
MNES Management Plan

Olive Downs Coking Coal Project

Prepared for Pembroke
August 2020

EMM Brisbane
Level 1, 87 Wickham Terrace
Spring Hill QLD 4000

T 07 3648 1200

E info@emmconsulting.com.au

www.emmconsulting.com.au

MNES Management Plan

Olive Downs Coking Coal Project

Report Number

B200461 RP#2

Client

Pembroke Olive Downs Pty Ltd

Date

26 August 2020

Version

v1 7

Prepared by



Patrick Finnerty

Ecologist

25 August 2020

Approved by



Berlinda Ezzy

Associate Ecologist

26 August 2020

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

© Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

Table of Contents

Abbreviations	vi
1 Introduction	1
1.1 Background	1
1.2 Purpose	1
1.3 Project description	3
1.3.1 Project activities	3
1.3.2 Project stages	4
1.4 Commonwealth approval	8
1.4.1 Condition 2 (EPBC 2017/7867)	8
1.4.2 Conditions 45 to 47 (EPBC 2017/7867)	9
1.4.3 Conditions 32 to 40 (EPBC 2017/7867)	11
1.5 Suitably qualified ecologists	13
1.6 Relationships to other plans	16
2 Matters of national environmental significance (MNES)	17
2.1 Ecology survey effort	17
2.2 Characteristics of the Project area	18
2.3 Threatened species habitat mapping	19
2.3.1 Greater Glider	19
2.3.2 Squatter Pigeon (Southern)	19
2.3.3 Ornamental Snake	20
2.3.4 Koala	21
2.3.5 Australian Painted Snipe	22
2.4 Threatened ecological communities	22
2.5 Relevant plans and guidelines	22
3 Impacts to MNES	38
3.1 Direct impacts	38
3.1.1 Vegetation clearance and habitat loss	38
3.1.2 Vehicle strike	39
3.1.3 Predation from pest animals	39
3.2 Indirect Impacts	40

3.2.1	Weeds	40
3.2.2	Pest animal habitat degradation	41
3.2.3	Noise and vibration	41
3.2.4	Artificial lighting	41
3.2.5	Dust	42
3.2.6	Fire	42
3.2.7	Impact summary	42
4	MNES management measures	44
4.1	MNES management measures	44
4.2	SMART principles	45
4.3	Adaptive management	45
4.3.1	Vegetation clearing phase	46
4.3.2	Construction Phase	65
4.3.3	Operational and Decommissioning Phases	71
5	MNES outcomes	76
5.1	Environmental outcomes	76
5.2	Mitigation and management measures	78
5.2.1	Weed management	78
5.2.2	Feral animal management	78
5.2.3	Grazing management	79
5.2.4	Fire management	83
5.2.5	Nest boxes	83
5.2.6	Fencing specification to exclude livestock from riparian areas	87
5.2.7	Koala monitoring (Stage 1)	88
5.2.8	Koala connectivity structures: exclusion fencing and Koala poles	90
5.2.9	Greater Glider connectivity structures: rope ladder crossings	92
5.2.10	Greater Glider monitoring (Stage 1)	95
5.2.11	Access road crossing design	100
6	Monitoring	102
6.1	Project area inspections	102
6.2	Greater Glider crossings and nest box monitoring	103
6.3	Habitat quality monitoring	103
6.3.1	Photo monitoring	104

6.4	Weed monitoring	104
6.5	Pest animal monitoring	105
6.6	Dust monitoring	105
6.7	Noise and vibration monitoring	105
6.8	Erosion and sediment control	105
6.9	Fire monitoring	106
6.10	Summary of MNES Monitoring Program	106
7	Reporting and administration	110
7.1	Reporting	110
7.2	Review of MMP	110
7.3	Responsibilities	110
7.4	Data management	111
8	Risk assessment	112
9	References	117

Appendices

Appendix A	Curriculum vitae	A.1
Appendix B	Fauna handling procedure	B.1
Appendix C	Implementation schedule	C.1

Tables

Table 1.1	Approved disturbance limits (ha) for MNES across the mine site and access roads	8
Table 1.2	Conditions of approval relevant to the MNES Management Plan	9
Table 1.3	Conditions of approval relevant to the MNES Management Plan	11
Table 1.4	Suitability qualified ecologists	14
Table 2.1	Relevant conservation advice, recovery plans and threat abatement plans	23
Table 3.1	Approved disturbance limits (ha) for MNES across the mine site and access roads	38
Table 3.2	Summary of potential impacts to MNES	42
Table 4.1	Avoidance, mitigation and management measures for vegetation clearing phase	46
Table 4.2	Avoidance, mitigation and management measures during construction	65
Table 4.3	Avoidance, mitigation and management measures during operations and decommissioning	71
Table 5.1	Specific MNES environmental outcomes	77
Table 5.2	Species-specific control methods for feral animals	79

Table 5.3	Biomass load management strategies	81
Table 6.1	Monitoring Program	107
Table 8.1	Consequence classification	112
Table 8.2	Likelihood classification	112
Table 8.3	Risk rating matrix	113
Table 8.4	Risk assessment and management	114
Table 9.2	Implementation schedule of management actions	C.2

Figures

Figure 1.1	Site locality	2
Figure 1.2	Mine site layout	6
Figure 1.3	Project stages	7
Figure 2.1	Ground-truthed regional ecosystems	24
Figure 2.2	Threatened species records	26
Figure 2.3	Greater Glider habitat	27
Figure 2.4	Squatter Pigeon habitat	29
Figure 2.5	Ornamental Snake habitat	31
Figure 2.6	Koala habitat	33
Figure 2.7	Australian Painted Snipe habitat	35
Figure 2.8	Brigalow TEC areas	37
Figure 4.1	Isaac River corridor to be retained	62
Figure 4.2	Grazing exclusion areas	63
Figure 5.1	Proposed Koala exclusion fencing	98
Figure 5.2	Proposed Greater Glider rope ladder crossings	99

Plates

Plate 5.1	Habisure system of nest box attachment (Franks and Franks 2006)	85
Plate 5.2	Nest box installed with habisure method on Jinker Track, Morton Bay Regional Council (EMM 2020)	86
Plate 5.3	Koala exclusion fencing Jinker Track, Morton Bay Regional Council (EMM 2020)	91
Plate 5.4	Koala escape pole (DES 2019)	92
Plate 5.5	Box Rope ladder crossings (image left with cables to adjacent trees) (Left Photo: EMM 2020, Right photo: Fauna Crossings 2020)	93

Plate 5.2	Camera to detect species using rope ladder crossing (Faunatech 2020)	95
Plate 5.3	Koala furniture under bridge (RMS 2017)	101
Plate 5.4	Image shows fauna furniture under bridge and fauna exclusion fencing leading up to bridge (RMS 2017)	101

Abbreviations

Acronym	Definition
CHPP	Coal handling and processing plant
CMSHA	Coal Mining Safety and Health Act 1999 (CMSHA)
CMSHR	Coal Mining Safety and Health Regulation 2017 (CMSHR)
CSG	Coal seam gas
DAF	Department of Agriculture and Fisheries (Queensland)
DAWE	Department of Agriculture, Water and the Environment (Commonwealth)
DES	Department of Environment and Science (Queensland)
DPM Envirosciences	DPM Envirosciences Pty Ltd
EA	Environmental Authority
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Ltd
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
EO	Environmental Officer
ESCP	Erosion and Sediment Control Plan
Ha	Hectares
ILF	In-line flocculation
km	kilometres
km/hr	Kilometres per hour
m	metres
ML	Mining Lease (ML700034, ML700035, ML700036, ML700032 and ML700033)
MMP	MNES Management Plan
MNES	Matters of National Environmental Significance
Mtpa	Mega-tonnes per annum
NC Act	Nature Conservation Act 1992
NSW	New South Wales
QCLNG	Qld Curtis LNG
Qld	Queensland
Pembroke	Pembroke Olive Downs Pty Ltd
The Project	Olive Downs Coking Coal Project and Access Road
RE	Regional ecosystem
REMP	Receiving Environment Monitoring Plan
RFS	Queensland Rural Fire Service
RMS	NSW Department of Roads and Maritime Services
ROM	Run of mine
SECP	Sediment and Erosion Control Plan

Acronym	Definition
SHMS	Safety and Health Management Systems (SHMS)
TEC	Threatened Ecological Community
TMR	Queensland Department of Transport and Main Roads
VHF	Very High Frequency
WoNS	Weeds of National Significance

1 Introduction

1.1 Background

Pembroke Olive Downs Pty Ltd (Pembroke) are the proponent for the Olive Downs Coking Coal Project (the Project). The Project is a greenfield metallurgical coal mine within the Bowen Basin, located approximately 40 kilometres (km) south-east of Moranbah, Queensland (Figure 1.1). The coal resource will be mined in stages by conventional open cut mining methods, with product coal to be transported by rail to the Dalrymple Bay Coal Terminal. The Project will produce up to 20 mega-tonnes per annum (Mtpa) of run of mine (ROM) coal over an anticipated operational life of approximately 79 years.

The Project was declared a 'Coordinated Project' for which an Environmental Impact Statement (EIS) was prepared that included detailed ecological studies and impact assessments on matters of state and national environmental significance. The Project was approved by the Queensland Coordinator-General in May 2019. The Project was declared a 'controlled action' due to potential for the mine to have a significant impact on matters of national environmental significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An approval was granted by the Minister on 14 May 2020 (EPBC 2017/7867) for the Project components being the mine site and access road, which are the subject of this report.

Conditions 45 to 47 of the EPBC approval (EPBC 2017/7867) require the preparation of a MNES Management Plan that pertains to the mine site and access road (Figure 1.1). All applicable conditions of approval pertaining to this report, and where they are addressed, is summarised in Section 1.4.

1.2 Purpose

In accordance with EPBC approval (EPBC 2017/7867) the purpose of this MNES Management Plan (MMP) is to demonstrate how impacts on the 'listed threatened species and community' and their habitat, will be avoided, mitigated, and managed. The applicable 'listed threatened species and community' referenced in the approval are:

- Koala (*Phascolartos cinereus*);
- Greater Glider (*Petauroides volans*);
- Squatter Pigeon (Southern) (*Geophaps scripta scripta*);
- Ornamental Snake (*Denisonia maculata*);
- Australian Painted Snipe (*Rostratula australis*); and
- Brigalow threatened ecological community (Brigalow TEC).

Pembroke is committed to develop and implement appropriate avoidance, mitigation and management measures during key phases of the Project being clearing, construction, operation and decommissioning. The MMP identifies these measures, the performance outcomes to be achieved, and monitoring to ensure the actions are effective in achieving the set interim and final performance criteria.

The MMP has been developed in accordance with the Project's approval (EPBC 2017/7867), specifically addressing Conditions 2 and 45 to 47 as summarised in Section 1.4 and guidance material provided by representatives of the Department of Agriculture, Water and the Environment (DAWE).

1.3 Project description

The Project area is approximately 26,164ha in total, situated across five mining leases (ML700034, ML700035, ML700036, ML700032 and ML700033) (Figure 1.3). Open cut mining areas will be developed, and rehabilitated, in a progressive manner over the life of the Project. There are two main domains for the open cut pits being Olive Downs South Domain and Willunga Domain (Figure 1.3). The Olive Downs South Domain in the north of the Project area will be mined first and progressively move south to the Willunga Domain as part of stages three and four.

Access to the respective domains will be provided by two local access roads:

- from Annandale Road to the Olive Downs South Domain (including an approved crossing of the Isaac River); and
- from the Fitzroy Developmental Road to the Willunga Domain.

The Isaac River is on the eastern boundary of the Project area in the north, and also divides the two domains in the central portion of the Project area. The two domains will be connected by crossings of the Isaac River for vehicular access and transfer of crushed ROM coal via an overland conveyor. A third, separate crossing of the Isaac River would also be utilised (subject to weather permitting) for waste rock emplacement and vehicular access in the north-east of the Olive Downs South domain. The approved Isaac River crossings are illustrated in Figure 1.3 and applicable EPBC conditions pertaining to the three river crossings are summarised in Section 1.4.

1.3.1 Project activities

The construction and operation of the Project will include following activities:

- development of the Olive Downs South and Willunga domain open cut mine areas;
- exploration activities;
- progressive development of soil stockpiles, laydown areas and borrow areas (e.g. for road base and ballast material);
- drilling and blasting (daytime only) of competent waste rock material;
- progressive placement of waste rock in emplacements adjacent to and nearby the open cut mine extents;
- progressive backfilling of the mine voids with waste rock behind the advancing open cut mining operations;
- progressive rehabilitation of waste rock emplacement areas;
- construction of an access road from Annandale Road to the Olive Downs South domain infrastructure area including a crossing of the Isaac River;
- progressive development of new haul roads and internal roads, including an Isaac River road crossing to provide access between the Olive Downs South and Willunga domains;
- installation and operation of an on-site coal handling and processing plant (CHPP) at the Olive Downs South domain along western boundary;
- installation and operation of on-site ROM coal handling and crushing facilities at the Willunga domain;

- transfer of crushed ROM coal from the Willunga domain to the CHPP at the Olive Downs South domain, via either haul road or overland conveyor with an Isaac River crossing;
- storage and disposal of CHPP rejects (coarse and fine rejects) during the initial years (until in-pit containment facilities become available) in initial rejects storage facilities including In-line Flocculation (ILF) cells;
- disposal of CHPP rejects (coarse and fine rejects) on-site within appropriate in-pit containment facilities, including mine voids behind the advancing open cut mining operations and, where circumstances allow, disposal in other out-of-pit containment facilities; and
- progressive development of sediment dams and water storage dams (including the North Western Water Dam, Central Water Dam, mine affected water dams, raw water dams, etc.) and installation of pumps, pipelines and other water management equipment and structures (including up-catchment diversions and temporary levees).

The operational hours of the Project would be 24 hours a day, seven days a week. Construction rosters are expected to be 12 hour shifts with 21 days on and seven days off. Vegetation clearing and construction activities would be undertaken during daytime hours up to seven days per week.

The main Project components in Stage 1 are shown in Figure 1.2. Detailed Project design and layouts are still being finalised for Stages 2 - 4. Therefore specific areas of infrastructure and disturbance will be finalised closer to the time of that stage commencing. It is therefore proposed this MMP is updated 12 months prior to each stage commencing to reflect the latest Project design, and to update specific mitigation and management measures as they apply to those areas (such as locations for Koala exclusion fencing). Further detail on reviews and updates to the MMP is provided in Section 7.

1.3.2 Project stages

The Project will be developed and operated over four main stages. Therefore some areas within the Project area will not be cleared and developed for over 30 years (particularly in the Willunga Domain). The intent for areas in later stages is that they are managed in their pre-existing (i.e. natural state) which may include some grazing. Existing patches of native vegetation will be maintained and managed to allow them to continue providing habitat for MNES species until they are required to be cleared.

Land clearing and construction is proposed to occur in the following four stages. Years for Stages 2 to 4 are indicative:

- Stage 1- 2021-2025 (5 years);
- Stage 2 – 2026-2031 (6 years);
- Stage 3 – 2032 -2050 (18 years); and
- Stage 4 – all works until completion of the Project (30 plus years).

The four Project stages are illustrated in Figure 1.3.

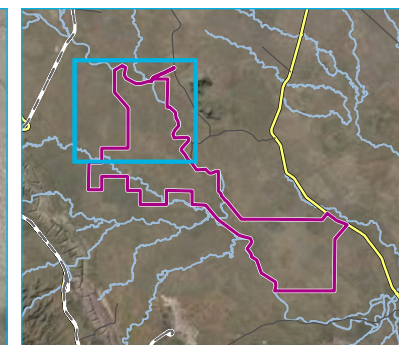
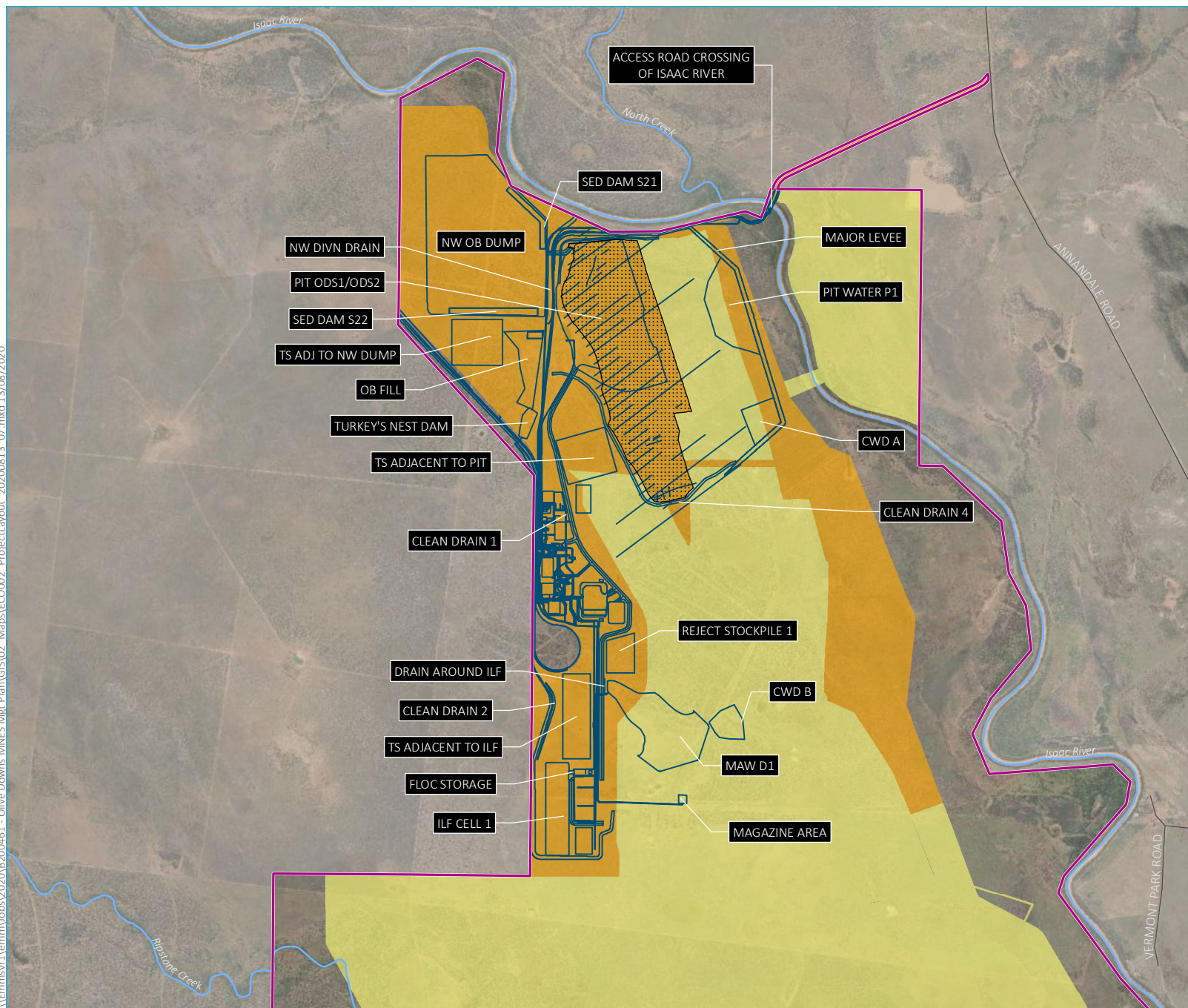
Stage 1 works are anticipated to commence in mid 2021 and will be focused on constructing the main site access road from Annandale Road, and setting up basic infrastructure, such as water supply, rail, power supply, coal crushing and processing facilities, water management and the first phase of buildings around rail spur.

Stage 1 works will include:

- construction of the Olive Downs South access road, including the bridge crossing over Isaac River;
- clearing vegetation within areas required for infrastructure and first open cut pit. Vegetation clearing is predicted to commence April 2021 (if weather conditions are not too wet) and continue over 18-24 months;
- construction of the mine infrastructure area (including offices, workshops, coal handling and processing plant (CHPP), ROM pad);
- development of the north-western waste emplacement;
- construction of temporary flood levees located within the Stage 1 boundary; and
- commencement of open cut mining in Pit 1.

Infrastructure that forms part of Stage 1 is illustrated in Figure 1.2.

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\EC0002 Project\Layout 20200813 07.mxd 13/08/2020



- KEY**
- Project area
 - Mine pit 1
 - Mine site layout
 - Rail line
 - Major road
 - Minor road
 - Named watercourse
- Project stages**
- Stage 1
 - Stages 2-4

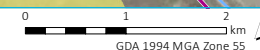
DRAFT

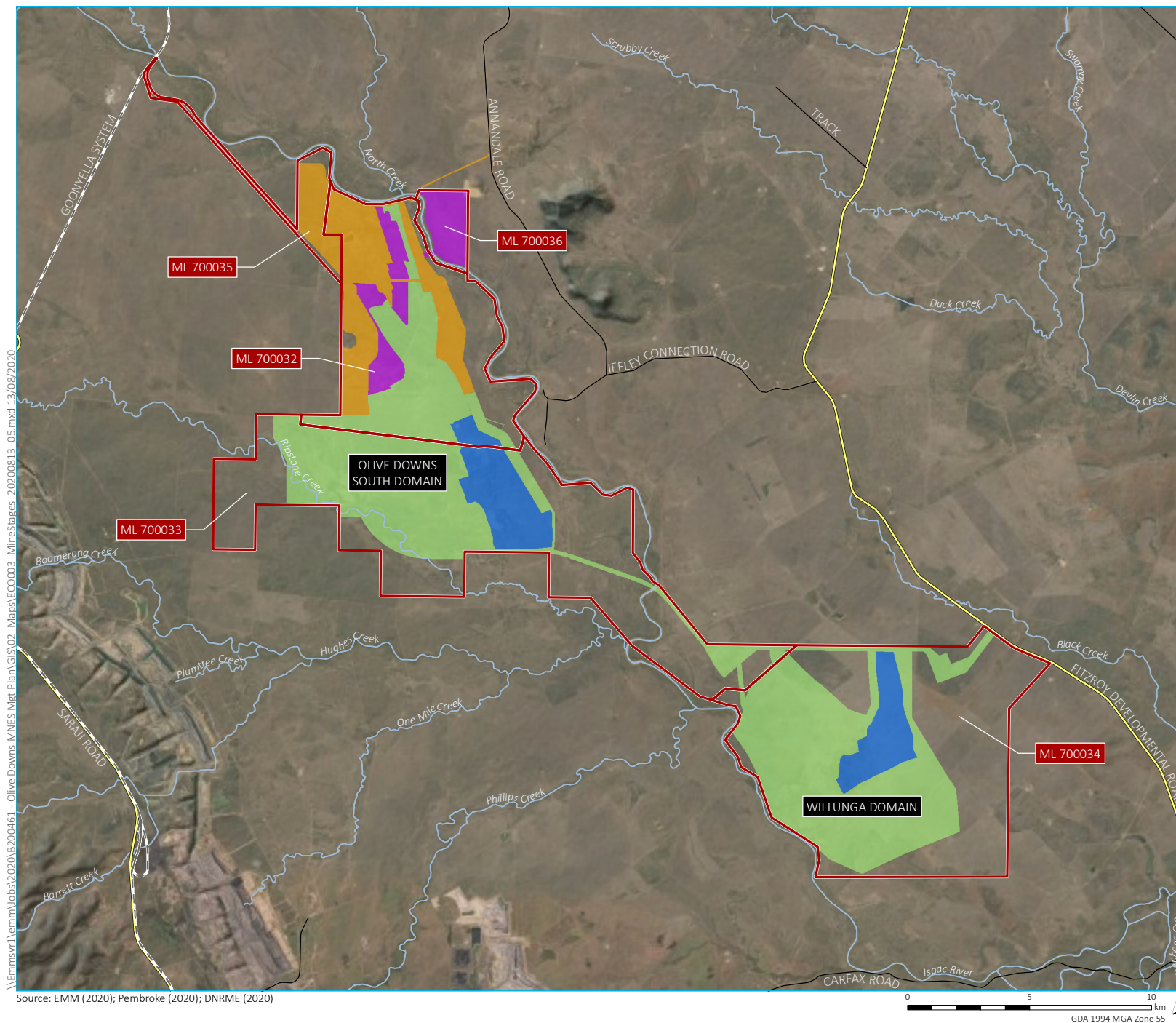
Mine site layout

Olive Downs
MNES management plan
Figure 1.2



Source: EMM (2020); Pembroke (2020); DNRME (2020)





DRAFT

Project stages

Olive Downs
MNES management plan
Figure 1.3

1.4 Commonwealth approval

The EPBC approval (EPBC 2017/7867) for the Project was granted on 14 May 2020. The applicable listed species and ecological community that are addressed in the approval and subject of this MMP are:

- Koala;
- Greater Glider;
- Squatter Pigeon (Southern);
- Ornamental Snake;
- Australian Painted Snipe; and
- Brigalow TEC.

Conditions 2 and 45 to 47 of the EPBC Act approval are directly relevant to the development of this MMP and are discussed in Sections 1.4.1 and 1.4.2. Conditions 32 to 40 pertaining to conservation of Koalas and Greater Glider through research and other conservation activities is also considered relevant, and incorporated into this MMP and outlined in Section 1.4.3. It should be noted that the conditions pertaining to the Ripstone Creek Diversion (Conditions 41 to 44) are not included in this MMP. A separate report will be prepared 15 years prior to the proposed commencement of the diversion as required under Condition 41. If required the MMP will be updated at that time to incorporate any applicable changes.

1.4.1 Condition 2 (EPBC 2017/7867)

Condition 2 of the EPBC Act approval relates to the maximum area of habitat for listed threatened species and ecological communities that Pembroke are permitted to impact over the life of the Project. The total impact areas are broken down across the four stages as summarised in Table 1.1.

Pembroke will ensure that clearing of species habitats and Brigalow TEC do not exceed these approved disturbance limits for each stage. Vegetation clearing and disturbance to MNES habitats will also not occur outside the approved staged areas.

Table 1.1 **Approved disturbance limits (ha) for MNES across the mine site and access roads**

MNES	Stage 1 (ha)	Stage 2 (ha)	Stage 3 (ha)	Stage 4 (ha)	Total (ha)
Koala (<i>Phascolarctos cinereus</i>) (combined populations of Qld, NSW and the ACT) habitat	1,110.50	367.50	3,939.50	354	5,771.50
Greater Glider (<i>Petauroides volans</i>) habitat	978.50	303	3,937	389	5,607.50
Squatter Pigeon (Southern) (<i>Geophaps scripta scripta</i>) breeding habitat	855	216.5	3,100	372	4,543.50
Squatter Pigeon (Southern) (<i>Geophaps scripta scripta</i>) foraging habitat	135.50	68	656.50	6.5	866.50
Ornamental Snake (<i>Denisonia maculata</i>) important habitat	1,032	298	5,109	1,307	7,746.00
Australian Painted Snipe (<i>Rostratula australis</i>) breeding habitat	16	3	70	25	114.00
Brigalow TEC	0	0	13	0	13.00

1.4.2 Conditions 45 to 47 (EPBC 2017/7867)

Conditions 45 to 47 relate to the requirements to develop and have approved, a MMP for the MNES listed in Condition 2. These conditions and where they have been addressed in this MMP are outlined in Table 1.2.

Table 1.2 Conditions of approval relevant to the MNES Management Plan

Condition	Condition Requirement	Where addressed
45	<p>To avoid, mitigate and manage impacts of the action on the listed threatened species and community and their habitat, the approval holder must submit a MNES Management Plan for the written approval of the Minister. The MNES Management Plan must be prepared by a suitably qualified ecologist and in accordance with the Department's Environmental Management Plan Guidelines (the Guidelines).</p> <ul style="list-style-type: none"> 	<p>The purpose of this plan, consistent with condition 45 is outlined in Section 1.2.</p> <p>Qualifications of the MMP authors and their suitability is provided in Section 1.5. Curriculum vitae of report authors are provided in Appendix A.</p> <p>The EMP Guidelines have been considered and incorporated as part of developing this MMP. The MMP has followed the Guidelines by adhering to:</p> <ul style="list-style-type: none"> • The general principles for the preparation of an EMP; • The required content (outlined in section 3 of the guideline) including outlining impacts and risks, management measures (such as management activities, controls, performance targets, monitoring and corrective actions); • The evaluation of the risks using the 'qualitative risk assessment methodology'; • Roles and responsibilities; and • Auditing and reporting.
46(a)	The MNES Management Plan must include details of specific environmental outcomes to be achieved for the listed threatened species and community and their habitat.	<p>Overarching environmental outcomes are specified in Section 5.1.</p> <p>Specific performance criteria and outcomes relating to each MNES species and Brigalow TEC, for each Project phase are provided in Tables 4.1, Table 4.2 and Table 4.3.</p> <p>Management measures, interim milestones and corrective actions are discussed in Section 5.</p>
46(b)	The MNES Management Plan must include interim milestones that set targets at 5-yearly intervals to track progress against achieving the environmental outcomes.	<p>Interim milestones have been described in Table 6.1. Interim milestones have been based on actions to be achieved, or outcomes, based on Project stages.</p> <p>Due to the long duration of the Project, and that a number of activities may occur at different phases, interim progress reviews are proposed at 5 yearly intervals as well as 12 months prior to the commencement of each stage. These reviews are to assess progress of the management plan actions, evaluate their effectiveness and apply adaptive management principles.</p>
46 (c)	Details of the measures, and timeframes for implementation, that will be taken in the project area to avoid, mitigate and manage impacts on the listed threatened species and community and their	<ul style="list-style-type: none"> • Specific details of the measures and timeframes for implementation of avoidance, mitigation and management of impacts on the listed threatened

Table 1.2 Conditions of approval relevant to the MNES Management Plan

Condition	Condition Requirement	Where addressed
	<p>habitat during clearance, construction, operation and decommissioning of the action, including but not limited to:</p> <ul style="list-style-type: none"> i) clearance of one corridor, of a maximum 45 metres in width, in the riparian zone of the Isaac River; ii) clearance of two corridors, of a maximum 60 metres in width, in the riparian zone of the Isaac River; iii) clearance of two corridors, of a maximum 30 metres in width, in the riparian zone of Ripstone Creek; iv) no clearance in the riparian zones of the Isaac River and Ripstone Creek other than that specified in this approval; v) removal and exclusion of grazing from all riparian zones in the project area; vi) installation of rope ladder crossings of the cleared corridors in the riparian zones of the Isaac River and Ripstone Creek to maintain Greater Glider (<i>Petauroides volans</i>) habitat connectivity; vii) enforced vehicle speed limits of 60 kilometres/hour or less; viii) installation of Koala-proof fences, without barb-wire, in Koala (<i>Phascolarctos cinereus</i>) (combined populations of Qld, NSW and the ACT) habitat and Greater Glider (<i>Petauroides volans</i>) habitat; and ix) installation of Koala poles at Koala-proof fences, with proposed spacing, in Koala (<i>Phascolarctos cinereus</i>) (combined populations of Qld, NSW and the ACT) habitat. 	<p>species and community are described in Sections 4 and 5.</p> <ul style="list-style-type: none"> • Specifically Tables 4.1, 4.2 and 4.3 outline these measures by each Project phase, and then they are grouped into avoidance, mitigation and management. • Clearance corridor specifications i), ii), iii) and iv) are confirmed in Section 4 and Figure 4.1 for Stage 1. • Exclusion of grazing (v) has been noted in Section 4.3. Grazing exclusion areas are shown in Figure 4.2. • Details on the installation of rope ladder crossings of the cleared corridors in the riparian zones (vi) are given in Section 6.2 and Figure 5.2. • Details on enforced speed limits (vii) and associated signage and speed humps are given in Section 4.3. • Details on the installation of Koala-proof fences (viii) and Koala poles (ix) are given in Section 5.2.8 and Figure 5.1 for Stage 1.
46(d)	Details on the specific timing, frequency and duration of the measures to be implemented.	<p>The specific timing, frequency and duration of avoidance, mitigation and management measures are summarised in Section 4 and 5.</p> <p>Specific timing, frequency and duration of monitoring is described in Section 6 and Table 6.1.</p>
46(e)	Evidence of how the measures are based on best available practices, appropriate standards, and supported by scientific evidence	References are provided in Section 4 and 5 in terms of how the proposed measures are based on best available practices and standards and/or guidelines.
46(f)	Details on how the measures have been developed with consideration of the S.M.A.R.T principle	<p>Section 4.2 states MMP has been developed in accordance with S.M.A.R.T principles.</p> <p>For example avoidance, mitigation and management actions are specific, performance criteria and outcomes measurable.</p>
46(g)	Details of the nature, timing and frequency of monitoring to inform progress against achieving the 5-yearly interim milestones (the frequency of monitoring must be sufficient to track progress towards each set of milestones, and sufficient to determine whether the milestones are likely to be achieved in adequate time to implement all necessary corrective actions)	Details on the nature, timing and frequency of monitoring to inform progress against performance criteria and interim targets are given in Section 6, Table 6.1 and Appendix C.
46(h)	Timing for the submission of internal monitoring reports which provide evidence demonstrating whether the interim milestones have been achieved	Details on the timing for the submission of internal monitoring reports are addressed in Section 7.1.

Table 1.2 Conditions of approval relevant to the MNES Management Plan

Condition	Condition Requirement	Where addressed
46(i)	Timing for the implementation of corrective actions if monitoring indicates the interim milestones will not or have not been achieved	Details on corrective actions, triggers for corrective actions and timing for implementation of corrective actions are given in Table 6.1.
46(j)	Risk analysis and a risk management and mitigation strategy for all risks to the successful implementation of the MNES Management Plan and timely achievement of the environmental outcomes, including a rating of all initial and post-mitigation residual risks in accordance with the risk assessment matrix	Details on risk analysis, risk management and mitigation strategy are provided in Section 8. The risk assessment includes pre and post-mitigation risk rankings.
46(k)	Evidence of how the measures and corrective actions take into account relevant approved conservation advices and are consistent with relevant recovery plans and threat abatement plans.	Reference to conservation advices, applicable recovery plans and literature are provided in Table 2.1 and Section 5 summarises how proposed measures are consistent with these advices and plans etc.
47	The approval holder must not commence the action until the MNES Management Plan has been approved by the Minister. The approved MNES Management Plan must be implemented.	Noted in Section 7.1.

1.4.3 Conditions 32 to 40 (EPBC 2017/7867)

Table 1.3 Conditions of approval relevant to the MNES Management Plan

Condition	Condition requirement	Where addressed
32	In addition to its obligations under the Environmental Offsets Policy , the approval holder must contribute \$100,000 (GST exclusive and indexed in line with CPI for each year to be equal to the value of \$100,000 on the date of commencement of Stage 2) each year for 10 years to a program where the total contribution will be used for the better protection and long-term conservation of the Koala and Greater Glider in the Bowen Basin.	<p>It is proposed financial contributions are made in Stage 1 associated with a Koala and Greater Glider monitoring program.</p> <p>The Koala monitoring program will provide more detailed information on Koala populations occurring in the Project area, their dispersal, provide an understanding of the effectiveness of avoidance and mitigation measures adopted during vegetation clearing, and a better understanding as to how Koalas may settle post vegetation clearing and establishing new home ranges. Further detail is provided in Section 5.2.7. This will have benefits to Koalas more broadly, including Koala populations in the Bowen Basin.</p> <p>The Greater Glider monitoring program will provide information on whether Greater Gliders are utilising nest boxes that have been installed, their dispersal in the Project area and broader areas, their home range and ability to establish new home ranges post loss of their original habitat. Further detail is provided in Sections 5.2.10 and 6.2. This will have benefits to Greater Glider more broadly and understanding of effective mitigation measures including glider crossings and nest boxes.</p>

Table 1.3 Conditions of approval relevant to the MNES Management Plan

Condition	Condition requirement	Where addressed
33	The approval holder must submit a framework to make financial contributions to the program for the written approval of the Minister at least 3 years prior to the commencement of Stage 2 . The approved framework must be implemented.	<p>It is recognised Pembroke are seeking to bring this condition forward to apply in Stage 1. The proposed Koala monitoring program and Greater Glider monitoring program are considered appropriate to be undertaken in Stage 1 as this is the first disturbance to these populations and where valuable information can be learned.</p> <p>More detailed implementation plans for this Koala and Greater Glider monitoring will be prepared to gain a Scientific Purposes Permit (SPP) and Animal Ethics approval. These approvals need to be in place prior to implementation of monitoring.</p> <p>Pembroke will look to develop a framework for additional contributions as required under this condition in the first few years of the Project.</p>
34	<p>The approval holder must not commence Stage 2 until it has provided notice, with documentary evidence, to the Department that the:</p> <ul style="list-style-type: none"> a. framework required under condition 33 has been approved by the Minister in writing; and b. the first financial contribution has been made. 	<p>Stage 2 will not be commenced until the framework is approved by DAWE. The first financial contribution is proposed as part of Stage 1 which is Koala monitoring and Greater Glider monitoring programs. The amount of financial contribution to implement the Koala and Greater Glider monitoring program will be finalised as part of a detailed implementation plan to be prepared as part of obtaining animal ethics approval and SPP.</p>
35	For each subsequent annual financial contribution, the approval holder must provide notice, with documentary evidence, to the Department within 20 business days after each such financial contribution has been made.	This will be done as required.
36	<p>The activities funded by the program must target in the Bowen Basin, at a minimum:</p> <ul style="list-style-type: none"> a. translocation programs to translocate Koala and Greater Glider individuals from the project area during pre-clearance surveys and clearing to determine its success in reducing individual mortality and its effects on the population size of the Koala and Greater Glider; b. revegetate, rehabilitate and restore habitat in the riparian zones associated with watercourses to create and maintain Koala and Greater Glider habitat connectivity; c. surveys to determine Koala and Greater Glider population density and carrying capacity across the Bowen Basin; and d. implement priorities identified in relevant recovery plans, threat abatement plans and/or approved conservation advices, and evaluate their success and cost effectiveness. 	<p>It is considered the proposed Koala and Greater Glider monitoring programs will contribute important knowledge about these species populations in the area, the effectiveness of mitigation measures such as nest boxes for Greater Glider and sequential clearing for Koalas. These programs align with (a) in that while individuals are not being caught and physically 'translocated' we are tracking their natural movements during clearing to determine success in reducing mortality and gaining more knowledge about their dispersal.</p>

Table 1.3 Conditions of approval relevant to the MNES Management Plan

Condition	Condition requirement	Where addressed
37	<p>At a minimum, the following information, prepared by an independent suitably qualified expert, must be provided to the Department prior to commissioning each activity:</p> <p>a. commitments, including financial commitments and proposed timeframes, that will be implemented to support the undertaking of the activity;</p> <p>b. the proposed timeframe for undertaking the activity;</p> <p>c. the independent suitably qualified expert/s who has designed and will implement the activity;</p> <p>d. timing of a peer-review of the outcomes of the activity;</p> <p>e. the proposed peer-reviewed scientific journal and/or other method/s to ensure the outcomes of the activity is made publicly available; and</p> <p>f. details, with supporting evidence, of the consultation undertaken (including with the Queensland Government and relevant Recovery Teams) on how the activity can complement and/or align with other studies for the Koala and Greater Glider in the Bowen Basin.</p>	<p>The proposed monitoring and research projects will be implemented by EMM in collaboration with highly experienced fauna ecologists who have implemented similar research and monitoring programs for projects in Qld including the Qld Government.</p> <p>The Implementation Plans that will need to be prepared for approval by animal ethics committee will be reviewed by an “independent suitably qualified expert” and the documents will include information on:</p> <ul style="list-style-type: none"> • Financial commitments • Timeframes • Outline of ecologists that will implement the activity • Timing for peer review of outcomes • How the results will be made publicly available • Consultation undertaken with DES and any relevant recovery teams on proposed activities and how they will complement and/or align with other studies in Bowen Basin.
38	The outcomes of each activity must be subject to a peer-review and must, at a minimum, be published on the approval holder's website for the remaining period of effect of this approval.	The results will be published on Pembroke's website.
39	A review of outcomes from the financial contributions must commence 5 years after the date of the first financial contribution or as otherwise agreed by the Minister in writing. This review must take into account progress of each activity and any subsequent on-ground actions, as well as the involvement of other holders of approvals under the EPBC Act making financial contributions.	To be completed.
40	A detailed report of the outcomes of the review must be provided to the Department within 6 months of the date of commencement of the review.	To be completed.

1.5 Suitably qualified ecologists

EMM have been engaged by Pembroke to prepare this MMP due to their expertise and experience in designing and implementing surveys for threatened ecological communities and species under EPBC Act, and preparing comprehensive impact assessments and environmental management plans. In particular EMM has experience working on some of Australia's largest resource and infrastructure projects, including the implementation of detailed field ecology surveys, habitat assessments and developing practical and sound avoidance, mitigation and management measures for threatened species and communities.

Five experienced ecologists have authored the preparation of this MMP, four of which have over 10 years experience designing and implementing surveys for the applicable listed threatened species and community and their habitat, as well as developing comprehensive avoidance, mitigation and management strategies.

EMM’s ecologists can give an authoritative assessment and advice on the presence and habitat requirements of the listed threatened species and community using relevant protocols, standards, methods and/or literature. The report authors also have a detailed understanding of effective strategies to manage impacts on threatened species during various Project phases, as well as developing effective monitoring programs.

Authors Berlinda Ezzy, Andrew Jensen and Ben Nottidge meet the definition of “suitably qualified ecologists” under the EPBC approval which states “**Suitably qualified ecologist**” means a person who has professional qualifications and at least 3 years of work experience designing and implementing surveys for the “**listed threatened species and community**” and their habitat, and can give an authoritative assessment and advice on the presence and habitat requirements of the “**listed threatened species and community**” using relevant protocols, standards, methods and/or literature”.

The experience of each ecologist involved in preparation of this MMP is summarised in Table 1.4. Curriculum vitae are provided in Appendix A.

Table 1.4 Suitability qualified ecologists

Ecologist	Qualifications and relevant experience
Nathan Garvey (Associate Ecologist and Divisional Leader – Bushfire, Ecology, Heritage and Spatial Solutions)	<p>Nathan is an experienced ecologist with over 17 years’ practice in ecological assessment. Nathan has delivered projects across a diverse range of sectors including mining, oil and gas, linear infrastructure, renewable energy and residential development. Nathan has vast field work experience and is a practitioner of biodiversity assessment and approvals, including biodiversity assessment for major projects and EPBC Act referrals. He is one of NSW’s leading experts in biodiversity offsetting.</p> <p>Nathan has greater than 3 years’ experience designing, implementing and conducting surveys for MNES species, including Koalas and Gliders, across NSW and Victoria. Other MNES species Nathan has performed Ecological monitoring and Management plans on include the Green and Golden Bell Frog, Southern Bent-wing Bat and the Growling Grass Frog.</p> <p>Nathan was the lead ecologist on the Snowy 2.0 project in NSW which required Nathan to develop and lead a comprehensive terrestrial and aquatic surveys across the project area. Targeted surveys for threatened species were completed including Smoky Mouse (listed under EPBC Act) . Nathan then led the impact assessments for the project at a State and Commonwealth level. Nathan is currently developing detailed monitoring programs going forward and finalising offset strategies.</p> <p>Nathan has prepared numerous threatened species monitoring and management plans including:</p> <ul style="list-style-type: none"> • Dunmore Hard Rock Quarry, flora and fauna management plan, Dunmore (Boral) • Beryl Solar Farm, biodiversity management plan, Beryl (Geolyse and Downer) • Mona Vale Road, biodiversity monitoring plan and implementation, Sydney NSW (Roads and Maritime Services) • Walgett Solar Farm, biodiversity management plan, Walgett (Geolyse and Epuron)
Berlinda Ezzy (Ecology Team Lead & Associate Ecologist)	<p>Berlinda is an Associate Ecologist with 20 years of professional experience. She has worked for local and state government in Queensland, as well as the private sector, across a range of environmental disciplines.</p> <p>Berlinda’s areas of expertise include environmental planning and approvals, threatened species management, coordinating delivery of field ecology surveys and reporting, impact assessments and biodiversity offsets. Berlinda led the Koala Conservation Unit at Department of Environment and Science (DES) for a number of years which included implementing a range of Koala conservation programs, developing an offset policy and assessing development applications to ensure measures were being put in place to avoid and mitigate impacts on Koalas.</p> <p>Berlinda has led complex projects as an environmental consultant for over 10 years and successfully managed a large number of ecology, impact assessment and offset projects for resource and infrastructure companies across Queensland and New South Wales. Berlinda’s experience includes preparation of Threatened Species Management Plans for the Woolgoolga to Ballina Pacific Highway Upgrade, QCLNG and APLNG projects. Berlinda has more than 3 years of experience in designing and implementing surveys for Greater Glider, Squatter Pigeon (southern), Ornamental Snake, Koala and</p>

Table 1.4 Suitability qualified ecologists

Ecologist	Qualifications and relevant experience
	<p>the Australian Painted Snipe. Projects in which Berlinda was involved in designing and implementing surveys for these species included Blackwater mine, Kevin's Corner, Boulder Creek and Specimen Hill wind farms, APLNG and Bowen Gas Project.</p> <p>Berlinda has also prepared a number of offset management plans and is engaged and consulted with by government agencies on biodiversity offsets due to her long standing experience in this area.</p>
Andrew Jenson (Associate Ecologist)	<p>Andrew has 15 years' ecological experience across a range of disciplines and industries including mining, renewables, and oil and gas. Key aspects of his work have included project management, client liaison, preparation of environmental impact statements, preparation of management plans, ecological reporting and surveying and ecological offset plans.</p> <p>Andrew routinely reviews environmental technical studies and has developed environmental management plans and negotiated environmental approval conditions for clients. Andrew has also been responsible for conducting a number of species impact significance assessments at both Commonwealth and state level and is familiar with the requirements of this process. Andrew has also been responsible for managing, coordinating and undertaking fieldwork campaigns across Queensland.</p> <p>Andrew has greater than 3 years' experience in designing, implementing and conducting surveys for MNES species. He has recently completed targeted fauna surveys at a proposed mine expansion in central Qld which included surveys for Koalas, Greater Glider, Ornamental Snake, Australian Painted Snipe and Squatter pigeon. Boulder Creek and Specimen Hill wind farms involved surveys for Koalas, Greater Glider and Squatter pigeon.</p>
Ben Nottidge (Associate Ecologist)	<p>Ben is a Senior Ecologist with over 15 years' experience conducting fauna surveys throughout Queensland in a consultancy context. During this time, Ben has worked on various CSG projects throughout Queensland including the Arrow Bowen Pipeline, Arrow Surat Pipeline, Arrow Curtis Island CSG Processing Site, Origin Coal Seam Gas Project and APLNG Curtis Island CSG Processing Site. He has worked on a range of components of these projects including the initial ecological assessments for wells and pipelines, pre-clear surveys, wildlife spotter-catching, targeted surveys for threatened fauna, environmental impact statements for fauna, EPBC referrals and pre-clearance surveys.</p> <p>Ben has undertaken numerous surveys, and has greater than 3 years experience in designing and implementing surveys for fauna and flora species listed as threatened under State and Commonwealth legislation. Much of his experience has been for large mining and infrastructure projects including the Blackwater Mine Expansion Project, Olive Downs Coal Project, Woolgar Gold Project, Columboola to Wandoan South Transmission Line, Trackstar Alliance Caboolture to Beerburum Rail Upgrade, Hail Creek Mine Expansion Project, Moranbah South Coal Project, Abbot Point Coal Terminal Expansion Project, Conner's River Dam Project. Ben's survey experience has included all target species including Greater Glider, Squatter Pigeon (southern), Ornamental Snake, Koala and the Australian Painted Snipe.</p> <p>Ben has expertise in:</p> <ul style="list-style-type: none"> • fauna and flora surveys using a range of methodologies • fauna taxonomy and ecology • targeted threatened species surveys and management • habitat assessments • fauna surveys including surveys consistent with DAWE and other relevant survey guidelines • rehabilitation and revegetation • wildlife radio-telemetry, translocations and home range analysis • wildlife spotter-catching <p>Ben has significant expertise, understanding in Koala ecology and experience leading Koala surveys and Koala monitoring. Ben was involved in undertaking Koala monitoring associated with the Moreton Bay Rail Link and Toowoomba Second Range Crossing projects in south east Qld where Koalas have been radio-tracked. This has included carrying out Koala surveys to identify if any individuals were in the project area, tagging and tracking individuals by radio-telemetry to identify Koalas dispersal in the</p>

Table 1.4 Suitability qualified ecologists

Ecologist	Qualifications and relevant experience
	local area, and assessing their health. Over 100 Koalas were tracked by Ben Nottidge and results published on a monthly basis. Diseased Koalas were taken to a vet to be treated and once well enough released at agreed release sites. The monitoring also allowed Koala deaths to be confirmed and cause identified such as by dogs and cars.
Patrick Finnerty (Ecologist)	Patrick is an ecologist with 5 years project experience across a range of sectors including utilities, infrastructure, construction and energy. Patrick has been involved in the successful delivery of numerous projects including ecological impact assessments, ecological and threatened species monitoring, management plans and stewardship feasibility studies. Patrick has project managed and has been the technical lead on some major ongoing biodiversity monitoring projects within NSW including a glider monitoring program for Roads and Maritime. He has a wide range of skills including complex survey logistics and planning, data management and report writing along with biodiversity assessments.

1.6 Relationships to other plans

Pembroke are required to prepare various management plans that address a range of environmental matters associated with the construction, operation and decommissioning of the Project. A number of these plans will be regulated under the Environmental Authority (EA) for the mine administered by the Department of Environment and Science (DES) and have an inter-relationship to this MMP. For example Pembroke will prepare a Weed and Pest Management Plan as part of the EA which will tie in with the identified feral management actions in this MMP.

Pembroke will ensure all documents prepared are consistent with this MMP.

The following management plans to be prepared that are relevant to this MMP are:

- Fauna Species Management Program (addressing management of animal breeding places under *Nature Conservation Act 1992*);
- Weed and Pest Management Plan;
- Erosion and Sediment Control Plan;
- Air Quality Management Plan (consistent with the dust mitigation activities presented in the Coal Dust Management Plan (QR Network 2010));
- Noise Management Plan;
- Blast Management Plan;
- Waste Management Plan;
- Water Management Plan & Receiving Environment Monitoring Program;
- Rehabilitation Management and Monitoring Plan;
- Groundwater dependent ecosystem and Wetland Monitoring Program; and
- Stage 1 Offset Area Management Plan.

2 Matters of national environmental significance (MNES)

As part of the Project's EIS to support State and Commonwealth approvals processes, detailed ecological assessments including targeted surveys for threatened species and communities were undertaken. These surveys and results are summarised in Appendix B – Terrestrial Fauna Assessment of the EIS (Pembroke 2018). The report was prepared by DPM Envirosciences in August 2018 titled 'Olive Downs Coking Coal Project – Terrestrial Fauna Assessment'. The purpose of the report was to:

- Determine the presence/absence of threatened flora and fauna species within the Project area;
- Assess the vegetation characteristics and the presence of ecological communities within the Project area;
- Describe the likely adverse impacts on MNES within the Project area;
- Describe measures that would be implemented to avoid and mitigate impacts on those MNES; and
- Assess the baseline habitat quality of habitats and ecological communities within the impact areas.

This section provides a summary of the key findings from the field ecology surveys for each MNES required to be addressed in this MMP. Detailed information including habitat quality within the Project area for each of the MNES and habitat quality plot data is outlined in Appendix E of the Terrestrial Fauna Assessment Report (DPM Envirosciences 2018).

2.1 Ecology survey effort

The field ecology surveys incorporated both dry season and wet season fauna surveys. A comprehensive fauna survey was undertaken within the mine site in Spring from 1-14 November 2016. A follow-up fauna survey was undertaken within the mine site in Autumn from 23 April to 4 May 2017 and again in Spring 4-9 September 2017. Habitat quality assessments were undertaken to provide preliminary data to support the offset strategy and EPBC offset calculator inputs and also to obtain initial baseline data on the habitat quality within the Project area.

A variety of flora and fauna survey methods were used to detect MNES during the impact assessment surveys. Flora surveys were undertaken in accordance with the Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland, Version 3.2 (Nelder et al. 2012) and Queensland Flora Survey Guidelines – Protected Plants (DEHP 2016). Assessment sites were undertaken across the entire Project area including 227 vegetation assessment sites in total comprising 222 quaternary sites and five tertiary sites.

Fauna assessments used across the Project area included systematic trap sites (Elliot, pitfall and funnel), spotlighting, call playback, camera trapping, active searching, harp traps, Anabats, Koala transects and observation (e.g. bird surveys and opportunistic observations). Survey methods undertaken were in accordance with applicable Commonwealth and Queensland threatened species and communities survey guidelines including:

- Commonwealth guidelines
 - EPBC Act survey guidelines for Australia's threatened reptiles (DSEWPC 2011a);
 - EPBC Act survey guidelines for Australia's threatened birds (DEWHA 2010a);
 - EPBC Act survey guidelines for Australia's threatened bats (DEWHA 2010b);

- EPBC Act survey guidelines for Australia’s threatened mammals (DSEWPC 2011b);
- EPBC Act draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC 2011c);
- EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DoE 2014a);
- Draft referral guidelines for nationally listed Brigalow Belt reptiles (DSEWPaC 2011c);
- SPRAT databases for relevant EPBC Act listed species and communities (as of July 2016);
- Queensland guidelines;
 - Flora Survey Guidelines – Protected Plants Nature Conservation Act 1992 (DEHP 2019); and
 - Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al. 2018).

2.2 Characteristics of the Project area

The Project area contains both remnant and regrowth forest and woodland, as well as broad open grazed grasslands. There is approximately 17,838 ha of cleared land that is not associated with any remnant native vegetation. These areas are classified as ‘agricultural grasslands dominated by buffel grass (*Cenchrus ciliaris*)’. Buffel grass is an introduced perennial pasture species that is highly productive, relatively palatable, and persistent under heavy grazing conditions, making it a useful pasture species for cattle. Buffel grass dominates the ground layer. Trees are largely absent but generally consist of isolated acacias and eucalypts. The fauna habitat value of agricultural grasslands across the Project area is typically low, owing to the relative lack of shelter / cover and food resources.

Cattle grazing and associated agricultural practices have impacted and caused degradation to the vegetation (including fauna habitats) across the Project area to varying extents. The different habitats across the Project area include:

- eucalypt dry woodlands on inland depositional plains dominated by Poplar box (*Eucalyptus populnea*) and Narrow-leaved ironbark (*E. crebra*);
- eucalypt open forests to woodlands on floodplains (predominantly occurring in riparian corridors of Isaac River and parts of Ripstone Creek);
- acacia dominated open forests, woodlands and shrublands which are only a small portion of area;
- palustrine wetlands (swamps);
- lacustrine wetlands (dams); and
- waterways (watercourses and drainage features).

Further detail on these habitat types are provided in Section 5 of the Terrestrial Fauna Assessment (DPM Envirosiences 2018). Ground-truthed regional ecosystems (GTRE) within the Project area are illustrated in Figure 2.1.

2.3 Threatened species habitat mapping

Seasonal fauna surveys confirmed the presence of four threatened fauna species listed as vulnerable under the EPBC Act on site. They were; Greater Glider, Squatter Pigeon, Ornamental Snake and Koala. One fauna species listed as endangered under the EPBC Act was also observed on site being the Australian Painted Snipe. Records of the species in proximity to the Project area are shown in Figure 2.2.

Post field surveys habitat mapping was undertaken as part of the ecological assessments and based on detailed vegetation mapping and presence of micro-habitats (eg gilgai for Ornamental Snake) to assign areas of potential habitat based on known species habitat preferences and field observations. Habitat mapping for each species in the Project area is provided in Figure 2.3 to Figure 2.7. Habitat mapping was refined in consultation with DAWE representatives as part of finalising the EPBC approval and informed the final Project offset requirements.

Further detail on each species and their habitats in the Project area are provided below.

2.3.1 Greater Glider

Within the Project area, the Greater Glider was recorded on numerous occasions along the Isaac River and associated tributaries and around wetland habitats (DPM Envirosciences 2018) (Figure 2.3). Recordings included direct observation and identification of scats within Eucalypt dry woodlands on inland depositional plains and Eucalypt open forest to woodlands on floodplains and wetlands. Majority of records along the Isaac River and Ripstone Creek.

Within the Project area it was determined that Greater Glider habitat includes remnant and regrowth forest or woodland which contain suitable hollow bearing trees (Figure 2.3). This includes:

- all areas of eucalypt open forests to woodlands on floodplains (i.e. REs 11.3.3, 11.3.4, 11.3.7 and 11.3.25);
- eucalypt dry woodlands on inland depositional plains (i.e. REs 11.3.2, 11.5.3, 11.5.8c, 11.5.9, 11.5.9b and 11.9.2);
- vegetation surrounding and within the lacustrine and palustrine wetlands (i.e. REs 11.3.27f, 11.3.27i, 11.3.3c and 11.5.17);
- Acacia woodland dominated / codominated by *E. cambageana* (i.e. RE 11.4.8); and
- patches of regrowth eucalypt forest or woodland with suitable hollow-bearing trees (primarily stags) (DPM Envirosciences 2019).

The species is known to have limited dispersal ability across vegetation that does not incorporate feeding or denning trees (TSSC 2016).

Habitat mapping for the Greater Glider has been undertaken in accordance with information contained in the conservation advice for this species and results of field ecology surveys, which determined that 5,607.5 ha of potential Greater Glider habitat will be directly impacted across the life of the Project.

2.3.2 Squatter Pigeon (Southern)

Within the Project area, the Squatter Pigeon (southern) was identified on ten occasions within Eucalypt dry woodlands on inland depositional plains (Figure 2.4). The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open forests that are dominated by eucalypts (DAWE 2020a). Areas of Eucalypt dry woodlands on inland depositional plains and Eucalypt open forests to woodlands on floodplains are considered potential habitat for this species (DPM Envirosciences 2018).

Squatter Pigeon (southern) habitats were divided up into breeding, foraging and dispersal. REs 11.5.3, 11.5.8c, 11.5.9, 11.5.9b, 11.5.18 and 11.7.2 provide breeding habitat (where within 1 km of a waterbody) because they contain suitable soils, vegetation structure and composition. In addition, REs 11.3.2 and 11.3.7 (on Land Zone 3) are considered suitable for breeding (where within 1 km of a waterbody) based on site observations of habitat usage, as most observations of Squatter Pigeon (southern) in the Project area were from these REs.

In the Project area, dispersal habitat includes:

- all woodland without suitable groundcover for breeding or foraging;
- woodland on land zones not suitable for breeding or foraging; and
- areas of cleared land less than 100 m wide linking areas of breeding and/or foraging habitat.

Habitat mapping for the Squatter Pigeon (southern) within the Project area has been undertaken in accordance with information contained in the conservation advice for this species and feedback from DAWE which determined that 4,543.5 ha of Squatter Pigeon (southern) breeding habitat and 866.5 ha of foraging habitat will be directly impacted across the life of the Project. Breeding, foraging and dispersal habitat for Squatter Pigeon (southern) is illustrated in Figure 2.4.

2.3.3 Ornamental Snake

Within the Project area four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 2.5). These records occurred within agricultural grasslands on cracking clays, around palustrine wetlands, within Acacia dominated open forests, woodland and shrublands, and one record within Eucalypt dry woodlands on inland depositional plains (expected to be a transient individual) (DPM Envirosciences 2018).

Ground-truthed soils mapping produced for the Olive Downs Coking Coal Project Soil and Land Suitability Assessment by GT Environmental (2018) across the Project area identified areas of gilgai relief, which are the most accurate reflection of potential habitat for this species. Brigalow TEC has also been identified as potential habitat for the Ornamental Snake. Mapping in the Project area identified two patches (13 ha) as being Brigalow TEC (DSEWPC 2011c). Other patches of Brigalow regrowth have been mapped as potential habitat where suitable habitat features are present (i.e. gulgais, wetlands and suitable prey habitat). It was determined that all areas of mapped gilgai soils (encompassing all Brigalow TEC) represent potential 'known important habitat' for the Ornamental Snake, as do all palustrine and lacustrine wetland REs (11.3.3, 11.3.27 and 11.5.17). REs known to be associated with this species (REs 11.4.8 and 11.4.9) (DSEWPC 2011) because the species was recorded on several occasions within these habitats across the Project area, and these habitats were found to support populations of native frogs (dominated by burrowing frogs), a food source for Ornamental Snake were also included. Ornamental Snake habitat areas are illustrated in Figure 2.5.

The riparian vegetation along the Isaac River, where the access road and proposed overland conveyor cross the river, is not identified as important potential habitat for the Ornamental Snake. Although there is some potential for the species to opportunistically take frogs in the area, the species is more likely to use the gilgai soils (as evidenced by the location of species records throughout the Project area) (DPM Envirosciences 2019).

Habitat mapping for the Ornamental Snake within the Project area has been undertaken in accordance with information contained in the conservation advice for this species, habitat descriptions provided in the SPRAT database (DAWE 2020b) and other relevant sources, such as the *Draft Referral Guideline for the Nationally listed Brigalow Belt Reptiles* (DSEWPC 2011a). Habitat mapping has determined that 7,746.0 ha of potential Ornamental Snake habitat will be directly impacted across the life of the Project.

2.3.4 Koala

Within the Project area the Koala was recorded on numerous occasions along the Isaac River and associate tributaries. Recordings included direct observation and identification of scats and scratches within Eucalypt dry woodlands on inland depositional plains, Eucalypt open forest to woodlands on floodplains, and around wetlands (DPM Envirosiences 2018b) (Figure 2.6).

From observations made during field surveys of the Project area, Koalas were observed more frequently along waterway corridors, particularly the Isaac River and Ripstone Creek. The potential habitat connections along the waterways (primarily the Isaac River and Ripstone Creek) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape (DPM Envirosiences 2018).

As outlined in the EIS, Koala habitat in the Project area meets the definition of Critical Koala Habitat within the *EPBC Act Referral Guidelines for the Vulnerable Koala* (DoE 2014a). Within the Project area it was determined that Koala habitat includes all areas of remnant woodland with known Koala food trees or shrublands with emergent Koala food trees. Koala habitat included:

- eucalypt open forests to woodlands on floodplains (i.e. REs 11.3.3, 11.3.4, 11.3.7 and 11.3.25);
- eucalypt dry woodlands on inland depositional plains (i.e. REs 11.3.2, 11.5.3, 11.5.8c, 11.5.9, 11.5.9b and 11.9.2);
- vegetation surrounding and within the lacustrine and palustrine wetlands (i.e. REs 11.3.27f, 11.3.27i, 11.3.3c and 11.5.17); and
- regrowth woodland or shrubland with known Koala food trees or shrublands with emergent Koala food trees (Figure 2.6) (DPM Envirosiences 2018).

Koala food trees in the Project area include:

- river red gum (*Eucalyptus camaldulensis*);
- Queensland blue gum (*E. tereticornis*);
- Brown's box (*E. brownii*);
- yapunyah (*E. ochrophloia*);
- coolabah (*E. coolabah subsp. coolabah*);
- mountain coolibah (*E. orgadophila*);
- poplar box (*E. populnea*);
- narrow-leaved ironbark (*E. crebra*);
- silver-leaved ironbark (*E. melanophloia*); and
- broad-leaved ironbark (*E. fibrosa*).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Habitat mapping for the Koala within the Project area has been undertaken in accordance with information contained in the conservation advice for this species and feedback from DAWE which determined that 5,771.5 ha of potential Koala habitat will be directly impacted across the life of the Project.

2.3.5 Australian Painted Snipe

Within the Project area a single Australian Painted Snipe was observed during the field surveys in a small wetted gilgai within the agricultural grasslands habitat type in the Willunga Domain (DPM Envirosciences 2018) (Figure 2.7).

Within the Project area, it was determined that all areas of lacustrine and palustrine wetlands (including wetland REs 11.3.27, 11.3.3 and 11.5.17) represent potential breeding habitat for the Australian Painted Snipe, particularly as water levels changed seasonally and islands or mounds and bare earth would be exposed (DPM Envirosciences 2019). Gilgai soils within the Project area would provide intermittent foraging habitat for this species when the gilgai depressions contain water. Habitat areas for the species are illustrated in Figure 2.7.

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed.

Habitat mapping for the Australian Painted Snipe within the Project area has been undertaken in accordance with information contained in the conservation advice for this species, habitat descriptions provided in the SPRAT database (DAWE 2020c) and field survey results. It has been determined that 114.0 ha of potential Australian Painted Snipe habitat will be directly impacted across the life of the Project.

2.4 Threatened ecological communities

Only one TEC under the EPBC Act was recorded within the Project area, namely Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community (Brigalow TEC). A total of approximately 13 ha of Brigalow TEC, across two patches, will be cleared for the proposed mine site and access road in Stage 3. A further patch of Brigalow TEC will be avoided (as it is outside of the approved staging areas) (Figure 2.8) and will be managed to ensure both direct and indirect impacts don't occur.

The Brigalow TEC patches in the Project area are illustrated in Figure 2.8.

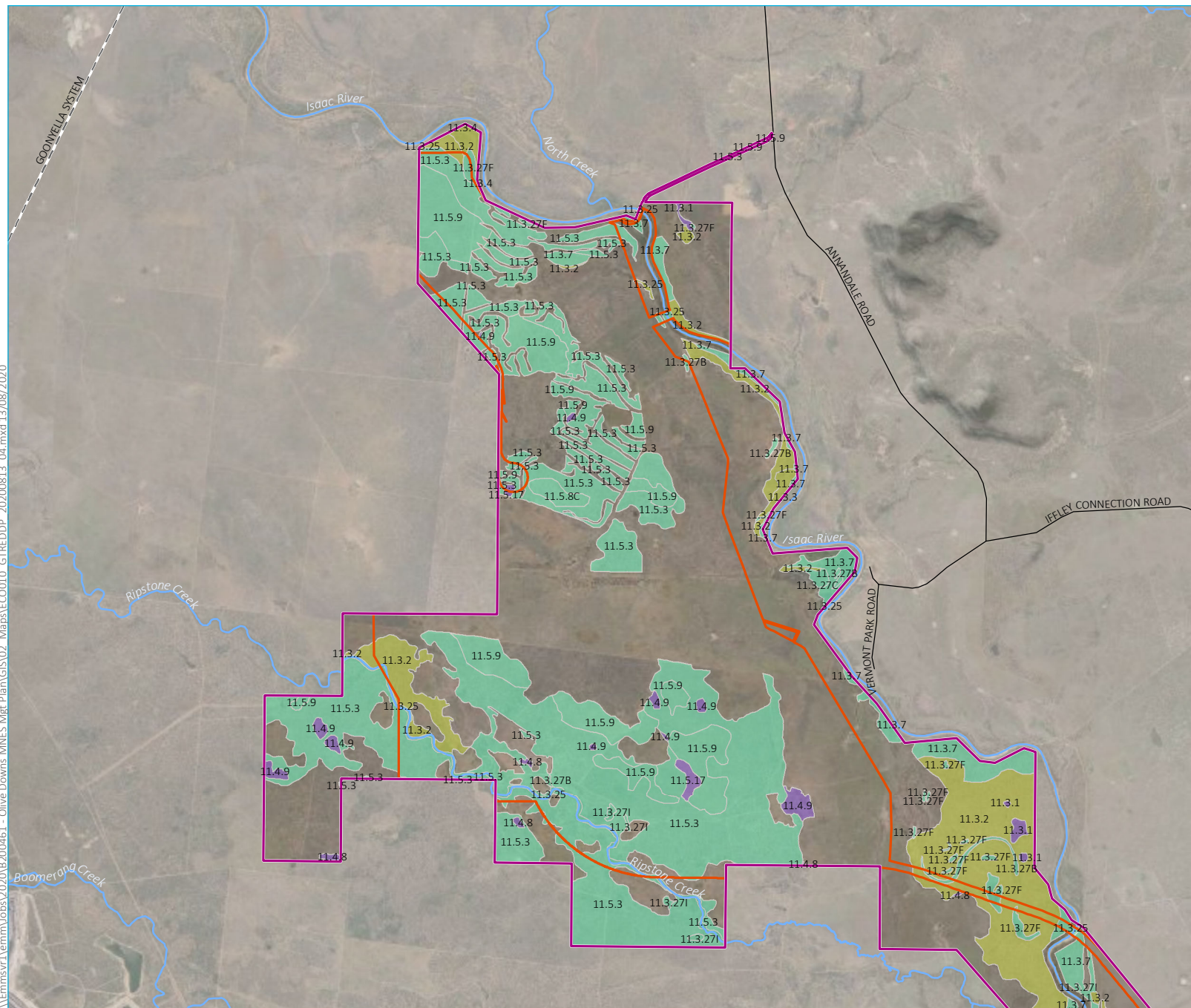
2.5 Relevant plans and guidelines

Table 2.1 lists the conservation advice, guidelines and management plans relevant to each of the MNES fauna species and TEC covered by this MMP. These documents have been reviewed in preparing the MMP to inform performance criteria (outlined in Tables 4.1, 4.2 and 4.3) and the key threatening processes to be addressed.

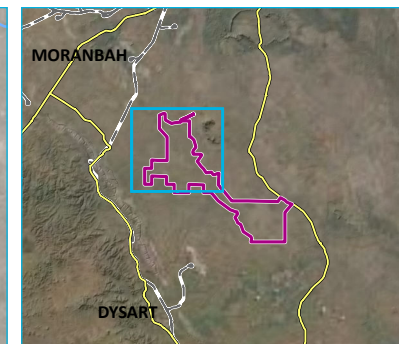
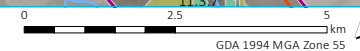
Table 2.1 Relevant conservation advice, recovery plans and threat abatement plans

MNES	Relevant conservation advice and plans	Recognised threats
Koala (<i>Phascolarctos cinereus</i>)	<ul style="list-style-type: none"> Approved Conservation Advice for <i>Phascolarctos cinereus</i>, Koala (combined populations in Queensland, New South Wales and the Australian Capital Territory), (DoE 2012) EPBC Act referral guidelines for the vulnerable koala (DoE 2014a) 	<ul style="list-style-type: none"> Habitat loss Habitat fragmentation Vehicle strike Predation by domestic or feral dogs Disease
Greater Glider (<i>Petauroides volans</i>)	<ul style="list-style-type: none"> Conservation Advice for <i>Petauroides volans</i>, Greater Glider (TSSC 2016) 	<ul style="list-style-type: none"> Habitat loss Habitat fragmentation Too intense or frequent fires Logging Barbed wire fencing (entanglement) Predation from owls Phytophthora root fungus Climate change
Squatter Pigeon (Southern) (<i>Geophaps scripta scripta</i>)	<ul style="list-style-type: none"> Approved Conservation Advice for <i>Geophaps scripta scripta</i> (Squatter Pigeon (southern)) (TSSC 2015); Threat abatement plan for predation by feral cats (DoE 2015); Threat abatement plan for competition and land degradation by rabbits (DoEE 2016); and Threat abatement plan for predation by the European red fox (DEWHA 2008) 	<ul style="list-style-type: none"> Habitat clearing Habitat degradation through overgrazing by livestock and feral herbivores such as rabbits Thickening of understorey Predation by feral cats and foxes .
Ornamental Snake (<i>Denisonia maculata</i>)	<ul style="list-style-type: none"> Approved Conservation Advice for <i>Denisonia maculata</i> (Ornamental Snake) (DoE 2014b). Draft referral guidelines for nationally listed Brigalow Belt reptiles (DSEWPac 2011c) Priority threat management for imperilled species of the Qld Brigalow Belt (Reyes et al 2016) 	<ul style="list-style-type: none"> Habitat clearing and degradation Degradation of habitat including wetland and frog habitat by feral pigs and livestock Cane toad ingestion
Australian Painted Snipe (<i>Rostratula australis</i>)	<ul style="list-style-type: none"> Approved Conservation Advice for <i>Rostratula australis</i> (Australian Painted Snipe) (TSSC 2013a) Information Sheet 	<ul style="list-style-type: none"> Loss and degradation of wetland habitat Grazing and associated trampling of wetland vegetation Replacement of native wetland vegetation by invasive weeds Predation by feral cats and foxes.
Brigalow TEC	<ul style="list-style-type: none"> Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community (TSSC 2013b) Information Sheet: Brigalow regrowth and the EPBC Act (Qld Herbarium 2003) 	<ul style="list-style-type: none"> Clearing Fire Weeds Feral animals Inappropriate grazing.

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO010 GTREDDP_20200813_04.mxd 13/08/2020



Source: EMM (2020); Pembroke (2020); DNRME (2020)



KEY

- Project area
- Stages 1-4
- Rail line
- Major road
- Minor road
- Named watercourse
- Ground-truthed regional ecosystems (VM status)
- Endangered
- Of Concern
- Least Concern

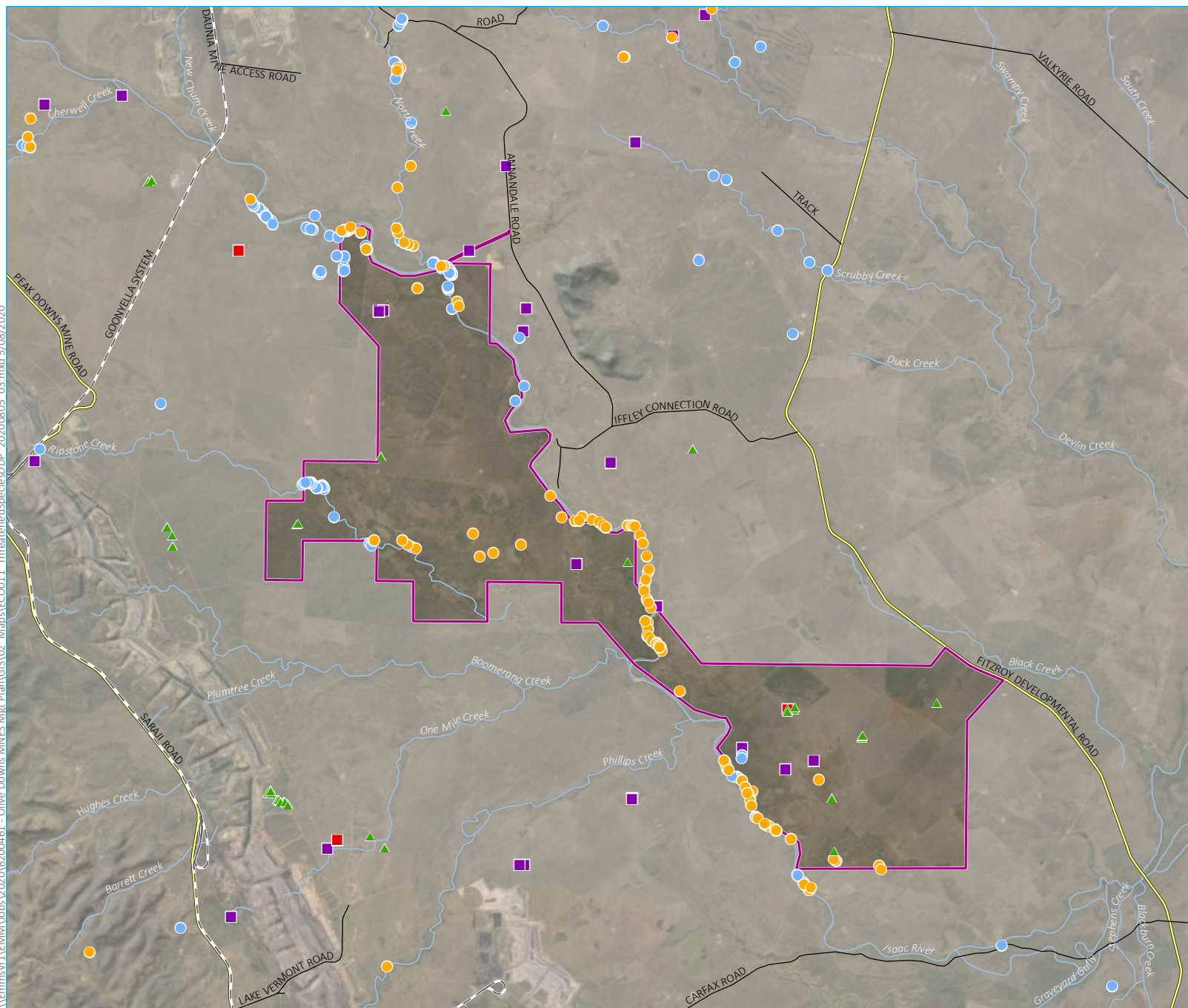
DRAFT

Ground-truthed regional ecosystems
map 1 of 2

Olive Downs
MNES management plan
Figure 2.1



\\Emmsvr1\EMM\Jobs\2020\0200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO011 ThreatenedSpecies\DP_20200805_03.mxd 5/08/2020



KEY

- Project area
- Rail line
- Major road
- Minor road
- Named watercourse

Threatend species records

Reptiles

- ▲ Ornamental Snake

Birds

- Australian Painted Snipe
- Squatter Pigeon

Mammals

- Greater Glider
- Koala

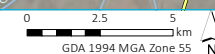
DRAFT

Threatened species records

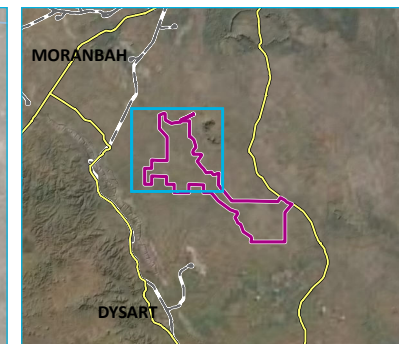
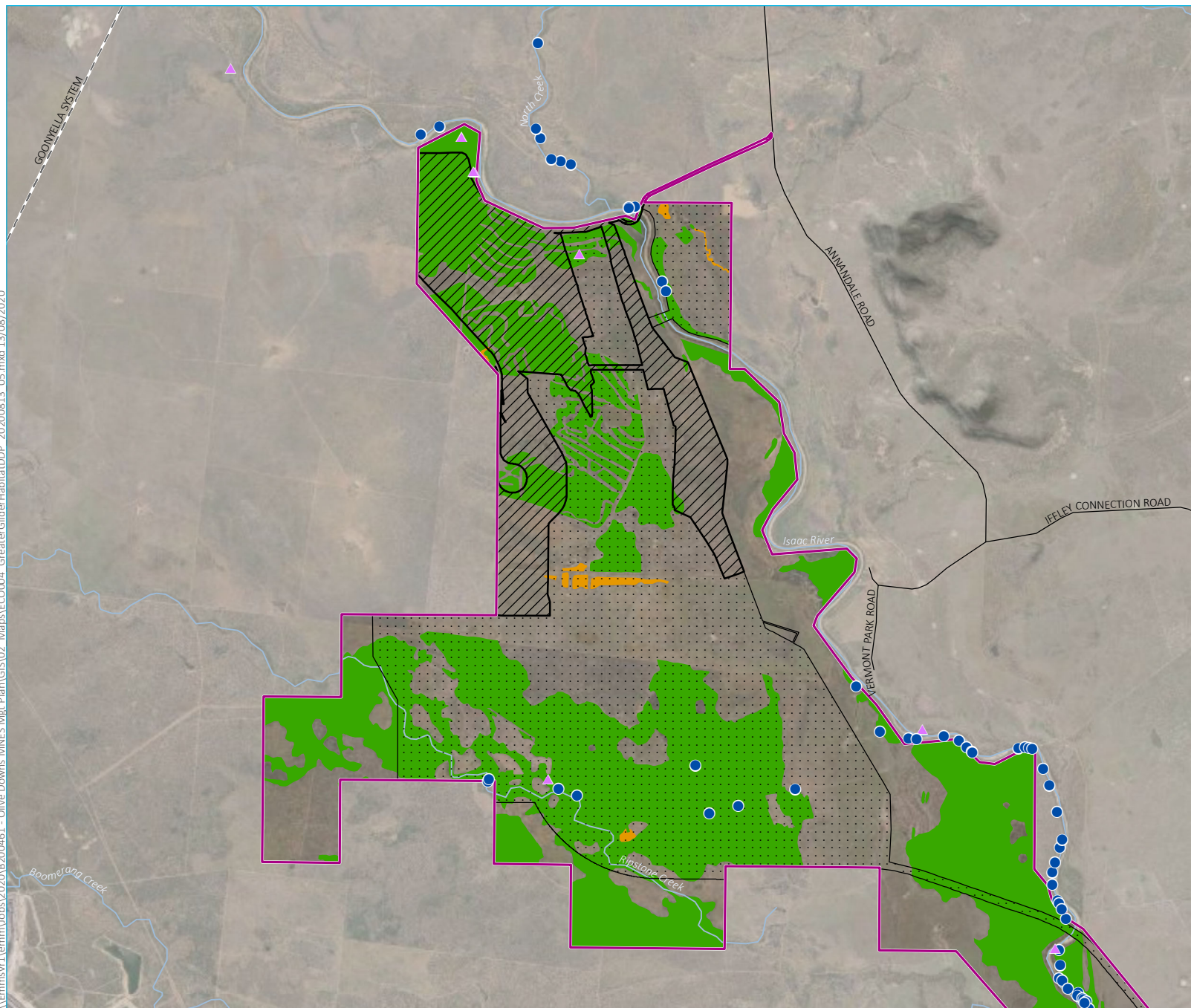
Olive Downs
MNES management plan
Figure 2.2



Source: EMM (2020); Pembroke (2020); DNRME (2020)



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO004 GreaterGliderHabitatDDP_20200813_05.mxd 13/08/2020



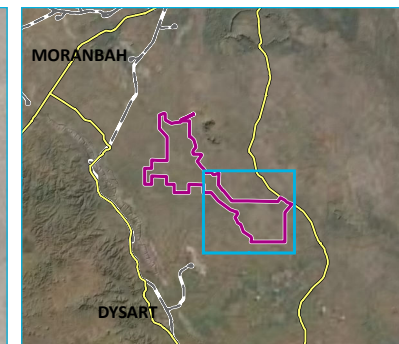
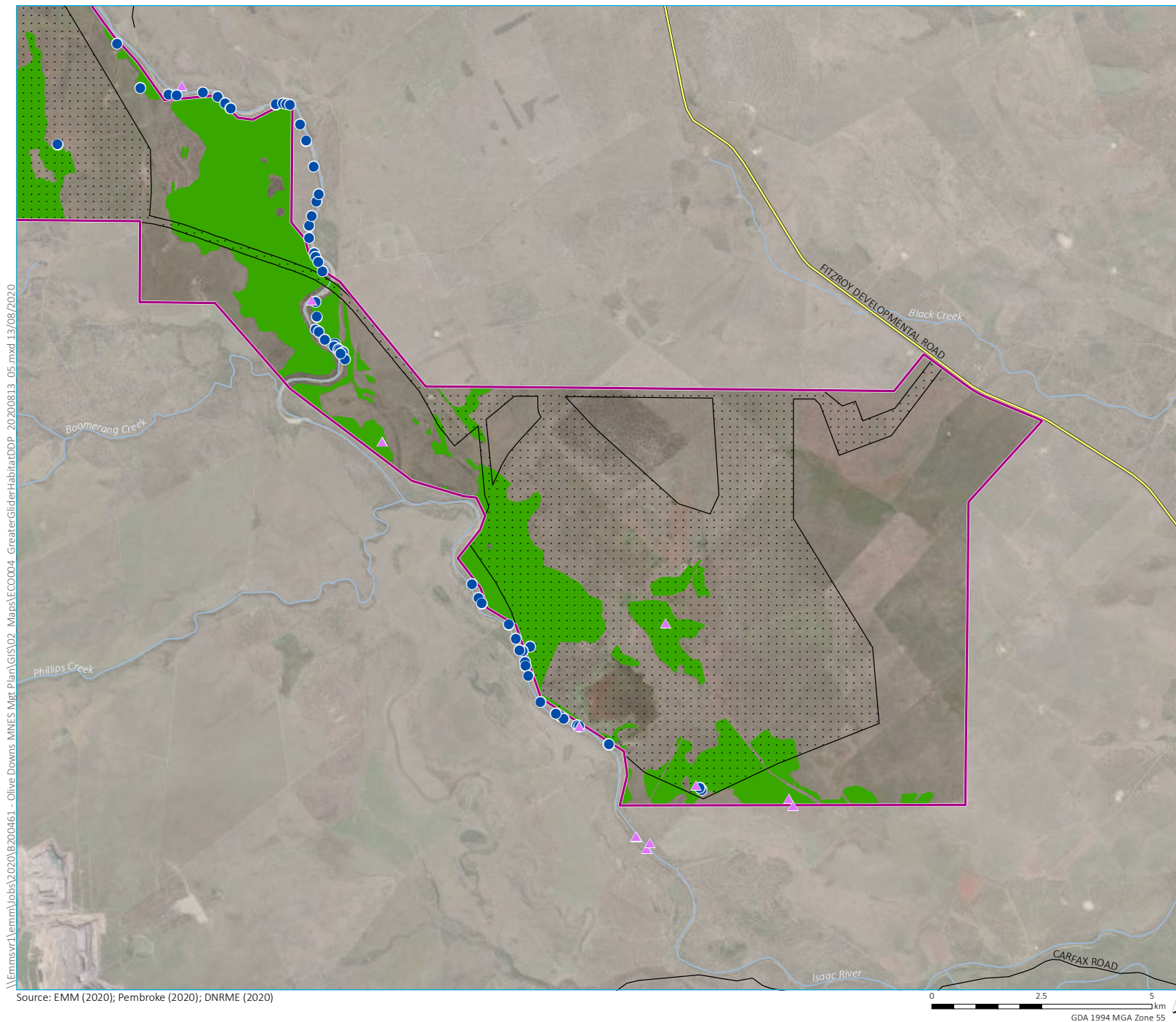
KEY

- Project area
- Stage 1 impact footprint
- Remaining impact footprint
- Rail line
- Major road
- Minor road
- Named watercourse
- Greater Glider records
- Observed
- ▲ Indirect evidence
- Greater Glider habitat
- Remnant
- Regrowth

DRAFT

Greater Glider habitat
map 1 of 2

Olive Downs
MNES management plan
Figure 2.3



KEY

- Project area
- Stage 1 impact footprint
- Remaining impact footprint
- Rail line
- Major road
- Minor road
- Named watercourse
- Greater Glider records
- Observed
- ▲ Indirect evidence
- Greater Glider habitat
- Remnant

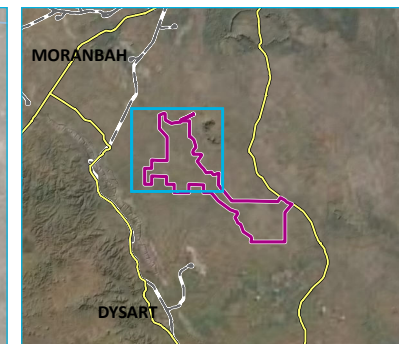
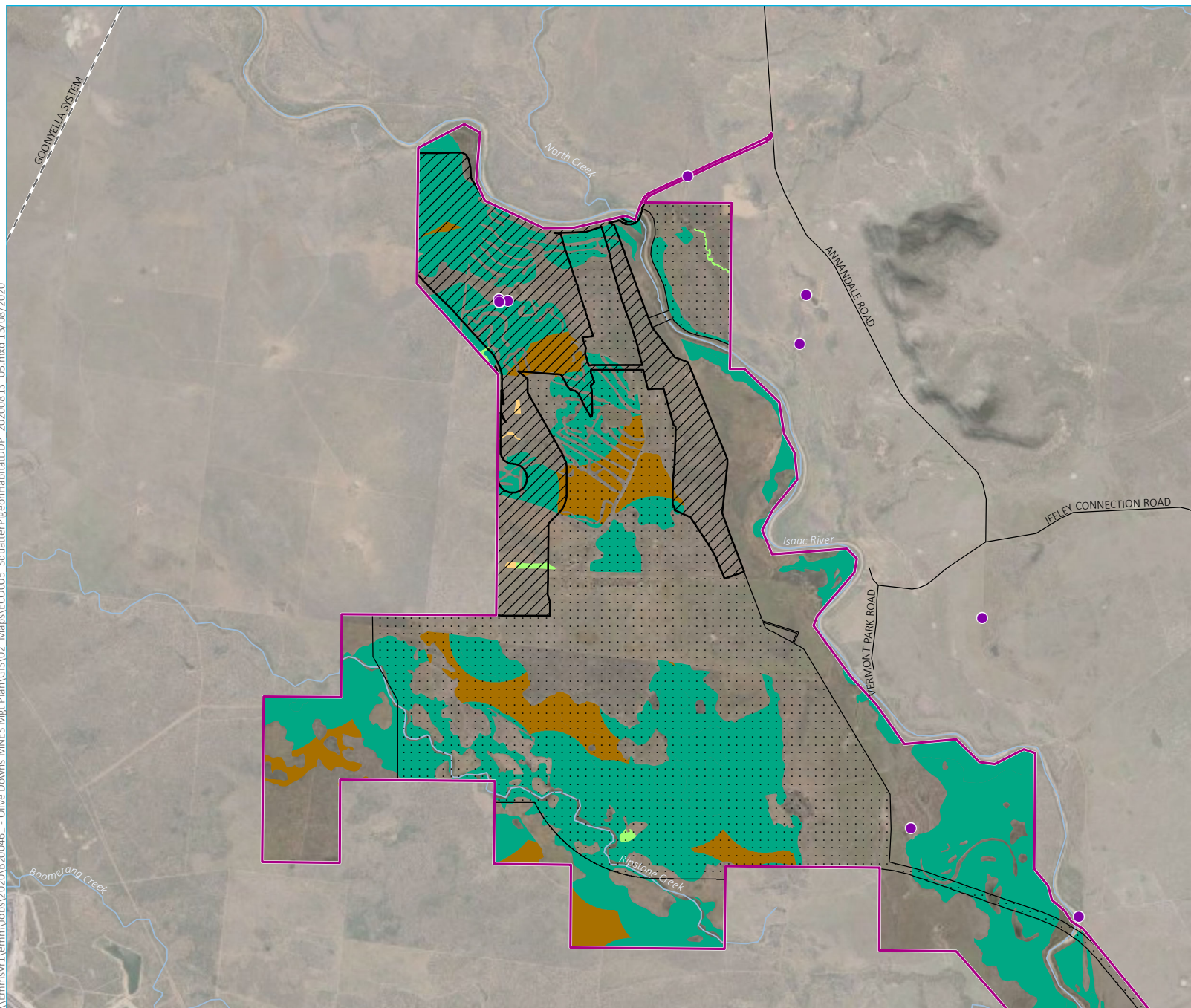
DRAFT

Greater Glider habitat
map 2 of 2

Olive Downs
MNES management plan
Figure 2.3



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNEs Mgt Plan\GIS\02 Maps\ECO005 - SquatterPigeonHabitat\DDP_20200813_05.mxd 13/08/2020



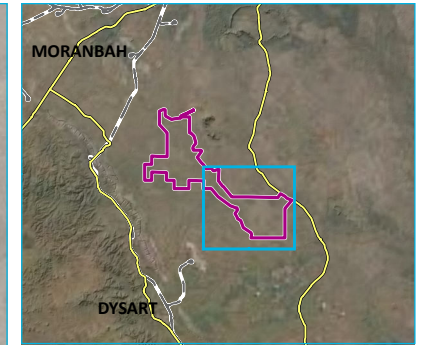
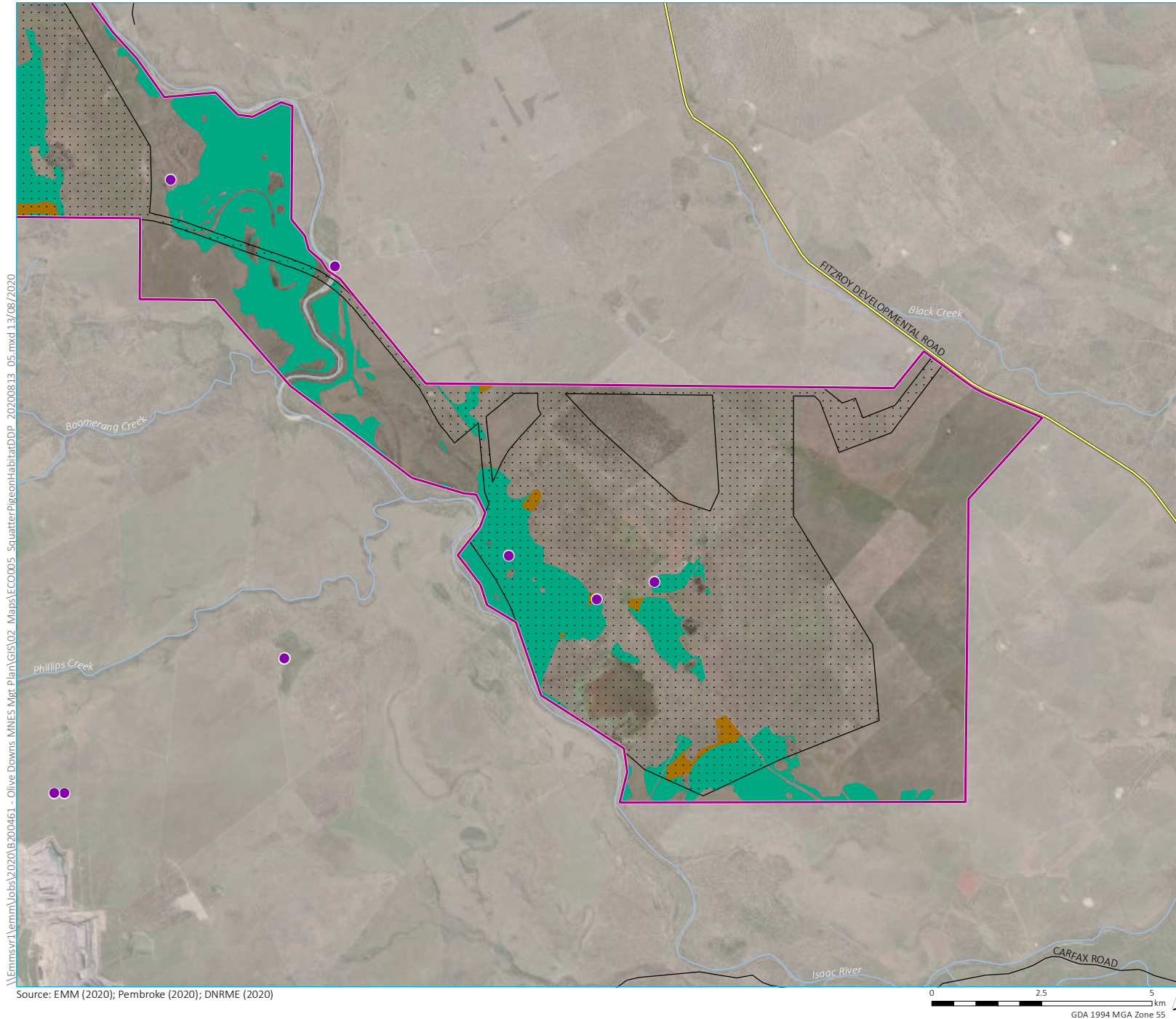
KEY

- Project area
- Stage 1 impact footprint
- Remaining impact footprint
- Rail line
- Major road
- Minor road
- Named watercourse
- Squatter Pigeon record
- Squatter Pigeon habitat**
- Breeding (remnant)
- Breeding (regrowth)
- Foraging (remnant)
- Foraging (regrowth)

DRAFT

Squatter Pigeon habitat
map 1 of 2

Olive Downs
MNEs management plan
Figure 2.4



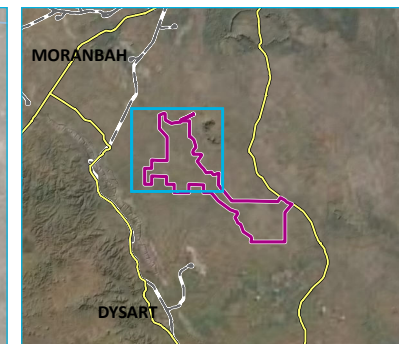
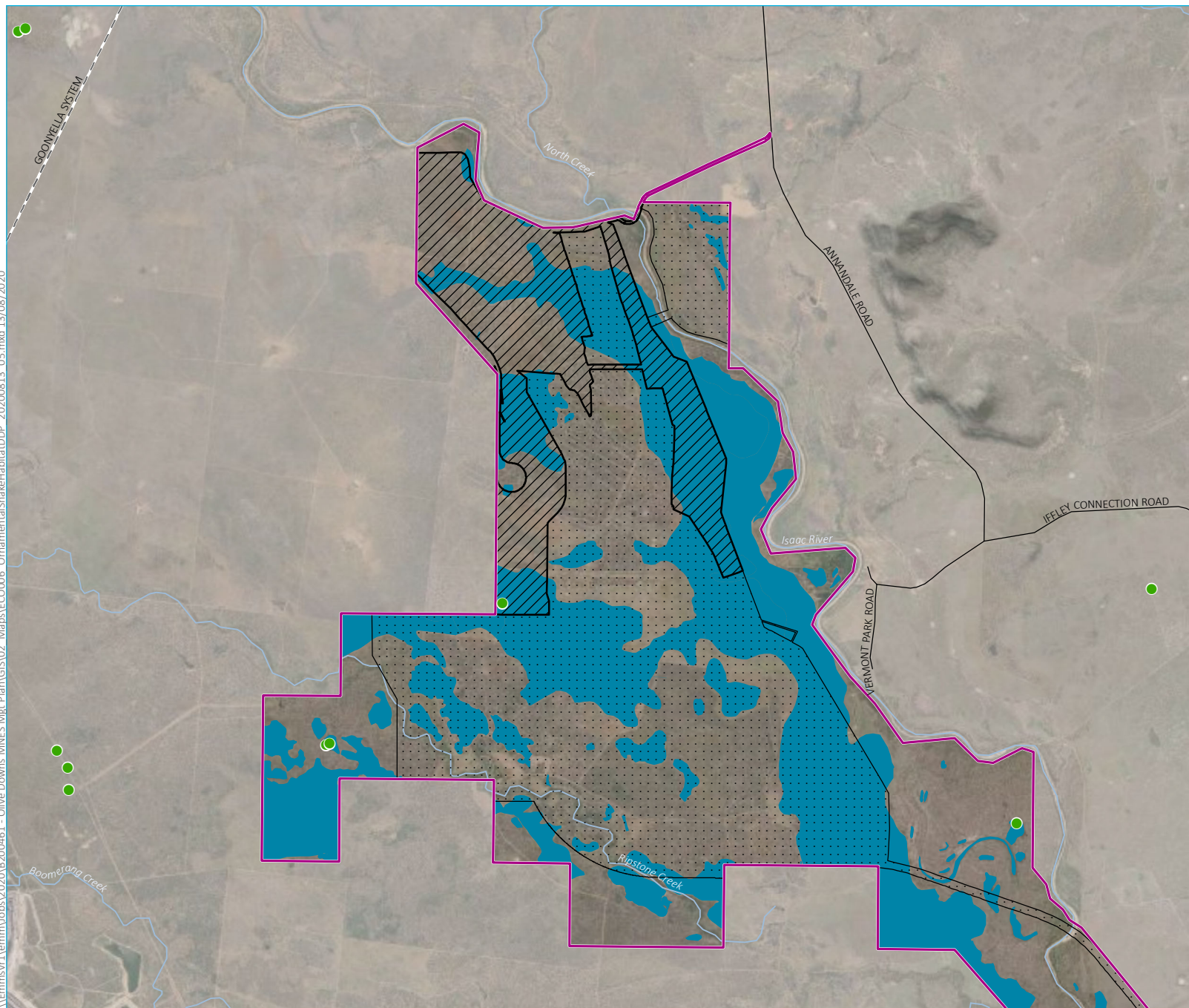
- KEY**
- Project area
 - Remaining impact footprint
 - Rail line
 - Major road
 - Minor road
 - Named watercourse
 - Squatter Pigeon record
 - Squatter Pigeon habitat
 - Breeding (remnant)
 - Foraging (remnant)

DRAFT

Squatter Pigeon habitat
map 2 of 2

Olive Downs
MNES management plan
Figure 2.4

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO006 OrnamentalSnakeHabitatDDP_20200813_05.mxd 13/08/2020



KEY

- Project area
- Stage 1 impact footprint
- Remaining impact footprint
- Rail line
- Major road
- Minor road
- Named watercourse
- Ornamental Snake record
- Ornamental Snake habitat

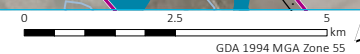
DRAFT

Ornamental Snake habitat
map 1 of 2

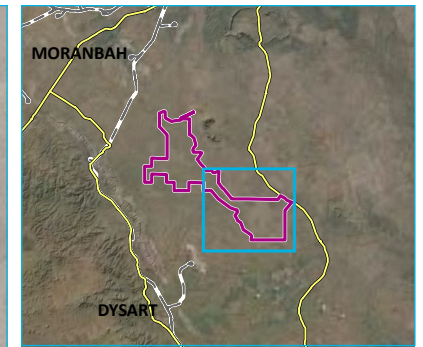
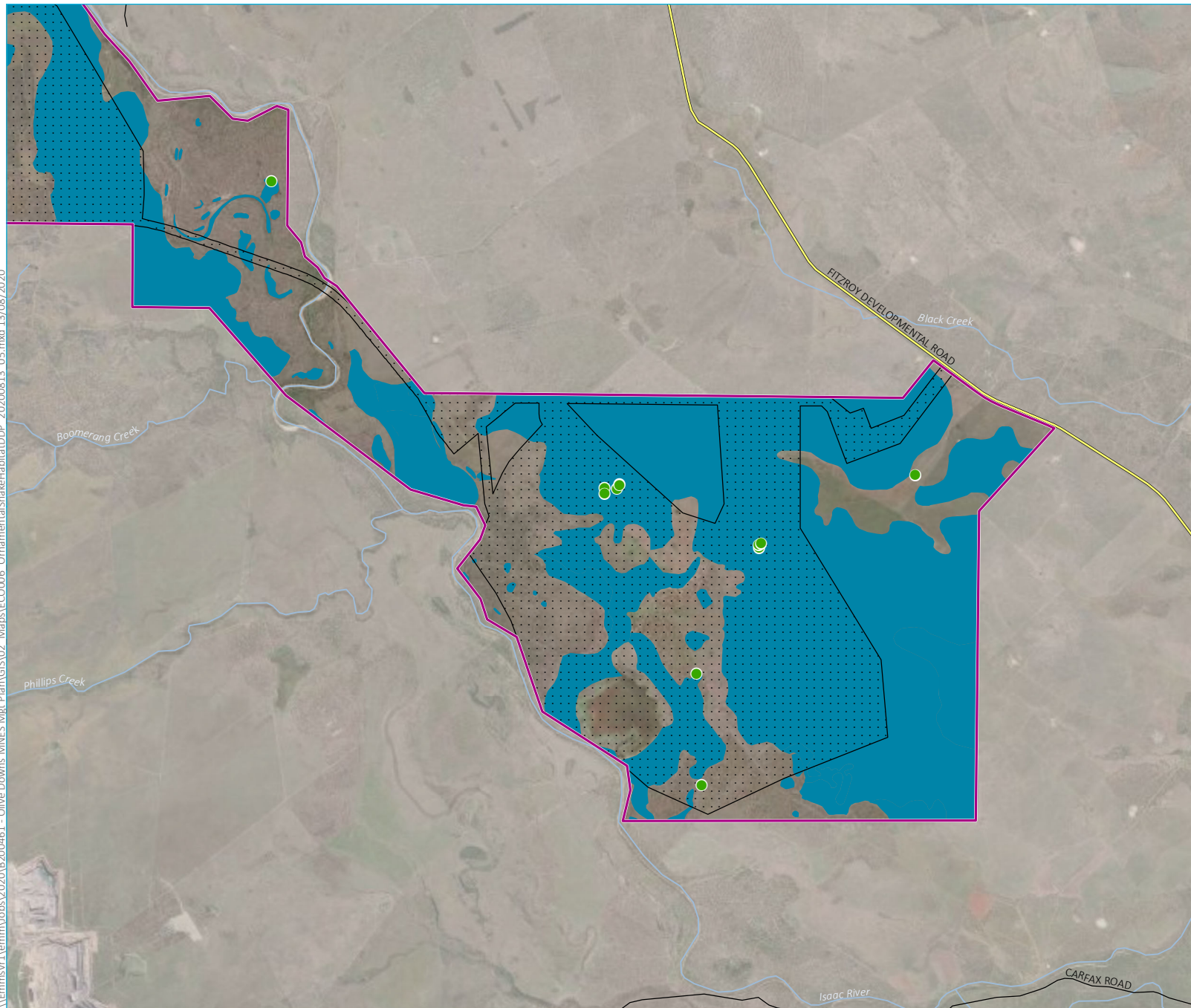
Olive Downs
MNES management plan
Figure 2.5



Source: EMM (2020); Pembroke (2020); DNRME (2020)



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\EC0006 OrnamentalSnakeHabitatDDP_20200813_05.mxd 13/08/2020



KEY

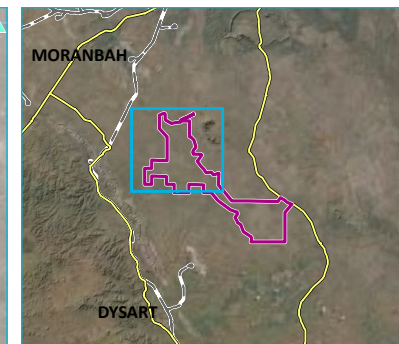
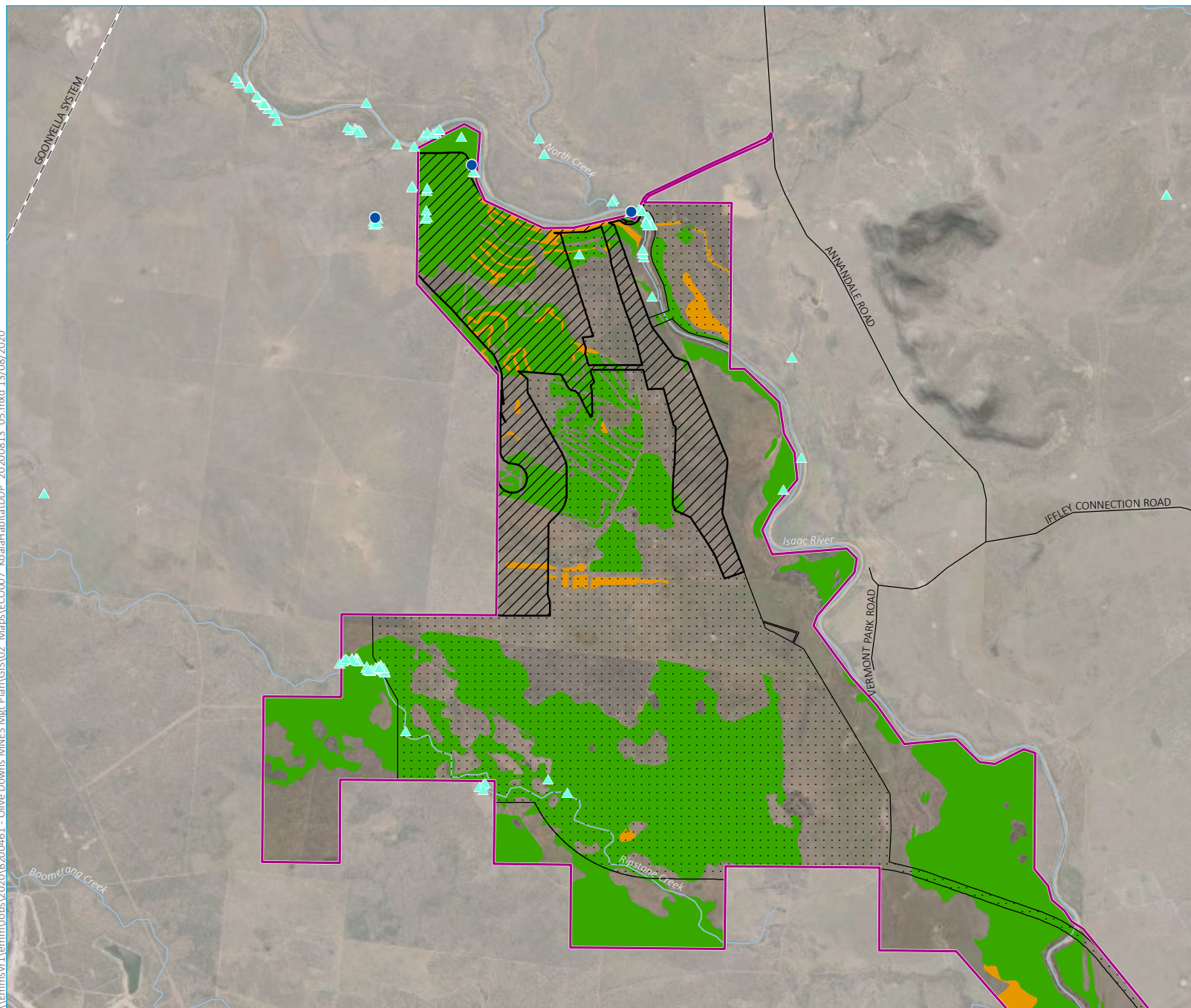
- Project area
- Remaining impact footprint
- Rail line
- Major road
- Minor road
- Named watercourse
- Ornamental Snake record
- Ornamental Snake habitat

DRAFT

Ornamental Snake habitat
map 2 of 2

Olive Downs
MNES management plan
Figure 2.5

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO007 KoalaHabitatDDP_20200813_05.mxd 13/08/2020



- KEY**
- Project area
 - Stage 1 impact footprint
 - Remaining impact footprint
 - - - Rail line
 - Major road
 - Minor road
 - Named watercourse
 - Koala records**
 - Observed
 - ▲ Indirect evidence
 - Koala habitat**
 - Remnant
 - Regrowth

DRAFT

Koala habitat
map 1 of 2

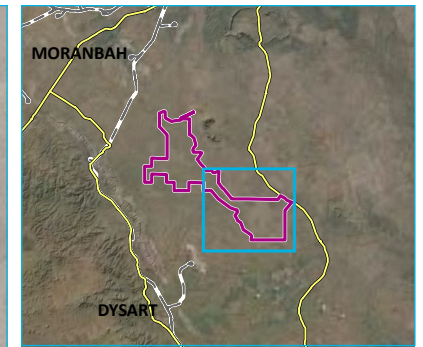
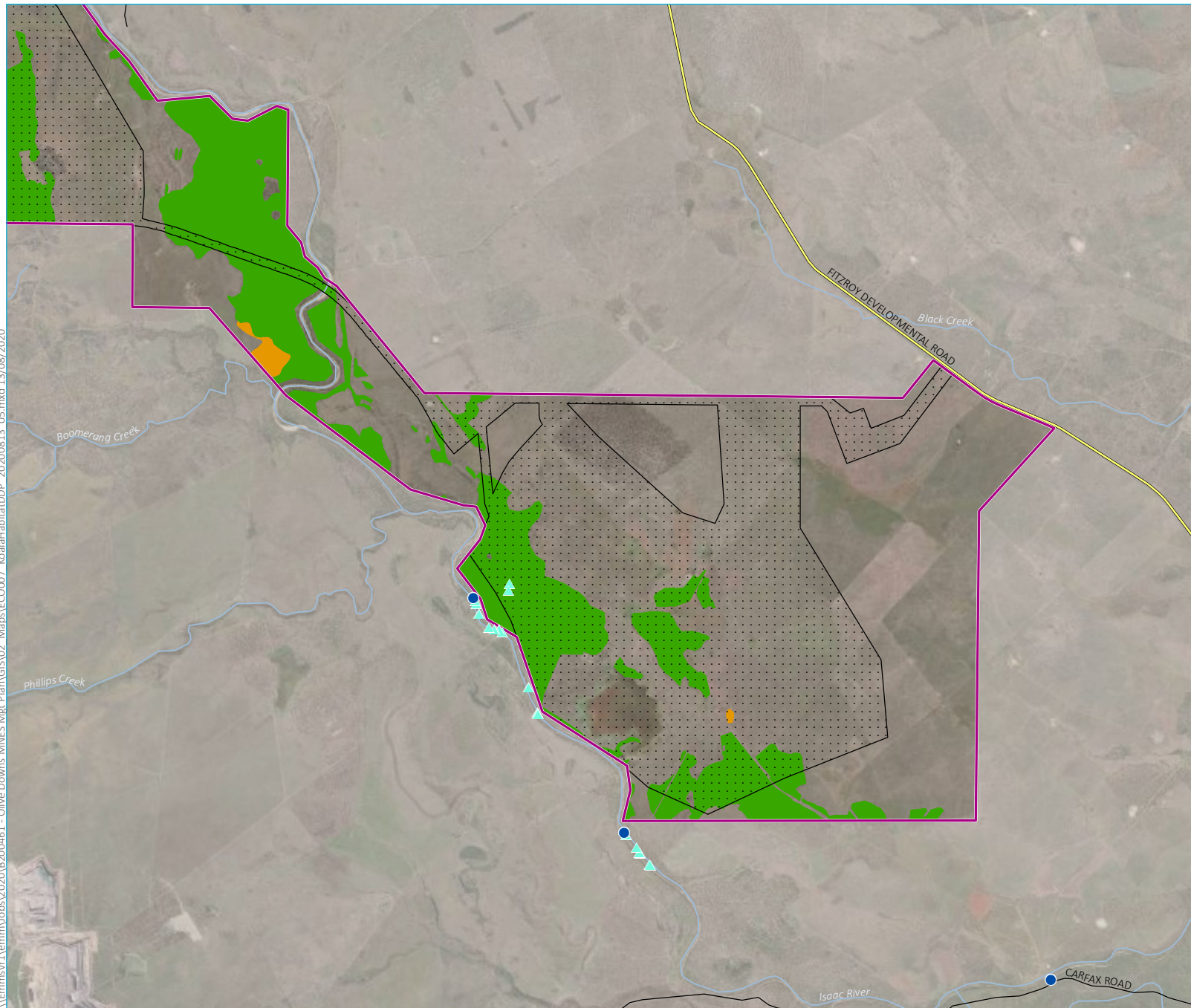
Olive Downs
MNES management plan
Figure 2.6



Source: EMM (2020); Pembroke (2020); DNRME (2020)



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO007 KoalaHabitatDDP_20200813_05.mxd 13/08/2020



KEY

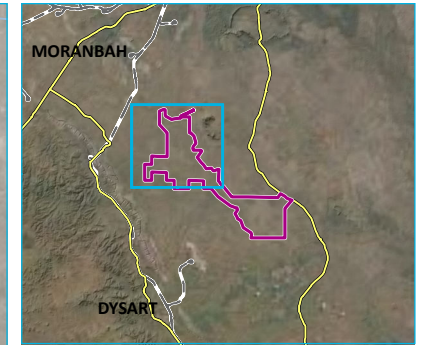
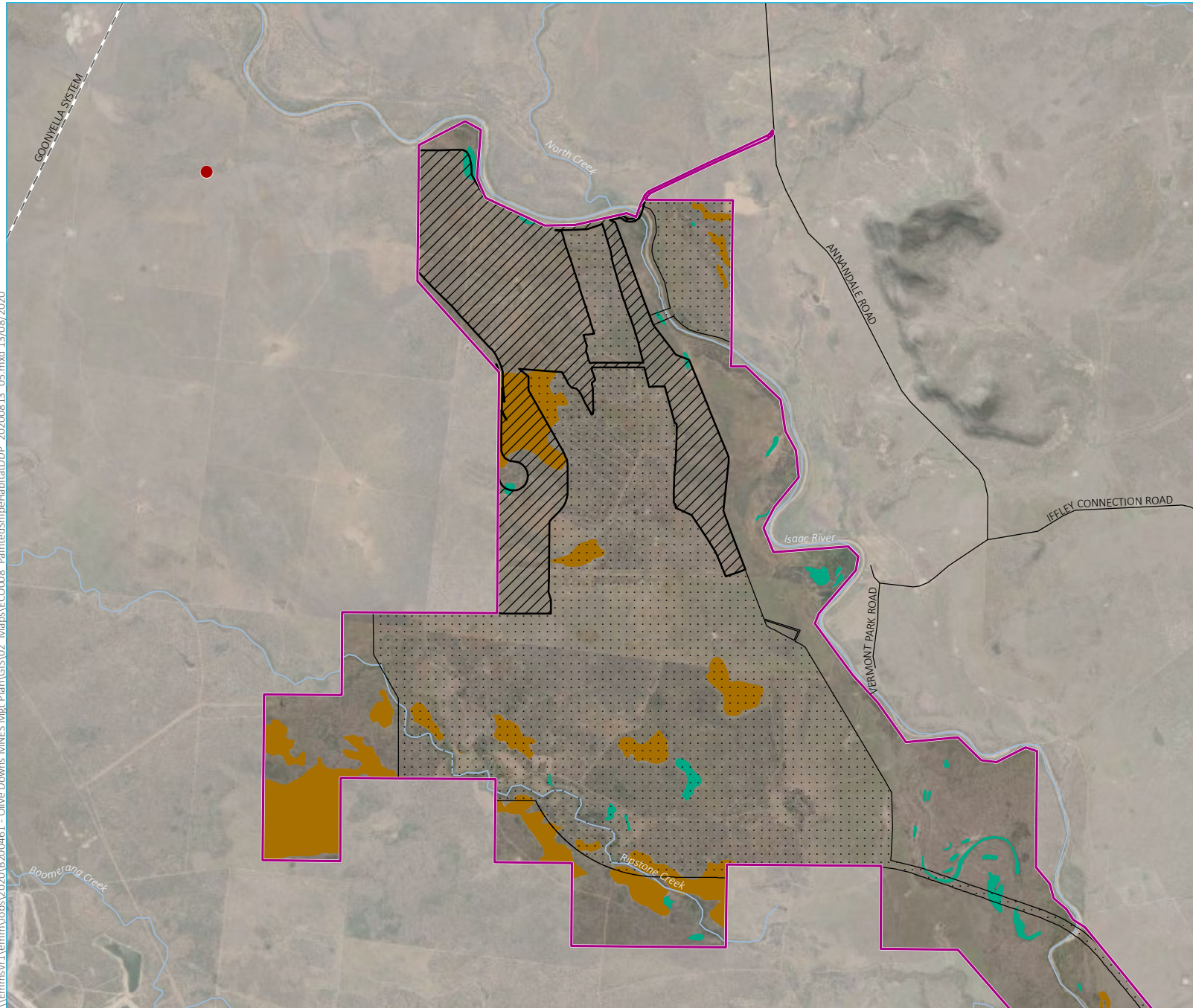
- Project area
- Stage 1 impact footprint
- Remaining impact footprint
- Rail line
- Major road
- Minor road
- Named watercourse
- Koala records**
- Observed
- ▲ Indirect evidence
- Koala habitat**
- Remnant
- Regrowth

DRAFT

Koala habitat
map 2 of 2

Olive Downs
MNES management plan
Figure 2.6

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO008 PaintedSnipeHabitatDDP_20200813_05.mxd 13/08/2020



KEY

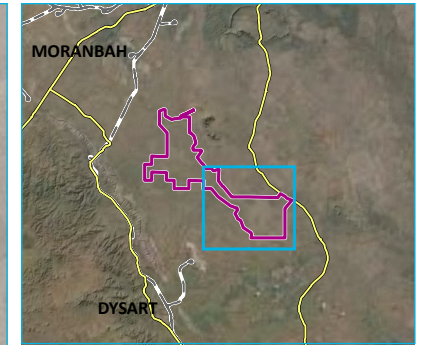
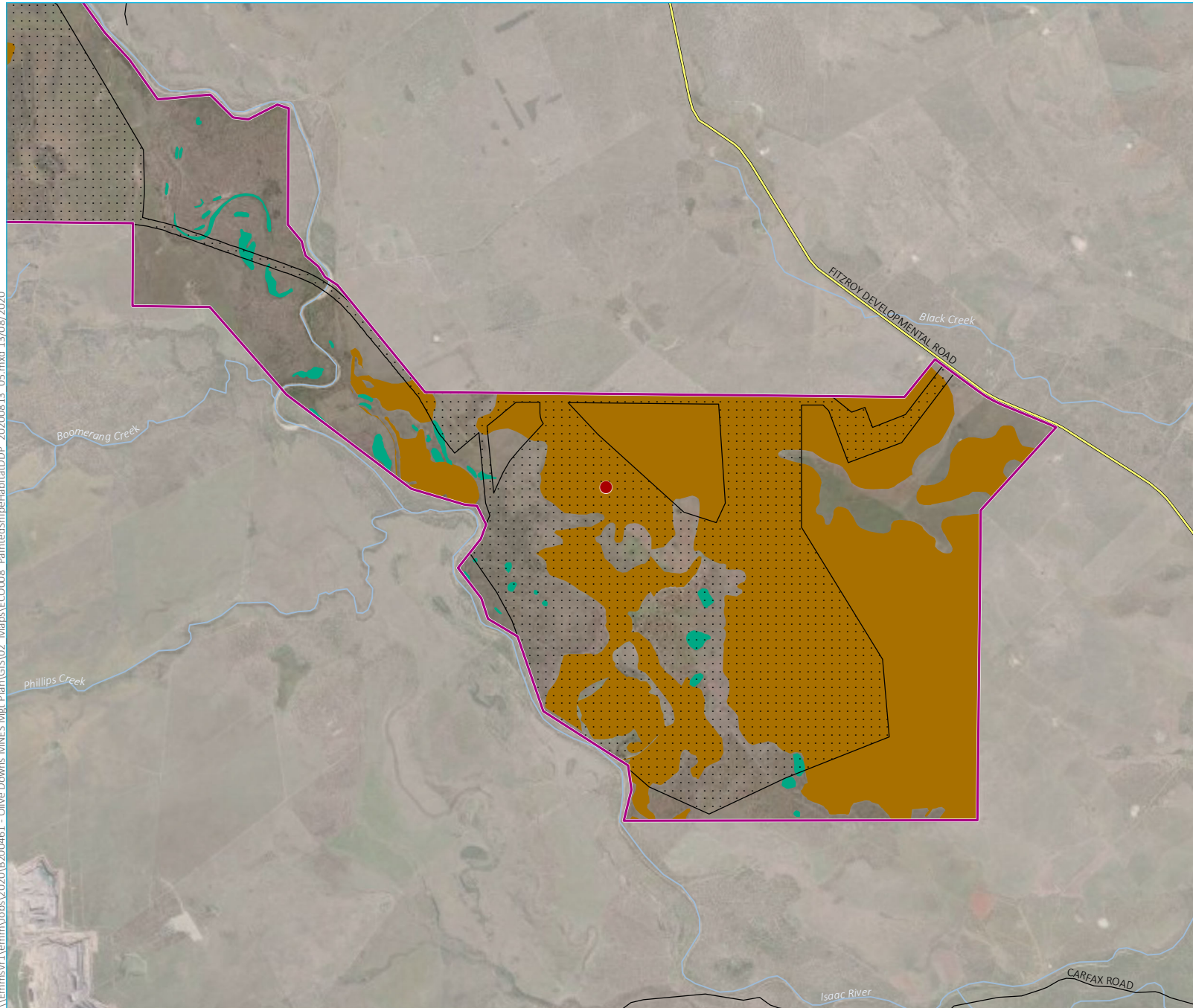
- Project area
- Stage 1 impact footprint
- Remaining impact footprint
- Rail line
- Major road
- Minor road
- Named watercourse
- Australian Painted Snipe record
- Australian Painted Snipe habitat
- Breeding
- Foraging

DRAFT

Australian Painted Snipe habitat
map 1 of 2

Olive Downs
MNES management plan
Figure 2.7

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\EC0008 PaintedSnipeHabitatDDP_20200813_05.mxd 13/08/2020



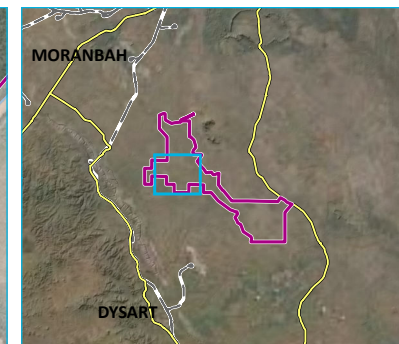
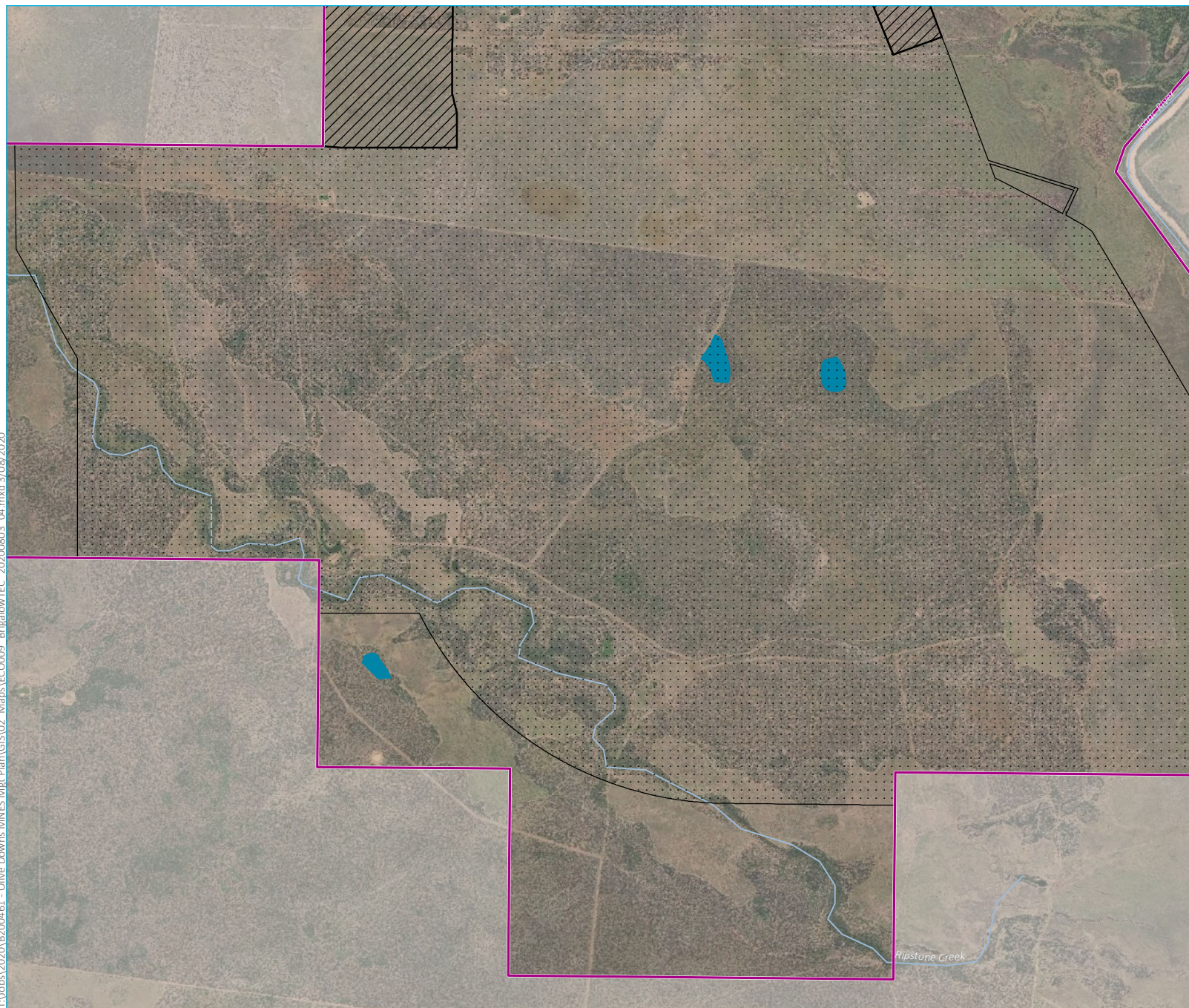
- KEY**
- Project area
 - Remaining impact footprint
 - Rail line
 - Major road
 - Minor road
 - Named watercourse
 - Australian Painted Snipe record
 - Australian Painted Snipe habitat**
 - Breeding
 - Foraging

DRAFT

Australian Painted Snipe habitat
map 2 of 2

Olive Downs
MNES management plan
Figure 2.7

T:\jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO009 BrigalowTEC 20200803 04.mxd 3/08/2020



- KEY
- Project area
 - Stage 1 impact footprint
 - Remaining impact footprint
 - Rail line
 - Major road
 - Named watercourse
 - Brigalow TEC

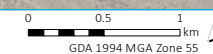
DRAFT

Brigalow TEC

Olive Downs
MNES management plan
Figure 2.8



Source: EMM (2020); Pembroke (2020); DNRME (2020)



3 Impacts to MNES

This section of the MMP describes the potential impacts that may occur to the prescribed MNES (listed in Section 1.4) as a result of the Project. Potential impacts may come from direct impacts (such as vegetation clearing, vehicle strike) or indirect impacts (such as weeds, increased noise and lighting). Impacts have the potential to occur in all Project phases being; clearing phase, construction, operation and decommissioning.

Below is a summary of the potential direct and indirect impacts that could occur to MNES as a result of the Project.

3.1 Direct impacts

3.1.1 Vegetation clearance and habitat loss

The Project will progressively establish infrastructure on the site and commence open cut mining. Development and operation of the mine will be completed over four stages over a mine life of 79 years and vegetation clearing will occur progressively.

The Project area is a total of approximately 26,164 ha and within that approximately 8,761 ha is remnant vegetation. Within all four stages up to approximately 5,771.50 ha of native vegetation will need to be cleared for the Project to establish infrastructure, access roads and open cut mining activities. Stage 1 will require the clearing of 1,100.50 ha of remnant and regrowth vegetation over a period of 18 to 24 months. Clearing for Stage 1 is anticipated to commence in mid-2021.

Impacts to threatened fauna species as a result of clearing may include:

- potential for individual species to be injured or killed during vegetation clearing;
- loss of habitat thereby requiring individuals to mobilise from the area and find new breeding and/or foraging habitats; and
- fragmentation of habitat reducing a species ability to move between habitats in the local area and region.

i Approved staged clearance and MNES impact limits

The approved extent of clearing MNES habitat for each Project stage is summarised in Table 3.1. The areas of MNES habitat within the approved disturbance areas are shown in Figure 2.3 to Figure 2.8.

Table 3.1 Approved disturbance limits (ha) for MNES across the mine site and access roads

MNES	Stage 1 (ha)	Stage 2 (ha)	Stage 3 (ha)	Stage 4 (ha)	Total (ha)
Koala (<i>Phascolarctos cinereus</i>) (combined populations of Qld, NSW and the ACT) habitat	1,110.50	367.50	3,939.50	354	5,771.50
Greater Glider (<i>Petauroides volans</i>) habitat	978.50	303	3,937	389	5,607.50
Squatter Pigeon (Southern) (<i>Geophaps scripta scripta</i>) breeding habitat	855	216.5	3,100	372	4,543.50
Squatter Pigeon (Southern) (<i>Geophaps scripta scripta</i>) foraging habitat	135.50	68	656.50	6.50	866.50

Table 3.1 **Approved disturbance limits (ha) for MNES across the mine site and access roads**

MNES	Stage 1 (ha)	Stage 2 (ha)	Stage 3 (ha)	Stage 4 (ha)	Total (ha)
Ornamental Snake (<i>Denisonia maculata</i>) important habitat	1,032	298	5,109	1,307	7,746.00
Australian Painted Snipe (<i>Rostratula australis</i>) breeding habitat	16	3	70	25	114.00
Brigalow TEC	0	0	13	0	13.00

Pembroke will record and report on the extent of vegetation clearing each year as part of annual reporting, and at the end of each stage a final report will be issued to DAWE showing final disturbance footprints for all MNES including spatial files. Monitoring is summarised in Section 6, and reporting Section 7.

3.1.2 Vehicle strike

Vehicles and trucks coming into the Project area, and moving within it (such as trucks and vehicles on mine haul roads) have the potential to result in fauna mortality. Road mortality has been implicated in the decline of wildlife populations, including species of conservation significance (Taylor & Goldingay 2004; Rowden, Steinhardt & Sheehan 2008). Koalas and gliders are known to be particularly susceptible to vehicle strike when attempting to cross road corridors whilst migrating between areas of habitat (DEHP 2012).

The rail spur that comes into the Project area may also have potential to impact on fauna species if individuals are able to get onto the railway corridor and be hit by the coal trains. The Project rail corridor has been located through areas of relatively low habitat value, i.e. primarily agricultural grasslands and regrowth vegetation. The frequency of services, the speed of the trains and rail embankment height indicates that the likelihood of incidents of fauna strike is low (DPM Envirosciences 2018).

Vehicle strike has the potential to occur in all Project phases as there will be vehicles and machinery during vegetation clearing, construction, operation and decommissioning. Larger truck movements will be greatest during the operational phase.

3.1.3 Predation from pest animals

Field surveys recorded the presence of a variety of exotic fauna (i.e pest animals), including species identified as restricted matters under the Queensland *Biosecurity Act 2014*, namely:

- cane toad (*Rhinella marina*);
- wild cat (*Felis catus*);
- dog (*Canis lupus familiaris*);
- hare (*Lepus europaeus*);
- European rabbit (*Oryctolagus cuniculus*);
- house mouse (*Mus musculus*); and
- feral pig (*Sus scrofa*).

Most pest animal species are assumed to have resident populations in the Project area and surrounds, though their abundance is likely to vary with the seasons. Pest species threaten populations of native wildlife in two main ways:

- direct predation (for example by foxes, cats and dogs). The Greater Glider, Squatter Pigeon, Ornamental Snake, Australian Painted Snipe and Koala all suffer from predation to varying degrees and predation is listed as a threat in their respective species EPBC Act conservation advice.
- competition for limited resources (rabbits, rodents and feral pigs); and
- habitat degradation such as feral pigs in gilgai and wetland habitats.

The mine activities have the potential to increase feral animal populations as there will be an increase in disturbance which may make it easier for feral animals such as feral cats and wild dogs to predate on wildlife, and mine personnel may leave food and/or rubbish that attract feral species to the site such as wild dogs, foxes and cats. Koalas will incur increased susceptibility to predation whilst dispersing from habitat being cleared, or whilst attempting to return to habitat that has been cleared. Pest animals have the potential to impact on MNES threatened fauna species during all Project phases.

3.2 Indirect Impacts

3.2.1 Weeds

Declared pest plants under the Qld *Biosecurity Act 2014* were recorded within the Project area during field inspections. Key weed species observed were:

- Rubbervine (*Cryptostegia grandiflora*);
- Harrisia Cactus (*Harrisia martini*);
- Bellyache Bush (*Jatropha gossypifolia*)
- Lantana (*Lantana camara*);
- Creeping Lantana (*Lantana montevidensis*);
- Common Pest Pear (*Opuntia stricta*);
- Velvety Tree Pear (*Opuntia tomentosa*);
- Parkinsonia (*Parkinsonia aculeata*);
- Parthenium (*Parthenium hysterophorus*);
- Freweed (*Senecio madagascariensis*); and
- Prickly Acacia (*Vachellia nilotica* subsp. *indica*).

With the exception of Harrisia Cactus, each of these introduced species is also listed as a weed of national significance (WoNS).

Exotic flora species are concentrated in areas suffering some form of disturbance, mostly clearing for cattle grazing (DPM Enviroscience 2018). The EPBC Act lists weed invasion as a 'key threatening process' to biodiversity due to the impact on wildlife and the landscape (DAWE 2020d). During clearing and construction there would be the

potential for disturbing weeds in the Project area from disturbance to vegetation and soil resulting in the movement of weeds within and outside of the Project area. This could increase the level of infestation in the Project locality and potentially facilitate the spread of weeds to adjacent areas.

Reduction of food resources and cover from the establishment and maintenance of buffel grass pastures have been identified as a threat to the Squatter Pigeon (southern) (DAWE 2020a) and is often seen to increase in response to disturbance (TSSC 2015). Weeds have the potential to degrade the condition of fauna habitat, compete with regenerating native flora species and increase fuel loads thereby increasing intensity of bushfires. Weeds such as lantana can reduce fauna species ability to move through areas such as Koalas or vines that get a hold in riparian communities can impact on species ability to utilise these areas. Aquatic weeds also have potential to degrade wetlands which is an impact to Australian Painted Snipe.

Weeds have the potential to impact on MNES threatened fauna species and Brigalow TEC during all Project phases.

3.2.2 Pest animal habitat degradation

A number of pest animals have the ability to degrade the condition of MNES habitats and are a recognised threat for a number of target threatened species.

The main identified threat to the Ornamental Snake is a continued legacy of past broadscale land clearing and habitat degradation. Destruction of wetland habitat by feral pigs is also a threat, along with the associated destruction of frog habitat and direct competition for their food source (frogs) (DoE 2014b).

Rabbits are a recognised threat to Squatter Pigeon. Their preferred habitats of open grassy woodland can be degraded due to overgrazing by feral herbivores such as rabbits (TSSC 2015).

3.2.3 Noise and vibration

During construction and operation of the Project there will be activities that will increase noise levels from the current baseline. At present there would be some noise that comes from agricultural activities in the local area but these are generally low and during the day. Noise levels will be increased from vegetation clearing operations, topsoil stripping, blasting of overburden and interburden, ROM coal mining and transport, coal handling and processing, overland conveyors and site rehabilitation. As the mining operation will be 24hrs, 7 days a week there is potential for threatened fauna species to be affected by noise in particular nocturnal species such as Greater Glider and Koalas due to their sensitivity to noise (DPM Envirosiences 2018).

The Project will result in ongoing and localised increases in noise and vibration disturbance in habitats that occur directly adjacent to these areas. The extent of this impact would depend on the distance between the activities and the adjacent habitat, the level of noise emanating, the type of habitat (dense forest is more resilient) and the hours of operation.

Noise impacts have potential to occur in all Project phases due to the range of activities that will occur over the life of the mine. Vegetation clearing and construction phases are likely to have increased noise levels only during the day while the operational phase will have elevated noise levels both during the day and night, as well as blasting activities.

3.2.4 Artificial lighting

Impacts to fauna associated with artificial lighting are expected to include avoidance of lit areas and disturbance to activity levels (particularly for birds and amphibians). Some species may be attracted to lit areas. For example, insectivorous bats may be attracted to swarming insects that congregate around lit areas at night. The Project would result in an increase in the use of artificial lighting within the Project locality (DPM Envirosiences 2018).

Artificial lighting is only likely to be an issue during the operational phase and decommissioning phase. Night work will not occur during vegetation clearing or construction phases.

3.2.5 Dust

Dust settling on native vegetation has potential to impact on growth and health of the plant. Excessive dust build up may also impact on micro-habitats such as gilgai which support Ornamental Snake. Dust levels may be increased due to haul roads being used in dry conditions where native vegetation close to the road could be impacted, or stripping of top soil and clearing of vegetation also has the potential to increase dust levels in that area. Dust is generally a localised and temporary impact. Rainfall can also help remove dust from vegetation, reduce dust coming up from dirt roads and increases ground cover which also helps minimise dust.

Dust has the potential to impact on MNES threatened fauna species habitats and Brigalow TEC during all Project phases.

3.2.6 Fire

A fire starting in the Project area may be caused by sparks originating from machinery, or an accident (such as a collision), scheduled burns getting out of control, hot works, spontaneous combustion of coal or from operators and personnel dropping matches or cigarette butts in the Project area where it can create a bushfire.

Too frequent fires, or intense bushfires have potential to kill wildlife, degrade or result in loss of habitat and foraging resources. Over time fire can also alter the structure of vegetation communities. Brigalow TEC is particularly vulnerable to hot fires and fire is a recognised threat. Brigalow may be killed by fire (Benson et al. 2006), although in Queensland only high intensity fires kill the root systems (Johnson 1964). A number of tree and shrub species that live in Brigalow communities are susceptible to hot fires.

Too intense or frequent fires is a recognised threat to Greater Glider. Population loss or declines have been documented in and after high intensity fires (Lindenmayer et al. 2013). Fire has the potential to impact on MNES threatened fauna species and Brigalow TEC during all Project phases.

3.2.7 Impact summary

A summary of the main impacts with potential to occur to MNES as a result of the Project that will be addressed in the MMP (and the relevant Project phase) is provided in Table 3.2.

Table 3.2 Summary of potential impacts to MNES

Impacts	Potential impacts to MNES	Impacted MNES	Applicable project phase
Vegetation clearing/habitat loss	Removal of vegetation that provides foraging and/or breeding habitat for a threatened species and ecological communities. Injury or death during clearing.	All	Clearance
Habitat fragmentation	Reduction in ability for threatened MNES species to disperse to adjacent habitat and move safely through the area	Squatter Pigeon, Ornamental Snake, Koala, Greater Glider, Australian Painted Snipe	All phases
Habitat degradation from feral animals	Loss of food resources and habitat degradation can occur from feral animals (i.e. wild pigs and rabbits).	Squatter Pigeon and Ornamental Snake	All phases

Table 3.2 Summary of potential impacts to MNES

Impacts	Potential impacts to MNES	Impacted MNES	Applicable project phase
Introduced plants	Dispersal of weeds throughout the Project area by vehicles, machinery, and people leading to habitat degradation. Weeds can also increase fuel load increasing likelihood of hot fires.	All	All phases
Predation by invasive fauna	Loss of individuals to predation by European Foxes, Feral Dogs and Feral Cats, which are known to increase in abundance around human habitation in dryland areas. Food waste attracting fauna pests to the Project Area. Cane toads are poisonous to Ornamental Snake.	Koalas, Squatter Pigeon, Ornamental Snake, Australian Painted Snipe	All phases
Noise and vibration	Loss of useable habitat in, and adjacent to, the Project Area due to noise and vibration disturbance.	All fauna. Particularly Koalas and Greater Glider due to being nocturnal.	All phases (predominantly construction and operation)
Air quality and dust	Dust deposition may impact on vegetation near to dust sources such as dirt access roads and during vegetation clearing if conditions are dry. Dust may reduce habitat quality such as gilgai.	All	All phases
Light	Loss of useable habitat in and adjacent to the Project Area due to light disturbance at night.	Greater Glider, Australian Painted Snipe, Ornamental Snake and Koala	Construction, operation, decommissioning
Vehicle strike	Mortality and injury from vehicle strike, due to an increased number of vehicles, machinery and access routes.	Squatter Pigeon, Ornamental Snake, Koala, Greater Glider	All phases
Erosion and sedimentation	Increased erosion of disturbed surfaces and increased sedimentation of waterways. Severe erosion can alter surface water flows and local hydrological regimes.	All	All phases (predominantly vegetation clearing and construction)
Fire	Fires can start from machinery, activities occurring on site and/or personnel. Fire may get into adjacent bushland being retained and result in loss or degradation of habitat and foraging resources. Increase in fuel load can increase the chance of bushfires occurring and their intensity. Hot bushfires can cause temporary and permanent losses of habitats such as hollows, fallen woody debris and Brigalow communities. They can also result in injury/mortality of threatened fauna species.	All	All phases

4 MNES management measures

A range of measures will be implemented to avoid, mitigate and manage direct and indirect impacts on the listed threatened fauna species and ecological community identified in Table 3.2. These measures may be specific to a particular Project phase, or will be implemented over the life of the Project as it is applicable to all Project phases.

Planning and management of disturbances for the proposed Project were assessed taking into consideration a set of hierarchical management principles as outlined in State and Commonwealth offset policies, that are designed to firstly avoid impacts, then mitigate and manage impacts to the environmental values.

This MMP has been developed considering these management principles (in order of preference) with relevance to impacts on MNES:

- Avoidance: Avoiding direct and indirect adverse impacts where possible through Project design;
- Mitigate: Mitigating direct and indirect adverse impacts where impacts cannot be avoided through actions to reduce likelihood or severity of impacts occurring such as modifying design (eg designing river crossings to allow fauna movement, glider rope crossings, employing specialist clearing and construction methods, reducing vehicle speed limits);
- Manage: Implement management actions to prevent or reduce impacts occurring such as weed and feral animal control, fire management. These actions are often over a longer timeframe;
- Remediation and rehabilitation: Actively and progressively remediate and rehabilitate impacted areas to promote and maintain long-term recovery; and
- Provide offsets: Pembroke are delivering environmental offsets for significant, residual impacts to MNES which are addressed in a separate Offset Strategy and offset management plan in accordance with the EPBC Act approval conditions.

4.1 MNES management measures

EMM has summarised the proposed avoidance, mitigation and management measures by Project phase and clearly identified:

- performance criteria;
- action to be undertaken;
- how it will be done;
- where it will be implemented in relation to the MNES and/or habitat and impact/action;
- when it will be implemented in relation to the impact/action, the Project stage and where relevant time of year and at what frequency/duration; and
- who is responsible for taking that action.

4.2 SMART principles

All MNES management measures have been developed to be consistent with S.M.A.R.T principles which are:

- **Specific** – prescriptive, with no uncertainty or ambiguity around their purpose or implementation.
- **Measurable** – the status (i.e. success or failure) and outcomes/results can be measured.
- **Achievable** – through the chosen method of implementation, by the responsible personnel and within the specified timeframe.
- **Relevant** – to the action/impact being controlled and to the protected matter.
- **Time bound** – have a timeframe for implementation.

4.3 Adaptive management

The implementation of this Offset Plan will use an adaptive management framework.

Adaptive management includes two key phases:

- establishment of the key components of a management framework including engaging stakeholders, developing clear and measurable objectives and performance criteria, identification and selection of potential management actions and the development of monitoring protocols which enable the evaluation of progress towards achieving objectives, and which will effectively contribute to the adaptive management decision making process; and
- an iterative learning phase which involves utilisation of the management framework to learn about the natural resource system and iteratively adapt management strategies and approaches based on what is learned (Williams & Brown 2016).

If a performance criteria or interim target has not been achieved, corrective actions will be implemented. Where there is uncertainty as to the cause of the management trigger (e.g. failure to achieve the interim performance target), the event or circumstance triggering corrective action will be reviewed, and management actions in this MMP may be revised accordingly.

4.3.1 Vegetation clearing phase

Table 4.1 Avoidance, mitigation and management measures for vegetation clearing phase

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Avoidance					
Ensure clearing of native vegetation and/or disturbance to MNES habitats does not occur outside of the approved disturbance limits for each stage (detailed in Table 3.1 of this MMP).	All	<p>Clearly identify the approved boundaries for vegetation clearing and disturbance under EPBC approval prior to any works occurring for that stage. Exclusion zones will also be clearly marked. This may be done via temporary fencing, signage, flagging tape and barricades.</p> <p>Clearing areas identified are to be inspected by an authorised Pembroke representative prior to clearing commencing to ensure they are accurate.</p> <p>Internal training will occur for all personnel involved in the vegetation clearing phase to ensure they are aware of the approved works areas, the requirements they need to meet, and sensitivity of the area for threatened species and communities.</p>	The approved disturbance areas for each stage as illustrated in Figure 1.3 and Figure 2.3 - Figure 2.8 for each MNES.	Prior to any vegetation clearing occurring for that stage.	Pembroke Site Manager
Where practical, retain areas of MNES habitats and/or mature, large trees, hollow-bearing trees or large stags as potential nesting and roosting habitat.	All	<p>When finalising areas required for the mine and associated infrastructure, identify where there may be opportunities to reduce clearing and retain individual trees with high ecological value or habitats such as gilgai. This would only be appropriate where the trees and/or habitat are situated on the boundaries of the site near other retained vegetation, and wildlife can safely utilise these areas.</p> <p>The trees or habitats to be retained are to be clearly marked and approved by the Pembroke Environmental Manager.</p>	Within approved disturbance areas for each stage as illustrated in Figure 1.3 and Figure 2.3 - Figure 2.8 for each MNES.	Prior to any vegetation clearing occurring for that stage.	Pembroke Environmental Manager
Maintain and protect a 200 m riparian buffer along Isaac River (Figure 4.1).	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>No works or vegetation clearing will occur within 200m from the Isaac River except for approved river crossings. This riparian corridor will be an exclusion zone and clearly identified on site plans.</p> <p>If there are any works proposed near the riparian buffer exclusion zone bollards will be constructed to ensure no</p>	Riparian areas along Isaac River and approved river crossings are shown in Figure 4.1.	During all Project phases	Pembroke Site Manager Pembroke Environmental Manager

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
		<p>impacts occur to the riparian vegetation or river. Fencing will be kept to a minimum during clearing so that fauna can access the riparian corridor as it is known to support MNES including Koalas and Greater Glider populations.</p> <p>Implement sediment and erosion control measures in accordance with an approved Sediment & Erosion Control Plan to minimise sediment runoff into Isaac River.</p> <p>Isaac River crossings to be limited to those specified within the EPBC approval which are:</p> <ul style="list-style-type: none"> • clearance of one corridor, a max. of 45m in width for the conveyor crossing (Figure 4.1); and • clearance of two corridors, a max. of 60m in width for two road crossings including haul road to eastern waste rock emplacement (Figure 4.1). <p>Maintain and manage the Isaac River riparian buffer for weeds and feral animals to allow natural regeneration of vegetation communities, reduce threats on MNES and maintain ecological condition.</p> <p>Remove and exclude grazing from the Isaac River riparian buffer.</p> <p>Refer Section 5 for further detail on weed and feral management actions.</p>			
Mitigation					
Identify potential fauna species utilising the site and locate release sites and micro-habitat to be salvaged.	All	<p>Suitably qualified ecologists will conduct pre-clearance surveys. A key purpose will be to identify all hollow-bearing trees and other habitat features such as nests, burrows, fallen logs. Any habitat features to be salvaged will be clearly marked and GPS location recorded.</p> <p>A report will be produced post survey summarising the number of hollows recorded, the size and number of hollows in each tree, and their GPS location.</p> <p>Pre-clearance surveys will also include conducting targeted surveys to identify presence of threatened</p>	Within the approved clearing area for each stage as shown in Figure 1.3.	At least 3 weeks prior to clearing commencing in a designated area.	Suitably qualified ecologists with experience in undertaking targeted surveys for these MNES species and pre-clearance surveys for threatened species in particular Koalas,

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
		<p>species in the area including Koalas, Greater Glider and Ornamental Snake. This will include spotlighting to increase detectability of the species over a number of consecutive nights. Further detail for each species is outlined below.</p> <p><u>Greater Gliders</u></p> <p>As Greater Gliders are dependent on large, hollow bearing trees for a sheltering/denning resource, nocturnal and diurnal pre-clear surveys will be conducted to identify and locate all potential Greater Glider habitat trees.</p> <ul style="list-style-type: none"> • Nocturnal pre-clear surveys will involve spotlighting/stag watching commencing at dusk to confirm Greater Gliders are present in the clearing area generally, and also to assist in determining which tree/s they are actively utilising. • Greater Gliders have been recorded emerging from their dens 35 minutes after dusk (Lindenmayer et al. 1999) with another study revealing emergence time after sunset ranged between 18-227 minutes (Smith et al. 2007). This highlights the importance of conducting spotlighting and stag watching surveys at this time to ensure active habitat trees can be identified. • Due to Greater Gliders utilising multiple tree hollow dens in different trees, replication of the nocturnal surveys will be conducted to provide the highest likelihood of identifying all greater glider habitat trees. A minimum of three consecutive nights will be surveyed. For example, Comport et al. (1996) found Greater Gliders in North Queensland utilised 4-6 different dens in any one month with one or two dens being occurred most frequently while Smith et al. (2007) found up to 20 different dens were used by individuals animals within their home range. 			Greater Glider and Ornamental Snake.

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
		<ul style="list-style-type: none"> • All identified and suitable hollow-bearing habitat trees located during spotlighting surveys will be recorded with a GPS and clearly identified with pink fluorescent flagging tape. Suitable hollow-bearing trees will be identified using the following key attributes: <ul style="list-style-type: none"> – alive/dead myrtaceous trees or dead non-myrtaceous trees over 30 cm diameter at breast height (DBH) (Smith et al. 2007); possessing – hollows with a diameter greater than 8 cm (Gibbons & Lindenmayer 2002) and at least 8 metres from the ground (Maloney 2007). <p><u>Koalas</u></p> <p>For Stage 1, Koalas will be surveyed prior to clearing and a tracking program will be implemented using radio-tracking collars. The purpose is to identify the number of Koalas that may be utilising the Stage 1 clearing area, where they are during clearing to avoid impacts on them, and gain other useful information about Koalas in the Project area and their movement post clearing as to where they establish new home ranges. Further detail is provided in Section 5.2.7.</p> <p><u>Ornamental Snake</u></p> <p>Spotlighting will occur in mapped areas of Ornamental Snake habitat. Spotlighting will occur over three consecutive nights to determine if the species are present. Prior to clearing commencing a fauna spotter catcher will survey the area the night prior and attempt to capture Ornamental Snake that may be out foraging. They will then be released that night to adjacent suitable habitats which are being retained outside of the Project stages.</p> <p><u>Pre-clearance survey methods</u></p>			

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
		<p>Diurnal pre-clear surveys will be conducted in conjunction with the nocturnal surveys and will use the following sequence:</p> <ul style="list-style-type: none"> • Clearing area clearly demarcated both on ground and in map form. Demarcation on the ground will be either temporary fencing/bunting or fauna exclusion fencing depending on whether vegetation adjacent to the clearing area will be retained. • Pre-clearance surveys will be conducted by suitably qualified ecologists/wildlife spotter-catchers. All trees within the clearing area will be thoroughly searched and all large trees that contain obvious or suspected hollows with an entrance diameter equal to or greater than 5-10cm large, hollow bearing trees will be recorded with a GPS and clearly identified with pink fluorescent flagging tape. Basic tree data will also be recorded at this time including tree species, if the tree is alive or dead, approximate DBH and number of hollows. • While some tree hollows may be obvious from the ground, not all may be clearly observed due to constraints such as the tree height and dense foliage obstruction the view. In such instances, if hollows cannot be clearly seen but are suspected of occurring in potential habitat trees for Greater Gliders, these tree will also be recoded as above. • Recorded GPS and tree data will be mapped and distributed to all relevant personnel involved in clearing operations. This data can then be used to assist in co-ordinating clearing operations i.e. • Identify and record GPS location of micro-habitats for salvage (ie naturally formed hollows, large fallen logs, trees for use as millable timber). • Identify suitable areas for fauna relocation in adjacent areas providing suitable habitat for the species. 			

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
		Suitable recipient sites for Greater Gliders and Ornamental Snake will be identified and GPS recorded. These will be areas that are close to the Project, that provide suitable habitat and will not be cleared in the future for the Project. They will also be areas in which nest boxes (suitable for Greater Glider) are to be installed prior to clearing. Further detail on nest boxes is provided in Section 0.			
Injuries or mortality to Koalas are avoided and mitigated during clearing through implementation of a monitoring program.	Koala	<p>Monitoring of Koalas using radio-tracking is proposed prior to clearing, during clearing and post clearing for Stage 1. Through such monitoring, the definitive locations of all monitored Koalas will be known during the vegetation clearing process. This will allow project ecologists/fauna spotter-catchers and other on ground personnel to modify clearing activities in areas where Koalas have been identified and therefore, no monitored Koalas will be overlooked during the clearing process. It will also help to understand a range of other Koala population information such as:</p> <ul style="list-style-type: none"> • The health of individual Koalas with Koalas in poor health to be taken to a local vet/wildlife carer for treatment; • Areas of habitat Koalas are using and for how long; • Sex, estimated age and if they have young; • Their movement corridors both on the Project area and adjacent areas. <p>Further detail on Koala tracking and monitoring prior to, during and post clearing is provided in Section 5.2.7.</p>	Koalas to be tracked will come from the proposed Stage 1 clearing area.	<p>Koala monitoring will commence during pre-clearance surveys at least 3-4 weeks prior to clearing commencing to allow sufficient data be recorded relating to regular activity areas and movement.</p> <p>While monitoring during clearing is the most important component in order to fulfil the objective of not injuring or killing Koalas during the clearing process, monitoring is also essential to determine the fate of Koalas post clearing. It is proposed Koalas are monitored for at least 3 months post clearing to determine where they move to after clearing, survival rates and where they may settle. Previous studies have shown Koalas may take months to establish a new home range following impacts (i.e.</p>	<p>Pembroke Environmental Manager</p> <p>Suitably qualified ecologists with experience in Koala tracking and appropriate permits in place.</p>

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
				clearing/translocation) and some individuals may travel long distances before settling.	
Retain habitat features for rehabilitation.	All	<p>During pre-clearance surveys micro-habitats for salvage will be identified.</p> <p>Some large tree hollows will be salvaged and put into identified recipient sites. Recipient sites will include areas that have suitable foraging habitat for Greater Glider and some existing hollows, as well as areas of suitable habitat with no hollows. They will also be areas to be retained by the Project and include areas in the proposed Stage 1 offset. Further detail on nest box installation is provided in Section 0.</p> <p>Fallen woody debris, large rocks etc will be moved to adjacent habitats.</p>	Within approved clearing areas and selected recipient sites.	<p>Habitat features to be salvaged will be identified during pre-clearance surveys.</p> <p>Movement of salvaged items to occur during clearing phase.</p>	<p>Suitably qualified ecologists to identify values for salvage.</p> <p>Pembroke Environmental Manager</p>
Salvage native seeds for rehabilitation.	All	<p>Native seed will be collected (where available) prior to clearing occurring.</p> <p>The seed will be appropriately stored and used for future rehabilitation.</p>	Within approved clearing areas and more broadly within the Project area (focusing on vegetation in seed) at different times of year.	Seed collection to occur in areas prior to clearing.	Third party contractor with appropriate permit for seed collection.

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Supplement Greater Glider breeding habitat with nest boxes.	Greater Glider	<p>During pre-clearance surveys Pembroke will record all tree hollows that are of suitable size for Greater Glider. Post completion of the pre-clearance surveys Pembroke will replace each Greater Glider hollow cleared with nest boxes on a 1:1 basis.</p> <p>The nest boxes will be a combination of plywood, polyethylene (recycled plastic) and natural hollows that were salvaged. This will allow for trials to be done as to whether Greater Glider prefer a certain type of nest box. They will be installed using the Habisure system.</p> <p>The nest boxes will be installed in trees via an elevated work platform, over 6m from the ground. Further detail on nest box program is provided in Section 0.</p> <p>Nest boxes will be placed into suitable Greater Glider habitat adjacent to clearing areas along Isaac River that will not be impacted by the Project and will actively be managed over life of the Project.</p>	<p>Agreed recipient sites.</p> <p>Potential recipient habitat for Greater Glider nest boxes is shown in Figure 4.1.</p> <p>Final locations are to be validated during pre-clearance surveys.</p>	<p>50% of required nest boxes will be installed prior to clearing commencing.</p> <p>50% of required nest boxes will be installed during clearing phase with is 12-18 months for Stage 1.</p>	Suitably qualified ecologists and third party contractor to install Greater Glider nest boxes.
Ensure all site personnel are trained and aware of MNES.	All	<p>All site personnel (including sub-contractors) will be inducted on the potential threatened species and TEC and sensitive environmental areas occurring within the Project area. Training will include inductions, toolbox talks, pre-starts and targeted training as required. Topics will include, but not be limited to, the two stage habitat removal process, clearing limits, no go zones, fauna descriptions and handling procedures. All site personnel working in the Project area will be informed of exclusion zones in place and where they occur.</p> <p>All site personnel will be required to sign the induction form to state they have read and understand all relevant material.</p>	Training will occur in the office and on-site during toolbox talks.	<p>Inductions will be required to be completed prior to works commencing on site.</p> <p>Training and education should occur on a regular basis during clearing phase.</p>	Pembroke Site Manager

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Ensure safe handling of MNES during clearing works.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>A suitably qualified fauna spotter catcher will be available during clearing and will direct clearing in a manner that encourages and allows fauna to safely move from the clearing area. Where animals are unable to move out of the area on their own as a result of injury or otherwise, they will be captured and placed in adjacent areas of equivalent habitat. In the event that fauna handling is required, the Fauna Handling and Rescue Procedure will be implemented (Appendix B).</p> <p>Fauna spotter catcher is to check the clearing area for presence of native fauna including threatened species.</p> <p>Where Koalas are present identify the tree they are in, adjacent trees and ensure these are not cleared until the individual has left the area of its own accord.</p> <p>Ensure there are safe exits for native fauna and that clearing is occurring towards habitat that will be retained. Fauna exclusion fencing may be erected to ensure Koalas and other fauna do not move towards high risk areas such as a busy road.</p> <p>Any captured fauna will be released into a pre-approved area. These release areas will be suitable habitat for the species, larger habitat areas that are being retained, with good connectivity. These release areas will have been identified during pre-clearance surveys.</p> <p>Any injured wildlife will be taken to a local vet or wildlife carer for treatment. This will be done in accordance with the Fauna Handling and Rescue Procedure provided in Appendix B.</p> <p>There will be at least one fauna spotter catcher present to each machine.</p>	In areas marked for clearing to occur.	<p>Fauna spotter catcher will be present just prior to and during clearing.</p> <p>Area will be checked prior to any vegetation being cleared. They will then continue to monitor and check for any wildlife during the clearing process.</p>	Suitably qualified ecologists with required Qld licence and at least five years experience.

<p>Avoid and minimise impacts to MNES species during vegetation clearing through sequential clearing.</p>	<p>Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe</p>	<p>Vegetation clearing will only occur within the approved clearing area and post fauna spotter catcher checking the area prior.</p> <p><u>Koalas</u></p> <p>The location of monitored Koalas will be identified with flagging tape and/or marking spray and any nearby trees with overlapping crowns or those trees that may impact the Koala's tree during felling will not be cleared until the Koala has moved from the area under it's own volition. In most situations this occurs overnight and will be confirmed by checking the monitored Koalas latest location. Once it has been confirmed the Koala has vacated the original tree, clearing can occur as usual following required checks for other fauna.</p> <p><u>Phase 1 of clearing</u></p> <p>Any habitat trees marked will be left during the first phase of clearing. The first phase will consist of removing understorey vegetation and smaller juvenile trees only. Juvenile trees are under 4 m in height or trunk circumference of less than 31.5cm at 1.3m above the ground.</p> <p><u>Phase 2 of clearing</u></p> <p>After 48hrs the second phase can commence which is to clear the remaining larger trees, including those with hollows. Trees with small hollows will be cleared using the "slow drop" technique. The tree will be brought down slowly by the machine and mulch put underneath to soften the fall. They will then be inspected by the fauna spotter catcher to ensure no wildlife remain in the hollow. Where possible fauna will be caught, and released into suitable recipient sites once clearing has stopped.</p> <p>If injured they will be taken to a local vet/wildlife carer for treatment.</p> <p>Large hollow bearing trees will be surveyed from an elevated work platform (EWP). The hollow will be checked for the presence of Greater Glider before felling. If Greater Gliders are confirmed as being present, they must be captured and removed from the trees prior to</p>	<p>The approved disturbance area for each stage.</p>	<p>During clearing works.</p>	<p>Pembroke Site Manager</p>
---	---	---	--	-------------------------------	------------------------------

felling. The safest and most efficient method to achieve this is through using an EWP.

Greater Glider habitat tree and vegetation management measures are provided below.

- It is crucial that Greater Gliders (and other arboreal fauna) are given the opportunity to disperse from the area once clearing has commenced under their own volition. To encourage this to occur, no habitat trees will be isolated (either singly or in groups) and instead dispersal corridors will be left in place that link vegetation with clearing areas to adjacent areas of retained habitat. Such corridors could consist of a single row of trees no more than 30-40m apart that will act as 'stepping stones' to allow Greater Gliders to glide from tree to tree.
- While dispersal described above is encouraged to assist in reducing the number of Greater Gliders within a clearing area, it is likely many will remain in their preferred denning trees at the time of clearing. Therefore, prior to felling, each habitat tree (those knowns or suspected to be used by Greater Glider) will be inspected using a EWP.
- Suitably qualified ecologists/wildlife spotter-catchers will inspect each trees hollows for Greater Glider. If the species is present, they will be captured by hand if possible. Or in a situation where they are too deep within a hollow to be reached, the hollow entrance will be blocked with a rag or towel and the limb cut where solid below the den. This latter method is preferred as it will cause less stress on captured Greater Gliders as opposed to physically extracting them from hollows during daylight.
- Once gliders are captured (either bagged or remaining in a hollow limb), they will be placed in a quiet, shady and cool location until release that night in the pre-determine release area/s. Those gliders within recovered hollows, will have the rag/towel removed from the hollow limb and will be left to emerge in their own time.

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
		<ul style="list-style-type: none"> Prior to release, those Greater Gliders that are to be monitored post release will be fitted with a radio-collar. Further detail on the radio-tracking of Greater Gliders is provided in Section 6.2. <p>All hollow limbs that are recovered during the EWP process will be salvaged and fixed to suitable trees in the pre-determined release area/s using EWPs to provide a denning resource for relocated Greater Gliders.</p> <p>Non-woody vegetation should be incorporated into the stripping of topsoil to retain any organic materials and nutrients. Topsoil is not to be mixed with subsoil and will be stockpiled separately for re-use.</p>			

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Reporting to be submitted post clearing phase.	All	<p>A Post-Clearing Report containing a summary of the results of pre-clearance surveys, what occurred during clearing, and any fauna rescues, injury or mortality during clearing activities.</p> <p>The Post-Clearing Report will be reviewed by the Pembroke Environmental Manager.</p> <p>The report will include:</p> <ul style="list-style-type: none"> • name and qualifications of ecologists that completed pre-clearance surveys and results; • name and qualifications of fauna spotter catcher/s present during clearing; • assessment of the habitat and handling of fauna; • information on clearing operations, dates, procedures, areas that were cleared; • number and size of hollows contained in trees removed; • live fauna sightings, captures, any releases or injured/shocked wildlife; • any damage to trees to be retained, nests or other fauna habitat features; • injury or mortality of fauna; • photographs of rescued fauna; and • records of all fauna rescue events, including locations to where fauna have been relocated. 	Areas approved for clearing	The report will be provided within 15 business days from the completion of substantial clearing to the Pembroke Environment Manager.	Subcontractor responsible for overseeing pre-clearance surveys and fauna spotter-catchers. Pembroke Environment Manager
Prevention of vehicle strike on MNES.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>All vehicles to maintain designated speed limit when on site of 60km/hr or lower.</p> <p>Speed limit signs to be installed on each road, and in a number of locations.</p> <p>Wildlife signage to be installed at key fauna habitat areas such as the main access road into site to identify potential for wildlife to be present and crossing the road.</p>	All Project internal roads to have reduced speed limits.	Signage to be installed prior to clearing commencing.	Pembroke Environmental Manager

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Exclusion of grazing from riparian areas.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>Fencing will be installed along riparian buffers of Isaac River and Ripstone Creek to ensure livestock cannot enter these areas. Fences will not have barbed wire and will be wildlife friendly (except for areas that may need to be fauna exclusion fencing due to adjacent mine development).</p> <p>Fencing specification is provided in Section 5.2.6.</p> <p>The fences will be regularly checked and maintained to ensure they haven't been damaged and livestock aren't getting through.</p>	Areas where livestock will be excluded is illustrated in Figure 4.2.	Fencing to exclude livestock from riparian areas will be installed during the first 12 months of the Project.	Pembroke Site Manager
Prevent the introduction and/or spread of weeds and/or disease within the Project area.	All	<p>All vehicles and machinery to be washed down prior to entering the site.</p> <p>Install wheel wash and rumble grids.</p> <p>A designated wash bay will be established where vehicles and machinery can be cleaned on site before leaving site.</p> <p>Ensure any soil and other materials brought into site are certified as weed free.</p> <p>Personnel are to ensure their clothing and boots do not carry weed seeds.</p> <p>Regular audits to be conducted to ensure vehicles and machinery have been washed down and weed free.</p> <p>Personnel to be trained in how to wash down their vehicles and equipment to ensure weed seeds and bacteria are not spread.</p>	Applicable to all Project areas	To be implemented in all Project phases.	Pembroke Site Manager Pembroke Environmental Manager

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Prevent soil runoff into watercourses.	All	<p>Put in place effective sediment and erosion control methods during vegetation clearing to ensure that if a rainfall event occurs sediment does not run off the site into adjacent watercourses.</p> <p>This may include installation of sediment fences to catch runoff from disturbed areas, flow diversion barriers and sand bags to slow runoff.</p> <p>This will be in accordance with the approved Sediment & Erosion Control Plan.</p>	In areas where vegetation clearing is occurring and soil is exposed. Particular focus in areas adjacent to watercourses.	Install sediment and erosion control measures prior to, and during the clearing phase.	Pembroke Environmental Manager
Prevent increase levels of dust.	All	<p>Pembroke will implement proactive and reactive dust control measures. These measures would include the use of weather forecasting and real-time measurement of dust levels and meteorological conditions to modify mining operations as required in order to achieve compliance with applicable air quality objectives at the nearest privately-owned receivers.</p> <p>Water down dirt tracks if dust plumes are arising.</p> <p>Speed limits of 60km or less to be put in place and enforced.</p>	In areas where vegetation clearing is occurring and soil is exposed.	During the clearing phase and all other phases. .	Pembroke Site Manager

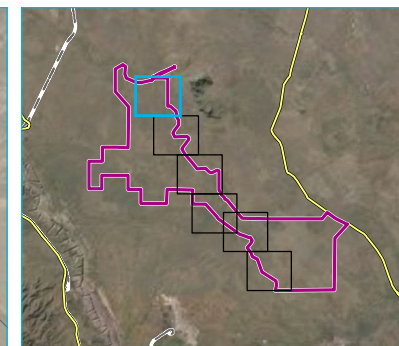
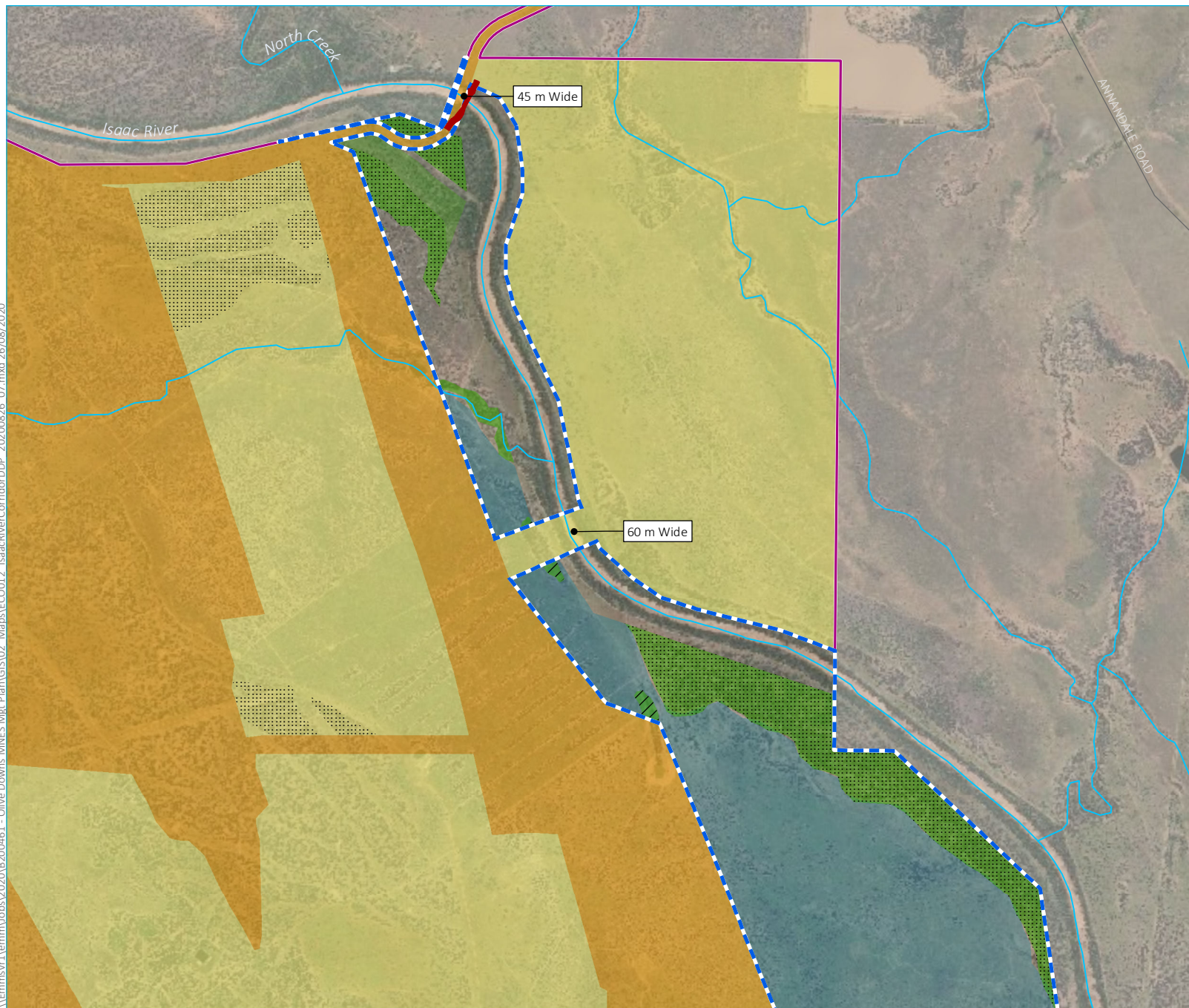
Management

Table 4.1 **Avoidance, mitigation and management measures for vegetation clearing phase**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Maintain habitat for MNES outside of the approved disturbance limits.	All	<p>Areas of mapped habitat for the MNES species (outside of approved disturbance limits) will be retained and managed for their habitat values.</p> <p>Active management will occur in these areas including weed management, feral animal management, grazing management and fire management. Management will aim to ensure these areas of habitat are retained and continue to support the species and habitat quality is not degraded over time.</p> <p>Further detail on weed management, feral animal control, grazing management and fire management is provided in Section 5.2.4.</p> <p>Monitoring to track habitat quality is outlined in Section 6.3 .</p>	MNES habitats to be retained (outside of approved disturbance limits) are shown in Figure 2.3 to Figure 2.8.	Management activities in these retained habitats will commence in Year 2 of the Project and apply during all Project phases.	Pembroke Environmental Manager Suitably qualified and experienced contractors will be used to assist in management activities.
Prevent uncontrolled fire events.	All	<p>The purpose of fire management will be to avoid and reduce the risks of an uncontrolled fire event occurring. In particular to avoid a hot bushfire occurring in the Project area as this has potential to result in death of MNES species, loss of habitats and Brigalow TEC.</p> <p>Fire management will include:</p> <ul style="list-style-type: none"> • establishing and maintaining access tracks and fire breaks; • implement measures to minimise mining activities starting a fire and having an emergency response plan to control any unplanned fires; • fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards; • manage fuel loads (this may be through grazing in some areas, cool mosaic burns and slashing where exotic grassland only); and • manage activities that could start a fire such as mulch stockpiles, machinery etc. 	<p>Access tracks and fire breaks will be established within approved disturbance areas.</p> <p>Areas outside of approved disturbance areas existing access tracks and fence boundaries will be maintained. These tracks will also act as firebreaks.</p>	<p>Access tracks and fire breaks to be installed during vegetation clearing phase.</p> <p>Access tracks and fire breaks to be maintained during all phases.</p>	Pembroke Site Manager

Figure 4.1 **Isaac River corridor to be retained**

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO012 IsaacRiverCorridorDDP 20200826 07.mxd 26/08/2020



- KEY**
- Project area
 - Project stage 1
 - Project stages 2-4
 - River crossing
 - Rail line
 - Major road
 - Minor road
 - Watercourse/drainage line
 - Isaac River corridor
 - Threatened species habitat (in corridor)
 - Greater Glider/Koala habitat
 - Oramental Snake habitat
 - Australian Painted Snipe habitat
 - Squatter Pigeon habitat

DRAFT

Isaac River corridor to be retained
map 1 of 6

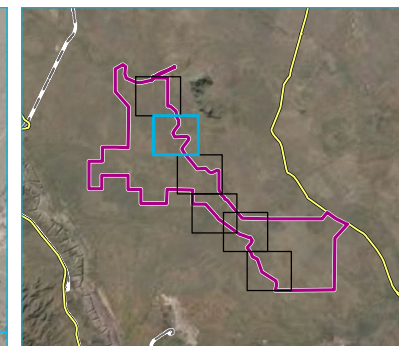
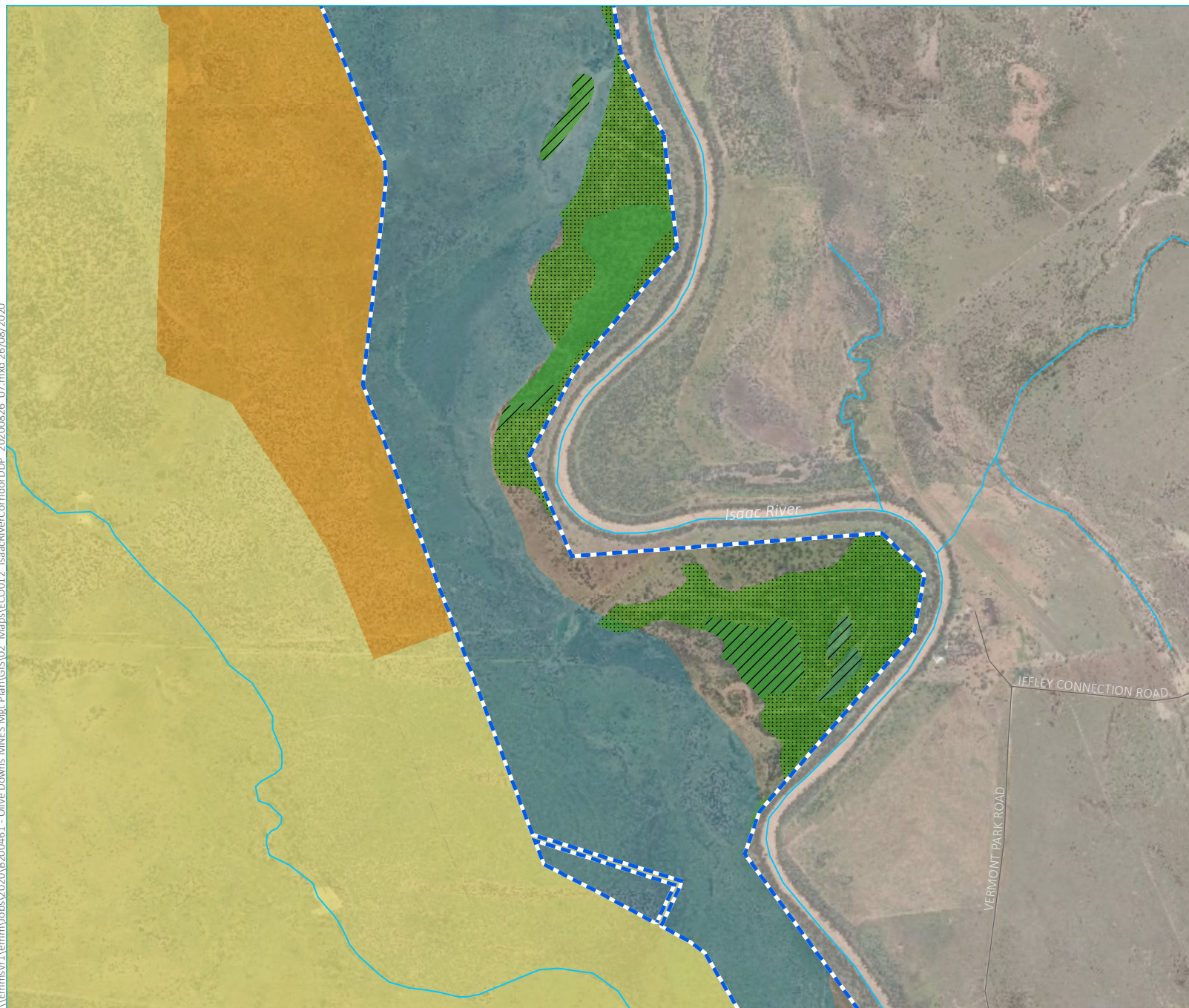
Olive Downs
MNES management plan
Figure 4.1



Source: EMM (2020); Pembroke (2020); DNRME (2020)



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO012 IsaacRiverCorridorDDP 20200826 07.mxd 26/08/2020



- KEY**
- Project area
 - Project stage 1
 - Project stages 2-4
 - Rail line
 - Major road
 - Minor road
 - Watercourse/drainage line
 - Isaac River corridor
 - Threatened species habitat (in corridor)
 - Greater Glider/Koala habitat
 - Oramental Snake habitat
 - Australian Painted Snipe habitat
 - Squatter Pigeon habitat

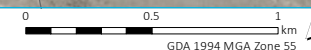
DRAFT

Isaac River corridor to be retained
map 2 of 6

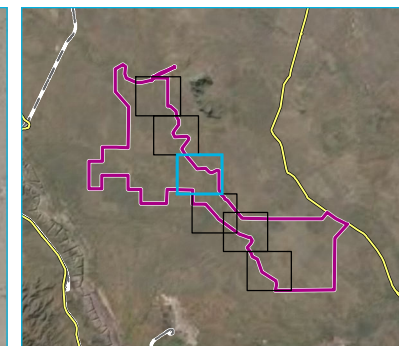
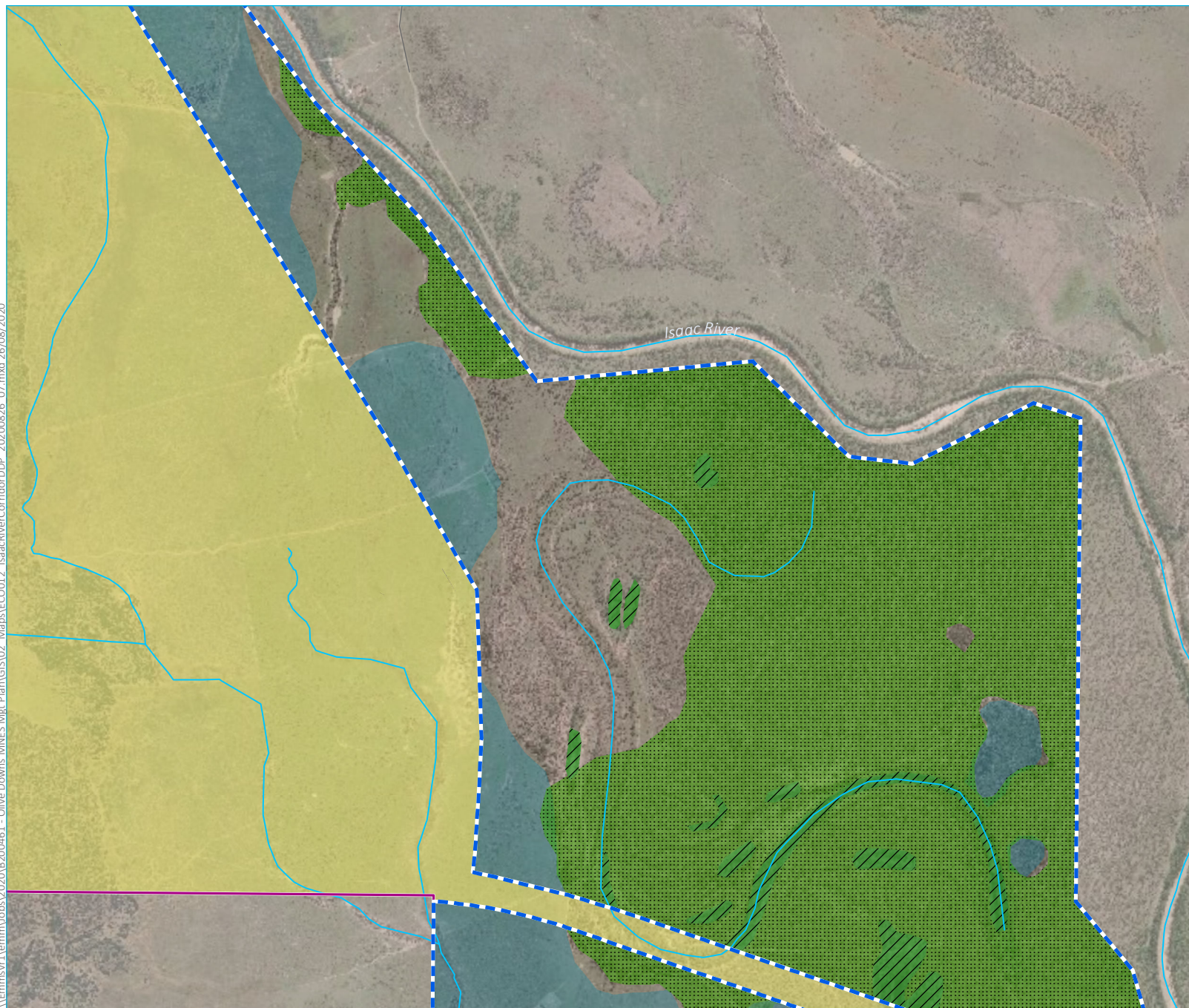
Olive Downs
MNES management plan
Figure 4.1



Source: EMM (2020); Pembroke (2020); DNRME (2020)



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO012 IsaacRiverCorridorDDP 20200826 07.mxd 26/08/2020



- KEY**
- Project area
 - Project stages 2-4
 - Rail line
 - Major road
 - Minor road
 - Watercourse/drainage line
 - Isaac River corridor
 - Threatened species habitat (in corridor)
 - Greater Glider/Koala habitat
 - Oramental Snake habitat
 - Australian Painted Snipe habitat
 - Squatter Pigeon habitat

DRAFT

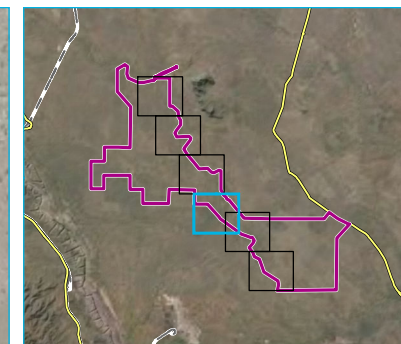
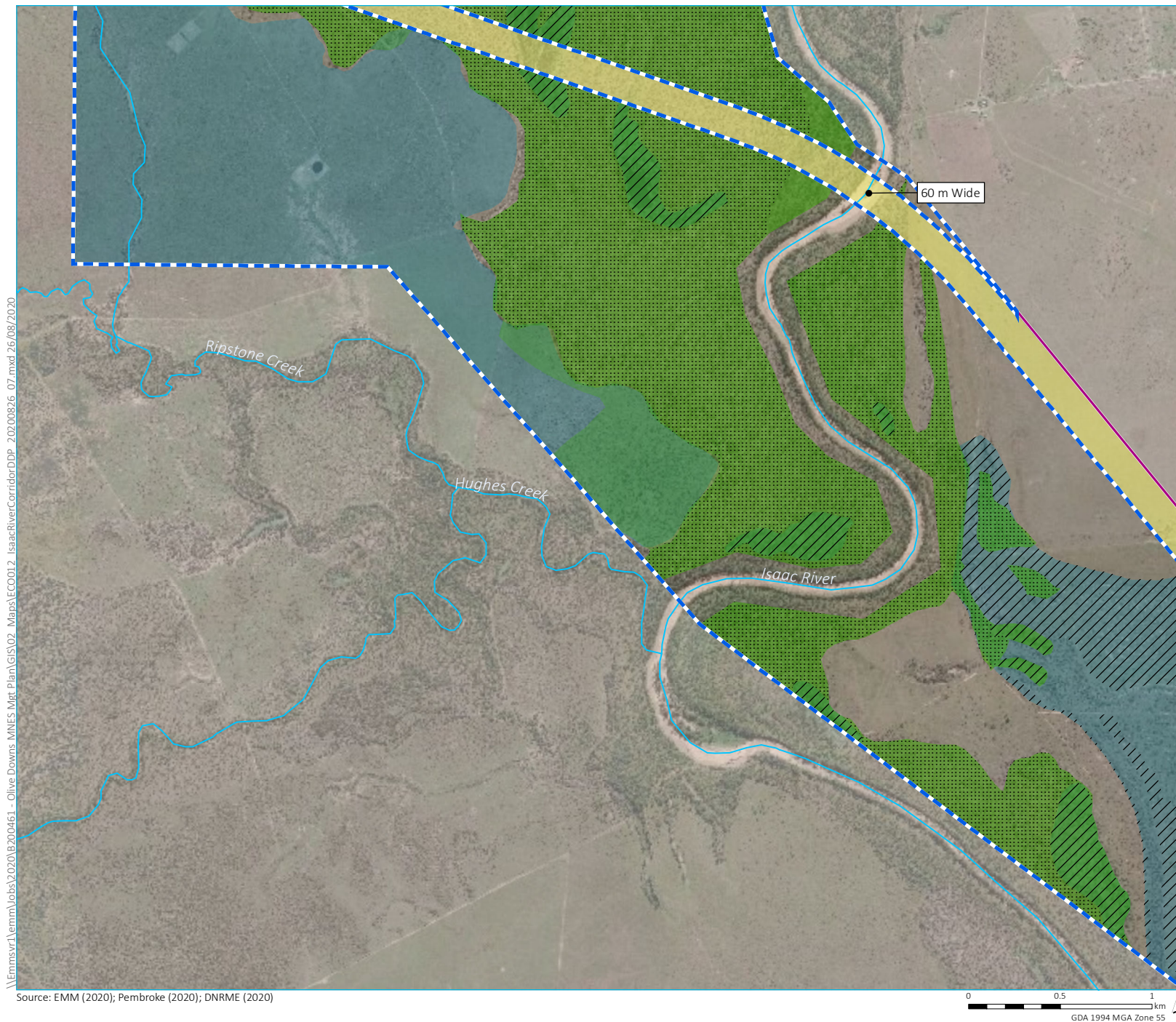
Isaac River corridor to be retained
map 3 of 6

Olive Downs
MNES management plan
Figure 4.1



Source: EMM (2020); Pembroke (2020); DNRME (2020)





- KEY**
- Project area
 - Project stages 2-4
 - Rail line
 - Major road
 - Minor road
 - Watercourse/drainage line
 - Isaac River corridor
 - Threatened species habitat (in corridor)**
 - Greater Glider/Koala habitat
 - Ornamental Snake habitat
 - Australian Painted Snipe habitat
 - Squatter Pigeon habitat

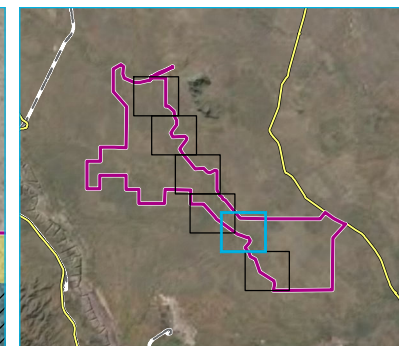
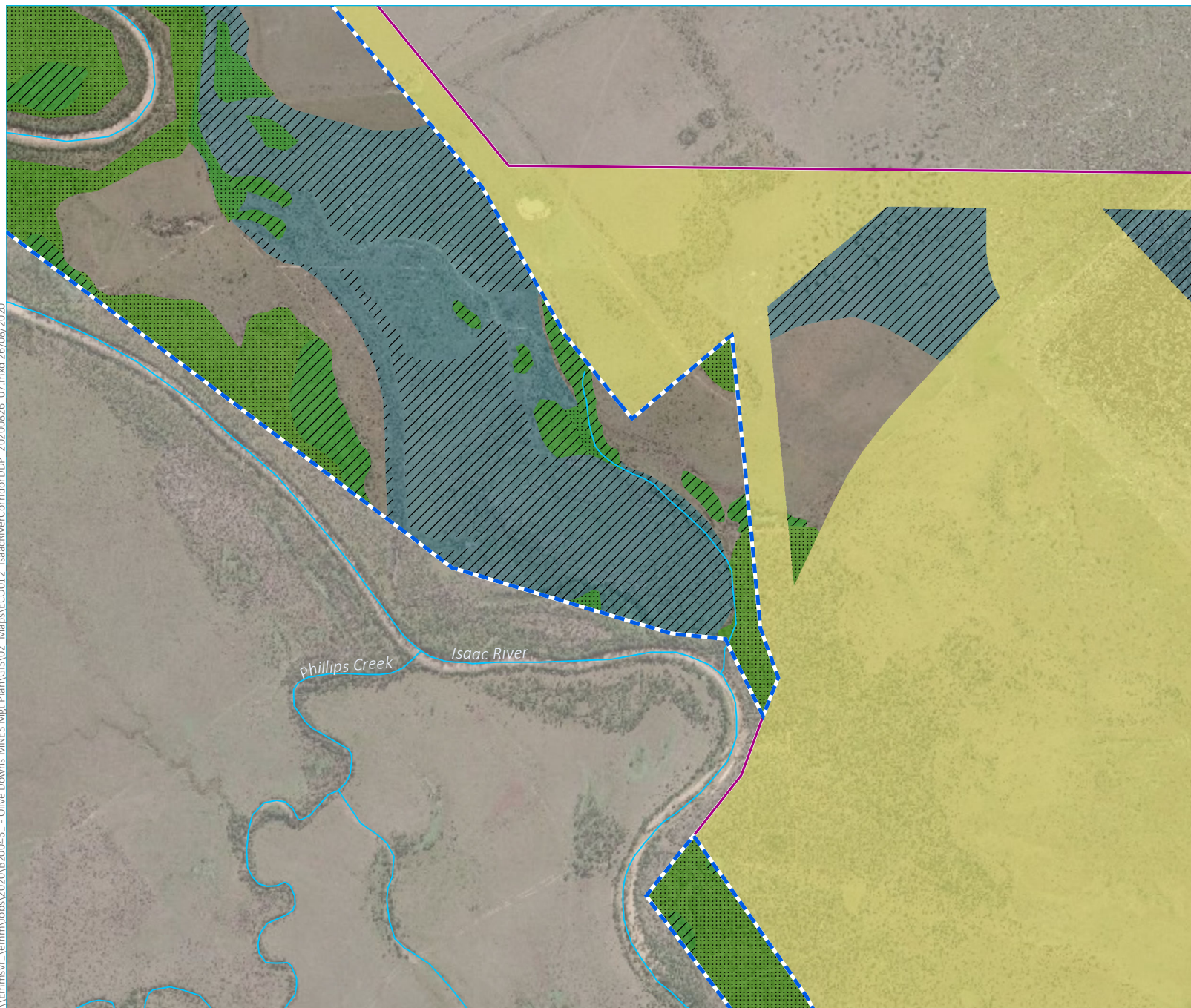
DRAFT

Isaac River corridor to be retained
map 4 of 6

Olive Downs
MNES management plan
Figure 4.1



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO012 IsaacRiverCorridorDDP 20200826 07.mxd 26/08/2020



- KEY**
- Project area
 - Project stages 2-4
 - Rail line
 - Major road
 - Minor road
 - Watercourse/drainage line
 - Isaac River corridor
 - Threatened species habitat (in corridor)
 - Greater Glider/Koala habitat
 - Oramental Snake habitat
 - Australian Painted Snipe habitat
 - Squatter Pigeon habitat

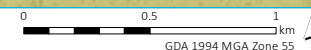
DRAFT

Isaac River corridor to be retained
map 5 of 6

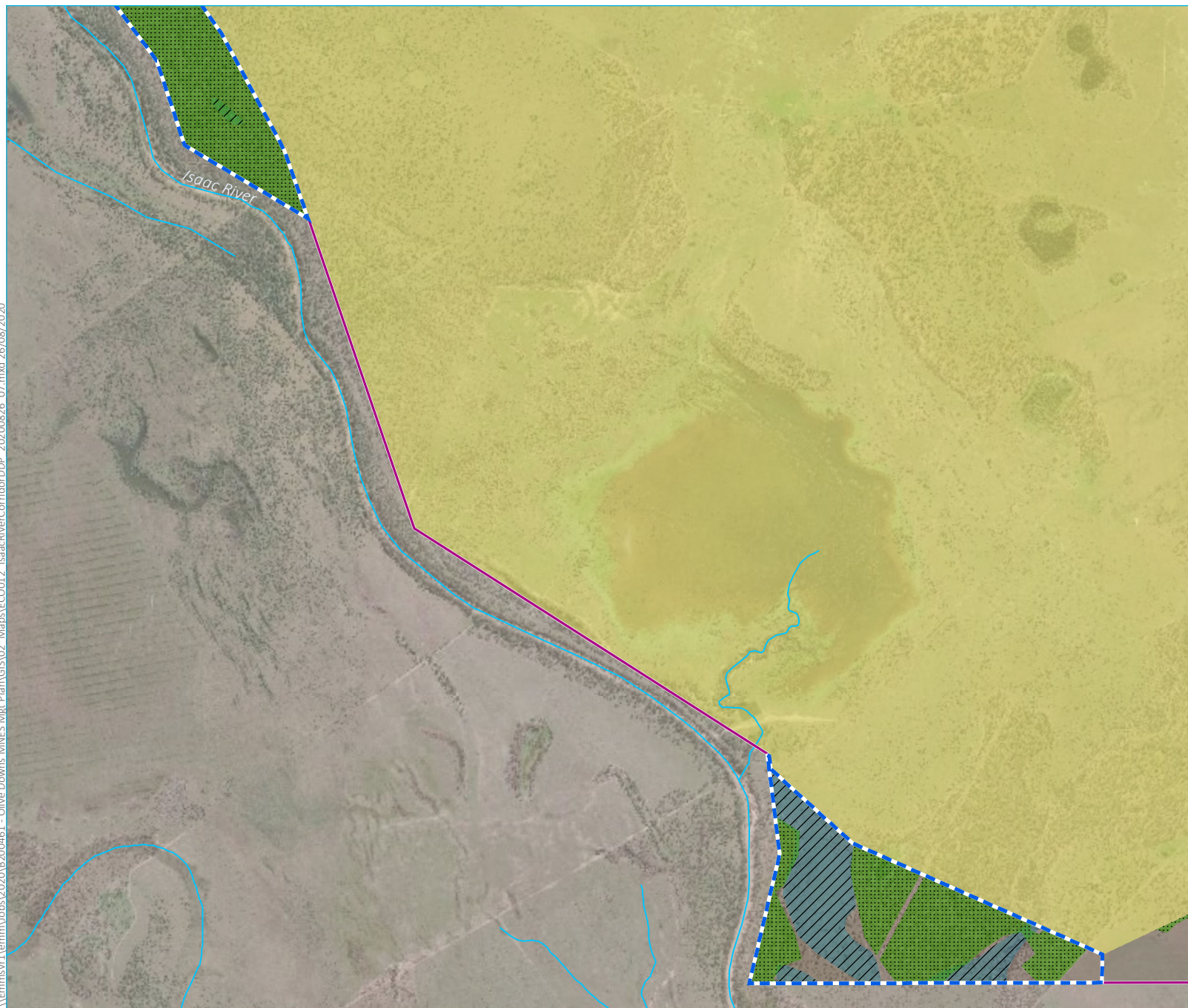
Olive Downs
MNES management plan
Figure 4.1



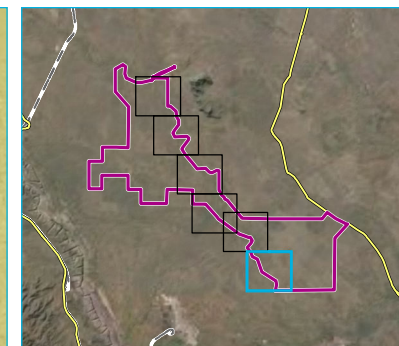
Source: EMM (2020); Pembroke (2020); DNRME (2020)



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO012 IsaacRiverCorridorDDP 20200826 07.mxd 26/08/2020



Source: EMM (2020); Pembroke (2020); DNRME (2020)



KEY

- Project area
- Project stages 2-4
- Rail line
- Major road
- Minor road
- Watercourse/drainage line
- Isaac River corridor
- Threatened species habitat (in corridor)
- Greater Glider/Koala habitat
- Oramental Snake habitat
- Australian Painted Snipe habitat
- Squatter Pigeon habitat

DRAFT

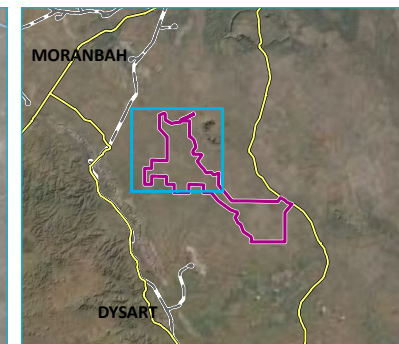
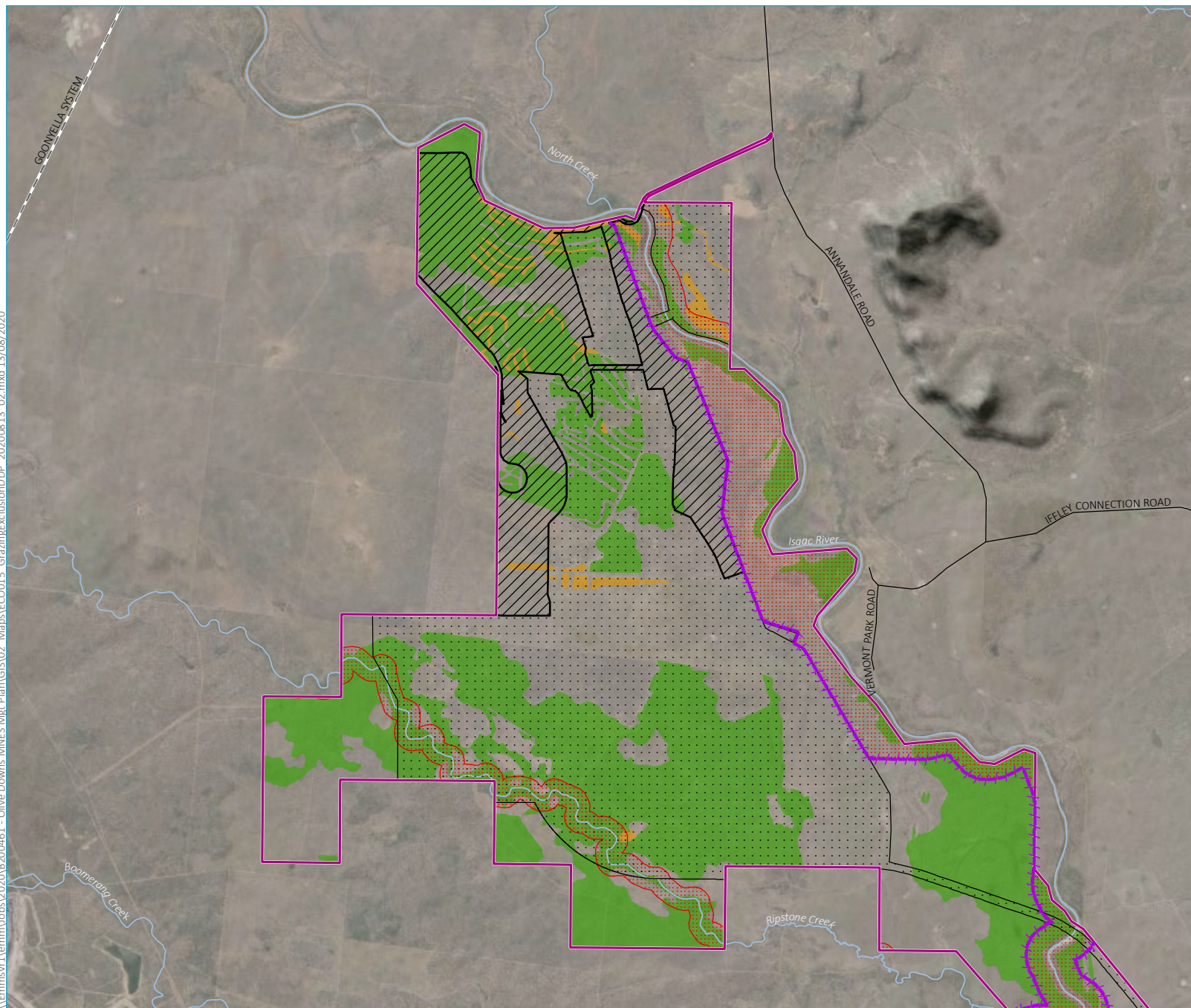
Isaac River corridor to be retained
map 6 of 6

Olive Downs
MNES management plan
Figure 4.1



Figure 4.2 Grazing exclusion areas

\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO015 - GrazingExclusion\DP - 20200813 02.mxd 13/08/2020



KEY

- Project area
- Project stage 1
- Project stages 2-4
- Rail line
- Major road
- Minor road
- Named watercourse
- Remnant vegetation
- Regrowth vegetation
- Livestock exclusion fencing
- Grazing exclusion area

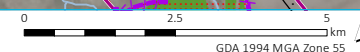
DRAFT

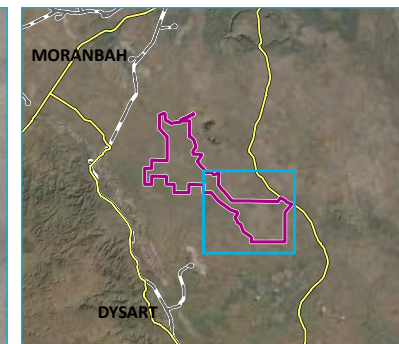
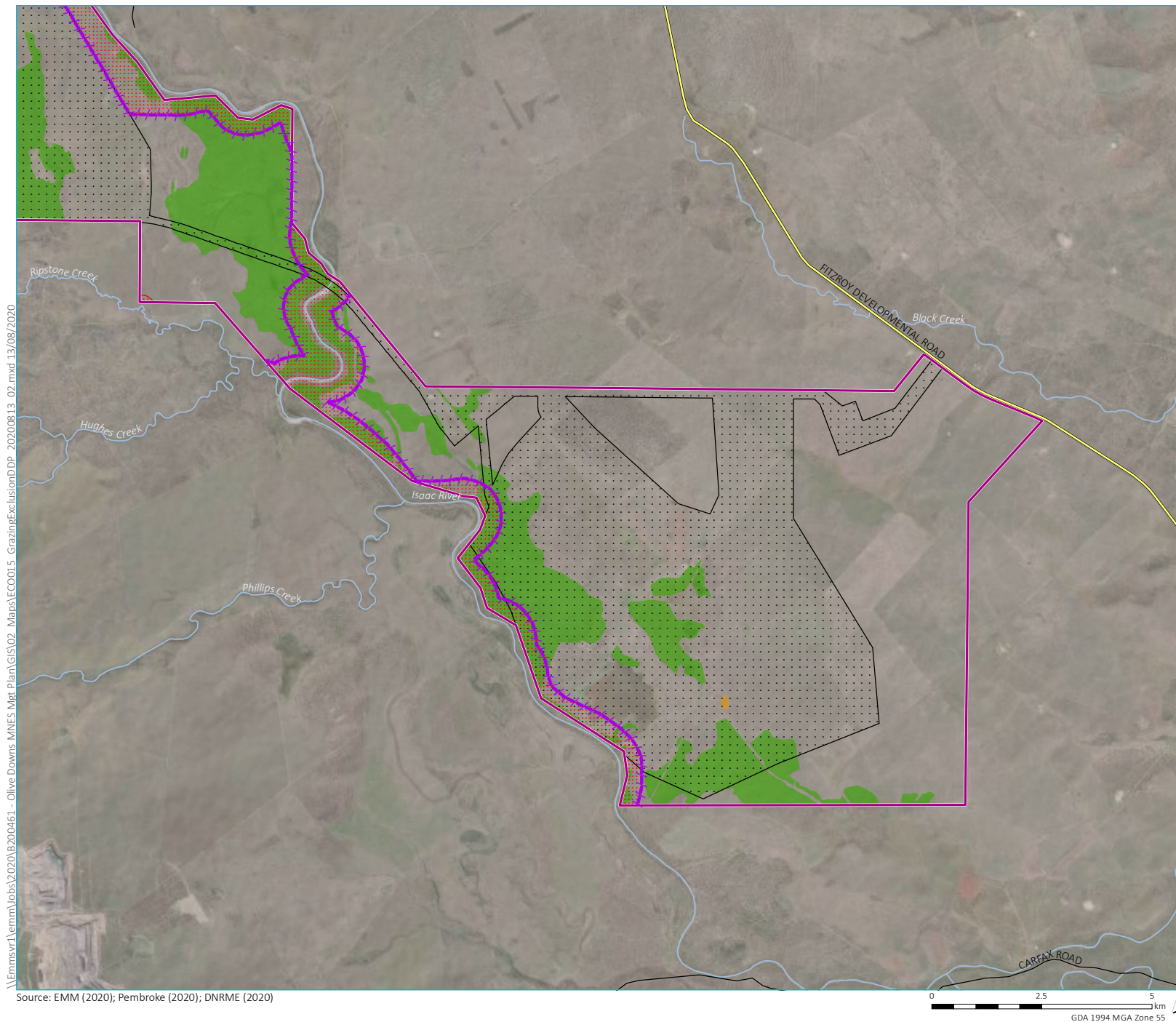
Grazing exclusion areas
map 1 of 2

Olive Downs
MNES management plan
Figure 4.2



Source: EMM (2020); Pembroke (2020); DNRME (2020)





KEY

- Project area
- Project stage 1
- Project stages 2-4
- Rail line
- Major road
- Minor road
- Named watercourse
- Remnant vegetation
- Regrowth vegetation
- Livestock exclusion fencing
- Grazing exclusion area

DRAFT

Grazing exclusion areas
map 2 of 2

Olive Downs
MNES management plan
Figure 4.2

4.3.2 Construction Phase

Table 4.2 Avoidance, mitigation and management measures during construction

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Avoidance					
Avoid and minimise Koala injuries and mortality during construction phase.	Koala	<p>Koala exclusion fencing is to be installed in key locations to keep individuals outside of active mine areas, avoid and minimise Koala injuries including from vehicles, and maintain their connectivity along Isaac River and to habitats in south.</p> <p>Koala exclusion fencing has been identified for Stage 1 only. Pembroke only have detailed design for Stage 1 therefore subsequent stages and exclusion fencing locations will be identified during the scheduled review of this MMP one year prior to commencement of Stage 2.</p> <p>Koala exclusion fencing specification is provided in Section 5.2.8 .</p>	As per Figure 5.1.	<p>Post vegetation clearing occurring in the area.</p> <p>Prior to main construction activities and threats occurring.</p>	Pembroke Environmental Manager
Maintain Greater Glider connectivity.	Greater Glider	<p>Installation of rope ladder crossings of permitted cleared corridors in riparian zones of Isaac River and Ripstone Creek is to occur. The purpose is to maintain Greater Glider habitat connectivity.</p> <p>Further detail regarding Greater Glider rope crossings is provided in Section 5.2.9.</p>	The designated locations for rope ladder crossings are shown in Figure 5.2.	<p>Post vegetation clearing occurring in the area including clearing for the river crossings.</p> <p>Prior to main construction activities occurring.</p>	<p>Pembroke Environmental Manager</p> <p>Suitably qualified and experienced ecologists to install</p>
Maintain Koala connectivity.	Koala	<p>The bridge crossing over Isaac River in Stage 1 is to allow Koala movement under the bridge along riparian banks.</p> <p>Bridge design is further described in Section 5.2.11.</p> <p>Exclusion fencing up to the bridge crossing will be installed to ensure they cannot go onto the bridge or access road.</p> <p>Install Koala fauna furniture under the bridge to help facilitate movement if there has been rainfall and water in river.</p>	Approved river crossing for Stage 1 as illustrated in Figure 1.2.	During construction	Pembroke Site Manager

Table 4.2 **Avoidance, mitigation and management measures during construction**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Prevent dog attacks to native fauna.	Koala, Ornamental Snake, Squatter Pigeon, Australian Painted Snipe	Site personnel will not be permitted to bring domestic dogs into the Project area.	All areas	During construction	Pembroke Site Manager
Mitigation					
Reduce potential impacts to fauna as a result of open trenches.	Ornamental Snake, Koala	<p>Trenches will be inspected and monitored. This includes as checking within two hours of sunrise and trapped fauna released. Additional monitoring will be undertaken following rainfall events.</p> <p>The time a trench is left open will be minimised.</p> <p>Fauna exit points including fauna ramps will be incorporated when construction is within 1 km of native vegetation, using appropriate material. Fauna refuges, such as sawdust-filled bags, will be provided regularly.</p> <p>As soon as practical following construction, the trench will be backfilled with excavated material, compacted and topsoil replaced and erosion controls implemented.</p>	Where trenches go through mapped MNES habitats or are within 1km of mapped MNES habitats.	During construction	Pembroke Site Manager
Prevent vehicle strike on MNES.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>All vehicles to maintain designated speed limit when on site of 60km/hr.</p> <p>Speed limit signs to be installed on each road, and in a number of locations.</p> <p>Wildlife signage to be installed at key fauna habitat areas such as the main access road into site to identify potential for wildlife to be present and crossing the road.</p>	All Project internal roads to have reduced speed limits.	Signage to be installed prior to clearing commencing.	Pembroke Environmental Manager

Table 4.2 **Avoidance, mitigation and management measures during construction**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Exclusion of grazing from riparian areas.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>Fencing will be installed along riparian buffers of Isaac River and Ripstone Creek to ensure livestock cannot enter these areas. Fences will not have barbed wire and will be wildlife friendly (except for areas that may need to be fauna exclusion fencing due to adjacent mine development).</p> <p>Fencing specification is provided in Section 5.2.6.</p> <p>The fences will be regularly checked and maintained to ensure they haven't been damaged and livestock aren't getting through.</p>	Areas where livestock will be excluded is illustrated in Figure 4.2.	Fencing to exclude livestock from riparian areas will be installed during the first 12 months of the Project.	Pembroke Site Manager
Prevent the introduction and/or spread of weeds and/or disease within the Project area.	All	<p>All vehicles and machinery to be washed down prior to entering the site.</p> <p>Install wheel wash and rumble grids.</p> <p>A designated wash bay will be established where vehicles and machinery can be cleaned on site before leaving site.</p> <p>Ensure any soil and other materials brought into site are certified as weed free.</p> <p>Personnel are to ensure their clothing and boots do not carry weed seeds.</p> <p>Regular audits to be conducted to ensure vehicles and machinery have been washed down and weed free.</p> <p>Personnel to be trained in how to wash down their vehicles and equipment to ensure weed seeds and bacteria are not spread.</p>	Applicable to all Project areas	To be implemented in all Project phases.	<p>Pembroke Site Manager</p> <p>Pembroke Environmental Manager</p>

Table 4.2 **Avoidance, mitigation and management measures during construction**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Prevent soil runoff into watercourses.	All	<p>Put in place effective sediment and erosion control methods during vegetation clearing to ensure that if a rainfall event occurs sediment does not run off the site into adjacent watercourses.</p> <p>This may include installation of sediment fences to catch runoff from disturbed areas, flow diversion barriers and sand bags to slow runoff.</p> <p>This will be in accordance with the approved Sediment & Erosion Control Plan.</p>	In areas where vegetation clearing is occurring and soil is exposed. Particular focus in areas adjacent to watercourses.	Install sediment and erosion control measures prior to, and during the clearing phase.	Pembroke Environmental Manager
Reduce light spill into adjacent habitat.	Greater Glider, Koala, Ornamental Snake	<p>Lighting in areas directly adjacent to retained MNES habitats will be reduced where practicable.</p> <p>Lighting will be designed in a manner that limits disruption on landscape character, views and visual amenity and lighting will be directed towards the infrastructure siting rather than dispersed into native vegetation when sites are adjacent to intact habitat.</p> <p>Lighting at night will be minimised during construction.</p>	In areas where project infrastructure requires lighting, particularly around buildings.	During construction phase	Pembroke Site Manager
Ensure all site personnel are trained and aware of MNES.	All	<p>All site personnel (including sub-contractors) will be inducted on the potential threatened species and TEC and sensitive environmental areas occurring within the Project area. Training will include inductions, toolbox talks, pre-starts and targeted training as required. Topics will include, but not be limited to, no go zones, fauna descriptions and handling procedures. All site personnel working in the Project area will be informed of exclusion zones in place and where they occur.</p> <p>All site personnel will be required to sign the induction form to state they have read and understand all relevant material.</p>	Training will occur in the office and on-site during toolbox talks.	<p>Inductions will be required to be completed prior to works commencing on site.</p> <p>Training and education should occur on a regular basis during construction phase.</p>	Pembroke Site Manager

Table 4.2 **Avoidance, mitigation and management measures during construction**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Ensure safe handling of MNES.	Koala, Greater Glider, Ornamental Snake	If Koala or Ornamental Snake are encountered within the construction area, workers can refer to the Fauna Handling and Rescue Strategy to minimise the risk of harming the fauna. Refer Appendix B.	Applicable to all Project areas	During construction, operation and decommissioning phases.	Pembroke Environmental Manager Suitably qualified and experienced contractors will be used to assist
Management					
Ensure no reduction in habitat quality within adjacent areas will occur as a result of the project.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>Areas of mapped habitat for the MNES species (outside of approved disturbance limits) will be retained and managed for their habitat values.</p> <p>Active management will occur in these areas including weed management, feral animal management, grazing management and fire management. Management will aim to ensure these areas of habitat continue to support the species and habitat quality is not degraded over time.</p> <p>Fencing to be delineated around exclusion areas.</p> <p>Further detail on weed management, feral animal control, grazing management and fire management is provided in Section 0.</p> <p>Monitoring to track habitat quality is outlined in Section 6.3.</p>	MNES habitats to be retained (outside of approved disturbance limits) are shown in Figure 2.3 - Figure 2.8.	Management activities will commence in Year 2 of the Project and apply during all Project phases.	Pembroke Environmental Manager Suitably qualified and experienced contractors will be used to assist in management activities.

Table 4.2 **Avoidance, mitigation and management measures during construction**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Prevent uncontrolled fire events.	All	<p>The purpose of fire management will be to avoid and reduce the risks of an uncontrolled fire event occurring. In particular to avoid a hot bushfire occurring in the Project area as this has potential to result in death of MNES species, loss of habitats and Brigalow TEC.</p> <p>Fire management will include:</p> <ul style="list-style-type: none"> • establishing and maintaining access tracks and fire breaks; • implement measures to minimise mining activities starting a fire and having an emergency response plan to control any unplanned fires; • fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards; • manage fuel loads (this may be through grazing in some areas, cool mosaic burns and slashing where exotic grassland only); and • manage activities that could start a fire such as mulch stockpiles, machinery etc. 	<p>Access tracks and fire breaks will be established within approved disturbance areas.</p> <p>Areas outside of approved disturbance areas existing access tracks and fence boundaries will be maintained. These tracks will also act as firebreaks.</p>	<p>Access tracks and fire breaks to be installed during vegetation clearing phase.</p> <p>Access tracks and fire breaks to be maintained during all phases.</p>	Pembroke Site Manager

4.3.3 Operational and Decommissioning Phases

Table 4.3 Avoidance, mitigation and management measures during operations and decommissioning

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Mitigation					
Maintain Koala and Greater Glider connectivity.	Koala and Greater Glider	Koala exclusion fencing, poles and furniture to be maintained. Greater Glider rope crossings to be maintained.	Approved river crossing for Stage 1 as illustrated in Figure 1.2.	Maintenance checks twice per year.	Pembroke Environmental Manager
Prevent dog attacks to native fauna.	Koala	Site personnel will not be permitted to bring domestic dogs into the Project area.	All areas	During construction	Pembroke Site Manager
Prevent vehicle strike on MNES.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	All vehicles to maintain designated speed limit when on site of 60km/hr. Speed limit signs to be installed on each road, and in a number of locations. Wildlife signage to be installed at key fauna habitat areas such as the main access road into site to identify potential for wildlife to be present and crossing the road.	All Project internal roads to have reduced speed limits.	Signage to be installed prior to clearing commencing.	Pembroke Environmental Manager
Exclusion of grazing from riparian areas.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	Fencing will be installed along riparian buffers of Isaac River and Ripstone Creek to ensure livestock cannot enter these areas. Fences will not have barbed wire and will be wildlife friendly (except for areas that may need to be fauna exclusion fencing due to adjacent mine development). Fencing specification is provided in Section 5.2.6. The fences will be regularly checked and maintained to ensure they haven't been damaged and livestock aren't getting through.	Areas where livestock will be excluded is illustrated in Figure 4.2.	Fencing to exclude livestock from riparian areas will be installed during the first 12 months of the Project.	Pembroke Site Manager

Table 4.3 **Avoidance, mitigation and management measures during operations and decommissioning**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Prevent the introduction and/or spread of weeds and/or disease within the Project area.	All	<p>All vehicles and machinery to be washed down prior to entering the site.</p> <p>Install wheel wash and rumble grids.</p> <p>A designated wash bay will be established where vehicles and machinery can be cleaned on site before leaving site.</p> <p>Ensure any soil and other materials brought into site are certified as weed free.</p> <p>Personnel are to ensure their clothing and boots do not carry weed seeds.</p> <p>Regular audits to be conducted to ensure vehicles and machinery have been washed down and weed free.</p> <p>Personnel to be trained in how to wash down their vehicles and equipment to ensure weed seeds and bacteria are not spread.</p>	Applicable to all Project areas	To be implemented in all Project phases.	Pembroke Site Manager Pembroke Environmental Manager
Prevent soil runoff into watercourses.	All	<p>Put in place effective sediment and erosion control methods during vegetation clearing to ensure that if a rainfall event occurs sediment does not run off the site into adjacent watercourses.</p> <p>This may include installation of sediment fences to catch runoff from disturbed areas, flow diversion barriers and sand bags to slow runoff.</p> <p>This will be in accordance with the approved Sediment & Erosion Control Plan.</p>	In areas where vegetation clearing is occurring and soil is exposed. Particular focus in areas adjacent to watercourses.	Install sediment and erosion control measures prior to, and during the clearing phase.	Pembroke Environmental Manager

Table 4.3 **Avoidance, mitigation and management measures during operations and decommissioning**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Reduce light spill into adjacent habitat.	Greater Glider, Koala, Ornamental Snake	Lighting in areas directly adjacent to retained MNES habitats will be reduced where practicable. Lighting will be designed in a manner that limits disruption on landscape character, views and visual amenity and lighting will be directed towards the infrastructure siting rather than dispersed into native vegetation when sites are adjacent to intact habitat. Lighting at night will be minimised during construction.	In areas where project infrastructure requires lighting, particularly around buildings.	During operational phase	Pembroke Site Manager
Ensure all site personnel are trained and aware of MNES.	All	All site personnel (including sub-contractors) will be inducted on the potential threatened species and TEC and sensitive environmental areas occurring within the Project area. Training will include inductions, toolbox talks, pre-starts and targeted training as required. Topics will include, but not be limited to, no go zones, fauna descriptions and handling procedures. All site personnel working in the Project area will be informed of exclusion zones in place and where they occur. All site personnel will be required to sign the induction form to state they have read and understand all relevant material.	Training will occur in the office and on-site during toolbox talks.	Inductions will be required to be completed prior to works commencing on site. Training and education should occur on a regular basis during construction phase.	Pembroke Site Manager
Ensure safe handling of MNES.	Koala, Greater Glider, Ornamental Snake, Australian Painted Snipe, Squatter Pigeon	If any MNES species are encountered within the construction area, workers can refer to the Fauna Handling and Rescue Strategy (Appendix B) to minimise the risk of harming fauna and assisting them to safety.	Applicable to all Project areas	During construction, operation and decommissioning phases.	Pembroke Environmental Manager Suitably qualified and experienced contractors will be used to assist.

Management

Table 4.3 **Avoidance, mitigation and management measures during operations and decommissioning**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Ensure no reduction in habitat quality within adjacent areas will occur as a result of the project.	Squatter Pigeon, Greater Glider, Koalas, Ornamental Snake and Australian Painted Snipe	<p>Areas of mapped habitat for the MNES species (outside of approved disturbance limits) will be retained and managed for their habitat values.</p> <p>Active management will occur in these areas including weed management, feral animal management, grazing management and fire management. Management will aim to ensure these areas of habitat continue to support the species and habitat quality is not degraded over time.</p> <p>Fencing to be delineated around exclusion areas.</p> <p>Further detail on weed management, feral animal control, grazing management and fire management is provided in Section 0.</p> <p>Monitoring to track habitat quality is outlined in Section 6.3.</p>	MNES habitats to be retained (outside of approved disturbance limits) are shown in Figure 2.3 - Figure 2.8.	Management activities will commence in Year 2 of the Project and apply during all Project phases.	<p>Pembroke Environmental Manager</p> <p>Suitably qualified and experienced contractors will be used to assist in management activities.</p>

Table 4.3 **Avoidance, mitigation and management measures during operations and decommissioning**

Performance criteria	Applicable MNES	Method	Where	Timing	Responsible party
Minimise residual impacts to MNES through progressive rehabilitation post mining.	All	<p>Rehabilitation will be implemented as soon as practicable following construction and decommissioning activities.</p> <p>Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements (B064). Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates</p> <p>After decommissioning, rehabilitation areas will be inspected for regrowth similar to the surrounding environment.</p> <p>A rehabilitation management plan for decommissioning will be developed and implemented which includes monitoring and maintenance of rehabilitated areas until rehabilitation sign off criteria are met</p>	In areas where open cut mining has been completed, or infrastructure is no longer required.	<p>Rehabilitation timeframes will be compliant with applicable Environmental Authority and approved Project Rehabilitation Management Plan.</p> <p>Rehabilitation will occur progressively from the operational phase through to decommissioning phase.</p>	Pembroke Site Manager

5 MNES outcomes

Further detail on the environmental outcomes to be achieved through implementation of this MMP, and specific management measures are discussed in sections below. This information supports the avoidance, mitigation and management measures outlined in Section 4.

5.1 Environmental outcomes

The overarching environmental outcomes sought to be achieved through implementation of the MMP are:

- Avoid and minimise injuries or mortality of MNES species during all Project phases, in particular the vegetation clearing phase.
- Disturbance does not occur to MNES habitats and Brigalow TEC outside of approved Project stages.
- MNES habitat areas outside of approved Project stages are managed to maintain habitat quality so they continue to support the species populations.
- Connectivity is maintained for Greater Glider and Koala. Connectivity structures are installed in proximity to habitats including along riparian corridors of Isaac River and Ripstone Creek. Connectivity structures to be installed include:
 - a. Greater Glider rope crossings;
 - b. Koala exclusion fencing in combination with Koala poles;
 - c. Bridge crossing of Isaac River facilitating Koala movement underneath the bridge including use of Koala furniture.
- Monitoring will allow for adaptive management of MNES species and evaluate success of mitigation measures.
- Key mitigation measures to be implemented and evaluated under this MMP are:
 - a. Radio-tracking of Koalas prior to, during and post clearing for Stage 1;
 - b. Radio-tracking of Greater Gliders during and post clearing for Stage 1;
 - c. Installation of Greater Glider nest boxes and monitoring use by Greater Gliders;
 - d. Installation of Greater Glider rope crossings and monitoring use by Greater Gliders;

Table 5.1 Specific MNES environmental outcomes

MNES	Outcomes
Koala (<i>Phascolarctos cinereus</i>) (combined populations of Qld, NSW and the ACT)	<p>Specific environmental outcomes for Koala are:</p> <ul style="list-style-type: none"> • Avoid and minimise injury and mortality to Koalas across the Project area through the use of best management practices; • Gain specific knowledge on Koala populations in Stage 1 area and effectiveness of clearing practices and protocols; • Maintain connectivity for Koalas through use of Koala exclusion fencing and Koala poles; • Maintain Koala habitats outside of disturbance footprints. • Avoid and minimise hot bushfires occurring in retained Greater Glider habitat.
Greater Glider (<i>Petauroides volans</i>)	<p>Specific outcomes for Greater Glider are:</p> <ul style="list-style-type: none"> • Avoid and minimise injury and mortality to Greater Glider across the Project area through the use of best management practices; • Gain specific knowledge on Greater Glider populations in Stage 1 area and effectiveness of clearing practices and protocols; • Supplement Greater Glider denning habitat through installation of artificial tree hollows; • Gain specific knowledge on Greater Glider use of nest boxes and natural tree hollows that have been installed; • Maintain connectivity for Greater Glider through use of glider rope crossings; • Maintain Greater Glider habitats outside of disturbance footprints; • Avoid and minimise hot bushfires occurring in retained Greater Glider habitat.
Squatter Pigeon (Southern) (<i>Geophaps scripta scripta</i>)	<p>Specific outcomes for Squatter pigeon are:</p> <ul style="list-style-type: none"> • Avoid and minimise injury and mortality to Squatter pigeons across the Project area through sequential clearing, reducing vehicle speed and reducing pest animal populations that are a direct threat to species; • Maintain Squatter pigeon habitats outside of disturbance footprints; • Maintaining local water supply/availability and water quality to ensure breeding habitat is not reduced; • Managing weed cover to maintain Squatter pigeon habitat quality.
Ornamental Snake (<i>Denisonia maculata</i>)	<p>Specific outcomes for Ornamental Snake are:</p> <ul style="list-style-type: none"> • Avoid and minimise injury and mortality to Ornamental Snake across the Project area through sequential clearing, reducing vehicle speed and reducing pest animal populations that are a direct threat to species; • Maintain Ornamental Snake habitats outside of disturbance footprints; • Manage grazing and weed cover to maintain Ornamental Snake habitat quality.
Australian Painted Snipe (<i>Rostratula australis</i>)	<p>Specific outcomes for Australian Painted Snipe are:</p> <ul style="list-style-type: none"> • Avoid and minimise injury and mortality to Painted Snipe across the Project area through sequential clearing, reducing vehicle speed and reducing pest animal populations that are a direct threat to species; • Maintain Australian Painted Snipe habitats outside of disturbance footprints; • Manage grazing and weed cover to maintain Painted Snipe habitat quality. • Maintain quality of wetlands and existing dams to ensure habitat is not reduced.

Table 5.1 **Specific MNES environmental outcomes**

MNES	Outcomes
Brigalow TEC	<p>Specific outcomes for Brigalow TEC are:</p> <ul style="list-style-type: none">• Maintain Brigalow TEC areas outside of disturbance footprints;• Prevent the introduction and spread of weeds to reduce threats to the Brigalow TEC;• Avoid and minimise hot bushfires occurring in Project area with fire excluded from Brigalow TEC patches.

5.2 Mitigation and management measures

To support achieving the environmental outcomes listed in Section 5.1 a number of mitigation and management measures are proposed (as outlined in Table 4.1 - Table 4.3). Further detail on key measures are provided below. The implementation schedule for each of the mitigation and management measures is outlined in Appendix C.

5.2.1 Weed management

Weed management will occur across the Project area, during all Project phases. The aim of weed management is to minimise the introduction, establishment and spread of restricted and prohibited pest plants under the *Biosecurity Act 2014* (BS Act) (Qld) and other invasive species, not regulated under the BS Act, that present a threat to vegetation communities and species habitat in the Project area.

Weed management will focus on preventing introduction and spread of weeds to the Project area and reducing the extent of existing weed infestations (with a particular focus on MNES habitat areas being retained along Isaac River) (Figure 4.1). Weeds are a recognised threat to MNES species including Squatter Pigeon (TSSC 2015), Australian Painted Snipe (TSSC 2013a) and Brigalow TEC (TSSC 2013b).

It is proposed a baseline weed survey will be completed in the first year of Project commencement. This will be implemented in conjunction with habitat quality assessments for those MNES habitat areas being retained. The survey will confirm weed species present, their distribution, and percentage cover across these MNES habitat areas. Large infestations will be mapped, and permanent photo monitoring points established.

Accordingly, a strategic grazing regime will be implemented to reduce the presence and biomass of exotic pasture grasses in the Project area and assist to manage weeds (refer to Section 5.2.3). Increased biomass can increase likelihood of hot bushfires occurring which is a recognised threat to Greater Glider and Brigalow TEC.

To supplement this, weeds will be managed using chemical and/or mechanical control in accordance with the control measures outlined in the Biosecurity Queensland Fact Sheets, for the relevant weed species on an annual basis. Weed biomass may also be reduced through a combination of crash grazing, slashing and/or hazard reduction burns and cool burns where relevant as grazing isn't permitted in riparian zones.

5.2.2 Feral animal management

Feral animal management will aim to reduce feral animal populations within the Project area and the habitat degradation they cause to MNES habitats. Invasive species have numerous negative impacts on native flora and fauna and the environment including habitat destruction, predation of small animals and potential disease transmission. Feral animals are a recognised threat to MNES species such as feral pigs for Ornamental Snake (DoE 2014b), foxes and cats on Squatter Pigeon (DEWHA 2008, DoE 2015) and wild dogs for Koalas (DoE 2014a).

Table 5.2 provides examples of approved species-specific feral animal control measures recommended by the Queensland and Commonwealth governments. Control of feral fauna will be undertaken via several methods that are:

- species specific (wherever possible);
- cause no or little damage to the natural environment;
- are undertaken by suitably qualified and experienced contractors;
- are humane; and
- meet relevant Work, Health, Safety and Environment regulatory requirements.

Results of feral animal assessments will be reviewed following each reporting event to inform the need for, location and timing of species-specific control measures in subsequent years.

Table 5.2 Species-specific control methods for feral animals

Species	Biosecurity Act 2014 status	Control method
Pig (<i>Sus scrofa</i>)	Category 3,4,6	Trapping – funnel entrance/tripped-gate entrance/pig-specific trigger Shooting – ground shooting or shooting from helicopter Poisoning – 1080 poison baits selectively positioned (DAF 2020a)
Wild dog (<i>Canis lupus familiaris</i>)	Category 3,4,6	Ground baiting – 1080 and PAPP poison baits selectively positioned Foot hold traps – must be padded or offset laminated jawed traps Shooting - opportunistic method (DAF 2020b)
Fox (<i>Vulpes vulpes</i>)	Category 3,4,5,6	Ground baiting – 1080 and PAPP poison baits selectively positioned Shooting – highly selective and carried out at night (DAF 2020c)
Feral cat (<i>Felis catus</i>)	Category 3,4,6	Shooting - highly selective and carried out at night Poisoning – fresh meat baits containing 1080 poison baits Trapping – rubber-jawed, leg-hold traps in ideal locations (DAF 2020d)
Rabbit (<i>Oryctolagus cuniculus</i>)	Category 3,4,5,6	Baiting – 1080 and pindone poison baits placed along bait trails Fumigation – before and during breeding season in burrows Trapping – cage trap/barrel trap Shooting – when rabbits are most active (DAF 2020e)

5.2.3 Grazing management

Livestock will be excluded from all riparian areas as required by Condition 46(c) of EPBC approval (EPBC 2017/7867). The riparian areas where grazing will not occur are illustrated in Figure 4.2.

In other areas that are not required for active mining, strategic grazing will be used to assist in managing fuel loads and weeds. Fuel load, or biomass, describes the fallen bark, leaf litter and small branches accumulating in the landscape (Geoscience Australia 2020). Increased biomass can increase likelihood of hot bushfires occurring which is a recognised threat to Greater Glider (TSSC 2016) and Brigalow TEC (TSSC 2013b). To minimise impacts on MNES habitats and any degradation of soils and water quality, strategic grazing will be excluded where rainfall causes inundated or waterlogged soils.

The following habitat types are considered sensitive to grazing and require different management strategies:

- riparian areas along major watercourses including existing remnant riparian vegetation and regenerating riparian vegetation;
- gilgai landforms including gilgai in cleared agricultural grasslands/shrublands as they provide habitat for Ornamental Snake;
- other remnant woodland areas; and
- regrowth woodland areas.

Table 5.3 outlines the biomass management strategies to be implemented for each habitat type and triggers for grazing.

Table 5.3 Biomass load management strategies

Grazing management area	Management strategy	Trigger for control
Riparian areas along watercourses	<p><i>Grazing is excluded</i></p> <p>To ensure creek banks are not degraded, existing riparian vegetation is retained and natural regeneration along riparian areas can occur, it is proposed grazing is excluded from these areas. Major watercourses and adjacent riparian areas (at least 50 m either side of any major water source) will be fenced off. Off-stream watering points will be installed to ensure cattle have adequate access to water. Areas not permitted to be grazed are shown in Figure 4.2.</p> <p>As riparian environments are susceptible to erosion, control utilising fire would also be avoided.</p> <p><i>Slashing</i></p> <p>Where control of fuel load/biomass is required, slashing would be preferred over grazing. Slashing will need to ensure no native tree saplings are harmed.</p>	<p>For biomass control:</p> <ul style="list-style-type: none"> restricted to areas with biomass cover of exotic species of >50%; slashing to be undertaken using manual brush cutters to a height of no less than 20 cm; and slashing to occur immediately prior to flowering and seeding period of key weed species to reduce seed set.
Gilgai landforms	<p><i>Grazing is excluded at certain times of year</i></p> <p>During set times of year (wet season) or following significant rainfall (>50 mm in 7 days), grazing will be excluded in these gilgai areas to ensure gilgai habitats are protected.</p> <p>At other times grazing will be used to control biomass and/or weeds in line with the grazing strategy outlined below for remnant woodland, regrowth woodland and cleared agricultural grasslands.</p>	<p>Following significant rainfall (>50 mm in 7 days), grazing will be excluded in these gilgai areas to ensure gilgai habitats are protected.</p> <p>Where grazing is permitted in these areas for biomass control refer to triggers set out below based on type of vegetation.</p>
Remnant woodland	<p><i>Grazing permitted to reduce biomass</i></p> <p>Crash grazing will be used to maintain native vegetation and grassy open woodland ecosystems. Crash grazing will be undertaken at specific times of year for short periods to control weed cover or control excessive grass biomass in above average growth seasons.</p> <p>Grazing will be undertaken at a time of year immediately prior to flowering of key weed species to reduce seed set, or as required to control biomass.</p> <p>Grazing should be excluded from any areas with low levels of weed cover (<50%) or low biomass (<70%).</p> <p><i>Cool mosaic burns to reduce biomass</i></p> <p>Fire will be implemented to control fuel load/biomass in line with recommendations in Section 5.2.4.</p>	<p>For biomass control:</p> <ul style="list-style-type: none"> Restricted to areas with biomass cover of >70%. Grazing undertaken within a grazing window, avoiding key growth period for native species. Groundcover maintained at a minimum of 70%. Sward heights of dominant grasses maintained at following minimum sward height: <ul style="list-style-type: none"> Short grasses (<0.6 m): maintained at 5 cm bulk sward height. Medium grasses (0.6 m to 1.2 m): maintained at 10 cm bulk sward height. Large grasses (>1.2 m): maintained at 20 cm bulk sward height. <p>Fire may be used to manage biomass, in line with recommendations in Section 5.2.4.</p>
Regrowth woodland	<p><i>Grazing excluded from young saplings/planted tubestock</i></p> <p>Areas of existing naturally regenerating native vegetation (i.e. naturally occurring areas of saplings or 'suckers') should be fenced off and grazing excluded. Grazing may not occur in these areas until the saplings</p>	<p>Exclude all grazing in naturally regenerating areas until saplings are capable of withstanding impacts from livestock (approximately 2–3 years).</p> <p>For weed control:</p> <ul style="list-style-type: none"> Restricted to areas with weed cover of >50% or areas with high threat weed (WONS or Bio Act listed).

Table 5.3 Biomass load management strategies

Grazing management area	Management strategy	Trigger for control
	<p>are of a size to withstand grazing and browsing from stock (approximately 2–3 years).</p> <p>After such time, crash grazing will be used to maintain native vegetation and grassy ecosystems. Crash grazing will be undertaken at specific times of year for short periods to control weed cover or control excessive grass biomass in above average growth seasons.</p> <p>Grazing will be undertaken at a time of year immediately prior to flowering of key weed species to reduce seed set, or as required to control biomass.</p> <p>Grazing should be excluded from any areas with low levels of weed cover (<50%) or low biomass (<70%).</p> <p><i>Cool mosaic burns to reduce biomass</i></p> <p>Fire will be implemented to control fuel load/biomass in line with recommendations in Section 5.2.4.</p>	<ul style="list-style-type: none"> • Grazing timed to occur immediately prior to flowering and seeding period of key weed species to reduce seed set. • Grazing undertaken for very short periods (time will be depending on paddock size, generally days). • Grazing removed once reduction in seed heads has occurred. <p>For biomass control:</p> <ul style="list-style-type: none"> • Restricted to areas with biomass cover of >70%. • Grazing undertaken within a grazing window, avoiding key growth period for native species. • Groundcover maintained at a minimum of 70%. • Sward heights of dominant grasses maintained at following minimum sward height: <ul style="list-style-type: none"> – Short grasses (<0.6 m): maintained at 5 cm bulk sward height. – Medium grasses (0.6 m to 1.2 m): maintained at 10 cm bulk sward height. – Large grasses (>1.2 m): maintained at 20 cm bulk sward height. <p>Fire may be used to manage biomass, in line with recommendations in Section 5.2.4.</p>
Cleared agricultural grasslands	<p><i>Grazing permitted to reduce biomass</i></p> <p>Crash grazing will be used to maintain native vegetation and grassy ecosystems. Crash grazing will be undertaken at specific times of year for short periods to control weed cover or control excessive grass biomass in above average growth seasons.</p> <p>Grazing will be undertaken at a time of year immediately prior to flowering of key weed species to reduce seed set, or as required to control biomass.</p> <p>Grazing should be excluded from any areas with low levels of weed cover (<50%) or low biomass (<70%).</p> <p>Once evidence of natural regeneration is occurring, the grazing management strategy for regrowth woodlands outlined above should be applied.</p> <p><i>Cool mosaic burns to reduce biomass</i></p> <p>Fire will be implemented to control fuel load/biomass in line with recommendations in Section 5.2.4.</p>	<p>For biomass control:</p> <ul style="list-style-type: none"> • Restricted to areas with biomass cover of >70%. • Grazing undertaken within a grazing window, avoiding key growth period for native species. • Groundcover maintained at a minimum of 70%. • Sward heights of dominant grasses maintained at following minimum sward height: <ul style="list-style-type: none"> – Short grasses (<0.6 m): maintained at 5 cm bulk sward height. – Medium grasses (0.6 m to 1.2 m): maintained at 10 cm bulk sward height. – Large grasses (>1.2 m): maintained at 20 cm bulk sward height. • Fire may be used to manage biomass, in line with recommendations in Section 5.2.4. <p>Once regeneration is evident, exclude all grazing in naturally regenerating areas until saplings are capable of withstanding impacts from livestock (approximately 2–3 years).</p>

5.2.4 Fire management

Access tracks and fencelines will be used as firebreaks within the Project area, and fire exclusion zones around infrastructure will be established.

The firebreaks will be maintained by grading along:

- all existing/proposed fence lines;
- all existing access tracks bordering or traversing Project area; and
- strategic grazing will be used to control fuel loads, where appropriate/necessary (see Section 5.2.3).

Grazing will be permitted in sections of the Project area on a managed and limited basis to control weeds and reduce fuel loads. The suitability of conditions for undertaking a grazing event will be informed by biomass monitoring events (see Section 5.2.3).

When necessary, fuel management (eg cool mosaic hazard reduction burns prior to the dry season) will be undertaken in consultation with the Qld Rural Fire Service (RFS). Consultation with RFS will also be required for controlled burning at appropriate intervals to promote regeneration and germination of native vegetation communities and species. Fire will be excluded from the Brigalow TEC patches.

5.2.5 Nest boxes

Nest boxes will be used to provide supplementary breeding and sheltering habitat that have been removed through vegetation clearance within the impact area. The target species for nest box utilisation is the Greater Glider, and the proposed nest box program is currently proposed to be trialled for Stage 1 of the project. These will be installed within adjacent suitable habitat that is not within any future disturbance areas. Pre-clearance ecology surveys will confirm exact location for nest boxes, and broad area will be within those areas along Isaac River shown in Figure 3.1.

They are known to use a large number of hollows within the home range, and they can use between 2-18 different hollows. They do not appear to build a nest as such, however, occasionally there is a lining of leaves (Wildlife Preservation Society of Qld 2019).

Considerations for the installation of nest boxes include:

- the target species;
- tree hollow preferences of native hollow-dependant fauna known or likely to occur in the locality;
- the sizes, types and quantities of potential tree hollows removed in the clearing process;
- the sizes, types and quantities of tree hollows existing in adjacent areas;
- the design, materials and quantity of nest boxes required; and
- monitoring and maintenance of the nest boxes.

i Greater Glider nest box design

Pembroke propose for the Stage 1 project, that during pre-clearance surveys mapping of all hollow-bearing trees to be removed during clearance including their exact location, size (DBH), number of hollows, entrance size, height,

and aspect are recorded. Tree hollows that meet the requirements for Greater Glider will be specifically identified and mapped. It is proposed that all suitable Greater Gliders hollows be replaced on a 1:1 basis with nest boxes (see Figure 4.1 for specific detail).

Based on literature review the design and installation of Greater Glider nest boxes should include:

- inner width/height of 250x300 mm;
- depths of 400 mm;
- entrance diameter of 80-90 mm;
- height above ground above 6-8 m; and
- rear entranced to face the host tree trunk (Hollow Log Homes, 2015).

It is proposed that three nest box types are trialled. This includes:

1. Birch Plywood Boxes – installed the with ‘Habisure System’ (Franks & Franks 2006) to prevent inadvertent tree damage (Plate 5.1). These boxes have a lifespan of 10 - 15 years;
2. CYPLAS Boxes - Made from 100% Recycled HDPE (High density polyethylene) and Queensland Cypress installed with the ‘Habisure System’ (Franks & Franks 2006) to prevent tree damage. These boxes are Termite and rot proof and have a lifespan of at least 30years; and
3. Salvaged large tree hollows retrieved from the clearing area.

ii Installation method

Pembroke commit that 50% of the identified Greater Glider potential tree hollows will be replaced prior to clearing commencing for Stage 1. With the remainder to be installed during clearing phase which is to occur over a 12-18 month period. The intent of installing a number of nest boxes for Greater Glider prior to clearing occurring is that they will provide alternative habitat for individuals displaced during clearing activities.

Salvaged tree hollows will be installed during the clearing phase.

A suitably qualified ecologist will supervise the installation of nest boxes in accordance with this plan. The ecologist would decide on the precise host trees taking into account information within this plan as well as the following factors:

- selecting mainly larger trees (both in dbh and canopy cover) for host trees where possible;
- selecting trees within genera known to be utilised by the target species (e.g. *Eucalyptus*, *Corymbia*, *Angophora*);
- consideration of location of habitat connectivity structures (i.e. glider crossing structures), existing hollows and food resources in relation to nest box location;
- the fixing arrangements for nest boxes with rear facing entrance holes will allow spaces between the nest boxes and trees for fauna to access the nest box (RMS 2017);
- nest boxes should generally be orientated between northwest and east to avoid hot afternoon sun and the dominant direction of severe storms. Rear entranced Glider boxes will have limited aspect-related issues (RMS 2014); and

- nest boxes should be placed in areas with limited artificial light sources.

Actual spacing of nest boxes within the recipient area will be determined based on consideration of the characteristics of available habitat including density of appropriate trees, existing hollows and target species for particular remnant vegetation patches.

Nest boxes will be attached to trees using the Habisure System (Franks & Franks 2006) (Plate 5.1 and Plate 5.2). This attachment method is recommended as it allows for at least one metre of diameter growth of the host tree before adjustment is required. Bolting or screwing nest boxes to trees is not recommended due to increased damage to trees and a comparatively short lifespan.

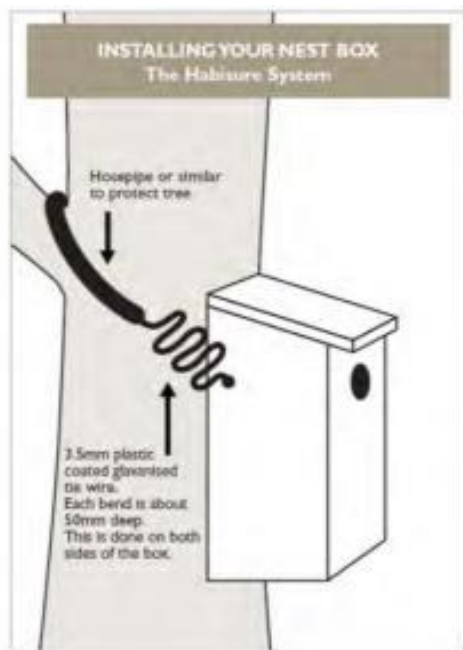


Plate 5.1 Habisure system of nest box attachment (Franks and Franks 2006)



Plate 5.2 **Nest box installed with habisure method on Jinker Track, Morton Bay Regional Council (EMM 2020)**

iii **Maintenance of nest boxes**

Maintenance inspections are to be undertaken in conjunction with monitoring events. Potential maintenance works would involve:

- repairing nest boxes;
- reattaching nest boxes to trees;
- removal of feral species (including possible retrofitting of nest boxes to exclude feral species);
- removal of excessive denning material (i.e. leaf litter);

- replacement of fallen, damaged or degraded nest boxes; and
- repositioning or relocation of dysfunctional nest boxes. If nest boxes need to be removed from the site for repair and shows signs of native fauna usage, alternative nest boxes will be installed in the same location upon removal of the damaged box (RMS 2017).

Monitoring of nest box use by Greater Gliders is outlined in Section 6.2.

iv Nest boxes best practice

Best practice has been shown in projects undertaken by Government departments such as Roads and Maritime (RMS) in NSW who have been installing artificial hollows (i.e nest boxes) for many years and have had success with gliders and other arboreal mammals using the nest boxes. Brisbane City Council is also undertaking work with the Queensland Glider Network (QGN) where they had installed nest boxes into Greater Glider habitat to the north of Brisbane and undertaking monthly monitoring. In March 2018 they successfully recorded a Greater Glider using a nest box. The QGN's nest box monitoring programs in Brisbane have highlighted how successful and important nest box programs can be, but there are challenges as not all nest boxes are utilised by target species and there is competition for use of the artificial hollows by Brush-tailed Possums, Common Myna etc. Local governments in South East Queensland are also regularly installing nest boxes as best practice near glider rope crossings as shown in Plate 5.2.

Nest boxes have been found to be occupied in greater numbers when placed in younger forests where there are fewer hollows (Lindenmayer et al. 2009). Lindenmayer et al. (2009) identify the importance of targeting the locations where nest boxes are placed. Additionally, a study by Goldingay et al. (2018) identified the main loss of functionality of nest boxes was a lack of maintenance over time. By placing nest boxes in areas of lower hollow density retained habitat will be improved.

5.2.6 Fencing specification to exclude livestock from riparian areas

As mentioned in Section 5.2.3, grazing is to be excluded from riparian areas (Figure 4.2). Fencing is an integral part of land management by acting as a barrier for stock movements. However, fences can restrict the movement of native wildlife, and can cause serious injury and deaths. Barbed wire, in particular, is a major hazard for wildlife with more than 75 wildlife species identified in Australia as occasional or regular victims of barbed wire fences, especially nocturnal animals such as bats, gliders and owls. Barbed wire fences are identified as a threat to the Greater Glider (TSSC 2016).

For existing fences, the top strand of barbed wire will be replaced with plain or borderline (white plastic coated) wire this can significantly reduce the risk of entanglement. Reflectors will also be placed on the top wire to increase detectability at night by wildlife.

For new fencing design parameters will include:

- Design a fence to allow for animals to pass underneath. Leave a minimum of 40 cm between the ground and the bottom wire.
- Choose a plain, high-tensile fencing wire or borderline (white plastic coated) for top strand. If this is tensioned correctly, this fencing material can contain most stock. Put reflective material on top strand so fauna can more easily see this at night.
- Electric fencing can be used with caution. Electric fencing has shown to be effective in keeping cattle out and not injuring wildlife. The hot wire should be kept above 40 cm to allow for small animals to pass under with ease. As it is cheaper and quicker to construct it may be useful to be installed around revegetation areas or gilgai where it is for a shorter period and a permanent fence isn't needed.

Fencing will:

- ensure creek banks are not degraded;
- retain existing riparian vegetation;
- allow for natural regeneration along riparian areas;
- protect aquatic habitat and water quality; and
- reduce stock loss from bogging and drowning.

5.2.7 Koala monitoring (Stage 1)

Despite their relatively large size and not utilising tree hollows, Koalas can often be difficult to spot during pre-clearance surveys and during actual vegetation clearing. This makes them particularly susceptible to being overlooked during the tree felling and when this occurs, severe injuries or mortality can occur. To significantly reduce the chances of this occurring it is essential to have an accurate understanding of the likely numbers to be utilising a proposed clearing area, and to be able to accurately determine the location of Koalas within the impact area just prior to clearing. This is proposed to be done through monitoring with telemetry devices (i.e. GPS/satellite and/or VHF tags or collars). With the overall performance objective to avoid and minimise any injuries or mortality occurring to Koalas during vegetation clearing phase.

It is therefore proposed that a Koala monitoring program is implemented as a trial for Stage 1. The proposed monitoring will have added benefits in that it will provide additional information on the Koala population utilising the Project area (such as number of individuals, their health, breeding, age etc), their movements and effectiveness of mitigation measures being put in place. Pembroke therefore propose this Koala monitoring program goes towards meeting requirements under Condition 32 (EPBC 2017/7867) that finances are put towards activities that contribute to the better protection and long-term conservation of the Koala and Greater Glider in the Bowen Basin. Condition 36 provides examples of what these activities might be and includes:

- translocation programs to translocate Koala and Greater Glider individuals from the Project area during pre-clearance surveys and clearing to determine its success in reducing individual mortality and its effects on the population size of the Koala and Greater Glider;
- surveys to determine Koala and Greater Glider population density and carrying capacity across the Bowen Basin; and
- implement priorities identified in relevant recovery plans, threat abatement plans and/or approved conservation advice, and evaluate their success and cost effectiveness.

Translocation of Koalas is not proposed as it is a very intrusive way of moving Koalas from a clearing area and other studies have shown it is ineffective. It is preferred that other avoidance and mitigation measures are trialled, such as sequential clearing, use of fauna spotter catchers, and tracking Koalas through use of radio collars to learn more about the Koala populations prior to clearing commencing, being able to identify their location during clearing to ensure impacts do not occur, and allow them to naturally disperse from the area of their own volition and monitor their dispersal. Therefore this is both an avoidance and mitigation measure, as well as a research undertaking for the species.

The Koala tracking program will allow information to be gathered on:

- individuals health (such as disease);
- age;
- sex;
- breeding;
- number or individuals; and
- dispersal.

Koala monitoring will commence during pre-clearance surveys at least 3-4 weeks prior to clearing commencing to allow sufficient data be recorded relating to regular activity areas and movement. This will be undertaken by suitably qualified ecologists appointed by Pembroke who have the appropriate Scientific Purposes Permit (SPP) and animal ethics approval in place. It is proposed two teams will implement the Koala monitoring as it will go over a four month period therefore teams can work on rotation basis.

While monitoring during clearing is the most important component in order to fulfil the objective of not injuring or killing Koalas during the clearing process, monitoring is also essential to determine the fate of Koalas post clearing. It is proposed Koalas are monitored for at least 3 months post clearing to determine where they move to after clearing, survival rates and where they may settle. Previous studies have shown Koalas may take months to establish a new home range following impacts (i.e. clearing/translocation) and some individuals may travel long distances before settling.

A more detailed Koala Monitoring Implementation Program will be developed that will form the basis for the Scientific Purposes Permit (SPP) and Animal Ethics applications and approvals. These approvals are required from the Queensland Government before the monitoring can be undertaken. This will include specific methodologies, timing, personnel and costs. The document will be provided to DAWE for approval and be reviewed by an “independent suitably qualified expert”. The financial contribution for implementing this Koala monitoring program is proposed to go towards meeting Condition 32.

The proposed monitoring implementation plans will be reviewed by an “independent suitably qualified expert” and the documents will include information on:

- financial commitments;
- timeframes;
- outline of ecologists that will implement the activity;
- timing for peer review of outcomes;
- how the results will be made publicly available; and
- consultation undertaken with DES and any relevant recovery teams on proposed activities and how they will complement and/or align with other studies in Bowen Basin.

Results will be made publicly available on Pembroke’s website.

Using telemetry to understand how Koalas use the Project area will significantly increase the likelihood that Koalas will not be injured during clearing and allow for adaptive management of the species during clearing phase. For example, Goldingay and Dobner (2013) were able to use GPS tracking to identify common routes for Koalas through a fragmented urban area to see where future management should include strategic habitat tree planting. By understanding Koalas movements in the Project area and potentially adjacent areas will assist Pembroke to identify the best mitigation approaches including location for exclusion fencing.

Koala monitoring using GPS prior to, during vegetation clearing and post vegetation clearing, has been used successfully in the Qld Moreton Bay Rail Project and the Toowoomba Second Range Crossing. No Koalas were injured during the clearing of vegetation for these projects as they were tracked and monitored in detail using the telemetry method. These programs also helped understand Koala population numbers in the Project area, the health of that population, threats and their dispersal.

5.2.8 Koala connectivity structures: exclusion fencing and Koala poles

Koala exclusion fencing and poles will be installed in key locations to serve the following purposes:

- retain and protect Koala habitat values in their natural state to allow koalas to feed, rest and move around;
- achieve permeability for Koalas through the landscape to ensure the safe movement of Koalas within and across a site; and
- reduce threats to resident and transient Koalas (DES 2019).

Specifically, Koala exclusion fences and poles will keep Koalas outside of active mine areas, avoid and minimise Koala injuries including from vehicles, and maintain their connectivity along Isaac River and to habitats in south. Koala exclusion fencing locations are highlighted in Figure 5.1. These are designed for Stage 1 only. Koala poles will be installed every 200m along the fenceline.

Installing fencing material that is unclimbable discourages Koalas from climbing the fence and entering the active mine area. Chain wire fencing with a smooth metal or perspex sheet on top of the fence in the direction that the Koala will attempt to climb is the preferred fencing material type (Plate 5.). The following specifications should be considered to ensure the effectiveness of koala exclusion fencing:

- The top of the unclimbable section of fencing must be least 1.5 m from the ground to prevent koalas jumping and gripping the top of the fencing.
- Fence bracing or supports are on the mining side of the fence, away from koala access.
- Fencing should extend to ground level along uneven or undulating ground.
- Escape poles should be placed on the mining side to allow koalas trapped in the mine to exit into habitat (Plate 5.). Escape poles will be installed at least every 200 m along the fenceline.
- Smooth metal or perspex sheet can be placed at the base of the fenceline to stop the movement of small to medium sized reptiles (Plate 5.) (DES 2019).

Koala exclusion fencing requires regular maintenance. Vegetation beside the fence should be regularly maintained to exclude trees and shrubs from within 3 m of the fence, to keep canopies of trees trimmed to remove links to tree canopies on the other side of the fence, and to remove fallen branches and vine growing on the fence which Koalas may use to climb over the fence.

Specific dimensions for Koala exclusion fencing are; galvanised chain-link fence with 2,100 x 50 x 3.15 mm mesh. Fence to be 1.5m in height. Metal sheeting to be attached to the top of the fence. Three strands of plain wire are to be placed at 60 mm and 1200 mm from the ground, with the remaining wire at the top of the posts. Ground mesh 600 x 50 x 2.5 mm to be placed 200 mm from the bottom, turned and pegged to the ground for a min. 400 mm. Posts to be spaced at max.3000 mm. Referred to as 'Qld Style Koala Fence' (Plate 5.3).



Plate 5.3 Koala exclusion fencing Jinker Track, Morton Bay Regional Council (EMM 2020)



Plate 5.4 Koala escape pole (DES 2019)

i Koala connectivity structure best practice

Koala fencing is required to exclude the species from areas in which they could be harmed such as highways, active mine sites, areas with heavy machinery etc. Fencing is key in avoiding and mitigating animal access to roads in order to avoid vehicular strike. RMS highway upgrades in NSW have used Koala exclusion fencing successfully across multiple highway upgrades and the above method of fencing is approved by DES and standard in all Qld Road Projects. Queensland Department of Transport and Main Roads (TMR) outline this method in the *Fauna Sensitive Design Road Manual: Volume 1 - Past and Existing Practices* (DMR 2000).

Koala exclusion fencing is also now standard for South East Queensland local governments when upgrading roads to ensure impacts from vehicle strike are minimised to Koalas where their habitat occurs on one or both sides. Koala exclusion fencing combined with Koala poles are shown to be an effective measure to reduce Koala mortality.

5.2.9 Greater Glider connectivity structures: rope ladder crossings

Greater Glider rope ladder crossings will be installed at each of the five clearance corridors within the Isaac River and Ripstone Creek riparian zones as required by Condition 46 (Figure 5.2). The objective is to support the movement of Greater Gliders across the river at these locations, where there is suitable habitat either side.

Rope ladder crossings have the potential to restore habitat connectivity disrupted by roads for some arboreal mammals, as confirmed by a 2012 study on the Pacific Highway monitoring the use of rope bridges by arboreal mammals. Several species of possum and glider were observed using the crossings (Goldingay 2012). Rope ladder crossings are generally attached to recycled electricity poles and have cables in the adjacent vegetation to provide tension and access (VicRoads 2012).

Rope ladder crossing design and materials will be based on the most up to date standards and design shown to be effective for gliders and crossing wide spans such as roads. There are two main rope ladder designs being:

1. Flat rope design - designed for the glider, squirrel and ringtail possums (Plate 5.6).

2. Boxed rope design - designed for the protection of the sugar glider, squirrel glider and possums (Plate 5.5).

These ladders range from 40 to 80 metres long and are made in 10 metre segments to allow easy installation.



Plate 5.5 Box Rope ladder crossings (image left with cables to adjacent trees) (Left Photo: EMM 2020, Right photo: Fauna Crossings 2020)



Plate 5.6 Flat rope ladder crossing design Jinker Track, Morton Bay Regional Council (EMM, 2020)

An advantage of rope ladder crossings is that they can be used by non-gliding arboreal fauna, such as the Brush-tailed Phascogale, Antechinus species, possums and small gliders (Sandpiper Ecological Surveys 2013). Rope bridges also provide greater flexibility as they can be designed to fit the forest gap, do not always rely on retention of tall trees close to the highway and avoid the need for median poles, except where there are larger gaps, thereby avoiding safety issues with such poles (Sandpiper Ecological Surveys 2013).

Rope bridges are generally attached to recycled electricity poles and have cables in the adjacent vegetation to provide tension and access.

Design considerations will include:

- the rope bridge is to be attached to suitable poles located at a safe distance back from the river;
- the exact location of the poles is to be determined on site and should consider locations of Greater Glider records and habitat trees at that location and adjacent;
- rope bridges must be linked to adjacent habitat for target species (habitat trees) eg via ropes or ladders tied off from the poles into surrounding trees. Nearby trees are essential to link the canopy bridge into the surrounding vegetation;
- design to provide a minimum seven metre clearance above the ground; and
- predator shields and pipes should be installed to discourage avian predators and provide shelter. Designs may include one or more cross bars, shelter pipes, and predator shields.

A remote camera trap will be placed on either end of the rope ladder crossing during installation by suitable qualified personnel to maintain a record of fauna usage. The cameras will be powered by solar panels. Usage of the crossings will be included in monitoring (Section 6.2) and annual reporting (Section 7.1).



Plate 5.2 Camera to detect species using rope ladder crossing (Faunatech 2020)

i Greater Glider connectivity structure best practice

Rope crossings have been used as standard practice by RMS NSW for mitigating fragmentation impacts on arboreal species such as Greater Gliders on projects such as the Karuah Bypass. TMR and SEQ local governments have been adopting the use of rope crossings for Gliders and other arboreal animals, such as on the Bruce Highway Upgrade.

They have become common practice and monitoring is showing them to be effective in providing connectivity for the species across cleared areas of habitat.

5.2.10 Greater Glider monitoring (Stage 1)

The Stage 1 area is known to support Greater Glider habitat and individuals have been recorded to the north and east along the Isaac River (Figure 2.3). It is proposed that if Greater Gliders are found in tree hollows during pre-clearance surveys in the Stage 1 clearing area, that they are collared and radio-tracked to gather information including:

- their dispersal within the Project area and surrounding areas during and post clearing;
- determine if they are utilising nest boxes that have been installed prior to clearing along the Isaac River and adjacent habitats (Figure 4.1);

- the health of individual Greater Gliders; and
- population numbers.

While mitigation actions will be implemented to encourage natural dispersal of Greater Glider from the clearing area, it is likely many will remain in their preferred denning trees at the time of clearing. Therefore, prior to felling, each habitat tree (known or suspected to be used by Greater Glider) will be inspected using an EWP.

Suitably qualified ecologists/wildlife spotter-catchers will inspect each trees hollow for Greater Glider. If the species is present, they will be captured by hand if possible. Or in a situation where they are too deep within a hollow to be reached, the hollow entrance will be blocked with a rag or towel and the limb cut where solid below the den. This latter method is preferred as it will cause less stress on captured Greater Gliders as opposed to physically extracting them from hollows during daylight.

Once gliders are captured (either bagged or remaining in a hollow limb), they will be placed in a quiet, shady and cool location until release that night in the pre-determine release area/s. Those gliders within recovered hollows, will have the rag/towel removed from the hollow limb and will be left to emerge in their own time.

Prior to release, those Greater Gliders that are to be monitored post release will be fitted with a radio-collar.

The monitoring of Greater Gliders is proposed as a trial for Stage 1. It will provide important information on Greater Glider populations in the Project area and enable learnings in terms of where Greater Gliders are dispersing, are they utilising nest boxes and their survival rates post clearing of their original denning tree. Monitoring is proposed to occur during clearing and three months post clearing.

Pembroke propose this Greater Glider monitoring program goes towards meeting requirements under Condition 32 (EPBC 2017/7867) that finances are put towards activities that contribute to the better protection and long-term conservation of the Koala and Greater Glider in the Bowen Basin. Condition 36 provides examples of what these activities might be and includes:

- translocation programs to translocate Koala and Greater Glider individuals from the **project area** during pre-clearance surveys and **clearing** to determine its success in reducing individual mortality and its effects on the population size of the Koala and Greater Glider;
- surveys to determine Koala and Greater Glider population density and carrying capacity across the Bowen Basin; and
- implement priorities identified in relevant recovery plans, threat abatement plans and/or approved conservation advice, and evaluate their success and cost effectiveness.

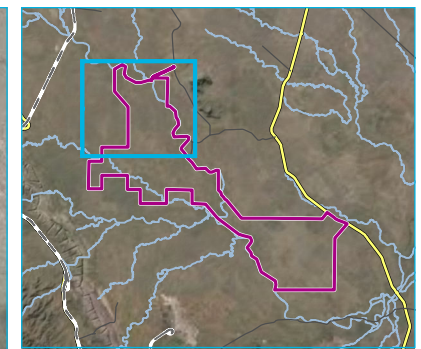
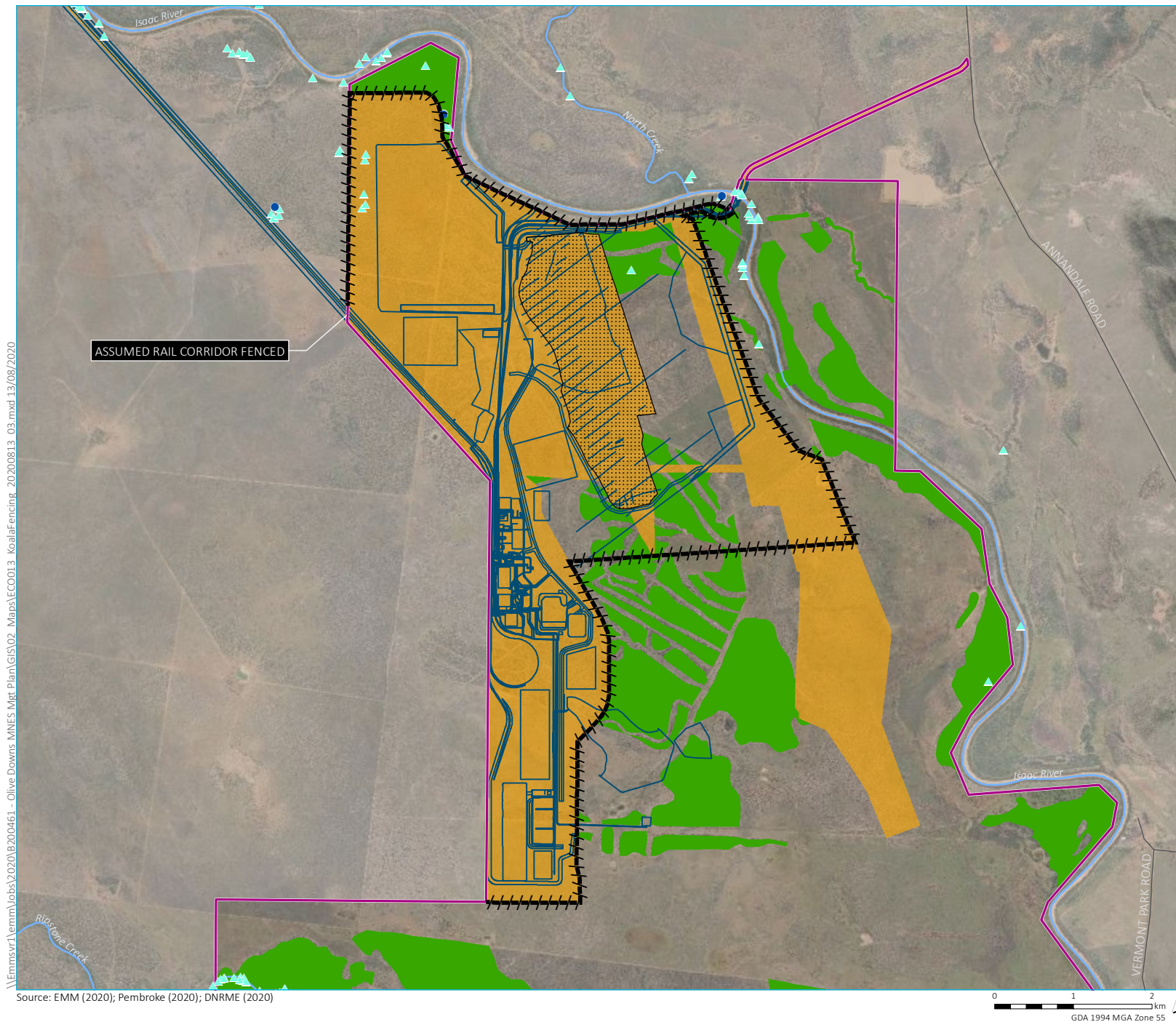
A more detailed Greater Glider Monitoring Implementation Program will be developed that will form the basis for the SPP and Animal Ethics applications and approvals. These approvals are required from the Queensland Government before the monitoring can be undertaken. This will include specific methodologies, timing, personnel and costs. The document will be provided to DAWE for approval and be reviewed by an “independent suitably qualified expert”. The financial contribution for implementing this Greater Glider monitoring program is proposed to go towards meeting Condition 32.

i Greater Glider monitoring best practice

Similar to tracking Koalas with telemetry, it will be important to understand the populations of Greater Glider within the Stage 1 area, effectiveness of sequential clearing methods, their dispersal and use of nest boxes.

Not a lot of studies have been undertaken on Greater Glider use of nest boxes therefore this is considered a really useful monitoring program to implement. Key information can be gathered on where they are denning, how far they disperse, and are certain nest box designs and heights more preferred than others.

Figure 5.1 Proposed Koala exclusion fencing



- KEY**
- Proposed Koala exclusion fencing
 - Project area
 - Project stage 1
 - Mine pit 1
 - Mine site layout
 - Rail line
 - Major road
 - Minor road
 - Named watercourse
 - Koala habitat (outside stage 1)
- Koala records**
- Observed
 - Indirect evidence

DRAFT

Proposed Koala exclusion fencing

Olive Downs
MNES management plan
Figure 5.1

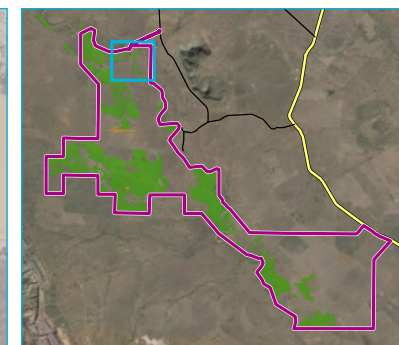
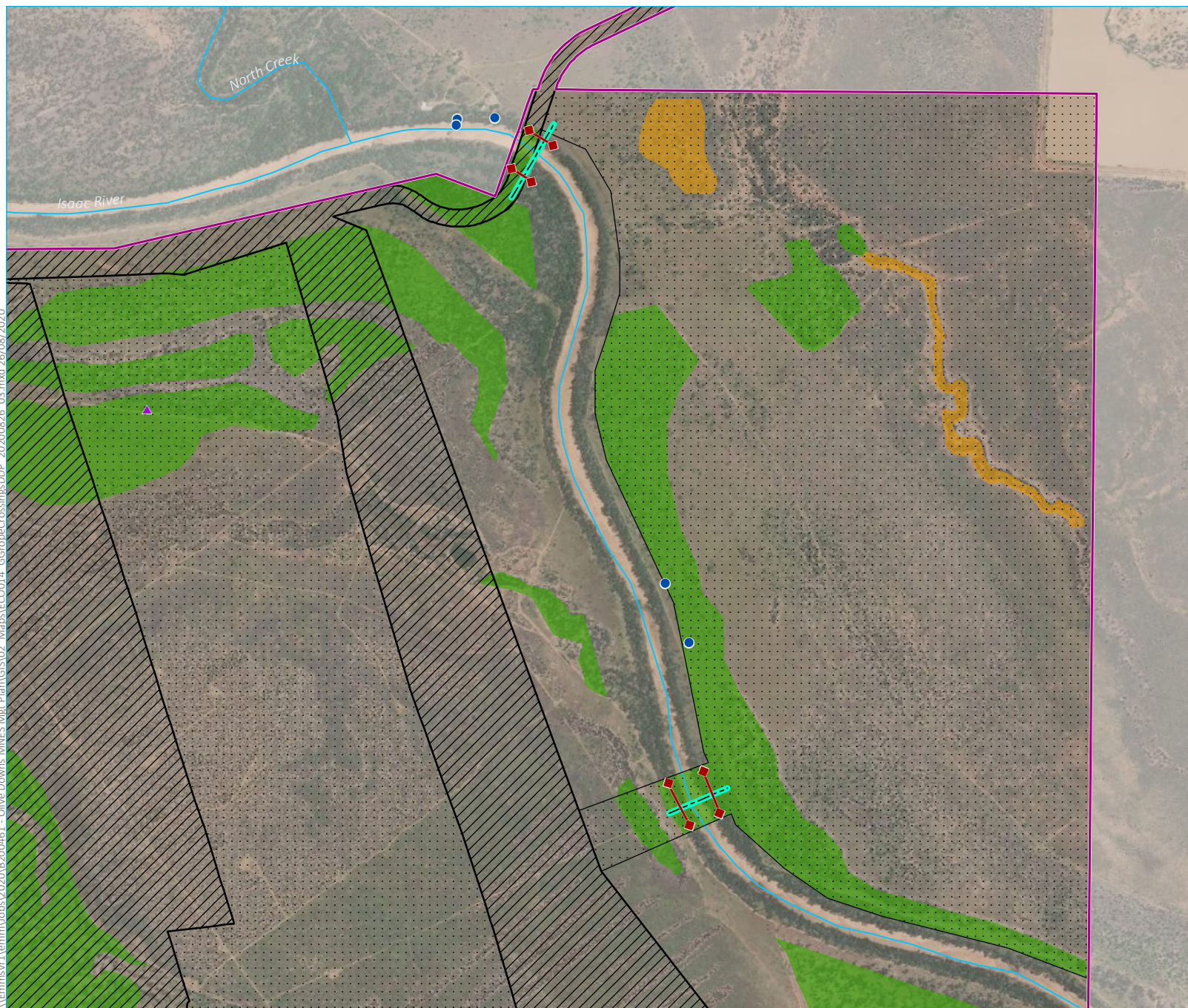


\\Emmsvr1\emmm\Jobs\2020\B\200461 - Olive Downs MNES Mgt Plan\GIS\02 Maps\ECO013 KoalaFencing_20200813_03.mxd 13/08/2020

Source: EMM (2020); Pembroke (2020); DNRME (2020)

Figure 5.2 Proposed Greater Glider rope ladder crossings

\\Emmsvr1\emms\Jobs\2020\B200461 - Olive Downs MNES Mit Plan\GIS\02 Maps\ECO014 - GropeCrossingsDOP - 20200826 03.mxd 26/08/2020



KEY

- ◆ Proposed rope ladder crossing location
- Project area
- Project stage 1
- Project stages 2-4
- Isaac River access road crossing
- Rail line
- Major road
- Minor road
- Named watercourse
- Greater Glider records
- Observed
- ▲ Indirect evidence
- Greater Glider habitat
- Remnant
- Regrowth

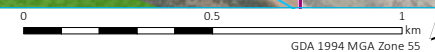
DRAFT

Proposed Greater Glider
rope ladder crossings
map 1 of 2

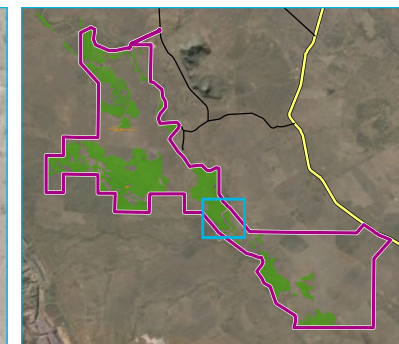
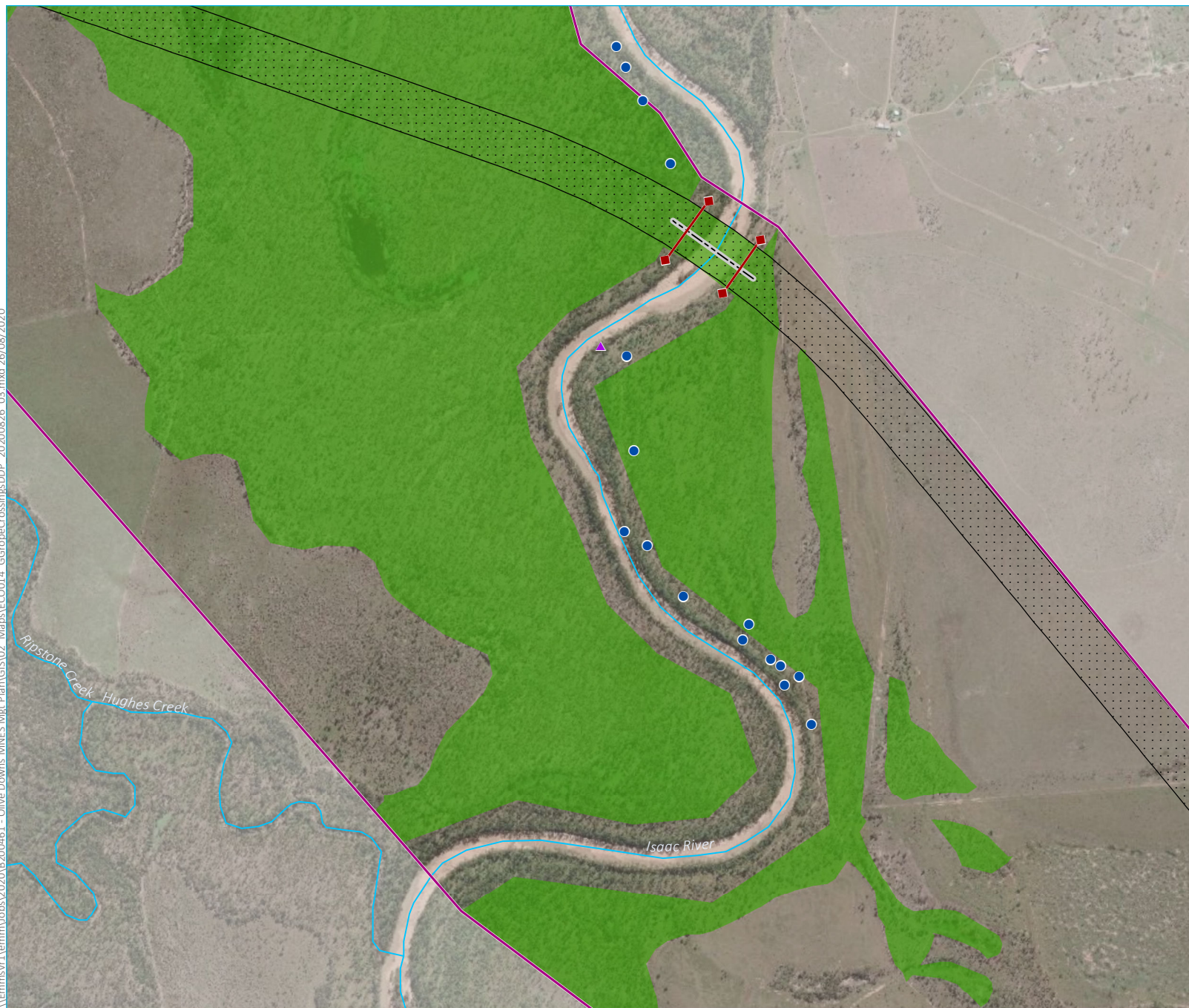
Olive Downs
MNES management plan
Figure 3.3



Source: EMM (2020); Pembroke (2020); DNRME (2020)



\\Emmsvr1\emmm\Jobs\2020\B200461 - Olive Downs MNEs Mgt Plan\GIS\02 Maps\ECO014 - GropeCrossingsDOP - 20200826 03.mxd 26/08/2020



KEY

- ◆◆ Proposed rope ladder crossing location
- Project area
- Project stage 1
- Project stages 2-4
- Isaac River crossing for conveyor belt
- Rail line
- Major road
- Minor road
- Named watercourse
- Greater Glider records
- Observed
- ▲ Indirect evidence
- Greater Glider habitat
- Remnant

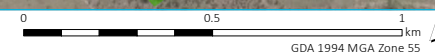
DRAFT

Proposed Greater Glider
rope ladder crossings
map 2 of 2

Olive Downs
MNEs management plan
Figure 3.3



Source: EMM (2020); Pembroke (2020); DNRME (2020)



5.2.11 Access road crossing design

An access road in the north of the Project area is required to allow entry to the site from Annandale Road. Where the access road crosses the Isaac River a bridge will be installed (Figure 1.2). The bridge will be raised and design elements will be included to allow native wildlife including Koalas to access the riparian corridor and be able to move north to south along the river. Under the bridge Koala fauna furniture will be installed to allow them to get off the ground in case of rainfall events where the water has come up higher on the bank, and to also evade predators.

Exclusion fencing will also be installed on either side of the access road (on both sides of the river) to ensure wildlife including Koalas cannot get onto the access road and bridge along the riparian area. Examples of fauna furniture under the bridge and fencing are shown in Plate 5.3 and Plate 5.4. Where feasible and reasonable, the design is to avoid placing piers in permanent water channels and on stream banks, to minimise alteration to water flow and/or damage to stream bank vegetation.

The bridge will be designed to include:

- a natural substrate at the abutment, such as soil or vegetation, where feasible and reasonable. Scattered rocks could be included;
- allow unimpeded water flow, stream bank and riparian vegetation, preferably on both sides of the water course; and
- the height of bridge will allow sufficient light and moisture to encourage growth of vegetation under the structures.

For effective connectivity, the 3.0 metre passage should consist of a natural substrate with refuge areas (scattered rocks, logs) and landscaping of the habitat corridor approach, not consisting of all rock and not consisting of scour protection. Note: location of piers should not restrict the designated fauna passage area or the width of the passage should be widened to accommodate the pier

Fauna fencing and landscaping would further improve connectivity by guiding fauna to the crossing and providing shelter within the crossing.



Plate 5.3 Koala furniture under bridge (RMS 2017)



Plate 5.4 Image shows fauna furniture under bridge and fauna exclusion fencing leading up to bridge (RMS 2017)

6 Monitoring

Pembroke commits to implementing a comprehensive monitoring program to ensure the MMP meets the environmental outcomes and performance criteria that have been established. A monitoring program has been developed and is detailed in following sections and summarised in Table 6.1.

The results of the monitoring program will be used to ensure identified avoidance, mitigation and management measures are being implemented effectively, to inform operational management decisions, to inform adaptive management of this MMP, and ultimately inform interim performance targets and completion criteria are met.

Results of monitoring will also be used to determine when corrective actions are required to be implemented. Monitoring results will also be reviewed from previous events to assess change over time and to inform the ongoing implementation of the MMP.

The monitoring methods are:

- specific to the MNES and performance criteria being assessed;
- designed to enable a determination if a criteria has been achieved or whether corrective actions are needed;
- quantitative and repeatable such that each monitoring event can be compared to each other to allow changes over time to be compared; and
- the frequency of monitoring will be sufficient to track progress towards each set of milestones, and sufficient to determine whether the milestones are likely to be achieved in adequate time to implement all necessary corrective action.

6.1 Project area inspections

The aim of general Project area inspections is to enable an assessment across the Project area to identify any potential issues that may require remedial action. These general inspections will be twice per year for the duration of the Project to assess the following:

1. Compliance with restrictions for vegetation clearing, and construction and operations are occurring within approved areas for that stage.
2. Check access tracks and firebreaks are being maintained.
3. Erosion and sediment control is being implemented effectively with a focus on areas adjacent to watercourses.
4. Fauna crossing structures, fencing, gates, vehicle speed signs are being maintained and in working order.
5. Weed hygiene protocols are being implemented.
6. Livestock are not within exclusion areas.
7. Check for any signs of land degradation (such as from feral animal activity).

6.2 Greater Glider crossings and nest box monitoring

i Rope crossings

A remote camera trap will be placed on either end of the rope ladder crossing to maintain a record of fauna usage. Camera footage will be reviewed quarterly for usage by Greater Gliders. Rope crossings will be visually inspected every six months to monitor the condition of the ropes. Any damaged rope crossings will be taken down and replaced immediately.

ii Nest boxes

Remote cameras will be installed on some nest boxes to maintain a record of fauna usage. Camera footage will be reviewed monthly for the first 12 months then quarterly for the next two years. Results will be reviewed to assess if the nest boxes have been successful.

Nest boxes will be visually inspected 6 months after their installation, and twice a year thereafter until construction is completed. These inspections should coincide with breeding cycles. Following the construction phase and during the operations phase, inspections will occur annually for at least 3 years. Ideally, monitoring should occur during late spring (RMS 2014). Monitoring will be conducted by a suitably qualified ecologist.

Visual monitoring can be undertaken with a flexible inspection camera pole to inspect the nest boxes. Observations including evidence of occupancy, species present, number of individuals and presence of pest activity will be recorded. During monitoring, nest boxes will be checked for wear and tear and may require maintenance. Any damaged nest boxes or nest boxes containing pest species will be taken down and replaced immediately.

6.3 Habitat quality monitoring

Habitat quality monitoring of MNES habitats (outside of approved Project stages) is proposed to demonstrate a decrease in habitat quality does not occur. Pembroke will be undertaking management activities in these areas to reduce threats such as weed management, feral animal management, grazing management and fire management to maintain habitat quality.

Habitat quality monitoring will be undertaken in accordance with the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2017) and converted to scores out of 10. Baseline sites will be established in representative patches of habitat for each MNES species and community in areas mapped in Figure 2.3 to Figure 2.8 (where the habitat occurs outside the approved disturbance areas). Habitat quality assessments will be undertaken by suitably qualified ecologists.

The habitat quality baseline surveys will be established in March/April of 2022. They will then be completed annually between March and April for the remainder of Stage 1. Habitat quality surveys will then be undertaken every second year for Stage 2 and every five years for Stage 3 and 4. Results will be compared to establish that habitat quality has not decreased overall, and any particular individual criteria have not worsened (i.e weed cover, canopy cover, recruitment etc).

This will provide benchmark scores for a number of key attributes including:

- recruitment;
- tree, shrub and grass species richness;
- canopy cover;
- canopy height;

- native grass cover;
- weed cover;
- connectivity;
- threats;
- quality of foraging;
- quality of shelter; and
- mobility.

Each survey site's data is scored individually against a BioCondition benchmark relevant to the RE represented at that site and compared against a set of maximum scores defined in the Guide to Determining Terrestrial Habitat Quality (DEHP 2017). The habitat quality assessments will also include permanent photo monitoring points to assist in assessing any changes over time, and assessment of weed abundance and distribution.

The same sites and methodology will be repeated at each monitoring event so scores can be compared for each attribute.

6.3.1 Photo monitoring

In areas where active management is being undertaken, photo monitoring offers a simple and effective visual means by which to capture the response of the vegetation to management actions. Photo monitoring will be conducted at all fixed habitat quality assessment monitoring sites. Photos at each photo monitoring point will be taken in a north, east, south and westerly direction. A permanent feature will be included within the photo frame to provide a fixed reference point. A record of the photographs will be maintained, including GPS co-ordinates, date, time, direction and the height above the ground the photograph was taken. Data from habitat quality assessments and photo monitoring will be recorded on survey sheets and these will be attached to the monitoring reports that will be included in the annual reports.

6.4 Weed monitoring

Weed monitoring sites will be randomly stratified, as well as having fixed monitoring sites at each of the MNES habitat quality transects. The weed monitoring sites will incorporate different vegetation communities (e.g. open woodland, riparian, Brigalow, wetlands). The fixed monitoring sites will be set at strategic trafficable areas (e.g. entry gates, creek crossings, stock watering points) to monitor potential introduction and/or irruptions of prohibited and restricted weed species.

Weed monitoring sites will be established in the first operational year of the Project as part of the weed baseline survey (discussed further in Section 5.2.1).

The Project area will be monitored for weeds every year (post wet season) for the first three years, followed by every two years for the remainder of the Project. Weed monitoring will determine the species richness and abundance, for the duration of the management period. The results of this monitoring will inform the methods for weed treatment and control (see Section 5.2.1).

Assessing the presence and abundance of weed cover will be done in accordance with the methodology outlined in the Guide for determining terrestrial habitat quality (DEHP 2017). Briefly, this method involves establishing a 50 m x 10m plot and dividing this plot into 20 smaller 5 m x 5 m sub-plots. Percent weed cover will be assessed in each

of the 20 sub-plots and the total percent weed cover determined by taking the average from the 20 plots. Photo monitoring will also be undertaken within each plot.

In addition to the permanent weed monitoring sites, all incidental observations of weeds will be recorded from the Project area during the six monthly general inspections of access roads, fencelines etc. Any new weed outbreaks noted will be recorded. This will provide instances of weed infestations that occur away from the permanent weed monitoring sites. If trigger levels for weeds are met or exceeded, additional monitoring will be undertaken and will occur in conjunction with appropriate management measures until the presence and distribution of weeds reduces to baseline levels or below. Further detail on corrective actions are set out in Table 6.1.

6.5 Pest animal monitoring

An initial assessment of the presence and distribution of pest animals was undertaken during the baseline ecological surveys (DPM Environmental 2018) undertaken between 1-14 November 2016. A follow-up comprehensive fauna survey was undertaken within the mine site in autumn from 23 April to 4 May 2017. Results found a number of pest animals were utilising the site including feral pigs, foxes, hares and wild dogs.

Pest animal surveys will be undertaken annually for the first three years, followed by every two years for the remainder of the Project in conjunction with and at the same survey locations as, the MNES habitat quality assessment surveys. Monitoring will primarily entail standardised timed visual observations as well as infrared camera trap monitoring. Relative abundance will be assessed using amongst other methods, number of animals encountered over a standard time frame, or a standard transect length but will be determined by the suitably qualified ecologist undertaking the assessments.

Evidence of faecal samples and damage cause by feral animals will also be recorded such as evidence of feral pigs in gilgai and wetlands. Feral animals will also be opportunistically surveyed throughout the year outside of monitoring times. Any evidence of mortality or injury to MNES as a result of feral animals will also be recorded during the surveys. If trigger levels for any feral animal species are met or exceeded, additional monitoring will be undertaken and will occur in conjunction with appropriate management measures until feral animal presence reduces to baseline levels or below. Corrective actions are set out in Table 6.1.

6.6 Dust monitoring

Dust deposition will be monitored in accordance with the Project's Air Quality Management Plan, as developed and implemented by an appropriately qualified person for all stages of the authorised mining activities.

6.7 Noise and vibration monitoring

Noise generated by mining activities will be monitored in accordance with the Project's Noise Management Plan, as developed and implemented by an appropriately qualified person for all stages of the authorised mining activities.

6.8 Erosion and sediment control

Water quality and erosion and sediment control will be monitored in accordance with the Project's Water Management Plan and Erosion and Sediment Control Plan as developed and implemented by an appropriately qualified person for all stages of the authorised mining activities.

Six monthly general inspections of the Project area will identify any areas of erosion that may require addressing.

6.9 Fire monitoring

Fire management within the Project area will be undertaken in accordance with the requirements of the Coal Mining Safety and Health Act 1999 (CMSHA), Coal Mining Safety and Health Regulation 2017 (CMSHR) and the Safety and Health Management Systems (SHMS) to mitigate fires from mining activities that have the potential to spread to MNES habitat. The CMSHR includes monitoring and review requirements for the SHMS.

Monitoring for biomass is outlined in the grazing management section Section 5.2.3. Monitoring of fuel loads is an ongoing task where grazing is permitted to ensure fuel loads are maintained at the right level. Habitat quality monitoring as outlined in Section 6.1 will also measure ground cover and support monitoring of biomass and potential fire risk.

Triggers and corrective actions associated with fire are provided in Table 6.1.

6.10 Summary of MNES Monitoring Program

Monitoring that will be undertaken to determine if environmental outcomes and performance criteria are being achieved are summarised below in Table 6.1. Monitoring methods are described, and if monitoring has identified the required outcomes are not being achieved, corrective actions are identified.

Table 6.1 Monitoring Program

Performance criteria	Management actions	Monitoring	Trigger for corrective action	Corrective actions	Timing of corrective action	Interim milestones
Avoid and minimise injuries and mortality of MNES species during all Project phases.	<ul style="list-style-type: none">• Undertake pre-clearance surveys prior to planned clearance.• At least two certified fauna spotter-catcher present during clearing activities.• Appropriate wildlife carer to be identified in the region and notified of any wildlife injuries for collection.• Koalas in Stage 1 area will be identified prior to clearing and tracked during clearing and post clearing for 3 months to ensure individuals are not harmed during clearing and to confirm their movements.• Sequential clearing protocols to be implemented.• Environmental awareness training pertaining to MNES identification and site utilisation to be provided to all site personnel.• Vehicle speed limits to be set at a maximum of 60km/hr for all internal roads.• Koala exclusion fencing and Greater Glider crossings installed in known habitat areas.	<ul style="list-style-type: none">• Review of pre-clearance survey results to occur for identification of all measures required prior to clearing activities commencing.• Site personnel to report any vehicle strikes on confirmed or potential MNES species within the Project area.• Incidental observation of MNES species to be reported.	<ul style="list-style-type: none">• MNES species mortality or injury occurs during any phase of the Project.	<ul style="list-style-type: none">• If injury or mortality occurs during clearing stop clearing until investigation completed.• If vegetation clearing procedures are not effective, identify improvements that are required.• Investigate and review incidence of an injury to, or the mortality of an MNES species and create contingency plans to reduce reoccurrence.• Slow speed down further.• Install speed bumps or other measures to reduce vehicle speed.• Install additional fauna exclusion fences adjacent to access roads if vehicle strikes are occurring.	<ul style="list-style-type: none">• Review of incidence to be undertaken within 5 business days of report.• If relates to vegetation clearing, implement corrective action prior to clearing commencing again.• If additional exclusion fencing is required this will be installed within one month of injury or fatality occurring.	<ul style="list-style-type: none">• At the completion of each stage injuries or mortality to MNES species have been avoided and/or minimised.• 12 months prior to the completion of each stage the MMP is reviewed and additional mitigation measures incorporated for the next stage including any changes to, or additional Koala exclusion fencing and Greater Glider rope crossings.
Ensure the project does not result in loss of MNES species habitats and Brigalow TEC outside of approved disturbance limits (as described in Table 1.1).	<ul style="list-style-type: none">• Infrastructure will be sited in accordance with the State and Commonwealth approval conditions.• Clearly delineating exclusion zones prior to clearing commencing.• Internal training for all personnel involved in the vegetation clearing phase to ensure they are aware of the approved works areas.• Clearing boundaries to be identified in maps and GIS that are provided to contractors.• Vehicles and machinery stay on designated tracks.	<ul style="list-style-type: none">• Pembroke Site Manager to check delineation of boundaries and sign off prior to clearing commencing.• Six monthly general inspections of Project area to check clearing and construction areas have not exceeded approved areas for disturbance. Also check vehicles and machinery are not going off designated tracks. Refer 6.1.	<ul style="list-style-type: none">• Clearing of MNES species habitat exceeds the approved disturbance limits provided in Table 1.1.• Evidence of disturbance to areas outside of approved limits (such as temporary work area or laydown placed outside of permitted area, vehicles going off tracks etc).	<ul style="list-style-type: none">• Clearing works are to cease immediately and DAWE notified of the incident within five business days. The incident will be recorded in the Project’s environmental and incident reporting system register.• Rehabilitation of the additional area that was cleared or disturbed.• Provide an offset for the cleared area if determined to be a significant impact to MNES.	<ul style="list-style-type: none">• Suitable corrective action to be agreed with DAWE post notification.• If rehabilitation/revegetation is required this will commence within two months of DAWE agreed action/s.• If an additional offset is required timing will be agreed with DAWE.	<ul style="list-style-type: none">• At the completion of clearing phase the clearing report confirms that all disturbance has occurred within approved disturbance limits.• 5 yearly interim reports issued to DAWE summarise the clearing areas and any areas of MNES retained, confirming MNES impacts are within approved limits.• GIS shapefiles provided to DAWE of cleared areas at 5 yearly interim reviews.
All MNES species habitat and Brigalow TEC outside of the Project stages are retained and managed to maintain habitat quality so they continue to support the species populations.	<ul style="list-style-type: none">• Areas of MNES habitat adjacent to the disturbance footprint and within the Project area (prior to mining, i.e. later stages, or outside the impacted footprint), will be clearly delineated.• Site access is only to occur along designated site access tracks. No unauthorised access is permitted.• Selected trees and/or logs will be salvaged and reused as fauna habitat to enhance retained vegetation habitat values (e.g. riparian habitat).• Implementation of dust suppression techniques.• Maintenance of existing fences.• Feral animals and weeds will be managed in accordance with the Project’s Weed and Pest Management Plan.• Light spill we be directed to the open cut pits to minimise light spill.• The use of low wattage lighting with list spill guards.• Koala exclusion fencing and Koala poles assist to keep Koalas outside of active mine areas and provide connectivity along riparian corridors.	<ul style="list-style-type: none">• Habitat quality assessments in retained MNES habitat will be undertaken annually for Stage 1, every two years for Stage 2 and five yearly for Stages 3 and 4 (Section 6.3).• Monitoring will be undertaken in accordance with the State guidelines for determining terrestrial habitat quality. These methods are outlined in the <i>Guide to determining terrestrial habitat quality</i> (DEHP 2017).• Pest animal monitoring as per Section 6.5.• Weed monitoring as per Section 6.4.• Six monthly general inspections of Project area to check koala exclusion fencing and poles are in good condition. Refer 6.1.	<ul style="list-style-type: none">• Monitoring shows habitat quality scores have decreased from baseline score, in more than 2 sites.• Permanent weed monitoring transects show a 20% increase in weed abundance and cover across all sites.• Pest animal monitoring shows habitat disturbance is occurring to MNES species habitats such as feral pigs impacts in wetland areas.	<ul style="list-style-type: none">• Should a decline in habitat quality scores be observed, the cause will be investigated.• Appropriate corrective actions may be:<ul style="list-style-type: none">– an increase in frequency of weed management;– changing weed control methods;– decrease or exclusion of grazing;– increase in feral animal control;– increasing the frequency of dust suppression techniques; and– repair fences if damaged, or installation of new fencing.	<ul style="list-style-type: none">• Corrective actions will be developed by a suitably qualified ecologist within 15 business days of the decline being detected.• Identified corrective actions will be implemented within one month of corrective actions being agreed.	<ul style="list-style-type: none">• At the end of each Project stage monitoring will demonstrate habitat quality for MNES habitats (outside of approved stages) has not declined from the baseline.• 5 yearly interim reviews will summarise the results of habitat quality monitoring and any corrective actions that have been implemented. The report will review effectiveness of those corrective actions.
Prevent the introduction and/or spread of weeds and/or disease within the Project area.	<ul style="list-style-type: none">• Weed hygiene protocols to be implemented including vehicle and machinery wash downs prior to entering site.• Weeds will be managed in accordance with the Project’s Weed and Pest Management Plan.• Targeted weed control measures within the Project area.	<ul style="list-style-type: none">• Six monthly general inspections of Project area will identify any new weed outbreaks that may occur outside of designated weed monitoring sites. Refer 6.1	<ul style="list-style-type: none">• New areas of weed outbreaks have been noted from the baseline surveys.• Permanent weed monitoring transects show a 20% increase in weed abundance and cover across all sites.	<ul style="list-style-type: none">• Should an increase in weed cover or presence of new weed species be observed, an investigation will be undertaken to determine the cause. This will involve reviewing adherence to the Weed and Pest Management Plan and an assessment of the distribution of weeds within the Project area in relation to	<ul style="list-style-type: none">• From the investigation, corrective actions will be developed by a suitably qualified person within 15 business days of the trigger being detected.• Identified corrective actions will be implemented within one	<ul style="list-style-type: none">• At the end of each Project stage monitoring will demonstrate weed abundance has been maintained or decreased across Project area.• 5 yearly interim reviews will summarise the results of weed monitoring and any corrective actions that have been

Table 6.1 Monitoring Program

Performance criteria	Management actions	Monitoring	Trigger for corrective action	Corrective actions	Timing of corrective action	Interim milestones
		<ul style="list-style-type: none">Permanent weed monitoring transects to be undertaken as per Section 6.4Weed monitoring will also occur as part of the habitat quality assessments in MNES habitats being retained. These assessments will be undertaken annually for Stage 1, every two years for Stage 2 and five yearly for Stages 3 and 4. Refer Section 6.3.		<ul style="list-style-type: none">baseline to determine the cause of the incursions.Appropriate corrective actions may be:<ul style="list-style-type: none">an increase in frequency of weed management;changing weed control methods;increasing weed hygiene practices ;changes to grazing regime; andincrease in feral animal control.	<ul style="list-style-type: none">month of corrective actions being agreed.	<ul style="list-style-type: none">implemented. The report will review effectiveness of those corrective actions.
Prevent MNES species habitat degradation as a result of pest animals.	<ul style="list-style-type: none">Pest animals will be managed in accordance with the Project’s Weed and Pest Management Plan.	<ul style="list-style-type: none">Monitoring of pest animals will be undertaken in conjunction with habitat quality assessments as outlined in Section 6.5.Habitat quality monitoring will be undertaken annually for the first three years then every two years thereafter.Monitoring of pest animals more broadly will also be undertaken as outlined in Section 6.5.This includes six monthly general inspections of the Project area to check for any evidence of feral animals.	<ul style="list-style-type: none">Observed increase in incidental sightings of feral animals.Observation of any MNES species mortality from pest animals such as dog attack on Koala.Evidence of pest animal degradation on MNES species habitats.	<ul style="list-style-type: none">Should an increase in pest animal presence, or evidence of damage to MNES habitats be occurring, an investigation will be undertaken to determine the cause. This will involve reviewing adherence to the Weed and Pest Management Plan.Consultation with DAF will occur on alternative pest animal control measures.Appropriate corrective actions may be:<ul style="list-style-type: none">an increase in frequency and/or duration of pest animal management;changing pest animal control methods;involving neighbouring properties if pest animals are coming from adjacent areas; andadditional exclusion fencing.	<ul style="list-style-type: none">From the investigation, corrective actions will be developed by a suitably qualified person within 15 business days of the trigger being detected.Identified corrective actions will be implemented within one month of corrective actions being agreed.	<ul style="list-style-type: none">At the end of each Project stage monitoring will demonstrate habitat degradation from pest animals has reduced from baseline.At the end of each Project stage no reports of MNES fauna mortality from pest animals.5 yearly interim reviews will summarise the results of pest animal monitoring and any corrective actions that have been implemented. The report will review effectiveness of those corrective actions.
Minimise impacts of dust deposition on MNES habitat.	<ul style="list-style-type: none">Dust suppression will be managed in accordance with the Project’s Air Quality Management Plan.	<ul style="list-style-type: none">Monitoring of dust deposition will be undertaken in accordance with the Project’s Air Quality Management Plan. Refer Section 6.6.	<ul style="list-style-type: none">Dust deposition levels exceed limits outlined in the Air Quality management Plan.Visual inspections of vegetation adjacent to the disturbance areas show visible signs of dust deposition.	<ul style="list-style-type: none">Pembroke to investigate whether the exceedance is a result of Project activities and notify the administering authority within seven days of the exceedance occurring.Pembroke will implement additional dust abatement measures such as watering down of dirt access roads.	<ul style="list-style-type: none">Corrective actions will be implemented within 10 business days of the trigger being detected.	<ul style="list-style-type: none">At the end of each Project stage it is confirmed dust has been appropriately managed and has not resulted in impacts on MNES habitats.5 yearly interim reviews will summarise the results of dust monitoring and any corrective actions that have been implemented. The report will review effectiveness of those corrective actions.
Prevent uncontrolled fire events.	<ul style="list-style-type: none">Fire management will be undertaken across the Project area which will include ensuring mining operations do not result in fires starting.Buffers will be maintained around potential ignition sources such as plant and machinery, haul roads and mine infrastructure areas.Prior to site entry, all relevant site personnel, including contractors, will be made aware of fire safety and risks.Maintain fire breaks.Fuel loads will be minimised and managed through grazing management, weed control and cool mosaic burns where appropriate.Fire is to be excluded from the Brigalow TEC.	<ul style="list-style-type: none">Monitoring of biomass (groundcover including organic litter) for fire management will be undertaken during the habitat quality assessments that will occur annually for the first three years then every two years thereafter (refer to Section 6.9.Fuel loads will also be monitored on an ongoing basis as part of the strategic grazing regime.Six monthly general inspections will be undertaken to ensure mining operations are implementing required fire safety procedures and fire breaks are being appropriately maintained.	<ul style="list-style-type: none">An uncontrolled fire occurs within the Project area that is due to mining activities.Fuel loads exceed specified thresholds.An unplanned bushfire occurs.	<ul style="list-style-type: none">Should an uncontrolled fire occur within the Project area, the Project’s Emergency Response Plan will be enacted. Should any corrective actions and changes to fire management be required, they will be done in accordance with the CMSHA and CMSHR.Changes to grazing regime may be required in response to climatic conditions. For example after high rainfall event fuel load may increase significantly. Therefore grazing intensity may need to be increased for a period of time.Additional cool mosaic burns may be required to manage fuel loads where grazing isn’t permitted.	<ul style="list-style-type: none">From the investigation, corrective actions will be developed by a suitably qualified person within 15 business days of the trigger being detected.Any corrective actions identified will be implemented within 10 business days of the trigger being detected.	<ul style="list-style-type: none">At the end of each Project stage it is confirmed fire and fuel loads have been appropriately managed and an unplanned bushfire has not occurred.At the end of each Project stage it is confirmed no fire has occurred in Brigalow TEC.5 yearly interim reviews will summarise the results of fire monitoring and any corrective actions that have been implemented. The report will review effectiveness of those corrective actions.

Table 6.1 Monitoring Program

Performance criteria	Management actions	Monitoring	Trigger for corrective action	Corrective actions	Timing of corrective action	Interim milestones
Maintain Greater Glider connectivity along Isaac River and provide supplementary breeding and sheltering habitat for Greater Glider.	<ul style="list-style-type: none">• Installation of rope crossings along Isaac River.• Installing nest boxes within Greater Glider habitat within the Isaac River buffer area. Some nest boxes will be installed prior to clearing for Stage 1 commencing. Remaining will be installed before the end of clearing phase for Stage 1.• Ongoing maintenance of rope crossings and nest boxes.	<ul style="list-style-type: none">• Monitor use of rope crossings through installation of cameras. Assess remote camera footage to identify if Greater Gliders are utilising the rope crossings. Refer Section 6.2.• Monitor Greater Gliders during Stage 1 clearing phase through radio-tracking collars. Identify if Greater Gliders are utilising installed nest boxes. Refer Section 6.2.• Undertake Greater Glider surveys to determine if they are using nest boxes such as spotlighting after dusk.• Monitor the condition of nest boxes and rope crossings.	<ul style="list-style-type: none">• Greater Gliders are found not to be utilising the nest boxes after 12 months of monitoring.• Greater Gliders are not utilising the rope crossings after 12 months of monitoring.• Damage of the rope crossings and nest boxes, including pest animal occupancy in nest boxes.	<ul style="list-style-type: none">• Weed control intensity and frequency may need to be increased if weeds were a contributing factor to increase in fire risk.• A suitably qualified ecologist will evaluate the potential reasons that nest boxes and /or rope crossings are not being utilised.• Corrective action may include relocate the nest boxes and/or adjust nest box heights.• Design of nest boxes could also be changed to assess if that is more effective.• Additional time for monitoring may also be required as other programs have shown it can take many months for observations to be found. Monitoring frequency may be increased and also include Greater Glider survey to determine their presence in the area.• If rope crossings are not being utilised, assess potential to change the design for a few rope crossings.• Relocating some rope crossings could also be done.• Should any nest boxes be occupied by pest fauna species, investigate measures to reduce these species from using them.	<ul style="list-style-type: none">• From the investigation, corrective actions will be developed by a suitably qualified ecologist within 20 business days of the trigger being detected.• Corrective actions will be implemented within 3 months following the corrective actions being agreed.• Should any rope crossings and nest boxes be damaged, they will be repaired within 20 business days after the damage has been identified.• 	<ul style="list-style-type: none">• At the end of each Project stage it is confirmed Greater Glider have been utilising rope crossings and nest boxes.• 5 yearly interim reviews will summarise the results of monitoring and any corrective actions that have been implemented. The report will review effectiveness of those corrective actions.

7 Reporting and administration

7.1 Reporting

An 'annual report' will be prepared at the end of each calendar year. The annual report will summarise:

- all management actions that have been completed in that 12 month period;
- all monitoring that has been completed and monitoring results;
- assessment of monitoring results against performance criteria to determine if they are being met; and
- identification of any issues that arose which required intervention or corrective actions to be implemented.

The annual report will feed into the annual compliance report which Pembroke is required to submit to DES. The annual report is also an opportunity to summarise findings to feed into the 5-year interim report.

The 5-year interim report will be prepared to track the past five years of monitoring and management actions. It will include a more detailed assessment against the performance criteria for that particular project stage, any corrective actions implemented, and any adaptive management learnings will also be discussed. The MMP will be revised post these 5 yearly interim reviews if required.

7.2 Review of MMP

This MMP will undergo formal reviews for effectiveness for managing impacts on MNES. It is proposed the formal reviews will be completed 12 months prior to the commencement of Stage 2, Stage 3 and Stage 4 of the Project. This will allow for more detailed Project design to be incorporated for each stage of the Project. It will also enable a detailed review of the mitigation and management actions, and monitoring program undertaken to be reviewed and their effectiveness evaluated.

The reviews will be conducted by a suitably qualified person, with the updated version (if required) submitted to DAWE for approval. Pembroke propose that the reviews completed 12 months prior to completion of a stage will result in an update to the MMP to include more detailed information on the subsequent stage (such as project layout, location of fauna exclusion fencing and any other changes that may be relevant).

7.3 Responsibilities

All personnel undertaking Project activities are responsible for adhering to the management strategies outlined within this plan, however, the following are accountable for its implementation:

1. Project Director for initiating formal reviews of MMP.
2. Project Environmental Manager for ensuring implementation of prescribed avoidance, mitigation and management strategies for each phase within this plan.
3. Project Site Manager for ensuring this MMP is implemented during Project clearing, construction, operation and decommissioning phases.
4. Project Environment Manager to review results of the review and ensure corrective actions are implemented in a timely and effective manner.

5. Project Environment Manager for record keeping including extents of disturbance for each Phase.

7.4 Data management

The Pembroke Environment Manager will be responsible for overseeing and managing all monitoring activities and programs required as part of this MMP. This will include maintaining data records to inform how mitigation and monitoring efforts are tracking towards interim milestones as per the requirements of Condition 46(g) of the EPBC Act approval which states that frequency of monitoring must be sufficient to track progress towards each set of milestones, and sufficient to determine whether the milestones are likely to be achieved.

Data will include field survey data forms, reports, spatial data, camera footage and photos. If required, this data will be made available to DAWE upon request.

8 Risk assessment

A risk assessment was undertaken using the risk assessment process provided by the DoEE to assess risks associated with failing to achieve the management objectives outlined in this MMP for mitigating impacts to MNES. For each identified risk, the potential consequence of the risk (Table 8.1) was assessed against the likelihood of that risk occurring (Table 8.2) to determine an overall risk rating using the matrix in Table 8.3.

The consequence and likelihood of each risk occurring was assessed following the implementation of the management and mitigation measures (i.e. control measures) to provide a residual risk rating.

Table 8.1 Consequence classification

Qualitative measure of consequences (what will be the consequence/result if the issue does occur)	
Minor	Minor risk of failure to achieve the MMPs objectives. Results in short term delays to achieving plan objectives, implementing low cost, well characterised corrective actions.
Moderate	Moderate risk of failure to achieve the MMPs objectives. Results in short term delays to achieving plan objectives, implementing well characterised, high cost/effort corrective actions.
High	High risk of failure to achieve the MMPs objectives. Results in medium-long term delays to achieving plan objectives, implementing uncertain, high cost/effort corrective actions.
Major	The SMPs objectives are unlikely to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies.
Critical	The SMPs objectives are unable to be achieved, with no evidenced mitigation strategies.

Table 8.2 Likelihood classification

Qualitative measure of likelihood (how likely is it that this event/circumstances will occur after management actions have been put in place/are being implemented)	
Highly likely	Is expected to occur in most circumstances.
Likely	Will probably occur during the life of the project.
Possible	Might occur during the life of the project.
Unlikely	Could occur but considered unlikely or doubtful.
Rare	May occur in exceptional circumstances

Table 8.3 Risk rating matrix

		Consequence				
		1.Minor	2.Moderate	3.High	4.Major	5.Critical
Likelihood	5.Highly likely	Medium	High	High	Severe	Severe
	4.Likely	Low	Medium	High	High	Severe
	3.Possible	Low	Medium	Medium	High	Severe
	2.Unlikely	Low	Low	Medium	High	High
	1.Rare	Low	Low	Low	Medium	High

For the purposes of this risk assessment, the risk levels are defined as follows:

- Severe: Unacceptable risk that must not proceed until suitable and comprehensive control measures have been adopted to reduce the level of risk.
- High: Moderate to critical consequences. Works should not proceed without considerations of additional actions to minimising the risk.
- Medium: Acceptable with formal review. Medium level risks require active monitoring due to the level of risk being acceptable.
- Low: Acceptable with active management not considered required.

Table 8.4 Risk assessment and management

Risk event	Description of risk	Initial risk rating	Relevant management actions/measures	Residual risk rating	Performance criteria	Management triggers	Corrective actions	Monitoring mechanism
Clearing occurs outside of approved disturbance areas and exceeds limits.	Clearing of habitat for MNES occurs outside of the approved disturbance limits.	Severe	<ul style="list-style-type: none"> Infrastructure will be sited in accordance with the State and Commonwealth approval conditions. Areas requiring vegetation removal will be clearly delineated to ensure disturbance to areas being retained is avoided. Limits of clearing are to be delineated using barricading or temporary fencing and signage prior to works commencing. Exclusion areas are to be clearly shown and labelled on all operational and management drawings and plans. GIS shapefiles of exclusion areas will be provided to clearing personnel and/or contractors prior to the commencement of clearing operations. Prior to entry to the Project area, all site personnel including contractors shall be made aware via toolbox talks and site information sheets, of the sensitive environs they will be working in and around and be advised of specific limitations to construction works being undertaken in or adjacent to threatened fauna habitat. All staff and contractors will be required to report sightings of SMP relevant fauna in the activity area to the EO immediately. The EO or delegate will routinely inspect the disturbance limit boundaries to ensure that no clearing or disturbance of vegetation or habitat beyond the approved limits has taken place. Pre-clearance surveys will be undertaken by a suitably qualified ecologist using approved State and Commonwealth survey guidelines 3 weeks prior to clearing activities commencing. A Fauna Spotter will be present for all clearing activities and will conduct a walk-through survey prior to commencement of clearing and prior to clearing works each day to check vegetation and other fauna habitats. 	Low	<ul style="list-style-type: none"> No evidence of clearing within exclusion areas. No unauthorised access into the exclusion areas. 	<ul style="list-style-type: none"> Evidence of clearing within the exclusion areas. Evidence of access into the exclusion zones e.g. vehicle tracks, damaged fences. 	<ul style="list-style-type: none"> Should clearing of habitat for MNES exceeds the approved disturbance limits in Table 3.1 of this MMP and/or occurs outside of the Project footprint, clearing, works are to cease immediately. The incident will be recorded in the Project's environmental and incident reporting system register. Assessment will occur to determine how the additional clearing occurred. Illegal clearing will be reported to DAWE and DES. Rectification measures of additional clearing will be agreed such as revegetation of that area. 	<ul style="list-style-type: none"> The Pembroke Environment Manager will monitor and record the total area of MNES habitat cleared every quarter and assess against the disturbance limits outlined in Table 3.1 of this MMP and the Project footprint as outlined in EPBC Act approval. Field monitoring to occur twice a year will report on any evidence of unauthorised access and clearing.
Introduction of invasive weed species and/or spread of existing invasive weed species	New weed species being established in the Project area and/or spread of existing weed species.	Medium	<ul style="list-style-type: none"> All vehicles entering the Project area are required to have a weed declaration form confirming their vehicle has had a certified weed washdown. A site induction will provide weed management information to staff, contractors and visitors. Access to the retained habitat areas will be limited. Chemical/grazing control methods of control. 	Low	<ul style="list-style-type: none"> No new weed species in the Project area. No increase in the density of existing weeds. Decrease in exotic pasture cover. Non-native cover less than 10%. 	<ul style="list-style-type: none"> New weed species detected. Increase in density of existing weeds. Failure of weed control attempts. Weed cover is greater than 10%. 	<ul style="list-style-type: none"> An investigation will be undertaken to determine the cause of increased weed cover. This will involve reviewing adherence to the Weed and Pest Management Plan and an assessment of the distribution of weeds within the Project area in relation to baseline to determine the cause of the incursions. Increase frequency and/or duration of weed control efforts. Investigate and/or implement alternate weed management control actions. Amend weed hygiene practices. 	The Weed and Pest Management Plan will document weed presence, weed control measures and relevant management options.

Table 8.4 Risk assessment and management

Risk event	Description of risk	Initial risk rating	Relevant management actions/measures	Residual risk rating	Performance criteria	Management triggers	Corrective actions	Monitoring mechanism
Increased populations of invasive animals	Populations of invasive fauna species increase or are incorrectly managed.	Medium	<ul style="list-style-type: none"> Use of baiting (1080/PAPP) in pre-selected areas where invasive animal populations are high. No domestic dogs allowed on site. A site induction will provide information about invasive animals to staff, contractors and visitors. 	Low	<ul style="list-style-type: none"> No increase in invasive animal populations. No new invasive animals detected. 	<ul style="list-style-type: none"> Increase in invasive animal populations. New invasive animals detected. 	<ul style="list-style-type: none"> Develop species specific additional measures to manage invasive animals. 	The Weed and Pest Management Plan will document invasive animal presence, control measures and relevant management options.
Vehicle strikes to MNES and other fauna	Site vehicles striking MNES and other fauna resulting in injury or mortality.	High	<ul style="list-style-type: none"> Vehicular traffic to be restricted to designated access tracks and an on-site speed limit would be applied. Speed limit signs to be installed on each road and in a number of locations. Wildlife signage to be installed at key fauna habitat areas such as the main access road into site to identify potential for wildlife to be present and crossing the road. A site induction will provide fauna injury information, including wildlife zoo and carers contact details, to staff, contractors and visitors. Fauna exclusion fencing to be installed to minimise fauna getting into high risk areas. 	Medium	<ul style="list-style-type: none"> . Avoiding and minimising MNES or other fauna injury or death. 	<ul style="list-style-type: none"> Any injury or mortality to a MNES species. 	<ul style="list-style-type: none"> An investigation will be undertaken to determine the cause of the fauna injury/mortality. Reduce vehicle speeds further. Erect additional fauna exclusion fencing in identified 'hot spots' where fauna are more likely to be present or injury occurred. 	<ul style="list-style-type: none"> The EO will monitor and record the total number of vehicle strikes.
Uncontrolled or unplanned fires	An uncontrolled or unplanned fire occurs because of project activities.	Severe	<ul style="list-style-type: none"> Fire breaks maintained around the Project area including buffers around potential ignition sources such as plant and machinery, haul roads and mine infrastructure areas. Strategic grazing will be used to control biomass (groundcover including organic litter) where appropriate/necessary. When necessary, hazard reduction burns prior to the dry season will be undertaken in consultation with the Qld RFS. Consultation with RFS will also be required for controlled burning at appropriate intervals. A site induction will provide fire safety information to staff, contractors and visitors. 	Medium	<ul style="list-style-type: none"> No uncontrolled or unplanned fires occur. Biomass at sustainable levels. 	<ul style="list-style-type: none"> Uncontrolled or unplanned fires occur. Fire damage to the Project area. Biomass increase. 	<ul style="list-style-type: none"> Should an uncontrolled fire occur within the Project area, the Project's Emergency Response Plan will be enacted. Identify source of the fire and ensure encroachment pathway managed. Monitoring of fuel loads for fire management will be undertaken during habitat quality assessments. Increase the frequency of biomass control measures and monitoring. 	<ul style="list-style-type: none"> The EO will monitor and record any fires that occur. Field monitoring will report on any cases of uncontrolled or unplanned fires.

Table 8.4 Risk assessment and management

Risk event	Description of risk	Initial risk rating	Relevant management actions/measures	Residual risk rating	Performance criteria	Management triggers	Corrective actions	Monitoring mechanism
MNES habitat degradation	Habitat degradation and a decline in habitat values within MNES habitat.	Medium	<ul style="list-style-type: none">• Areas of MNES habitat adjacent to the disturbance footprint and within the Project area (i.e. mine lease) not to be cleared, will be clearly delineated and shown and labelled on all operational and management drawings and plans.• Site access is only to occur along designated site access tracks. No unauthorised access is permitted.• Selected trees and/or logs will be salvaged and reused as fauna habitat to enhance retained vegetation habitat values (e.g. within Isaac River and Ripstone Creek). Trees and other habitat features to be salvaged will be identified and flagged by the Fauna Spotter/Catcher during the walk-through survey and/or clearance activities.• Feral animals and weeds will be managed in accordance with the Project’s Weed and Pest Management Plan.• Light spill will be directed to the open cut pits to minimise light spill.• Fences will be erected along major riparian corridors to minimise damage from livestock.	Low	<ul style="list-style-type: none">• No evidence of clearing in exclusion areas.• Decreased abundance of feral animals and weeds.• No evidence of livestock, erosion, compaction or degraded water quality.	<ul style="list-style-type: none">• Evidence of clearing within exclusion areas.• Increased presence of feral fauna and weeds.• Habitat quality scores decreasing over two consecutive monitoring periods.• Evidence of livestock, erosion, compaction or degraded water quality.	<ul style="list-style-type: none">• Habitat quality assessments in MNES habitat will be undertaken.• Develop species specific management plans.• Rehabilitation of MNES habitat.• Increasing feral animal and weed control measures or revising the type of measures implemented.• Repair fences if damaged, or installation of new ones.	<ul style="list-style-type: none">• Field monitoring will report on evidence of MNES habitat degradation.
Trapped MNES fauna	MNES fauna become trapped in the mining Project area.	Medium	<ul style="list-style-type: none">• Koala exclusion fencing and poles to be installed.• Glider rope crossings to be installed.• Fauna exit ramps to be installed.• Fauna bridge across Isaac River to be installed.	Low	<ul style="list-style-type: none">• No evidence of MNES fauna being trapped within the mining Project area.	<ul style="list-style-type: none">• MNES fauna being trapped within the mining Project area.	<ul style="list-style-type: none">• An investigation will be undertaken to determine the cause of MNES fauna being trapped in the mining Project area.• Amend fauna crossing methodologies and equipment.• Increase monitoring of fauna crossings by installing remote sensing cameras in relevant areas.	<ul style="list-style-type: none">• Field monitoring will report on evidence of trapped MNES fauna.

9 References

- Benson, JS, Allen, CB, Togher, C. and Lemmon, J (2006). New South Wales Vegetation Classification and Assessment: Part 1 Plant communities of the NSW Western Plains. *Cunninghamia* 9: 383-450.
- Comport, SS, Ward, SJ, and Foley, WJ (1996). Home ranges, time budgets and food-tree use in a high-density tropical population of greater gliders, *Petauroides volans minor* (Pseudocheiridae: Marsupialia). *Wildlife Research* 23, 401–419.
- DAF (2020a). Feral pig *Sus scrofa*, Department of Agriculture and Fisheries, viewed 10 August 2020 from https://www.daf.qld.gov.au/__data/assets/pdf_file/0005/70925/feral-pig.pdf
- DAF (2020b). Wild dog *Canis familiaris*, Department of Agriculture and Fisheries, viewed 10 August 2020 from https://www.daf.qld.gov.au/__data/assets/pdf_file/0003/74487/wild-dog.pdf
- DAF (2020c). European red fox *Vulpes vulpes*, Department of Agriculture and Fisheries, viewed 10 August 2020 from https://www.daf.qld.gov.au/__data/assets/pdf_file/0019/73810/european-red-fox.pdf
- DAF (2020d). Feral cat *Felis catus*, Department of Agriculture and Fisheries, viewed 10 August 2020 from https://www.daf.qld.gov.au/__data/assets/pdf_file/0004/61987/feral-cat.pdf
- DAF (2020e). Rabbit *Oryctolagus cuniculus*, Department of Agriculture and Fisheries, viewed 10 August 2020 from https://www.daf.qld.gov.au/__data/assets/pdf_file/0015/62700/rabbit.pdf
- DAWE (2020a). *Geophaps scripta scripta* in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra.
- DAWE (2020b). *Denisonia maculata* in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra.
- DAWE (2020c). *Rostratula australis* in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra.
- DAWE (2020d). Listed Key Threatening Processes in Species Profile and Threats Database, Department of Agriculture, Water and the Environment, Canberra.
- DEHP (2012). Koalas and cars, Department of Environment and Heritage protection, Queensland.
- DEHP (2017). Guide to Determining Terrestrial Habitat Quality, Department of Environment and Heritage Protection, State of Queensland.
- DEHP (2019). Flora Survey Guidelines – Protected Plants, Nature Conservation Act 1992, Department of Environment and Heritage Protection, State of Queensland.
- DES (2019). Koala-sensitive Design Guideline: A guide to koala-sensitive design measures for planning and development activities, Queensland Government.
- DEWHA (2008). Threat abatement plan for predation by the European red fox, Biodiversity Conservation Branch, DEWHA, Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra.
- DEWHA (2010a). Survey guidelines for Australia’s threatened bird – Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity conservation Act 1999, Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra.

DEWHA (2010b). Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity conservation Act 1999, Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra.

DoE (2012). Approved conservation advice for *Phascolarctos cinereus*, Koala (combined populations in Queensland, New South Wales and the Australian Capital Territory, Department of the Environment, Canberra.

DoE (2014a). EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory), Department of the Environment, Commonwealth of Australia.

DoE (2014b). Approved Conservation Advice for *Denisonia maculata* (Ornamental Snake). Department of the Environment, Canberra.

DoE (2015). Threat abatement plan for predation by feral cats, Community Information Unit Department of Environment and Energy, Commonwealth of Australia.

DoEE (2016). Threat abatement plan for competition and land degradation by rabbits, Community Information Unit Department of Environment and Energy, Commonwealth of Australia.

DMR (2000). Fauna Sensitive Road Design. Volume 1 - Past and Existing Practices. Queensland Department of Main Roads, Planning, Design and Environment Division. Brisbane.

DPM Envirosiences (2018). Olive Downs Coking Coal Project – Terrestrial Fauna Assessment, prepared by DPM Envirosiences Pty for Pembroke Olive Downs Pty Ltd

DSEWPC (2011a). Environment Protection and Biodiversity Conservation Act 1999 - Draft Referral Guidelines for Australia's threatened reptiles, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

DSEWPC (2011b). Environment Protection and Biodiversity Conservation Act 1999 - Draft Referral Guidelines for Australia's threatened mammals, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

DSEWPC (2011c). Environment Protection and Biodiversity Conservation Act 1999 - Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Eyre TJ, Ferguson DJ, Hourigan CL, Smith GC, Mathieson MT, Kelly, AL, Venz MF, Hogan, LD & Rowland, J (2018). Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland. Department of Environment and Science, Queensland Government, Brisbane.

Fauna Crossings (2020). Rope Ladder Fauna Crossings. Images collected from <https://faunacrossings.com.au/working-at-heights/>

Franks, A & Franks, S (2006). Nest Boxes for Wildlife: A Practical Guide. Blooming Books, Melbourne.

Geoscience Australia (2020). Bushfire. Geoscience Australia, Symonston.

Gibbons, P & Lindenmayer, D.B. (2002). Tree Hollows and Wildlife Conservation In Australia, CSIRO Publishing.

Goldingay R.L. (2012). Characteristics of tree hollows used by Australian arboreal and scansorial mammals. *Australian Journal of Zoology*, 59, 277-294.

Goldingay, RL, Thomas, KJ and Shanty, D (2018), Outcomes of decades long installation of nest boxes for arboreal mammals in southern Australia. *Ecological Management & Restoration*, vol. 19, pp. 204-211.

Goldingay RL, and Dobner, B (2013) Home range areas of koalas in an urban area of north-east New South Wales. *Australian Mammalogy*, vol. 36, pp. 74-80.

- GT Environmental (2018). Olive Downs Coking Coal Project Soils and Land Suitability Assessment. Prepared on behalf of Pembroke, Sydney.
- Johnson, R.W (1964). Ecology and control of brigalow in Queensland. Queensland Department of Primary Industries, Brisbane.
- Lindenmayer, D.B, Cunningham, R.B., Pope, M.L. & Donnelly, C.F. (1999). The response of arboreal marsupials to landscape context: a large-scale fragmentation study. *Ecological Applications*, 9, 594-611.
- Lindenmayer, D.B., Blanchard, W, McBurney, L, Blair, D, Banks, S.C., Driscoll, D, Smith, A.L. & Gill A.M. (2013). Fire severity and landscape context effects on arboreal marsupials. *Biological Conservation*, 167, 137-148.
- Lindenmayer, DB, Welsh, A, Donnelly, C, Crane, M, Michael, D, Macgregor, C, McBurney, L, Montague-Drake, R & Gibbons, P (2009). Are nest boxes a viable alternative source of cavities for hollow-dependent animals? Long-term monitoring of nest box occupancy, pest use and attrition. *Biological Conservation*, vol. 142(1), pp. 33-42
- Maloney, K.S. (2007). The status of the Greater Glider (*Petauroides volans*) in the Illawarra region. University of Wollongong Thesis Collection.
- Neldner, VJ, Wilson, BA, Thompson, EJ and Dillewaard, HA (2012). Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland. Version 3.2. Updated August 2012, Queensland Herbarium, Queensland Department of Science, Information Technology and Innovation, Brisbane.
- Prevett, P, Hives, N and Cerini, G (1992), Koala protection and fenced freeways. Ballarat University College.
- Qld Herbarium (2003). Brigalow (*Acacia harpophylla* dominant and co-dominant) information sheet. Courtesy of QLD Herbarium, Toowoong.
- QR Network (2010). Coal Dust Management Plan. Queensland Rail City network, Brisbane.
- Reyes, P.R, Firn, J, Nicol, S, Chadès, I, Stratford, DS, Martin, TG, Whitten, S, Carwardine, J (2016). Priority Threat Management for Imperilled Species of the Queensland Brigalow Belt, CSIRO, Brisbane.
- RMS (2014). Nest Box Management Plan (Sections 4 & 5) – Woolgoola to Ballina Pacific Highway upgrade. Prepared by Parsons Brinckerhoff for Roads and Maritime Services.
- RMS (2017). Foxground and Berry bypass Princes Highway upgrade – Nest Box Management Plan. Roads and Maritime Services, Sydney.
- Rowden, P & Steinhardt, D & Sheehan, M. (2008). Road crashes involving animals in Australia. Accident analysis and prevention, 40, 1865-71.
- Sandpiper Ecological Surveys (2013). Pacific Highway Upgrade – Woolgoola to Glenugie. Aerial Crossings and Exclusion Fencing. Report prepared for Roads and Maritime Services.
- Smith, GC, Mathieson, M, and Hogan, L (2007). Home range and habitat use of a low-density population of greater gliders, *Petauroides volans* (Pseudocheiridae: Marsupialia), in a hollow-limiting environment. *Wildlife Research*, 34, 472–483.
- Taylor, BD, and Goldingay, RL (2004). Wildlife road-kills on three major roads in north-eastern NSW. *Wildlife Research* 31:83–91.
- TSSC (2013a). Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe), Threatened Species Scientific Committee.

TSSC (2013b). Approved Conservation Advice for the Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community. Department of the Environment, Canberra.

TSSC (2015). Approved Conservation Advice for *Geophaps scripta scripta* (Australian Painted Snipe), Threatened Species Scientific Committee.

TSSC (2016). Approved Conservation Advice for *Petauroides volans* (Greater Glider), Threatened Species Scientific Committee.

VicRoads (2012). Fauna sensitive road design guidelines, VicRoads Environmental Sustainability.

Wildlife Preservation Society of Qld (2019). Greater Glider. Page viewed on 12 August 2020 <https://wildlife.org.au/greater-glider/>

Williams, BK & Brown, ED (2016). Technical challenges in the application of adaptive management, *Biological Conservation*, 195, 255–263.

Appendix A

Curriculum vitae

Nathan Garvey

Associate Director - Ecology | Divisional Leader Ecology, Heritage and Spatial Solutions

Curriculum vitae

Nathan is an experienced ecologist with over 17 years' practice in ecological assessment across eastern Australia. Nathan has delivered projects across a diverse range of sectors including mining, oil and gas, linear infrastructure, renewable energy and residential development. Nathan is practitioner of biodiversity assessment and approvals, including biodiversity assessment for major projects and EPBC Act referrals. He is one of NSW's leading experts in biodiversity offsetting.

Nathan provides an innovative, whole-of-project approach, delivering solutions for our clients and working with teams to ensure high quality outcomes.

Qualifications

- Bachelor of Science, University of NSW, 2001
- Graduate Diploma (Biological Science), University of NSW, 2003
- Certified Environmental Practitioner (CEnvP)
- Biodiversity Assessment Method (BAM) Accredited Assessor
- Ecological Consultants Association of NSW – member since 2010
- Environment Institute of Australia and New Zealand (EIANZ) – Member since 2007

Career

- EMM Consulting, 2017–present
- Senior Consultant Ecologist and Resource Group Manager, Biosis, 2010–2017
- Consultant Zoologist, Biosis, 2009–2010
- Zoologist, Biosis, 2009–2009
- Technical Assistant, Biosis, 2007–2009
- Project Manager and Ecologist, Cumberland Ecology, 2003–2007
- Research Assistant, University of New South Wales, 2001–2003

Representative experience

Biodiversity assessments

- Snowy 2.0, biodiversity assessment and EPBC referral, Kosciuszko National Park NSW (Snowy Hydro Ltd)
- McPhillamys Gold Project, biodiversity assessment, Blayney (Regis Resources)
- New England Solar Farm, biodiversity assessment, Uralla (UPC Renewables)
- Mugga Quarry, biodiversity assessment and EPBC referral, Symonston (Boral)
- Gulgong Solar Project, biodiversity assessment, Gulgong (Vena Energy)
- Wagga Wagga Solar Project, biodiversity assessment, Gulgong (Vena Energy)

- Orange Grove Solar Farm, biodiversity assessment, Orange Grove (Overland Sun Farming)
- Quorn Park solar project, biodiversity assessment, Parkes (Renewable Energy Consultancy)
- Blueys Estate Planning Proposal, biodiversity assessment, Blueys Beach (City Plan Services)
- Wee Waa Solar Farm, biodiversity assessment, Wee Waa (Overland Sun Farming)
- Junee Solar Farm Grid Connection Biodiversity Assessment, Junee (Geolyse and Terrain Solar)
- Coffs Harbour Bypass, biodiversity assessment and EPBC referral, NSW (Aurecon and NSW Roads and Maritime Services)
- Goonumbla Solar Farm, biodiversity assessment, Goonumbla (Geolyse and Renewable Energy Developments)
- Gunnedah, Limondale, Hay and Hillston Solar Farms, biodiversity assessments, NSW (Overland Sun Farming)
- Walgett Solar Farm, biodiversity assessment and biodiversity management plan, Walgett (Geolyse and Epuron)
- Amended Rocky Hill Coal Project, biodiversity assessment, targeted fauna surveys and EPBC referral, Gloucester (RW Corkery & Co and Gloucester Resources Limited)
- Yarraman Abattoir and Feedlot, biodiversity impact assessment, Yarraman (KMH Environmental)
- Brandy Hill Quarry Expansion, biodiversity impact assessment, Brandy Hill (Hanson Construction Materials)
- Underground Expansion Project, biodiversity assessment and EIS for the EPBC referral, Wollongong (Hansen Bailey and Wollongong Coal)
- Nyngan Inground Storage, biodiversity assessment, Nyngan (NSW Public Works)
- Crest Road Albion Park, flora and fauna assessment, Albion Park (MMJ Wollongong and Spinitu)
- Princes Highway Upgrade, Foxground and Berry Bypass, biodiversity assessment, Foxground (AECOM and Roads and Maritime Services)
- Princes Highway Upgrade, Berry Bypass, biodiversity assessment, Berry (AECOM and Roads and Maritime Services)
- AGL Camden North Gas Project, flora and fauna assessment, Camden (AGL Upstream Investments)
- Dundas Tablelands Wind Farm, detailed flora and fauna assessment, Casterton (Origin Energy)

- Underground Expansion Project, biodiversity offset strategy, Russell Vale (Wollongong Coal)

Biodiversity offsets

- Snowy 2.0 Exploratory Works, biodiversity offset framework and strategy (Snowy Hydro Ltd)
- Gunlake Quarry, BioBanking agreement, Marulan (Gunlake Quarries)
- 33 – 35 Warradale Road, Silverdale: credit sourcing and retirement, Silverdale (SitePlus and TRN Group)
- Western Sydney Priority Growth Areas, biodiversity advice (Office of Environment and Heritage)
- Wilton Gardens and Wilton East, biodiversity offset advice and strategy, Wilton (Country Garden Australia)
- Albion Park Rail Bypass project, offset site advice, Albion Park (Shellharbour City Council)
- BioBanking Assessor services, various location in NSW (NSW Office of Environment and Heritage)
- Redgum Ridge Western Precinct, biodiversity certification, Figtree (Clifford Developments)
- Redgum Ridge Western Precinct, BioBanking Agreement, Figtree (Clifford Developments)
- 89 Port Stephens Drive Taylors Beach, BioBanking Agreement and BioBanking Statement, Taylors Beach (Port Stephens Council)
- Lots 4 and 6 DP 243079 Wilton, BioBanking Agreement, Wilton (Weaving Family Trust)
- 33 – 35 Warradale Road, Silverdale, BioBanking Statement, Silverdale (SitePlus and TRN Group)
- 33 – 35 Warradale Road, Silverdale, BioBanking Agreement, Silverdale (SitePlus and TRN Group)
- NorthConnex, biodiversity offset strategy, Sydney NSW (Lend Lease Bouyeres Joint Venture)
-

Peer review and expert witness services

- Gunlake Quarry: modification to cent in Land and Environment, Marulan (Gunlake Quarries)
- IRT Culburra Beach Development Application: biodiversity assessment peer review, Culburra Beach (Illawarra Retirement Trust)
- Blueys Estate Biodiversity Assessment: peer review, Blueys Beach (City Plan Services)
- Expert review of the Addendum to NSW Biodiversity Offset Policy for Major Projects: Upland swamps impacted by longwall mining subsidence (NSW Minerals Council).
- Tarrone Gas-fired Power Station, expert witness statement, Tarrone (URS Corporation)
- Ballarat Koala Habitat Assessment, expert witness testimony to the Victorian Civil and Administrative Tribunal, Vic (VCAT)

Ecological monitoring and management plans

- Dunmore Hard Rock Quarry, flora and fauna management plan, Dunmore (Boral)
- Beryl Solar Farm, biodiversity management plan, Beryl (Geolyse and Downer)
- Mona Vale Road, biodiversity monitoring plan and implementation, Sydney NSW (Roads and Maritime Services)
- Walgett Solar Farm, biodiversity management plan, Walgett (Geolyse and Epuron)
- Balickera Tunnel, targeted microbat surveys, Balickera (GHD and Hunter Water)
- Additional Crossing of the Clarence River at Grafton, flora and fauna management plan, NSW (Fulton Hogan)
- Dendrobium Mine, biodiversity management plans and monitoring (Illawarra Coal)
- Longwall 6 and 7, biodiversity and upland swamp management plans, Russell Vale (Wollongong Coal)
- NRE No. 1 Colliery Dam 6 Green and Golden Bell Frog monitoring program, Russell Vale (Wollongong Coal)
- Appin Area 9, biodiversity management plan, Appin (Illawarra Coal)
- Shell Port Kembla, Green and Golden Bell Frog management plan, Port Kembla NSW (URS Australia)
- Penshurst Wind Farm, targeted surveys for the Brolga and Southern Bent-wing Bat, Penshurst (RES Australia)

- Holcim Colac Quarry, Coorangamite Water Skink translocation plan, Colac (Holcim Australia)
- Victorian Desalination Plant, targeted surveys for the Growling Grass Frog, Wonthagi (GHD)

Publications and presentations

- BAM – where does fauna fit into the requirements of the new Biodiversity Conservation Act? Presented to the *Ecological Consultants Association of NSW annual conference*, 2017.
- The Biodiversity Conservation Act 2016: a new framework for biodiversity assessment in NSW and how you can be prepared, presented to EMM breakfast seminar, Sydney, 2017.
- An assessment of changes in the extent and distribution of upland swamps in relation to longwall mining, report to Wollongong Coal, 2015.
- The assessment and offsetting of indirect impacts, presented at *Biodiversity Offsetting for Mining, Infrastructure and Urban Development Conference*, Sydney, 2015.
- Coastal upland swamps and longwall mining, presented to *the Australian Institute of Mining and Metallurgy*, Wollongong, 2014.
- Garvey, N, Ben-Ami, D, Ramp, D & Croft, D 2010, Survival behaviour of swamp wallabies during prescribed burning and wildfire, *Wildlife Research* 37(1), pp. 1–12.



Servicing projects
throughout
Australia and
internationally

NATHAN GARVEY

Associate Director - Ecology | Divisional
Leader Ecology, Heritage and Spatial
Solutions

T 02 4907 4800

D 02 4907 4810

M 0477 717 010

E ngarvey@emmconsulting.com.au

Level 3, 175 Scott Street
Newcastle NSW 2300

Berlinda Ezzy

Ecology Team Lead & Associate Ecologist

Curriculum vitae

Berlinda is an Associate Ecologist with 20 years of professional experience. She has worked for local and state government, as well as the private sector, across a range of environmental disciplines. Berlinda's areas of expertise include environmental planning and approvals, threatened species management, coordinating delivery of field ecology surveys and reporting, impact assessments and biodiversity offsets.

Berlinda has led complex projects as an environmental consultant for over 10 years and successfully managed a large number of ecology, impact assessment and offset projects for resource and infrastructure companies across Queensland and New South Wales.

Berlinda is also engaged and consulted with by government agencies on biodiversity offsets due to her long standing experience in this area.

Qualifications

- Bachelor of Applied Science (Honours) Natural Systems and Wildlife Management, University of Queensland, 1998

Career

- Ecology Team Lead, EMM Consulting, 2018–present
- Senior Project Manager and Ecology and Offsets Lead, Amec Foster Wheeler Australia, 2011–2018
- Senior Manager, Environmental Offsets, Ecofund Queensland, 2009–2011
- Manager of Wildlife, Queensland Parks and Wildlife Service, 2008–2009
- Team Leader (Koala Conservation), Senior Planner (Marine and Coastal Planning), Senior Biodiversity Planning Officer, Environmental Protection Agency (now Department of Environment and Science), 2005–2008
- Senior Environmental Planning Officer, Logan City Council, 1999–2004
- Conservation Officer (Moreton Bay Marine Park), Queensland Parks and Wildlife Service, 1998

Representative experience

Infrastructure

- Inland Rail (Qld Geotech Program) preparation of EPBC Act referral, protected plant surveys, Protected Plant Reports, Clearing application under NC Act, Environmental Management Plan, Approvals Strategy and Species Management Program, Qld (ARTC)
- Inland Rail (Qld sections) biodiversity offset assessments, preparation of Qld Biodiversity Offset Strategy, identification of potential offset sites, preparations for meeting with Department of Environment and Energy (ARTC)
- Inland Rail (Qld sections) managing pre-clearance ecology surveys and associated reporting for proposed disturbance sites along corridor to support Geotech program (ARTC)
- Woolgoolga to Ballina Pacific Highway Upgrade, Threatened Species Mg't Plans

- Moomba to Wilton Pipeline, ecology and cultural heritage surveys and due diligence assessments of proposed maintenance areas, Western Qld, NSW and South Australia (APA)
- Wiggins Island Coal Terminal, environmental offset assessments, identification of offset sites, ecology surveys of shortlisted offset property, landholder consultation, preparation of offset management plan (Aurizon)

Oil and Gas

- Spring Gully Gas Project, Significant Impact Assessments, environmental offset analysis and advice, Env Offset Strategy, Central Qld (Origin Energy)
- Bowen Gas Project, EPBC Act referral, identification of environmental offset properties, ecology surveys of offset properties, landholder engagement and preparation of offset management plans, Central Qld (Arrow Energy)
- Australia Pacific LNG, Threatened Species Management Plans, Central Qld (Origin Energy)

Mining

- Olive Downs Mine, biodiversity offset assessments, engaging with government regulators, ecology surveys of offset site, preparing offset management plan
- Blackwater Mine, coordination of baseline surveys including terrestrial and aquatic ecology, threatened species habitat mapping, groundwater and noise for proposed future expansion, central Qld (BMA)
- Blackwater Mine, ecology surveys including habitat mapping and significant impact assessments for proposed seismic investigations (BMA)
- Bauxite Hills Mine Project, coordination of seasonal terrestrial and aquatic surveys and impact assessments, Cape York (Metro Mining)
- Bauxite Hills Mine Project, preparation of Environmental Offset Strategy (addressing State and Federal requirements), Cape York (Metro Mining)
- Bauxite Hills Mine Project, monitoring surveys for receiving environment monitoring program, Qld (Metro Mining)
- Kevin's Corner Coal Mine, coordination of terrestrial ecology surveys, impact assessments, preparation of environmental offset strategy, EPBC Act referral, Galilee Basin (Hancock Galilee)
- Mount Isa Mines, Biodiversity studies including vegetation community surveys, fauna surveys and

condition assessments, Mount Isa (Mount Isa Mines)

- Moorlands Coal Project, environmental offset strategy, central Qld (Cuesta Coal)
- Walton Coal Mine, Environmental Offset Strategy, central Qld (Aquila Resources).

Auditing

- Audit of application of Koala state planning regulatory provisions and offsets, South East Qld (Moreton Bay Regional Council)
- Audit of solar farm approvals and requirement for EPBC Act referral, Gympie (AMP Power)

Renewable Energy

- Baseline terrestrial ecology surveys including regional ecosystem surveys and mapping, threatened flora surveys, threatened fauna surveys, bird utilisation surveys and habitat mapping for two wind farms, Qld (Epuron)

Government

- Provision of strategic advice and analysis on review of current environmental offset framework in Queensland including specific advice regarding pros and cons of mitigation banking, Qld (Department of Environment and Science)



Servicing projects
throughout
Australia and
internationally

BERLINDA EZZY

Associate Ecologist

T 07 3648 1200

D 07 3648 1207

M 0458 280 016

E bezzy@emmconsulting.com.au

Level 1, 87 Wickham Terrace

Spring Hill QLD 4000

Andrew Jensen

Associate Ecologist

Curriculum vitae

Andrew has 15 years' consulting experience across a range of environmental disciplines and industries including mining, renewables, and oil and gas.

Key aspects of his work have included project management, client liaison, preparation of environmental impact statements, preparation of management plans, ecological reporting and surveying, ecological offset plans, management of subcontractors and health and safety processes.

Andrew routinely reviews environmental technical studies and has developed environmental management plans and negotiated environmental approval conditions for clients. Andrew has also been responsible for conducting a number of species impact significance assessments at both Commonwealth and state level and is familiar with the requirements of this process. Andrew has also been responsible for managing, coordinating and undertaking fieldwork campaigns across Queensland.

Qualifications

- Bachelor of Science (Hons), University of St Andrews, 2003

Career

- Associate Ecologist, EMM Consulting, 2019–present
- Senior Environmental Scientist, CDM Smith, 2017–2019
- Senior Environmental Consultant, Coffey, 2010–2017
- Environmental Scientist, Royal Haskoning UK, 2004–2009
- Field Surveyor, British Trust for Ornithology (UK), 2007–2008
- Technician, Royal Haskoning (UK), 2003–2004
- GIS Technician, Essex County Council (UK), 2001–2002

Representative experience

- Mount Fox Wind Farm, ecological desktop assessments and constraints analysis, Qld (Windlab Limited)
- Blackwater Coal Mine, coordinating and implementing baseline ecological surveys and reporting including threatened fauna species surveys, Blackwater (BHP)
- Cape River Substation, Vegetation clearing permit, Pentland (Windlab)
- Kennedy Energy Park, Ecological assessment and EPBC referral, Hughenden (Windlab)
- McPhillamys Gold Mine, Ecological Surveys and Biodiversity Assessment Report, Blayney NSW (Regis Resources)
- Carmichael Coal Mine, Secondment to Adani Mining for environmental approvals and compliance role, Brisbane (Adani Mining)
- Secondment to BHP for environmental approvals, Brisbane (BHP)
- Tipton West Dalby Pipeline, Ecological Surveys, Dalby (APA Group)
- Rugby Run Solar Farm, Secondment to Adani Renewables, Brisbane/Moranbah (Adani Renewables)
- Reedy Creek Wallumbilla Pipeline, Ecological Surveys, Reedy Creek (APA Group)
- Styx Coal Mine, Supplementary Ecological Surveys, Marlborough (Waratah Coal)
- Bauxite Hills Mine, Ecological Surveys, north of Weipa (Metro Mining)

- Frieda River Project, Aquatic Ecology Impact Assessment, Papua New Guinea (PanAust)
- Chifley Road upgrade, Review of Environmental Factors, Chifley NSW (Roads and Maritime)
- Granville Platform Upgrade, Review of Environmental Factors, Granville NSW (Sydney Trains)
- Erskineville platform upgrade, Review of Environmental Factors, Erskineville NSW (Sydney Trains)
- Menangle Park gas pipeline, Review of Environmental Factors, Menangle Park NSW (Jemena)
- Riverwood Bridge upgrade, Review of Environmental Factors, Riverwood NSW (Sydney Trains)
- P'nyang Project appraisal well, Preparation of ESIA, Papua New Guinea (Oil Search)
- P'nyang Project, Preparation of EIS, Papua New Guinea (Esso PNG P'nyang Ltd)
- Former Mary Kathleen uranium mine, Environmental Condition and Rehabilitation Assessment, near Mount Isa (Queensland Government)
- Sarsfield Gold Mine Expansion Project Supplementary Report to the EIS, Ravenswood (Carpentaria Gold)
- PNG LNG Pipeline Project, Preconstruction Environmental Surveys, Papua New Guinea (Spiecapag)
- PNG LNG Project, Secondment to ExxonMobil, Papua New Guinea (ExxonMobil)
- Moura Pipeline, Ecological Assessment and EPBC Referral, Moura (Queensland Nitrates)
- Hillalong Project, Ecological Surveys for reassignment of vegetation mapping, Glenden (Shandong Energy)
- Surat Gas Project, Supplementary Report to the EIS, Brisbane/Surat Basin (Arrow Energy)
- Arrow LNG Plant, Supplementary Report to the EIS, Brisbane/Gladstone (Arrow Energy)
- Moranbah Gas Project, Threatened Species Management Plan, Brisbane (Arrow Energy)
- Arrow LNG Plant, Preparation of EIS, Brisbane/Gladstone (Arrow Energy)
- Pagham Harbour Coastal Defence Scheme, Preparation of EIS, Pagham UK (Environment Agency)
- QE2 Teesport Berth Development, Preparation of EIS, Teesport UK (PD Teesport)
- Round 3 Offshore Windfarms, Review of Ecological Constraints, Edinburgh UK (Airtricity)
- Onshore Windfarm bird survey methodology design, Edinburgh UK (Enertrag)
- Dover Harbour Terminal 2 Development, Preparation of EIS, Dover UK (Dover Harbour Board)
- Dudgeon Offshore Windfarm, Preparation of EIS, Edinburgh UK (Dudgeon Offshore Wind)
- Elgin Flood Alleviation Scheme, Ecological Surveys, Elgin UK (Moray Council)
- Seaham Harbour Redevelopment, Preparation of EIS, Seaham UK (Durham Council)
- Titchwell Managed Realignment, Preparation of EIS, Norfolk UK (Royal Society for the Protection of Birds)
- Forres (River Findhorn) Flood Alleviation Scheme, Ecological Surveys and Preparation of EIS, Elgin UK (Moray Council)
- Helix Project Phase II, Ecological Surveys, Grangemouth UK (British Waterways)
- Forres (River Findhorn) Flood Alleviation Scheme, Ecological Surveys, Elgin UK (Moray Council)
- Proposed Firth of Forth Windfarm, Review of Constraints, Edinburgh UK (Airtricity)
- Seahouses seawall upgrade, Ecological Surveys, Seahouses UK (Northumbria Council)
- Thames Estuary Maintenance Dredging, Review of Ecological Data, London UK (Port of London Authority)
- BERR Offshore Energy Strategic Assessment, Review of Survey Method, Edinburgh UK (BERR)
- Bo'ness Harbour Development, Wintering Bird Management Plan, Bo'ness UK (ING Estate)
- Brent Decommissioning, Sensitivity Assessment and Environmental Risk, Edinburgh UK (Shell)
- Canvey Biodiesel Plant, Preparation of EIS Addendum, Canvey UK (Sure Green Fuels)
- Barrow Waterfront Harbour Revision Order, Preparation of EIS, Barrow UK (West Lakes Renaissance)
- Trow Quarry Remediation Project, Ecological Surveys and Preparation of EIS, Trow UK (South Tyneside Council)
- Isle of Grain Windfarm, Review of Ecological Data, Isle of Grain UK (British Petroleum)
- Newhaven Desalination Plant, Preparation of EIS, Newhaven UK (Clarity Ltd)



Servicing projects
throughout
Australia and
internationally

ANDREW JENSEN

Associate Ecologist

T 07 3648 1200

D 07 3648 1205

M 0404 348 638

E ajensen@emmconsulting.com.au

Level 1, 87 Wickham Terrace
Spring Hill QLD 4000

Patrick Finnerty

Ecologist

Curriculum vitae

Patrick is an ecologist and environmental management professional with project experience across a range of sectors including utilities, infrastructure, construction and energy. Patrick has been involved in the successful delivery of a range of projects including ecological impact assessments, ecological monitoring and management plans.

Patrick has also undertaken academic and field research for various environmental and ecological projects in New South Wales, Western Australia and South Africa.

Qualifications

- Bachelor of Science (Advanced) (Hons I) and University Medal, University of Sydney, 2017
- HLTAID003 Provide First Aid Certificate – S512/4032
- White Card – Work Safety in the Construction Industry, 2018

Career

- EMM Consulting, 2018–present
- Casual employment with Benbow Engineering and Environmental Consulting, 2018
- Casual employment with Western Australia Department of Parks and Wildlife, 2017
- Graduate Field Ecological Scientist (Casual), SMEC Consulting, 2017
- Casual employment with the NSW Office of Environment and Heritage, 2017

Representative experience

Ecological impact assessment and due diligence

- Snowy 2.0, field investigations including soil surveys, vegetation mapping and targeted species survey for environmental impact statements, Kosciuszko National Park NSW (Snowy Hydro Limited)
- Gunlake Quarry Biodiversity and Conservation Agreement, vegetation assessment of potential offset areas, NSW (Gunlake Quarries)
- Beryl Solar Farm Biodiversity Assessment Report, Beryl NSW (Downer Group)
- New England Solar Farm, targeted fauna and flora surveys and vegetation assessments, Uralla (UPC)

Ecological monitoring and management plans

- Mona Vale Rd Upgrade Biodiversity Monitoring, targeted surveys for Giant Burrowing Frog, Red-crowned Toadlet and Eastern Pygmy Possum, Terrey Hills to Ingleside, NSW (Roads and Maritime Services)

Relevant environmental experience

- Western Australia Department of Parks and Wildlife: conducted a number of invasive species environmental and pest control projects in Kununurra.
- NSW Office of Environment and Heritage: conducted a number of native mammal environmental and ecological research projects.
- Worked as part of a collaborative research team that conducted a four month investigation into the environmental impact of African elephants in Hazyview, Kruger National Park, South Africa.

Publications

- Finnerty P B, Shine R & Brown G P 2018, The costs of parasite infection: Effects of removing lungworms on performance, growth and survival of free-ranging cane toads, *Functional Ecology* 32(2), pp. 402–415.
- Finnerty P B, Shilton C M, Shine R & Brown G P 2018, Using experimental de-worming to measure the immunological and pathological impacts of lungworm infection in cane toads, *International Journal for Parasitology: Parasites and Wildlife* 6(3), pp. 310–319.
- Finnerty P B, Shine R & Brown G P 2019, Survival of the feces: Does a nematode lungworm adaptively manipulate the behaviour of its cane toad host? *Ecology and Evolution* 8 (9), pp. 1–13.
- Finnerty P B, Stutz R S, Price C J, Banks P B & McArthur C 2017, Leaf odour cues enable non-random foraging by mammalian herbivores, *Journal of Animal Ecology* 86(6), pp. 1317–1328.



Servicing projects
throughout
Australia and
internationally

PATRICK FINNERTY

Ecologist

T 02 9493 9500

D 02 9493 9552

M 0499 998 444

E pfinnerty@emmconsulting.com.au

Ground floor, 20 Chandos Street
St Leonards NSW 2065

BEN JAMES NOTTIDGE

EDUCATION

2002 **First Class Honours (Animal Studies)**
University of Queensland

This degree examined the health and dispersal patterns (using radio telemetry) of translocated and rehabilitated koalas in two different locations on the Gold Coast, Queensland.

2001 **Bachelor of Applied Science (Protected Area Management)**
University of Queensland

The Protected Area Management degree focused upon natural and cultural resources within conservation systems and how economic, social and ecological factors influence the management of protected areas. Where possible I enrolled in as many wildlife and ecology based subjects as my program would allow.

PROFESSIONALS SKILLS & ATTRIBUTES

- Demonstrated ability to produce various scientific reports and professional documents
- Thorough understanding of statutory and regulatory processes regarding urban development, land-clearing and environmental impacts
- Thorough knowledge of ecological assessment requirements and methods including animal trapping, animal handling and ethics
- Broad knowledge of flora and fauna identification, including identification of tracks, scats and traces
- Experience in wildlife project design, radiotelemetry and scientific research
- High level of understanding of urban wildlife management, population management issues and ethics
- Experience in feral animal monitoring and control
- Proven ability to manage projects of varying size
- Proven ability to supervise and train staff as required
- Demonstrated ability of project costing and ensuring budgets and timeframes are met
- Excellent interpersonal and communication skills
- Proven ability to develop positive working relationships with clients and regulatory authorities
- Proven ability to work effectively and reliably as part of a team environment or independently as required

- Ability and willingness to learn and perfect additional skills and knowledge as required
- Proficient in the use of computers and various software programs.

EMPLOYMENT HISTORY

Director/Principal Ecologist
GreenLeaf Ecology

January 2011 - Current

- Fauna surveys
- EIS
- Habitat assessment & mapping
- Fauna management plan formulation
- Threatened species management plan formulation and implementation
- Wildlife radio-telemetry projects
- Targeted threatened species surveys
- Koala survey, capture and monitoring
- Feral animal monitoring and control
- Project management
- Offset site revegetation/rehabilitation - implementation and monitoring
- Wildlife spotter-catching and management during vegetation clearing

Key projects while in this position include:

- EIS ecological (fauna) surveys (pre and post wet season), Blackwater Mine Expansion Project - (BMA)
- Warner Koala Management Project, Warner (CSR Ltd)
- Targeted threatened species surveys and habitat mapping, Project Ironbark No. 1 Coal Project, Coppabella (Fitzroy Australia Resources)
- Targeted threatened species surveys and habitat mapping, Beerwah East (Major Development Area)
- EIS ecological (fauna) surveys (pre and post wet season), MDL 361, Pentland, (Great Northern Energy)
- EIS ecological (fauna) survey (pre wet season), Woolgar Gold Project, Woolgar, (Strategic Minerals)
- Bruce Highway Upgrade Project (Caloundra Road to Sunshine Motorway) - targeted threatened species surveys and habitat mapping, threatened amphibian pre-clear surveys and ongoing threatened amphibian population monitoring (Department of Transport and Main Roads/Fulton Hogan-Seymour Whyte JV)
- EIS ecological (fauna) surveys (pre and post wet season and offset sites), Olive Downs South and Willunga Coal Project, Coppabella (Pembroke Resources)
- Toowoomba Second Range Crossing Project - koala habitat assessment, survey, capture and monitoring (Department of Transport and Main Roads)
- EIS fauna survey (pre and post wet season), Arrow Bowen Pipeline (Arrow Energy)
- Moreton Bay Rail Koala Tagging and Monitoring Project and Alternative Habitat Offsets Monitoring Project (Department of Transport & Main Roads)
- Ecological Assessment and PMAV for the Kawana STP Rising Main Diversion (Unitywater)
- Targeted threatened amphibian survey and translocation project, Stone Ridge, Narangba (Stockland)
- Revegetation/rehabilitation vegetation offsets project, Tanawha (Unitywater)
- Targeted fauna survey and habitat assessment for threatened fauna species in the southern Brigalow Belt, Chinchilla (Origin Energy)
- Targeted fauna surveys, pre-clearing surveys, habitat assessments, Curtis Island (Australia Pacific LNG)
- EIS fauna survey, Foxleigh Proposed Coalmine, Middlemount (Anglo American)

- EIS fauna survey, Moranbah South Proposed Coalmine, Moranbah (Anglo American)
- EIS fauna survey, Valeria Proposed Coalmine, Capella (Rio Tinto)
- EIS fauna survey, Winchester South Proposed Coalmine, Moranbah (Rio Tinto)
- EIS fauna surveys including targeted koala surveys and wildlife spotter-catching, Hail Creek Coalmine, Nebo (Rio Tinto)
- Giant Barred Frog Species Management Plan, Belli Park (Sunshine Coast Council)
- Koala radio-tracking, wildlife spotter-catching, fauna surveys, revegetation, Brendale (CSR Ltd)
- Koala surveys, capture and habitat assessment for the Road Ecology Koala Study, multiple sites from Redlands to Kurwongbah (Griffith University)
- Targeted threatened amphibian and mammal surveys, Caloundra South Proposed Development, Caloundra (Stockland)
- Threatened amphibian targeted surveys, habitat assessment and mapping, Caboolture Landfill Expansion, Caboolture (Moreton Bay Regional Council)

Manager/Senior Ecologist
Ecological Services Unit,
Australia Zoo Wildlife Warriors Worldwide Ltd

February 2007 - January 2011

- Wildlife translocations
- Wildlife radio-telemetry projects
- Wildlife management projects
- Flora and fauna assessments
- Wildlife capture utilising darting anaesthesia
- Advising developers on ecologically sensitive design and planning
- Pre-clearing fauna surveys and fauna rescue programs
- Acquiring Animal Ethics Committee approval and Scientific Purposes Permits for research and wildlife management projects
- Planning, co-ordination and implementation of fauna trapping programs
- Project costing and invoicing
- Project management
- Staff management and training
- Supervise and train University students during workshops and work experience
- Consultation and liaison with a range of key stakeholders and clients including local residents, contractors, other consultants, Local, State and Federal Governments

Key projects while in this position include:

- Australia Pacific LNG Project, Curtis Island
 - Ensure client compliance with conditional clearing permit
 - Record type and quantity of vegetation cleared during geo-technical investigation works
 - Conduct wildlife spotter-catcher duties during vegetation clearing
 - Conduct targeted species surveys and habitat assessments
- Trackstar Alliance Rail Upgrade - Caboolture to Beerburrum
 - Pre-clearing fauna surveys
 - Wildlife Spotter-catching during vegetation clearing
 - Direct vegetation clearing methodologies
 - Advise Trackstar environmental staff as required
 - Liaise and work with a wide range of Trackstar personnel from contractors to Superintendent
- Warner Springs Residential and Industrial Development (CSR Ltd), Warner

- Fauna Surveys
 - Koala radio-tracking to determine home ranges of resident population including koala capture and thorough health assessments
 - Using radio-tracking data to guide habitat retention
 - Negotiating development layout and design with a range multi-disciplinary consultants to maximise ecological outcomes while ensuring economic requirements of the project were met
 - Formulate an offset strategy to mitigate development impacts
 - Liaise with key stakeholders including local councils and non-government organisations
 - Advise the client on a range of issues including development design and habitat retention, wildlife management and revegetation
 - Manage revegetation projects on site
- Sit on an Expert Panel for Moreton Bay Regional Council's *Conservation Significance Mapping Project*
 - Provide advice to Council representatives regarding the location of ecologically significant areas and known significant species distribution within the Shire
- Eco-librium Residential Development (CSR Pty Ltd), Narangba
 - Fauna Surveys
 - Koala radio-tracking to determine home ranges of resident population including koala capture and thorough health assessments
 - Using radio-tracking data to guide habitat retention
 - Negotiating development layout and design with a range multi-disciplinary consultants to maximise ecological outcomes while ensuring economic requirements of the project were met
 - Liaise with key stakeholders including local councils, non-government organisations and members of the public
 - Advise the client on a range of issues including development design and habitat retention and wildlife management
- Macropod Management, Sanctuary Cove Golf Club, Gold Coast
 - Capture of Eastern Grey Kangaroos using projectile anesthesia
 - Conduct macropod population census
 - Macropod handling
 - Assist in health assessments and reproductive management including surgery
- Assessment of the Wildlife Spotter-catcher Process and Nature Conservation Protection Mechanisms in Moreton Bay Regional Council Shire
 - Analyse the effectiveness of Nature Conservation Overlays
 - Ground truth mapped vegetation and potential fauna release sites
 - Provide recommendations to Council on measures to improve ecological mapping and the wildlife spotter-catcher process

Self Employment

Proposed Energex Corridor, Forest Glen - Raymonde Raiz (landowner) **August 2010 - January 2011**

- Investigate potential impact of proposed infrastructure
- Conduct targeted surveys for threatened species
- Conduct habitat assessment for threatened species

Site Investigation for Biodiversity Offsets, Toorbul - Ecofund Queensland **September - October 2010**

- Assess habitat suitability for targeted species
- Conduct targeted surveys for threatened species
- Assess the suitability of the site as a location for future biodiversity offsets

Wallum Sedgefrog Monitoring, Peregrine - James Warren & Associates **March 2009 - present**

- Conduct threatened species monitoring as per the requirements of the Management Plan
- Conduct targeted surveys for the Wallum Sedgefrog (*Litoria longiburensis*) within retained conservation zones on an approved development site

Environmental Scientist
James Warren & Associates

Sept 2003 - February 2007

- Flora and fauna Assessments
- Targeted surveys for significant flora and fauna
- Due diligence investigations
- Preparation of vegetation and fauna management plans
- Site constraints analysis
- Pre-clearing fauna surveys and wildlife spotter-catching activities
- Licence and permit applications to State Government
- Assist in the formulation of reports for the Queensland Planning and Environment Court
- Planning, co-ordination and implementation of fauna trapping programs
- Ecological monitoring and record keeping
- Supervise, train and direct other company personnel as required
- Manage projects of varying size
- Project costing and budgeting
- Attend and contribute to project meetings
- Develop a knowledge and understanding of Federal (*Environment Protection and Biodiversity Conservation Act 1999*) and State (*Nature Conservation Act 1992 & Vegetation Management Act 1999*) legislation
- Vegetation management - formulation and application of PMAV's and map amendments under the provisions of the *Vegetation Management Act 1999*
- Consultation and liaison with local residents, Local, State and Federal Governments departments, business groups and non-government organisations during the development process

Key projects while in this position include:

- The Edge Noosa, Kin Kin (SEQ)
 - Extensive Ecological Assessment and respond to Government Information Request
 - Targeted surveys for significant flora and fauna
 - Significant species habitat and vegetation mapping
- Coolum Ridges, Peregrine Beach (SEQ)
 - Respond to Government Information Request
 - Targeted surveys for significant flora and fauna
 - Koala surveys and mapping of primary and secondary habitat
- Pelican Links, Caloundra (SEQ)

- Ecological Assessment and respond to Government Information Request
 - Targeted surveys for significant flora and fauna
 - Significant species habitat and vegetation mapping
 - Preparation of a PMAV for site vegetation
 - Map remnant vegetation occurring on site
 - Assist in the preparation of Court documents
 - Significant species habitat and vegetation mapping
- Residential Development, Mission Beach (NQ)
 - Targeted fauna surveys and habitat assessment for three endangered species (Southern Cassowary, Laced-eyed Tree-frog, Mahogany Glider)
- Shoal Point, Mackay (CQ)
 - Targeted surveys for vulnerable fauna (False Water-rat)
 - Map extent of marine vegetation
 - Determine and map extent of remnant vegetation
 - Flora survey
- Rodds Harbour, Turkey Beach (CQ)
 - Ecological Assessment
 - Targeted surveys for significant flora and fauna
 - Determine and map extent of remnant vegetation

Urban Wildlife Management Projects:

Sept - Oct 2005

Brisbane City Council, Wacol Wastewater Treatment Plant, Wacol

(Contract position)

Environmental Consultant

- Obtain an accurate population size of Eastern Grey Kangaroos inhabiting the Waste Water Treatment and Management area
- Determine and implement an adequate management option that fulfilled the ecological and legal / ethical requirements for wildlife management on behalf of the client
- Relocation of the population to a suitable pre-determined area
- Assist wildlife veterinarian with animal tranquilization using a dart gun
- Prepare report on the project and future management options

**Aug - Sept 2003,
Nov 2005**

The Pines Golf Course, Sanctuary Cove, Gold Coast

(Contract position)

Environmental Consultant

- Obtain an accurate population size and demographic census of Eastern Grey Kangaroos inhabiting the Golf Course area
- Survey all boundary fences and record any breaches that may allow immigration / emigration
- Test animals reaction in relation to being approached and firing of a dart gun at close proximity
- Assist wildlife veterinarian in preparation of darts and darting of all animals with a tranquilizer gun
- Assist with veterinary procedures including ear tagging all animals, record individual data, general physical examination, contraceptive implantation, administration of medications
- Preparation of detailed project report and management plan

**Aug 2003 (contract position) Edenbrooke Residential Developments,
Seventeen Mile Rocks
*Environmental Consultant***

- Perform a site assessment on remaining native bushland in a development site
- Record vertebrate fauna present at the site through observations and recent traces
- Record basic floristic composition within the site
- Identify boundaries and fences of the site, i.e. whether these would inhibit or assist in the removal process of fauna
- Provide options in relation to the removal of remaining vertebrate species in the site prior to development

**June 1996 - Dec 2000 Big Pineapple, Woombye
*Animal Keeper***

- Caring for a wide range of native and domestic animals
- After hours care of native wildlife
- Animal food preparation (including harvesting of Koala food trees)
- Medical treatment of animals
- Public presentations with animals
- Wildlife handling and capture of problem animals
- Cleaning, maintenance and construction of enclosures
- Gardening and landscaping
- Primary production work
- Public liaison
- Liaison with a wide range of people in various departments
- Ordering and purchasing stock and equipment
- Training and supervising staff

VOLUNTARY WORK

2010-2015	Frogsearch - Kroombit Tops National Park, DERM (March & December)
2010	Wallum Sedgefrog surveys assisting PhD candidate - Mooloolah River National Park and Beerburrum State Forest, Griffith University (February & September)
2010	False Water Rat targeted surveys - Bribie Island, DERM (August)
2010	Wallum Sedgefrog targeted surveys - Bribie Island, DERM (November)

WORK EXPERIENCE

2003	Quoll Seekers Network
2001	QPWS, Maleny, QLD
2000	QPWS, Carnarvon Gorge, QLD

2000 QWPS, Currawinya, QLD
1999 NTCC, Borroloola, NT

PUBLICATIONS

- Hanger, J.J. and Nottidge, B.J. 2009. Draft Code of Practice for the Welfare and Management of Wild Animals Affected by Land-clearing and the Modification or Destruction of Wildlife Habitats and Wildlife Spotter/catchers.
- Nottidge, B.J. 2002. Monitoring the health and dispersal patterns of translocated and rehabilitated Koala at two locations on the Gold Coast, *in press*.

LICENCES / MEMBERSHIPS / CERTIFICATES

- Wildlife Preservation Society of Qld (member)
- Queensland Frog Society (member)
- 2010-2020 Australian Wildlife Conservancy (Contributor)
- Current Rehabilitation Permit (Wildlife Spotter-Catcher) - Department of Environment and Heritage Protection
- 2004 Blue Card (Construction Industry) #129922
- 2014 SARC Card (QR Trackside Safety Card)
- Current manual vehicle drivers licence
- Current Senior First Aid and CPR Certificate
- Coal Board Medical
- 4WD Driver Certificate
- Generic Coal Surface Induction (S11)
- Coal Seam Gas Inductions (Arrow Energy, APLNG, QGC)

REFEREES

Mr Jason Richard
Principal Project Officer
Office of the Coordinator General
Queensland Government
M: 0457 750 157

Dr Jon Hanger
Managing Director
Endeavour Veterinary Ecology Pty Ltd
M: 0429 933 761
E: jon@endeavourvet.com.au

Mr Steve Marston
Director/Principal Ecologist
Ecological Survey and Management
M: 0448 899 649
E: steve.marston@ecosm.com.au

Appendix B

Fauna handling procedure

The purpose of the fauna handling procedure is to outline and specify the actions to be undertaken when handling and relocating fauna during vegetation clearing or Project operations. The following procedures will take effect when a fauna species is discovered and requires handling to remove it from threat, or if it is injured, during the vegetation clearing phase or during Project operations to get it to care. This program has been developed in accordance with the Code of Practice for Care of Sick, Injured or Orphaned Protected Animals in Queensland (DES 2011).

The objective and scope of this procedure is to minimise impacts on native fauna as a result of the Project and is applicable to all native species.

i Fauna Handling procedures

Considerations for the general handling procedures of different species of different Taxa are outlined in Table B1. Depending on the circumstances certain activities (outlined in Table B2) will need to take place in response to the animals listing status (Critically Endangered, Endangered or Vulnerable), physiological requirements and condition.

Native species fauna handling is to be conducted

Table B1 **Handling of animals**

Taxa	Techniques/procedures
Arboreal animals	<p>Trees that have been identified to support hollows will be taken down with extra care and hollows will be checked by fauna spotter-catcher for arboreal mammals. Trees with hollows large enough to support Greater Glider are being managed from an elevated work platform and any species present will be removed (where possible) to avoid injury during tree clearing process.</p> <p>In the event an arboreal mammal is identified it will be placed in a hessian bag and kept in a cool, shady place until it can be released that night into a pre-identified release site. Handling time is to be minimised.</p>
Mammals	<p>Potential injury from mammals to fauna spotter/catchers, if handled incorrectly, is a risk. Handling time of each individual animal should be minimised and animals should be placed in a hessian bag, canvas bag or box with ample ventilation (depending on the animals ability to escape).</p>
Bats	<p>A number of bat species are carriers of the Australian Bat Lyssavirus (ABL) which any individual conducting Fauna spotter/catcher work should be vaccinated against. All bats will be stored in individual calico bags or bat nest box.</p> <p>Microbat species will use tree hollows and decorticated bark to roost during daylight hours therefore an assessment of each tree to be cleared will need to be completed prior to removal.</p>
Birds	<p>Potential injury from birds to fauna spotter/catchers, if handled incorrectly, is a risk. Handling time of each individual animal should be minimised and animals should be placed in a hessian bag, canvas bag or box with ample ventilation (depending on the animals ability to escape).</p>

Table B1 **Handling of animals**

Taxa	Techniques/procedures
Amphibians	<p>Frogs are the only native Amphibians in Australia. Handling of frogs needs to be done with care in order to not spread the Amphibian Chytrid Fungus and is to be undertaken with the correct hygiene protocols according to the Interim hygiene protocol for handling amphibians (DEHP) and Hygiene protocols for the control of diseases in Australian frogs 2011 (DAWE 2011).</p> <p>Frogs and tadpoles are to be placed in disinfected plastic containers/buckets with a small amount of water and native vegetation between capture and relocation.</p>
Non-serpentine reptiles	<p>All reptiles should be transported in breathable hessian or canvas bags depending on the strength of the animal. Handling time of each individual should be minimised and conducted by the appropriate personnel.</p> <p>Varanid species are known to possess venom and bacteria in their bite with the potential to cause significant harm to personnel.</p>
Snakes	<p>Due to the potential lethality of a bite from many species of snakes, handling of these species should only be attempted, where required, by appropriately qualified personnel utilising the appropriate tools (snake hooks and bags) for no-contact handling.</p>

Table B2 **Activities when handling animals**

Activity	Techniques/procedures
Threatened species	<p>If habitat features with the potential to harbour threatened species (such as hollows for greater gliders) occur within the clearing path it is requirement that thorough searches are conducted in order to rule out impacts to threatened species. Searches of tree hollows large enough to support Greater Glider will be checked from an elevated work platform.</p> <p>If a threatened species is located within the clearing area, it will be re-located to a safe pre-determined release area.</p>
Nests and Juveniles	<p>If young animals or eggs are located within a nest, defer clearing (where possible) until eggs have hatched or juveniles have left the nest. If this is not possible, carefully capture or pick up any hatchlings and keep them warm. Turn over juveniles to a pre-determined wildlife carer or vet.</p> <p>If young arboreal mammals or birds are located within a hollow, they will be transported in boxes with appropriate furniture and placed in previously prepared nesting boxes at the pre-determined relocation site. The method of relocation will be dependent on the species.</p>
General relocation	<p>Animals should only be released one at a time and within the correct habitat containing the requirements for the individual animals survival. This should not occur during times of heavy rainfall.</p>
Release of nocturnal species	<p>Nocturnal species, when captured during the day, must immediately be placed in a dark, secure location and re-released shortly after dusk so as to not overly stress the animal.</p>
Injured animals	<p>Injured animals need care according to the condition they are caught in. This needs to be undertaken in accordance with the Code of Practice for Care of Sick, Injured or Orphaned Protected Animals in Queensland under the NC Act.</p> <p>A pre-determined veterinarian and animal rehabilitation group will be assigned the task of tending to injuries and recovery before release.</p>
Euthanasia	<p>Euthanasia will be carried out in instances where pest animals are caught or native animals have been critically injured. A pre-determined veterinarian will be used to conduct the euthanasia after the animal has been assessed.</p>

Table B2 **Activities when handling animals**

Activity	Techniques/procedures
Release site selection	All release sites will be pre-selected to coincide with the quality and features of the vegetation being cleared. This will be done in order to make sure the habitat requirements of each species is met when released and gives the optimal chance for survival. Release sites will be assessed and finalised during pre-clearance ecology surveys (prior to clearing).

ii **Fauna likely to be affected by vegetation clearing**

Some species, such as birds or macropods are largely mobile and will not be directly impacted by the vegetation clearing procedures. Other species likely to be impacted by the vegetation clearing are:

- Arboreal species such as possums;
- Microbats residing on trees;
- Less mobile species and those dependent on certain habitat features such as lizards or nesting birds; and
- Species utilising tree hollows.

Vegetation clearing activities will result in the loss of habitat and potential injury or mortality if depending on clearing procedure. Mobile species are at risk of vehicle collision.

iii **Relocation procedure**

Relocation will be undertaken by a licenced Ecologist and all species records will be maintained in a register. Each individual animal will be released according to the following procedure:

1. Appropriate release sites for all predicted species will be pre-determined by the project lead ecologist;
2. Sites where habitat is suitable and similar and located close to the original capture location is preferential;
3. Relocation of nocturnal species such as Owl's or Greater Gliders will be undertaken after dusk;
4. Release during periods of heavy rainfall will be avoided; and
5. Species dependent on hollows, such as Greater Gliders, and those with young will be released into an appropriately sized nest box set-up at a pre-determined release site.

iv **Fauna capture recordings**

The fauna spotter catcher will maintain records of all fauna captured and relocated during the vegetation clearing works. The following details are required to be recorded by the operating fauna spotter catcher for both the capture and release locations of an individual animal:

- Collector's name;
- Start date;

- GPS location of capture;
- Number of individuals;
- Status for the period between capture and release;
- Species scientific name;
- Count;
- Date; and
- Any additional comments.

v [Reporting](#)

The lead ecologist will report all records of fauna found, relocated and euthanised to DES. The lead ecologist will report any animal injury or death of a threatened species to the Pembroke Environmental Manager.

Appendix C

Implementation schedule

Table 9.1 **Implementation schedule of management actions**

Activity	Management actions	Project stages and phases*																Timing and/or frequency	Related monitoring
		Stage 1 (Years 1-5)				Stage 2 (Years 6-11)				Stage 3 (Years 12-30)				Stage 4 (Years 30-79)					
		VC	C	O	D	VC	C	O	D	VC	C	O	D	VC	C	O	D		
Clearing native vegetation	Delineate exclusion areas	✓				✓				✓				✓				Prior to any vegetation clearing occurring for that stage.	Two general monitoring inspections per year (refer to Section 6.1 for further details).
	Fence riparian buffer zones and exclude livestock	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Fencing will be installed in Stage 1. Fencing will be maintained throughout Project.	Two general monitoring inspections per year (refer to Section 6.1 for further details).
	Pre-clearance surveys	✓				✓				✓				✓				At least 3 weeks prior to clearing commencing in a designated area.	A Fauna Spotter will be present to monitor clearing activities (refer to Section 4.3 for further details).
	Use of fauna spotter-catchers	✓	✓			✓	✓			✓	✓			✓	✓			Immediately prior to and during any vegetation clearing occurring for that stage. As required during construction phase.	A Fauna Spotter will be present to monitor clearing activities (refer to Section 4.3 for further details).
	Koala monitoring for Stage 1	✓	✓															At least 3-4 weeks prior to clearing. Koala tracking will continue during clearing phase and continue 3 months post clearing. Applies to Stage 1 only at this stage.	Monitoring for at least 3 months post-clearing.
	Nest box installation for Stage 1	✓	✓	✓	✓													50% of required nest boxes will be installed prior to clearing commencing. 50% of required nest boxes will be installed either during Stage 1 clearing phase.	First inspection after 6 months, then annually thereafter (refer to Section 6.4.7 for further details).

Training site personnel	Inductions and pre-starts to include information on MNES	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Once during site induction. Pre-starts to inform of updates as required. Training and inductions are ongoing for all stages and phases.	Internal audits of training to be undertaken.
Fauna connectivity structures	Koala exclusion fencing	✓	✓			✓	✓			✓	✓			✓	✓			Post vegetation clearing occurring in the area. Prior to main construction activities occurring.	Two general monitoring inspections per year (refer to Section 5.2.6 for further details).
	Greater Glider rope crossings	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Post vegetation clearing occurring in the area including clearing for the river crossings. Prior to main construction activities occurring.	Two general monitoring inspections per year (refer to Section 6.4.7 for further details).
	Fauna exit ramps		✓	✓			✓	✓			✓	✓			✓	✓		During construction. As required during operations.	Monitoring within two hours of sunrise and trapped fauna released. Additional monitoring following rainfall events (refer to Table 4.2 for further details).
	Bridge crossing Isaac River		✓				✓											First bridge to be constructed in Stage 1. Second bridge crossing to be constructed in Stage 2.	Two general monitoring inspections per year (refer to Section 6.1 for further details).
Weed management	Reducing extent of existing weeds and minimising the risk of introduction of additional weed species	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Annually.	Two general monitoring inspections per year (refer to Section 6.1 for further details).
Pest animal management	Minimising introduction of invasive animals and manage existing invasive animal populations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Annually.	Annually for the first 3 years, followed by every 2 years for the (refer to Section 6.4.2 for further details).

Grazing management	Strategic grazing to manage fuel loads and weeds	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Ongoing basis.	Fuel loads monitored regularly. Two general monitoring inspections per year (refer to Section 6.1 for further details).	
Fire management	Manage fuel load	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Ongoing basis.	Fuel loads monitored regularly. Two general monitoring inspections per year (refer to Section 6.4.6 for further details).	
	Fire break establishment and management																		
	Cool burns (when required)																		
Sediment and erosion management	Prevent soil runoff into watercourses	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Ongoing basis.	Two general monitoring inspections per year (refer to Section 6.4.5 for further details).	
Dust management	Water down dirt tracks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Ongoing basis.	To be outlined in a Air Quality Management Plan to be prepared (refer to Section 6.4.3 for further details).	
	Speed limits of 60km or less to be enforced																		
Rehabilitation	Progressive rehabilitation			✓	✓			✓	✓		✓	✓				✓	✓	Progressively as mining areas are completed and infrastructure no longer required.	To be outlined in a Rehabilitation Management Plan to be prepared.
MNES Habitat Quality Monitoring	Undertake habitat quality monitoring and scoring to detect any decrease in habitat quality.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Baseline scores to be established in 2022. Yearly for Stage 1. Every two years Stage 2. Every five years Stages 3 and 4.	Habitat quality monitoring is summarised in Section 6.3.	
Reporting	Post-clearing report	✓				✓				✓				✓			Once after clearing.	Refer to Section 7.2 reporting details.	
	Annual report	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Annually.		
	5 yearly interim report	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Every five years.		
	MMP formal review				✓				✓			✓					12 months prior to the commencement of each stage.		

*VC – vegetation clearing, C – construction, O – operations, D- decommissioning

