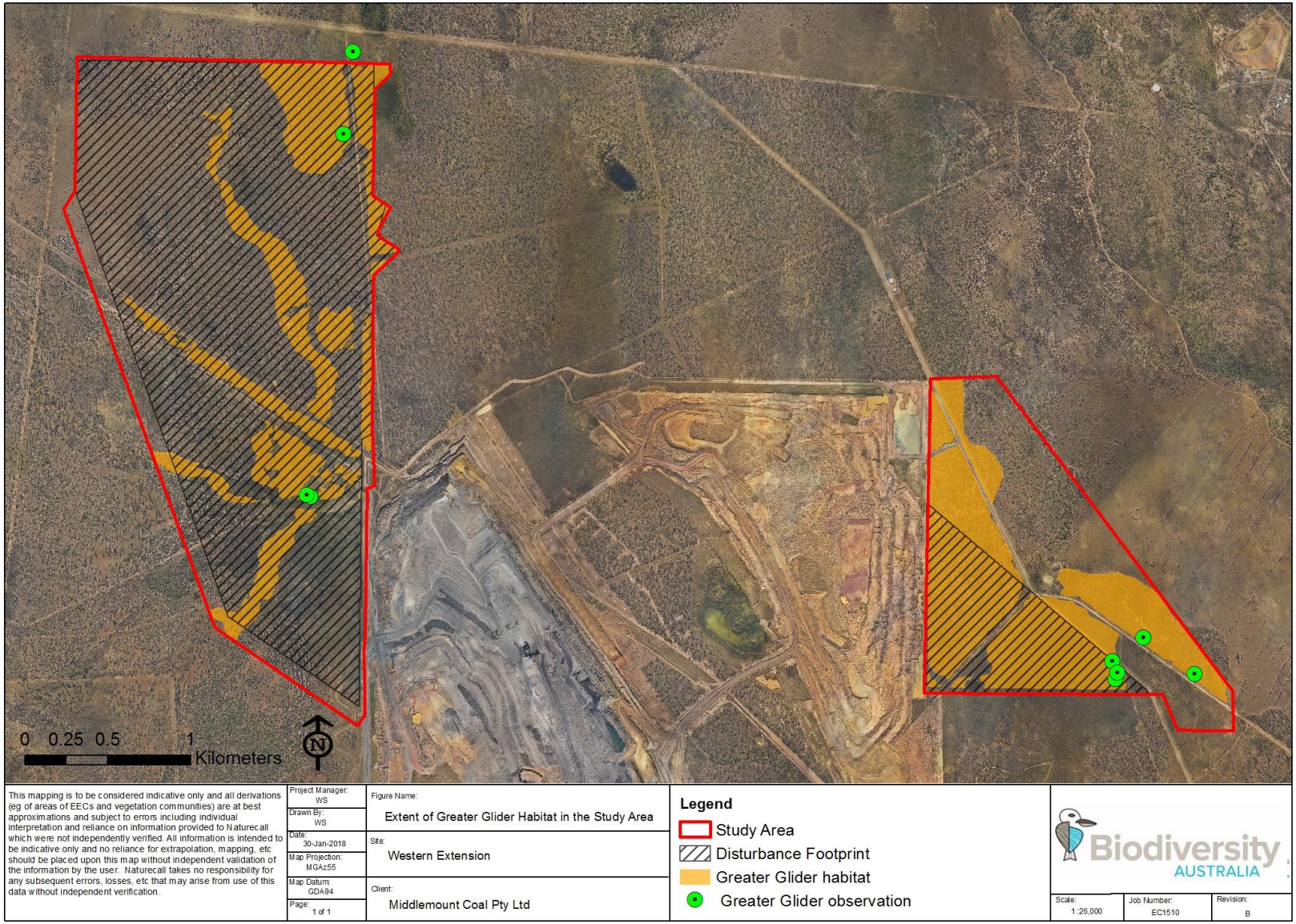

Figure 21c: Protected wildlife habitat – Koala

This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: WS	Figure Name: Extent of Koala Habitat in the Study Area
Drawn By: WS	
Date: 30-Jan-2018	Site: Western Extension
Map Projection: MGAz55	
Map Datum: GDA94	Client: Middlemount Coal Pty Ltd
Page: 1 of 1	

Legend

- Study Area
- Disturbance Footprint
- Koala habitat
- Koala scats recorded

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1 :26,000	EC1510	B

Figure 21d: Protected wildlife habitat – Squatter Pigeon

This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	30-Jan-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1

Figure Name: Extent of Squatter Pigeon Habitat in the Study Area

Site: Western Extension

Client: Middlemount Coal Pty Ltd

Legend

- Study Area
- Disturbance Footprint
- Squatter Pigeon habitat
- Squatter Pigeon observation

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1 :26,000	EC1510	B

4.5. Matters of National Environmental Significance

The protected matters search tool (DEE 2017) identified a range of MNES that could potentially occur in the locality. Threatened species and ecological communities listed as MNES were recorded in the study area during the field surveys. These are discussed in the following sections.

4.5.1. Threatened Ecological Communities

Vegetation conforming to the Brigalow EEC was recorded on both the eastern and western study area during the field survey. The process used to identify this TEC is described in Section 3.2.3.

A total of 25.5 ha of Brigalow EEC has been mapped in the study area, with 22 ha occurring within the Project area. The Brigalow communities in the study areas are equivalent to RE 11.3.1 (15 ha), 11.4.9 (0.5 ha) and regrowth vegetation (6.5 ha).

A description of these communities is provided in Section 5.2.1. Figure 16 shows the distribution of this TEC over the study area.

4.5.2. Threatened Species

Three federally listed threatened species were recorded in the study area during the field surveys – the Greater Glider, Squatter Pigeon and Koala. These are all listed as Vulnerable under the EPBC Act. The occurrence and distribution of these species on site has been discussed in Section 4.3.6.

As shown in Table 22 below, one additional fauna species listed as vulnerable under the EPBC Act is considered a potential occurrence in the study area. This, along with the recorded species, are assessed in the MNES Significance Assessment in Section 8. The potential for threatened species to occur in the study area is also reviewed in Appendix 1.

Table 22: Potentially occurring threatened fauna species

Group	Species	Predicted Type of Occurrence	Listing Status		Likelihood Of Occurrence
			NC Act	EPBC Act	
Reptiles	Ornamental Snake (*Denisonia maculata*)	Species or species habitat likely to occur within area	V	V	Low chance of occurrence given disturbance history and lack of preferred habitat.

4.5.3. Migratory Species

No migratory species recorded during the survey. A significant number of EPBC Act listed migratory bird species are known or considered potential occurrences in the locality (DEE 2017b).

These species are shown in Table 23, with an evaluation made on likelihood of occurrence based on cited ecology.

Table 23: Potentially occuring migratory species

Group	Species	Predicted Type of Occurrence	Likelihood Of Occurrence
Birds	Fork-tailed Swift (*Apus pacificus*)	Species or species habitat likely to occur within area	Fair potential, as transient, between October-April.
	Glossy Ibis *(Plegadis falcinellus)*	Species or species habitat likely to occur within area	Small areas of suitable habitat occur within the study areas. Moderate chance of occurrence
	Satin Flycatcher (*Myiagra cyanoleuca*)	Species or species habitat may occur within area	Broadly suitable habitat on site. Low chance of occurrence.
	Black-faced Monarch (*Monarcha melanopsis*)	Species or species habitat known to occur within area	Broadly suitable habitat on site. Low chance of occurrence.
	Oriental Cuckoo (*Cuculus optutus*)	Species or species habitat may occur within area	Broadly suitable habitat on site. Low chance of occurrence.

Migratory birds listed under international agreements (and the EPBC Act) are also 'Special Least Concern' fauna species listed under the NC Act.

5.0 Potential Impacts

5.1. Direct Impacts

Direct impacts on flora and fauna from the Project are evaluated below.

5.1.1. Vegetation and Habitat Loss

MCPL has minimised potential impacts associated with land clearance through the use of existing infrastructure and facilities (where possible) and minimising out-of-pit waste emplacements via backfilling of the open cut pit void.

As a result, the Project area covers an area of approximately 571 ha, of which the majority (380.5 ha) is cleared or non-remnant vegetation. Over the life of the Project, a total of approximately 190.5 ha of remnant vegetation would be cleared (Table 24).

The vegetation that would be removed contains a number of fauna habitat components such as potential nesting/denning/roosting habitat for hollow-obligate species in hollow-bearing trees, shelter provided by dense vegetation and fallen timber, foraging resources (e.g. nectar and sap sources), fruiting resources, seeds and grains along with prey habitat.

Table 24: Details on vegetation to be removed

Field-verified RE	BD Status	VMA Status	EPBC Status	Habitat type	Area (ha)
11.3.1	Endangered	Endangered	Endangered	Acacia harpophylla woodland/forest	15
11.3.2	Of Concern	Of Concern	-	Eucalypt woodland/forest	43.5
11.3.2/11.3.4	Of Concern	Of Concern	-	Eucalypt woodland/forest	1.5
11.3.27d	Of Concern	Least Concern	-	Wetlands	1.9
11.4.9	Endangered	Endangered	Endangered	Acacia harpophylla woodland/forest	0.5
11.5.3	No concern at present	Least Concern		Eucalypt woodland/forest	128
				Total	**190.5**
				Regrowth	**249.5**

The vegetation proposed to be removed by the Project includes potential habitat resources for the following threatened fauna species:

- Ornamental Snake (15.5 ha, comprising only of remnant vegetation);
- Squatter Pigeon (388.5 ha, comprising 189ha of remnant vegetation and 199.5 ha of regrowth);
- Greater Glider (175 ha, comprising only of remnant vegetation); and
- Koala (175 ha, comprising only of remnant vegetation).

5.1.2. Impacts to Individual Fauna

The removal of native vegetation associated with the Project, particularly hollow-bearing trees and logs, has the potential for direct mortality of fauna species. This potential risk is increased during the breeding seasons (generally spring to late autumn), and cooler seasons when mammals and reptiles enter torpor.

To reduce the likelihood of direct mortality to native fauna species, MCPL would implement the vegetation clearance protocol described in Section 6.

5.1.3. Habitat Fragmentation

The woodland communities in the western area are patchy and fragmented and do not provide strong connectivity across the study areas. The woodland is more contiguous on the eastern study area and provides connectivity, however is fragmented by several roads and fencelines.

The Project area is adjacent to the approved mine surface disturbance area and clearance of the vegetation in the Project area is not likely to isolate any external habitats (only increase the size of the existing footprint). The removal of vegetation from the study area would however increase the level of local fragmentation and reduce connectivity between remaining habitats in the locality.

The Project would also increase the barrier already presented by the existing mine for terrestrial fauna species which would generally avoid crossing cleared land. This would have the greatest impact on less mobile species including herpetofauna (e.g. snakes, lizards and frogs), arboreal mammals (e.g. Sugar Glider and Greater Glider) and small mammals (e.g. rodents).

While fragmentation at the local scale would be high, the loss of habitat resulting from the Project in the wider area would only incrementally increase fragmentation in an already highly fragmented landscape. Many of the fauna groups represented in the area are highly mobile (e.g. birds, bats macropods), and would be accustomed to the level of fragmentation. Post-mine landforms are proposed to be progressively rehabilitated to include woodland habitat.

5.2. Indirect Impacts

The Project may also potentially result in indirect impacts, as detailed in the following sections.

5.2.1. Edge Effects

Existing vegetation in the Project area and adjacent land is currently fragmented from pastoral areas, roads and easements; hence any edge effects are likely to have already manifested. Newly exposed edges created by clearing works may be subject to higher levels of weed invasion.

Further, given the open nature of the adjacent woodland habitats, no alterations to microclimate or species assemblage are likely to occur as a result of the Project.

5.2.2. Erosion and Sedimentation

The Project has the potential to increase the natural rate of erosion and sediment with, and downstream of, the Project area due to the additional disturbance areas associated with the extension to the open cut pit and waste emplacement. MCPL would revise the exitsing *Erosion and Sediment Control Plan* (WRM Water and Environment [WRM] 2012) to manage erosion and sedimentation in the Project area and downstream.

With the continuation of these management measures it is unlikely that the Project would result in significant erosion or sedimentation impacts that would adversely impact native flora and/or fauna within, or downstream of the Project area.

5.2.3. Hydrological Regime Changes

The Project would result in changes to the natural flow regimes of the local drainage features due to the capture and re-use of drainage from operational disturbance areas. The Project water management system would generally be based on the existing water management system with revisions undertaken progressively over the life of the Project (WRM, 2018).

No measurable impacts on surface water quality are likely to occur from changes in surface water as (WRM, 2018):

- no uncontrolled spills of mine affected water from the mine water dam are predicted;
- release of treated water from sediment dams (designed in accordance with the Best Practice Erosion and Sediment Control [International Erosion Control Association Australasia, 2008]) to the downstream environment would only occur in accordance with the existing EA conditions which is unlikely to have a measurable impact on receiving water quality; and
- there is a predicted negligible impact on the downstream water quality through controlled releases from the Project in accordance with the existing EA.

In addition, WRM (2018) has concluded that the diversion of Drainage Line 1 is unlikely to result in a change to the natural flow regime of the receiving waters, given it would:

- be designed in accordance with the relevant guidelines;
- replicate the natural features of Drainage Line 1; and
- have the same hydrological characteristics of Drainage Line 1.

Based on the implementation of management strategies and measures described in WRM (2018) it is unlikely that the Project would result in significant hydrological regime changes that would adversely impact native flora and/or fauna within, or downstream of the Project area.

MCPL would continue to conduct annual monitoring of the water quality, habitat characteristics and macroinvertebrate diversity of the receiving waters as described in their Receiving Environment Monitoring Program (MCPL, 2016).

5.2.4. Dust

The Project would result in the generation and distribution of dust from Project-related activities such as blasting, materials handling and vehicle movements (Katestone 2018).

While the potential dust impacts on flora and/or fauna in surrounding habitats associated with the Project may increase in comparison to the existing operations, it is expected that the Project would result in a reduction in potential dust impacts in comparison to the existing/approved Middlemount Coal Mine operations (Katestone, 2018) and this would in turn decrease the potential impacts on native species.

5.2.5. Weed Invasion

Weed cover on the study area is generally limited to introduced pasture species (e.g. Buffel Grass, Sabi Grass, *Stylosanthes sp*.) and occasional Prickly Pear. The Project has limited potential to be invaded by weeds due to on-going soil disturbance, however road edges may become colonised by weeds.

There is a low likelihood of weeds spreading into adjoining native woodland/forest vegetation as a result of the Project because the control of declared weeds is an existing management measure that would be adopted for the Project area. Further, construction areas and the post-mine landforms would be progressively rehabilitated with native vegetation (limiting opportunities for weeds to grow).

5.2.6. Vehicle Strike

The Project would contain new haul roads which would increase the risk of road strike to the site. All roads on the mine site are however limited to 40km/h which would greatly reduce the risk of road strike.

5.2.7. Noise

The Project would result in the generation noise from Project-related activities such as blasting, materials handling and vehicle movements (Renzo Tonin 2018). Similarly to the potential dust impacts, the scale of noise impacts would increase in comparison to the existing operations as operational noise sources and the extent of blasting would be extended into the new mining areas (Renzo Tonin 2018).

Any potential noise-related impact on fauna residing in surrounding habitat would likely be localised and minor given fauna often readily habituate to continuous noise and sudden noises from blasting would only occur in intervals. This has been evidenced during the current, and previous, survey work surrounding the existing operations through sightings of fauna using habitat adjacent to active mining areas.

5.2.8. Artificial Lighting

The Project would result in an increase (relative to the existing operations) in the use of artificial lighting within the Project locality. Despite this, the incremental impact of this additional night-lighting is expected to be minor given the lights would be operated in accordance with the relevant Australian Standard.

5.2.9. Introduction of Feral/Introduced Species

A number of feral species were detected during the survey, most notably the feral cat, wild dog and fox which are known to prey upon native fauna. Feral pests that are already present in the Project area are likely to displace into adjoining areas during construction, however, the number of feral pests that would be displaced would be reduced by controlling feral pests. As outlined in Section 6.4, the control of feral pests is an existing measure that would be adopted for the Project area.

5.2.1. Fauna and Final Void

Owen Foley (2014) prepared a *Residual Void Flora and Fauna Capability Study* for the *Residual Void Study* (MCPL 2014). As per the approved final void, the base of the proposed final voids would gradually begin to fill with water which would gradually increase in salinity over time (WRM Water & Environment 2018). The high walls of the final void would not contain vegetative cover but rather steep rock slopes and cliffs (Owen Foley 2014).

5.2.2. Bushfire

Bushfire is an essential component of vegetation dynamics in Australia, but the frequency and intensity must be appropriate to each vegetation type and most accidental wildfires are not likely to be beneficial.

An increase in mine activities and mine vehicles could potentially increase the risk of starting wildfires through hot exhausts, hot works or human error. The Project area is contiguous with areas of vegetated land, and as such is both prone to wildfire incursion and a potential source of fire.

Bushfire prevention and management measures are described in Section 6.7.

5.3. Cumulative Impacts

Removal of vegetation and habitat for the Project would add to cumulative loss of vegetation from past landuses and significant clearing associated with the existing/approved Middlemount Coal Mine. The Project would also contribute to the cumulative impacts of vegetation clearance associated with a number of operational mines within the wider locality, these include:

- German Creek East – located approximately 5 km south of the Project area;
- Foxleigh – located approximately 15 km south-east of the Project area;
- Lake Lindsay – located approximately 15 km south south-east of the Project area; and
- Norwich Park – located approximately 20 km north-west of the Project area.

At a site level, the proposed clearance associated with the Project would result in an increase in remnant vegetation clearance of approximately 43% when compared to the existing/approved Middlemount Coal Mine.

Approximately 440 ha of native vegetation is approved to be cleared for the Middlemount Coal Mine, however, the loss of vegetation associated with the approved mining operations has already been offset in accordance with the relevant State and Commonwealth legislation.

On a larger scale, the native vegetation communities/regional ecosystems to be cleared during the life of the Project all occur more widely in surrounding landscapes and subregions (after Accad *et al.,* 2017). The Project would result in the loss of approximately 0.03% of the remnant vegetation remaining within the Isaac Comet Dows Subregion (Accad, et al., 2017).

The proposed offset areas for the Project would significantly increase the area of protected habitat that will be managed for conservation (bringing the total to 5,871 ha [MCPL, 2018; 2019]). The existing and proposed offset areas provide habitat for a number of common and threatened species as demonstrated from monitoring surveys (EHP 2012, Naturecall 2014-2017) and their continued regeneration will help offset biodiversity losses from the Middlemount Coal Mine. In addition, the progressive rehabilitation of mining areas over the life of the Project would provide habitat in the medium to long term.

Given the above, the additional clearance associated with the Project is considered to represent only a minor increase in cumulative vegetation loss. Accordingly, the Project is not anticipated to have a significant cumulative impact on terrestrial ecology.

6.0 Mitigation Measures

The Project would be subject to a number of mitigation measures to reduce the overall impact of the development on biodiversity and ensure potential off-site impacts are minimised. The conclusions of the impact assessments undertaken have assumed that the following mitigation measures will be implemented.

6.1. Refinement of the Mine Design to Avoid Land Clearance

The following refinements to the mine design have resulted in minimising additional land disturbance:

- use of existing infrastructure and facilities at the Middlemount Coal Mine, where possible, to avoid the need for additional clearance works;
- optimising the backfilling of the open cut pit to minimise the overall mine footprint (i.e. reduce the size of the out-of-pit waste emplacement); and
- locating the proposed waste emplacements to be continuous with the existing/approved waste emplacements to minimise the total disturbance footprint.

6.2. Vegetation Clearing Management

The following measures would be implemented to manage clearing on site:

- The sequence of vegetation clearing would be undertaken in a manner to ensure fauna is not isolated from adjacent habitat preventing their escape.
- Approved disturbance limits would be clearly marked (e.g. via pegging and/or flagging tape) before clearing in order to prevent any inadvertent clearance. Site induction would specify that no clearing is to occur beyond the marked area and any machinery or materials associated with the development are not to be parked/stored in adjacent retained vegetation.
- Where possible, timing of vegetation clearing would avoid the breeding season for the Greater Glider (i.e. April to June).
- The area of clearing work is to be inspected for fauna by a fauna spotter immediately prior to commencement of any vegetation removal. Pre-clearing checks would include searches of habitat (e.g. lifting and destructive searches of logs) and searches for bird nests. If possible, any detected fauna is to be relocated to nearby suitable areas prior to clearing.
- During the pre-inspection, all hollow-bearing trees, stags and large hollow logs are to be clearly marked with flagging tape to allow easy identification during clearing.
- A fauna spotter is to remain on site to supervise clearing to retrieve any fauna detected during works and undertake appropriate action (e.g. euthanize severely injured animals and/or relocate uninjured animals where possible).
- If a Koala is present in the proposed clearing area, it would be left to move away from the clearance area on its own accord.

- Measures described in the Middlemount Coal Species Management Program would continue to be followed.

6.3. Rehabilitation

Consistent with EA EPML00716913, the rehabilitation goals for the existing Middlemount Coal Mine would remain unchanged for the Project. These areas are:

- to ensure the final landform is safe to humans and wildlife;
- to ensure the site is non-polluting;
- to ensure the final landform is stable; and
- to ensure the site is able to sustain an agreed post-mining land use.

Rehabilitation progress and rehabilitation activities would regularly be re-evaluated and the results would inform future rehabilitation initiatives. All post-mine landforms, except final voids and sections of the low wall, would have a self-sustaining vegetation or rock mulch cover.

6.4. Weed Management

MCPL currently implements weed control measures at the existing operations in accordance with the *Middlemount Coal Mine Environmental Management Plan* (MCPL, 2017).. These measures would be continued for the Project and include spot spraying of *Biosecurity Act 2014* listed weed species.

6.5. Feral Animal Management

MCPL currently implements feral animal control measures at the existing operations in accordance with the *Middlemount Coal Mine Environmental Management Plan* (MCPL, 2017). These measures would be continued for the Project and include wild dog and cat control.

6.6. Erosion and Sedimentation

MCPL currently implements standard erosion and sedimentation control measures at the existing operations. These measures would be continued for the Project and would be applied as per an Erosion and Sediment Control Plan (WRM 2012).

6.7. Artificial Lighting

Artificial lighting would be required during the operation of Project. This would not be directed into adjacent retained habitat to reduce impacts on nocturnal fauna potentially using this habitat.

6.8. Bushfire prevention and management

MCPL would aim to maintain vegetation structure and composition, protect mine assets and safeguard human life through the implementation of bushfire management techniques, including:

- physical protection of assets through clean firebreaks

- active fire suppression of unplanned and potentially destructive fires (to vegetation and built assets)
- pro-active fuel and ecosystem management to sustain ecological fire regimes as much as possible.

7.0 Significant Residual Impact Assessment - Matters of State Environmental Significance

The *Queensland Environmental Offsets Policy* (DEHP 2017b) has a *Significant Residual Impact Guideline* (DEHP 2014c) to determine if a prescribed activity would have a significant residual impact on MSES. A significant residual impact is defined as an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a prescribed environmental matter that:

a) *remains, or will or is likely to remain, (whether temporarily or permanently) despite on-site avoidance and mitigation measures for the prescribed activity; and*

b) *is, or will or is likely to be, significant.*

Table 25 provides a significant residual impact assessment summary on MSES for the Project.

Table 25: Matters of State Environmental Significance - Significant Residual Impact Assessment

Prescribed Environmental Matter	Presence on site	Significant Residual Impact Likely?
Regulated Vegetation		
Endangered or Of Concern RE	The Project area contains Endangered and Of Concern REs	Yes. Refer to Section 7.1.
Regional ecosystems (not within an urban area) that intersect a wetland on the vegetation management wetlands map	RE 11.3.27d intersects a mapped wetland in the north of the Project area	No. The potential impact would be less than 2 ha, which is not considered to be significant.
Regional ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse on the vegetation management watercourse map	The Project area does not contain a watercourse as per the advice provided by DNRM on 3 October 2017.	-
Connectivity areas		
Connectivity area that is a regional ecosystem (not in urban area) The study area contains remnant vegetation that forms part of a corridor mapped as being of State biodiversity significance.	The study area contains remnant vegetation	Yes. Refer to Section 7.2 for discussion.
Wetlands and watercourses		
A wetland of HES shown on the Map of referable wetlands	A small area of a wetland of HES (0.75 ha) occurs within the Project area and has been assessed for significant residual impacts.	Yes. Refer to detailed assessment in Section 7.3

Prescribed Environmental Matter	Presence on site	Significant Residual Impact Likely?
Protected wildlife habitat		
Habitat for an animal that is vulnerable wildlife	Three species listed as vulnerable under the NC Act were recorded on site during the survey (Koala, Greater Glider and Squatter Pigeon). Two additional threatened fauna species (Powerful Owl and Ornamental Snake) are considered to have potential to occur on the site and be potentially impacted by the Project.	Yes. Assessment in Section 7.4 has determined that a significant residual impact on the Koala and Greater Glider is likely.
Habitat for an animal that is special least concern wildlife	One species listed as special least concern fauna under the NC Act was recorded on site during the survey (Echidna).	No significant residual impact is likely.
Legally secured offset area		
Any areas declared as an environmental offset protection area, high nature conservation value under the VM Act or another area prescribed under a regulation.	A portion of two legally secured Offset Areas occur in the Study area. These have been assessed against the criteria in Section 7.5	Assessment in Section 7.5 has determined that the Project will have a significant residual impact on these areas.

7.1. Regulated Vegetation

7.1.1. Components to Be Assessed

Regulated vegetation is a 'prescribed regional ecosystem' that:

- is an Endangered or Of Concern RE;
- intersects with an area shown on the vegetation management wetlands map; or
- is located within the defined distance from the defining banks of a watercourse identified on the vegetation management watercourse map.

7.1.2. Factors to Be Considered

For clearing other than clearing for linear infrastructure, a significant residual impact is triggered if the following thresholds are exceeded (Figure 22).

Figure 22: Significant residual impact criteria – regulated vegetation

		Clearing in a regional ecosystem that is: *endangered*, or *of concern*	Clearing in the portion of a regional ecosystem that lies within a mapped wetland	Clearing in a regional ecosystem that is within the defined distance of a watercourse
1	**For clearing for linear infrastructure:** – greater than 25m wide in a grassland (structural category) regional ecosystem; or – greater than 20m wide in a sparse (structural category) regional ecosystem; or – greater than 10m wide in a dense to mid-dense (structural category) regional ecosystem. **For clearing other than clearing for linear infrastructure:** – area greater than 5 ha where in a grassland (structural category) regional ecosystem; or – area greater than 2 ha where in a sparse (structural category) regional ecosystem; or – area greater than 0.5 ha where in a dense to mid-dense(structural category) regional ecosystem.	✓	✓	✓
2	Clearing within 50m of the defining bank	N/A	✓	N/A
3	Clearing within 5m of the defining bank	N/A	N/A	✓

Source; (DEHP, 2014c)

7.1.3. Assessment of Significance

The Project would involve the removal of Endangered and Of Concern REs. The area of impact and trigger thresholds for a significant residual impact are shown in Table 26.

Table 26: Significant residual impact test – regulated vegetation

Field-verified RE	VMA Status	Category	Structural category	Area to be removed	Significant impact?
11.3.1	Endangered	Regulated Vegetation	Mid dense	15 ha	**Yes**
11.3.2	Of Concern	Regulated Vegetation	Sparse	43.5 ha	**Yes**
11.3.2/11.3.4	Of Concern	Regulated Vegetation	Sparse	1.5 ha	**No**
11.3.27d	Least concern	Mapped Wetland	Sparse	1.9 ha	**No**
11.4.9	Endangered	Regulated Vegetation	Mid dense	0.5 ha	**Yes**

7.1.4. Conclusion

Clearing of regulated vegetation for the Project would exceed the threshold a trigger a significant residual impact for RE 11.3.1, 11.3.2 and 11.4.9.

7.2. Connectivity Areas

As mentioned in Table 26, the LFC Tool was applied to the Project. The output from the tool showed that the Project exceeded the threshold for an impact on connectivity and fragmentation (see log file in Appendix 12).

7.3. Wetlands and Watercourses

7.3.1. Components to Be Assessed

An offset may be required for the following wetlands:

- wetland in a wetland protection area;
- wetlands of HES; and
- wetland or watercourse in a high ecological value waters.

The western study area contains part of a HES wetland (0.75 ha) as shown in Figure 19.

7.3.1.1. Factors to Be Considered

An action is likely to have a significant residual impact on prescribed wetlands or watercourses if it is likely that the action would result in environmental values being affected in any of the following ways (DEHP, 2014b):

a) *areas of the wetland or watercourse being destroyed or artificially modified;*

b) *a measurable change in water quality of the wetland or watercourse—for example a change in the level of the physical and/or chemical characteristics of the water, including salinity, pollutants, or nutrients in the wetland or watercourse, to a level that exceeds the water quality guidelines for the waters; or*

c) *the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected; or*

d) a substantial and measurable change in the hydrological regime or recharge zones of the wetland, e.g. a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland; or

e) an invasive species that is harmful to the environmental values of the wetland being established (or an existing invasive species being spread) in the wetland.

7.3.1.2. Assessment of Significance

This section addresses each of the previous points listed.

a) areas of the wetland or watercourse being destroyed or artificially modified;

The portion of ephemeral wetland on the site (0.75 ha) would be removed as part of the Project as it falls within the Project area. The remainder of the wetland falls within the area covered by the existing/approved Middlemount Coal Mine and outside the existing/approved Middlemount Coal Mine to the north.

b) a measurable change in water quality of the wetland or watercourse—for example a change in the level of the physical and/or chemical characteristics of the water, including salinity, pollutants, or nutrients in the wetland or watercourse, to a level that exceeds the water quality guidelines for the waters; or

The HES wetland would be removed.

c) the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected; or

It is unlikely that any aquatic fauna species would be dependent on the ephemeral wetland.

d) a substantial and measurable change in the hydrological regime or recharge zones of the wetland, e.g. a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland; or

The HES wetland would be removed.

e) an invasive species that is harmful to the environmental values of the wetland being established (or an existing invasive species being spread) in the wetland

The HES wetland would be removed.

7.3.1.3. Conclusion

The Project is likely to have a significant residual impact on the HES wetland because it removes an area (0.75 ha) of the mapped HES wetland.

7.4. Protected Wildlife Habitat

7.4.1. Components to be Assessed - Endangered and Vulnerable Wildlife

The following species are subject to the significant residual impact test as they have been recorded within the wider locality or are considered to have at least a low potential to use habitat in the Project area at some time (e.g. now or if they were to potentially recover and expand) and thus have potential to be impacted by the Project:

- **Mammals:** Koala, Greater Glider.
- **Birds:** Squatter Pigeon, Powerful Owl.
- **Reptiles:** Ornamental Snake.

7.4.1.1. Factors to be Considered

An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to (DEHP, 2014b):

- *lead to a long-term decrease in the size of a local population; or*
- *reduce the extent of occurrence of the species; or*
- *fragment an existing population; or*
- *result in genetically distinct populations forming as a result of habitat isolation; or*
- *result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat; or*
- *introduce disease that may cause the population to decline, or*
- *interfere with the recovery of the species; or*
- *cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species*.

A population for a species is defined by the guidelines (DEHP 2014b) as an occurrence of the species in a particular area. In relation to endangered, vulnerable and special least concern species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within that particular bioregion.

7.4.1.2. Assessment of Significance

This section addresses each of the previous points listed.

a) lead to a long-term decrease in the size of a local population; or

Koala

The Koala recorded in the eastern study area during the survey, and has also been recorded on MCPL lands to the south-west of the site. Sparse local records and poor local soil quality (and hence low quality habitat) would mean Koalas in the area would have large home ranges which are likely to be associated with riparian areas where preferred browse trees are common. This is consistent with Koala sightings on MCPL lands on alluvial flats and riparian areas associated with Roper Creek.

The Project would remove approximately 175 ha of known/potential habitat for the Koala, and in conjunction with existing/approved Middlemount Coal Mine, would result in a significant loss of habitat. Due to limited abundance of preferred browse species and poor soils, the habitat to be removed is however considered lower quality habitat that would only form part of the marginal home range of a Koala.

The Project would reduce connectivity and habitat linkages for the local Koala population, however some connective habitat would be retained to the north of the study area which would continue to provide a corridor for the Koala. No significant increase in threats to the Koala such as road kill or dog attack would result from the Project.

The removal/modification of a portion of habitat for the Koala is unlikely to lead to a long-term decrease in the size of a local population of Koala given:

- the Koala has not been observed within the Project area (only scats);
- similar potential habitat for this species is more widespread in the landscape outside the Project area; and
- Koala records are widespread in the landscape outside the Project area.

Greater Glider

The Greater Glider was recorded in several locations in the Project area. It has also been extensively recorded in the Stage 2 Offset Area to the west of the site (Naturecall 2017b). Greater Gliders have small home ranges ranging between 1.3 and 4 ha (Comport et al. 1996, Pope et al. 2005, TSSC 2016). The study areas would therefore encompass entire home ranges of the Gliders, and they would be also expected to extend off site.

The Project would remove approximately 175 ha of habitat for this species comprising open woodlands. This habitat would be used for both foraging and denning/breeding within hollow-bearing trees. When the cumulative impact of the Project and the existing/approved Middlemount Coal Mine is considered, the large loss of habitat and reduction in connectivity is likely to lead to a long term decrease of the local population.

Squatter Pigeon (southern)

The Squatter Pigeon was recorded in the eastern study area, but not within the Project area. It has also been previously recorded in the south of the western study area during previous studies (Naturecall 2013, PB 2010).

The study areas contain suitable habitat for this species in the form of woodland habitat as well as non-remnant woodland vegetation and disturbed areas which are also frequently used for foraging (DEE 2017). This species has large seasonally nomadic home ranges (DotE TSSC 2015) hence the local population would extend well beyond the Project area.

The Project would see the removal of approximately 388.5 ha of known/potential habitat for this species. In terms of the large home range of this species, its high mobility and the presence of extensive alternative habitat in the locality, the Project is unlikely to lead to a decrease in the local population.

Powerful Owl

The Powerful Owl has not been recorded on MCPL lands or in the locality, hence the site only provides potential habitat for this species. Due to the large home range of this species (Soderquist and Gibbons 2007), a potential population would extend well beyond the site.

The Project would impact this species via the loss of approximately 175 ha of open woodland habitat which has the potential to be used for foraging and nesting within hollow-bearing trees. While this may lead to a localised reduction of prey resources and nesting sites, given that the territories of this species are measured in terms of thousands of hectares (Soderquist and Gibbons 2007), the relatively minor loss of carrying capacity resulting from the Project, while a negative impact, is not sufficient to undermine a local pair's ability to obtain sufficient forage to raise young to fledging. Given this, and the extent of habitat remaining in the locality, the Project would unlikely lead to a long term decrease in the size of a local population.

Ornamental Snake

This species was not recorded in the study area during the surveys despite targeted surveys undertaken in different seasons. It has however been recorded on MCPL land to the south of the site near Roper Creek by PB in 2010 (Section 2.6.3).

The Project area provides suitable habitat for the Ornamental Snake in the form of Brigalow habitats nearby ephemeral drainage lines which provide habitat for preferred prey species.

The Project would remove 15.5 ha of potential habitat which comprises remnant Brigalow habitats. Given that a number of targeted surveys undertaken by Biodiversity Australia and other consultants since 2010 have not detected this species within the study area, it is only considered to be a low chance of occurrence within the potential habitat in the Project area. As such, the removal of potential habitat in the project area is unlikely to lead to a long term decrease in the local population.

b) reduce the extent of occurrence of the species; or

The habitats present on the study areas only contain a low density of preferred foraging trees for the Koala and would only provide secondary foraging habitat and habitat linkages. The Project would remove an estimated 175ha of habitat for this species, and given that known habitat in the eastern study area would be removed, the extent of occurrence is likely to be reduced to some degree.

For the Greater Glider, the Project would remove approximately 175ha of known and potential habitat which is likely to reduce the extent of occurrence of the local population.

For the Powerful Owl and Squatter Pigeon, while the Project would reduce the amount of potential habitat for these species on a local scale, given the extent of higher quality habitat on adjacent land and in the locality, and the large home range of these species, the removal of the habitat would unlikely reduce the extent of occurrence.

For the Ornamental Snake, given that a population of this species has not been detected in the study area, no known habitat would be removed and the extent of occurrence of this species would not be reduced as a result of the Project. The extent of potential habitat for this species would however be reduced, and this could impact the species recovery in the local area.

c) fragment an existing population; or

The Powerful Owl and Squatter Pigeon are highly mobile species and known to be capable of crossing human-modified habitat. The Project would thus offer no barrier to movement and hence would not fragment an existing population.

The Koala is also relatively mobile, able to cross clearings and roads, though is highly susceptible to other threats such as dog attack and vehicle strike. The Project would reduce connectivity for the Koala population, however connective habitat would still remain around the study area to the north. As such, while the Project would lead to further fragmentation of habitat and reduce connectivity, there is not potential for fragmentation of an existing population.

The Greater Glider relies on canopy connection to move throughout its home range and would rarely come to the ground and cross clearings and open ground. The Project would remove connective habitat for this species, and in conjunction with approved mining activities in MCPL leases, is likely to fragment populations of the Greater Glider, especially those which occur in the eastern study area.

Removal of habitat for the Project would be unlikely to fragment a population of the Ornamental Snake given its low likelihood to occur on the site and that some connective habitat would remain around the sites to the north.

d) result in genetically distinct populations forming as a result of habitat isolation; or

As mentioned above, the Project would be unlikely fragment or isolate an existing population of the more mobile species (Squatter Pigeon, Powerful Owl, Koala). Similarly for the Ornamental Snake, the habitat remaining to the north of the sites would provide connective habitat for this species if it were to occur in the study area and hence gene flow between potential populations could continue and not result in genetic isolation.

For the Greater Glider, the Project has the potential to isolate populations of the Greater Glider given that they are less mobile and require a continuous canopy connection to move through their home range and disperse. There is some potential for any isolated populations to reestablish dispersal and gene flow post mining operations when the disturbance footprint is rehabilitated.

e) result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat; or

The Project area currently has a number of introduced and invasive species including predators such as the feral cat and fox and weed species including Prickly Pear. No new species that is likely to affects any of the subject species would likely be introduced as a result of the Project.

f) introduce disease that may cause the population to decline, or

Due to the nature of the Project, the risk of a new disease (relevant to the species) being introduced to the site would be unlikely.

g) interfere with the recovery of the species; or

Ideally, the goal in threatened species recovery is to increase the abundance and range of the threatened species, so that it is not in risk of becoming extinct. As detailed previously, the Project would lead to habitat loss and contribute to threatening processes which would interfere with the recovery of the subject threatened species to varying degrees. This includes directly reducing habitat for the species known to occur and reducing the amount of available potential habitat for other species.

h) cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.

For the Squatter Pigeon and Powerful Owl, the habitat in the Project area has an evident disturbance history and is unlikely to qualify as an ecologically significant location, especially given the extent of identical and higher quality habitat that occurs in the wider area.

The Koala and Greater Glider have been recorded in the study area and that habitats within the Project area would provide foraging and breeding habitat, as well as habitat linkages

The Ornamental Snake has not been recorded in the study area and it is unlikely that the habitats present would constitute ecologically significant locations for this species.

7.4.1.3. Conclusion

The Project is not considered to result in a significant residual impact on the Powerful Owl and Squatter Pigeon, due their high mobile nature and the large extent of suitable habitat in the wider area that is readily accessible.

The impact of the Project on the Ornamental Snake is uncertain, however given that it was not recorded on site, the impact of the Project is unlikely to be significant.

For the Koala and Greater Glider, the Project would have a greater impact, especially when the cumulative impact of other approved mining activities are considered. The Project is likely to result in a significant residual impact on these species.

Thus, as per the *Significant Residual Impact Guideline* (DEHP 2014b), the Project would require an offset for these species.

7.4.2. Components to be Assessed – Special Least Concern (non-migratory) Animals

The Echidna is listed as a Special Least Concern species under the NC Act and was recorded in the western study area during the survey.

7.4.2.1. Factors to be Considered

An action is likely to have a significant impact on a special least concern (non-migratory) animal wildlife habitat if it is likely that it will result in (DEHP, 2014b):

- *a long-term decrease in the size of a local population; or*
- *a reduced extent of occurrence of the species; or*
- *fragmentation of an existing population; or*
- *result in genetically distinct populations forming as a result of habitat isolation; or*
- *disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species.*

7.4.2.2. Assessment of Significance

This section addresses each of the previous points listed.

a) a long-term decrease in the size of a local population; or

The Echidna was recorded via PIR camera located near a dam on unnamed Drainage Line 2. The Echidna has also been recorded previously on MCPL land in the Stage 2 offset area and near Parrot Quarry Road during previous surveys (Naturecall 2016a). A local population of the Echidna would extend well beyond the study area given these previous records and that large areas of suitable habitat occurs on adjacent and nearby lands.

The Project would impact the Echidna via removing habitat which includes open woodland and regrowth. This would affect foraging habitat and connectivity would also be reduced. However given that the local population would extend well beyond the site, and that large areas of suitable habitat would remain to the west within the Stage 2 offset area, the Project is only likely to affect a few individuals of the overall population and would be unlikely to lead to a decline.

b) a reduced extent of occurrence of the species; or

The Project would remove habitat that may be used by the local population of this species. This would result in a minor contraction of the extent of occurrence**.**

c) fragmentation of an existing population; or

The Echidna is relatively mobile and would be able to cross disturbed areas and open ground. Sufficient connectivity for this species is likely to remain after clearance and no populations are likely to become fragmented as a result of the Project.

d) result in genetically distinct populations forming as a result of habitat isolation; or

As discussed above, no fragmentation or isolation of the local population is likely to result from the Project.

e) disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species.

The Project would affect generic foraging and potentially breeding habitat for the local Echidna population. Given the extent of similar and higher quality habitat located on adjacent and nearby lands, the habitat on site is unlikely to be of any specific significance to the local population.

7.4.2.3. Conclusion

The Project is unlikely to have a significant impact on the habitat or local population of the Echidna.

7.5. Legally Secured Offset Areas

Legally secured offset areas are any areas declared as an environmental offset protection area, high nature conservation value under the VM Act or another area prescribed under a regulation.

As discussed in Section 4.4.5, portions of two legally secured offset areas are located within the Project area. These comprise the Stage 2 Offset Area and Rail Loop and Spur Offset Area. The Project area would impact part of these offset areas.

The proposed offset strategy (Section 9) addresses the impacts on these offset areas.

8.0 Significance Assessments - Matters of National Environmental Significance

8.1. General Assessment Overview

On 8 January 2018, the Project was referred under the EPBC Act (2016/7649). On 8 February 2018, a delegate of the Commonwealth Minister for the Environment declared the Action to be a 'controlled action' for the purpose of the EPBC Act due to potential adverse impacts on the following controlling provisions under Part 3 of the EPBC Act:

- sections 18 and 18A of the EPBC Act (listed threatened species and communities); and
- sections 24D and 24E of the EPBC Act (a water resource, in relation to coal seam gas development and large coal mining development).

The EPBC Act referral decision DoEE included a list of MNES which DoEE considers is likely to be significantly impacted by the Project. These included:

- Brigalow EEC;
- Squatter Pigeon (Vulnerable);
- Koala (Vulnerable);
- Greater Glider (Vulnerable);
- Ornamental Snake (Vulnerable); and
- Grey-headed Flying Fox (Vulnerable).

These MNES are all considered in the following assessments with the exception of the Grey-headed Flying Fox. The Grey-headed Flying Fox has very few formal records within the locality, with no historical records within Wildlife Online (DEHP 2016). The only reference to Grey-headed Flying Fox records within the locality comes from the Department of the Environment and Energy (2018e) – National Flying-fox Monitoring viewer which has a annually monitored Flying-fox camp in the centre of the Middlemount Township (approximately 3km north-east).

In 2014, the Flying-fox camp was recorded to have a population of between 2500 – 9,999 Grey-headed Flying Fox present (DEE, 2018e) and does not represent a nationally important Flying-fox camp. There have been no subsequent Grey-headed Flying Fox records since August 2014. The Project area does not have tall closed forests near streams, rivers or estuaries that would provide favourable habitat for Grey-headed Flying Fox roosts. As such, the species is considered unlikely to occur in a roosting capacity. At very most, the species may use the study site as a minute portion of a much larger foraging range hence any potential impacts would be minute.

Protected Species Assessments

The following EPBC Act threatened species require assessment:

- Squatter Pigeon (Vulnerable).
- Koala (Vulnerable).

- Greater Glider (Vulnerable).
- Ornamental Snake (Vulnerable).

8.1.1. Assessment

Brigalow EEC

The Action would result in the direct clearance of a total of approximately 22 ha of Brigalow EEC in the Action area (of which approximately 6.5 ha is regrowth). The Brigalow EEC would be cleared to enable the realignment of the Thirteen Mile Gully Diversion and provide additional surface footprint for out-of-pit waste rock emplacement.

In regard to potential indirect impacts, as described above, the Brigalow EEC in the Action area is in good condition despite construction of the existing Thirteen Mile Gully Diversion. It is expected that the construction of the realigned section of the Thirteen Mile Gully Diversion would also result in negligible indirect impacts (from threats such as weeds [DEE, 2018] and potentially dust) on the adjacent Brigalow EEC. The Brigalow EEC is not dependant on groundwater and would not be adversely impacted by changes to local hydrology.

The Action is not likely to result in significant impacts from edge effects on potential habitat for this species outside of the Action area given the potential habitat is poorly connected to the Action area due to the existing fragmentation. Newly exposed edges created by clearing works may be subject to higher levels of weed invasion, however, weed management measures would apply to the existing offset area and the mining lease. Further, the realigned section of the Thirteen Mile Gully Diversion would be established and revegetated early in the mine life (by Year 6), thus limiting the time the habitat edges are exposed.

In regard to fragmentation impacts, the potential habitat for this species is patchy and fragmented and do not provide strong connectivity to adjacent habitats. The action would not isolate any external habitats and only marginally increase fragmentation in an already highly fragmented landscape.

The Middlemount Coal Mine is currently approved to remove approximately 4 ha of Brigalow EEC as part of the Middlemount Coal Project Stage 2 (EPBC 2010/5394) (Parsons Brinkerhoff, 2010a). Considering the clearance required for the Action, the Middlemount Coal Mine (inclusive of EPBC 2010/5394 and EPBC 2017/8130) would result in the cumulative total clearance of approximately 26 ha of Brigalow EEC. This is, however, offset by a greater area of Brigalow EEC.

The Brigalow EEC in the Action is not able to be avoided as the Thirteen Mile Gully Diversion is required to be realigned to allow for access to additional coal resources within ML 70379. Potential impacts to Brigalow EEC would be minimised through implementation of the following measures:

- Boundaries of Brigalow EEC areas to be cleared, and those not to be cleared, would be defined before and during clearing activities.
- Weed management techniques would continue to be implemented within the mining lease (e.g. weed control [spraying] and washdown of machinery when moving from weed infested areas).

- The revegetation species list for the realigned section of the Thirteen Mile Gully Diversion would include species characteristic of the Brigalow EEC.

Ornamental Snake

The Ornamental Snake has not been recorded in the Action area. The Action would result in the direct clearance of a total of approximately 15.5 ha of potential habitat for the Ornamental Snake. The potential habitat would mainly be cleared to enable the realignment of the Thirteen Mile Gully Diversion and provide additional surface footprint for out-of-pit waste rock emplacement.

Although some potential habitat for this species would be cleared, the area to be cleared is not considered material nor crucial to the viability of the local population of this species. The Action is unlikely to have a significant impact on the Ornamental Snake (after DEWHA, 2013) as there is a low chance of the snake occurring in the Action area given disturbance history and lack of preferred habitat.

The Action is not likely to indirectly impact this species through an increase in feral animals, weeds or adverse alteration of hydrology in potential habitat. Further, the vibrations from blasting associated with the Action (for the additional six years of the mine life) is not likely to impact the Ornamental Snake due to the occasional and short period of blasts.

The Action is not likely to result in significant impacts from edge effects on potential habitat for this species outside of the Action area given the potential habitat is poorly connected to the Action area due to the existing fragmentation. Newly exposed edges created by clearing works may be subject to higher levels of weed invasion, however, weed management measures would apply to the existing offset area and the mining lease. Further, the realigned section of the Thirteen Mile Gully Diversion would be established and revegetated early in the mine life (by Year 6), thus limiting the time the habitat edges are exposed.

In regard to fragmentation impacts, the potential habitat for this species is patchy and fragmented and do not provide strong connectivity to adjacent habitats. The action would not isolate any external habitats and only marginally increase fragmentation in an already highly fragmented landscape.

The Middlemount Coal Mine is currently approved to remove approximately 47 ha of potential habitat for the Ornamental Snake as part of the Middlemount Coal Project Stage 2 (EPBC 2010/5394) (Parsons Brinkerhoff, 2010a). Considering the clearance required for the Action, the Middlemount Coal Mine (inclusive of EPBC 2010/5394 and EPBC 2017/8130) would result in the cumulative total clearance of approximately 62.5 ha of habitat for the Ornamental Snake.

Potential impacts to the Ornamental Snake would be minimised through implementation of the following measures:

- Education of staff, including contractors, in relation to the risks to fauna and how to manage animals which are injured or displaced, including this species.
- MCPL would use a licensed spotter-catcher and/or carer during clearing activities.

- Weed management techniques would continue to be implemented within the mining lease (e.g. weed control [spraying] and washdown of machinery when moving from weed infested areas).
- Continuation of the feral animal control measures within the mining lease, including the control of European Red Fox and Feral Cat (recognised threats to this species), biannually for the life of the mine.
- Progressive rehabilitation of disturbance areas to progressively provide habitat resources during and post-mining (e.g. the revegetation species list for the realigned section of the Thirteen Mile Gully Diversion would include species characteristic of the Brigalow EEC [potential habitat for this species]).

A National or State recovery plan has not been prepared for this species. The above measures are predicted to be effective in reducing potential adverse impacts on the Ornamental Snake because they are focused on addressing the recognised threats to the species that would occur (e.g. clearing) or could otherwise occur (e.g. feral animal incursion) as a result of the Action.

Squatter Pigeon (southern)

The Action would result in the direct clearance of a total of approximately 388.5 ha of known and potential habitat for the Squatter Pigeon (southern), comprising approximately 190.5 ha of woodland vegetation (RE 11.3.1, RE 11.3.2, RE 11.3.2/11.34, RE 11.3.27d, RE 11.4.9 and RE 11.5.3) and 198 ha of vegetation in the early stage of regrowing from past clearance.

The area to be cleared is not considered material nor crucial to the viability of the local population of this species. The Action is unlikely to have a significant impact on the Squatter Pigeon (southern) (after DEWHA, 2013) given large home range of this species, its high mobility and the presence of extensive alternative habitat in the locality.

The Action is not likely to result in significant impacts from edge effects on potential habitat for this species outside of the Action area given the potential habitat is poorly connected to the Action area due to the existing fragmentation. Newly exposed edges created by clearing works may be subject to higher levels of weed invasion, however, weed management measures would apply to the existing offset area and the mining lease.

In regard to fragmentation impacts, the potential habitat for this species is patchy and fragmented and do not provide strong connectivity to adjacent habitats. The action would not isolate any external habitats and only marginally increase fragmentation in an already highly fragmented landscape. Post-mine landforms are proposed to be progressively rehabilitated to include woodland habitat, ultimately resulting in a greater coverage of woodland habitat.

The Middlemount Coal Mine is currently approved to remove approximately 1,100 ha of potential habitat for the Squatter Pigeon (southern) as part of the Middlemount Coal Project Stage 2 (EPBC 2010/5394) (Parsons Brinkerhoff, 2010a) and 181 ha of potential habitat as part of the North-eastern Extension. Considering the clearance required for the Action, the Middlemount Coal Mine (inclusive of EPBC 2010/5394 and EPBC 2017/8130) would result in the cumulative total clearance of approximately 1,669.5 ha of habitat for the Squatter Pigeon (southern).

Potential impacts to the Squatter Pigeon (southern) would be minimised through implementation of the following measures:

- Education of staff, including contractors, in relation to the risks to fauna and how to manage animals which are injured or displaced, including this species.
- MCPL would use a licensed spotter-catcher and/or carer during clearing activities.
- Continuation of the feral animal control measures within the mining lease, including the control of European Red Fox (*Vulpes vulpes*) and Feral Cat (*Felix catus*), biannually for the life of the mine.
- All roads in the Action area would be limited to a 40 kilometres per hour (km/h) speed limit which would reduce the risk of vehicle strike.
- Progressive rehabilitation of disturbance areas to progressively provide habitat resources during and post-mining (e.g. overburden revegetated with species characteristic of Poplar Box Woodland).

A National or State recovery plan has not been prepared for this species. The above measures are predicted to be effective in reducing potential adverse impacts on the Squatter Pigeon (southern) because they are focused on addressing the recognised threats to the species that would occur (e.g. clearing) or could otherwise occur (e.g. feral animal incursion) as a result of the Action.

Koala

The Action would remove approximately 175 ha of known and potential habitat for the Koala (RE 11.3.2, RE 11.3.2/11.3.4, RE 11.3.27d and RE 11.5.3). Biodiversity Australia (2019a) consider that lower quality habitat would be removed that would only form part of the marginal home range of a Koala due to limited abundance of preferred food trees (secondary foraging habitat) and poor soils. The habitat within the study area is unlikely to support Koala breeding given the low density of preferred food trees and existing habitat fragmentation.

The vegetation in the early stages of regrowing from past clearance is not suitably advanced to be foraging or dispersal habitat for the Koala.

Better quality potential habitat for the Koala is more widespread in the landscape outside the Action area (e.g. more abundant important Koala food trees [Queensland Blue Gum – *Eucalyptus tereticornis*] occur along the watercourses to the south-west of the Middlemount Coal Mine) (Naturecall, 2016b). Koalas mainly feed on the foliage of *Eucalyptus* spp. however they may also feed on related genera such as *Corymbia* spp.. Queensland Blue Gum and River Red Gum (*Eucalyptus camaldulensis*) are recognised as important for the species in the northern part of their range (Van Dyck and Strahan, 2008).

The potential indirect impacts on the Koala associated with the Action (e.g. vehicle strike, noise, vibration, artificial lighting and/or the introduction of introduced species) are considered to be minimal and would only incrementally increase the likelihood of existing indirect impacts associated with the existing mining operations.

The change in cumulative impact on the Koala in the locality as a result of the Action (considering impacts from other surrounding developments and the Action) is considered to be minimal because of the localised nature of the Action compared to the wider distribution of

this species, especially when considering the biodiversity offsets which have been (or would be) provided.

Potential impacts to the Koala would be minimised through implementation of the following measures:

- Education of staff, including contractors, in relation to the risks to fauna and how to manage animals which are injured or displaced, including this species.
- MCPL would use a licensed spotter-catcher and/or carer during clearing activities. If a Koala is present in the proposed clearing area, it would be left to move away from the clearance area on its own accord.
- Continuation of the feral animal control measures within the mining lease, including the control of Wild Dog (which is a recognised threat to the Koala [DotE, 2014]), biannually for the life of the mine.
- All roads in the Action area would be limited to a 40 km/h speed limit which would reduce the risk of vehicle strike.
- Progressive rehabilitation of disturbance areas to progressively provide habitat resources during and post-mining (e.g. overburden revegetated with species characteristic of Poplar Box Woodland).

Greater Glider

The Action would remove approximately 175 ha of known/potential habitat for the Greater Glider, comprising open woodlands RE 11.3.2, RE 11.3.2/11.3.4, RE 11.3.27d and RE 11.5.3 (Figure 16). The condition of the habitat is reduced by past disturbances (e.g. logging), but the Greater Glider is likely to use the habitat for both foraging and denning/breeding within remaining hollow-bearing trees. Similar and better habitat known to be used by the Greater Glider is more widespread in the landscape outside the Action area. The records within offset areas are shown on Figure 17.

The potential indirect impacts on the Greater Glider associated with the Action (e.g. vehicle strike, noise, vibration, artificial lighting and/or the introduction of introduced species) are considered to be minimal and would only incrementally increase the likelihood of existing indirect impacts associated with the existing mining operations.

The Action is not likely to result in significant impacts from edge effects on potential habitat for this species outside of the Action area given the potential habitat is poorly connected to the Action area due to the existing fragmentation. Newly exposed edges created by clearing works may be subject to higher levels of weed invasion, however, weed management measures would apply to the existing offset area and the mining lease.

In regard to fragmentation impacts, the potential habitat for this species is patchy and fragmented and does not provide strong connectivity to adjacent habitats. The action has potential for some minor isolation of external habitats and will increase fragmentation. Post-mine landforms are proposed to be progressively rehabilitated to include woodland habitat, ultimately resulting in a greater coverage of woodland habitat.

The change in cumulative impact on the Greater Glider as a result of the Action will be high at the local scale, however in consideration of the wider distribution of the species, extent of remaining habitat and the biodiversity offsets which have been (or would be provided), the cumulative impact in the locality is likely to be minimal.

Potential impacts to the Greater Glider would be minimised through implementation of the following measures:

- Education of staff, including contractors, in relation to the risks to fauna and how to manage animals which are injured or displaced, including this species.
- MCPL would use a licensed spotter-catcher and/or carer during clearing activities.
- Where possible, timing of clearing habitat for this species would avoid the breeding season (i.e. April to June).
- Progressive rehabilitation of disturbance areas to progressively provide habitat resources during and post-mining (e.g. overburden revegetated with species characteristic of Poplar Box Woodland).

A National or State recovery plan has not been prepared for this species. The above measures are predicted to be effective in reducing potential adverse impacts on the Greater Glider because they are focused on addressing the recognised threats to the species that would occur as a result of the Action (e.g. clearing).

9.0 Offset Strategy

MCPL has prepared an offset strategy for the Project. The offset strategy is described in the *Middlemount Coal Mine Western Extension Project Environmental Assessment Report* (MCPL, 2018) and the *Middlemount Coal Mine Western Extension Project Preliminary Documentation* (MCPL, 2019).

10.0 Conclusion

The assessment and survey has identified that the site and surrounding area is generally in a modified state as a result of a number of past and current disturbances such as clearing, cattle grazing and mining activities. This has reduced the support value of the habitat on site for locally recorded and potentially occurring species and resulted in indirect impacts that may have discouraged them from using habitat in the area.

Desktop searches and confirmation during field surveys found that the study areas contain two REs listed as Engdangered under the NC Act and EPBC Act and two listed as Of Concern under the NC Act. These comprised Brigalow and Open Woodland on alluvial plains communities. No threatened flora species were recorded on the site during surveys, and none were considered to be potential occurrences.

Targeted fauna surveys undertaken on the study areas over two different seasons detected three threatened fauna species listed as Vulnerable under the NC Act and EPBC Act. These comprised the Koala, Greater Glider and Squatter Pigeon. Due to the presence of suitable habitat/vegetation associations and local records, two threatened fauna species, comprising the Powerful Owl and Ornamental Snake, were considered to be potential occurrences on the study areas. One Special Least Concern species comprising the Echidna was also recorded on site during the field surveys.

The recorded and potentially occurring threatened fauna species were assessed under the relevant State and Federal legislation which determined that the Project has the potential to result in a significant residual impact/significant impact on the Greater Glider, Koala and Birgalow ecological communties.

Other MSES that occur in the study areas are regulated vegetation, HES wetlands and legally secured offset areas. These have been assessed against the relevant significant residual impact criteria.

No other MSES or MNES were identified on site during the desktop assessment or found during the survey.

An offset strategy has been prepared for the Project which would see a large tract of land dedicated as a conservation area and managed accordingly. With the impact avoidance, mitigation and offset measures proposed there not expected to be a significant residual impact on biodiversity from the Project.

11.0 References

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Appendix 1: Potential Occurrence Assessment

A1.0 Potential Occurrence Assessment

The following tables are used as a summary to address threatened species (as detailed below) in terms of potential occurrence, and likelihood of being significantly affected by the Project, and hence requiring formal assessment. A threatened species has been assessed if it is:

a) Recorded on-site;

b) Not recorded on site, but recorded within a 10 km radius (the locality), and may occur to some degree on-site due to potential habitat, key habitat component, etc.;

c) Not recorded in the locality as yet, but recorded in the bioregion, and thus may occur in the locality, and possibly to some extent, may occur on the site, due to potential habitat.

The "*habitat requirements*" column is derived from the previously listed references. Likelihood of occurrence is based on the probability of occurrence in terms of:

- Habitat extent (e.g. sufficient to support an individual or the local population; comprises all of home range; forms part of larger territory, etc.); quality (i.e. condition, including an assessment of threats, historical land uses on and off-site, and future pressures); interconnectivity to other habitat; and ability to provide all the species life-cycle requirements (either the site alone, or other habitat within its range);
- Occurrence frequency (i.e. on-site resident; portion of larger territory; seasonal migrant or transitory opportunist and thus when and how often, etc.)
- Usage ie breeding or non-breeding; opportunistic foraging (e.g. seasonal, migratory or opportunistic); marginal fringe of core range; refuge; roosts; etc.

An indicative 1-5 scale used by the author to indicate the likelihood of the species to potentially occur in the habitat on the study sites (if they have not been recorded in the locality) is as follows:

- 0: *Unlikely* (<1% probability) - no potentially suitable habitat; too disturbed; or habitat is very poor. No or few records in region or records/site very isolated e.g. by pastoral land, urbanisation, etc.
- 1: *Low* (1-10%)- few minor areas of potential habitat; highly modified site/habitat; or few habitat parameters present, but others absent or relatively insignificant (sub-optimum habitat). Usually very few records in locality.
- 2: *Fair* (11-25%) - some significant areas of potential habitat, but some habitat parameters limited. Potential for occasional foraging e.g. from nearby more optimal areas or known habitat. Records at least within 10-15 km radius of site.
- 3: *Good* (26-50%) - significant abundance of habitat parameters/areas of habitat, and more locally e.g. adjacent. Potential part of larger territory, but probably unable to support breeding in isolation. Recorded within 10 km in similar habitat/environs.

- 4: *Moderate* (51-75%) - quite good potentially suitable habitat on and adjacent to the site, and/or good quality and abundance of some vital habitat parameters. Records within <10km, or adjacent to site, or adjacent to high quality habitat where species likely to occur.
- 5: *High* (>75%) - very good to optimum habitat occurring on or adjacent to the site (support breeding pair or population). Recorded within 5-10 km of site in same or similar habitat.

A1.1 Flora

Searches of relevant literature and databases (DEHP 2017e) only found records of a single flora species in the locality. A number of other species have the potential to occur within the locality based on regional records and presence of suitable habitat. In the table below, these species are evaluated for their potential to occur on the site.

Table 35: Potential occurrence assessment for threatened flora species

Species	No. of local records	NC Act	EPBC Act	Link to profile	Likelihood of Occurrence
Cerbera dumicola	1	NT	-	http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/species/?cerbera-dumicola	Recorded in the locality and in the Stage 2 project to the west of the site (PB 2010). The site did not contain suitable habitat for this species and it was not found. Unlikely to occur.
Cycas megacarpa	0	E	E	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=55794	No preferred habitat on site and not recorded locally. This distinctive species would be expected to be readily detected if present. Unlikely to occur.
Dichanthium queenslandicum	0	V	E	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=5481	Only small areas of preferred habitat on site and not recorded locally or on MCPL lands during previous surveys. Site disturbance history would also reduce potential to occur. Unlikely to occur.
Digitaria porrecta	0	NT	-	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=12768	Only small areas of preferred habitat on site and not recorded locally or on MCPL lands during previous surveys. Site disturbance history would also reduce potential to occur. Unlikely to occur.
Homopholis belsonii	0	E	V	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=2406	No typical habitat on site and no local records. Unlikely to occur.
Picris evae	0	V	V	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=10839	Site may broadly qualify as potential habitat, however no local records and site occurs beyond known population extent. Unlikely to occur.
Solanum elachophyllum	0	E	-	http://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:apni.taxon:139341	No suitable habitat and not recorded locally or on MCPL lands during previous surveys. Unlikely to occur.

Species	No. of local records	NC Act	EPBC Act	Link to profile	Likelihood of Occurrence
Rhaponticum australe	0	V	V	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=22647	No typical habitat on site and not recorded in the locality or on MCPL lands during previous surveys. Site disturbance history would also reduce potential to occur. Unlikely to occur.
Hydrocharis dubia	0	-	-	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=3650	No suitable habitat and not recorded locally or on MCPL lands during previous surveys. Unlikely to occur.
Trioncinia retroflexa	0	E	-	http://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:apni.taxon:576466	No suitable habitat and not recorded locally or on MCPL lands during previous surveys. Unlikely to occur.
Bertya pedicellata	0	NT	-	http://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:apni.taxon:278995	No suitable habitat and not recorded locally or on MCPL lands during previous surveys. Unlikely to occur.
Daviesia discolor	0	V	V	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=3567	No suitable habitat and not recorded locally or on MCPL lands during previous surveys. Unlikely to occur.
Acacia arbiana	0	NT	-	http://bie.ala.org.au/species/ACACIA+ARBIANA	Recorded outside the locality south-west of Middlemount. No suitable habitat occurs on the site however and it has not been recorded on MCPL lands during previous surveys. Unlikely to occur.
Acacia spania	0	NT	-	http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/species/?acacia-spania	No suitable habitat and not recorded locally or on MCPL lands during previous surveys. Unlikely to occur.
Cadellia pentastylis	0	V	V	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=9828	No typical habitat on site and no local records. Expected to be readily detected if present. Unlikely to occur.

A1.2 Fauna

As previously noted, a number of threatened and migratory fauna have been recorded in the locality, and a number of others are considered potential occurrences. In the table below, these species are evaluated for their potential to occur on the site.

Table 36: Potential occurrence assessment for threatened and migratory species

Animal Group	Common Name (Scientific Name)	Local Records	NC Act	EPBC Act	Link to Profile	Likelihood Of Occurrence
Birds	Glossy Black Cockatoo (*Calyptorhynchus lathamii*)	0	V	-	http://www.birdsinbackyards.net/species/Calyptorhynchus-lathami	No suitable foraging habitat is present in the study area. Not recorded locally or on MCPL lands during previous surveys. Unlikely chance of occurrence.
	Red Goshawk (*Erythrotriorchis radiatus*)	0	E	V	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=942	Site and general area comprises low quality foraging habitat due to lack of permanent waterways. No local or regional records. Unlikely to occur.
	Powerful Owl (*Ninox strenua*)	0	V	-	http://www.birdlife.org.au/bird-profile/powerful-owl	Site contains potential foraging and nesting habitat as part of a wider area. No local records and not recorded on MCPL lands during previous surveys. **Low chance of occurrence.**
	Australian Painted Snipe (*Rostratula australis*)	0	V	E	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=77037	No large permanent wetlands or waterways occur on site, and no local records, hence this species is unlikely to occur.
	Black-throated Finch (*Poephila cincta cincta*)	0	E	E	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64447	Site represents poor potential habitat for this species. No local records and site occurs beyond known distribution. Unlikely to occur.
	Star Finch (*Neochimla ruficauda ruficauda*)	0	E	E	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=26027	Site represents poor potential habitat for this species due to lack of permanent water and disturbance history. No local records. Unlikely to occur.

Animal Group	Common Name (Scientific Name)	Local Records	NC Act	EPBC Act	Link to Profile	Likelihood Of Occurrence
	Painted Honeyeater (*Grantiella picta*)	0	V	V	http://www.birdlife.org.au/bird-profile/painted-honeyeater	Site provides generic foraging habitat for this species. Lack of local and regional records, disturbance history or site and locality would however reduce potential to occur. Unlikely to occur.
	Eastern Osprey (*Pandion cristatus*)	0	-	M	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=952	No suitable foraging habitat occurs on site. Unlikely to occur.
	Latham's Snipe (*Gallinago hardwickii*)	1	-	M	http://birdlife.org.au/bird-profile/lathams-snipe	No large permanent wetlands or waterways occur on site, and no local records, hence this species is unlikely to occur.
	Glossy Ibis (*Plegadis falcinellus*)	1	-	M	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=991	Some potential habitat occurs on site. **Moderate chance of occurrence.**
	Fork-tailed Swift (*Apus pacificus*)	0	-	M	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=678	**Fair potential**, as transient, between Oct-April
	Rufous Fantail (*Rhipidura rufifrons*)	0	-	M	http://birdlife.org.au/bird-profile/Rufous-Fantail	No suitable habitat on site. Unlikely to occur.
	Satin Flycatcher (*Myiagra cyanoleuca*)	0	-	M	http://birdlife.org.au/bird-profile/Satin-Flycatcher	Broadly suitable habitat occurs on site. **Low chance of occurrence.**
	Black-faced Monarch (*Monarcha melanopsis*)	1	-	M	http://www.birdlife.org.au/bird-profile/black-faced-monarch	Broadly suitable habitat occurs on site. **Low chance of occurrence.**
	Yellow Wagtail (*Motacilla flava*)	0	-	M	http://www.birdlife.org/datazone/speciesfactsheet.php?id=8411	No suitable habitat on site. Unlikely to occur.
	Oriental Cuckoo (*Cuculus optatus*)	0	-	M	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=710	Broadly suitable habitat on site. **Low chance of occurrence.**
Mammals	Northern Quoll (*Dasyurus hallucatus*)	0	-	E	http://www.wildlife.org.au/wildlife/speciesprofile/mammals/northern_quoll.html	Site may provide generic foraging and denning habitat, however disturbance history of site and general area, presence of feral predators, coupled with lack of records would significantly reduce potential. Unlikely to occur.
	Bridled Nail-tail Wallaby	0	E	E	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=23	Site habitat generally unsuitable and beyond known distribution.

Animal Group	Common Name (Scientific Name)	Local Records	NC Act	EPBC Act	Link to Profile	Likelihood Of Occurrence
	(*Onychogalea fraenata*)				9	Unlikely to occur.
	Grey-headed Flying Fox (*Pteropus poliocephalus*)	0	-	V	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186	Site contains a generic nectar foraging resource, however no potential roosting habitat occurs in the study site or adjacent. It is recognised that there is a DES monitored flying-fox camp at Middlemount township (DEE, 2018e), approximately 3 km north-east of the Project. There have been no Grey-headed Flying Fox records at this camp since August 2014 and the species has not been recorded on MCPL land despite numerous surveys. Very low to unlikely chance of occurrence.
	South-eastern Long-eared Bat (*Nyctophilus corbeni*)	0	V	V	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=83395	Site contains generic potential foraging habitat for this species, however no preferred foraging habitats are present. Not detected on site during targeted surveys, or during previous surveys on MCPL land. Expert advice suggests that the site is beyond the known distribution of this species (Greg Ford pers comm.). Unlikely to occur.
Reptiles	Ornamental Snake (*Denisonia maculata*)	2	V	V	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1193	Recorded to the south-east of the site in the Stage 2 project area, however not found in the study site during this or previous surveys despite targeted searches. The site contains some preferred Brigalow habitats and a wetland. However these habitats have been disturbed as a result of cattle grazing and weed invasion. **Low chance of occurrence.**
	Yakka Skink (*Egernia rugosa*)	0	V	V	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1420	Site contains broadly suitable vegetation associations and habitat components for this species however it has not been recorded on site despite targeted surveys or on MCPL lands during previous surveys. Unlikely to occur.

Animal Group	Common Name (Scientific Name)	Local Records	NC Act	EPBC Act	Link to Profile	Likelihood Of Occurrence
	Golden-tailed Gecko (*Strophurus taenicauda*)	0	NT	-	https://www.ehp.qld.gov.au/wildlife/threatened-species/near-threatened/goldentailed_gecko.html	Site contains broadly suitable vegetation associations and habitat components for this species however it has not been recorded on MCPL lands during previous surveys. Disturbance history of the locality and presence of feral predators would also reduce potential to occur. Unlikely to occur.
	Dunmall's Snake (*Furina dunmalli*)	0	V	V	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59254	Some potential habitat occurs on site however no local records and not recorded on MCPL lands to date. Disturbance history and modification of surrounding habitats would also reduce potential to occur. Unlikely to occur.
	Common Death Adder (*Acanthophis antarcticus*)	0	V	-	https://www.ehp.qld.gov.au/wildlife/animals-az/common_death_adder.html	No typical or preferred habitat for this species is present on site and no local records. Unlikely to occur.
	Southern Snapping Turtle (*Elseya albagula*)	0	E	CE	https://www.ehp.qld.gov.au/wildlife/animals-az/whitethroated_snapping_turtle.html	No suitable habitat occurs on the site or adjacent. Unlikely to occur.
	Retro Slider (*Lerista allanae*)	0	E	E	https://www.ehp.qld.gov.au/wildlife/animals-az/allans_lerista.html	No suitable habitat occurs on the site or adjacent. Unlikely to occur.
	Fitzroy River Turtle (*Rheodytes leukops*)	0	V	V	https://www.ehp.qld.gov.au/wildlife/animals-az/fitzroy_river_turtle.html	No suitable habitat occurs on the site or adjacent. Unlikely to occur.

Appendix 2: Site Flora Species List

Frequency: D Dominant at least in some areas,
C Common,
O Occasional,
U Uncommon,
R Rare on site, few specimens.

* Denotes an introduced species

Common Name	Scientific Name	Frequency
Canopy Trees		
Brigalow	*Acacia harpophylla*	R
-	*Angophora leiocarpa*	U
Clarkson's Bloodwood	*Corymbia clarksoniana*	D
Ghost Gum	*Corymbia dallachiana*	O
Moreton Bay Ash	*Corymbia tessellaris*	O
Brown Bloodwood	*Corymbia trachyphloia*	U
Reid River Box	*Eucalyptus brownii*	U
Dawson's Gum	*Eucalyptus cambageana*	C
Silver-leaved Ironbark	*Eucalyptus melanophloia*	O
Poplar Box	*Eucalyptus populnea*	D
Queensland Blue Gum	*Eucalyptus tereticornis*	R
Weeping Paperbark	*Melaleuca leucadendra*	R
Understorey Trees and Shrubs		
Chalky Wattle	*Acacia cretata*	U
Ironwood	*Acacia excelsa*	O
Black Wattle	*Acacia leiocalyx*	O
Mimosa Bush	*Acacia farnesiana**	U
Nelia	*Acacia oswaldii*	U
Native Willow	*Acacia salicina*	O
Bonaree	*Alectryon oleifolius*	R
Bull Oak	*Allocasuarina luehmannii*	U
Red Ash	*Alphitonia excelsa*	O
Bitter Bark	*Alstonia constricta*	U
Dead Finish	*Archidendropsis basaltica*	O
Whitewood	*Atalaya hemiglauca*	U
Coffee Bush	*Breynia oblongifolia*	O
Prickly Pine	*Bursaria incana*	U
Wild Orange	*Capparis canescens*	U
Nepine	*Capparis lasiantha*	O
-	*Capparis loranthifolia*	U
Currant Bush	*Carissa ovata*	O
Leichardt Bean	*Cassia brewsteri*	D
Belah	*Casuarina cristata*	O

Common Name	Scientific Name	Frequency
River Oak	*Casuarina cunninghamiana*	R
Limebush	*Citrus glauca*	U
Lollybush	*Clerodendrum floribundum*	U
Medicine Bush	*Coelospermum reticulatum*	U
-	*Denhamia cunninghamii*	U
Olive-leaved Denhamia	*Denhamia oleaster*	O
Small-leaved Ebony	*Diospyros humilis*	R
Sticky Hop Bush	*Dodonaea viscosa*	O
Yellow tulip	*Drypetes deplanchei*	U
Ellangowan Poison Bush	*Eremophila deserti*	O
Fuchsia Bush	*Eremophila maculata*	U
False Sandalwood	*Eremophila mitchellii*	D
Turkey Bush	*Erythroxylum australe*	C
Scrub Leopardwood	*Flindersia dissosperma*	C
Wilga	*Geijera parviflora*	O
Silver Oak	*Grevillea parallela*	O
Beefwood	*Grevillea striata*	U
Dysentery Bush	*Grewia latifolia*	O
Bootlace Oak	*Hakea lorea*	O
Harrisia Cactus	*Harrisia martini**	O
Queensland Ebony	*Lysiphyllum carronii*	O
-	*Melaleuca nervosa*	U
Boobialla	*Myoporum acuminatum*	U
Native Olive	*Notelaea microcarpa*	U
Prickly Pear	*Opuntia stricta**	O
Velvet Tree Pear	*Opuntia tomentosa**	O
Emu Apple	*Owenia acidula*	U
Quinine Tree	*Petalostigma pubescens*	D
Weeping Pittosporum	*Pittosporum angustifolium*	U
-	*Psydrax attenuata*	U
Northern Sandalwood	*Santalum lanceolatum*	C
Maroon Bush	*Scaevola spinescens*	O
Potato Bush	*Solanum ellipticum*	U
Yellow-wood	*Terminalia oblongata*	D
Vine Tree	*Ventilago viminalis*	C
Grasses		
Cockatoo Grass	*Alloteropsis semialata*	O
Dark Wiregrass	*Aristida calycina*	U
Bunched Kerosene Grass	*Aristida contorta*	O
Jericho Wiregrass	*Aristida jerichoensis*	C
Feathertop Wiregrass	*Aristida latifolia*	O
Purple Wire-grass	*Aristida personata*	O

Common Name	Scientific Name	Frequency
Forest Blue Grass	*Bothriochloa bladhii*	C
Pitted Bluegrass	*Bothriochloa decipiens*	U
Desert Bluegrass	*Bothriochloa ewartiana*	O
Indian Bluegrass	*Bothriochloa pertusa**	U
Common Native Couch	*Brachyachne convergens*	O
Buffel Grass	*Cenchrus ciliaris**	D
Slender Chloris	*Chloris divaricata*	C
Rhodes Grass	*Chloris gayana**	U
Windmill Grass	*Chloris truncata*	O
Golden Beard Grass	*Chrysopogon fallax*	O
Barbed Wire Grass	*Cymbopogon refractus*	O
Couch Grass	*Cynodon dactylon*	R
Button Grass	*Dactyloctenium radulans*	O
Queensland Bluegrass	*Dichanthium sericeum*	O
Cotton Panic	*Digitaria brownii*	U
Umbrella Grass	*Digitaria divaricatissima*	O
-	*Enteropogon acicularis*	O
Wiry Panic	*Entolasia stricta*	U
Brown's Lovegrass	*Eragrostis brownii*	O
Clustered Lovegrass	*Eragrostis elongata*	U
Purple Lovegrass	*Eragrostis lacunaria*	U
Woodland Lovegrass	*Eragrostis sororia*	O
Silky Browntop	*Eulalia aurea*	U
Black Speargrass	*Heteropogon contortus*	C
Swamp Ricegrass	*Leersia hexandra*	O
Green Panic	*Megathyrus maximus**	O
Red Natal Grass	*Melinis repens**	O
Native Millet	*Panicum decompositum*	O
Hairy Panic	*Panicum effusum*	O
Yabila Grass	*Panicum queenslandicum*	O
Brigalow Grass	*Paspalidium caespitosum*	U
-	*Paspalidium distans*	C
Freshwater Couch	*Paspalum distichum*	U
Comet Grass	*Perotis rara*	O
Fairy Grass	*Sporobolus caroli*	U
-	*Themeda avenacea*	U
Kangaroo Grass	*Themeda triandra*	O
Sabi Grass	*Urochloa mosambicensis**	C
Groundcovers		
Chaff Flower	*Achyranthes aspera*	O
Common Joyweed	*Alternanthera nodiflora*	O
Khaki Weed	*Alternanthera pungens**	O

Common Name	Scientific Name	Frequency
Prickly Poppy	*Argemone ochroleuca*	U
Cobbler's Pegs	*Bidens pilosa**	C
Blue Trumpet	*Brunoniella australis*	O
Yellow Buttons	*Chrysocephalum apiculatum*	C
-	*Commelina cyanea*	U
Native Wandering Jew	*Commelina diffusa*	O
Scurvy Grass	*Commelina ensifolia*	U
Darling Lily	*Crinum flaccidum*	O
Yellow Rattlepod	*Crotalaria mitchelii*	C
-	*Desmodium sp.*	U
-	*Eclipta prostrata*	U
Ruby Saltbush	*Enchylaena tomentosa*	O
Winter Apple	*Eremophila debilis*	R
Asthma Plant	*Euphorbia hirta*	U
Tropical Speedwell	*Evolvulus alsinoides*	U
Gomphrena Weed	*Gomphrena celosioides*	C
Slender Violet-bush	*Hybanthus monopetalus*	U
Narrow-leaved Indigo	*Indigofera linifolia*	O
Phasey Bean	*Macroptilium lathryodes*	U
Spiked Malvastrum	*Malvastrum americanum**	U
Native Sensitive Plant	*Neptunia gracilis*	U
-	*Oxalis perennans*	U
Pigweed	*Portulaca oleracea*	C
Hairy Pigweed	*Portucaca pilosa*	U
-	*Phyllanthus maderaspatensis*	U
-	*Rostellularia adscendens*	O
Soft Roly-poly	*Salsola australis*	O
-	*Sauropus hirtellus*	U
Galvanised Burr	*Sclerolaena birchii*	R
Sesbania Pea	*Sesbania cannabina*	O
Pin Sida	*Sida fibulifera*	U
Fine Sida	*Sida filiformis*	O
Flannel Weed	*Sida hackettiana**	O
Paddy's Lucerne	*Sida rhombifolia**	U
Spiked Sida	*Sida subspicata*	O
Small-leaved Nightshade	*Solanum parvifolium*	U
Stylo	*Stylosanthes scabra**	D
Caltrop	*Tribulus terrestris*	U
Speedwell	*Veronica sp**	U
Australian Bluebell	*Wahlenbergia gracilis*	U
Noogoora Burr	*Xanthium occidentale**	U

Common Name	Scientific Name	Frequency
Sedges, Rushes and Aquatics		
Dirty Dora	*Cyperus difformis*	O
Tall Flatsedge	*Cyperus exaltatus*	O
Slender Flat-sedge	*Cyperus gracilis*	C
-	*Eleocharis sphacelata*	O
-	*Fimbristylis dichotoma*	U
Hairy Carpet Weed	*Glinus lotoides*	U
Common Rush	*Juncus usitatus*	U
Spiny-headed Matrush	*Lomandra longifolia*	U
Nardoo	*Marsilea hirsuta*	C
-	*Monochoria cyanea*	U
Water Snowflake	*Nymphoides indica*	U
Swamp Lily	*Ottelia ovatifolia*	R
Lianas, Scramblers and Epihpytes		
Tarvine	*Boerhavia dominii*	U
Small-leaved Water Vine	*Clematicissus opaca*	U
Tiger Orchid	*Cymbidium canaliculatum*	O
-	*Glycine latifolia*	U
-	*Glycine sp.*	U
Bush Banana	*Marsdenia viridiflora*	R
-	*Rhynchosia minima*	O

Appendix 3: Site Fauna Species List

Common Name	Scientific Name	Detection Method[1]
Birds		
Buff-rumped Thornbill	*Acanthiza reguloides*	OBS, HC
Grey Teal	*Anas gracilis*	OBS
Pacific Black Duck	*Anas superciliosa*	OBS
Red-winged Parrot	*Aprosmictus erythropterus*	OBS
Wedge-tailed Eagle	*Aquila audax*	OBS
Intermediate Egret	*Ardea intermedia*	OBS
White-necked Heron	*Ardea pacifica*	OBS
Pacific Baza	*Aviceda subcristata*	OBS
Sulphur-crested Cockatoo	*Cacatua galerita*	OBS,HC
Pallid Cuckoo	*Cacomantis pallidus*	OBS
Pheasant Coucal	*Centropus phasianinus*	HC
Red-capped Plover	*Charadrius ruficapillus*	OBS
Spotted Bowerbird	*Chlamydera maculata*	OBS
Grey Strike-thrush	*Colluricincla harmonica*	OBS
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	OBS, HC
Torresian Crow	*Corvus orru**	OBS, HC
Pied Butcherbird	*Cracticus nigrogularis*	HC
Grey Butcherbird	*Cracticus torquatus*	OBS
Blue-winged Kookaburra	*Dacelo leachii*	OBS, HC
Laughing Kookaburra	*Dacelo novaeguineae*	HC
Mistletoebird	*Dicaeum hirundinaceum*	OBS
Emu	*Dromaius novaehollandiae*	OBS, CAM
White-faced Heron	*Egretta novaehollandiae*	OBS
Blue-faced Honeyeater	*Entomyzon cyanotis*	OBS
Galah	*Eolophus roseicapillus*	OBS
Bar-shouldered Dove	*Geopelia humeralis*	OBS, HC
Peaceful Dove	*Geopelia placida*	OBS
Squatter Pigeon[#]	***Geophaps scripta scripta***	OBS
White-throated Gerygone	*Gerygone albogularis*	HC
Magpie-lark	*Grallina cyanoleuca*	OBS, HC, CAM
Brolga	*Grus rubicunda*	OBS, CAM
Australian Magpie	*Gymnorhina tibicen*	OBS, HC
Whistling Kite	*Haliastur sphenurus*	OBS, HC
White-headed Stilt	*Himantopus leucocephalus*	OBS
Yellow Honeyeater	*Lichenostomus flavus*	OBS
Singing Honeyeater	*Lichenostomus virescens*	OBS

Common Name	Scientific Name	Detection Method[1]
Brown Honeyeater	*Lichmera industincta*	OBS
Variegared Fairy Wren	*Malurus lamberti*	OBS
Red-backed Fairy-wren	*Malurus melanocephalus*	OBS
Noisy Miner	*Manorina melanocephala*	OBS, HC
Rainbow Bee-eater	*Merops ornartus*	OBS, HC
Black Kite	*Milvus migrans*	OBS
Leaden Flycatcher	*Myiagra rubecula*	OBS
Cotton Pygmy-goose	*Nettapus coromandelianus*	OBS
Southern Boobook	*Ninox novaeseelandiae*	OBS, HC
Crested Pigeon	*Ocyphaps lophotes*	OBS
Olive-backed Oriole	*Oriolus sagittatus*	OBS
Rufous Whistler	*Pachycephala rufiventris*	OBS
Striated Pardalote	*Pardalotus striatus*	OBS, HC
Red-capped Robin	*Petroica goodenovii*	OBS
Common Bronzewing	*Phaps chalcoptera*	OBS
Little Friarbird	*Philemon citreogularis*	OBS
Noisy Friarbird	*Philemon corniculatus*	OBS, HC
Royal Spoonbill	*Platalea regia*	OBS, CAM
Pale-headed Rosella	*Platycercus adscitus*	OBS, HC
Tawny Frogmouth	*Podargus strigoides*	OBS
Hoary-headed Grebe	*Poliocephalus poliocephalus*	OBS
Grey-crowned Babbler	*Pomatostomus temporalis*	OBS, HC
Grey Fantail	*Rhipidura albiscapa*	OBS
Willie Wagtail	*Rhipidura leucophrys*	OBS
Apostlebird	*Struthidea cinerea*	OBS
Australasian Grebe	*Tachybaptus novaehollandiae*	OBS
Double-barred Finch	*Taeniopygia bichenovii*	OBS
Straw-necked Ibis	*Threskiornis spinicollis*	OBS
Forest Kingfisher	*Todiramphus macleayii*	OBS
Sacred Kingfisher	*Todiramphus sanctus*	OBS
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*	OBS
Rainbow Lorikeet	*Trichoglossus haematodus*	OBS, HC
Barn Owl	*Tyto alba*	OBS, HC
Masked lapwing	*Vanellus miles*	OBS
Mammals		
Rufous Bettong	*Aepyprymnus rufescens*	OBS, CAM
White-striped Freetail Bat	*Austronomus australis*	ANA
Wild Dog	*Canis lupus familiaris**	TRA, CAM
Greater Northern Freetail bat	*Chaerephon jobensis*	ANA
Gould's Wattled Bat	*Chalinolobus gouldii*	HARP, ANA
Chocolate Wattled Bat	*Chalinolobus morio*	HARP, ANA

Common Name	Scientific Name	Detection Method[1]
Little Pied Bat	*Chalinolobus picatus*	ANA
Feral Cat	*Felis catus*	OBS, CAM
Water Rat	*Hydromys chrysogaster*	TRA, CAM
Eastern Grey Kangaroo	*Macropus giganteus*	OBS, SC, CAM
Common Wallaroo	*Macropus robustus*	OBS
Red-necked Wallaby	*Macropus rufogriseus*	OBS, CAM
Eastern Bent-wing Bat	*Miniopterus orianae oceanensis*	ANA
Northern Free-tailed bat	*Mormopterus lumsdenae*	ANA
Eastern Free-tailed Bat	*Mormopterus ridei*	ANA
Gould's Long-eared Bat	*Nyctophilus gouldi*	HARP
European Rabbit	*Oryctolagus cuniculus**	OBS, SC, CAM
Greater Glider	***Petauroides volans***	OBS, SC
Koala#	***Phascolarctos cinereus***	SCA
Yellow-bellied Sheathtail-Bat	*Saccolaimus flaviventris*	ANA
Inland Broad-nosed Bat	*Scotorepens balstoni*	ANA
Little Broad-nosed Bat	*Scotorepens greyii*	ANA
Feral Pig	*Sus scrofa**	Wallows
Short-beaked Echidna^	*Tachyglossus aculeatus*	CAM
Troughton's Sheathtail-Bat	*Taphozous troughtoni*	ANA
Common Brushtail Possum	*Trichosurus vulpecula*	OBS, CAM, SCA
Inland Forest Bat	*Vespadelus baverstocki*	ANA
Eastern Cave bat	*Vespadelus troughtoni*	HARP, ANA
Fox	*Vulpes vulpes**	TRA
Amphibians		
Green-striped Frog	*Cyclorana alboguttata*	OBS
Short-footed Frog	*Cyclorana brevipes*	OBS, HC
Eastern Snapping Frog	*Cyclorana novaehollandiae*	OBS, HC
Salmon Striped Frog	*Limnodynastes salmini*	OBS, HC
Spotted Grass Frog	*Limnodynastes tasmaniensis*	OBS
Dwarf Tree frog	*Litoria fallax*	HC
Emerald Spotted Treefrog	*Litoria peronii*	HC
Desert Tree Frog	*Litoria rubella*	OBS, HC
Barking Frog	*Lymnodynastes fletcheri*	OBS, HC
Ornate Burrowing Frog	*Platyplectrum ornatum*	OBS, HC
Ornate Burrowing Frog	*Platyplectrum ornatum*	OBS
Cane Toad	*Rhinella marina**	OBS, HC
Reptiles		
Jacky Lizard	*Amphibolurus muricatus*	OBS
Brown Tree Snake	*Boiga irregularis*	OBS
Open-litter Rainbow-skink	*Carlia pectoralis*	OBS
Copper-tailed Skink	*Ctenotus taeniolatus*	OBS
Green Tree Snake	*Dendrelaphis punctulata*	OBS

Common Name	Scientific Name	Detection Method[1]
Dubious dtella	*Gehyra dubia*	OBS
Bynoe's Gecko	*Heteronotia binoei*	OBS
Eastern Mulch-slider	*Lerista fragilis*	OBS
Fish		
Spangled Perch	*Leiopotherapon unicolour*	OBS
Eel-tailed Catfish	*Tandanus tandanus*	OBS

[1] Codes: Direct Observation (OBS), Heard Call (HC), Tracks (TRA), Scat (SC), PIR Camera (CAM) Anabat recording (ANA),Harp Trap (HARP)
* Denotes exotic species; **BOLD** denotes threatened under EPBC ACT # - Threatened under NC Act
^ - Special Least Concern under NC Act

Appendix 4: PIR Camera Photos

PIR Camera photo 1: Wild Dog

PIR Camera photo 2: Glossy Ibis

PIR Camera photo 3: Feral Cat

PIR Camera photo 4: Whistling Kite

PIR Camera photo 5: Rufous Bettong

PIR Camera photo 6: Emu

PIR Camera photo 7: Brushtail Possum

PIR Camera photo 8: Eastern Grey Kangaroo

PIR Camera photo 9: Echidna

Appendix 5: Wildlife Online Search Results

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: Native
Status: Rare and threatened species
Records: All
Date: All
Latitude: -22.838
Longitude: 148.65
Distance: 10
Email: Will.Steggall@naturecall.com.au
Date submitted: Wednesday 13 Dec 2017 14:10:49
Date extracted: Wednesday 13 Dec 2017 14:30:02

The number of records retrieved = 3

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		V	V	1
animals	mammals	Pseudocheiridae	*Petauroides volans*	greater glider		V	V	3
plants	higher dicots	Apocynaceae	*Cerbera dumicola*			NT		2/2

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix 6: Matters of State Environmental Significance Report

Queensland Government

Department of Environment and Heritage Protection

Environmental Reports

Matters of State Environmental Significance

Area of Interest: Longitude: 148.62919 Latitude: -22.82804

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@ehp.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.

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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, AOI details

Area of Interest	148.62919,-22.82804 with 2 kilometre radius
Size (ha)	1256.6
Local Government(s)	ISAAC REGIONAL
Bioregion(s)	Brigalow Belt
Subregion(s)	Isaac - Comet Downs
Catchment(s)	Fitzroy

Refer to **Map 1** for locality information.

Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992*;

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004*;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  • Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;

  • Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;

  • Category R areas on the regulated vegetation management map;

  • Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;

  • Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014*;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Referable Wetlands under the Environmental Protection Regulation 2008;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;

- Legally secured offset areas.

Refer to **Appendix 1** for a description of MSES categories.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

MSES Criteria 1 - STATE CONSERVATION AREAS	0.0 ha	0.0%
1.1 Protected Areas	0.0 ha	0.0%
1.2 Marine Parks	0.0 ha	0.0%
1.3 Fish Habitat Areas	0.0 ha	0.0%
MSES Criteria 2 - WETLANDS AND WATERWAYS - area features	29.5 ha	2.3%
MSES Criteria 2 - WETLANDS AND WATERWAYS - linear features	0.0 km	Not applicable
2.1 High Ecological Significance wetlands on the map of Referable Wetlands	29.5 ha	2.3%
2.2 High Ecological Value (HEV) wetlands	0.0 ha	0.0%
2.2 High Ecological Value (HEV) waterways **	0.0 km	Not applicable
2.3 Strategic Environmental Areas (SEA)	0.0 ha	0.0%
MSES Criteria 3 - SPECIES	0.0 ha	0.0%
3.1 Threatened species and Iconic species	0.0 ha	0.0%
MSES Criteria 4 - REGULATED VEGETATION - area features	74.7 ha	5.9%
MSES Criteria 4 - REGULATED VEGETATION - linear features	7.3 km	Not applicable
4.1 Vegetation Management Regional Ecosystems and Remnant Map *	44.2 ha	3.5%
4.2 Vegetation Management Wetland Map *	30.5 ha	2.4%
4.3 Vegetation Management Watercourse Map **	7.3 km	Not applicable
MSES Criteria 5 - OFFSET AREAS	0.0 ha	0.0%
5.1 Legally secured offset areas	0.0 ha	0.0%
Total MSES (criteria 1.1, 1.2, 1.3, 2.1, part of 2.2, 2.3, 3.1, 4.1, 4.2 and 5.1) calculated for area features only	76.1 ha	6.1%

Please note that the area and percent area figures in the table above will not necessarily add up to the "Total MSES" figures due to overlapping values.

**The total extent area of regulated vegetation (Criteria 4.1) may be overestimated due to the presence of dominant and/or subdominant non-regulated regional ecosystems in mixed patches of vegetation, i.e. the total area of mixed vegetated patches is included irrespective of whether the patch consists only partly of endangered, of concern or wetland regional ecosystems.*

***The total linear extent of watercourses may be overestimated in some instances, as both banks (rather than the centreline) of waterbodies and larger watercourses where present are mapped by the State, increasing the extent of linear features*.

Additional Information with Respect to MSES Values Present

Criteria 1 - State Conservation Areas

1.1 Protected Areas

(no results)

1.2 Marine Parks

(no results)

1.3 Fish Habitat Areas

(no results)

Refer to **Map 2 - MSES Criteria 1 - State Conservation Areas** for an overview of the relevant MSES.

Criteria 2 - Wetlands and Waterways

2.1 High Ecological Significance wetlands on the Map of Referable Wetlands

Natural wetlands that are 'High Ecological Significance' (HES) on the Map of Referable Wetlands are present

2.2 High Ecological Value (HEV) wetlands

(no results)

2.2 High Ecological Value (HEV) waterways

(no results)

2.3 Strategic Environmental Areas

(no results)

Refer to **Map 3 - MSES Criteria 2 - Wetlands and Waterways** for an overview of the relevant MSES.

Criteria 3 - Species

3.1 Threatened species and Iconic species

Threatened and/or iconic species habitat within the AOI (derived from records/essential habitat mapping)

(no results)

**NCA E or V - Endangered or Vulnerable status under the NCA; VMA ehab - VMA essential habitat; Iconic - Iconic species.*

To request a species list for an area, or search for a species profile, access Wildlife Online at:
https://www.qld.gov.au/environment/plants-animals/species-list/

Koala bushland habitat

(no results)

Dugong areas

(no results)

Refer to **Map 4 - MSES Criteria 3 - Species** for an overview of the relevant MSES.

Criteria 4 - Regulated Vegetation

4.1 Endangered and Of Concern regional ecosystems and Category R Regulated Vegetation

Regulated Vegetation Description	Regional Ecosystem Patch	VMA status
rem_oc	11.3.2	O-dom
rem_end	11.3.2/11.3.21	E-subdom
rem_end	11.3.1/11.3.2	E-dom
rem_oc	11.3.2/11.3.7	O-dom
rem_end	11.4.9	E-dom

For further information relating to regional ecosystems in general, go to:
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/
For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:
https://environment.ehp.qld.gov.au/regional-ecosystems/

4.2 Vegetation Management Wetlands

Vegetation Management Wetlands are mapped as present

Wetlands datasource

Qld Wetlands Mapping

4.3 Watercourses shown on the Vegetation Management Watercourse and Drainage Feature Map

A vegetation management watercourse is mapped as present

Watercourses datasource

Vegetation Management Watercourse Map

Refer to **Map 5 - MSES Criteria 4 - Regulated Vegetation** for an overview of the relevant MSES.

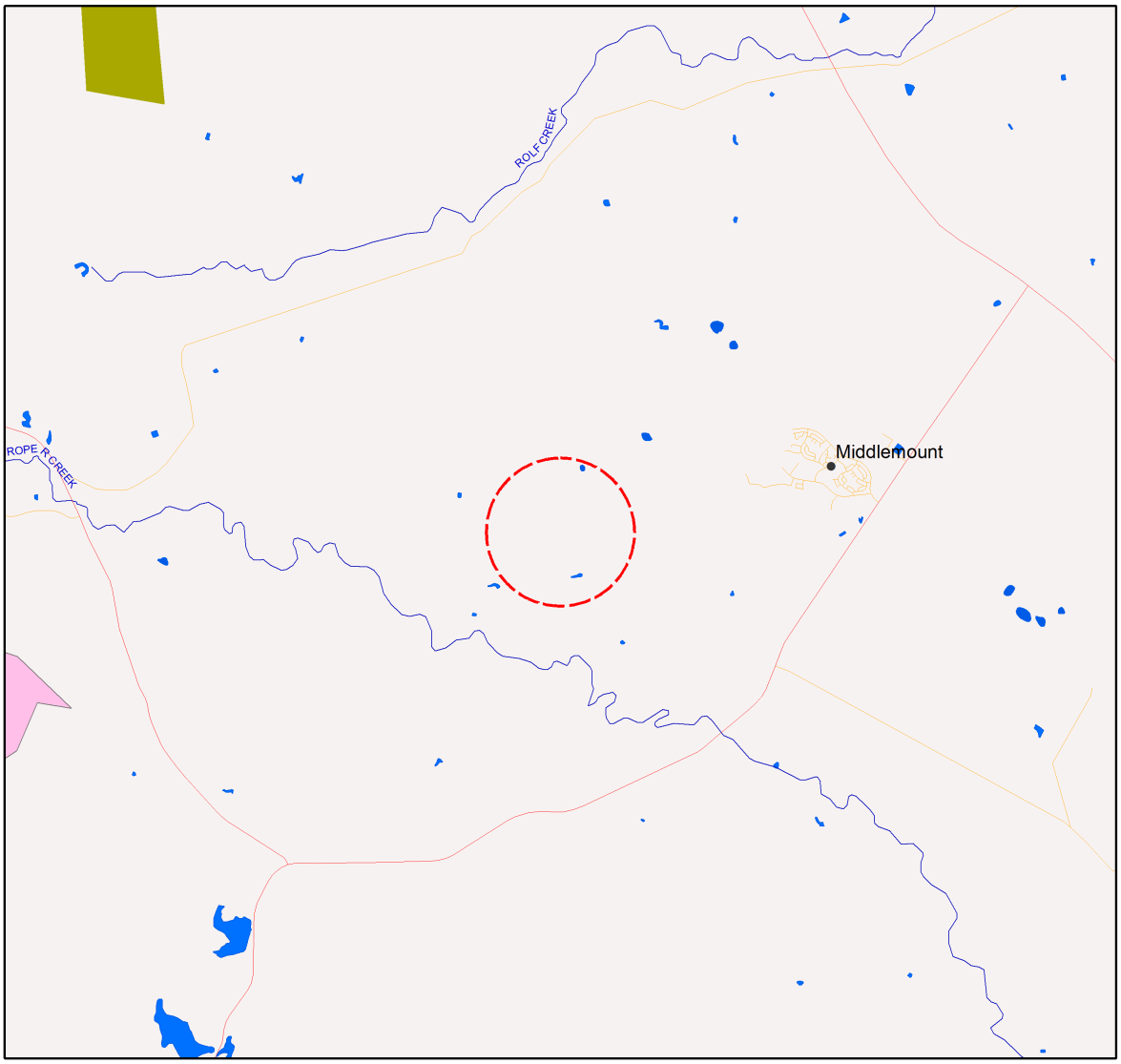
Criteria 5 - Offset Areas

5.1 Legally secured offset areas

(no results)

Refer to **Map 6 - MSES Criteria 5 - Offset Areas** for an overview of the relevant MSES.

Maps
Map 1 - Location



Locality Map

Legend

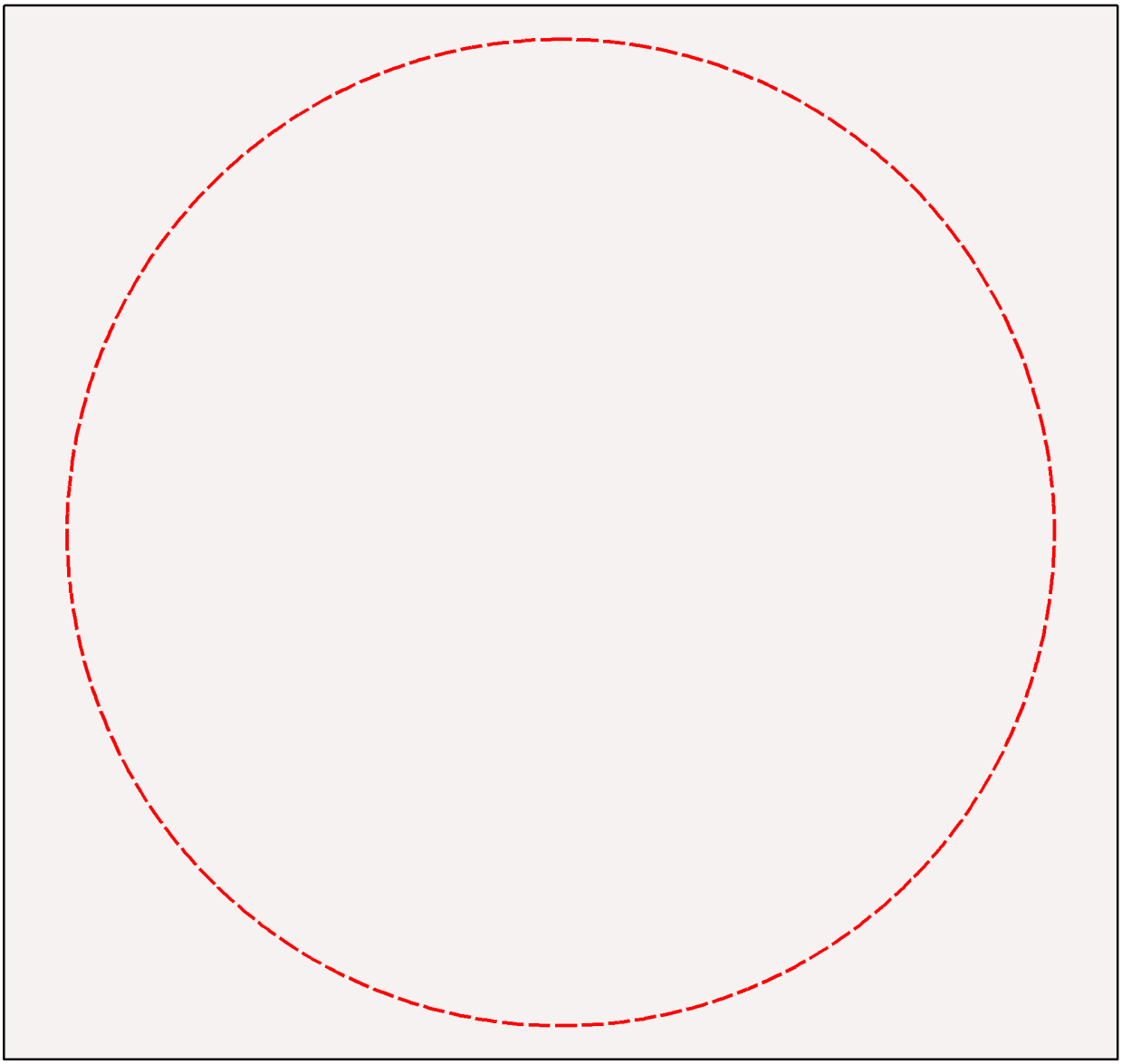
- 2 kilometre buffer
- Towns
- Highway
- Connector
- Street/Local Road
- National Park (Scientific)
- National Park
- National Park (CYPAL)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve
- Nature Refuges
- Lakes and Reservoirs
- Major rivers/creeks
- Queensland

N

0 0.9 1.8 2.7 3.6 4.5 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

Map 2 - MSES Criteria 1 - State Conservation Areas



MSES Criteria 1- State Conservation Areas

Area of Interest

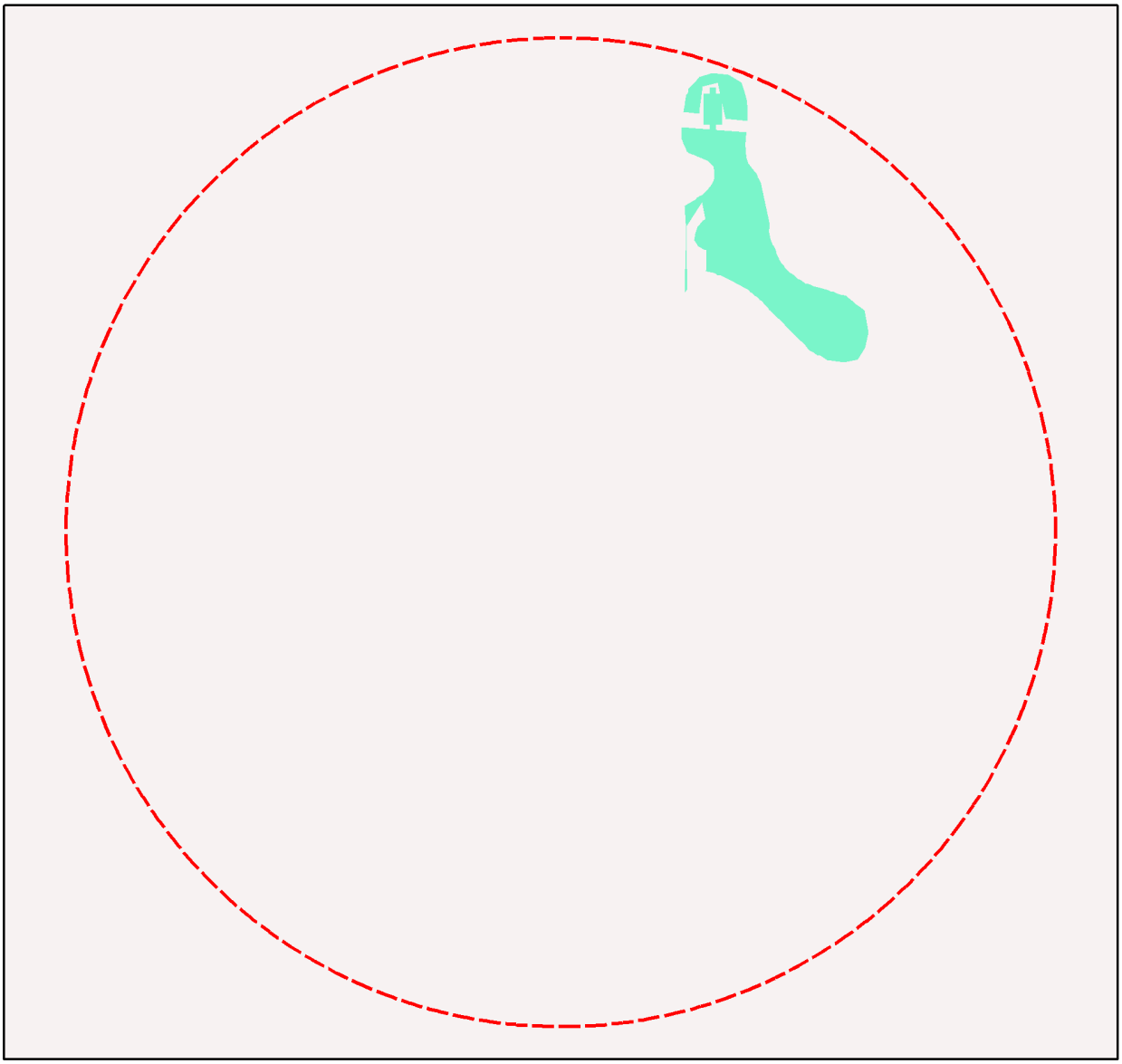
- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- MSES Protected area
- MSES Declared fish habitat area
- MSES Marine park

N

0 0.15 0.3 0.45 0.6 0.75 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

Map 3 - MSES Criteria 2 - Wetlands and Waterways



MSES Criteria 2 - Wetlands and Waterways

Area of Interest

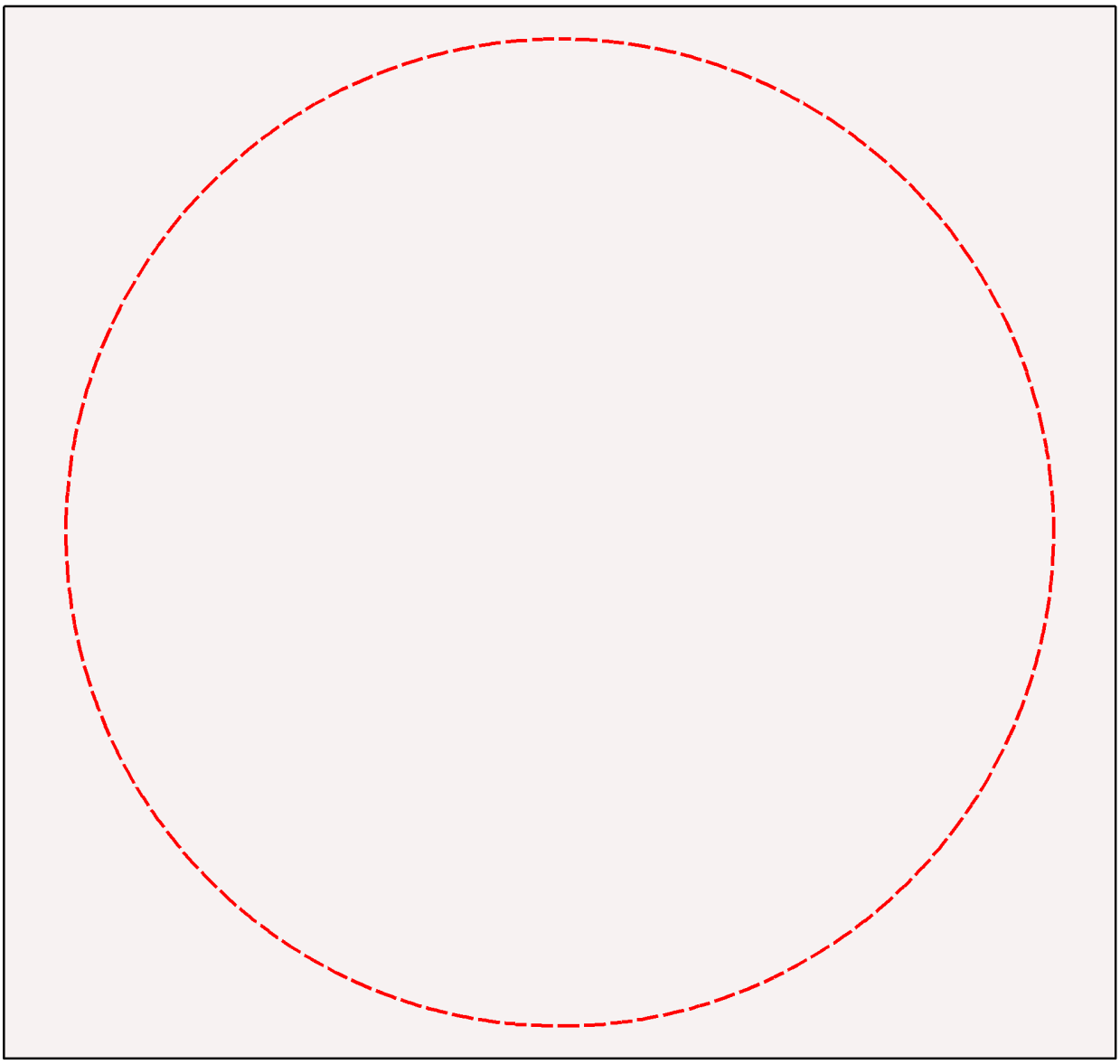
- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- MSES - High ecological value waters (watercourses)
- MSES - Strategic environmental area (designated precinct)
- MSES - High ecological value waters (wetland)
- MSES - High ecological significance wetlands

N

0 0.15 0.3 0.45 0.6 0.75 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

Map 4 - MSES Criteria 3 - Species



MSES Criteria 3 - Species

Area of Interest

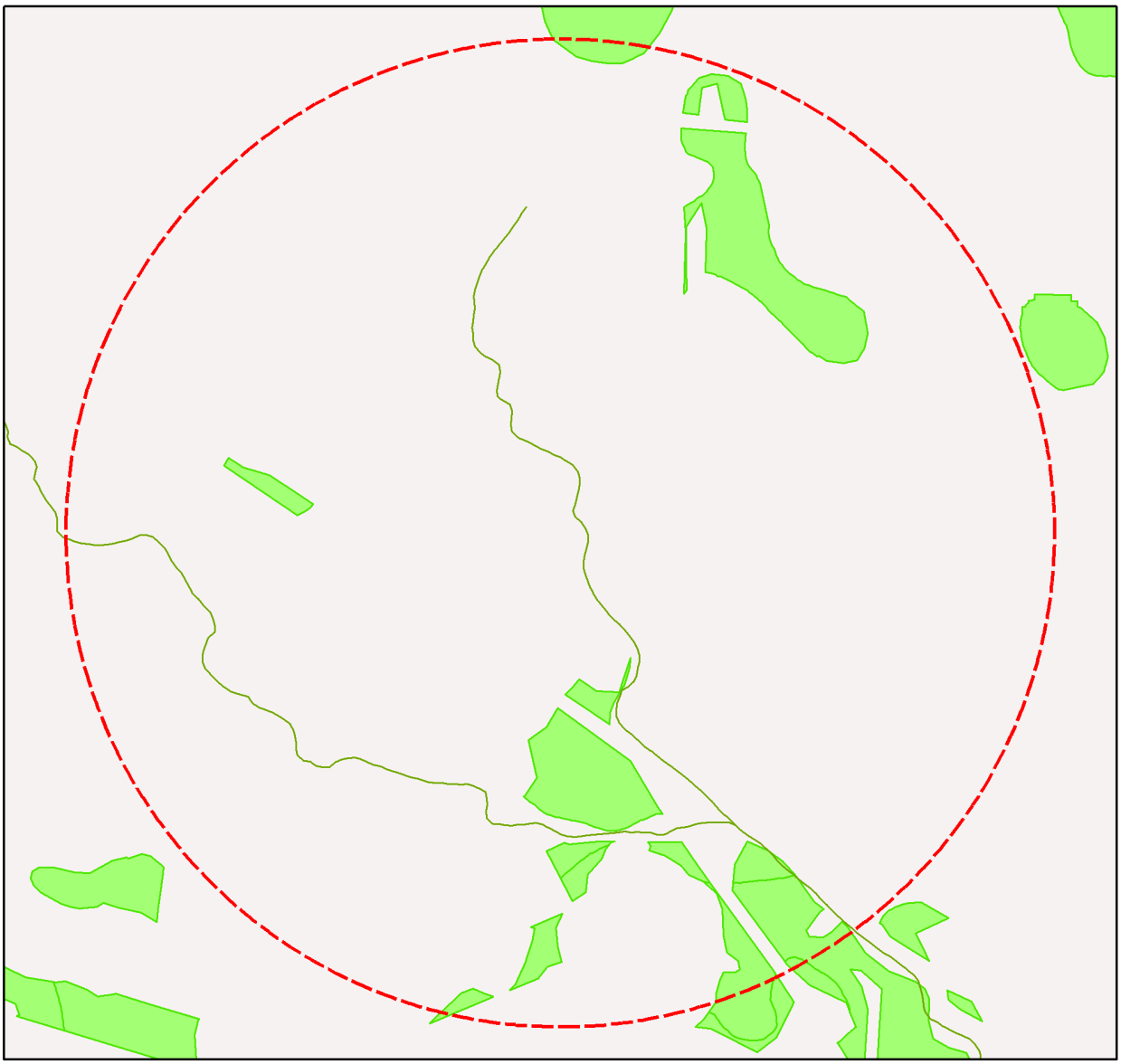
- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- MSES - Wildlife habitat

N

0 0.15 0.3 0.45 0.6 0.75 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

Map 5 - MSES Criteria 4 - Regulated Vegetation



MSES Criteria 4 - Regulated Vegetation

Area of Interest

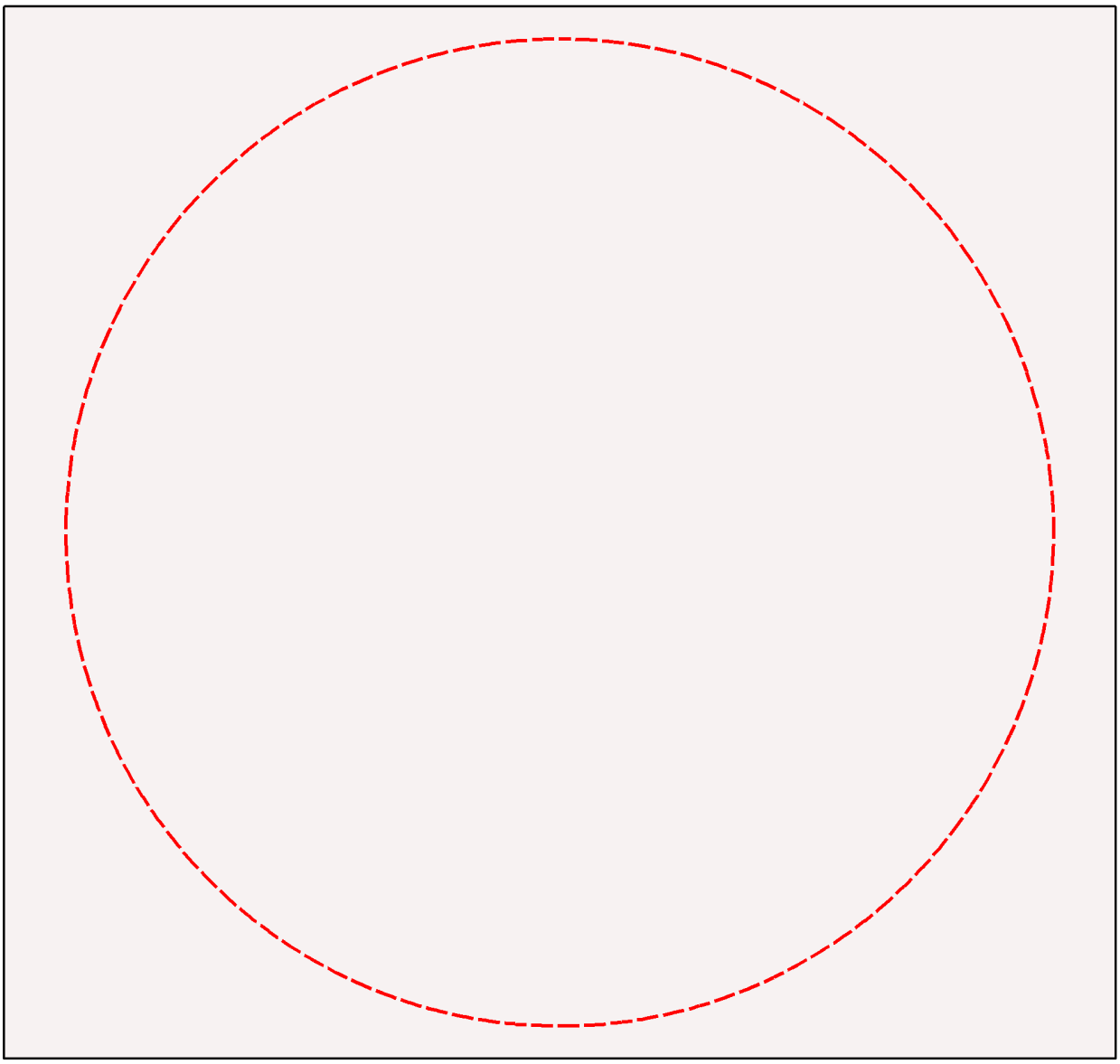
- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- MSES - Regulated vegetation (intersecting a watercourse)
- MSES - Regulated vegetation

N

0 0.15 0.3 0.45 0.6 0.75 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

Map 6 - MSES Criteria 5 - Offset Areas



MSES Criteria 5 - Offset Areas

Area of Interest

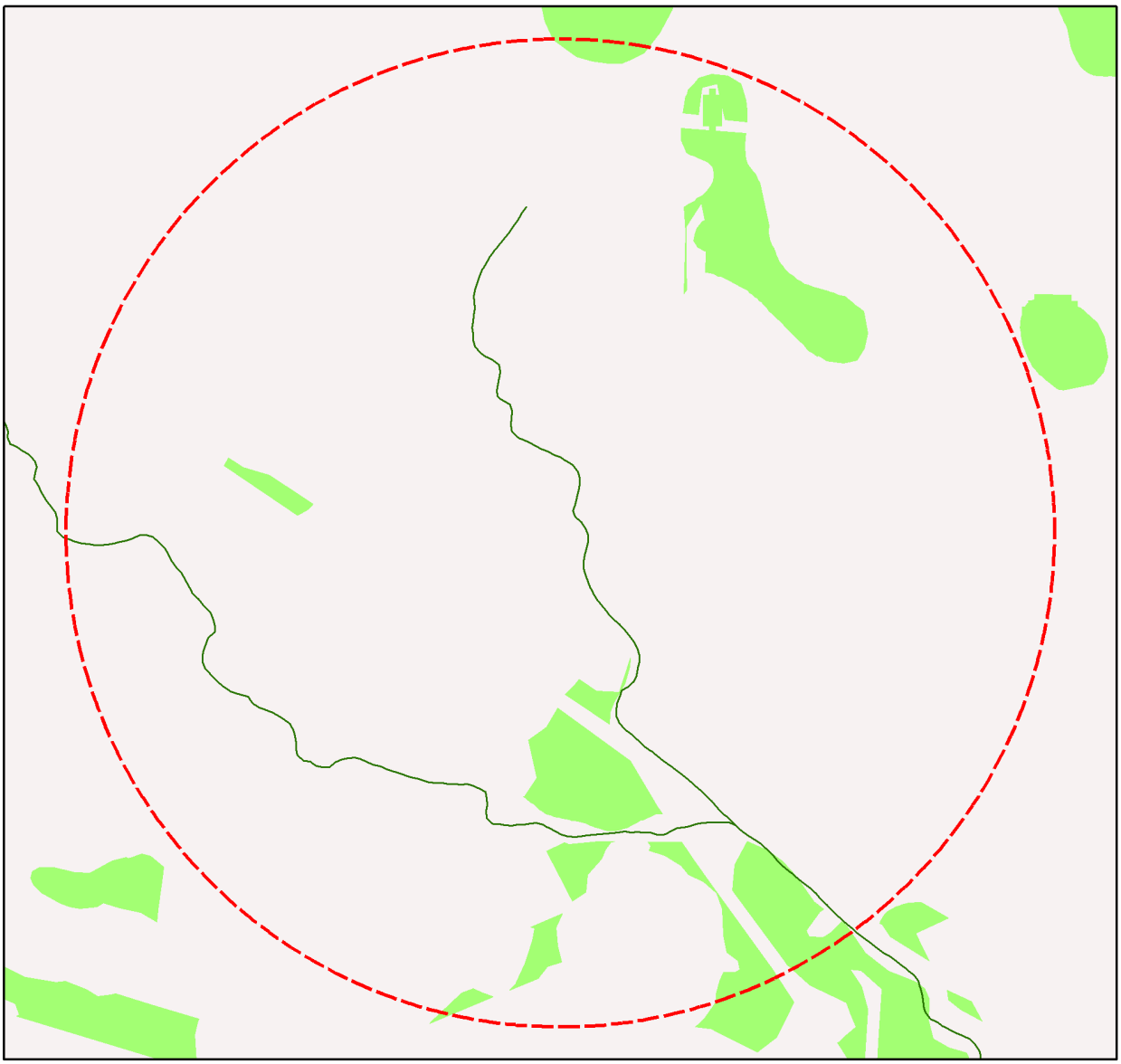
- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- MSES - Legally secured offset area

N

0 0.15 0.3 0.45 0.6 0.75 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

Map 7 - Matters of State Environmental Significance



Matters of State Environmental Significance

Area of Interest

- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Matters of State Environmental Significance (watercourses)
- Matters of State Environmental Significance (areas)

N

0 0.1 0.2 0.3 0.4 0.5 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) Criteria

Feature Name	Description
1.1 Protected Areas (NCA)	Protected areas under the *Nature Conservation Act 1992*, except coordinated conservation areas.
1.2 Marine Parks (MPA)	The following State marine parks zones under the *Marine Parks Act 2004*: - Marine National Park zone; - Marine Conservation Park zone; - Scientific Research zone; - Preservation zone; - Buffer zone.
1.3 Fish Habitat Areas (FA)	The following areas under the *Fisheries Act 1994* including: All fish habitat areas.
2.1 'High Ecological Significance' wetlands on the Map of Referable Wetlands	All natural wetlands that are 'High Ecological Significance' (HES) on the Map of Referable Wetlands. Exclude: any amendments to the Map of Referable Wetlands.
2.2 High Ecological Value (HEV) wetlands and waterways (EP Act)	Natural wetlands and waterways that occur in HEV (maintain) freshwater and estuarine areas under the Environmental Protection (Water) Policy.
2.3 Strategic Environmental Areas (RPI Act)	Designated precinct areas under the *Regional Planning Interests Act 2014*.
3.1 Threatened species and Iconic species (NCA)	Habitat for: Threatened wildlife under *Nature Conservation Act 1992* including: 'Endangered' and 'Vulnerable' species. Special least concern animals under the *Nature Conservation Act 1992* including: Koala (outside SEQ); Echidna and Platypus.
4.1 Vegetation Management Regional Ecosystem and Remnant Map (VMA)	Include VMA 'Endangered' and 'Of Concern' remnant (Category A and B) and high value regrowth (Category C) REs and Category R (GBR regrowth watercourse) areas from the Regulated Vegetation Management Map.
4.2 Vegetation Management Wetland Map (VMA)	Wetlands that are lakes and swamps shown on the Vegetation Management Wetlands Map.
4.3 Vegetation Management Watercourse and Drainage Feature Map (VMA)	Watercourses shown on the Vegetation Management Watercourse and Drainage Feature Map.
5.1 Legally secured offset areas (VMA, EP Act, SPA, TIA, EA)	Offset areas legally secured under a covenant, conservation agreement or development approval condition.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html.

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance
- Matters of State environmental significance drainage lines
- Boundaries of the Great Barrier Reef Marine Park

Note: MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Underlying data sources used to develop individual releases of complied MSES mapping include, but are not limited to:

- Regulated vegetation including:

- Regulated Regional Ecosystems and Regrowth
- Regulated Essential habitat
- Regulated Wetlands
- Regulated Watercourses and Drainage
- Former Regrowth

- Queensland Wetland Mapping (v3)
- Essential Habitat Mapping
- Protected Areas
- Marine Parks
- Fish Habitat Areas
- Strategic Environmental Areas
- The Map of Referable Wetlands:

- Wetland Protection Areas (HES wetlands in the GBR)
- Wetland Management Areas (contains other HES wetlands)

Datasets reflective of the above matters can be downloaded via the Queensland Spatial Catalogue:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
EHP	- Department of Environment and Heritage Protection
EP Act	- *Environmental Protection Act 1994*
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- *Vegetation Management Act 1999*

Appendix 7: Department of Environment and Heritage Protection Regional Ecosystem Report

Queensland Government

Department of Environment and Heritage Protection

Environmental Reports

Regional Ecosystems

Biodiversity Status

Area of Interest: Longitude: 148.62919 Latitude: -22.82804

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no matters of interest have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the status used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Natural Resources and Mines website

https://www.dnrm.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@dsitia.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.

Table of Contents

Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details

Area of Interest	148.62919,-22.82804 with 2 kilometre radius
Size (ha)	1256.6
Local Government(s)	ISAAC REGIONAL
Bioregion(s)	Brigalow Belt
Subregion(s)	Isaac - Comet Downs
Catchment(s)	Fitzroy

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	11.7	0.9
Of concern	109.5	8.7
No concern at present	404.1	32.2
Total remnant vegetation	525.4	41.8

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem is regularly reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c).

The Queensland Herbarium has developed a methodology for mapping regional ecosystems across Queensland. As new information is obtained, the descriptions and status of regional ecosystems is updated. Regional ecosystems and broad vegetation groups descriptions in the format of Sattler and Williams (1999) are maintained in the Regional Ecosystem Description Database (REDD). Vegetation communities and regional ecosystems are amalgamated into the higher level classification of broad vegetation groups (BVGs).

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of matters relevant to the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Natural Resources and Mines website.

https://www.dnrm.qld.gov.au/

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI, the associated short description, Biodiversity Status using the Queensland Herbarium's framework and the extent area present within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
11.3.1	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains	Endangered	9.4	0.8
11.3.2	Eucalyptus populnea woodland on alluvial plains	Of concern	31.7	2.5
11.3.25	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Of concern	43.6	3.5
11.3.27	Freshwater wetlands	Of concern	30.5	2.4
11.3.7	Corymbia spp. woodland on alluvial plains	Of concern	3.8	0.3
11.4.9	Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains	Endangered	2.3	0.2
11.5.3	Eucalyptus populnea ± E. melanophloia ± Corymbia clarksoniana woodland on Cainozoic sand plains and/or remnant surfaces	No concern at present	404.1	32.2
non-rem	None	None	731.2	58.2

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before European settlement.

Table 4 provides further information in regards to the remnant regional ecosystems present within the site with respect to the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
11.3.1	In 2013, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained	25a	None	Low
11.3.2	In 2013, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained	17a	Contains palustrine wetland (e.g. in swales).	Low

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
11.3.25	In 2013, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained	16a	Riverine wetland or fringing riverine wetland.	Low
11.3.27	In 2013, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained	34d	Palustrine or Lacustrine wetland (e.g. vegetated swamp or lake).	Low
11.3.7	In 2013, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained	9e	None	Low
11.4.9	In 2013, <10% of the pre-clearing area remained	25a	Contains palustrine wetland (e.g. in swales).	Low
11.5.3	In 2013, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained	17a	None	Low
non-rem	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

Map 6 displays the distribution of mapped wetland systems within the area of interest.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
11.3.1	Habitat for threatened fauna species including painted honeyeater, Grantiella picta particularly in subregion 35 (Oliver et al. 2003).
11.3.2	Habitat for threatened flora species Homopholis belsonii.
11.3.25	Habitat for threatened flora species including Eucalyptus raveretiana. Shown to be associated with a high fauna species richness in the Taroom area (Venz et al. 2002). Within parts of the Fitzroy catchment, this RE is known habitat for the threatened freshwater turtle Rheodytes leukops. Known to be important habitat for other riparian freshwater turtle species.
11.3.27	Habitat for a diverse range of fauna species (Venz et al. 2002) particularly birds. Hydrocharis dubia is a vulnerable water plant that occasionally occurs in this RE. 11.3.27a: Provides wetland habitat for a flora and fauna.
11.3.7	Habitat of the endangered northern hairy-nosed wombat, Lasiorhinus krefftii.
11.4.9	None
11.5.3	None
non-rem	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional).

A comprehensive description of BVGs is available at:

https://publications.qld.gov.au/dataset/vegetation-qld/resource/921fa786-e6d5-4a8a-9b0c-e532d2ce3f32

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	731.2	58.2
16a	Open forest and woodlands dominated by Eucalyptus camaldulensis (river red gum) (or E. tereticornis (blue gum)) and/or E. coolabah (coolabah) (or E. microtheca (coolabah)) fringing drainage lines. Associated species may include Melaleuca spp., Corymbia tessellaris (carbeen), Angophora spp., Casuarina cunninghamiana (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded. (land zone 3) (MGD, BRB, GUP, CHC, MUL, DEU, EIU, NWH, SEQ, [NET, WET]) (All bioregions except CYP and CQC)	43.6	3.5
17a	Woodlands dominated by Eucalyptus populnea (poplar box) (or E. brownii (Reid River box)) on alluvium, sand plains and footslopes of hills and ranges. (land zones 3, 5, 10, 9, 4, 11, 12, [8]) (BRB, MUL, DEU, MUL, EIU)	435.8	34.7
25a	Open forests to woodlands dominated by Acacia harpophylla (brigalow) sometimes with Casuarina cristata (belah) on heavy clay soils. Includes areas co-dominated with A. cambagei (gidgee) and/or emergent eucalypts (land zones 4, 9, 3, 11, 7, 12, [5, 8]) (BRB, MUL, MGD, DEU, [SEQ])	11.7	0.9
34d	Palustrine wetlands. Freshwater swamps/springs/billabongs on floodplains ranging from permanent and semi-permanent to ephemeral. (land zone 3) (GUP, EIU, BRB, CYP, CHC, [MGD])	30.5	2.4
9e	Open forests, woodlands and open woodlands dominated by Corymbia clarksoniana (grey bloodwood) (or C. novoguinensis or C. intermedia (pink bloodwood) or C. polycarpa (long-fruited bloodwood)) frequently with Erythrophleum chlorostachys (red ironwood) or Eucalyptus platyphylla (poplar gum) predominantly on coastal sandplains and alluvia. (land zones 3, 5, 2) (CYP, BRB, CQC, WET, EIU)	3.8	0.3

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant area (hectares) of each vegetation community derived from the regional ecosystem mapping (spatial) data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Quantitative site data from relatively undisturbed sites are extracted from CORVEG and summarized to provide information specific to each vegetation community.

Technical descriptions include the attributes: tree canopy height and cover and native plant species composition of the predominant layer, which are used to assess the remnant status of vegetation under the *Vegetation Management Act 1999*.

However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used where possible (Neldner et al. 2012 (PDF)* section 3.3.1 of:

http://www.qld.gov.au/environment/assets/documents/plants-animals/herbarium/herbarium-mapping-methodology.pdf

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

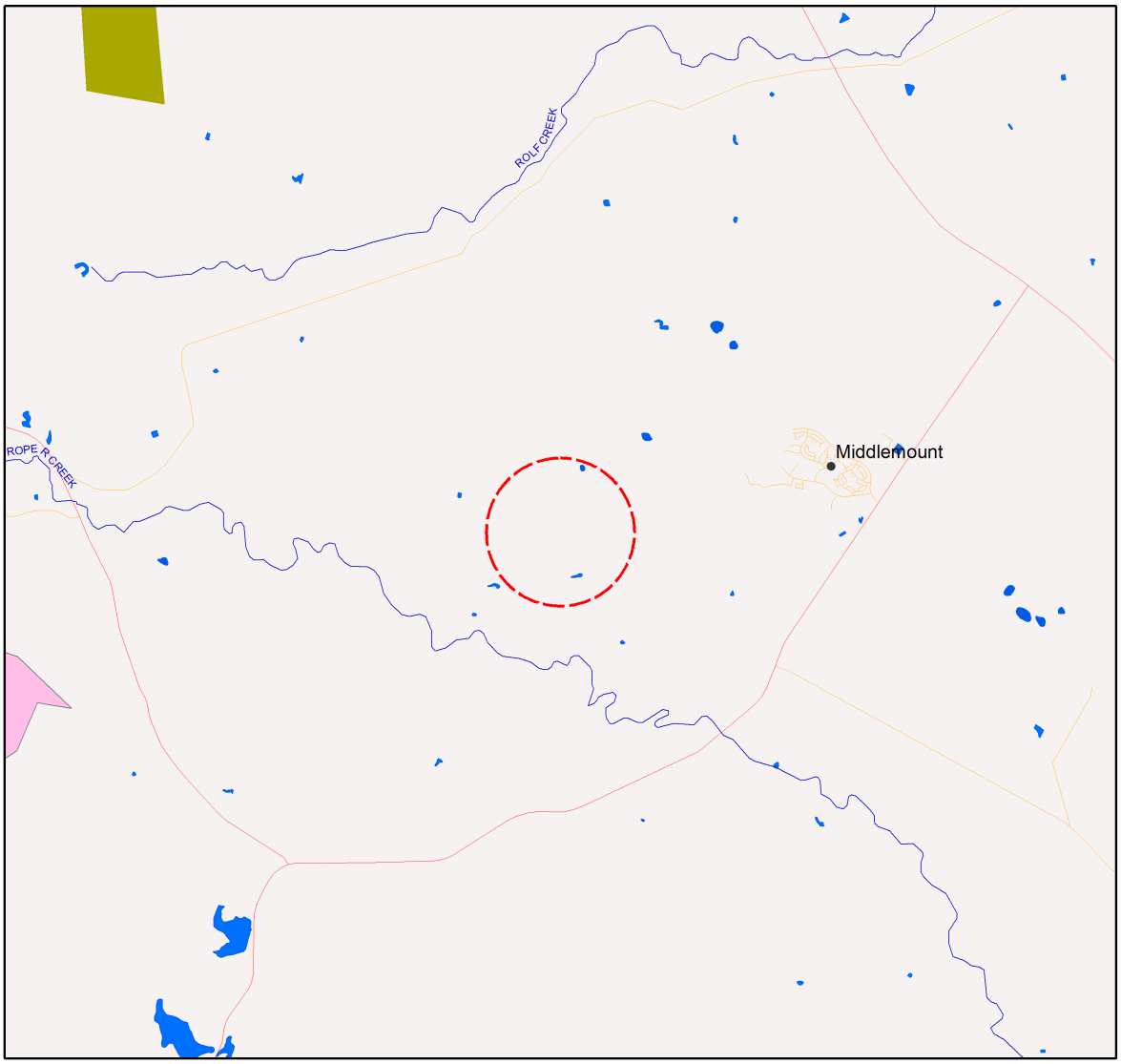
http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

Benchmarks are subject to review based on additional data and expert opinion. Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
11.3.1	Not currently available	Available
11.3.2	Not currently available	Available
11.3.25	Not currently available	Available
11.3.27	Not currently available	Not currently available
11.3.7	Not currently available	Not currently available
11.4.9	Not currently available	Not currently available
11.5.3	Not currently available	Not currently available
non-rem	Not currently available	Not currently available

Maps
Map 1 - Location



Locality Map

Legend

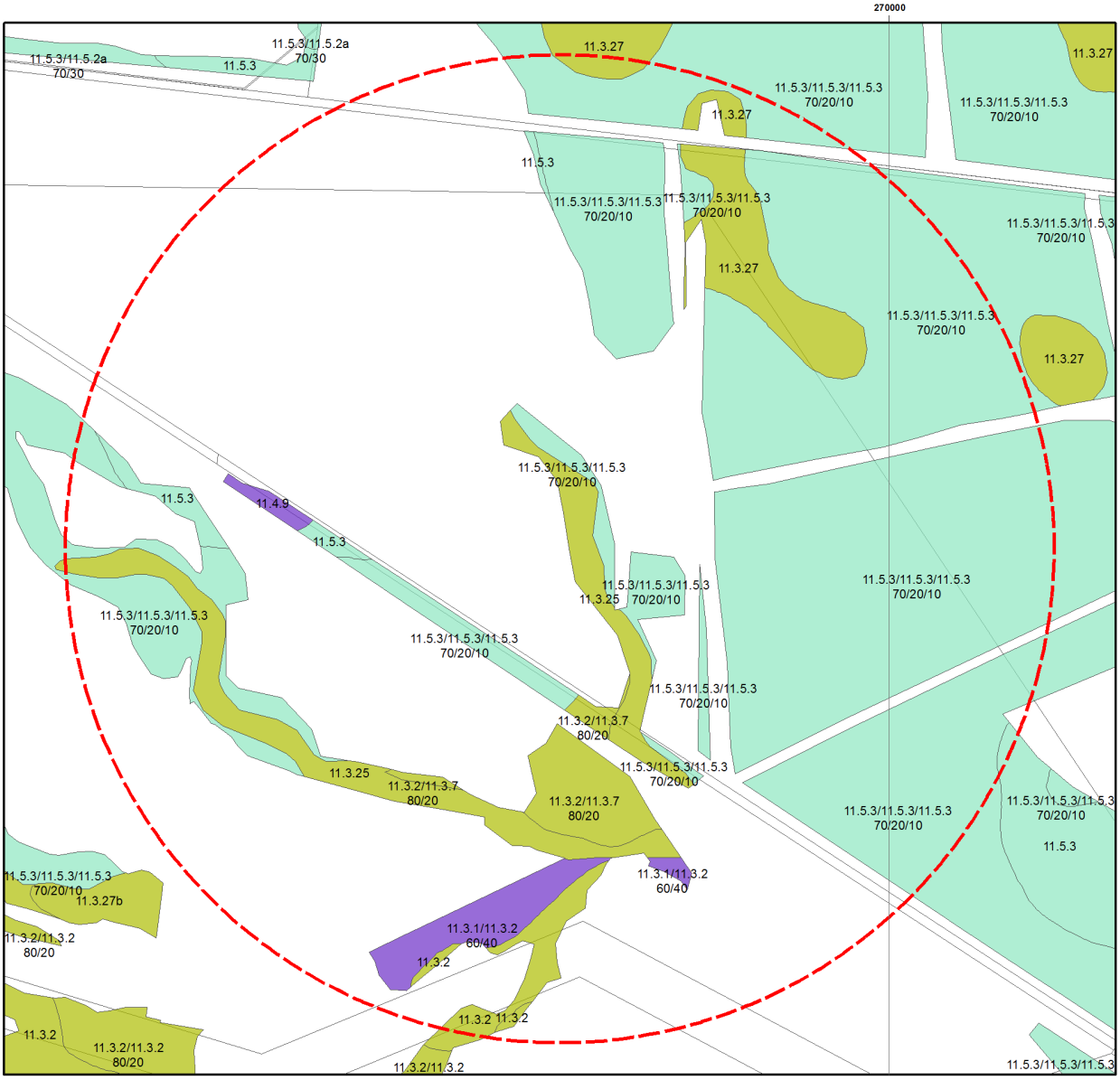
- 2 kilometre buffer
- Towns
- Highway
- Connector
- Street/Local Road
- National Park (Scientific)
- National Park
- National Park (CYPAL)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve
- Nature Refuges
- Lakes and Reservoirs
- Major rivers/creeks
- Queensland

N

0 0.9 1.8 2.7 3.6 4.5 Kilometers

This product is projected into:
GDA 1994 Queensland Albers

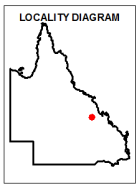
Map 2 - Remnant regional ecosystems



Remnant 2015 Regional Ecosystems

Biodiversity Status

- 2 kilometre buffer
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Non-remnant vegetation, cultivated or built environment
- Plantation
- Water
- Cadastral Boundaries



N

0 0.25 0.5 0.75 1 km

This product is projected into GDA 1994 Queensland Albers

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

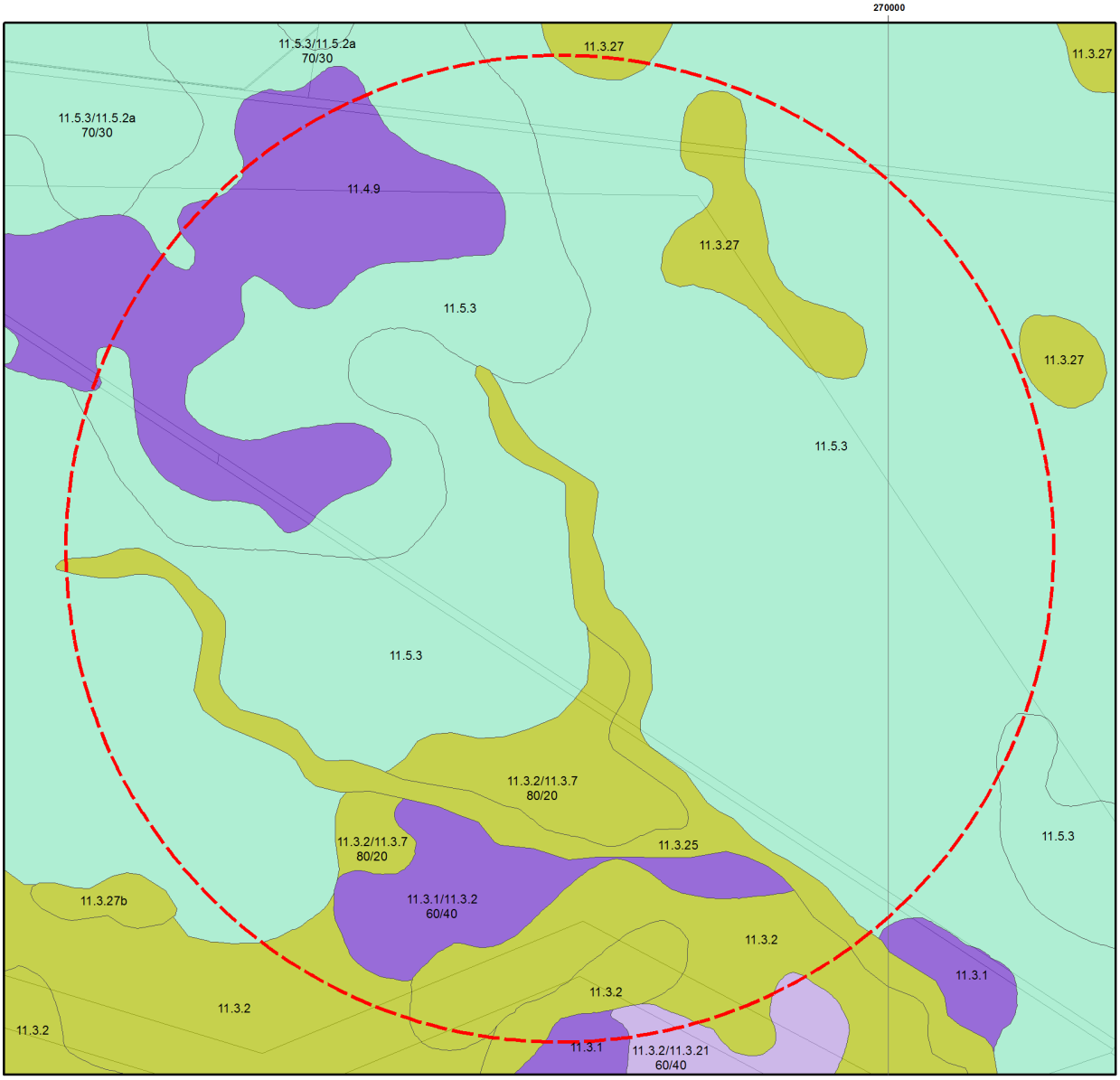
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".

Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.

Non-remnant vegetation includes regrowth and disturbed native vegetation.

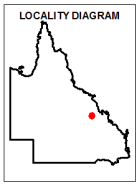
Map 3 - Pre-clearing remnant regional ecosystems



Pre-clearing Regional Ecosystems

Biodiversity Status

- 2 kilometre buffer
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Water
- Cadastral Boundaries



N

0 0.25 0.5 0.75 1 km

This product is projected into GDA 1994 Queensland Albers

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

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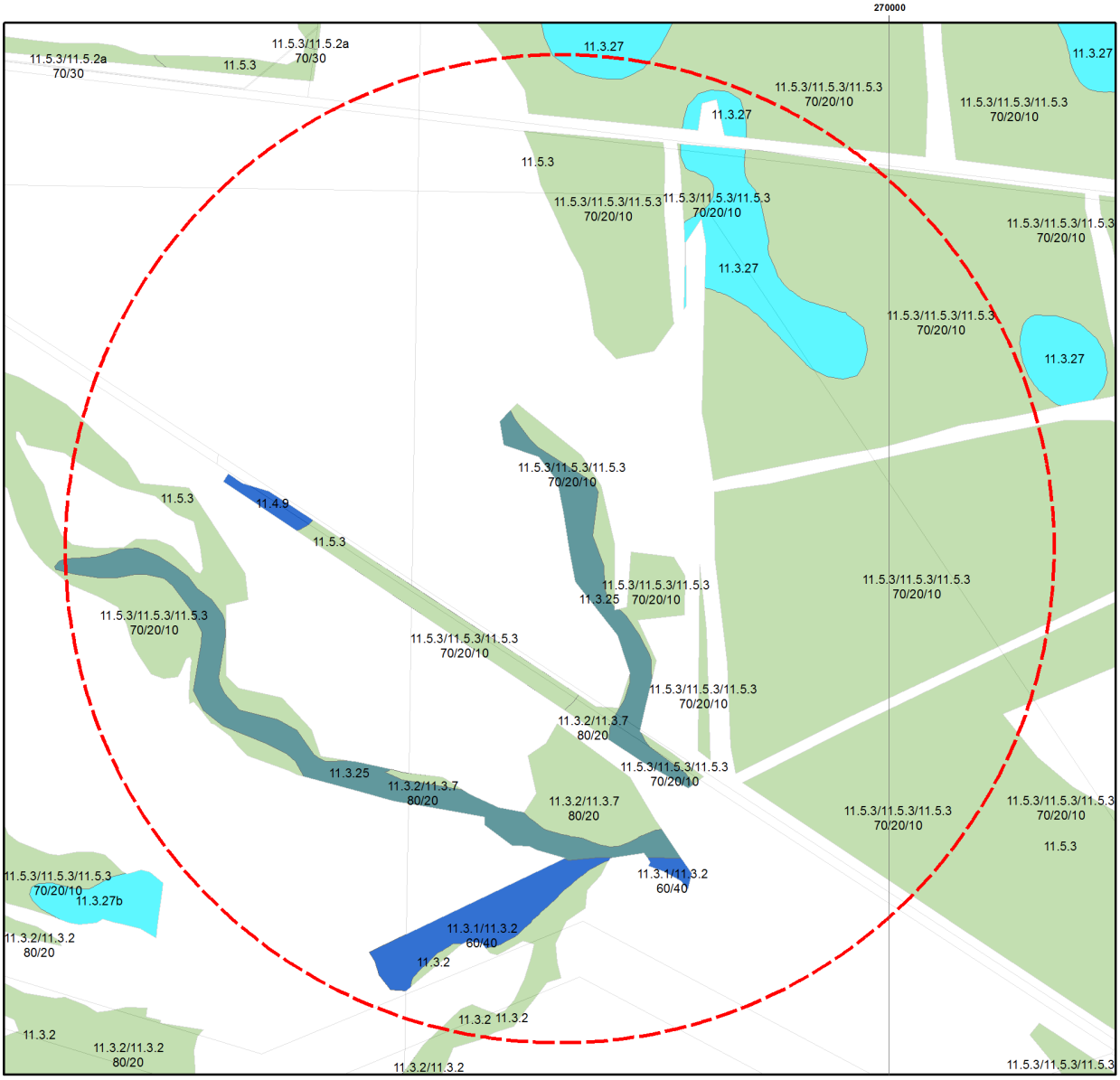
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

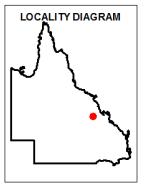
Map 4 - Remnant regional ecosystems by BVG (5M)



Remnant 2015 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

- 2 kilometre buffer
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Non-remnant vegetation, cultivated or built environment
- Water
- Cadastral Boundaries



N

0 0.25 0.5 0.75 1 km

This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

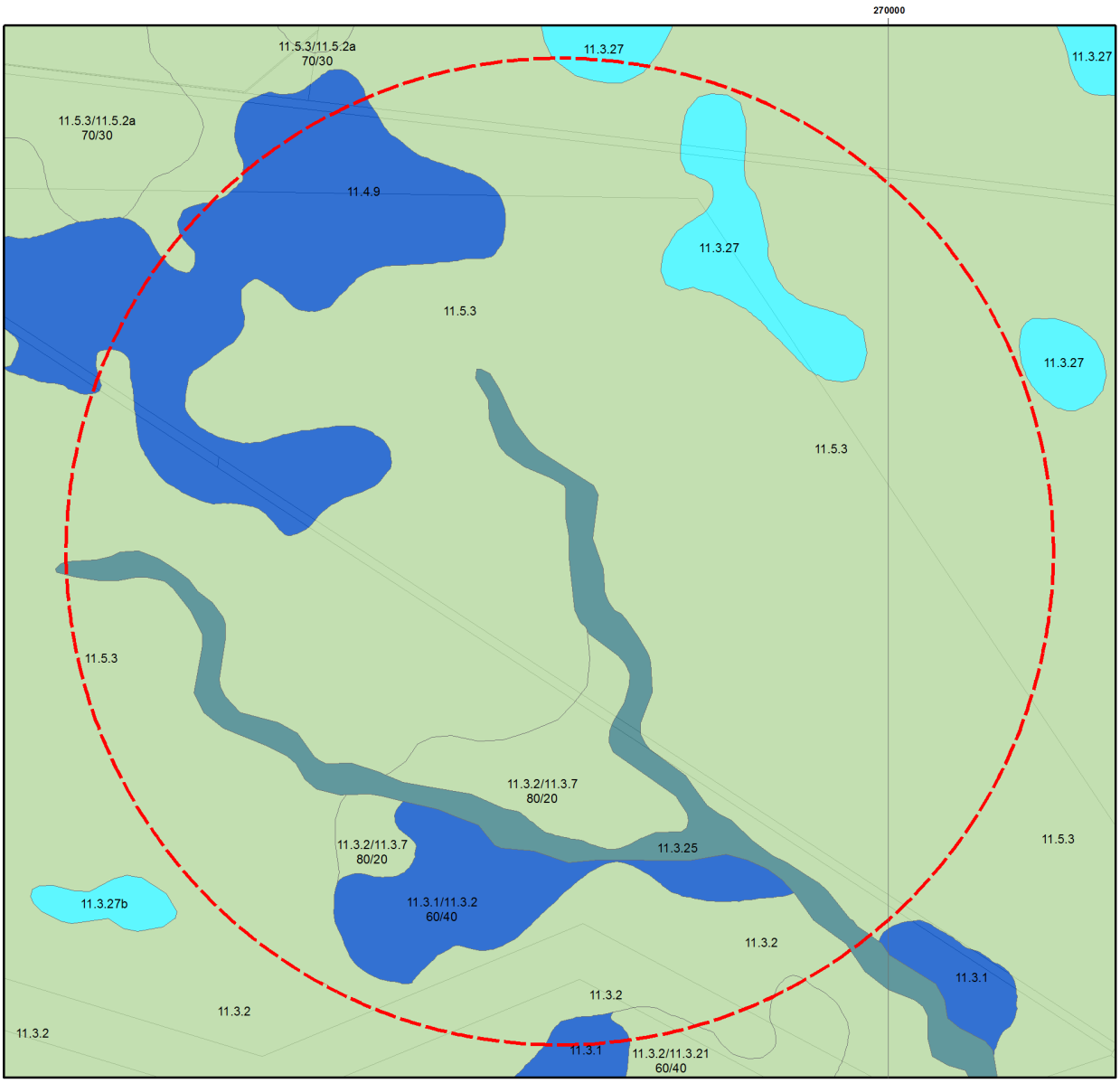
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".

Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.

Non-remnant vegetation includes regrowth and disturbed native vegetation.

Map 5 - Pre-clearing remnant regional ecosystems by BVG (5M)



Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

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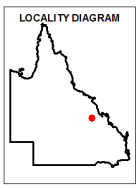
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Water
- Cadastral Boundaries



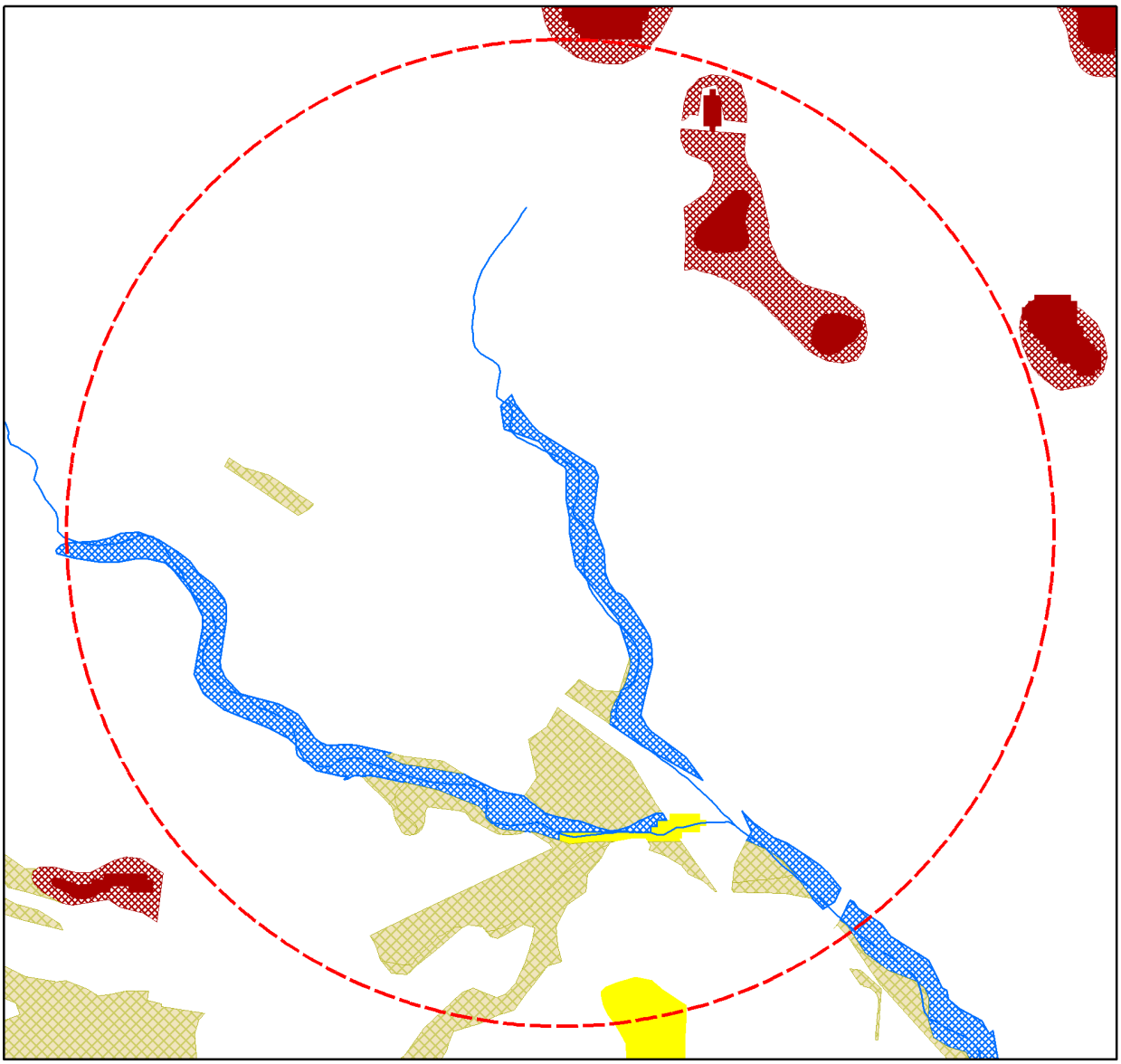
N

0 0.25 0.5 0.75 1 km

This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Map 6 - Wetlands and waterways



Queensland Wetland Data

Legend

- 2 kilometre buffer
- Towns (gazateer)

Queensland Wetland Data

- Riverine Drainage Lines
- Springs

Wetland System - Water Bodies

- Marine Waterbodies
- Estuarine Waterbodies
- Riverine Waterbodies
- Lacustrine Waterbodies
- Palustrine Waterbodies

Wetland System - Regional Ecosystems

- Marine RE
- Estuarine RE
- Riverine RE
- Lacustrine RE
- Palustrine RE
- RE 51-80% wetland (mosaic units)
- RE 1-50% wetland (mosaic units)

N

0 180 360 540 720 900 m

This product is projected into:
GDA 1994 Queensland Albers

Accuracy information: The positional accuracy of wetland data mapped at a scale of 1:100,000 is +/-100m with a minimum polygon size of 5ha or 75m wide for linear features, except for areas along the east coa st which are mapped at the 1:50,000 scale with a positional accuracy of +/-50m, with a minimum polygon size of 1ha or 35m wide for linear features. Wetlands smaller than 1ha are not delineated on the wetland data. Consideration of the effects of mapped scale is necessary when interpret ing data at a larger scale, e.g. 1:25,000. For property assessment, digital linework should be used as a guide only. The extent of wetlands depicted on this map is based on rectified 2013 Landsat ETM+ imagery supplied by Statewide Landcover and Trees Study (SLATS), Department of Science, Information Technology and Innovation (DSITI). The extent of water bodies is based on the maximum extent of inundation derived from available Landsat imagery up to and including the 2013 imagery.

Links and Other Information Sources

The Department of Environment and Heritage's Website -

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

https://publications.qld.gov.au/dataset/vegetation-qld/resource/921fa786-e6d5-4a8a-9b0c-e532d2ce3f32

The methodology for mapping regional ecosystems can be downloaded from:

http://www.qld.gov.au/environment/assets/documents/plants-animals/herbarium/herbarium-mapping-methodology.pdf

Technical descriptions for regional ecosystems can be obtained from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from:

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, such as the year at which the extent of remnant is reflective of, refer to the metadata associated with the relevant Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) and which is available through the Queensland Government Information System portal,

http://dds.information.qld.gov.au/dds/

The Queensland Globe is a mapping and data application implemented inside the Google Earth TM application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

http://www.dnrm.qld.gov.au/mapping-data/queensland-globe

References

Neldner, V.J., Wilson, B.A., Thompson, E.J., and Dillewaard, H.A. (2012). *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland*. Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts.

(http://www.qld.gov.au/environment/assets/documents/plants-animals/herbarium/herbarium-mapping-methodology.pdf)

Neldner, V.J., Niehus R.E., Wilson, B.A. McDonald, W.J.F. and Ford, A.J. (2014). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts.

(https://publications.qld.gov.au/dataset/vegetation-qld/resource/921fa786-e6d5-4a8a-9b0c-e532d2ce3f32)

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1: Source Data

The dataset listed below is available for download from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

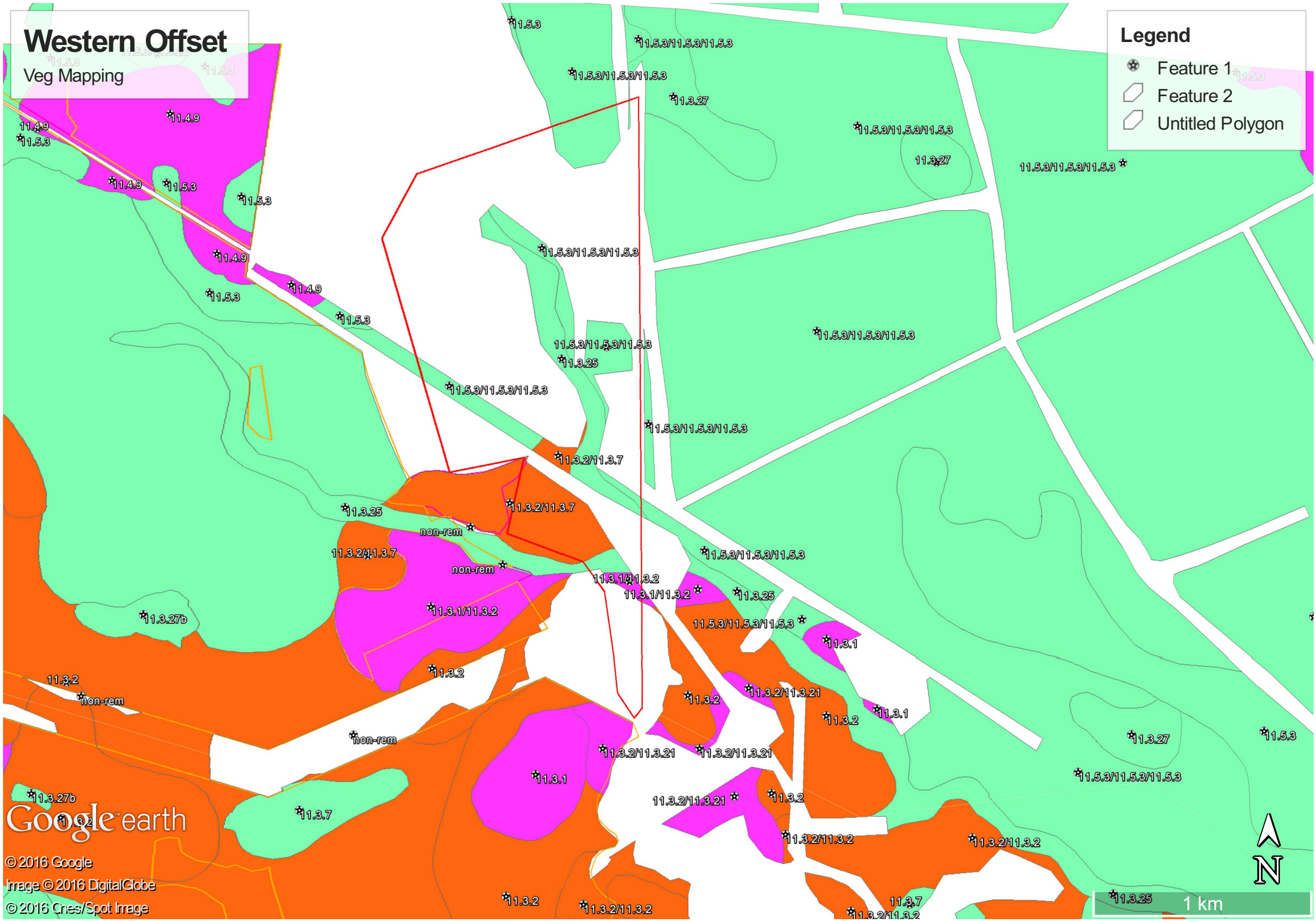
http://dds.information.qld.gov.au/dds/

- Remnant Regional Ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

Appendix 2 - Acronyms and Abbreviations

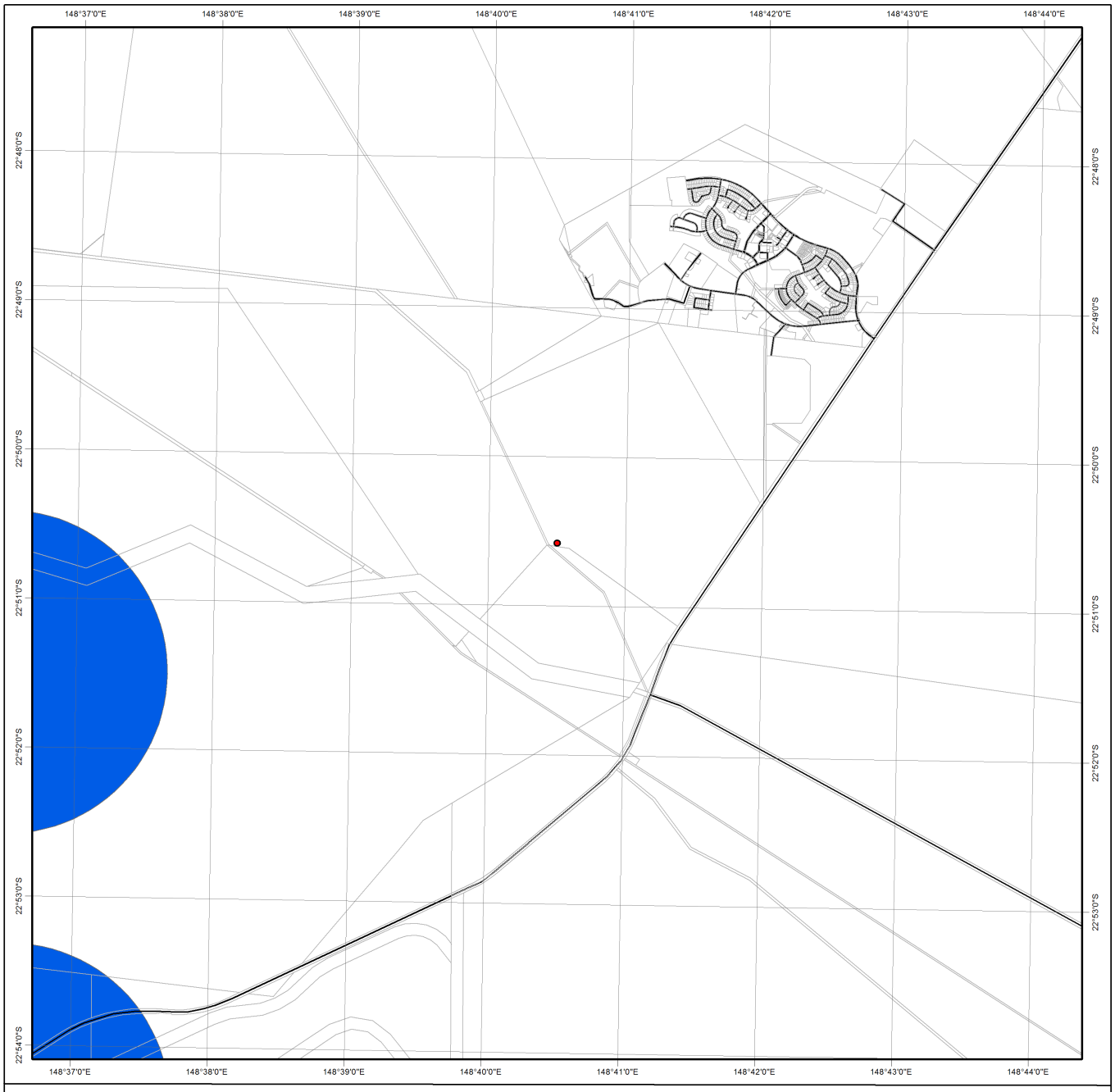
AOI	- Area of Interest
DNRM	- Department of Natural Resources and Mines
EHP	- Department of Environment and Heritage Protection
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
VMA	- *Vegetation Management Act 1999*

Appendix 8: Department of Natural Resources and Mines Regulated Vegetation Report


Western Offset
Veg Mapping
Legend
Feature 1
Feature 2
Untitled Polygon
11.5.3
11.5.3/11.5.3/11.5.3
11.3.27
11.4.9
11.3.25
11.3.2/11.3.7
non-rem
11.3.1/11.3.2
11.3.27b
11.3.2
11.3.2/11.3.21
11.3.1
11.3.7
11.3.2/11.3.2
11.3.27
11.5.3/11.5.3/11.5.3
Google earth
© 2016 Google
Image © 2016 DigitalGlobe
© 2016 Cnes/Spot Image
N
1 km

Appendix 9: High Risk Vegetation Trigger Report

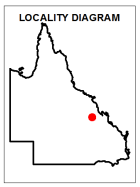
23/05/2017 16:38:25
Longitude: 148.675 Latitude: -22.843



Protected Plants Flora Survey Trigger Map

Legend

- Coordinates
- High risk area
- Cadastral line
  Property boundaries shown are provided as a locational aid only
- Freeways / motorways / highways
- Secondary roads / streets



N

0 490 980 1,470 1,960 2,450 m

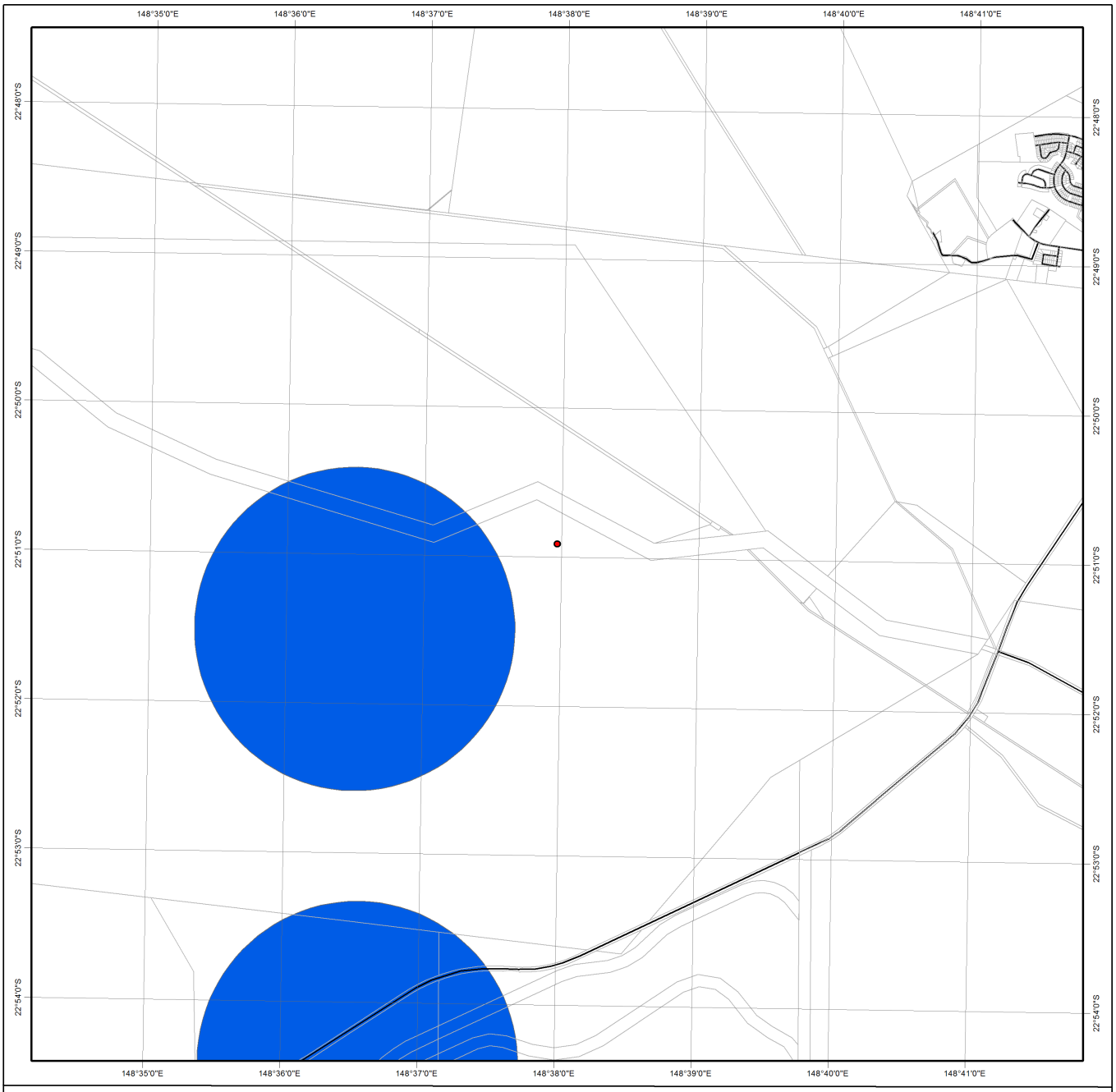
This product is projected into:
GDA 1994 Queensland Albers

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Heritage Protection at palm@ehp.qld.gov.au

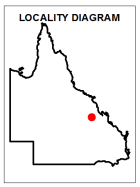
09/03/2017 10:00:55
Longitude: 148.6328 Latitude: -22.848517



Protected Plants Flora Survey Trigger Map

Legend

- Coordinates
- High risk area
- Cadastral line
  Property boundaries shown are provided as a locational aid only
- Freeways / motorways / highways
- Secondary roads / streets



N

0 490 980 1,470 1,960 2,450 m

This product is projected into:
GDA 1994 Queensland Albers

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Heritage Protection at palm@ehp.qld.gov.au

Queensland Government

Appendix 10: Matters of National Environmental Significance Report

Australian Government
Department of the Environment and Energy

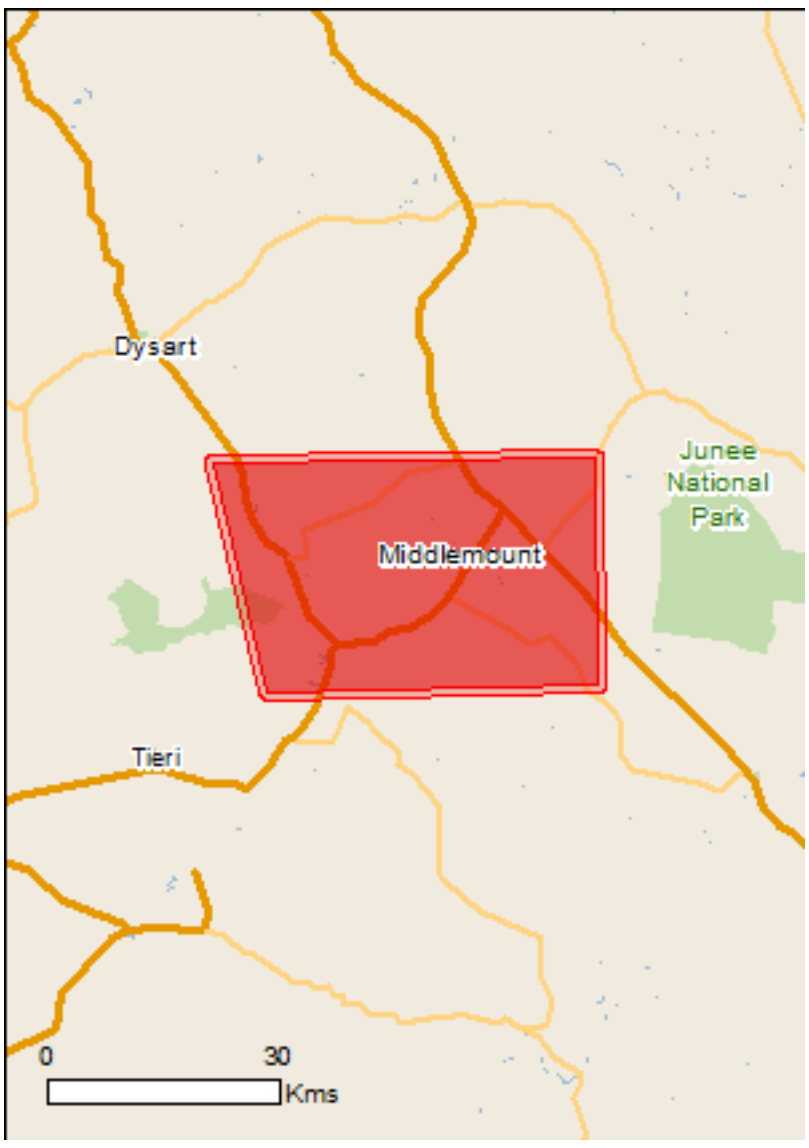
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

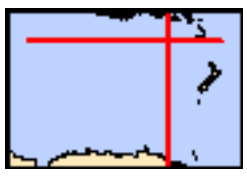
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 22/11/17 13:24:13



Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	23
Listed Migratory Species:	13

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	18
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered	Community likely to occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Dichanthium queenslandicum		
King Blue-grass [5481]	Endangered	Species or species habitat known to occur within area
Dichanthium setosum		
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Delma torquata		
Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Denisonia maculata		
Ornamental Snake [1193]	Vulnerable	Species or species habitat known to occur within area
Egernia rugosa		
Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Elseya albagula		
Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat likely to occur within area
Furina dunmalli		
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Lerista allanae		
Allan's Lerista, Retro Slider [1378]	Endangered	Species or species habitat may occur within area
Rheodytes leukops		
Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Norwich Park	QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-22.715327 148.413936,-22.71026 148.858882,-22.953273 148.861629,-22.96086 148.477107,-22.96086 148.477107,-22.715327 148.413936

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 11: Groundwater Dependent Ecosystems Database Report

Australian Government
Bureau of Meteorology

Groundwater Dependent Ecosystem Map Report

N

GDE, Reliant on surface expression of groundwater (rivers, springs, wetlands)

- Identified in previous study: fieldwork
- Identified in previous study: desktop
- High potential for groundwater interaction
- Moderate potential for groundwater interaction
- Low potential for groundwater interaction

GDE, Reliant on subsurface groundwater (vegetation)

- Identified in previous study: fieldwork
- Identified in previous study: desktop
- High potential for groundwater interaction
- Moderate potential for groundwater interaction
- Low potential for groundwater interaction
- No Ecosystems analysed

GDE, Subterranean (Cave & Aquifers)

- Identified in previous study: fieldwork
- Identified in previous study: desktop
- No Ecosystems analysed

1:64,346

Metres 1,000 2,000 3,000 4,000 5,000

Data source - Data are assumed to be correct as supplied from Commonwealth, State and Territory data suppliers or referenced projects.

Date: 19 May, 2017

Appendix 12: Landscape Fragmentation and Connectivity Tool Output

Department of Environment and Heritage Protection (DEHP)
Landscape Fragmentation and Connectivity (LFC) Tool version 1.4 LOGFILE
Process started at 26-02-2018 03:03:51 PM
Python version: 2.7.10 (default, May 23 2015, 09:40:32) [MSC v.1500 32 bit (Intel)]
Arcpy version: 10.4
Username: Libby

INPUT PARAMETERS
Output Workspace: H:\LFC Tool\Middlemount_WE_Rev4
Threshold lookup table: H:\LFC Tool\LFC_data.gdb\tbl_Regional_frag_local_threshold
Remnant cover layer: H:\LFC Tool\Qld Regulated Vegetation Map V1.48.gdb\Regulated_vegetation_management_map_EDITED
Remnant cover layer edited: True
Regional buffer extent: 20 kilometres
Local buffer extent: 5 kilometres
Impact layer: H:\LFC Tool\Middlemount_WE_Rev4\ProposedDisturbanceExtent.shp
layer projection: GDA_1994_MGA_Zone_56
Raster cell resolution for analysis: 10 metres
Edge Width: 50 metres
(The distance from non-remnant landscapes through to the core ecosystem - the edge of remnant ecosystems)
Default projection: H:\LFC Tool\scripts\QLD Albers Equal Area Conic.prj

15:03:51 Checking out the spatial analyst tool - required for LFC

15:03:51 _____BEGINNING LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS_____

15:03:51 This tool will categorise the landscape into:
{0: 'non-rem', 1: 'patch', 2: 'edge', 3: 'perforated', 4: 'core (< 100 hectares)', 5: 'core (100-500 hectares)', 6: 'core (> 500 hectares)'}

15:03:54 H:\LFC Tool\Middlemount_WE_Rev4\lyr_file does not exist, creating it now.
15:03:54 Copying across impact site feature(s) and calculating area in hectares (AreaHA)
15:03:55 Making a local copy of the impact site
15:03:55 Preparing remnant cover layer for analysis
15:03:56 Created regional scale buffer of 20 kilometres
15:03:56 Created local scale buffer of 5 kilometres
15:04:03 Clipped the remnant cover to the regional buffer extent
15:04:07 Unioned the pre impact remnant layer with the impact site
15:04:08 Attributed the impact area as non-remnant
15:04:08 Categorised the cover attributes in clip_remcover_pre.shp ready for raster conversion
15:04:20 Converted clip_remcover_pre.shp to raster

15:04:20 Categorised the cover attributes in clip_remcover_post.shp ready for raster conversion
15:04:32 Converted clip_remcover_post.shp to raster

15:04:32 Run Landscape fragmentation analysis on the pre impact regional landscape

NATURALLY VEGETATED AND CLEARED LAND BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES

CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 4.3 MINUTES)

15:08:51 Run Landscape fragmentation analysis on the post impact regional landscape

NATURALLY VEGETATED AND CLEARED LAND BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES
CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 4.2 MINUTES)

Extracting a local subset of lfc_regional_pre_impact
Extracting a local subset of lfc_regional_post_impact

Collating pre and post impact statistics and trigger assessment
15:13:14 Summarising area statistics for: lfc_localmsk_pre_impact
15:13:14 Summarising area statistics for: lfc_localmsk_post_impact
15:13:14 Summarising area statistics for: lfc_regional_pre_impact
15:13:14 Summarising patch count for lfc_localmsk_pre_impact
15:13:19 Summarising patch count for lfc_localmsk_post_impact

Analysing impact on Connectivity Areas

SIGNIFICANCE TEST ONE

The regional total area is 160953.94
The regional extent of core remnant is 40884.68
The regional extent of core remnant is 25.40 percent
This level of regional fragmentation sets a local impact threshold of: 5.0 percent

The table below lists the local impact thresholds for categories of regional core remnant extent:

REGIONAL CORE CATEGORY	LOCAL IMPACT THRESHOLD
< 10	2.0
10 - 30	5.0
30 - 50	10.0
50 - 70	20.0
70 - 90	30.0
>90	50.0

Area of core at the local scale (pre impact): 2965.24
Area of core at the local scale (post impact): 2874.12
Percent change of core at the local scale (post impact): 3.07

SIGNIFICANCE TEST TWO

The number of core remnant areas occurring on the site: 8
The number of core remnant areas remaining on the site post impact: 4

(Only core polygons greater than or equal to 1 hectare are included)

RESULT

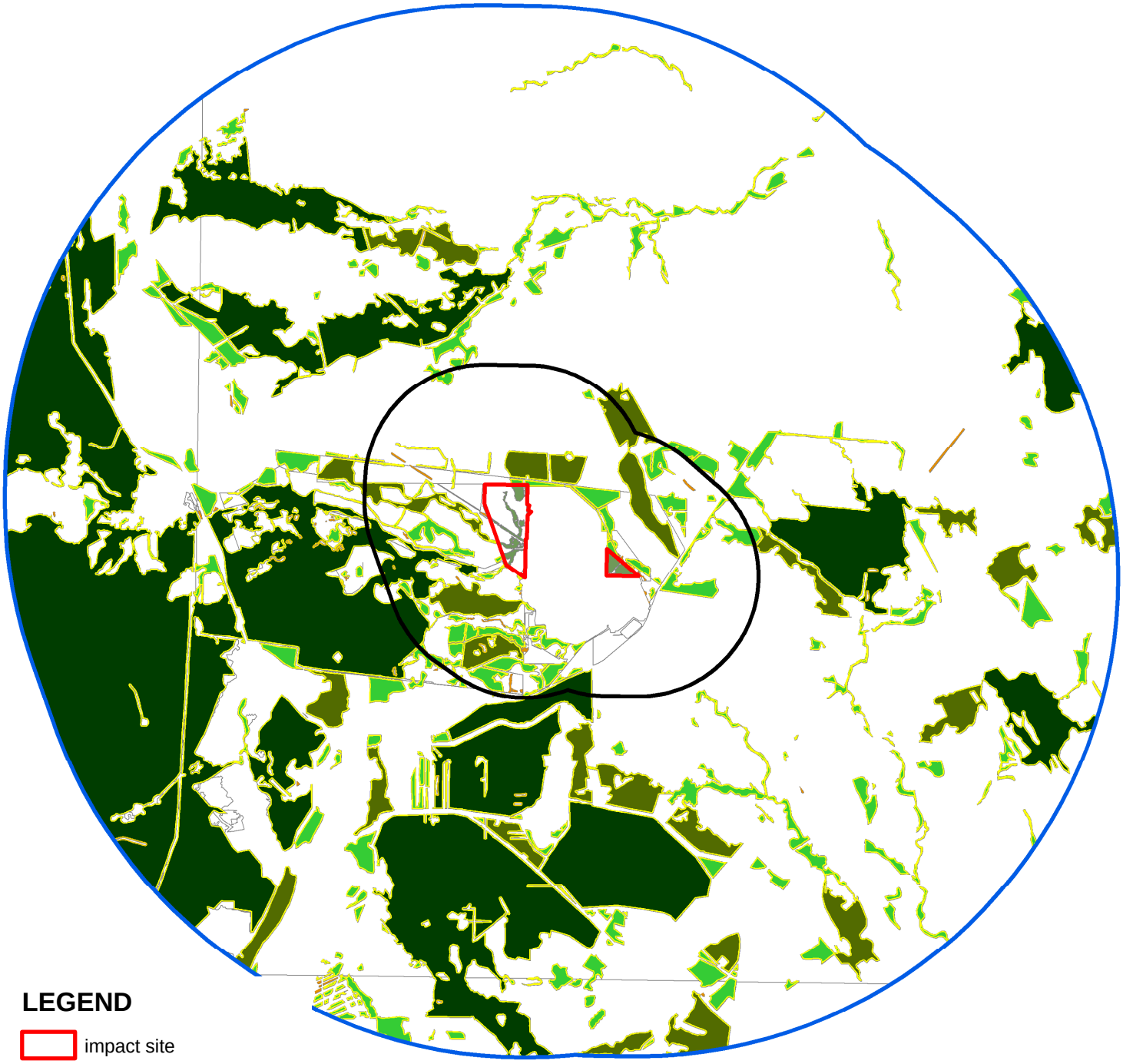
15:13:30 This analysis has determined a SIGNIFICANT impact on connectivity areas
(A significant reduction in core remnant at the local scale is False OR a change from core to non-core remnant at the site scale is True)

The significance table has been written to: ..\main_output\lfc_significance_assessment.csv
The local scale summary table has been written to: ..\main_output\lfc_local_scale_summary.csv
The site scale summary table has been written to: ..\main_output\lfc_site_scale_summary.csv
GIS layer files copied into folder \lyr_file within the project folder.
View layers in ArcMAP using..\H:\LFC Tool\Middlemount_WE_Rev4\lyr_file\lyr_file\Connectivity Area Impact Assessment.lyr

Please scrutinise the output tables and spatial layers to confirm the desktop modelling of connectivity area impact

This analysis used an edited version of the Regulated Vegetation layer.

15:14:43 _____COMPLETED LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS_____



LEGEND

- impact site
- impact site local buffer
- impact site regional buffer
- patch
- edge
- perforated
- core (< 100 hectares)
- core (100-500 hectares)
- core (> 500 hectares)
- other

clip_remcover_pre

Cover

- remnant
- non-remnant

Middlemount Western Extension Project
Landscape Fragmentation and Connectivity (LFC)
Qld Regulated Vegetation Map V1.48

Appendix 13: Anabat Analysis Reports

Microbat Call Identification Report

Prepared for ("Client"):	Naturecall Environmental
Survey location/project name:	Middlemount – Impact Area
Survey dates:	28 April - 3 May 2017
Client project reference:	
Job no.:	NAT-1701a
Report date:	2 June 2017

Methods

Data received

The data set received for analysis included 12 Anabat ZCA files, recorded over five consecutive nights (28th April – 2 May, 2017) using two Anabat Express detectors (Titley Scientific, Brisbane).

The ZCA files were converted to Anabat call sequence files (zero-crossing analysis format) using *AnalookW* (Corben 2015). This process yielded 5196 files for analysis; however, the majority of those files contained only non-bat background noise (e.g. from rain and/or wind and/or insects).

Call identification

All sequence files were viewed using *AnalookW* (Corben 2015) and a subset of files with representative samples of all call types recorded on each night by each detector was selected for detailed analysis. Species identification was achieved manually by comparing the call spectrograms of the selected calls with those of reference calls from south- and central-eastern Queensland and/or with published call descriptions (e.g. Reinhold *et al.* 2001; Pennay *et al*. 2004).

Species determination was also guided by considering probability of occurrence based on published distribution maps (e.g. Churchill 2008; van Dyck *et al.* 2013) and/or online databases (e.g. *Atlas of Living Australia* http://www.ala.org.au).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Reardon *et al.* (2015).

Results & Discussion

Some 621 bat calls were identified, representing at least 15 and as many as 17 species (Table 1). Fourteen species were positively identified from at least one diagnostic call, while a number of call types had characteristics potentially attributable to two or more species. Such calls were allocated to species groups, with all group members considered possibly present unless they were reliably identified from other calls.

The unresolved species groups include (see Glossary for explanation of terms used):

- *Chalinolobus gouldii / Scotorepens balstoni / Mormopterus ridei*
    - Calls with predominantly curvilinear pulse shapes and characteristic frequency (Fc) in the range 30-34 kHz
    - *C. gouldii* positively identified where pulses were relatively steep and showed distinctive alternating frequency pattern
    - Calls with steep pulses at uniform frequency, and usually with more curved pulse-bodies than those attributed to *C. gouldii*, were allocated to *S. balstoni*
    - *M. ridei* identified from calls with flatter, broader pulses at uniform frequency
    - Many calls had mixed and/or intermediate pulse shapes and/or were fragmented and could have been from any of these three species

- *Chalinolobus morio / Vespadelus troughtoni*
    - Calls with steep, curvilinear (FM-qCF) pulses at Fc=49-54 kHz
    - *C. morio* differentiated on the basis of slanted pulse-body and down-sweeping tail
    - *V. troughtoni* positively identified if pulse bodies distinctly curved with up-swept tail (i.e. “hooked”)
    - Some calls too fragmented and/or brief to reliably determine these characteristics
- *Chalinolobus nigrogriseus* / *Scotorepens greyii*
    - Steep curvilinear pulses with uniform Fc around 37-39 kHz
    - Majority of relevant calls were allocated to *S. greyii* on the basis of relatively narrow (short-duration) pulses with distinctively hooked pulse bodies
    - A few calls with slightly longer-duration pulses and straighter pulse bodies could have been from *C. nigrogriseus*
- *Chalinolobus picatus / Vespadelus baverstocki / Scotorepens greyii*
    - Steep curvilinear pulses with Fc ~ 39-43 kHz
    - Calls with uniform Fc at <40 kHz and hooked pulse-body were allocated to *S. greyii*
    - *V. baverstocki* identified where pulses had hooked pulses with uniform Fc >41 kHz
    - Where alternating pulse frequency was clear and pulse shape generally lacking a clear hook in the body, calls were attributed to *C. picatus*
    - Many calls had intermediate pulse shapes and/or variable (but not distinctly alternating) frequency and could have been any of these species
- *Vespadelus baverstocki / Miniopterus orianae oceanensis*
    - Fc overlaps in the range 43-46 kHz
    - *V. baverstocki* identified where calls had relatively short duration pulses with distinctive hooked body
    - Calls with slanted pulse bodies of relatively longer duration allocated to M*. o. oceanensis*
    - A few calls too brief and/or fragmented to reliably differentiate
- *Nyctophilus* spp.
    - Readily distinguished from other bat calls due to steep, almost-linear pulse shape
    - two *Nyctophilus spp.* potentially occur in study area (*N. geoffroyi* & *N. gouldi*), but they cannot be differentiated using call characteristics
- *Taphozous troughtoni / Mormopterus lumsdenae*
    - Curvilinear pulses, usually of narrow band-width (qCF shape) in the frequency range 22-26 kHz
    - *M. lumsdenae* positively identified where pulse-shape varies within a call sequence, often including broader bandwidth pulses with down-swept tails (FM-qCF-FM)
    - Calls with almost-flat, uniform pulses of relatively shorter duration were allocated to *T. troughtoni*
    - Several calls too brief and/or fragmented to reliably differentiate

Table 1. Microbat species recorded in the Middlemount Impact Area, April-May 2017.

♦ = at least one call from the site was attributed unequivocally to the species

□ = calls similar to those of the species were recorded, but could not be reliably identified

Detector	**Impact area Unit 1**					**Impact Area Unit 2**				
Date	28/4	29/4	30/4	1/5	2/5	28/4	29/4	30/4	1/5	2/5
Total sequence files	260	423	1581	359	469	180	90	513	975	386
Number of calls identified	66	47	89	74	63	50	23	56	78	75
Chalinolobus gouldii	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Chalinolobus morio	♦	♦	♦	♦	♦	♦	♦			
Chalinolobus nigrogriseus		□	□		□	□			□	
Chalinolobus picatus	□	♦	♦	♦	♦	♦	♦	□	□	♦
Nyctophilus species	♦	♦	♦			♦		♦	♦	♦
Scotorepens balstoni	♦	□	□	□				♦	□	♦
Scotorepens greyii	♦	♦	♦	♦	♦	□	♦	♦	♦	♦
Vespadelus baverstocki	□	□	□	♦	♦			♦	♦	♦
Vespadelus troughtoni			□	♦						
Miniopterus orianae oceanensis	♦	♦	♦	□		♦	♦		□	□
Austronomus australis	♦	♦	♦		♦		♦	♦		
Chaerephon jobensis	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Mormopterus lumsdenae		♦	♦	♦	♦	♦		♦	♦	♦
Mormopterus ridei	♦	□	♦	□	□	♦	♦	□	♦	♦
Saccolaimus flaviventris	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Taphozous troughtoni	♦							□		♦

References

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Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

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Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

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Glossary

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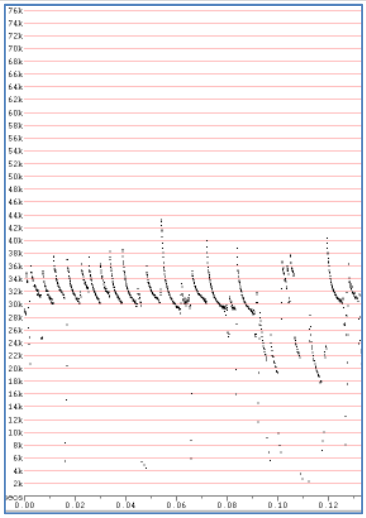
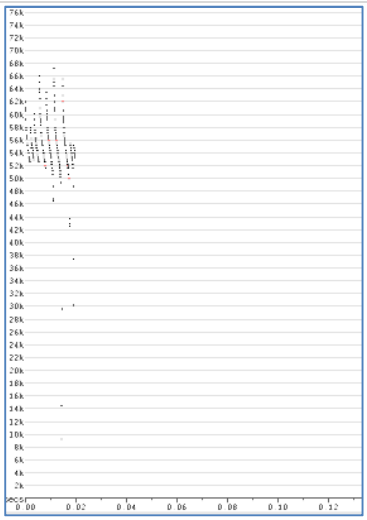
Call	Refers to a single bat call, made up of a series of individual sound *pulses* in one or more *phases* (*search, approach, feeding buzz*).
CF (=Constant Frequency)	A type of *pulse* in which the dominant component consists of a more-or-less 'pure tone' of sound at a Constant Frequency; with *shape* appearing flat on the sonogram. Often also contains a brief *FM* component at the beginning and/or end of the CF component (*viz.* FM-CF-FM).
Characteristic frequency (Fc)	The frequency of the flattest part of a *pulse*; usually the lowest frequency reached in the *qCF* component of a pulse. This is often the primary diagnostic feature for species identification.
Duration	The time period from the beginning of a *pulse* to the end of the pulse.
Feeding buzz	The terminal part of a *call*, following the *approach phase*, emitted as the bat catches a prey item; a distinctive, rapid series of very steep, very short-duration pulses.
FM (=Frequency Modulated)	A type of *pulse* in which there is substantial change in frequency from beginning to end; *shape* ranges from almost vertical and linear through varying degrees of curvature.
FC range	Refers to the range of frequencies occupied by the *characteristic frequency* section of *pulses* within a call or set of calls.
Frequency sweep or "band-width"	The range of frequencies through which a *pulse* sweeps from beginning to end; Maximum frequency (Fmax) – minimum frequency (Fmin).
Knee	The transitional part of a *pulse* between the initial (usually steeper) frequency sweep and the *characteristic frequency* section (usually flatter); time to knee (Tk) and frequency of knee (Fk) can be diagnostic for some species.
Pulse	An individual pulse of sound within a bat *call*; the *shape*, *duration* and *characteristic frequency* of a pulse are the key diagnostic features used to differentiate species.
Pulse body	The part of the *pulse* between the *knee* and *tail* and containing the *characteristic frequency* section.
Pulse shape	The general appearance of a *pulse* on the sonogram, described using relative terms related to features such as slope and degree of curvature. See also *CF, qCF* and *FM*.
qCF (=quasi Constant Frequency)	A type of *pulse* in which there is very little change in frequency from beginning to end; *shape* appears to be almost flat. Some pulses also contain an *FM* component at the beginning and/or end of the qCF component (*viz.* FM-qCF).
Search phase	The part of a bat *call* generally required for reliable species diagnosis. A consistent series of *pulses* emitted by a bat that is searching for prey or and/or navigating through its habitat. Search phase pulses generally have longer duration, flatter slope and more consistent shape than *approach phase* and *feeding buzz* pulses.
Sequence	A sequence of *pulses* that may be from one or more bats; but generally refers to a *call* or part (e.g. *phase*) of a call.
Tail	The final component of a *pulse*, following the *characteristic frequency* section; may consist of a short or long sweep of frequencies either upward or downward from the Fc; or may be absent.

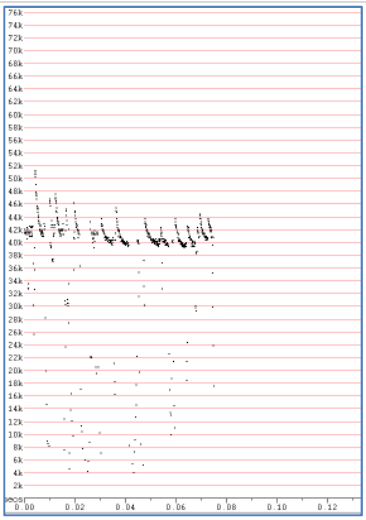
Appendix Representative call sequences recorded in the Middlemount Impact Area.
y-axis=frequency kHz; x-axis=time sec (time between pulses removed)



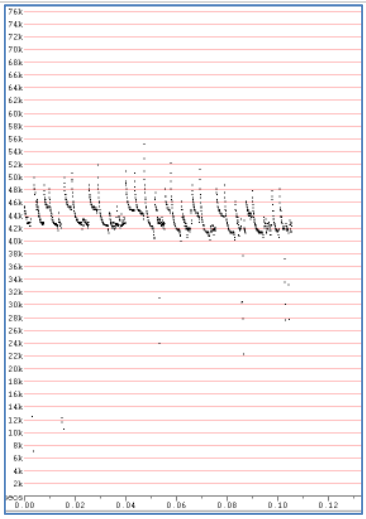
Chalinolobus gouldii



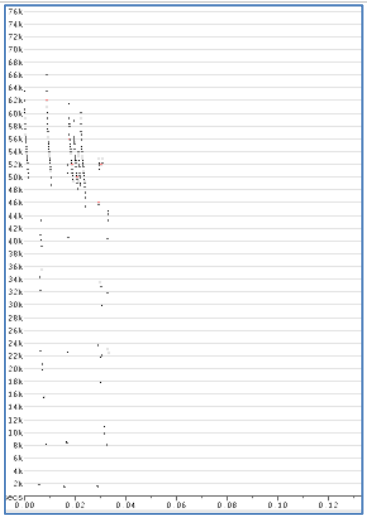
Chalinolobus morio



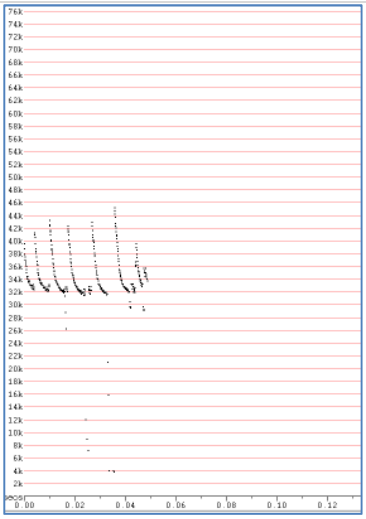
Possibly *Chalinolobus nigrogriseus*



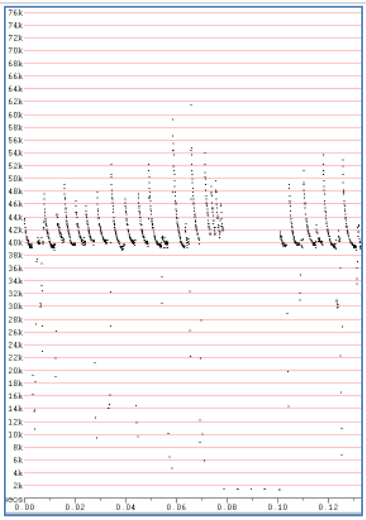
Chalinolobus picatus



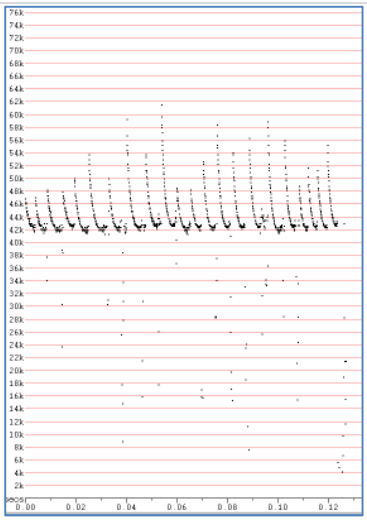
Nyctophilus species



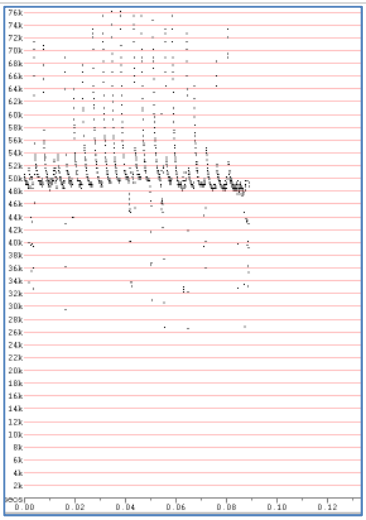
Scotorepens balstoni



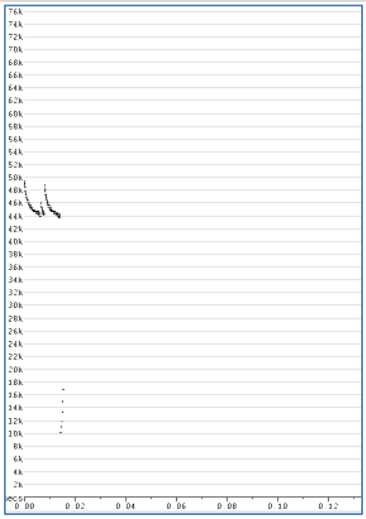
Scotorepens greyii



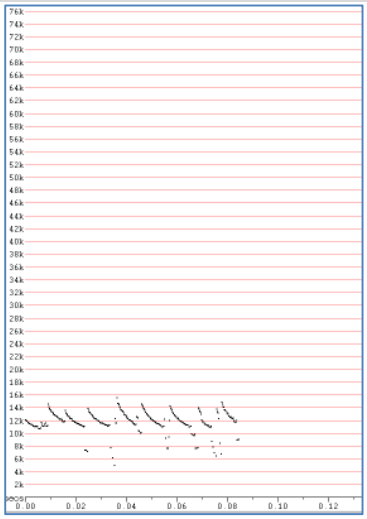
Vespadelus baverstocki



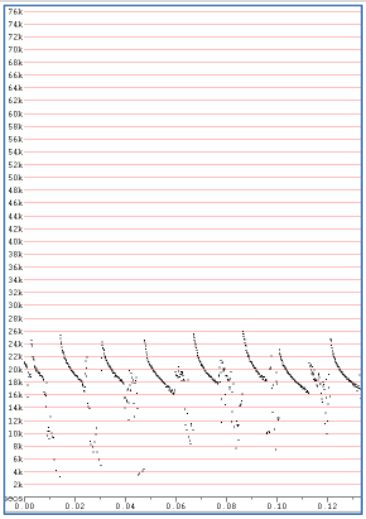
Vespadelus troughtoni



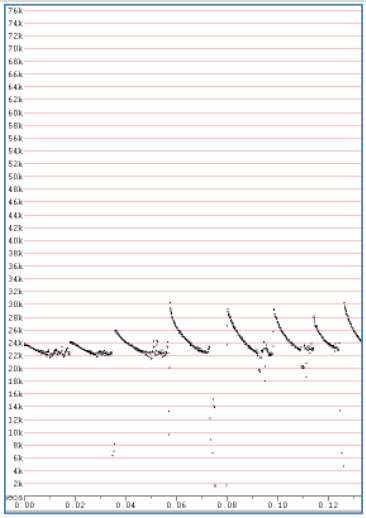
Miniopterus orianae oceanensis



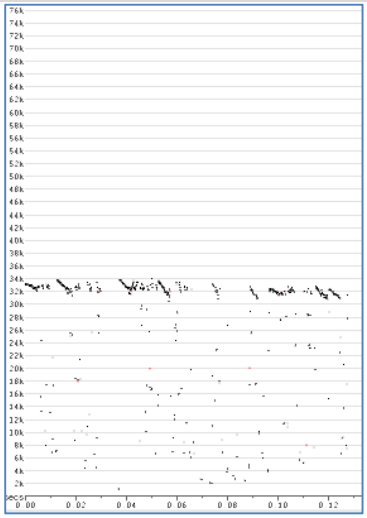
Austronomus australis



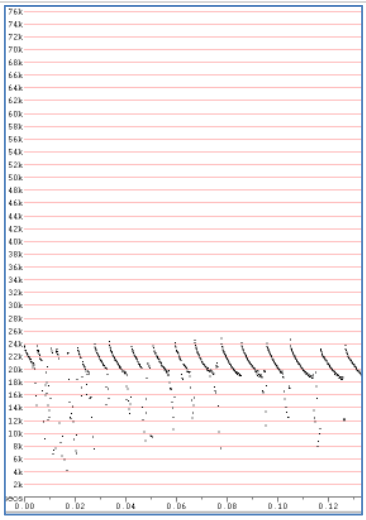
Chaerephon jobensis



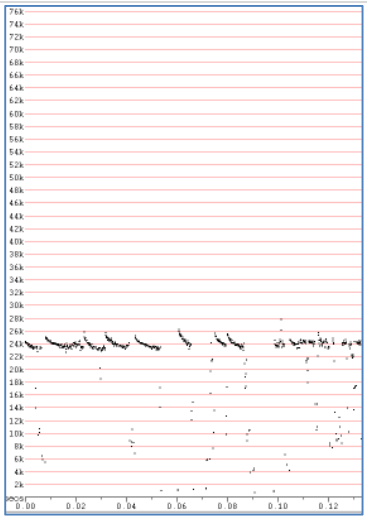
Mormopterus lumsdenae



Mormopterus ridei



Saccolaimus flaviventris



Taphozous troughtoni

Microbat Call Identification Report

Prepared for ("Client"):	Naturecall Environmental
Survey location/project name:	Middlemount Area
Survey dates:	14-19 September 2017
Client project reference:	
Job no.:	NAT-1702
Report date:	4 October 2017

Methods

Data received

The data set received for analysis included nine Anabat ZCA files, recorded by two Anabat Express detectors (Titley Scientific, Brisbane) between 14th and 19th September 2017, at four separate sites, south-west of Middlemount (Table 1).

The ZCA files were converted to Anabat call sequence files (zero-crossing analysis format) using *AnalookW* (Corben 2015). This process yielded 2345 sequence files for analysis.

Table 1. Anabat deployment details for the Middlemount survey, 14-19 September 2017.

Location	Latitude	Longitude	Detector	Date	Start time	Stop time
West-1	-22.8281	148.6299	Anabat1	14-Sep	17:30	06:30
				15-Sep	17:30	06:30
West-2	-22.8394	148.6289	Anabat1	16-Sep	17:30	06:30
				17-Sep	17:30	06:30
				18-Sep	17:30	06:30
East-1	-22.8428	148.6719	Anabat2	14-Sep	17:30	06:30
				15-Sep	17:30	06:30
East-2	-22.8468	148.6807	Anabat2	16-Sep	17:30	06:30
				17-Sep	17:30	01:34*

* Detector LOG file for Anabat2 shows "battery dead" at 01:34 AM on 18th September.

Call identification

All sequence files were viewed using *AnalookW* (Corben 2015) and a subset of files with representative samples of all call types recorded on each night by each detector was selected for detailed analysis. Species identification was achieved manually by comparing the call spectrograms of the selected calls with those of reference calls from eastern Queensland and/or with published call descriptions (e.g. Reinhold *et al.* 2001; Pennay *et al*. 2004).

Species determination was also guided by considering probability of occurrence based on published distribution maps (e.g. Churchill 2008; van Dyck *et al.* 2013) and/or online databases (e.g. *Atlas of Living Australia* http://www.ala.org.au).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Reardon *et al.* (2015).

Results & Discussion

Most sequence files contained recognisable bats calls, although many were only brief and/or fragmented and of limited use for species identification. A total of 368 bat calls were identified, representing at least 11 and as many as 14 species (Table 2). Ten species were positively identified from at least one diagnostic call, while several call types had characteristics potentially attributable to two or more species. Such calls were allocated to species groups, with all group members considered possibly present unless they were reliably identified from other calls.

The unresolved species groups include (see Glossary for explanation of terms used):

- *Chalinolobus gouldii / Scotorepens balstoni / Mormopterus ridei*
    - Calls with predominantly curvilinear pulse shapes and characteristic frequency (Fc) in the range 29-34 kHz
    - *C. gouldii* positively identified where pulses were relatively steep and showed distinctive alternating frequency pattern
    - Calls with steep pulses at uniform frequency, and usually with more curved pulse-bodies than those attributed to *C. gouldii*, were allocated to *S. balstoni*
    - *M. ridei* was identified from calls with flatter, broader pulses at uniform frequency
    - Some calls had mixed and/or intermediate pulse shapes and/or were fragmented and could have been from any of these three species
- *Chalinolobus morio / Vespadelus troughtoni*
    - Calls with steep, curvilinear (FM-qCF) pulses at Fc=49-54 kHz
    - Two very brief calls were allocated to this group – one from East Location 1 and one from West Location 2
    - Each call had pulse characteristics most like *C. morio* (slanted pulse-body and down-sweeping tail), but with just one pulse per call it was not possible to reliably attribute to either species
- *Chalinolobus nigrogriseus* / *Scotorepens greyii*
    - Steep curvilinear pulses with uniform Fc around 37-39 kHz
    - Majority of relevant calls were positively attributed to *S. greyii* based on relatively narrow (short-duration) pulses with distinctively hooked pulse bodies
    - A few calls from each of the two “West” sites had slightly longer-duration pulses and straighter pulse bodies, so could have been from *C. nigrogriseus*
- *Chalinolobus picatus / Vespadelus baverstocki / Scotorepens greyii*
    - Steep curvilinear pulses with Fc ~ 39-43 kHz
    - Calls with uniform Fc at <40 kHz and hooked pulse-body were allocated to *S. greyii*
    - *V. baverstocki* identified where pulses had hooked pulses with uniform Fc >42 kHz
    - Where alternating pulse frequency was clear and pulse shape generally lacking a clear hook in the body, calls were attributed to *C. picatus*
    - Some calls had intermediate pulse shapes and/or variable (but not distinctly alternating) frequency and could have been from any of these species

- *Nyctophilus* spp.
    - Readily distinguished from other bat calls due to steep, almost-linear pulse shape
    - two *Nyctophilus spp.* potentially occur in study area (*N. geoffroyi* & *N. gouldi*), but they cannot be differentiated using call characteristics

Table 2. Microbat species recorded during the Middlemount Survey, September 2017.

♦ = at least one call from the site was attributed unequivocally to the species

□ = calls similar to those of the species were recorded, but could not be reliably identified

Detector:	**Anabat 1 (west)**		**Anabat 2 (east)**	
Location:	**West-1**	**West-2**	**East-1**	**East-2**
Dates:	14-16 Sep	16-19 Sep	14-16 Sep	16-18 Sep
Total sequence files:	1009	636	525	175
Number of calls identified:	78	168	77	45
Chalinolobus gouldii	♦	♦	♦	♦
Chalinolobus morio	□			□
Chalinolobus nigrogriseus	□	□		
Chalinolobus picatus	♦	♦	□	
Nyctophilus species	♦	♦	♦	
Scotorepens balstoni	♦	♦	□	
Scotorepens greyii	♦	♦	♦	♦
Vespadelus baverstocki	♦	♦	♦	
Vespadelus troughtoni	□			□
Chaerephon jobensis	♦	♦	♦	♦
Mormopterus lumsdenae	♦	♦	♦	♦
Mormopterus ridei	♦	♦	♦	♦
Saccolaimus flaviventris	♦	♦	♦	♦

References

Churchill, S. (2008). *Australian Bats*. Jacana Books, Allen & Unwin; Sydney.

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Knee	The transitional part of a *pulse* between the initial (usually steeper) frequency sweep and the *characteristic frequency* section (usually flatter); time to knee (Tk) and frequency of knee (Fk) can be diagnostic for some species.
Pulse	An individual pulse of sound within a bat *call*; the *shape*, *duration* and *characteristic frequency* of a pulse are the key diagnostic features used to differentiate species.
Pulse body	The part of the *pulse* between the *knee* and *tail* and containing the *characteristic frequency* section.
Pulse shape	The general appearance of a *pulse* on the sonogram, described using relative terms related to features such as slope and degree of curvature. See also *CF, qCF* and *FM*.
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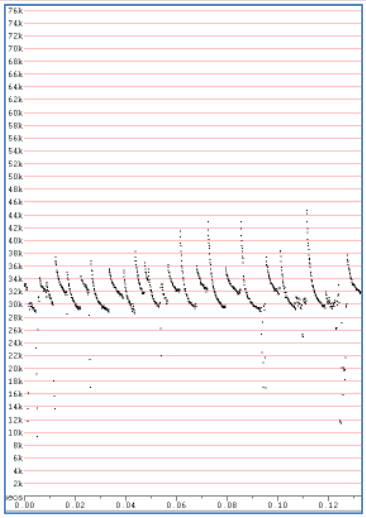
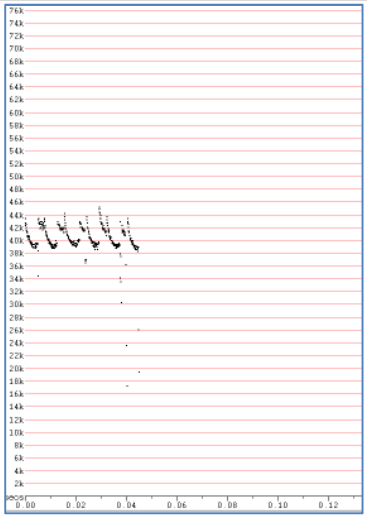
Search phase	The part of a bat *call* generally required for reliable species diagnosis. A consistent series of *pulses* emitted by a bat that is searching for prey or and/or navigating through its habitat. Search phase pulses generally have longer duration, flatter slope and more consistent shape than *approach phase* and *feeding buzz* pulses.
Sequence	A sequence of *pulses* that may be from one or more bats; but generally refers to a *call* or part (e.g. *phase*) of a call.
Tail	The final component of a *pulse*, following the *characteristic frequency* section; may consist of a short or long sweep of frequencies either upward or downward from the Fc; or may be absent.

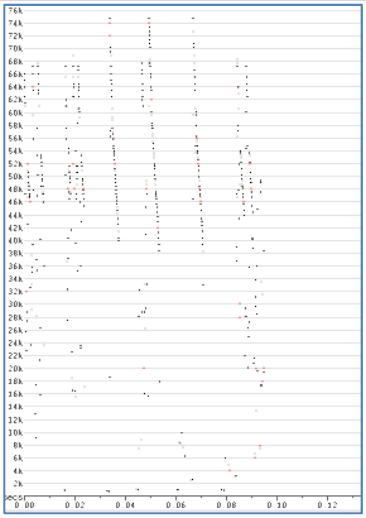
Appendix Representative call sequences recorded in the Middlemount survey, September 2017. y-axis=frequency kHz; x-axis=time sec (time between pulses removed)



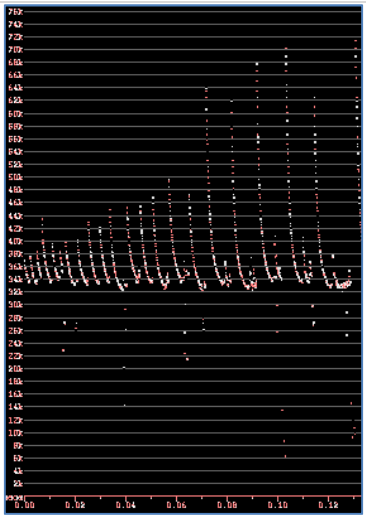
Chalinolobus gouldii



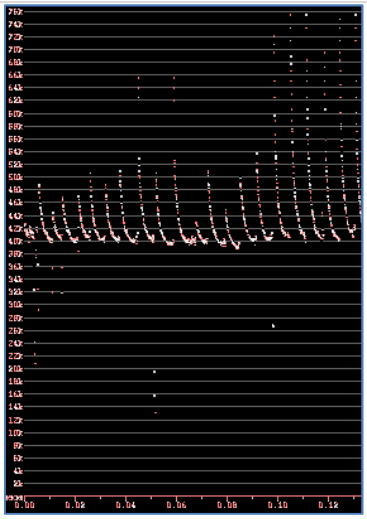
Chalinolobus picatus



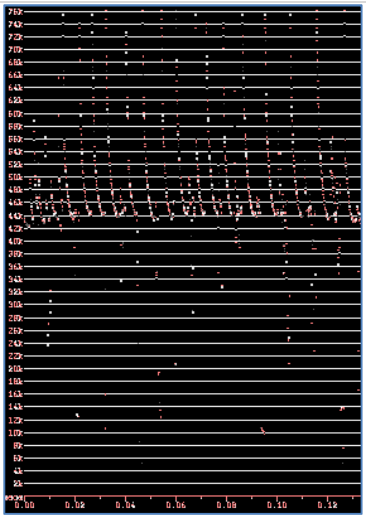
Nyctophilus species



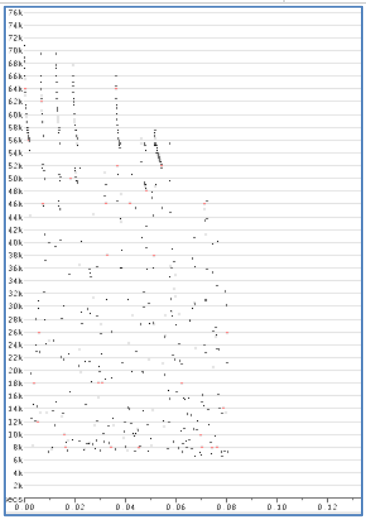
Scotorepens balstoni



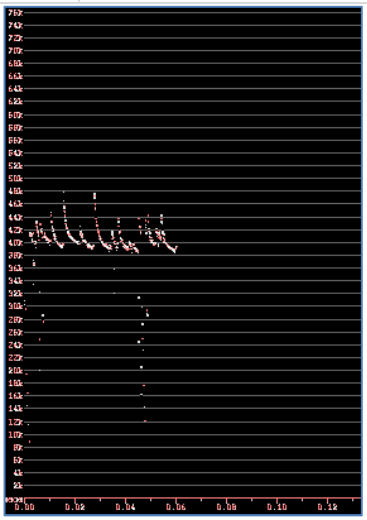
Scotorepens greyii



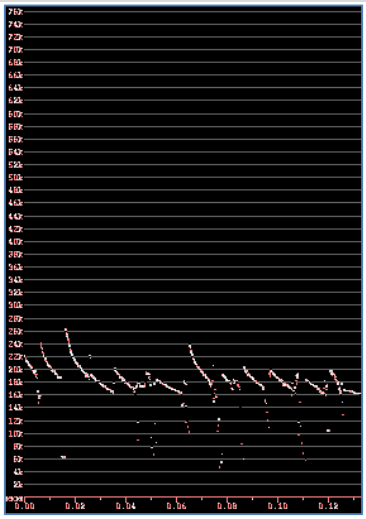
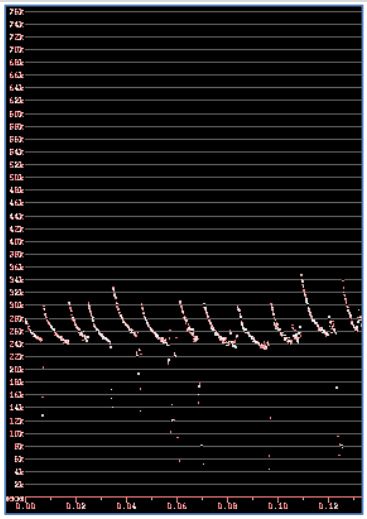
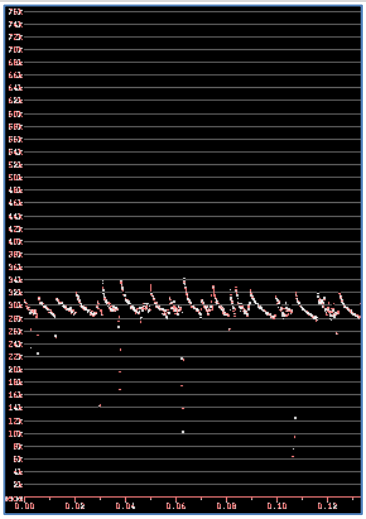
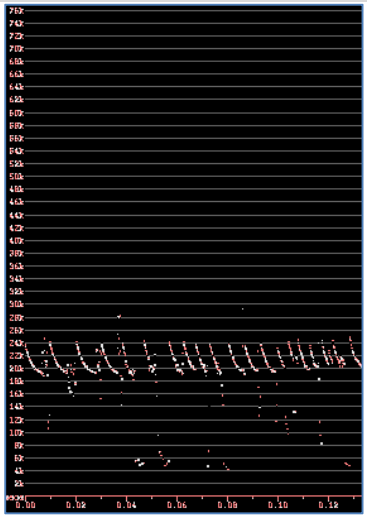
Vespadelus baverstocki



Chalinolobus morio or *Vespadelus troughtoni*



Chalinolobus nigrogriseus or *S. greyii*

 *Chaerephon jobensis*	 *Mormopterus lumsdenae*	 *Mormopterus ridei*
	 *Saccolaimus flaviventris*	

Appendix 14: Scat Analysis Results

Will Steggall

From: Mya Gaby
Sent: Tuesday, 3 October 2017 7:50 AM
To: Will Steggall; Karl Robertson
Subject: Fw: Scat analysis
Attachments: Invoice_280917-01.pdf

From: Trace Ecology <traceecology@gmail.com>
Sent: Thursday, September 28, 2017 4:29 PM
To: Mya Gaby
Subject: Scat analysis

Hi Mya,

I have taken a look at those scats for you. Results are as follows:

Site 1 (Drainage line): *Trichosurus vulpecula* (Common Brushtail Possum)

Site 2 (Next to road): *Phascolarctos cinereus* (Koala)

Please let me know if you require anything else.

Please find an invoice attached.

Kind regards,

Luke Foster
E: traceecology@gmail.com
M: 0423 501 384

TRACE ECOLOGY
Hair, Scat & Bone Analysis

Appendix 15: Offset Area Baseline Report

Western Extension Project

Offset Area Baseline Report

Client:

Middlemount Coal Pty Ltd

March 2019

Document Status

Version	Purpose	Author	Reviewed By	Approved By	Date
Rev 0.3	Draft	Mya Gaby	Will Steggall		23/02/2018
Rev 1.0	Draft	Mya Gaby	Will Steggall	Will Steggall	19/03/2018
Rev 2.0	Final draft	Mya Gaby	Will Steggall	Will Steggall	03/05/2018
Rev 3.0	Final	Mya Gaby	Will Steggall	Will Steggall	07/03/2019

Document Control

Copy No.	Date	Type/Via	Issued to	Name	Purpose
1	23/02/2018	Electronic	Naturecall Info	Clare Fitch	File Copy
2	23/02/2018	Electronic/E-mail	Resource Strategies	Joe Fittell	Client Review
3	19/03/2018	Electronic	Naturecall Info	Clare Fitch	File Copy
4	19/03/2018	Electronic/E-mail	Resource Strategies	Joe Fittell	Client Review
5	03/05/2018	Electronic	Biodiversity Australia Info	Clare Fitch	File Copy
6	03/05/2018	Electronic/E-mail	Resource Strategies	Joe Fittell	Client Copy
5	07/03/2019	Electronic	Biodiversity Australia Info	Clare Fitch	File Copy
6	07/03/2019	Electronic/E-mail	Resource Strategies	Joe Fittell	Client Copy

Project Number: EC1687

Our Document Reference: EC1687-BEC-REPMCPLOffsetAreaBaselineReport-rev3.0

List of Figures

List of Tables

List of Photos

Executive Summary

Biodiversity Australia Pty Ltd has been requested by Middlemount Coal Pty Ltd (MCPL) to undertake a baseline ecological assessment consisting of vegetation validation and terrestrial habitat quality assessments of four offset areas to be established for the Middlemount Coal Mine Western Extension Project (the Project).

The study sites are located approximately 270 kilometers (km) north-west of Rockhampton and 9 km south-west of the Middlemount Township and comprise the following areas:

1. Western Extension Commonwealth Offset Area (1) and (2)
2. Western Extension State Offset Area
3. Modified Stage 2 Commonwealth Offset Area (2) and (3)
4. Modified Rail Loop and Spur Offset Area (3a) and (3b)

Flora and fauna surveys were undertaken throughout the study sites from 18-21 July 2017 and 20-26 November 2017. Terrestrial habitat quality assessments were conducted in accordance with the *Guide to Determining Terrestrial Habitat Quality Version 1.2* at a total of 44 locations spread across the study sites. The fauna surveys comprised habitat suitability assessment, opportunistic surveys for threatened species, track, scat and secondary evidence searches, as well as, opportunistic fauna observations.

No threatened flora species were detected during the survey. Ecosystems were ground-truthed during the 2017 surveys and the Regional Ecosystem valuation process identified a total of fourteen distinct regional ecosystems across the study sites. Four of these are listed as Endangered (RE 11.3.1, RE 11.4.8, RE 11.4.9 and RE 11.4.9a) and three are listed as Of Concern (RE 11.3.2, RE 11.3.4 and RE 11.5.18) under the Queensland *Vegetation Management Act, 1999.*

The surveys also ground-truthed areas of the *Brigalow (Acacia harpophylla* dominant and co-dominant*)* threatened ecological community listed as Endangered under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act)*.*

Three threatened fauna species were recorded during the field surveys, namely the Koala, Greater Glider and Squatter Pigeon (southern). These species are listed as Vulnerable under the Queensland *Nature Conservation Act, 1992* [NC Act] and EPBC Act. A fourth threatened species, the Ornamental Snake, was also considered a potential occurrence in the study sites based on local records identified in the literature and database searches and presence of suitable habitat.

Species habitat index scores were calculated for the Squatter Pigeon (southern), Greater Glider, Koala and Ornamental Snake for each assessment unit within the Western Extension Commonwealth Offset Area.

1.0 Introduction

Middlemount Coal Pty Ltd (MCPL) has lodged an amendment application to the Middlemount Coal Mine Environmental Authority (EA) EPML00716913 in accordance with section 224 of the Queensland (Qld) *Environmental Protection Act, 1994* (EP Act) to approve an extension of the Middlemount Coal Mine (Figure 1) (herein referred to as the Middlemount Coal Mine Western Extension Project [the Project]).

On 8 January 2018, the Project was referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) (2016/7649). On 8 February 2018, a delegate of the Commonwealth Minister for the Environment declared the Action to be a 'controlled action' for the purpose of the EPBC Act due to potential adverse impacts on the following controlling provisions under Part 3 of the EPBC Act:

- sections 18 and 18A of the EPBC Act (listed threatened species and communities); and
- sections 24D and 24E of the EPBC Act (a water resource, in relation to coal seam gas development and large coal mining development).

Biodiversity Australia Pty Ltd (formerly trading as Naturecall Environmental) was commissioned by MCPL to validate vegetation and undertake terrestrial habitat quality assessments of four offset areas to be established for the Middlemount Coal Mine Western Extension Project (the Project).

2.0 Background Information

2.1. Location of the Study Sites

The study sites are located approximately 270 kilometres (km) north-west of Rockhampton and 3 km south-west of the Middlemount Township (Figure 1). They fall within in the Isaac-Comet Downs sub-region of the North Brigalow Belt Bioregion, and are within the Fitzroy catchment.

The study sites, as shown in Figure 2, comprise the following Offset Areas:

1. Western Extension Commonwealth Offset Area (1) and (2)
2. Western Extension State Offset Area
3. Modified Stage 2 Commonwealth Offset Area (2) and (3)
4. Modified Rail Loop and Spur Offset Area (3a) and (3b)

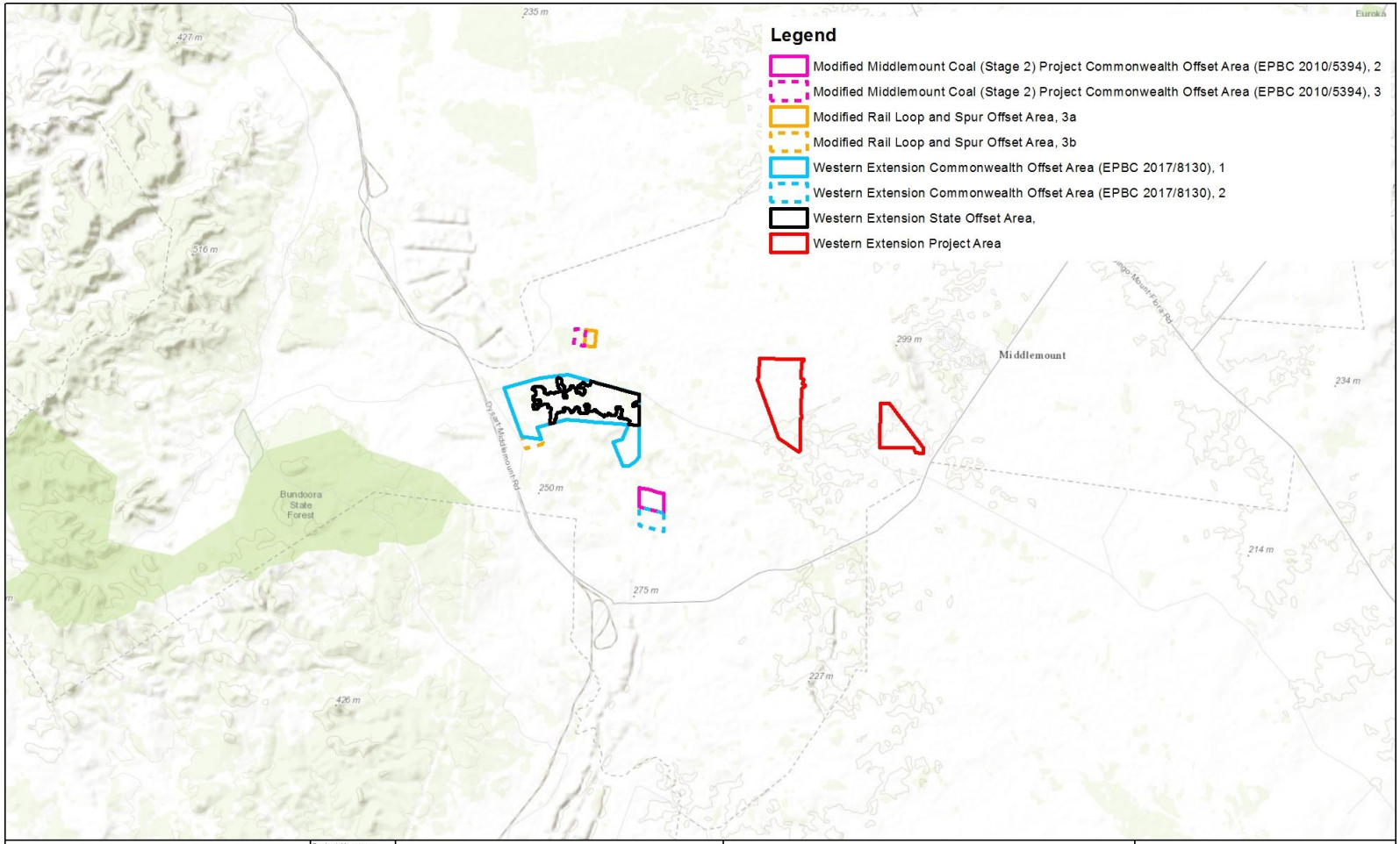
The Offset Areas are located on freehold land owned by MCPL and total approximately 1,843 hectares (ha) in area. The four Offset Areas include a combination of forested/woodland areas and cleared grazing land. The four Offset Areas are adjacent to three existing MCPL offset areas.

2.2. Study Objectives

The primary objectives of the Offset Baseline Report were to:

- ground truth Regional Ecosystems;
- providing written descriptions of the baseline health and quality of each Regional Ecosystem;
- characterise vegetation (remnant and non-remnant);
- identify and map the pre-clearing regional ecosystem of the study area (considering the Government pre-clear layer);
- identify and map any Matters of State Environmental Significance (MSES) and Matters of National Environmental Significance (MNES);
- apply the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (Department of Environment and Heritage Protection [DEHP] 2017a). to the Regional Ecosystems;
- apply the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a) to the Regional Ecosystems predicted to occur prior to clearing;
- map threatened ecological communities listed under the EPBC Act;
- map potential habitat for potentially occurring threatened species relevant to the Project (Ornamental Snake, Squatter Pigeon (southern), Koala and Greater Glider);
- apply the Habitat Quality Scoring Template to calculate the habitat quality score of the four Offset Areas; and
- undertake targeted surveys for threatened species relevant to the Project (Ornamental Snake, Squatter Pigeon (southern), Koala and Greater Glider).

Figure 1: Location of the Offset Areas



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: WS	Figure Name: Location of the Offset Areas
Drawn By: WS	
Date: 3-May-2018	Site: Western Extension Offset Areas
Map Projection: MGAz55	
Map Datum: GDA94	Client: Middlemount Coal Pty Ltd
Page: 1 of 1	

0 2.5 5 10 Kilometers

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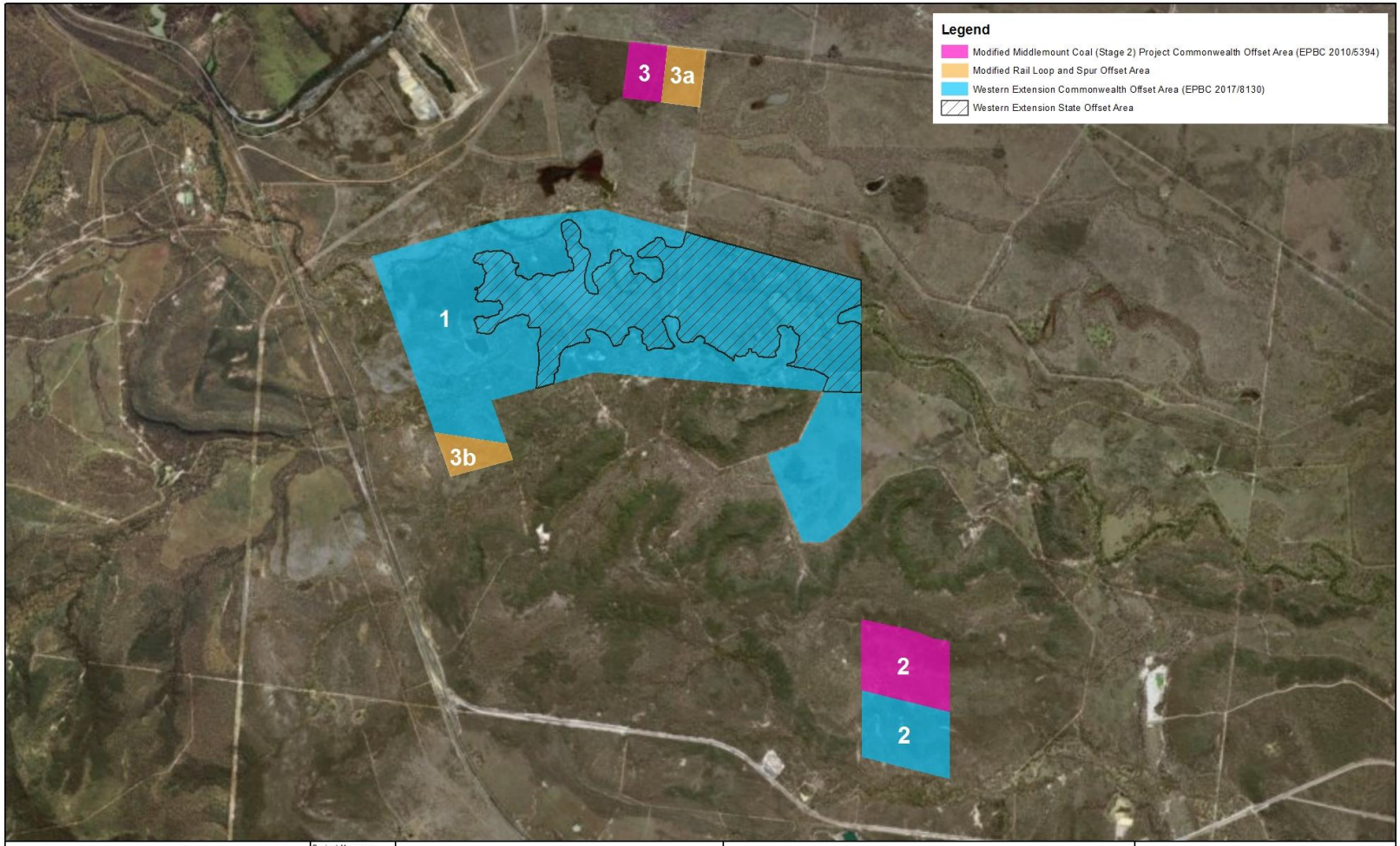
Scale:	Job Number:	Revision:
1 : 200,000	EC1687	C

Figure 2: Offset Areas



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Proposed Offset Areas
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd

0 0.75 1.5 3 Kilometers

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1:55,000	EC1687	C

3.0 Existing Environment

3.1. Soils, Topography and Geology

The study area comprises gently undulating lowlands with slopes ranging from <5 to 30 degrees. Elevated areas and scarp retreat zones are located in the Western Extension Commonwealth Offset Area (2) and the Modified Stage 2 Commonwealth Offset Area (2). Level and low lying areas occurring in the Modified Stage 2 Commonwealth Offset Area (3) and in the central and northern extent of the Western Extension Commonwealth Offset Area (1) along an alluvial plain associated with Roper Creek (Figure 3). The hydrological features of the study site and Roper Creek are discussed in Section 3.4.

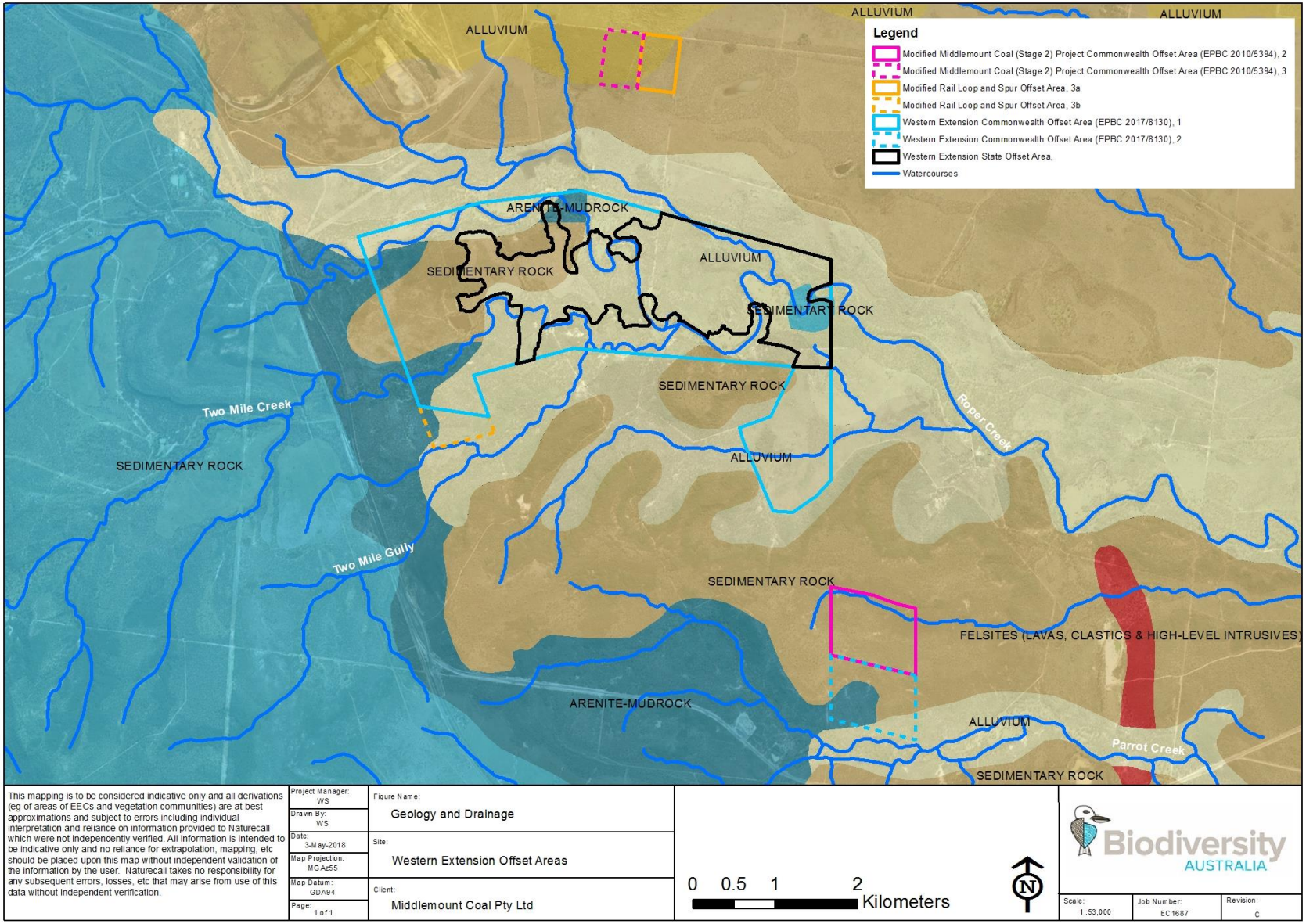
Surface geology of the study area comprises several formations including alluvium associated with Roper Creek (clay, silt, sand and gravel), sedimentary rocks and felsites (lavas, clastics and high level intrusives) as shown in Figure 3. The dominant underlying geology is the Duaringa Formation which comprises sedimentary rocks including mudstone, sandstone, siltstone and conglomerate (Department of Natural Resources and Mines [DNRM] 2015).

Soil types within the study sites vary widely depending on the topographic location and underlying geology. The most prevalent soil type within the study area comprise silty to sandy loams and clays.

A total of four land zones are mapped over the study sites (Wilson and Taylor 2012; Department of Science, Information Technology and Innovation [DSITI] 2017), comprising:

- Land Zone 3: Recent Quaternary alluvial systems.
- Land Zone 4: Tertiary-early Quaternary clay plains.
- Land Zone 5: Tertiary-early Quaternary loamy and sandy plains and plateaus.
- Land Zone 7: Cainozoic duricrusts.

Figure 3: Geology and Drainage



3.2. Regional Ecosystems

Existing DSITI (2017) Regional Ecosystem mapping of the Offset Areas indicates that 19 Regional Ecosystems are present (Table 1, Figure 4). This DSITI mapping was verified in the field by Biodiversity Australia in 2017.

3.3. Pre-clearing Regional Ecosystems

The Pre-clearing Regional Ecosystems digital data layer (DSITI 2017) of the non-remnant vegetation throughout the study sites indicate that 21 Regional Ecosystems formerly occurred in this area (Table 2; Figure 5). This layer was refined by Biodiversity Australia through field surveys.

Table 1: DSITI Mapped Regional Ecosystems within the study sites

Regional Ecosystem	Short Description	VMA Status	EPBC Status
11.10.12	*Eucalyptus populnea* woodland on medium to coarse-grained sedimentary rocks	LC	-
11.10.7	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	LC	-
11.3.1/11.3.2	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains; and *Eucalyptus populnea* woodland on alluvial plains	E/OC	E
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	OC	-
11.3.2/11.3.27	*Eucalyptus populnea* woodland on alluvial plains and Freshwater wetlands	OC/LC	-
11.3.2/11.3.7	*Eucalyptus populnea* woodland on alluvial plains and *Corymbia spp.* woodland on alluvial plains	OC/LC	-
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	LC	-
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus spp.* woodland on alluvial plains	OC	-
11.3.4/11.3.7	*Eucalyptus tereticornis* and/or *Eucalyptus spp.* woodland on alluvial plains; and *Corymbia spp*. woodland on alluvial plains	OC/LC	-
11.3.7	*Corymbia spp*. woodland on alluvial plains	LC	-
11.4.2	*Eucalyptus spp.* and/or *Corymbia spp*. grassy or shrubby woodland on Cainozoic clay plains	OC	-
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	E	E
11.4.8/11.4.9	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains; and *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	E	E
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii +/- Casuarina cristata* open forest to woodland.	E	E
11.5.2/11.5.2a	*Eucalyptus crebra*, *Corymbia spp*., with *E. moluccana* on lower slopes of Cainozoic sand plains and/or remnant surfaces; and *Allocasuarina luehmannii* low tree layer with or without emergent woodland	LC	-
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	LC	-

Regional Ecosystem	Short Description	VMA Status	EPBC Status
11.5.911.5.3	*Eucalyptus crebra* and other *Eucalyptus spp*. and *Corymbia spp.* woodland on Cainozoic sand plains and/or remnant surfaces; and *Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	LC	-
11.7.2/11.5.18	*Acacia spp.* woodland on Cainozoic lateritic duricrust. Scarp retreat zone; and *Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces	LC/OC	-
11.7.2/11.7.4	*Acacia spp.* woodland on Cainozoic lateritic duricrust. Scarp retreat zone; and *Eucalyptus decorticans* and/or *Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius* woodland on Cainozoic lateritic duricrust	LC	-

E – Endangered, OC – Of Concern, NC – No Concern at present, LC – Least Concern, VMA – Vegetation Management Act, EPBC –Environmental Protection and Biodiversity Conservation Act, BD Status –Biodiversity Status (according to the Queensland Government).
Source: DEHP 2017b

Table 2: Pre-clearing Regional Ecosystems mapped by DSITI within the study sites

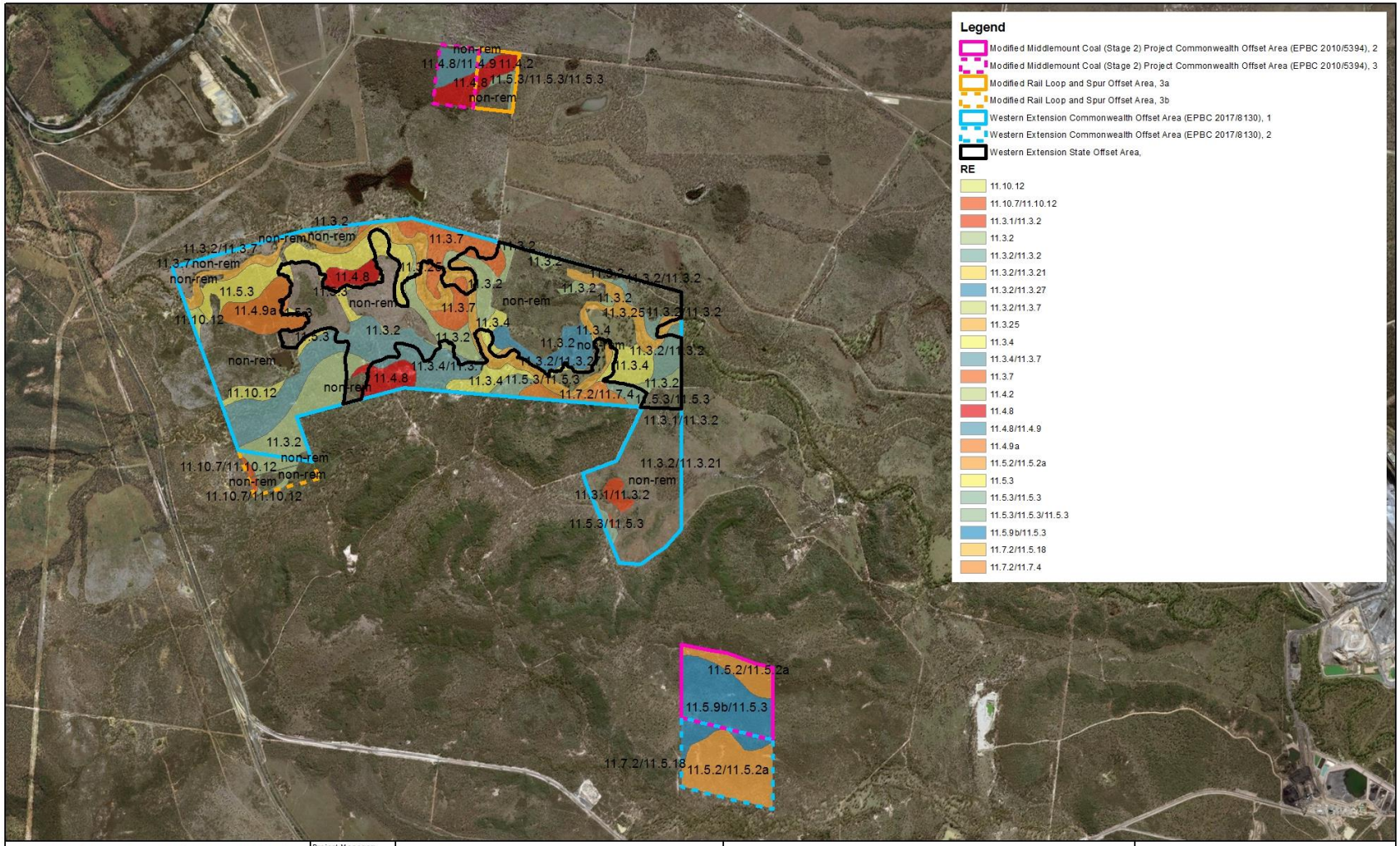
Regional Ecosystem	Short Description	VMA Status	EPBC Status
11.10.12	*Eucalyptus populnea* woodland on medium to coarse-grained sedimentary rocks	LC	-
11.10.7/11.10.12	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks; and *Eucalyptus populnea* woodland on medium to coarse-grained sedimentary rocks	LC	-
11.3.1/11.3.2	*Acacia harpophylla* and/or *Casuarina cristata* open-forest on alluvial plains; and *Eucalyptus populnea* woodland on alluvial plains	E/OC	-
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	OC	-
11.3.2/11.3.21	*Eucalyptus populnea* woodland on alluvial plains; and *Dichanthium sericeum* and/or *Astrebla spp*. grassland on alluvial plains. Cracking clay soils	OC/E	E
11.3.2/11.3.27	*Eucalyptus populnea* woodland on alluvial plains; and Freshwater wetlands	OC/LC	-
11.3.2/11.3.7	*Eucalyptus populnea* woodland on alluvial plains; and *Corymbia spp*. woodland on alluvial plains	OC/LC	-
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	LC	-
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus spp.* woodland on alluvial plains	OC	-

Regional Ecosystem	Short Description	VMA Status	EPBC Status
11.3.4/11.3.7	*Eucalyptus tereticornis* and/or *Eucalyptus spp.* woodland on alluvial plains; *and Corymbia spp*. woodland on alluvial plains	OC/LC	-
11.3.7	*Corymbia spp*. woodland on alluvial plains	LC	-
11.4.2	*Eucalyptus spp.* and/or *Corymbia spp*. grassy or shrubby woodland on Cainozoic clay plains	OC	-
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or A. argyrodendron on Cainozoic clay plains	E	E
11.4.8/11.4.9	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or A. argyrodendron on Cainozoic clay plains; and *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	E	E
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii +/- Casuarina cristata* open forest to woodland	E	E
11.5.2/11.5.2a	*Eucalyptus crebra*, *Corymbia spp*., with *E. moluccana* on lower slopes of Cainozoic sand plains/remnant surfaces; and *Allocasuarina luehmannii* low tree layer with or without emergent woodland	LC	-
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	LC	-
11.5.3/11.5.2a	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfgaces; and *Allocasuarina luehmannii* low tree layer with or without emergent woodland	LC	-
11.5.9/11.5.3	*Eucalyptus crebra* and other *Eucalyptus spp*. and *Corymbia spp.* woodland on Cainozoic sand plains and/or remnant surfaces; and *Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	LC	-
11.7.2/11.5.18	*Acacia spp.* woodland on Cainozoic lateritic duricrust. Scarp retreat zone; and *Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces	LC/OC	-
11.7.2/11.7.4	*Acacia spp.* woodland on Cainozoic lateritic duricrust. Scarp retreat zone; and *Eucalyptus decorticans* and/or *Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius* woodland on Cainozoic lateritic duricrust	LC	-

E – Endangered, OC – Of Concern, NC – No Concern at present, LC – Least Concern, VMA – Vegetation Management Act, EPBC –Environmental Protection and Biodiversity Conservation Act, BD Status –Biodiversity Status (according to the Queensland Government).

Source: DEHP 2017b

Figure 4: DSITI Mapped Regional Ecosystems



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Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	DSITI RE Mapping
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd

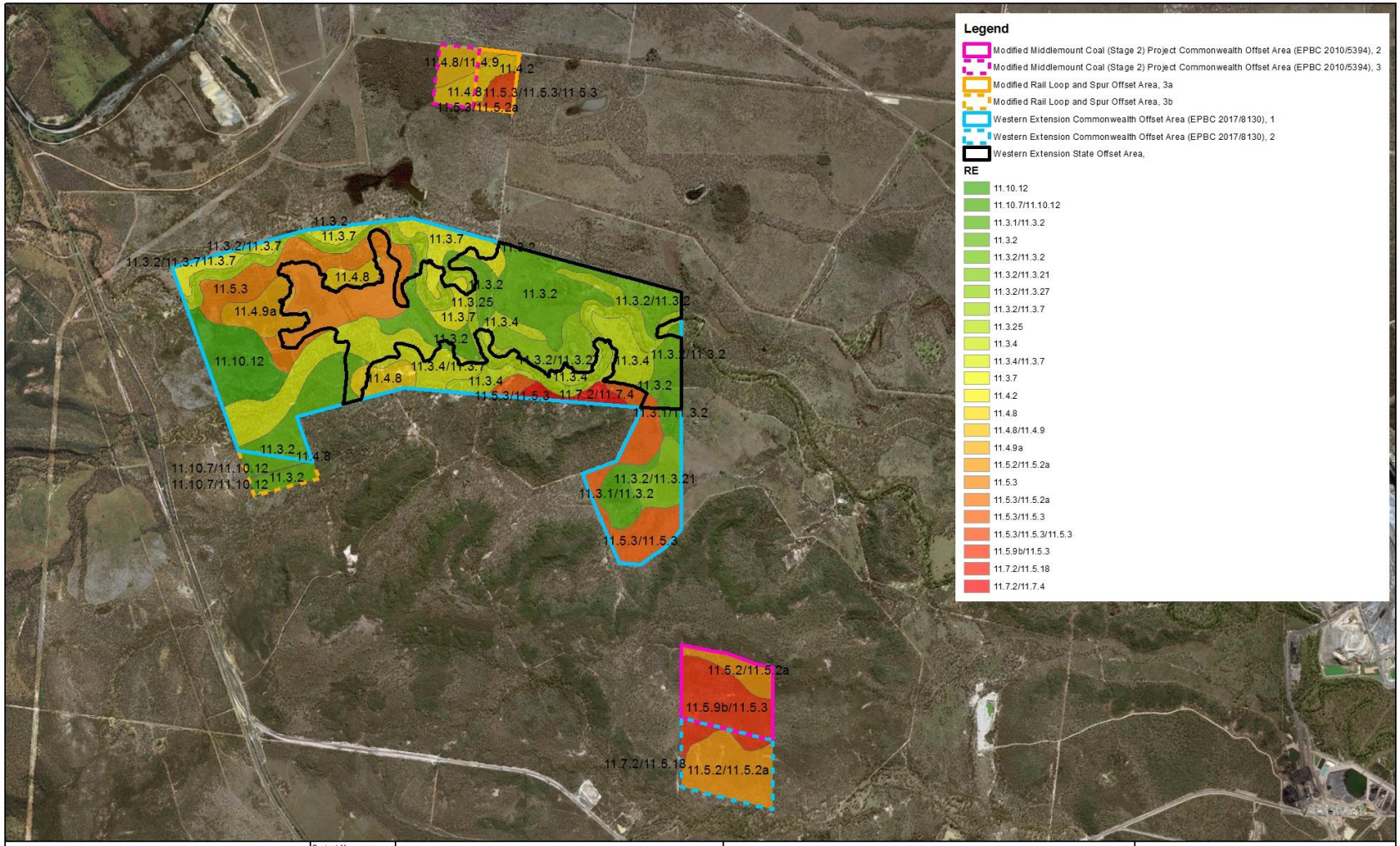
0 0.75 1.5 3 Kilometers

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1:45,000	EC1687	C

Source: DSITI 2017

Figure 5: Mapped Pre-clearing Regional Ecosystems



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	DSITI Pre-clear RE Mapping
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd

0 0.75 1.5 3 Kilometers

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1:45,000	EC1687	C

3.4. Drainage Features

The study site is located in the Fitzroy River Basin which drains an area of approximately 150,000km^2 (DNRM 2015). The main drainage feature of the study site is Roper Creek which passes through the Western Extension Commonwealth Offset Area (1) (Figure 3). Roper Creek was found to be largely dry during the field surveys (Photo 1), however some pools remained. A number of other smaller tributaries and drainage lines flow through the Offset Areas into Roper Creek.

These watercourses are all ephemeral (i.e. flow is restricted to periods after rainfall). Whilst these watercourses were not flowing during the field surveys, recent rainfall events resulted in a number of temporary waterholes within the watercourses.

Only the Western Extension Commonwealth Offset Area (1) contains a permanent water source, comprising a large dam in the western extent of the area (Photo 2) and several smaller dams. These water sources would provide a permanent water source for native fauna and habitat for a range of bird species.

Photo 1: Section of Roper Creek

Photo 2: Permanent dam in Offset Area

3.5. Landuse and Disturbance History

The study sites do not contain any developed areas such as dwellings or farm infrastructure. The primary current landuse for the study site is beef cattle grazing, which mostly occurs along Roper Creek and other cleared areas of the Western Commonwealth Extension Offset Area (1). No other agricultural activities are conducted within the study site.

Historically, the main disturbance activities within the locality were related to land clearing associated with cattle grazing, which has occurred extensively in low-lying areas including creek flats, and clay plains. Grazing and trampling by cattle has suppressed regeneration over some cleared areas, however natural regeneration is occurring extensively throughout the study sites.

The Modified Rail Loop and Spur and Modified Stage 2 Commonwealth Offset Areas show few signs of disturbance and largely comprise remnant vegetation.

3.6. Summary of Previous Threatened Species Recorded

A number of flora and fauna surveys have been undertaken on lands surrounding the study site (Parsons Brinckerhoff [PB] 2010; Ecology and Heritage Partners [EHP] 2012, 2013a, 2013b, 2013c; Naturecall, 2013, 2014a, 2014b, 2014c, 2015, 2016, 2017a, 2017b; GHD 2012). These surveys have resulted in the detection of a number of flora and fauna species listed under the *Nature Conservation Act, 1992* (NC Act) and/or EPBC Act which include:

- *Cerbera dumicola* which is listed as 'Near Threatened' under the NC Act (PB 2010; EHP 2012; Naturecall 2016).

- Koala (*Phascolarctos cinereus*), which is listed as 'Vulnerable' under the NC Act and EPBC Act (PB 2010; Naturecall 2014b, 2016, 2017a; EHP 2012).
- Greater Glider (*Petauroides volans*), which is listed as 'Vulnerable' under the NC Act and EPBC Act (Naturecall 2014b, 2017a, 2017b).
- Squatter Pigeon (southern) (*Geophaps scripta scripta*), which is listed as 'Vulnerable' under the NC Act and EPBC Act (PB 2010; EHP 2012; Naturecall 2013, 2014a, 2014c, 2017a).
- Ornamental Snake (*Denisonia maculata)*, which is listed as 'Vulnerable' under the NC Act and EPBC Act (PB 2010).

4.0 Methodology

4.1. Desktop Study and Literature Review

A desktop study was completed prior to the field survey to gather relevant information and data. The following databases and Geographic Information System (GIS) layers were searched/obtained:

- Department of the Environment and Energy (DEE) Protected Matters Search Tool (DEE 2017a) using a 2km search radius.
- DEHP Wildlife Online database (DEHP 2017c) using a 10km search radius.
- DSITI Regional Ecosystems Mapping digital data layer (DSITI 2017).
- DSITI Pre-clearing Regional Ecosystems digital data layer (DSITI 2017).

In addition to the desktop searches, the following literature was reviewed:

- *Ecological Investigations within the Offset Area for Stage 2 of the Middlemount Coal Mine, Queensland* (EHP 2012).
- *Vegetation Offsets for Middlemount Rail Spur and Loop* (EHP 2013a).
- *Vegetation Offsets for Parrot Quarry* (EHP 2013b).
- *Vegetation Offsets for Middlemount Coal Mine Thirteen Mile Gully Diversion* (EHP 2013c).
- *Middlemount Coal Mine Rail Loop and Spur Vegetation Offset Proposal* (MCPL 2013a).
- *Parrot Quarry Vegetation Offset Proposal* (MCPL 2103b).
- *Thirteen Mile Gully Diversion Vegetation Offset Proposa*. (MCPL 2013c).
- *Middlemount Coal Mine Offset Management Plan/Vegetation Management Plan* (MCPL 2013d).
- *Ecological Monitoring for Offset Area* (Naturecall 2013).
- *Ecological Assessment Report for Bingegang Pipeline Relocation*, *Middlemount Coal Mine* (Naturecall 2014a).
- *Ecological Monitoring for Offset Area: Use of the Offset Area by Fauna* (Naturecall 2014b).
- *Ecological Monitoring for Offset Area Year 2* (Naturecall 2014c).
- *Terrestrial Ecology Impact Assessment: Western Extension*, Middlemount Coal Mine (Naturecall 2015).
- *Vegetation Validation and Terrestrial Habitat Assessment*, *Middlemount Coal Mine* (Naturecall 2016).
- *Ecological Impact Assessment: Western Extension*, *Middlemount Coal Mine (in prep)* (Naturecall 2018).
- *Ecological Monitoring for Offset Area Year 4* (Naturecall 2017a).
- *North-eastern Extension Offset Area - Offset Baseline Report*, *Middlemount Coal Mine*.(Naturecall 2017b).
- *Middlemount Coal Project (Stage 2) Terrestrial Ecological Impact Assessment* (PB 2010).

Existing DSITI Regional Ecosystem mapping of the study site (Section 3.2), as well as previous mapping on adjoining land (PB 2010; EHP 2012; Naturecall 2016) was obtained and used in conjunction with satellite imagery to identify the broad vegetation types present. This preliminary mapping assisted with survey design and allowed comparison to the floristic data collected during the survey.

4.2. Field Surveys

Field surveys were undertaken across the study site to achieve the various project objectives (see Section 2.2). The different offset areas were subject to various survey methods and effort over two survey periods from 18-21 July and 20-26 November 2017.

Field surveys over the Modified Stage 2 Commonwealth Offset Area (2) and Western Extension Commonwealth Offset Area (2) study sites were also undertaken from 9-15 June 2016 as part of the Northeast Extension Offset Area project.

A detailed summary of the methods applied to the Offset Areas is provided in the following sections.

4.2.1. Vegetation and Habitat Quality Surveys

Regional Ecosystem and Non-remnant Vegetation Verification

Vegetation surveys were initially carried out over the study site to ground truth Regional Ecosystem mapping and Pre-clearing RE mapping. This was undertaken by Biodiversity Australia Ecologists from 18-21 July 2017. Further refinement of RE mapping was undertaken during the November survey period.

Field surveys were undertaken in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner et al. 2017). A total of 15 quaternary survey sites were carried out across the study site (Figure 6). This allowed accurate mapping of Regional Ecosystems, and validation of vegetation status (i.e. remnant/non-remnant).

The following information was recorded at each quaternary survey site:

- Date.
- Structural Code.
- Ecologically Dominant Layer (EDL) Height.
- EDL Cover.
- Land Zone.
- Regional Ecosystem Map Unit.
- Collector/s.
- X/Y Coordinate.
- Remnant Vegetation Cover

The location of quaternary survey sites is shown in Figure 6.

4.2.2. Threatened Ecological Community Identification

Vegetation communities identified during the surveys were assessed for their conservation status under the EPBC Act, VM Act and DEHP Biodiversity Status. Brigalow communities were also assessed according to the Approved conservation advice for the Brigalow EEC (Department of the, Environment, [DofE] 2013) and the Species Profile and Threats Database (DEE, 2019).

Habitat Quality Assessment

Habitat Quality Assessments were conducted throughout the study site in accordance with the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a). These surveys were carried out by Biodiversity Australia ecologists from 20-26 November 2017.

The following sections describe the procedures involved in the surveys.

Defining Assessment Units

Assessment units for the site condition assessments were defined according to the ground-truthed Regional Ecosystems. Each distinct RE was assigned as a single assessment unit as per the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a).

Sampling Sites

Based on a desktop assessment of the study site and minimum effort requirements described in the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a) a minimum of 49 plots/transects were suggested as shown in Table 3 below.

A total of 44 plots/transects were undertaken in November 2017. A geo-referenced map showing the location of survey sites is shown in Figure 6. Site selection was targeted to sample a representative coverage of the site vegetation.

As seen in Table 3 below, some assessment units had less than the suggested number of sites in the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a), yet the guidelines describe that site numbers can be reduced. This was due to the vegetation across the assessment unit being in very similar condition and not warranting additional condition assessments. In this circumstance, photographs were taken to demonstrate the similarity (streamlines sites) as allowed for in Section 4.4 of the guidelines (DEHP 2017a).

No field assessment of AU4 (RE 11.3.27d) was undertaken as it was not identified until after the field survey was carried out.

Table 3: Sampling Sites in all Offset areas

Assessment Unit	Regional Ecosystem	Area (ha)	Suggested no. of Sampling Sites	Sampling Sites Completed 2017
Western Extension Commonwealth Offset Area				
AU1	11.3.1	16.5	2	2
AU2	11.3.2	281	4	7
AU3	11.3.25	57	3	3
AU4	11.3.27d	4	2	0
AU5	11.3.4/11.3.4a	117.5	4	6
AU6	11.3.7	29	2	2
AU7	11.4.8	17	2	2
AU8	11.4.9/11.4.9a	42.5	2	4
AU9	11.5.18	4	2	1
AU10	11.5.2a	52.5	3	1
AU11	11.5.3	86.5	3	5
AU12	11.5.9	18.5	2	1
AU13	11.7.2	3	2	2
AU14	11.7.4	13.5	2	2
AU15 (Non-Rem)	11.3.1	32	2	2
AU16 (Non-Rem)	11.3.2	144	4	2
AU17 (Non-Rem)	11.3.4/11.3.4a	46	2	2
AU18 (Non-Rem)	11.3.7	13	2	1
AU19 (Non-Rem)	11.5.3	209	4	3
Western Extension State Offset Area				
AU1	11.3.1	8	2	1
AU2	11.3.2	185	4	4
AU3	11.3.25	17.5	2	1
AU4	11.3.27d	4	2	0
AU5	11.3.4/11.3.4a	17	2	2
AU6	11.5.3	8.5	2	1
AU7 (Non-Rem)	11.3.1	13.5	2	1
AU8 (Non-Rem)	11.3.2	105	4	2
AU9 (Non-Rem)	11.3.4/11.3.4a	12	2	1
AU10(Non-Rem)	11.5.3	83	3	2
Modified Commonwealth Stage 2 (a and b) Offset Area				

Assessment Unit	Regional Ecosystem	Area (ha)	Suggested no. of Sampling Sites	Sampling Sites Completed 2017
AU1	11.4.8	15.5	2	1
AU2	11.4.9	14	2	1
AU3	11.5.18	18	2	2
AU4	11.5.2a	7	2	1
AU5	11.5.3	12.5	2	1
AU6	11.5.9	47	2	2
Rail Loop and Spur (a and b) Offset Area				
AU1	11.3.2	10	2	2
AU2	11.4.8	7	2	1
AU3	11.4.9	9.0	2	1
AU4	11.5.3	6	2	2
AU5 (Non-Rem)	11.3.2	13	2	1
AU6 (Non-Rem)	11.5.3	11.5	2	2

Site Condition Assessment

The following information was recorded at each of the terrestrial habitat quality assessment sites using a combination of measured plots and transects:

- Observer, location and date.
- Regional Ecosystem (assessment unit).
- Photographic record of vegetation.
- Habitat description (e.g. presence of habitat resources for native fauna).
- Canopy and subcanopy height (measured using stick method).
- Canopy and subcanopy percentage cover.
- Native plant species richness (as a percentage) in each layer.
- Number of large trees located within a 100m x 50m plot.
- Recruitment of woody perennial species (i.e. proportion of dominant layer regenerating).
- Coarse woody debris within a 50m x 20m plot.
- Non-native plant cover percentage.
- Groundcover composition.

The values for each habitat quality attribute were recorded in the field on Biocondition data sheets (Eyre et al, 2015). This data was then added to the *Habitat Quality Scoring Template, Version 1.0* (DEHP 2014).

For Assessment Units that had multiple sampling sites the values for each attribute were totaled and then averaged in order to have one value for each attribute. This approach was confirmed with DES. For each Assessment Unit the values recorded at the sampling sites were then compared against the relevant Regional Ecosystem benchmark data for each attribute to give an overall score for each attribute. Summing these scores determined the overall score for Site Condition for each Assessment Unit. This was all calculated through the Habitat Quality Scoring Template.

Site Context Assessment

Site context attributes were measured via desktop assessment using GIS mapping and spatial analysis as per the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a). ArcGIS Version 10.2.2 was used for all GIS mapping and spatial analysis.

This data was then added to the Habitat Quality Scoring Template which automatically compares the site context attributes to the Site Context Scoring sheet to determine the overall site context score for each Assessment Unit.

It is important to note that the “Distance to permanent watering point” was not calculated as this attribute is measured for intact Bioregions only and the Brigalow Belt Bioregion is fragmented (DEHP 2017a).

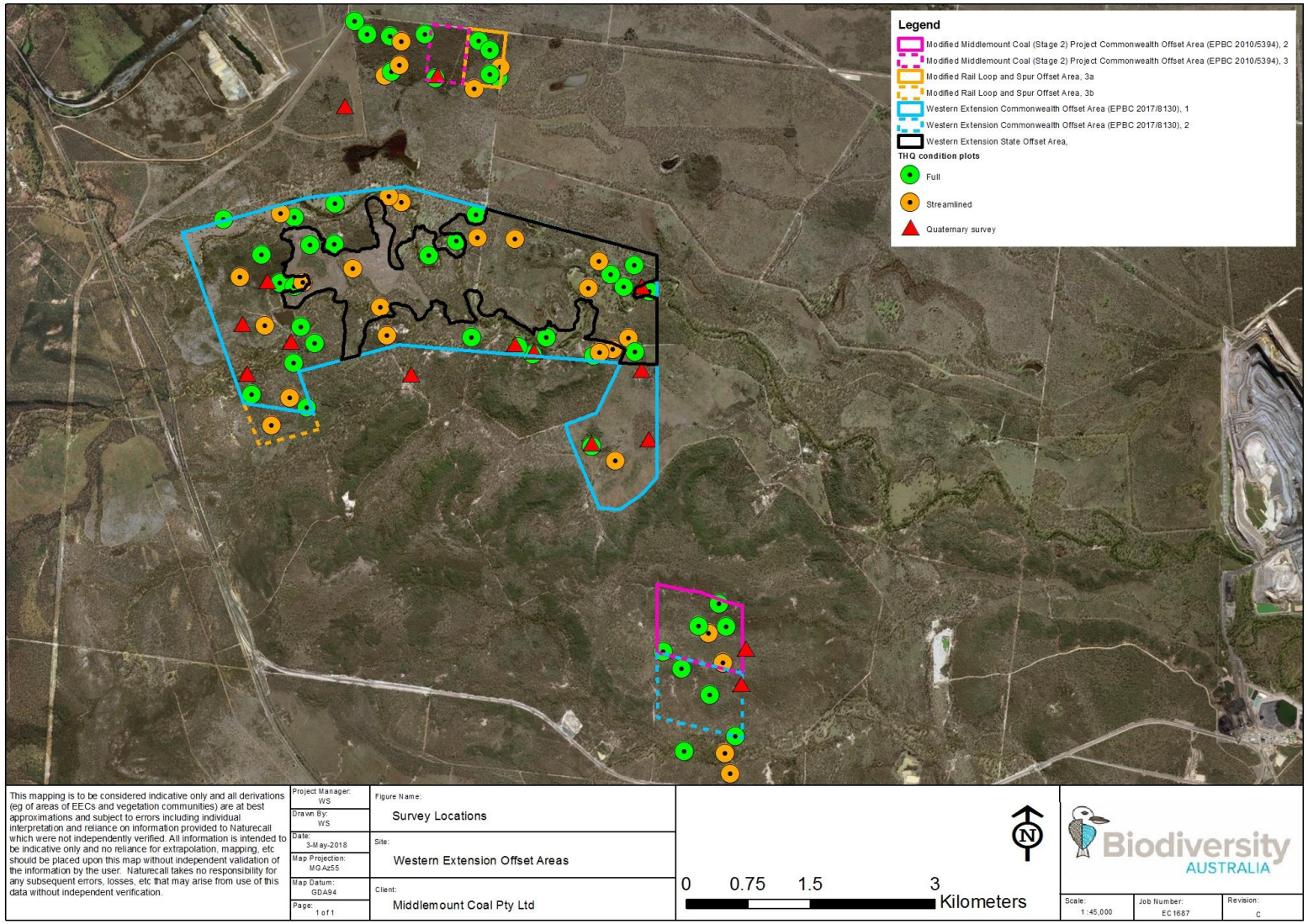
Fauna Species Habitat Assessment

A desktop review was completed prior to the field survey to gather relevant information and data on the Squatter Pigeon (southern), Greater Glider, Koala and Ornamental Snake. Opportunistic surveys and habitat suitability assessment for the Squatter Pigeon (southern), Greater Glider, Koala and Ornamental Snake were then undertaken within the study site (See Section 4.2.2). Using the information gathered and expert knowledge of the general locality (based on previous field surveys), the Species Habitat Index scores were determined using the Species Habitat Index Scoring Guide as per the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017a).

Final Habitat Quality Score

The final Habitat Quality Score was automatically calculated within the Habitat Quality Scoring Template provided. Each of the above three indicators are scored then summed and translated to a final score out of 10, with a score of 10 representing a fully intact ecosystem and 1 representing a totally cleared area (DEHP 2017a).

Figure 6: Location of survey sites



4.2.3. Threatened Fauna Surveys

Opportunistic fauna surveys were carried out throughout the study sites during the November 2017 survey period. The surveys comprised the following:

- Habitat suitability assessment.
- Diurnal bird surveys.
- Track, scat, secondary evidence and physical habitat searches.
- Spotlighting transects
- Opportunistic fauna observations.

Further details are provided in the following sections.

Habitat Suitability Assessment

The condition and features (e.g. hollows, fallen logs, foraging resources and leaf litter) of the various habitat types within the study sites were recorded during the field surveys. Any permanent and non-permanent water sources were also recorded and photographed.

Detailed data on habitat parameters such as groundcover density and composition, vegetation structure, coarse woody debris and weed cover was collected as part of the site condition assessment described in Section 4.2.1.

Diurnal Bird Surveys

The diurnal bird surveys consisted of specific censuses of at least 30 minutes duration and were undertaken at a different location each morning during the survey period. Bird species were generally surveyed by detecting calls and searching with binoculars at specific points or along a walking transect. The surveys targeted permanent water sources, roads/tracks and other areas of suitable habitat for the Squatter Pigeon (southern).

Track, Scat ,Secondary Evidence and Physical Habitat Searches

Searches for scats and tracks were undertaken opportunistically throughout the study sites in conjunction with other surveys and when traversing between vegetation survey sites.

The sandy roads and dry creek beds within and around the study sites provided ideal locations for track searches, and any tracks found were photographed and identified using Triggs (1996) as a reference text.

Physical habitat searches of the site involved:

- Lifting of debris to search for reptiles and frogs.
- Inspection of dense vegetation for bird nests.
- Observation of likely basking sites for reptiles and frogs.
- Searching for scats, tracks, digging and scratches across the study site as they could indicate the presence of numerous native species (e.g. Koala).

Spotlighting Transects

Spotlighting was undertaken throughout the Western Extension Commonwealth Offset Area (1) over one night during the November survey period for a total of three hours.

This involved driving transects from a vehicle moving at walking pace along roads and tracks. Two hand held LED spotlights and a thermal imagery camera were utilised.

All habitat components (i.e. understory/canopy trees, dense vegetation, logs), were searched for terrestrial and arboreal fauna.

5.0 Results

5.1. Vegetation Survey Results

5.1.1. Floristics

The study sites were found to have reasonable floristic diversity, however weeds and naturalised pasture species such as Buffel Grass are present over large areas. The comprehensive flora list for the study sites is presented in Appendix 1.

A total of 115 flora species were recorded during the surveys, including 16 exotic species (Appendix 1). The highest diversity was found at less disturbed sites where an intact ground layer was present and there was less evidence of disturbance from cattle grazing.

5.1.2. Regional Ecosystems

The RE validation process identified a total of fourteen distinct regional ecosystems across the study sites. Approximately 66% of the Offset Areas (approximately 899ha) qualified as remnant vegetation[1], with the remaining 34% (approximately 469 ha) determined to be non-remnant. The following sections provide a detailed description of the ground-truthed RE mapping across the study sites.

Western Extension Commonwealth Offset Area

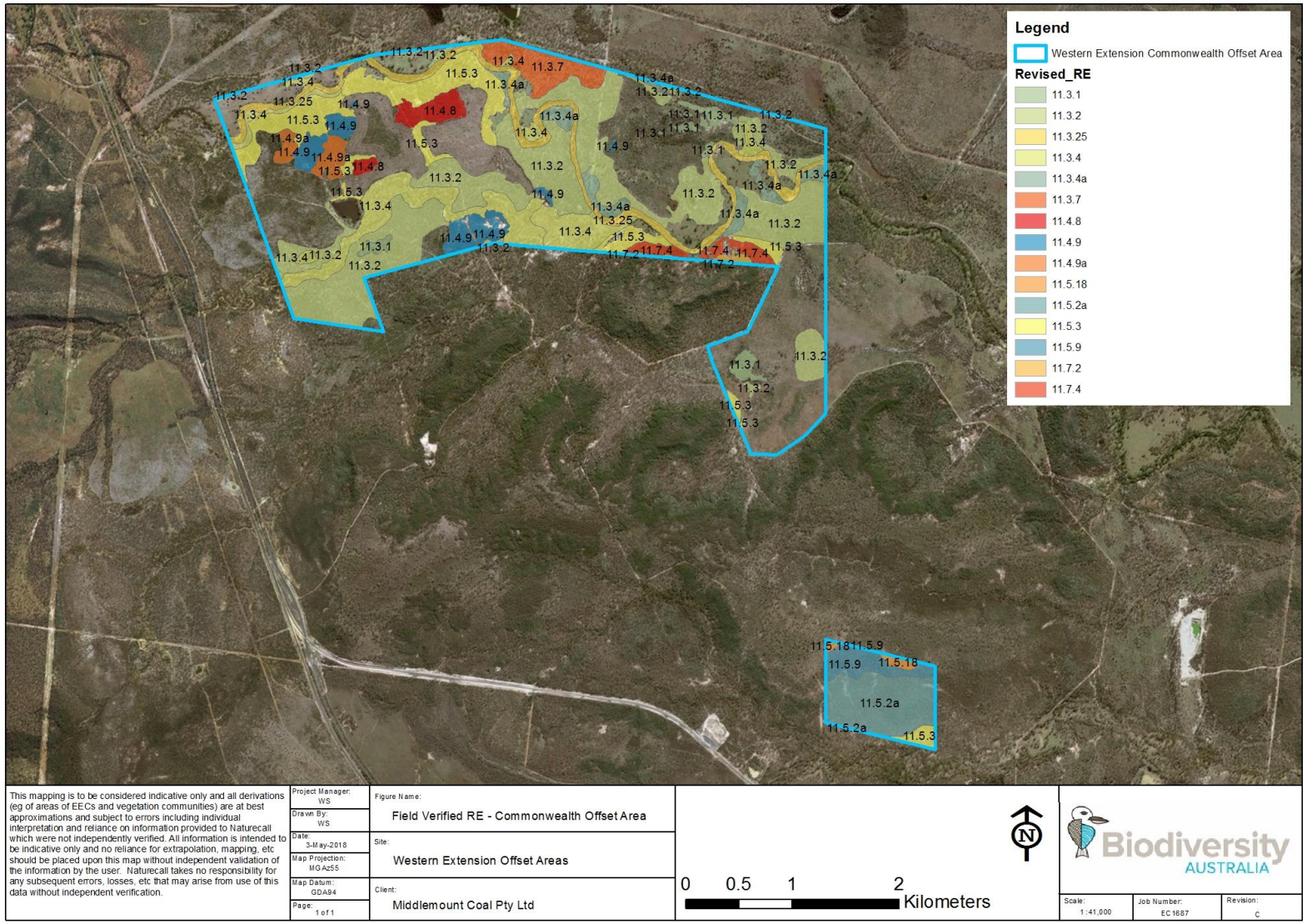
Table 4 details the RE's present in the Western Extension Commonwealth Offset Area (1 and 2) along with the area (in ha) and conservation status. A map of the RE's in the Western Extension Commonwealth Offset Area is provided in Figure 7.

[1] As defined by Neldner et al. (2017)

Table 4: Western Extension Commonwealth Offset Area Regional Ecosystems

Regional Ecosystem	Short Description	Field Verified Area (ha)	VMA Status	EPBC Status
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	16.5	E	E
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	281	OC	-
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	57	LC	-
11.3.27d	*Eucalyptus camaldulensis* and/or *E. tereticornis* woodland. A range of sedges and grasses occur in the ground layer including *Fimbristylis vagans*, *Myriophyllum striatum, Nitella pseudoflabellata* and *Pseudoraphis sp*. Occurs fringing large lakes. Palustrine wetland (e.g. vegetated swamp)	4	LC	-
11.3.4/11.3.4a	*Eucalyptus tereticornis* and/or *Eucalyptus spp*. woodland on alluvial plains; and *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	117.5	OC	-
11.3.7	*Corymbia spp.* woodland on alluvial plains	29	LC	-
11.4.8	*Eucalyptus cambageana woodland to open forest with Acacia harpophylla or A. argyrodendron on Cainozoic clay plains*	17	E	E
11.4.9/11.4.9a	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains; *Corymbia tessellaris* woodland. On alluvial sandridges to elevated levees and level terraces adjacent to larger stream channels which are irregularly flooded or possibly relict. Occurs on deep, loose neutral to alkaline red or pale uniform sand or non-sodic texture contrast soil. This unit has very low subsoil salinity in all profiles . Floodplain (other than floodplain wetlands)	42.5	E/ E	E/E
11.5.2a	*Allocasuarina luehmannii* low tree layer with or without emergent woodland	52.5	LC	-
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	86.5	LC	-
11.5.9	*Eucalyptus crebra and other Eucalyptus spp. and Corymbia spp.* woodland on Cainozoic sand plains and/or remnant surfaces	23.5	LC	-
11.5.18	*Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces	9	OC	-
11.7.2	*Acacia spp.* woodland on Cainozoic lateritic duricrust. Scarp retreat zone	3	LC	-
11.7.4	*Eucalyptus decorticans* and/or *Eucalyptus spp*., *Corymbia spp*., *Acacia spp*., *Lysicarpus angustifolius* woodland on Cainozoic lateritic duricrust	13.5	LC	-

Figure 7: Field verified Regional Ecosystems – Western Extension Commonwealth Offset Area



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGA≥55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Field Verified RE - Commonwealth Offset Area
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd
Scale:	1:41,000
Job Number:	EC1687
Revision:	C

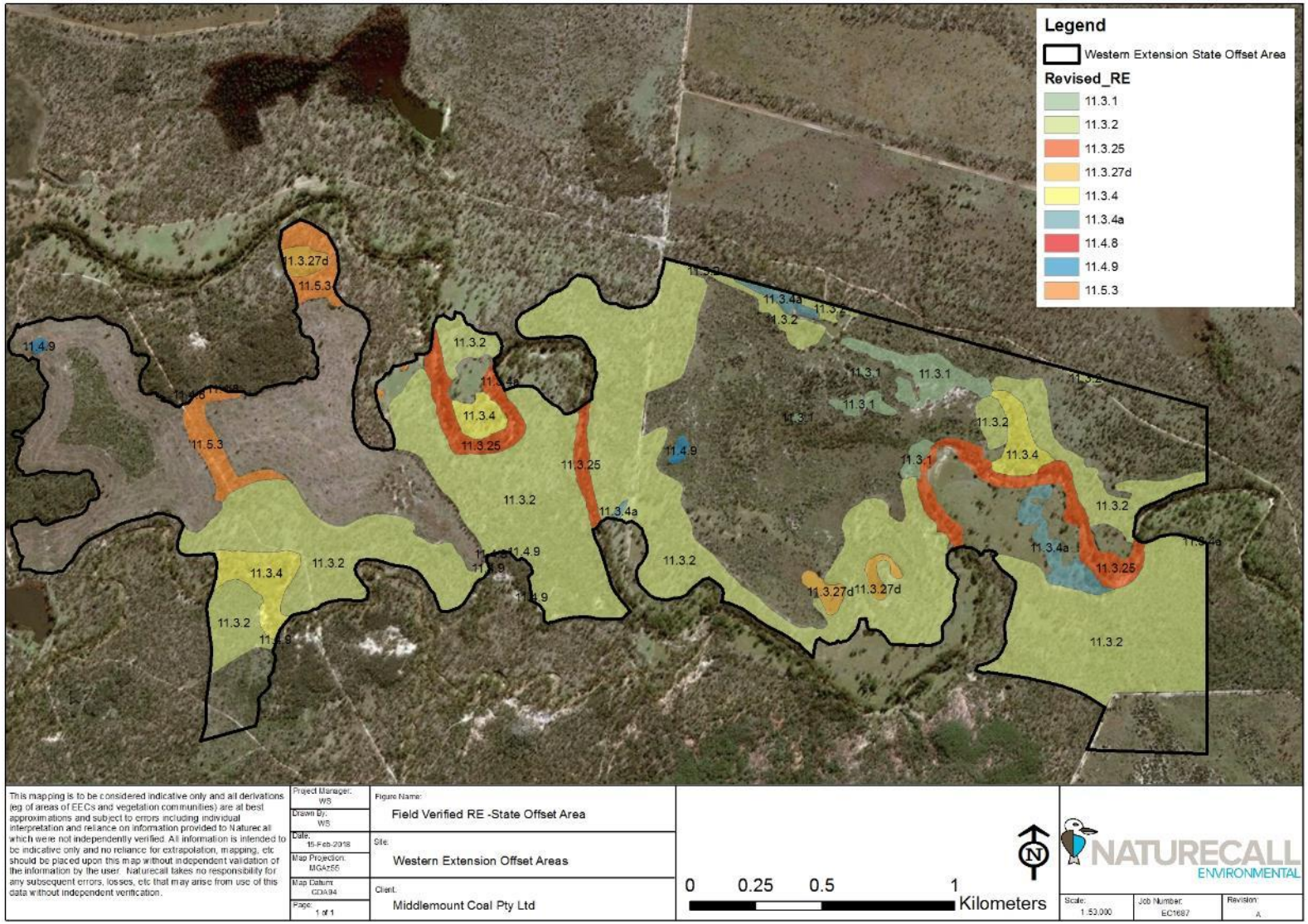
Western Extension State Offset Area

Table 5 details the RE's present in the Western Extension State Offset Area along with the area (in ha) and conservation status. A map of the RE's in the Western Extension State Offset Area is provided in Figure 8.

Table 5: Western Extension State Regional Ecosystems

Regional Ecosystem	Short Description	Field Verified Area (ha)	VMA Status	EPBC Status
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open-forest on alluvial plains	8	E	-
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	185	OC	-
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	17.5	LC	-
11.3.27d	*Eucalyptus camaldulensis* and/or *E. tereticornis* woodland. A range of sedges and grasses occur in the ground layer including *Fimbristylis vagans*, *Myriophyllum striatum, Nitella pseudoflabellata* and *Pseudoraphis sp*. Occurs fringing large lakes. Palustrine wetland (e.g. vegetated swamp).	4	LC	-
11.3.4/11.3.4a	*Eucalyptus tereticornis* and/or *Eucalyptus spp*. woodland on alluvial plains; *Corymbia tessellaris* woodland. On alluvial sandridges to elevated levees and level terraces adjacent to larger stream channels which are irregularly flooded or possibly relict. Occurs on deep, loose neutral to alkaline red or pale uniform sand or non-sodic texture contrast soil. This unit has very low subsoil salinity in all profiles . Floodplain (other than floodplain wetlands)	17	OC	-
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains	0.5	E	E
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	8.5	LC	-

Figure 8: Field verified Regional Ecosystems – Western Extension State Offset Area



Modified Rail Loop and Spur Offset Area

Table 6 details the RE's present in the Modified Rail Loop and Spur Offset Area (3a and 3b) along with the area and conservation status. A map of the RE's in this Offset Area is provided following the table.

Table 6: Rail Loop and Spur Offset Area Regional Ecosystems

Regional Ecosystem	Short Description	Field Verified Area (ha)	VMA Status	EPBC Status
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	10	OC	-
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	7	E	E
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains; and *Acacia harpophylla, Lysiphyllum carronii +/- Casuarina cristata* open forest to woodland	9	E	E
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	6	LC	-

Figure 9: Field verified Regional Ecosystems – Rail Loop and Spur Offset Area

This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Field Verified RE - Rail Loop and Spur Offset Area
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd

0 0.5 1 2 Kilometers

Biodiversity AUSTRALIA

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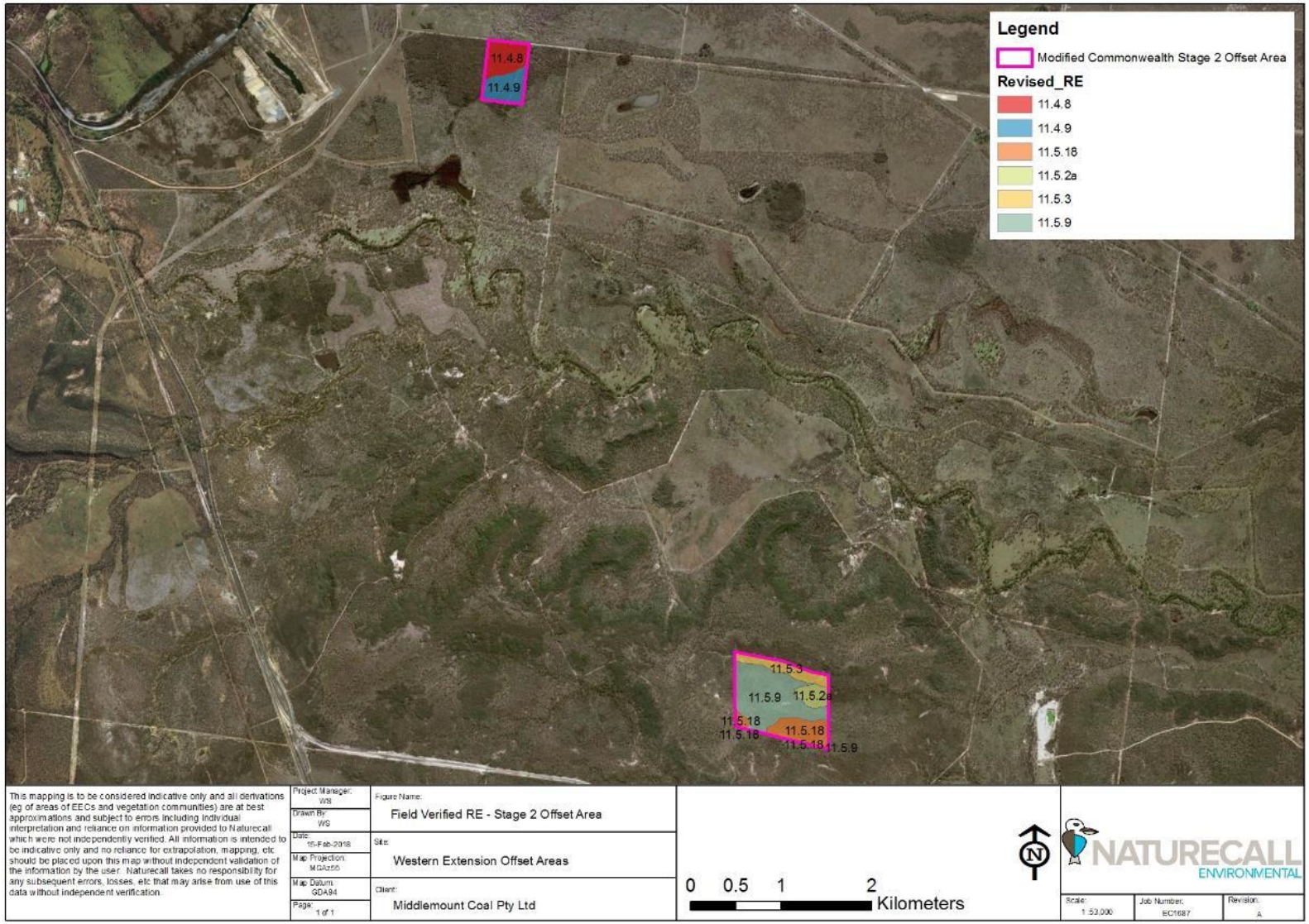
Modified Stage 2 Commonwealth Offset Area

Table 7 details the RE's present in the Modified Stage 2 Commonwealth Offset Area (2 and 3) along with the area (in ha) and conservation status. A map of the RE's in the Modified Stage 2 Commonwealth Offset Area (2 and 3) is provided in Figure 10.

Table 7: Modified Stage 2 Commonwealth Offset Area Regional Ecosystems

Regional Ecosystem	Short Description	Field Verified Area (ha)	VMA Status	EPBC Status
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	15.5	E	E
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains	14	E	E
11.5.18	*Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces	18	OC	-
11.5.2a	*Allocasuarina luehmannii* low tree layer with or without emergent woodland	7	LC	-
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	12.5	LC	-
11.5.9	*Eucalyptus crebra* and other *Eucalyptus spp.* and *Corymbia spp*. woodland on Cainozoic sand plains and/or remnant surfaces	47	LC	-

Figure 10: Field verified Regional Ecosystems – Modified Stage 2 Commonwealth Offset Area



5.1.3. Pre-clearing Regional Ecosystems

The Pre-clearing RE validation process refined the DSITI pre-clearing RE mapping for non-remnant areas. This identified five RE's likely to occur within non-remnant areas of the study sites which covered an area of approximately 469 ha.

The following sections identify and describe the Pre-clearing RE's identified per offset area.

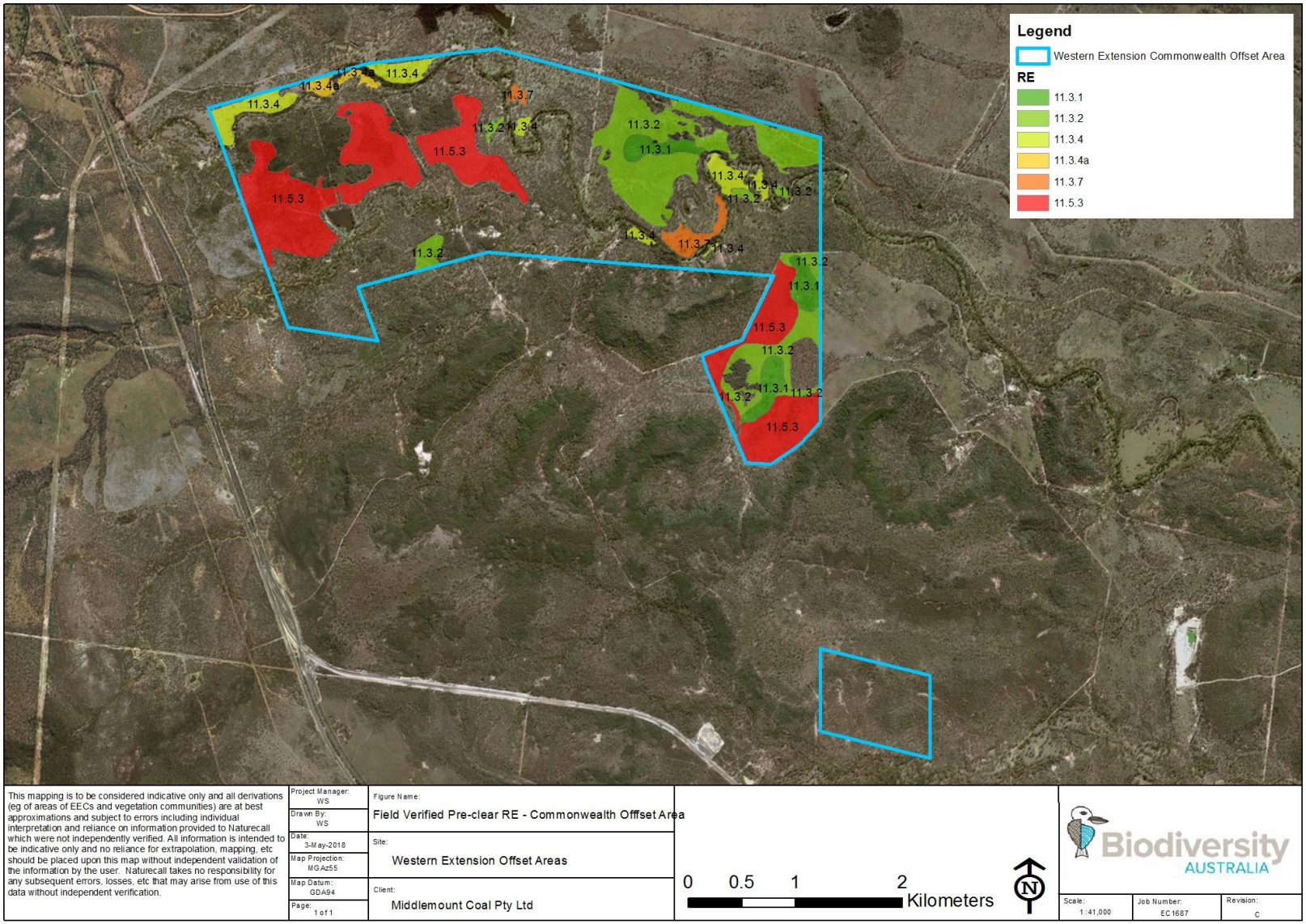
Western Extension Commonwealth Offset Area

Table 8 details the Pre-clearing RE's present within non-remnant areas of the Western Extension Commonwealth Offset Area (1 and 2) along with the area (in ha) and conservation status. A map of the field verified Pre-clearing RE's in the Western Extension Commonwealth Offset Area is provided in Figure 11.

Table 8: Western Extension Commonwealth Offset Area Pre-clearing Regional Ecosystems

Regional Ecosystem (non-remnant)	Short Description	Field Verified Area (ha)	VMA Status	EPBC Status
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	32	E	E
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	144	OC	-
11.3.4/11.3.4a	*Eucalyptus tereticornis* and/or *Eucalyptus spp*. woodland on alluvial plains; *Corymbia tessellaris* woodland. On alluvial sandridges to elevated levees and level terraces adjacent to larger stream channels which are irregularly flooded or possibly relict. Occurs on deep, loose neutral to alkaline red or pale uniform sand or non-sodic texture contrast soil. This unit has very low subsoil salinity in all profiles . Floodplain (other than floodplain wetlands)	46	OC	-
11.3.7	*Corymbia spp.* woodland on alluvial plains	13	LC	-
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	209	LC	-

Figure 11: Field-verified Pre-clearing RE – Western Extension Commonwealth Offset Area



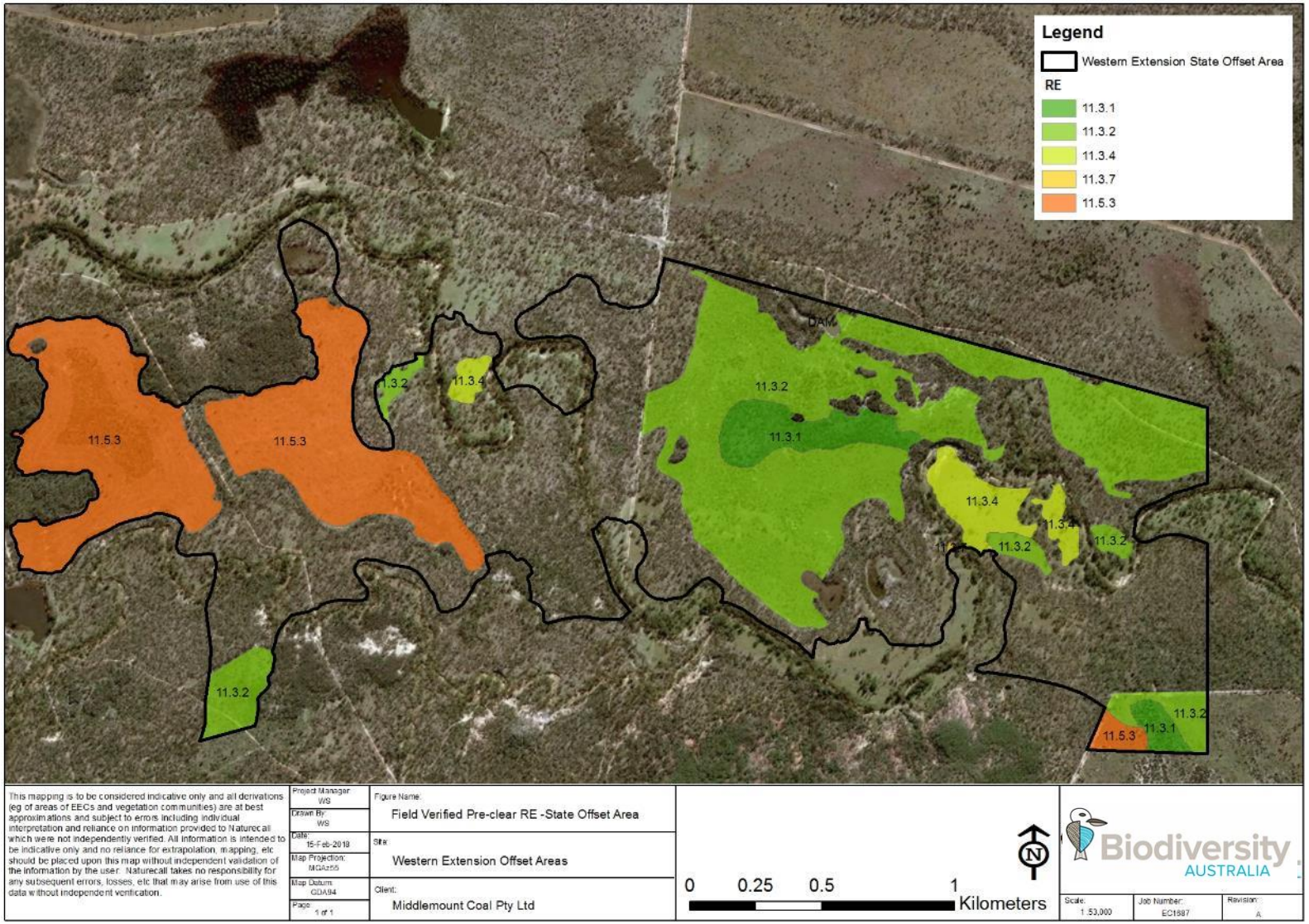
Western Extension State Offset Area

The following table (Table 9) details the Pre-clearing RE's present within non-remnant areas of the Western Extension State Offset Area along with the area (in ha) and conservation status. A map of the field verified Pre-clearing RE's in the Western Extension State Offset Area is provided in Figure 12.

Table 9: Western Extension State Offset Area Pre-clearing Regional Ecosystems

Regional Ecosystem (non-remnant)	Short Description	Field Verified Area (ha)	VMA Status	EPBC Status
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	13.5	E	E
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	105	OC	-
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus spp*. woodland on alluvial plains	12	OC	-
11.5.3	*Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	83	LC	-

Figure 12: Field verified Pre-clearing RE – Western Extension State Offset Area



Modified Rail Loop and Spur Offset Area

The following table (Table 10) details the Pre-clearing RE's present within non-remnant areas of the Modified Rail Loop and Spur Offset Area (3a and 3b) along with the area (in ha) and conservation status. A map of the field verified Pre-clearing RE's in the Modified Rail Loop and Spur Offset Area is provided in Figure 13.

Table 10: Rail Loop and Spur Offset Area Pre-clearing Regional Ecosystems

Regional Ecosystem (non-remnant)	Short Description	Field Verified Area (ha)	VMA Status	EPBC Status
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	13	OC	-
11.5.3	*Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	11.5	LC	-

Figure 13: Field-verified Pre-clearing RE – Modified Rail Loop and Spur Offset Area

This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Field Verified Pre-clear RE - Rail Loop and Spur
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd

0 0.5 1 2 Kilometers

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1 : 41,000	EC1687	C

5.1.4. Threatened Flora

The southern portions of the study sites comprising the Modified Stage 2 Commonwealth Offset Area (2) and Western Extension Commonwealth (2) Offset Areas contained potential habitat for *Cerbera dumicola*, however none were recorded during the surveys.

5.1.5. Endangered and Of Concern Regional Ecosystems

Queensland Vegetation Management Act Status

Under the VM Act, the following Endangered and Of Concern REs were identified and ground-truthed within the study sites:

Endangered Regional Ecosystems:

- RE 11.3.1 - *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.
- RE 11.4.8 - *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains.
- RE 11.4.9 - *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains.
- RE 11.4.9a - *Acacia harpophylla, Lysiphyllum carronii +/- Casuarina cristata* open forest to woodland.

Of Concern Regional Ecosystems:

- RE 11.3.2 - *Eucalyptus populnea* woodland on alluvial plains.
- RE 11.3.4 - *Eucalyptus tereticornis* and/or *Eucalyptus spp*. woodland on alluvial plains.
- RE 11.5.18 - *Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces.

The area (in ha), of each of these communities is presented in Table 11 and their extent and location within the study sites is illustrated in Figure 14.

Environmental Protection and Biodiversity Conservation Act Status

Four Regional Ecosystems conforming to *Acacia harpophylla* dominant and co-dominant' listed as Endangered under the EPBC Act (Brigalow EEC) were identified and accurately ground-truthed during the survey. The type and area of these communities is shown in Table 11 and illustrated in Figure 15.

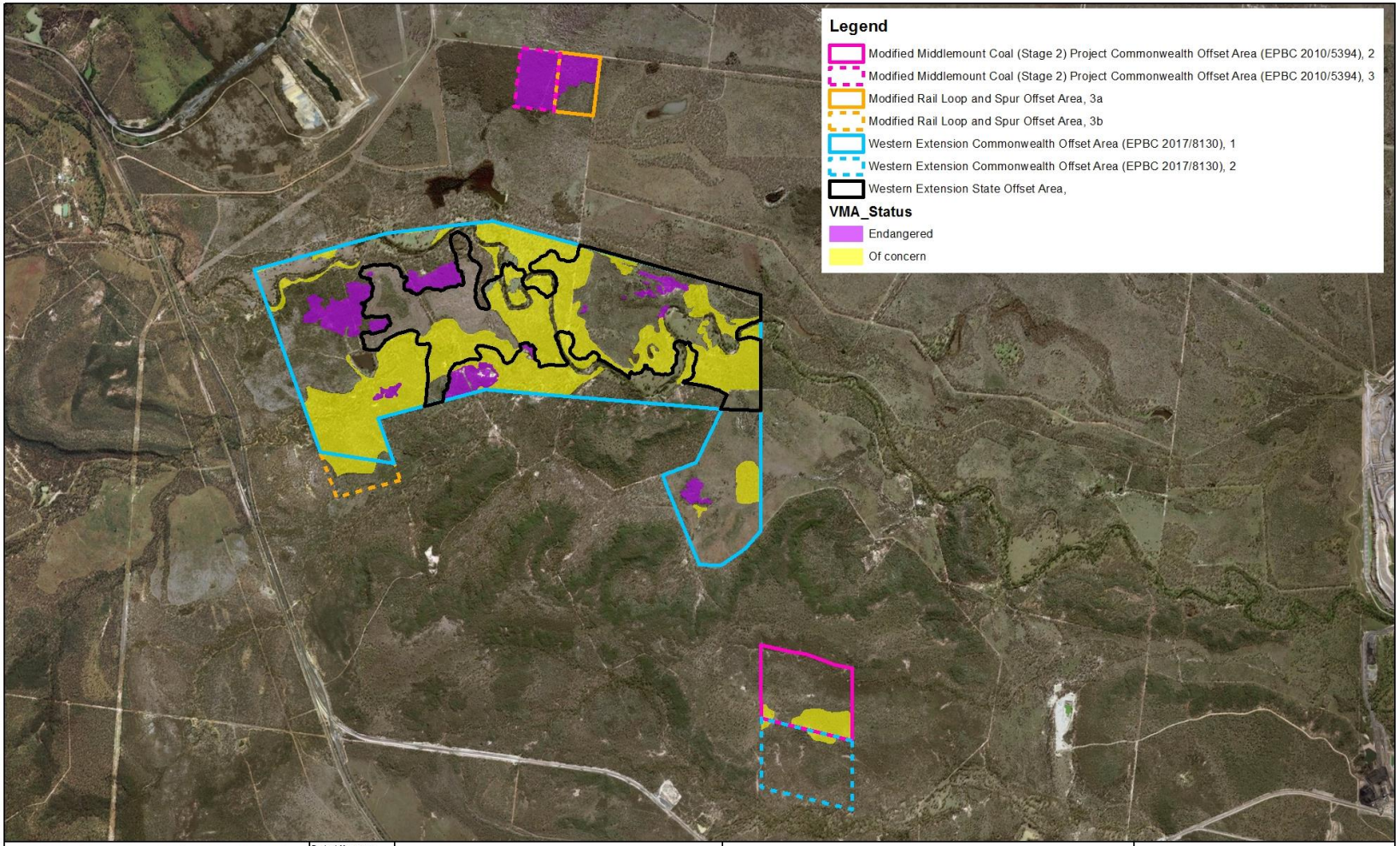
All of these RE types would qualify as the Brigalow EEC. There were a few small isolated patches of remnant vegetation that would not meet the minimum size threshold (<0.5ha) to qualify as the Brigalow EEC.

There are also some areas of non-remnant vegetation that have the potential to qualify as the Brigalow EEC, however these have not been mapped at this stage.

Table 11: Type and area of Brigalow EEC communities in the study sites

Revised RE	BD Status	VMA Status	EPBC Status	Area (ha)
Commonwealth				
11.3.1	Endangered	Endangered	Endangered	16.5
11.4.8	Endangered	Endangered	Endangered	17
11.4.9	Endangered	Endangered	Endangered	29
11.4.9a	Endangered	Endangered	Endangered	13.5
State				
11.3.1	Endangered	Endangered	Endangered	8
Modified Stage 2 Commonwealth (3)				
11.4.8	Endangered	Endangered	Endangered	15.5
11.4.9	Endangered	Endangered	Endangered	14
Rail Loop & Spur (3a)				
11.4.8	Endangered	Endangered	Endangered	7
11.4.9	Endangered	Endangered	Endangered	9

Figure 14: Endangered and Of Concern Regional Ecosystems Listed Under the VM Act



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: WS
Drawn By: WS
Date: 3-May-2018
Map Projection: MGAz55
Map Datum: GDA94
Page: 1 of 1

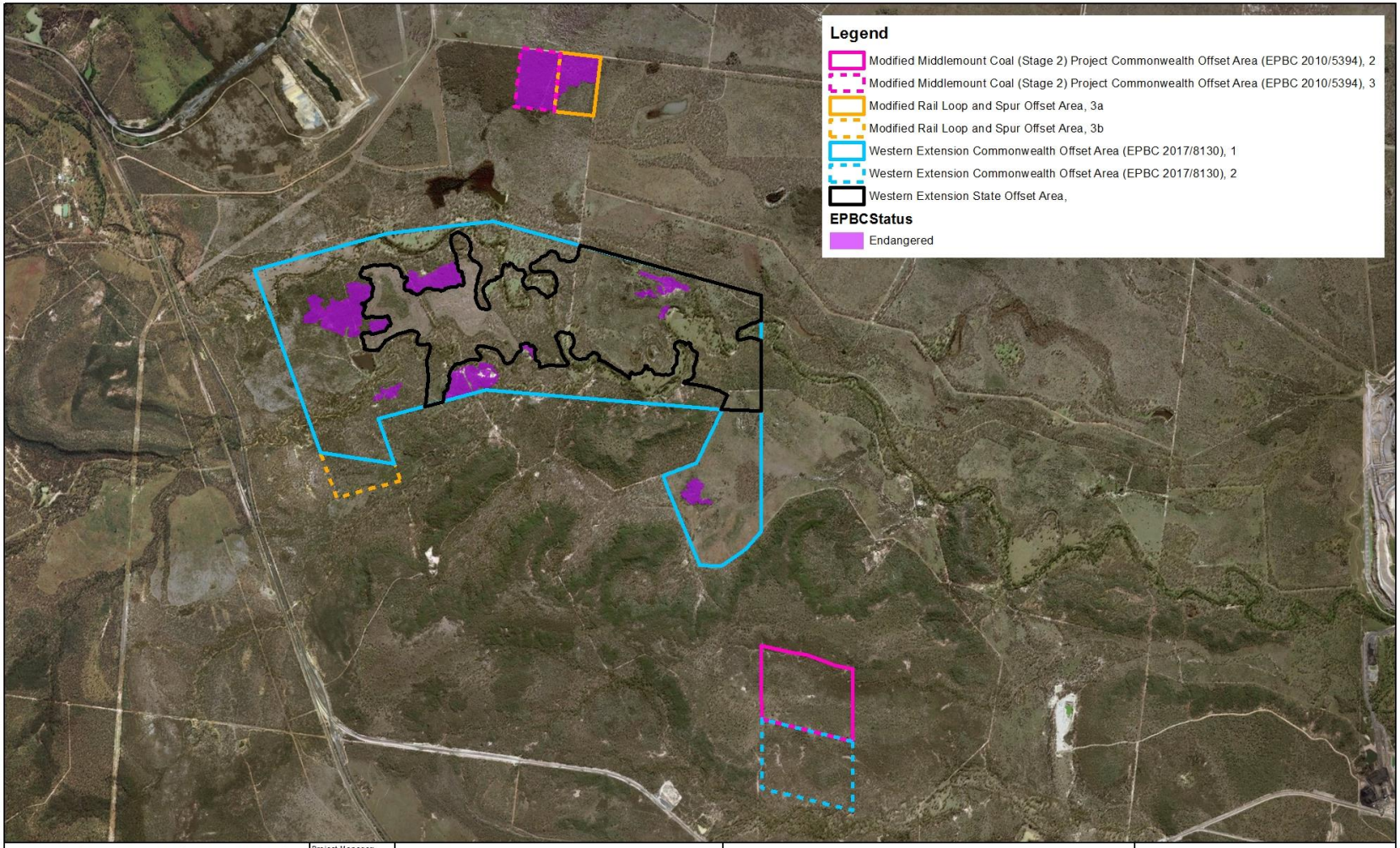
Figure Name: Endangered and Of Concern RE
Site: Western Extension Offset Areas
Client: Middlemount Coal Pty Ltd

0 0.75 1.5 3 Kilometers

Biodiversity AUSTRALIA

Scale: 1:41,000
Job Number: EC1687
Revision: C

Figure 15: Threatened Ecological Communities Listed Under the EPBC Act



This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Naturecall which were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. Naturecall takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: WS
Drawn By: WS
Date: 3-May-2018
Map Projection: MGAz55
Map Datum: GDA94
Page: 1 of 1

Figure Name: Threatened Ecological Communiites
Site: Western Extension Offset Areas
Client: Middlemount Coal Pty Ltd

0 0.75 1.5 3 Kilometers

Biodiversity AUSTRALIA

Scale: 1:41,000
Job Number: EC1687
Revision: C

5.1.6. Exotic Flora Species

A total of 15 exotic flora species were recorded within the study sites. Weed invasion is common throughout, especially in disturbed areas, however it is largely limited to the groundcover stratum. Naturalised introduced pasture species such as Buffel Grass (*Cenchrus ciliaris*), Sabi Grass (*Urochloa mosambicensis*) and Red Natal Grass (*Melinis repens*) along with herbs including *Sida spp.*. Cobblers Pegs (*Bidens pilosa*), Gomphrena Weed (*Gomphrena celosioides*) and Stylo (*Stylosanthes scabra*) were the main weeds encountered. These species dominated the ground layer in the derived grassland habitats, and incursion of these species into adjacent eucalypt woodlands was common.

Table 12 lists the noxious weeds declared under the *Biosecurity Act 2014* recorded within the study sites. Occasional Prickly Pear (*Opuntia elata*), Harrisia Cactus (*Harissa martinii*) and Velvety Tree Pear (*Opuntia tomentosa*) were recorded. The noxious weed distribution of these species was patchy and these species are unlikely to pose a significant risk to the ecological integrity of the study sites due to their low density.

Table 12: Noxious Weeds Recorded Within the Study Sites

Scientific Name	Common name	Biosecurity Act Category	Weed of National Significance	Abundance
Opuntia elata	Prickly Pear	Class 2,3,4 and 5	Yes	Low
Opuntia tomentosa	Velvety Tree Pear	Class 3	Yes	Low
Harrisia martinii	Harrisia Cactus	Class 3	No	Low

5.1.7. Baseline Condition of Regional Ecosystems (Western Extension Commonwealth Offset Area (1 and 2) and Western Extension State Offset Area)

RE 11.3.1 – *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains

RE 11.3.1 within the Western Extension Commonwealth Offset Area (1) and Western Extension State Offset Area was dominated by *Acacia harpophylla*. Native forb species richness and number of large trees scored lower when compared to the benchmark values for this RE. Weed cover was also slightly higher than the benchmark value. However, overall the baseline health and quality of remnant RE 11.3.1 was high.

RE 11.3.2 – *Eucalyptus populnea* woodland on alluvial plains

RE 11.3.2 within the Western Extension Commonwealth Offset Area (1) and Western Extension State Offset Area was dominated by *Eucalyptus populnea*. Recruitment of woody perennial species, native grass and native forb species richness, native perennial grass cover and number of large trees all scored lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.3.2 was average.

RE 11.3.25 - Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines

Within the Western Extension Commonwealth Offset Area (1) and Western Extension State Offset Area *Eucalyptus tereticornis,* and *Casuarina cunninghamiana* dominated this RE. Roper Creek runs through part of the RE. Weed cover was high, particularly along drainage lines and this was reflected in the score for this attribute. Recruitment of woody perennial species, native shrub, grass and forb species richness, tree canopy cover, native perennial grass cover, organic litter and coarse woody debris scored lower than the benchmark values. Overall the baseline health and quality of RE 11.3.25 was average.

RE 11.3.27d - Eucalyptus camaldulensis and/or E. tereticornis woodland.

This RE comprises low lying land on a floodplain that would hold water for extended periods after rain. Tree and shrub cover is sparse and the groundcover composition is variable depending on the time of year.

A range of sedges and grasses occur in the ground layer including *Fimbristylis vagans*, *Cyperus gracilis, Juncus usitatus, Eragrostis spp*. and Swamp Ricegrass (*Leersia hexandra*). The ground layer was dry and grassy at the time of survey, however standing water and a variety of aquatic and semi-aquatic species would be present in the wet season. Weed cover was low and the main disturbance noted was trampling from cattle.

RE 11.3.4 and 11.3.4a - Eucalyptus tereticornis and/or Eucalyptus spp. woodland on alluvial plains and Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines

RE 11.3.4 and 11.3.4a within the Western Extension Commonwealth Offset Area (1) and Western Extension State Offset Area was characterised by *Eucalyptus tereticornis* open woodlands on alluvial formations associated with Roper Creek. Previous clearing and thinning for grazing was evident in some areas. Recruitment of woody perennial species, native grass and forb species richness, tree canopy height, shrub canopy cover, native perennial grass cover and number of large trees scored lower than the benchmark values. Overall the baseline health and quality of RE 11.3.4/11.3.4a was average.

RE 11.3.7 – *Corymbia spp.* woodland on alluvial plains

RE 11.3.7 within the Western Extension Commonwealth Offset Area (1) and Western Extension State Offset Area was dominated by *Corymbia clarksoniana* and *Corymbia tessellaris*. The majority of attribute values scored slightly lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.3.7 was average.

RE 11.4.8 – *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains

Within the Western Extension Commonwealth Offset Area (1) and Western Extension State Offset Area *Acacia harpophylla* dominated this RE habitat. Weed cover was low throughout. Native forb species richness, shrub canopy cover and native perennial grass cover scored lower when compared to the benchmark values for this RE. However, overall the baseline health and quality of RE 11.4.8 was high.

RE 11.4.9 and 11.4.9a – Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains; and Acacia harpophylla, Lysiphyllum carronii +/- Casuarina cristata open forest to woodland

RE 11.4.9 and11.4.9a within the Western Extension Commonwealth Offset Area (1) and Western Extension State Offset Area was dominated by *Acacia harpophylla* and *Casuarina cristata*. Native shrub and forb species richness, tree canopy cover, shrub canopy cover and native perennial grass cover scored lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.4.9 and11.4.9a was average.

RE 11.5.18 – *Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces

The shrub *Micromyrtus capricornia* was the dominant species in this RE. The groundcover comprises an intact layer of native grasses. Weed cover was very low throughout. The majority of attribute values scored slightly lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.5.18 was average.

RE 11.5.2a –*Allocasuarina luehmannii* low tree layer with or without emergent woodland

Allocasuarina luehmannii (Bull Oak) was the dominant species throughout this RE. The RE featured very low weed cover. Recruitment of woody perennial species, native tree and grass species richness, tree canopy cover, shrub canopy cover, native perennial grass cover and coarse woody debris scored lower than the benchmark values. Overall the baseline health and quality of RE 11.5.2a was average.

RE 11.5.3 - *Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces

RE 11.5.3 within the Western Extension Commonwealth Offset Area (1 and 2) and Western Extension State Offset Area was dominated by *Eucalyptus populnea*. The remnant Poplar Box woodland was in good condition. Recruitment of woody perennial species, native shrub and forbs species richness, shrub canopy cover, native perennial grass cover and organic litter scored lower than the benchmark values in some areas. Overall the baseline health and quality of RE 11.5.3 was average when compared to the benchmark.

RE 11.5.9 - *Eucalyptus crebra* and other *Eucalyptus spp*. and *Corymbia spp*. woodland on Cainozoic sand plains and/or remnant surfaces

Few weeds were present and a high number of tree species were recorded within RE 11.5.9. *Eucalyptus crebra* was the dominant canopy species within this RE. Recruitment of woody perennial species was significantly lower than the benchmark value. Overall the baseline health and quality of RE 11.5.9 was average which was reflected in the habitat quality scoring.

RE 11.7.2 - *Acacia spp.* woodland on Cainozoic lateritic duricrust. Scarp retreat zone

Within the Western Extension Commonwealth Offset Area (1), *Acacia shirleyi* (Lancewood) characterised this RE, with mono specific stands present throughout. Native shrub, grass and forbs species richness, tree canopy cover, shrub canopy cover, organic litter and coarse woody debris scored lower than the benchmark values. Overall the baseline health and quality of RE 11.7.2 was average.

RE 11.7.4 - Eucalyptus decorticans and/or Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius woodland on Cainozoic lateritic duricrust

The remnant woodland within RE 11.7.4 was dominated by *Eucalyptus crebra.* Native tree species were diverse with 18 species recorded. Ground cover was dominated by grasses with low levels of coarse woody debris present. Overall the baseline health and quality of RE 11.7.4 was average.

Non-remnant Vegetation

According to Neldner et al. (2017):

"Woody vegetation is vegetation for which the predominant stratum is composed mainly of woody vegetation such as trees or shrubs. The Herbarium assesses and maps woody dominated vegetation as remnant if it meets the definition used in the Vegetation Management Act 1999, which is:

vegetation, part of which forms the predominant canopy of the vegetation—

(a) covering more than 50% of the undisturbed predominant canopy; and

(b) averaging more than 70% of the vegetation's undisturbed height; and

(c) composed of species characteristic of the vegetation's undisturbed predominant canopy."

The field surveys indicated that approximately 444 ha of the Western Extension Commonwealth Offset Area (1) and approximately 213.5 ha of the Western Extension State Offset Area did not meet this definition and as such is mapped as non-remnant vegetation. These areas have been previously cleared, are grazed by cattle and displayed high levels of weed invasion, however the majority of weeds were naturalized pasture grasses.

Overall, regrowth Eucalypts and Acacias were the most common of these trees recorded in non-remnant area while *Corymbia* species were only occasionally present.

Despite this, it was noted that these areas displayed positive signs of natural regeneration.

5.1.8. Baseline Condition of Regional Ecosystems (Modified Stage 2 Commonwealth Offset Area 2 and 3)

RE 11.4.8 – *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains

Within the Modified Stage 2 Commonwealth Offset Area (3) *Acacia harpophylla* dominated RE 11.4.8. The majority of attributes for RE 11.4.8 scored lower when compared to the benchmark value. The overall baseline health and quality of RE 11.4.8 was average.

RE 11.4.9– *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains

RE 11.4.9 within the Modified Stage 2 Commonwealth Offset Area (3) was dominated by *Acacia harpophylla* and *Casuarina cristata*. The majority of attributes for RE 11.4.9 scored lower when compared to the benchmark value. Overall the baseline health and quality of RE 11.4.9 was average.

RE 11.5.18 – *Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces

Within the Modified Stage 2 Commonwealth Offset Area (2) *Micromyrtus capricornia* dominated RE 11.5.18. Weed cover was very low throughout. The majority of attribute values scored slightly lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.5.18 was average.

RE 11.5.2a –*Allocasuarina luehmannii* low tree layer with or without emergent woodland

Allocasuarina luehmannii (Bull Oak) was the dominant species throughout RE 11.5.2a. The RE featured very low weed cover. Recruitment of woody perennial species, native tree and grass species richness, tree canopy cover, shrub canopy cover, native perennial grass cover and coarse woody debris scored lower than the benchmark values. Overall the baseline health and quality of RE 11.5.2a was average.

RE 11.5.3 - *Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces

Few weeds were present and a high number of tree species were recorded within RE 11.5.3, with *Eucalyptus populnea* being the dominant species recorded. Recruitment of woody perennial species, native shrub, grass and forbs species richness, tree and shrub canopy cover and organic litter scored lower than the benchmark values. Overall the baseline health and quality of RE 11.5.3 was average when compared to the benchmark.

RE 11.5.9 - *Eucalyptus crebra* and other *Eucalyptus spp*. and *Corymbia spp*. woodland on Cainozoic sand plains and/or remnant surfaces

Eucalyptus crebra was the dominant canopy species within RE 11.5.9. The majority of attribute values scored slightly lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.5.9 was average which was reflected in the habitat quality scoring.

5.1.9. Baseline Condition of Regional Ecosystems (Modified Rail Loop and Spur Offset Area 3a and 3b)

RE 11.3.2 – *Eucalyptus populnea* woodland on alluvial plains

RE 11.3.2 within the Modified Rail Loop and Spur Offset Area (3b) was dominated by *Eucalyptus populnea*. Recruitment of woody perennial species, native grass and native forb species richness, shrub canopy cover and native perennial grass cover all scored lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.3.2 was average.

RE 11.4.8 – *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains

Within the Modified Rail Loop and Spur Offset Area (3a), *Acacia harpophylla* dominated RE 11.4.8. Weed cover was low throughout. The majority of attribute values scored slightly lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.4.8 was average.

RE 11.4.9– *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains

RE 11.4.9 within the Modified Rail Loop and Spur Offset Area (3a) was dominated by *Acacia harpophylla* and *Casuarina cristata*. Recruitment of woody perennial species, native shrub and forb species richness, tree and shrub canopy cover, native perennial grass cover and course woody debris all scored lower when compared to the benchmark values for this RE. Overall the baseline health and quality of RE 11.4.9 was average.

RE 11.5.3 - *Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces

RE 11.5.3 within this study site was dominated by *Eucalyptus populnea*. Recruitment of woody perennial species, native shrub, grass and forbs species richness, tree and shrub canopy cover and native perennial grass cover scored lower than the benchmark values. Overall the baseline health and quality of RE 11.5.3 was average when compared to the benchmark.

Non-remnant Vegetation

According to Neldner et al. (2017):

> *"Woody vegetation is vegetation for which the predominant stratum is composed mainly of woody vegetation such as trees or shrubs. The Herbarium assesses and maps woody dominated vegetation as remnant if it meets the definition used in the Vegetation Management Act 1999, which is:*
>
> *vegetation, part of which forms the predominant canopy of the vegetation—*
>
> *(a) covering more than 50% of the undisturbed predominant canopy; and*
>
> *(b) averaging more than 70% of the vegetation's undisturbed height; and*
>
> *(c) composed of species characteristic of the vegetation's undisturbed predominant canopy."*

The field surveys indicated that approximately 25 ha of the Rail Loop and Spur Offset Area (3a and 3b) did not meet this definition and as such is mapped as non-remnant vegetation. These areas have been previously cleared, are grazed by cattle and displayed high levels of weed invasion, however the majority of weeds were naturalized pasture grasses.

Overall, regrowth Eucalypts and Acacias were the most common of these trees recorded in non-remnant area while Corymbia species were only occasionally present.

Despite this, it was noted that these areas displayed positive signs of natural regeneration.

5.2. Habitat Quality Assessment (Western Extension Commonwealth Offset Area 1 and 2)

The habitat quality assessment results for the Western Extension Commonwealth Offset Area are provided in the *Middlemount Coal Mine Western Extension Project (EPBC 2017/8130) EPBC Act Preliminary Assessment Documentation Terrestrial Habitat Quality Data* (Biodiversity Australia, 2019).

5.3. Habitat Quality Assessment (Western Extension State Offset Area)

Site condition

The vegetation throughout the Western Extension State Offset Area is in a good condition overall.

Remnant vegetation communities covered approximately 240.5 ha (53%) of the Western Extension State Offset Area while non-remnant vegetation communities covered approximately 213.5 ha (47%).

The less disturbed remnant areas displayed attributes with similar values to the published benchmarks (DSITI 2017). Vegetation condition throughout the non-remnant REs varied but overall showed positive signs of natural regeneration. There are several areas of the Western Extension State Offset Area that have been previously cleared and are grazed by cattle. These areas all displayed high levels of weed invasion, however the majority of weeds were naturalized pasture grasses. Many of these non-remnant areas recorded positive signs of native tree recruitment and natural regeneration.

Across the Western Extension State Offset Area, assessment units (within remnant vegetation) scored between 47 and 61 (out of a possible 80) for overall site condition (Table 13). Within remnant vegetation Assessment Unit 1 (RE 11.3.1) scored the highest and Assessment Unit 6 (RE 11.5.3) scored the lowest for overall site condition (Table 13).

Across the Western Extension State Offset Area, assessment units (within non-remnant vegetation) scored between 33 and 45 (out of a possible 80) for overall site condition (Table 13). Assessment Unit 9 (RE 11.3.4) scored the highest and Assessment Unit 7 (RE 11.3.1) scored the lowest for overall site condition (Table 13).

Site context

Across the Western Extension State Offset Area, assessment units scored between 18 and 25 (out of a possible 26) for site context (Table 13). Assessment Units 3, 5 and 10 scored the highest for site context (Table 13).

Assessment Unit Habitat Quality Scores

Table 13 summarises the site condition and site context scores for each assessment unit.

Table 13: Habitat Quality Scores for Western Extension State Offset Area

Assessment Unit	RE	Site Condition Score	Site Context Score	Assessment Unit Habitat Quality Score
1	11.3.1	61	20	7.64
2	11.3.2	55	24	7.45
3	11.3.25	52.5	25	7.31
4	11.3.27d	-	-	-
5	11.3.4/11.3.4a	53	25	7.36
6	11.5.3	47	24	6.70
7 (non rem)	11.3.1	33	18	5.60
8 (non rem)	11.3.2	43.5	24	6.68
9 (non rem)	11.3.4	45	24	6.51
10 (non rem)	11.5.3	41	25	6.53

Final Habitat Quality Scores

The following table summarises the final habitat quality scores for each assessment unit. The overall Habitat Quality Score for the Western Extension State Offset Area is 6.94.

Table 14: Final Habitat Quality Score for Western Extension State Offset Area

Assessment Unit	1	2	3	4	5	6	7 (NR)	8 (NR)	9 (NR)	10 (NR)
RE	11.3.1	11.3.2	11.3.25	11.3.27d	11.3.4	11.5.3	11.3.1	11.3.2	11.3.4	11.5.3
Habitat Quality Score (measured)	81	79	77.5	N/A	78	71	51	67.5	69	66
Habitat Quality Score (max)	106	106	106	N/A	106	106	91	101	106	101
Assessment Unit Area (ha)	8.04	185.27	17.65	4.03	17.32	8.81	13.44	105.39	12.27	83.03
Assessment Unit Habitat Quality Score	7.64	7.45	7.31	N/A	7.36	6.70	5.60	6.68	6.51	6.53
Size weighting	0.02	0.41	0.04	N/A	0.04	0.02	0.03	0.23	0.03	0.18
Weighted Assessment Unit Habitat Quality Score	0.14	3.06	0.29	N/A	0.28	0.13	0.17	1.55	0.18	1.19
FINAL TOTAL HABITAT QUALITY SCORE	**6.94**									

5.4. Habitat Quality Assessment (Modified Stage 2 Commonwealth Offset Area 2 and 3)

The habitat quality assessment results for the Modified Stage 2 Commonwealth Offset Area are provided in the *Middlemount Coal Mine Western Extension Project (EPBC 2017/8130) EPBC Act Preliminary Assessment Documentation Terrestrial Habitat Quality Data* (Biodiversity Australia, 2019).

5.5. Habitat Quality Assessment (Modified Rail Loop and Spur Offset Area 3a and 3b)

Site condition

The vegetation throughout the Modified Rail Loop and Spur Offset Area is in good condition overall. The Modified Rail Loop and Spur Offset Area was approximately 56.5 ha and made up of remnant and non-remnant vegetation communities. Remnant vegetation communities covered 32 ha (57%) while non-remnant vegetation communities covered 24.5 ha (43%) of the Modified Rail Loop and Spur Offset Area.

The less disturbed remnant areas displayed attributes with similar values to the published benchmarks (DSITI, 2017). Vegetation condition throughout the non-remnant REs varied but overall showed positive signs of natural regeneration. There are several areas within the Modified Rail Loop and Spur Offset Area that have been previously cleared and are grazed by cattle. These areas all displayed high levels of weed invasion, however the majority of weeds were naturalized pasture grasses. Many of these non-remnant areas recorded positive signs of native tree recruitment and natural regeneration.

Across the Modified Rail Loop and Spur Offset Area, assessment units (within remnant vegetation) scored between 40 and 56 (out of a possible 80) for overall site condition (Table 15). Within remnant vegetation, Assessment Unit 3 (RE 11.4.9) scored the highest and Assessment Unit 2 (RE 11.4.8) scored the lowest for overall site condition (Table 15).

Across the Modified Rail Loop and Spur Offset Area, assessment units (within non-remnant vegetation) scored between 37 and 43.5 (out of a possible 80) for overall site condition (Table 15). Assessment Unit 5 (11.3.2) scored the highest and Assessment Unit 6 (RE 11.5.3) scored the lowest for overall site condition (Table 15).

Site context

Across the Modified Rail Loop and Spur Offset Area, assessment units scored between 13 and 25 (out of a possible 26) for site context (Table 15). Assessment Units 1 and 5 scored the highest for site context (Table 15).

Species habitat index

Species habitat index scores were calculated for the Squatter Pigeon (southern) across the Modified Rail Loop and Spur Offset Area.

- Squatter Pigeon (southern): the species habitat index scored 28 for both remnant and non-remnant AU's (out of a possible 50).

Assessment Unit Habitat Quality Scores

Table 15 summarises the site condition, site context and species habitat index scores for each assessment unit using the Squatter Pigeon (southern) species habitat index data.

Final Habitat Quality Scores

Table 16 below summarises the final habitat quality scores for each assessment unit and for the Modified Rail Loop and Spur Offset Area overall, using the Squatter Pigeon (southern) species habitat index data.

The final Total Habitat Quality Score for the Approved Commonwealth Offset Area is 5.90.

Table 15: Habitat Quality Scores for Modified Rail Loop and Spur Offset Area

Assessment Unit	RE Type	Site Condition Score	Site Context Score	Species Habitat Index Score (Squatter Pigeon [southern])	Assessment Unit Habitat Quality Score (Squatter Pigeon [southern])
1	11.3.2	53	25	28	6.79
2	11.4.8	40	15	28	5.32
3	11.4.9	56	13	28	6.22
4	11.5.3	55	14	28	6.22
5 (non rem)	11.3.2	43.5	25	28	6.39
6 (non rem)	11.5.3	37	18	28	5.32

Table 16: Final Habitat Quality Score for Modified Rail Loop and Spur Offset Area (Squatter Pigeon [southern[)

(Squatter Pigeon (southern) Species Index Data)

Assessment Unit	1	2	3	4	5	6
RE	11.3.2	11.4.8	11.4.9	11.5.3	11.3.2	11.5.3
Habitat Quality Score (measured)	106.00	83.00	97.00	97.00	96.50	83.00
Habitat Quality Score (max)	156.00	156.00	156.00	156.00	151.00	156.00
Assessment Unit Area (ha)	0.58	7.31	9.00	2.59	13.44	11.59
Assessment Unit Habitat Quality Score	6.79	5.32	6.22	6.22	6.39	5.32
Size weighting	0.01	0.16	0.20	0.06	0.30	0.26

Weighted Assessment Unit Habitat Quality Score	0.09	0.87	1.26	0.36	1.93	1.39
FINAL TOTAL HABITAT QUALITY SCORE	**5.90**					

5.6. Fauna Survey Results

5.6.1. Fauna Habitat Types

Broad fauna habitats within the study sites were categorized and mapped into seven broad habitat types using the same classifications as PB (2010) (Figure 16). The broad fauna habitat types include:

- Eucalypt woodland/forest.
- Micromyrtus shrubland.
- Riparian habitat.
- Wetlands (natural/artificial).
- *Acacia shirleyi* forest.
- *Acacia harpophylla* woodland/forest.
- Regrowth/derived grassland.

Table 17 details the regional ecosystems which make up each broad fauna habitat type along with the area (in ha) of each.

Table 17: Broad Fauna Habitat Types

Broad Fauna Habitat Type	Regional Ecosystem	Field Verified Area (ha)
Eucalypt Woodland	11.3.2	291
	11.3.4/11.3.4a	117.5
	11.3.7	29
	11.5.2a	59.5
	11.5.3	105
	11.5.9	65.5
	11.7.4	13.5
Subtotal (Eucalypt Woodland)		**681**
Acacia harpophylla woodland/forest	11.3.1	16.5
	11.4.8	39.5
	11.4.9/11.4.9a	65.5
Subtotal (*Acacia harpophylla*)		**121.5**
Riparian habitat	11.3.25	57
Wetlands	11.3.27d	4
Acacia shirleyi forest	11.7.2	3
Micromyrtus shrubland	11.5.18	22
Regrowth	-	469
TOTAL		**1357.5**

Table 18 describes the habitat values per category, with focus on habitat value and suitability for foraging, nesting, roosting, and breeding requirements for potentially occurring threatened species listed under the NC Act and EPBC Act.

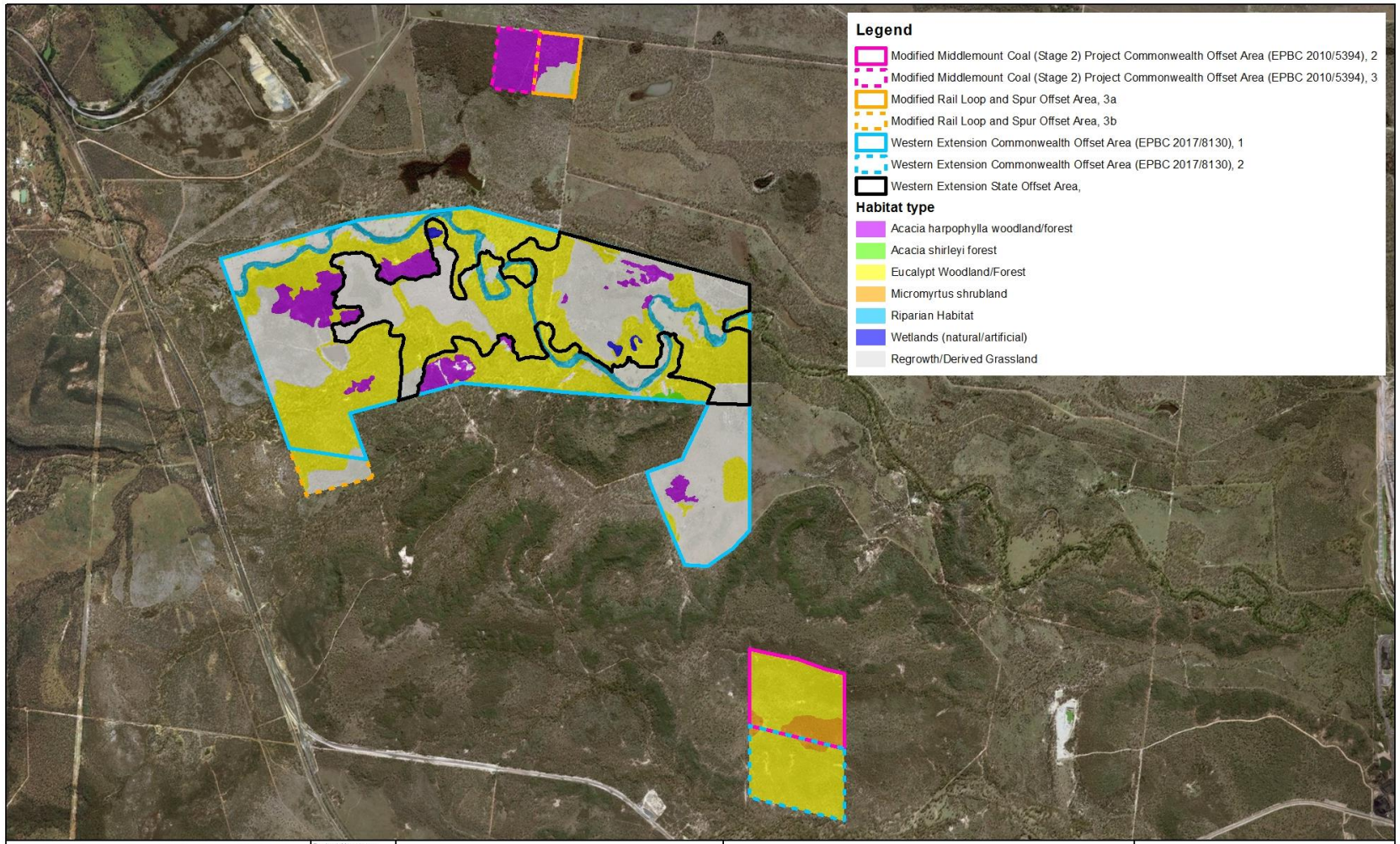
Table 18: Fauna Habitat Assessment

Habitat Attribute / Category	Site Values					
	1. Eucalypt woodland/forest	2. Micromyrtus shrubland	3. Riparian habitat	4. *Acacia shirleyi* forest	5. *Acacia harpophylla* woodland/forest	6. Regrowth/derived grassland
Groundcover	Variable density and composition depending on disturbance history e.g. rotational grazing regime. Some areas feature a moderately dense cover of exotic grasses while some are more open and dominated by native grasses and shrubs. A number of native grass species provide a potential food resource for the Squatter Pigeon (southern). Some areas also have a mosaic of open sandy areas and native grasses which is preferred habitat for this species.	Comprises open grassy groundcover (mostly native grasses) and areas of bare ground. A number of native grass species provide potential food resources for the Squatter Pigeon (southern).	Generally, a good cover of native grasses, sedges and herbs. Some areas dominated by Buffel Grass.	Sparse to open ground cover of native grasses, with areas of bare ground.	Sparse to open ground cover of mostly native grasses, with areas of bare ground. Provides potential shelter and prey habitat for threatened reptiles.	Dominant ground cover composition of exotic grasses with native grasses and herbs being less common. Areas with a higher percentage of native grass species would provide food resources for the Squatter Pigeon (southern).
Leaf Litter	High under canopy trees, and scattered throughout the mixed grass undergrowth.	Overall low density of leaf litter present due to the lack of canopy trees.	Generally thin leaf litter throughout due to open canopy.	Density of leaf litter was low overall with some small accumulations noted.	Mature Brigalow habitats contained dense accumulations of leaf litter which would provide shelter and prey habitat for a range of small reptiles.	Sparse leaf litter.
Logs and Debris	Reasonable abundance of hollow logs and debris present due to the nature of Eucalyptus shedding limbs. Larger logs provide shelter and prey habitat for ground dwelling reptiles.	Low density of coarse woody debris in the form of small fallen timber at the base of scattered canopy eucalypts. Marginal potential habitat values for threatened fauna overall.	Some accumulations of coarse woody debris and logs under canopy trees. Marginal potential habitat values for threatened fauna overall.	High density of coarse woody debris, which is typical of this habitat type.	High density of coarse woody debris, which is typical of this habitat type.	Very few logs observed. Some log and debris piles as a result of past clearing occur.
Rocky outcrops	Only some small to medium surface rock present.	Some small surface rock present.	Absent	Rocky outcrops are very common in this habitat type. Provide potential shelter, basking sites and prey habitat for a range of common reptiles and small mammals.	Absent	Absent

Habitat Attribute / Category	Site Values					
	1. Eucalypt woodland/forest	2. Micromyrtus shrubland	3. Riparian habitat	4. *Acacia shirleyi* forest	5. *Acacia harpophylla* woodland/forest	6. Regrowth/derived grassland
Aquatic habitat	Aquatic habitats in this habitat type were largely limited to small ephemeral creeks and soaks that would only hold water for short periods.	Absent	The ephemeral creeks and drainage lines were largely dry during the survey, however some had small pools of water remaining. Semi-permanent billabongs and pools in the creek bed would provide water sources for the Squatter Pigeon (southern).	Absent	Brigalow habitats contain small depressions and melon holes that would hold water during the wet season.	A few large dams were located within non-remnant areas. One large dam in the south of the site contained established aquatic vegetation. Dams on site attracted a range of wetland birds and provided permanent water sources for a range of fauna including the Squatter Pigeon (southern).
Hollows	Hollow-bearing trees and stags were common within this habitat type. A range of hollow-sizes are present i.e. <5cm to >20cm diameter cavities. Hollows provide nesting/denning/roosting habitat for a number of threatened fauna species such as the Greater Glider.	Scattered eucalyptus and corymbias in this habitat type contained hollows. Hollows that are present would provide potential roosting habitat for threatened fauna species.	Hollow-bearing trees were generally uncommon in this habitat type and would largely be occupied by common birds such as Galahs and Lorikeets.	Absent.	Low occurrence of tree hollows in occasional eucalyptus species present.	No hollow bearing trees present due to previous clearing history.
Nectar sources	Woodland habitats contain a range of nectar producing species e.g. eucalypts, acacias and grevilleas.	Low nectar source overall. Flowering *Micromyrtus* shrubs would be an insect attractant for Microbats.	Nectar sources in riparian habitats include eucalypts and Melaleucas, some of which were flowering during the survey.	*Acacia shirleyi* is the primary nectar source and would provide foraging resources for fauna when in flower.	*Acacia harpophylla* is the primary nectar source and would provide foraging resources for fauna when in flower.	This habitat type does not provide a significant nectar source due to the lack of mature trees.
Koala food trees	Moreton Bay Ash, Poplar Box and Narrow-leaved Ironbark are the main Koala browse species in this community (Department of the Environment [DotE] 2014). A Koala was recorded in this habitat type near Roper Creek (Photo 3).	Absent aside from a few Narrow-leaved Ironbark.	This community is dominated by Queensland Blue Gum which is a preferred browse species for Koalas.	Absent	*Eucalyptus cambageana* is located within this habitat type and, although a less common food source for the Koala, meets the definition of a Koala food tree (DotE 2014).	Absent aside from occasional areas of regrowth *Eucalypts* and *Corymbia spp*.

Habitat Attribute / Category	Site Values					
	1. Eucalypt woodland/forest	2. Micromyrtus shrubland	3. Riparian habitat	4. *Acacia shirleyi* forest	5. *Acacia harpophylla* woodland/forest	6. Regrowth/derived grassland
Connectivity values	Provides strong habitat links and connectivity values across the site, especially north-south connections with adjacent habitat in the east and west of the site. Some areas of woodland are fragmented by roads and cleared areas. This habitat type would benefit the local movements of a range of fauna species, including arboreal species such as the Koala.	The shrubland habitats would complement the connectivity values of other habitat types and provide shelter and cover for small terrestrial species and passerine birds.	Riparian habitats provide connectivity along Roper Creek. Due to the open nature of this habitat type, it is only likely to be used by mobile species capable of crossing open ground. Important connectivity values for the Koala.	This habitat type is generally surrounded by woodland habitats and would provide similar connectivity values. Rocky scarp habitats are likely to assist local movements of reptiles and small mammals.	The Brigalow habitats would contribute to the connectivity values of the other site habitats. Patches provide good 'stepping stone' habitats for birds.	Continued regeneration of non-remnant areas over time would help re-establish linkages for flora and fauna across the site and broader landscape.

Figure 16: Broad Fauna Habitat Types Present on the Study Site



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Project Manager: WS
Drawn By: WS
Date: 3-May-2018
Map Projection: MGA55
Map Datum: GDA94
Page: 1 of 1

Figure Name: Broad Habitat Types
Site: Western Extension Offset Areas
Client: Middlemount Coal Pty Ltd

0 0.5 1 2 Kilometers

Biodiversity AUSTRALIA

Scale: 1:51,000
Job Number: EC1687
Revision: C

5.6.2. Fauna Species Detected

A total of 87 fauna species were detected during the survey either opportunistically or during targeted surveys. A complete list of fauna species detected is provided in Appendix 2. Birds were the most common fauna group observed with a total of 72 species detected. Eleven mammals (including three introduced species) and four reptiles were also detected (Appendix 2).

The species assemblage on the study sites is considered typical for the area based on results of previous surveys on adjacent and nearby lands (e.g.PB 2010;EHP, 2012; Naturecall 2013, 2014b, 2015, 2016).

5.6.3. Threatened Fauna Species

The Koala (*Phascolarctos cinereus*), which is listed as Vulnerable under the NC Act and EPBC Act was observed at one location within the Western Extension Commonwealth Offset Area (1) during spotlighting surveys.

The Greater Glider (Petauroides volans) which is listed as Vulnerable under the NC Act and EPBC Act was observed during spotlighting surveys at five locations within the study sites, of which three records occur within the Western Extension Commonwealth Offset Area (1).

The Squatter Pigeon (southern) (*Geophaps scripta scripta*), which is listed as Vulnerable under the NC Act and EPBC Act was not observed within the study sites, but was observed on the Dysart Road to the southwest of the site.

Opportunistic surveys for the threatened Ornamental Snake (*Denisonia maculata*), which is listed as Vulnerable under the NC Act and EPBC Act, were carried out over the survey period, however it was not detected.

Further information on each of these species is provided below.

***Koala* (*Phascolarctos cinereus*)**

An adult Koala was recorded just to the south of Roper Creek within the Western Extension Commonwealth Offset Area (1) during a spotlighting survey on 22 November 2018 (Photo 3, Figure 18). The Koala was recorded within a Queensland Blue Gum within vegetation equivalent to RE 11.3.4.

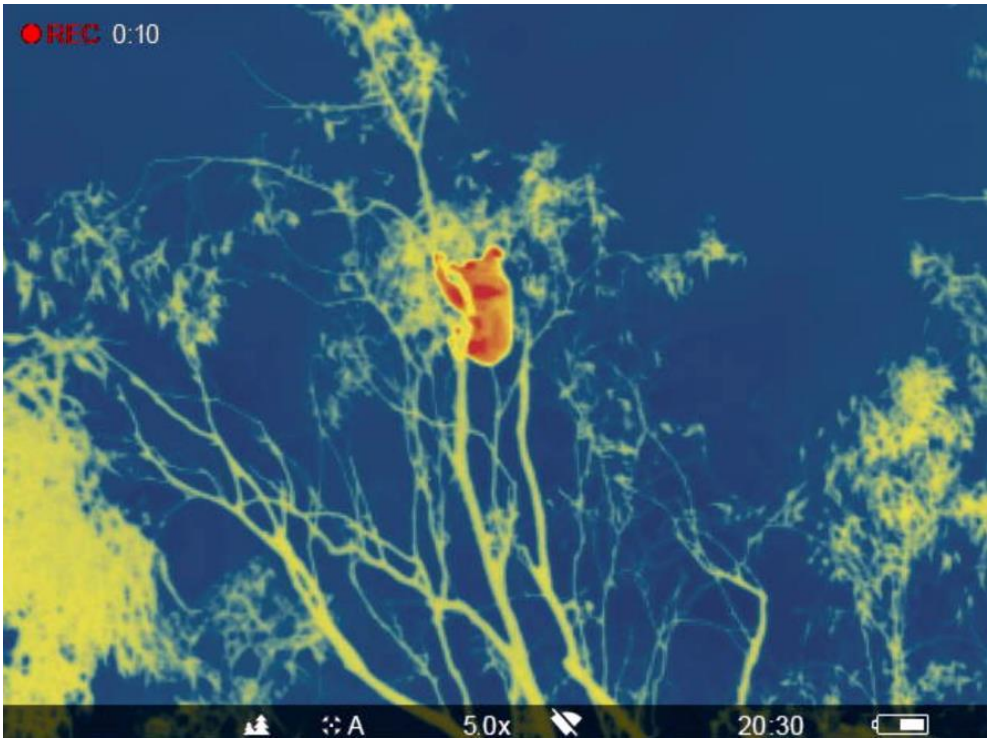
Koalas have also been recorded on adjacent land to the north by Ecology and Heritage Partners (2012) and adjacent to Parrot Quarry Road by Naturecall (2014b) (Figure 17).

Koala food trees (as defined in the *EPBC Act Referral Guidelines for the Vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)* [DotE 2014] and *Nature Conservation [Koala] Conservation Plan 2006 and Management Program 2006-2016* [EPA 2006]) are present within the study sites, in particular Queensland Blue Gum (identified as an important food species for the Koala [Van Dyck and Strahan 2008; Land for Wildlife 2014]), Moreton Bay Ash, Queensland Peppermint, Poplar Box and Narrow-leaved Ironbark.

A large portion of the Regional Ecosystems mapped within the offset areas would provide known and potential habitat for the Koala based on the occurrence of preferred Koala food trees (Figure 18). This includes RE 11.3.2, RE 11.3.4, RE 11.3.4a, RE 11.3.7, RE 11.3.25, RE 11.3.27d, RE 11.5.2a, RE 11.5.3, RE 11.5.9 and RE 11.7.4.

In addition, these areas would provide beneficial movement corridors (i.e. connectivity) for the Koala throughout the landscape, particularly along Parrot creek.

Photo 3: Koala recorded in the Offset Area



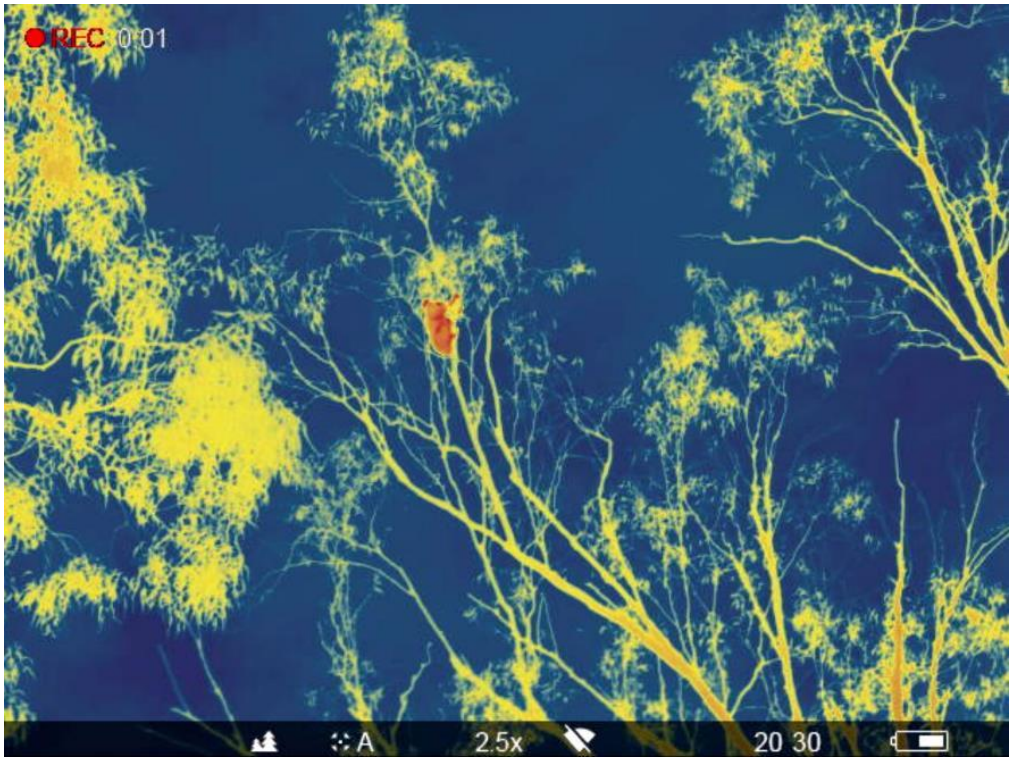
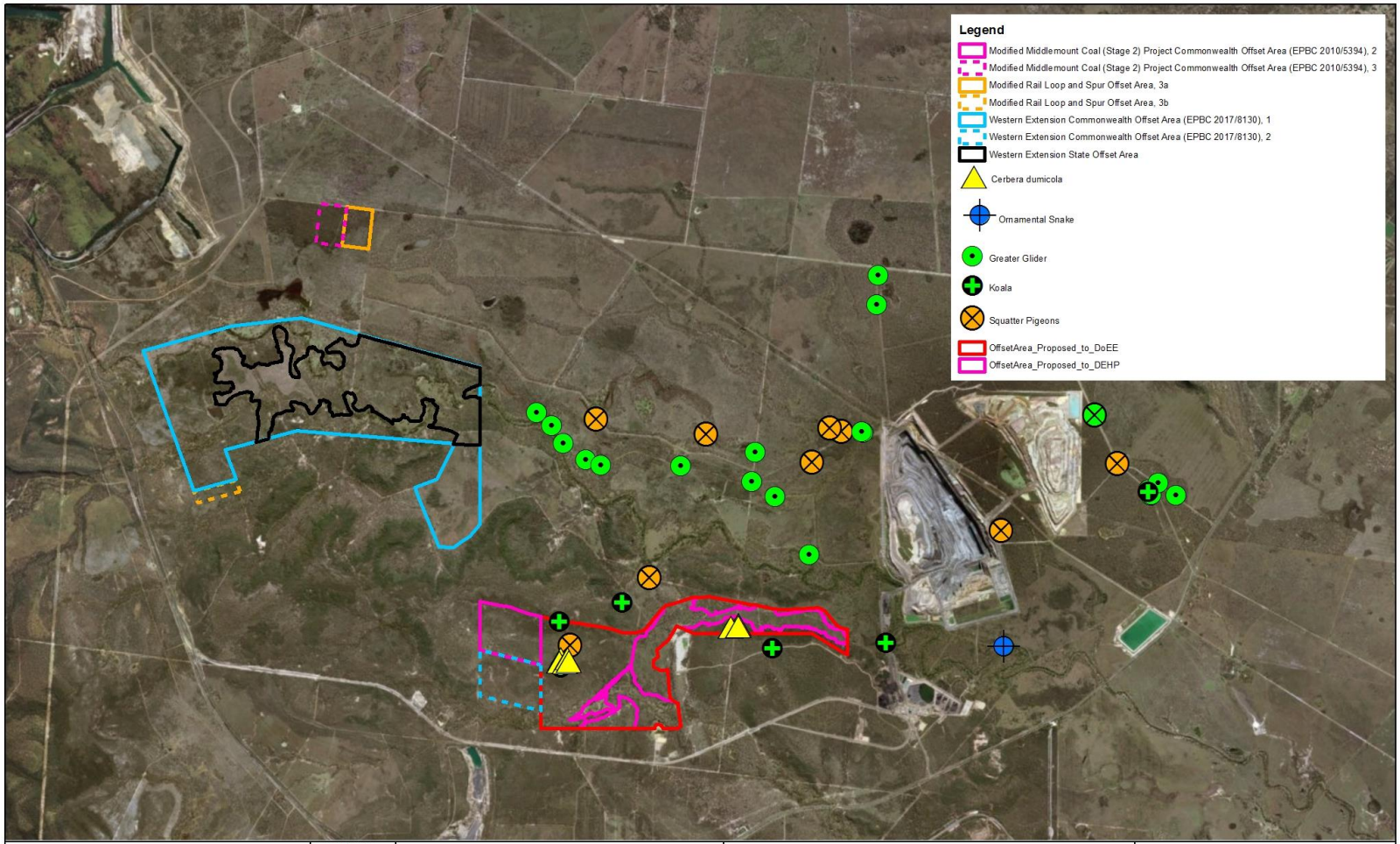


Figure 17: Previously recorded threatened species in the surrounding area



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Project Manager: WS	Figure Name: Previously Recorded Threatened Species
Drawn By: WS	
Date: 15-Mar-2018	Site: Western Extension Offset Areas
Map Projection: MGAz55	
Map Datum: GDA94	Client: Middlemount Coal Pty Ltd
Page: 1 of 1	

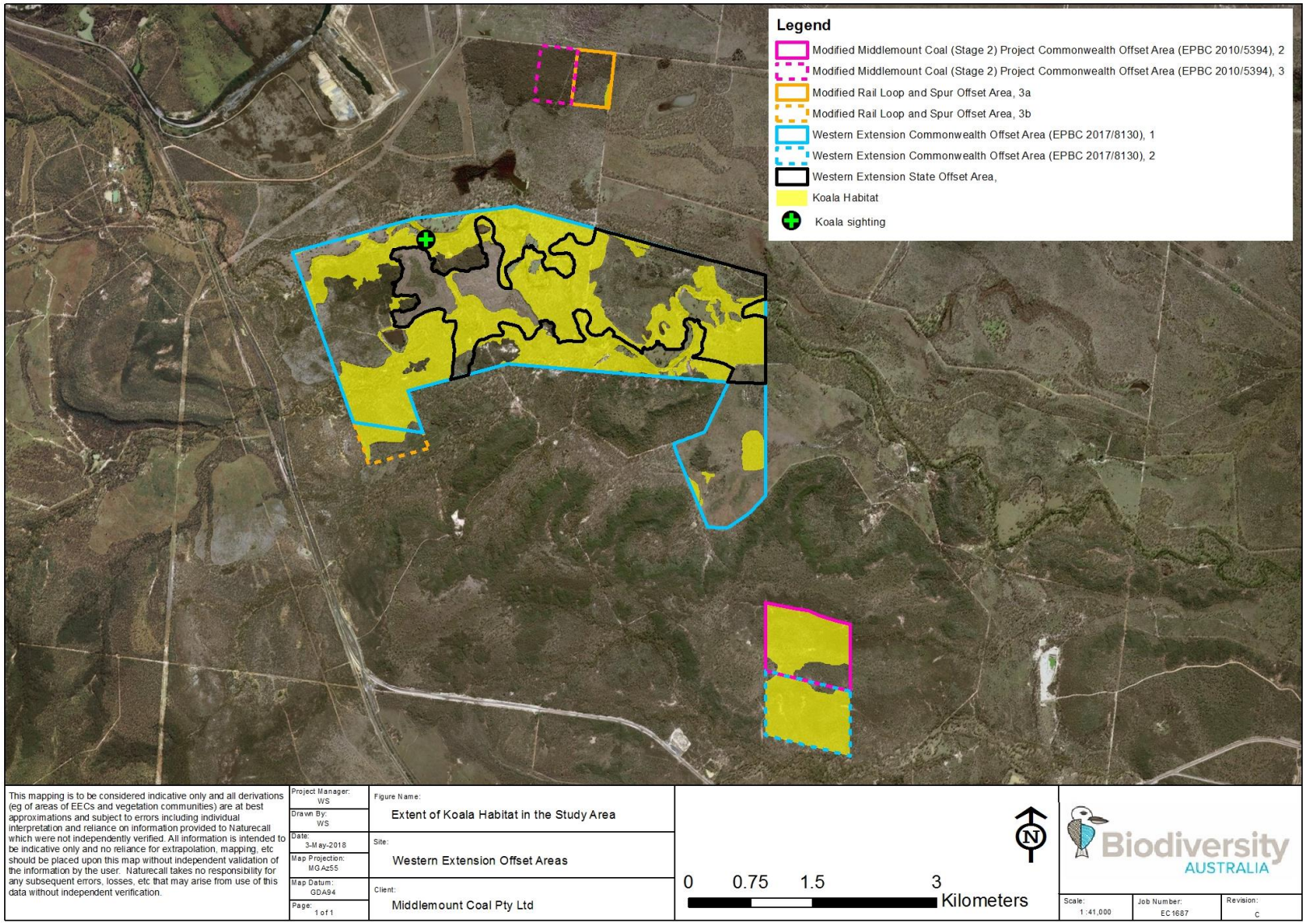
N

0 1.25 2.5 5 Kilometers

NATURECALL Biodiversity AUSTRALIA

Scale: 1:41,000	Job Number: EC1687	Revision: A

Figure 18: Koala habitat within each Offset Area



Greater Glider (Petauroides volans)

Four Greater Gliders were observed during a spotlighting survey on 22 November (Photo 4). Three were recorded within the north of the Western Extension Commonwealth Offset area (1) and one was recorded near the Dysart Road to the west. They were all recorded in open woodland habitats near Roper Creek equivalent to RE 11.5.3 and 11.3.7.

A fifth deceased Greater Glider was observed on 25th November to the south of the Western Extension Commonwealth Offset area (1) when en-route to vegetation survey plots. It was found entangled on a barbed wire fence, and was likely to have become entangled several weeks prior (Photo 5).

The Greater Glider occurs in forests and woodlands across eastern Australia where it forages on eucalypt leaves and occasionally flowers (Threatened Species Scientific Committee [TSSC] 2016). It requires large tracks of remnant forests which contain old growth trees containing hollows which it uses for denning (TSSC 2016).

Previous observations of this species on MCPL land (see Figure 17 above) have noted that it prefers woodland an open forest associated with major creeks and drainage lines, equivalent to RE types 11.3.25, 11.3.2, 11.3.4, 11.3.4a, 11.3.27d, 11.5.3 and 11.3.7. It has also been occasionally noted in Poplar Box woodland equivalent to RE 11.5.3. Preferred forage species appear to be Moreton Bay Ash, Silver-leaved Ironbark and Poplar Box.

The Western Extension Commonwealth Offset Area (1) contains extensive suitable habitat for the Greater Glider, and it has been demonstrated to occur here during the field surveys (Photos 4 & 5; Figure 19). Habitats that are known to support this species include woodland dominated by Blue Gum, Clarkson's Bloodwood, Silver-leaved Ironbark, Poplar Box and Moreton Bay Ash in riparian zones and creek flats associated with Roper Creek.

Approximately 575 ha of known and potential habitat for the Greater Glider occurs in the Western Extension Commonwealth Offset Area represented by all Eucalypt forests and woodlands present as these contain trees with hollows suitable for denning. Hollow-bearing trees and stags are common and a range of hollow-sizes are present i.e. <5 cm to >20 cm diameter cavities.

The Western Extension Commonwealth Offset Area also contains approximately 400 ha of cleared land likely to have been formerly potential habitat (i.e. Eucalypt forests and woodlands).

Note that RE 11.5.2a and 11.5.9 were excluded as potential habitat for this species as the tree canopy was generally sparse, the community was exposed and very dry and hollow-bearing trees were rare.

Photo 4: Greater Glider recorded

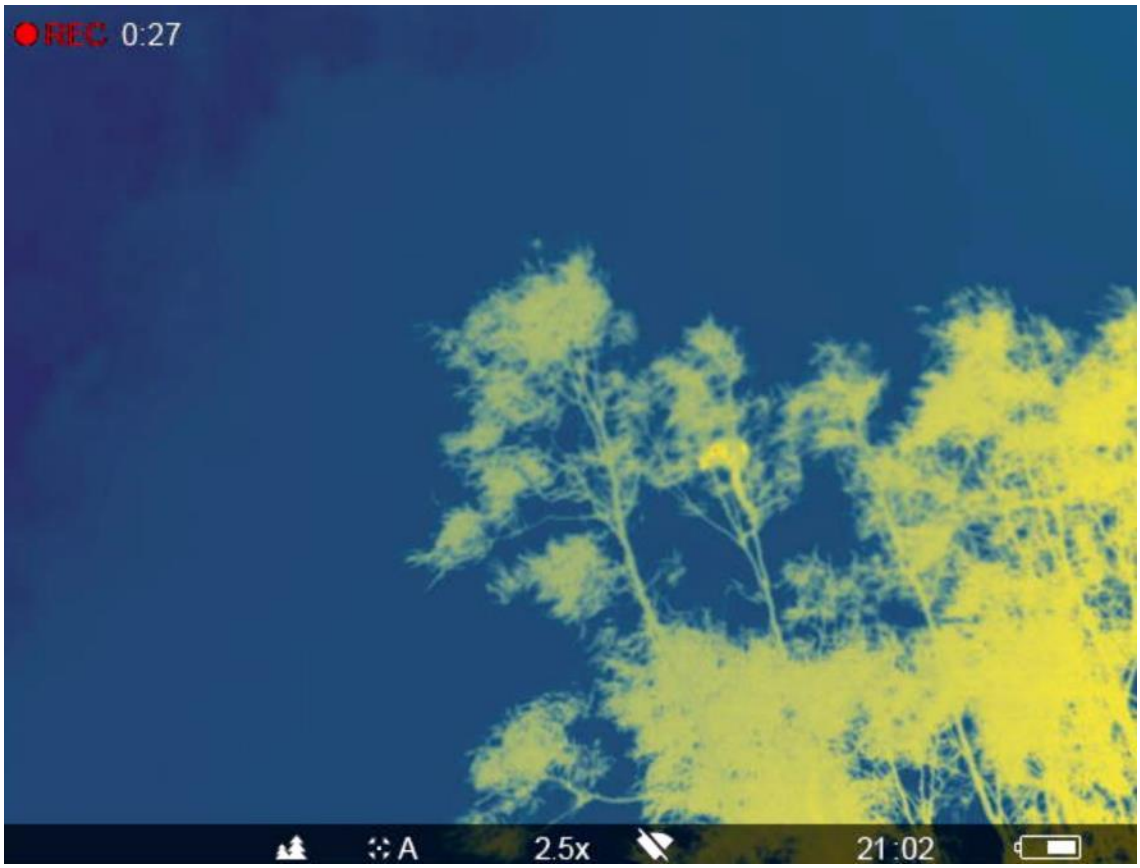
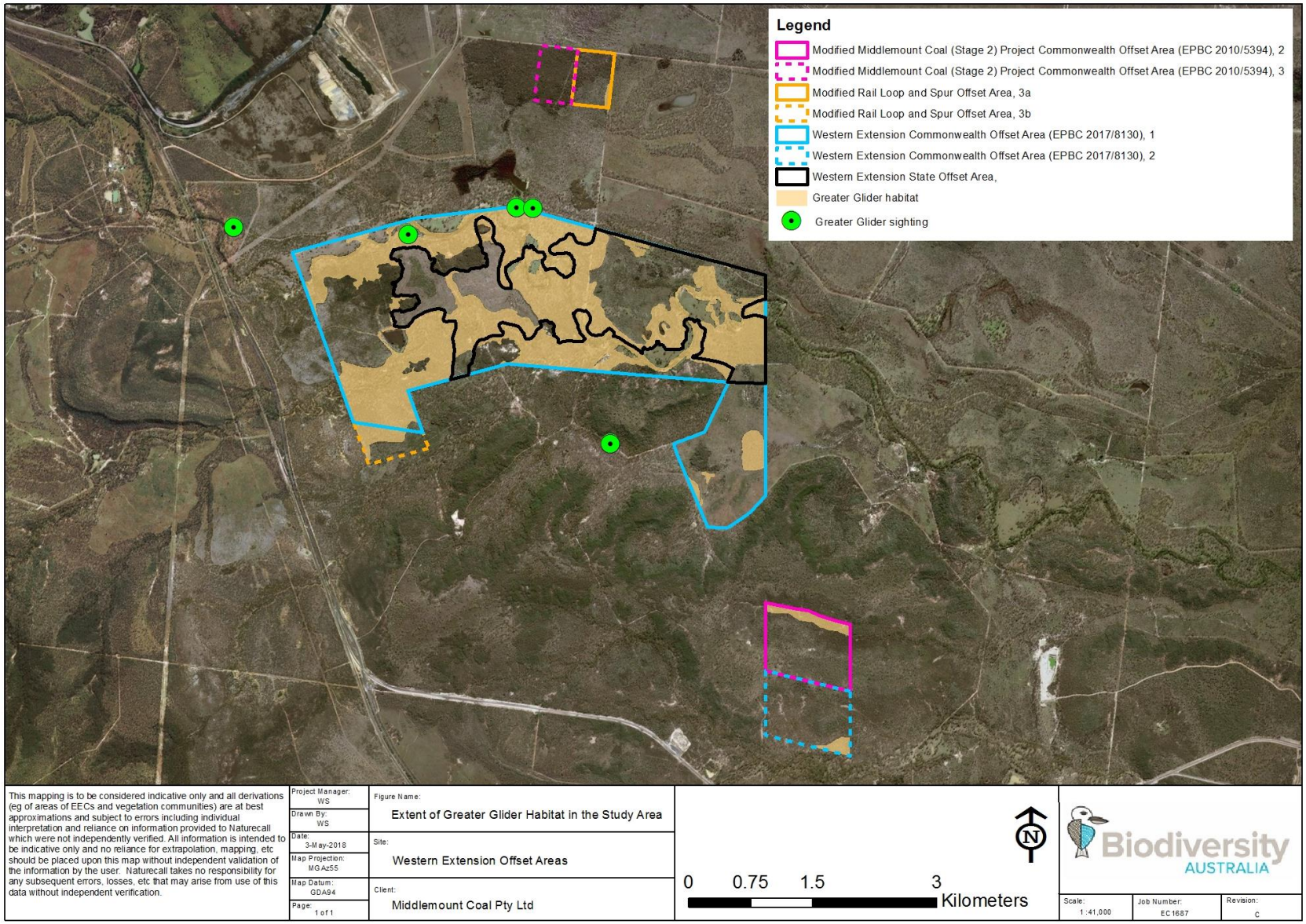


Photo 5: Greater Glider on barbed wire fence

Figure 19: Greater Glider habitat within the study sites



Squatter Pigeon (southern) (Geophaps scripta scripta)

The Squatter Pigeon (southern) has been recorded adjacent to the proposed offset areas (Figure 22) in habitat which is contiguous with the proposed offset areas. Given the nearby records, the presence of potential habitat and nature of the species, it is highly likely that the Squatter Pigeon (southern) would use habitat in the proposed offset area.

Habitat for the Squatter Pigeon (southern) in the Action area is considered to comprise of all remnant and regrowth habitat with a suitable groundcover.

Western Extension Commonwealth Offset Area contains approximately 1,155 ha of potential habitat for the Squatter Pigeon (southern), comprising approximately 749.5 ha of woodland and 405.5 ha of vegetation in the early stage of regrowing from past clearance.

The offset area is suitably located (on the same property) to benefit the same local population of this species that would use habitat within the Action area.

Roper Creek and Two Mile Gully traverse the Western Extension Commonwealth Offset Area such that most of the potential habitat for this species is within 1 km of these watercourses and therefore potential breeding habitat.

Similar to the Action area, some vegetation in the early stage of regrowing from past clearance (approximately 400 ha) is not considered potential habitat for this species because the dominant ground cover composition is exotic grasses, with native grasses and herbs being less common.

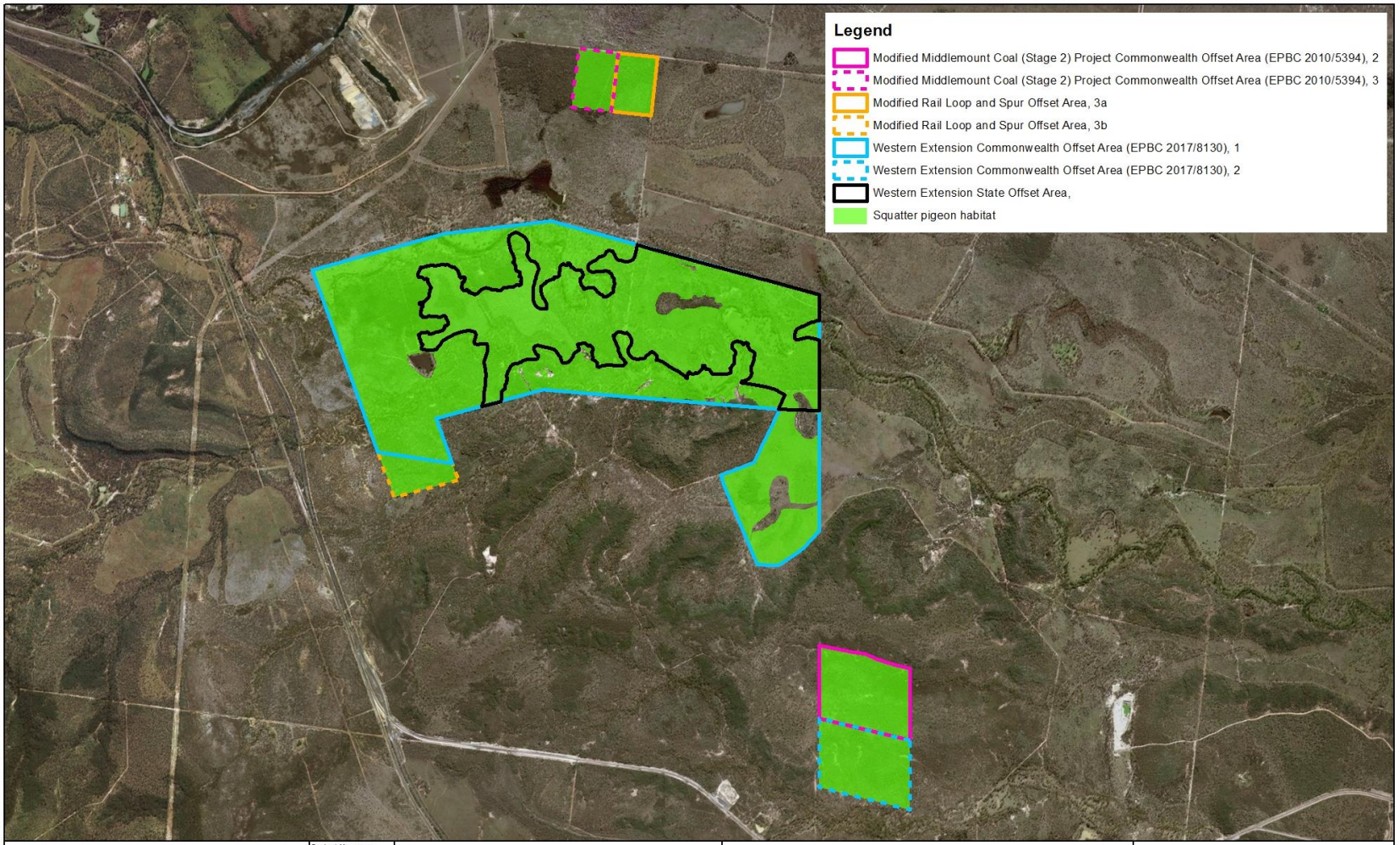
The Western Extension Commonwealth Offset Area is providing the equivalent type of habitat to that within the Action area.

Note that RE 11.7.2 was excluded as potential habitat for this species due to very rocky or bare ground with low native grass cover.

The breeding habitat described above would also provide foraging resources for this species. The breeding habitat would also provide dispersal habitat for this species.

There are no additional areas of forest or woodland which would specifically aid the dispersal of the Squatter Pigeon (southern). There are very small areas of cleared land between patches of habitat (less than 100 m apart). These are not considered ‘dispersal habitat’ for the species.

Figure 20: Squatter Pigeon (southern) habitat within the study sites



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Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Extent of Squatter Pigeon Habitat in the Study Area
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd

0 0.75 1.5 3 Kilometers

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1:41,000	EC1687	C

Ornamental Snake (Denisonia maculata)

The Western Extension Commonwealth Offset Area contains approximately 76 ha of potential suitable habitat for the Ornamental Snake (represented by RE 11.3.1, RE 11.4.8, RE 11.4.9 and RE 11.4.9a).

Consistent with the proposed clearance area, given the Ornamental Snake was previously recorded in RE 11.3.1 (Brigalow) (Parsons Brinkerhoff, 2010a) and it provides suitable microhabitat for the species (e.g. woody debris, ground litter, cracking clay soils and gilgai), this RE is considered to provide potential habitat.

Roper Creek and Two Mile Gully traverse the Western Extension Commonwealth Offset Area providing habitat that is favoured by its prey – frogs (DEE, 2019).

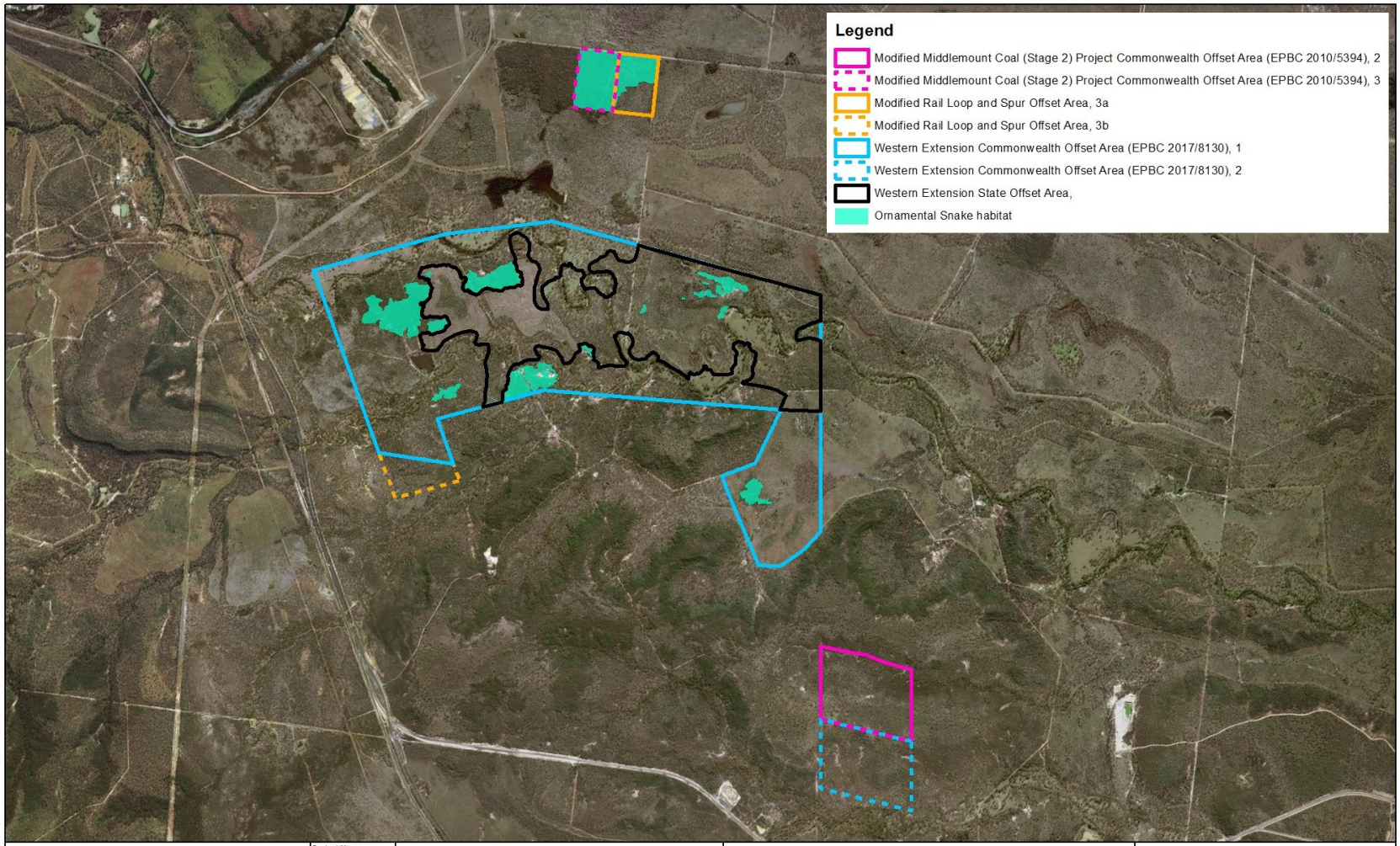
The offset area contains 30 ha of cleared land likely to have been formerly potential habitat (i.e. Brigalow RE 11.3.1). These areas currently do not have sufficient microhabitat requirements (e.g. fallen timber) for shelter and prey species. These cleared areas are currently not considered habitat for the species.

RE 11.4.8, RE 11.4.9 and RE 11.4.9a within the Western Extension Commonwealth Offset Area are preferred habitat (approximately 59.5 ha).

All of the potential habitat in the Western Extension Commonwealth Offset Area (described above) is suitable habitat for this species. No suitable habitat in the Action area is known to be important as defined by the EPBC Act Draft Referral Guidelines for the Nationally listed Brigalow Belt Reptiles (DSEWPaC 2011c) as:

- the species has not been recorded in the habitat in the Western Extension Commonwealth Offset Area;
- the Western Extension Commonwealth Offset Area is not near the limit of the species' known range (after DSEWPaC 2011c);
- the Western Extension Commonwealth Offset Area does not contain large patches of contiguous, suitable habitat and viable landscape corridors, as the habitat is instead small and fragmented (Figure 2 - Attachment E); and
- the Western Extension Commonwealth Offset Area does not contain a unique habitat type containing known records of the species.

Figure 21: Ornamental Snake habitat within the study sites



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Project Manager:	WS
Drawn By:	WS
Date:	3-May-2018
Map Projection:	MGAz55
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Extent of Ornamental Snake Habitat in the Study Area
Site:	Western Extension Offset Areas
Client:	Middlemount Coal Pty Ltd

0 0.75 1.5 3 Kilometers

Biodiversity AUSTRALIA

Scale:	Job Number:	Revision:
1:41,000	EC1687	C

Summary

Table 27 provides a summary of the extent of potential habitat for each of the above threatened species within each relevant offset area. Figure 22 also shows the location of threatened fauna species detected during the recent fauna surveys.

Table 19: Area of potential habitat for threatened species within the Offset Areas

Species	Potential Habitat			
	Western Extension Commonwealth Offset Area	Western Extension State Offset Area	Modified Stage 2 Commonwealth Offset Area (a) and (b)	Modified Rail Loop and Spur Offset Area (a) and (b)
Ornamental Snake	76	N/A	29.5	N/A
Squatter Pigeon (southern)	1,155	N/A	114.5	N/A
Koala	664.5	N/A	N/A	N/A
Greater Glider	575	N/A	12.4	N/A

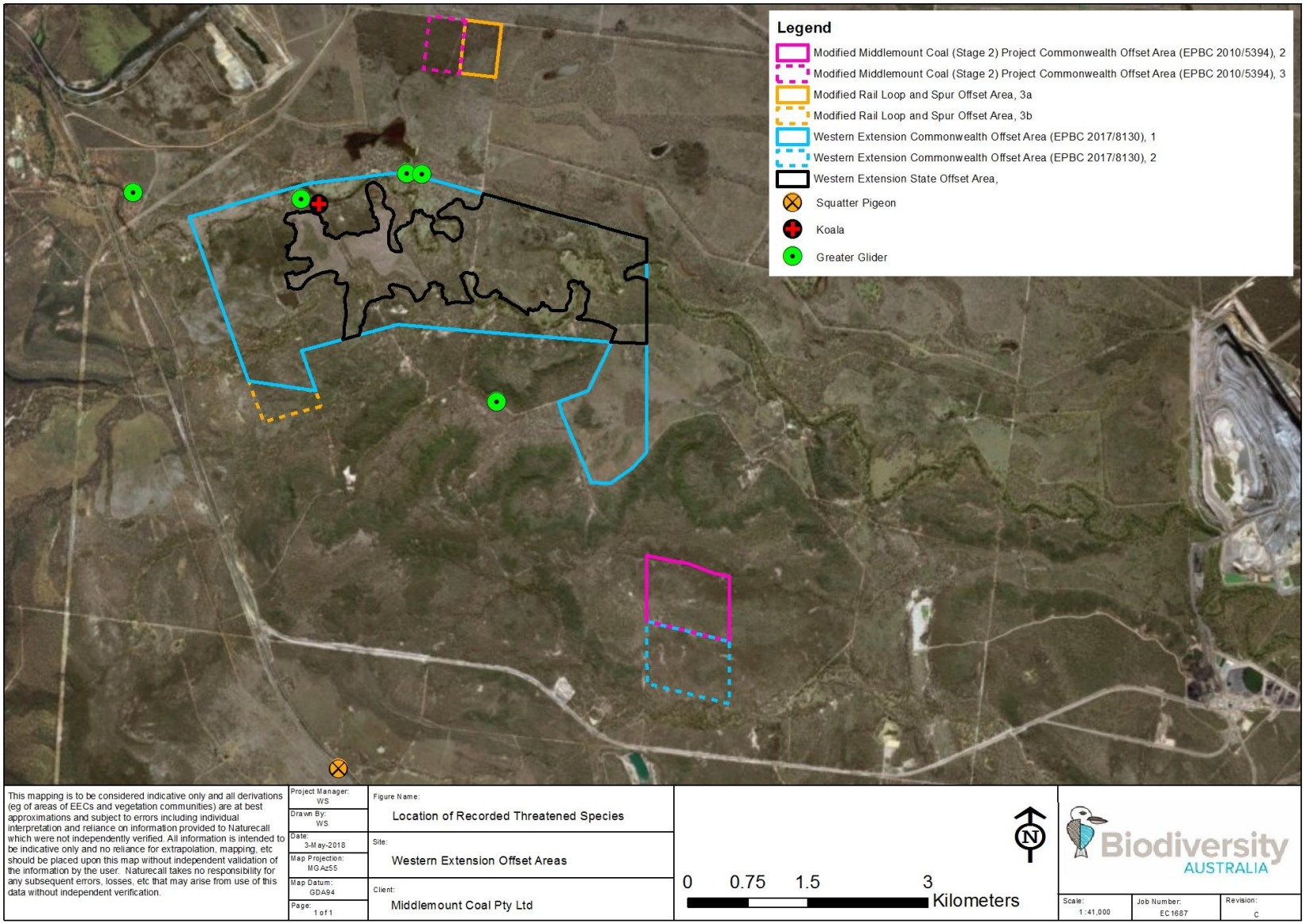
5.6.4. Migratory Fauna Species

No migratory species were recorded during the field surveys.

5.6.5. Exotic Fauna Species

A feral cat was directly observed in the Western Extension Commonwealth Offset Area (1) during the spotlighting survey. Cat tracks were also occasionally observed on the surrounding roads and access tracks. No wild dogs were observed within the study sites, however dog tracks were recorded on access tracks and in dry creek beds. The only other exotic fauna species detected within the study sites was the European Rabbit.

Figure 22: Threatened fauna species detected during recent surveys



6.0 Summary and Conclusion

The study sites are located approximately 270 km north-west of Rockhampton and 3 km south-west of the Middlemount Township. The study sites comprise freehold land owned by MCPL and total approximately 1,843 ha in area. This includes a combination of forested/woodland areas along with cleared grazing land.

A desktop study (including comprehensive literature review) was carried out prior to the field survey to gather relevant information and data. Existing DSITI RE mapping of the study sites, as well as previous mapping on adjoining land was obtained and used in conjunction with satellite imagery to identify the broad vegetation types present within the study sites.

Flora and fauna surveys were undertaken throughout the study sites from 18-21 July 2017 and 20-26 November 2017. Terrestrial habitat quality assessments were completed at 44 locations spread across the four offset areas. The fauna surveys comprised habitat suitability assessment, opportunistic surveys for threatened species, track, scat and secondary evidence searches as well as opportunistic fauna observations.

The study sites was categorised into seven broad fauna habitat types (i.e. eucalypt woodland/forest, micromyrtus shrubland, riparian habitat, *acacia shirleyi* forest, wetlands, *acacia harpophylla* woodland/forest, and regrowth/derived grassland). Eucalypt woodland was the most common habitat type on the study sites. A number of habitat features were well represented in eucalypt woodlands such as hollow-bearing trees, coarse woody debris, nectar sources and native groundcover. It is considered that the various habitat types present on site would provide suitable habitat for a range of conservation significant fauna species including the Squatter Pigeon (southern), Greater Glider, Koala and Ornamental Snake.

No threatened flora species were detected during the survey. The less disturbed remnant areas displayed attributes with similar values to the published benchmarks. While non-remnant areas generally contained more weed species they showed positive signs of natural regeneration.

Three threatened fauna species were recorded during the field surveys, namely the Koala, Greater Glider and Squatter Pigeon (southern). These species are listed as Vulnerable under the NC Act and EPBC Act. A fourth threatened species, the Ornamental Snake, was also considered a potential occurrence in the study sites based on local records identified in the literature and database searches and presence of suitable habitat.

Species habitat index scores were calculated for the Squatter Pigeon (southern), Greater Glider, Koala and Ornamental Snake for each assessment unit within the Western Extension Commonwealth Offset Area.

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Appendix 1: Site Flora Species List

Common name	Scientific name	NC Act Status
Canopy Trees		
Ironwood	*Acacia excelsa*	LC
Brigalow	*Acacia harpophylla*	LC
Inland Rosewood	*Acacia rhodoxylon*	LC
Lancewood	*Acacia shirleyi*	LC
Smooth-barked Apple	*Angophora leiocarpa*	LC
Clarkson's Bloodwood	*Corymbia clarksoniana*	LC
Dallachy's Gum	*Corymbia dallachiana*	LC
Moreton Bay Ash	*Corymbia tessellaris*	LC
Reid River Box	*Eucalyptus brownii*	LC
Dawson's Gum	*Eucalyptus cambageana*	LC
Narrow-leaved Ironbark	*Eucalyptus crebra*	LC
Peppermint	*Eucalyptus exserta*	LC
Silver-leaved Ironbark	*Eucalyptus melanophloia*	LC
Poplar Box	*Eucalyptus populnea*	LC
Queensland Blue Gum	*Eucalyptus tereticornis*	LC
Swamp Box	*Lophostemon suaveolens*	LC
Understorey Trees and Shrubs		
Bendee	*Acacia catenulata*	LC
-	*Acacia cretata*	LC
Black Wattle	*Acacia leiocalyx*	LC
Native Willow	*Acacia salicina*	LC
Bull Oak	*Allocasuarina luehmannii*	LC
Red Ash	*Alphitonia excelsa*	LC
Bitter bark	*Alstonia constricta*	LC
Whitewood	*Atalaya hemiglauca*	LC
Coffee Bush	*Breynia oblongifolia*	LC
Prickly Pine	*Bursaria incana*	LC
Wild Orange	*Capparis canescens*	LC
Narrowleaf bumble-tree	*Capparis loranthifolia*	LC
-	*Capparis mitchelli*	LC
Currant Bush	*Carissa ovata*	LC
Leichhardt Bean	*Cassia brewsteri*	LC
Belah	*Casuarina cristata*	LC
River Oak	*Casuarina cunninghamiana*	LC
Limebush	*Citrus glauca*	LC
-	*Denhamia cunninghamii*	LC
Native Ebony	*Diospyros humilis*	LC
Hop Bush	*Dodonaea viscosa*	LC

Common name	Scientific name	NC Act Status
Turkey Bush	*Eremophila deserti*	LC
Harrisia Cactus	*Harrisia martinii**	LC
Batswing Coral Tree	*Erythrina vespertilio*	LC
False Sandalwood	*Eremophila mitchellii*	LC
Emu Bush	*Eremophila nivea*	LC
Cocaine Tree	*Erythroxylum australe*	LC
Native Guava	*Eupomatia laurina*	LC
Sandpaper Fig	*Ficus opposita*	LC
Scrub Leopardwood	*Flindersia dissosperma*	LC
Wilga	*Geijera parviflora*	LC
Beefwood	*Grevillea striata*	LC
Dysentery Bush	*Grewia latifolia*	LC
Bootlace Oak	*Hakea lorea*	LC
Red Bauhinia	*Lysiphyllum carronii**	LC
Black Teatree	*Melaleuca bracteata*	LC
Fibrebark	*Melaleuca nervosa*	LC
-	*Micromyrtus capricornia*	LC
Boobialla	*Myoporum montanum*	LC
Native Olive	*Notelaea microcarpa*	LC
Prickly Pear	*Opuntia elata**	LC
Velvety Tree Pear	*Opuntia tomentosa**	
Gooya	*Owenia acidula*	LC
-	*Pittosporum sp.*	LC
Quinine Tree	*Petalostigma pubescens*	LC
-	*Psydrax attenuata*	LC
-	*Solanum parvifolium*	LC
Yellow-wood	*Terminalia oblongata*	LC
Vine Tree	*Ventilago viminalis*	LC
Grasses		
Kerosene Grass	*Aristida holathera*	LC
Feathertop Wiregrass	*Aristida latifolia*	LC
Buffel Grass	*Cenchrus ciliaris**	LC
-	*Chloris sp.*	LC
Windmill Grass	*Chloris truncata*	LC
Cotton Panic Grass	*Digitaria brownii*	LC
-	*Eragrostis sp.*	LC
Black Speargrass	*Heteropogon contortus*	LC
Golden Weather-grass	*Hypoxis hygrometrica*	LC
Blady Grass	*Imperata cylindrica*	LC
Red Natal Grass	*Melinis repens**	LC
Brigalow Grass	*Paspalidium caespitosum*	LC

Common name	Scientific name	NC Act Status
-	*Setaria sp.**	LC
Fairy Grass	*Sporobolus caroli*	LC
Kangaroo Grass	*Themeda triandra*	LC
Sabi Grass	*Urochloa mosambicensis**	LC
Groundcovers		
Chaff Flower	*Achyranthes aspera**	LC
Mexican Poppy	*Argemone ochroleuca**	LC
Creeping Saltbush	*Atriplex semibaccata*	LC
Cobbler's Pegs	*Bidens pilosa**	LC
-	*Cassytha sp.*	LC
Rock Fern	*Cheilanthes sieberi*	LC
Lambs Quarter's	*Chenopodium album**	LC
Yellow Buttons	*Chrysocephalum apiculatum*	LC
Flaxleaf Fleabane	*Conyza bonariensis**	LC
Darling Lily	*Crinum flaccidum*	LC
Lance-leaved Rattlepod	*Crotalaria lanceolata**	LC
Yellow Rattlepod	*Crotalaria mitchellii*	LC
Slender Flat-sedge	*Cyperus gracilis*	LC
Ruby Saltbush	*Enchylaena tomentosa*	LC
Winter Apple	*Eremophila debilis*	LC
Gomphrena Weed	*Gomphrena celsioides**	LC
Parthenium	*Parthenium hysterophorus**	LC
Pigweed	*Portulaca oleracea**	LC
White root	*Pratia purpurascens**	LC
Soft Roly-poly	*Salsola kali*	LC
Flannel Weed	*Sida hackettiana**	LC
Spiked Sida	*Sida subspicata*	
Stylo	*Stylosanthes scabra**	LC
Purple top	*Verbena bonariensis**	LC
Bluebell	*Wahlenbergia gracilis*	LC
Spiny-headed Matrush	*Lomandra longifolia*	LC
Lianas, Scramblers and Twiners		
Nepine	*Capparis lasiantha*	LC
-	*Desmodium macrocarpum*	LC
-	*Glycine clandestina*	LC
Bush Banana	*Marsdenia viridiflora*	LC
Rough Silkpod	*Parsonsia lanceolata*	LC
Orchids and Epiphytes		
Tiger Orchid	*Cymbidium canaliculatum*	LC

* Denotes an introduced species

Appendix 2: Site Fauna Species List

Common Name	Scientific Name	Detection Method[1]
Birds		
Grey Teal	*Anas gracilis*	OBS
Pacific Black Duck	*Anas superciliosa*	OBS, HC
Australasian Darter	*Anhinga novaehollandiae*	OBS
Richards Pipit	*Anthus novaeseelandiae*	OBS
Red-winged Parrot	*Aprosmictus erythropterus*	OBS
Great Egret	*Ardea alba*	OBS
Cattle Egret	*Ardea ibis*	OBS
Australian Bustard	*Ardeotis australis*	OBS
Hardhead	*Aythya australis*	OBS
Sulphur-crested Cockatoo	*Cacatua galerita*	OBS, HC
Pheasant Coucal	*Centropus phasianinus*	OBS
Azure Kingfisher	*Ceyx azureus*	OBS
Red-capped Plover	*Charadrius ruficapillus*	OBS
Australian Wood Duck	*Chenonetta jubata*	OBS
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	OBS, HC
Australian Raven	*Corvus coronoides*	HC
Torresian Crow	*Corvus orru*	OBS, HC
Cicadabird	*Coracina tenuirostris*	OBS, HC
Pied Butcherbird	*Cracticus nigrogularis*	HC
Grey Butcherbird	*Cracticus torquatus*	OBS
Black Swan	*Cygnus atratus*	OBS
Laughing Kookaburra	*Dacelo novaeguineae*	OBS, HC
Blue-winged Kookaburra	*Dacelo leachii*	OBS
Emu	*Dromaius novaehollandiae*	OBS
White-faced Heron	*Egretta novaehollandiae*	OBS
Black-fronted Dotterel	*Elseyornis melanops*	OBS
Blue-faced Honeyeater	*Entomyzon cyanotis*	OBS
Galah	*Eolophus roseicapilla*	OBS
Eastern Koel	*Eudynamys orientalis*	OBS
Dollarbird	*Eurystomus orientalis*	OBS
Australian Hobby	*Falco longipennis*	OBS
Eurasian Coot	*Fulica atra*	OBS
Bar-shouldered Dove	*Geopelia humeralis*	OBS
Peaceful Dove	*Geopelia placida*	OBS, HC
White-throated Gerygone	*Gerygone albogularis*	OBS, HC
Magpie-lark	*Grallina cyanoleuca*	OBS

Common Name	Scientific Name	Detection Method[1]
Brolga	*Grus rubicunda*	OBS
Australian Magpie	*Gymnorhina tibicen*	OBS, HC
Whistling Kite	*Haliastur sphenurus*	OBS, HC
Black-winged Stilt	*Himantopus himantopus*	OBS
Welcome Swallow	*Hirundo neoxena*	OBS
Red-backed Fairy-wren	*Malurus melanocephalus*	OBS
Noisy Miner	*Manorina melanocephala*	OBS, HC
Rainbow Bee-eater	*Merops ornatus*	HC
Little Pied Cormorant	*Microcarbo melanoleucos*	OBS
Black Kite	*Milvus migrans*	OBS
Cotton Pygmy-Goose	*Nettapus coromandelianus*	OBS
Crested Pigeon	*Ocyphaps lophotes*	OBS
Olive-backed Oriole	*Oriolus sagittatus*	OBS
Striated Pardalote	*Pardalotus striatus*	OBS, HC
Australian Pelican	*Pelecanus conspicillatus*	OBS
Little Black Cormorant	*Phalacrocorax sulcirostris*	OBS
Pied Cormorant	*Phalacrocorax varius*	OBS
Common Bronzewing	*Phaps chalcoptera*	OBS
Little Friarbird	*Philemon citreogularis*	OBS,HC
Noisy Friarbird	*Philemon corniculatus*	OBS, HC
Pale-headed Rosella	*Platycercus adscitus*	OBS, HC
Glossy Ibis	*Plegadis falcinellus*	OBS
Tawny Frogmouth	*Podargus strigoides*	OBS
Hoary-headed Grebe	*Poliocephalus poliocephalus*	OBS
Grey-crowned Babbler	*Pomatostomus temporalis*	OBS, HC
Willie Wagtail	*Rhipidura leucophrys*	OBS
Channel-billed Cuckoo	*Scythrops novaehollandiae*	OBS
Apostlebird	*Struthidea cinerea*	OBS
Australian Grebe	*Tachybaptus novaehollandiae*	OBS
Double-barred Finch	*Taeniopygia bichenovii*	OBS
Australian White Ibis	*Threskiornis molucca*	OBS
Straw-necked Ibis	*Threskiornis spinicollis*	OBS
Forest Kingfisher	*Todiramphus macleayii*	OBS
Rainbow Lorikeet	*Trichoglossus haematodus*	HC
Masked Lapwing	*Vanellus miles*	OBS
Singing Honeyeater	*Lichenostomus virescens*	OBS,HC
Mammals		
Dog	*Canis lupus familiaris**	TRA
Feral Cat	*Felis catus**	OBS

Common Name	Scientific Name	Detection Method[1]
Eastern Grey Kangaroo	*Macropus giganteus*	OBS, SC, TRA
Common Wallaroo	*Macropus robustus*	OBS
Swamp Wallaby	*Wallabia bicolor*	OBS
Red-necked Wallaby	*Macropus rufogriseus*	OBS
Rufous Bettong	*Aepyprymnus rufescens*	OBS
European Rabbit	*Oryctolagus cuniculus**	SC
Greater Glider+^	***Petauroides volans***	**OBS**
Koala+^	***Phascolarctos cinereus***	**OBS**
Common Brushtail Possum	*Trichosurus vulpecula*	OBS
Reptiles		
Open Litter Rainbow Skink	*Carlia pectoralis*	OBS
Wall Skink	*Cryptoblepharus virgatus*	OBS
Copper-tailed Skink	*Ctenotus taeniolatus*	OBS
Bynoe's Gecko	*Heteronotia binoei*	OBS

[1] **Codes: Direct Observation (OBS), Heard Call (HC), Tracks (TRA), Scat (SC)**
* **Denotes exotic species**
^ **Vulnerable EPBC Act**
\+ **Vulnerable NC Act**
\# **Migratory EPBC Act**