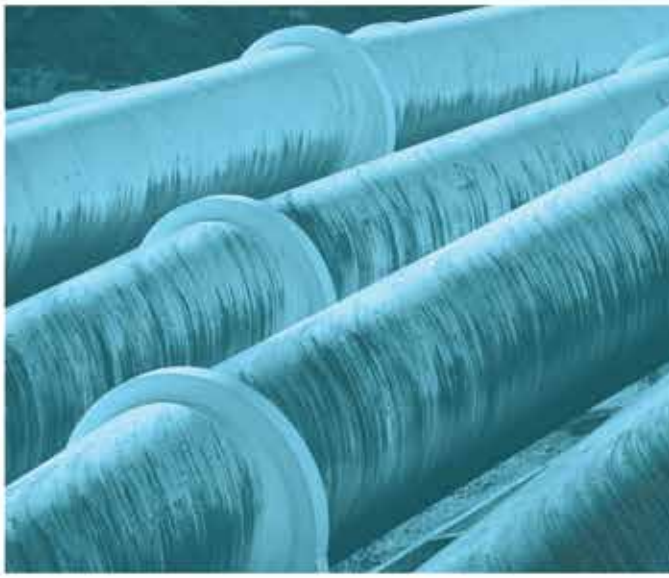



Olive Downs

Stage 1 Offset Area Management Plan (v3)

Prepared for Pembroke Resources
November 2020

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Olive Downs

Stage 1 Offset Area Management Plan (v3)

Report Number

B190716 RP#1

Client

Pembroke Resources

Date

13 November 2020

Version

v3 Final

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13 November 2020

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13 November 2020

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1 Introduction

1.1 Background

Pembroke Olive Downs Pty Ltd (Pembroke) are the proponent for the Olive Downs Coking Coal Project (herein referred to as the Project). The Project is a greenfield metallurgical coal mine within the Bowen Basin, located approximately 40 kilometres (km) south-east of Moranbah, Queensland.

The Project comprises four separate components being:

- a rail spur connecting the mine site to the Norwich Park Branch Railway;
- a water pipeline connecting to the Eungella pipeline network;
- an electricity transmission line (ETL); and
- the mine and access road (Figure 1.1).

The coal resource will be mined by conventional open cut mining methods, with product coal to be transported by rail to the Dalrymple Bay Coal Terminal.

The four key Project components were referred to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) via separate referrals, and subsequently determined to be 'controlled actions' requiring assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The four referrals are:

1. Olive Downs Project Water Pipeline (EPBC 2017/7868);
2. Olive Downs Project Electricity Transmission Line (EPBC 2017/7869);
3. Olive Downs Project Rail Spur (EPBC 2017/7870); and
4. Olive Downs Mine Site and Access Road (EPBC 2017/7867).

All referrals were assessed under the bilateral agreement between the Commonwealth and the State of Queensland, via an Environmental Impact Statement (EIS). All four referrals have now received approvals under the EPBC Act, with the last approval being the mine site and access road dated 14 May 2020.

Pembroke have undertaken extensive ecological surveys and impact assessments as part of preparing the EIS for the Project, evaluating the potential for significant impacts to occur to both matters of state and national environmental significance. The total extent of surface disturbance over the life of mine is estimated at 16,300 hectares (ha). Disturbance will occur progressively; therefore, the mine has been broken up into four main delivery stages. Stage 1 includes the first five years of construction and operation of the mine site and access road, plus construction of all ancillary facilities such as the water pipeline, electricity transmission line (ETL) and rail spur.

The EIS identified that significant impacts are likely to occur to matters of national environmental significance (MNES), and environmental offsets will be required for those matters. Pembroke have received approval to deliver the offsets in a staged manner, coinciding with the designated four mine stages. Offsets required for Stage 1 works, including breakdown for each Project component, is summarised in Table 1.1.

The required offsets are proposed to be delivered as direct, land-based offsets and Pembroke have identified the Stage 1 offset area for approval. Pembroke have commissioned detailed ecological surveys across the Stage 1 offset area to confirm the area supports, or has the potential to support, the required MNES and further details on the suitability of the offset are provided in this Offset Area Management Plan (OAMP).

Table 1.1 Stage 1 significant residual impacts to be offset

MNES habitats	Mine site and access road impact - Stage 1 (ha)	Water pipeline impact (ha)	Electricity transmission line impact (ha)	Rail spur impact (ha)	Total Stage 1 Impacts (ha)
Ornamental Snake (*Denisonia maculata*)	1,032	8	10.5	33	**1,083.5**
Australian Painted Snipe (*Rostratula australis)*	16	1	0	6.5	**23.5**
Squatter Pigeon (*Geophaps scripta scripta*)	990.5[1]	21.5[2]	23.5[3]	40.5[4]	**1,076**
Koala (*Phascolarctos cinereus*)	1,110.5	28	22	43.5	**1,204**
Greater Glider (*Petauroides volans*)	978.5	28	20.5	43.5	**1,070.5**

Notes:
1. This includes 855 ha of Squatter Pigeon breeding habitat and 135.50 ha of foraging habitat.
2. This includes 15 ha of Squatter Pigeon breeding habitat and 6.5 ha of foraging habitat.
3. This includes 18.5 ha of Squatter Pigeon breeding habitat and 5 ha of foraging habitat.
4. This includes 40 ha of Squatter Pigeon breeding habitat and 0.5 ha of foraging habitat.

1.2 Purpose and scope

The purpose of this Stage 1 OAMP is to describe the offset area, the performance outcomes to be achieved for each MNES, management actions to be implemented to achieve the set outcomes, risks to achieving those outcomes and appropriate corrective actions, and outline a monitoring and reporting program.

Approval conditions require Pembroke to compensate for the clearance of listed threatened species habitat and ecological community through provision of environmental offsets that are consistent with the EPBC Act Environmental Offsets Policy (DSEWPC 2012a).

Conditions of approval pertaining to environmental offsets and the Stage 1 OAMP are summarised in Table 1.2, Table 1.3, Table 1.4 and Table 1.5, including references to relevant sections where addressed within the OAMP.

Table 1.2 Conditions of approval pertaining to offsets – Mine Site & Access Road (EPBC 2017/7867)

Condition number	Requirements	Section of report addressed
2.	During each stage of the action, the approval holder must not clear more than the areas (in hectares) of habitat for each listed threatened species and community as specified in the following table:	Noted. Stage 1 approved impacts are being offset under this OAMP as summarised in Section 1.1.

MNES	Stage 1	Stage 2	Stage 3	Stage 4
Koala	1,110.5	367.5	3,939.50	354
Greater Glider	978.5	303	3,937	389
Squatter Pigeon (breeding)	855	216.5	3,100	322
Squatter Pigeon (foraging)	135.5	68	656.5	6.5
Ornamental Snake	1,032	298	5,109	1,307
Australian painted snipe	16	3	70	25
Brigalow TEC	0	0	13	0

3.	To compensate for the clearance of habitat for listed threatened species and community for Stage 1 up to the limits as specified in condition 2, the approval holder must provide an environmental offset consistent with the Environmental Offsets Policy.	Table 2.1
4.	The environmental offset to compensate for the clearance of 978.5 ha of Greater Glider (*Petauroides volans*) habitat for Stage 1 must result in a measured increase in Greater Glider (*Petauroides volans*) habitat connectivity in the riparian zones within the Stage 1 environmental offset.	Section 3.3.5, Section 4.2.7 and Table 4.6
5.	The approval holder must submit a Stage 1 Offset Area Management Plan (OAMP) prepared by a suitably qualified ecologist for the written approval of the Minister. The approval holder must not commence the action until the Stage 1 OAMP has been approved in writing by the minister. The approved Stage 1 OAMP must be implemented.	Section 2.4
6.	The Stage 1 OAMP must include the offset information to compensate for the clearance of listed threatened species and community habitat as provided for in condition 2 in accordance with the principles of the Environmental Offsets Policy.	Table 2.1
7.	To assess the effectiveness of the management actions in the Stage 1 OAMP to increase Greater Glider (*Petauroides volans*) habitat connectivity in the riparian zones within the Stage 1 environmental offset, the approval holder must engage an independent suitably qualified expert to undertake an assessment every 5 years from the implementation date of the approved Stage 1 OAMP until the approved Stage 1 OAMP offset completion criteria are achieved.	Section 3.3.5, Section 6 and Section 7.4
8.	The approval holder must ensure each assessment of the effectiveness of the management actions in the Stage 1 OAMP is: • subject to a peer-review completed within 6 months of the completion of each such assessment; and • published on its website with the findings of the peer-review within 6 months of the completion of the peer-review and for the duration of this approval.	Section 4.2.6, Table 6.2 and Section 7.4
9.	The approval holder must legally secure the Stage 1 environmental offset within 2 years from the date that the Stage 1 OAMP is approved by the Minister in writing. The approved OAMP must be attached to the legal mechanism used to legally secure the Stage 1 environmental offset.	Section 4.2.9
10.	The approval holder must notify the Department within 5 business days of the mechanism to legally secure the Stage 1 environmental offset being executed.	Section 4.2.9

Table 1.3 Conditions of approval pertaining to offsets – Transmission Line (EPBC 2017/7869)

Condition	Requirements	Section of report addressed
1.	1. The approval holder must not **clear** outside of the **project area** and must not **clear** more than: a. 22 hectares (ha) of Koala (*Phascolarctos cinereus*) (combined populations of Qld, NSW and the ACT) habitat; b. 20.5 ha of Greater Glider (*Petauroides volans*) habitat; c. 18.5 ha of Squatter Pigeon (Southern) (*Geophaps scripta scripta*) breeding habitat; d. 5 ha of Squatter Pigeon (Southern) (*Geophaps scripta scripta*) foraging habitat; and e. 10.5 ha of Ornamental Snake (*Denisonia maculata*) important habitat.	Noted. Stage 1 approved impacts are being offset under this OAMP as summarised in Section 1.1.
2.	To compensate for the clearance of listed threatened species habitat as specified in condition 1, the approval holder must provide an environmental offset consistent with the Environmental Offsets Policy.	Table 2.1
3.	The approval holder must submit an Offset Area Management Plan (OAMP) prepared by a suitably qualified ecologist for the written approval of the Minister. The approval holder must not commence the action until the OAMP has been approved in writing by the minister. The approved OAMP must be implemented.	Section 2.4
4.	The OAMP must include the following information for the offsets required to compensate for the clearance of listed threatened species habitat as provided for in condition 1 in accordance with the principles of the Environmental Offsets Policy:	
	a. a description of the offset, including location, size, condition, environmental values present and surrounding land uses;	Section 3
	b. baseline data, including results from field validated surveys, and quantifiable ecological data on habitat quality and other supporting evidence that documents the presence of each listed threatened species and the quality of each listed threatened species habitat within the offset area;	Section 3 and supporting documentation
	c. an assessment of site habitat quality using methods agreed to in writing by the Department;	Section 3.2 and supporting documentation
	d. details of how the offset are will provide connectivity with other habitats and biodiversity corridors and/or will contribute to a larger strategic offset for each listed threatened species;	Section 3.2.3
	e. maps and shapefiles to clearly define the location and boundaries of the offset area, accompanied by offset attributes;	Figure 3.1 –Figure 6.1 Shapefiles to be provided separately to DAWE
	f. specific offset completion criteria derived from the site habitat quality to demonstrate the improvement in the quality of each listed threatened species habitat in the offset area over the period of effect of this approval;	Table 4.6 Table 6.3
	g. details of the management actions, and timeframes for implementation, to be carried out to meet the offset completion criteria;	Section 4
	h. interim milestones that set targets at 5-yearly intervals for progress towards achieving the offset completion criteria;	Table 6.3

Table 1.3 Conditions of approval pertaining to offsets – Transmission Line (EPBC 2017/7869)

Condition	Requirements	Section of report addressed
	i. 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 offset area is likely to achieve the milestones in adequate time to implement all necessary corrective actions);	Section 6
	j. proposed timing for the submission of monitoring reports which provides evidence demonstrating whether the interim milestones have been achieved;	Section 7.1 and 7.4
	k. timing for the implementation of corrective actions if monitoring activities indicate the interim milestones will not or have not been achieved;	Section 4, Table 6.2
	l. a risk analysis and a risk assessment and mitigation strategy for all risks to the successful implementation of the OAMP and timely achievement of the offset completion criteria, including a rating of all initial and post-mitigation residual risks in accordance with the risk assessment matrix;	Section 5
	m. evidence of how the management actions and corrective actions take into account relevant approved conservation advices and are consistent with relevant recovery plans and threat abatement plans; and	Section 4 and Table 4.6
	n. details of the legal mechanism for legally securing the offset area, such that legal security remains in force over the offset area for at least the period of effect of this approval.	Section 4.2.9
5.	The approval holder must legally secure the environmental offset within 12 months from the date that the OAMP is approved by the Minister in writing. The approved OAMP must be attached to the legal mechanism used to legally secure the offset area.	Section 4.2.9
6.	The approval holder must notify the Department within 5 business days of the legal mechanism being executed.	Section 4.2.9
7.	The legal mechanism used to legally secure the offset area must remain in force for the period of effect of this approval.	Section 4.2.9

Table 1.4 Conditions of approval pertaining to offsets – Water pipeline (EPBC 2017/7868)

Condition	Requirements	Section of report addressed
1.	The approval holder must not **clear** outside of the **project area** and must not **clear** more than: a. 28 hectares (ha) of Koala (Phascolarctos cinereus) (combined populations of Qld, NSW and the ACT) habitat; b. 28 ha of Greater Glider (*Petauroides volans*) habitat; c. 15 ha of Squatter Pigeon (Southern) (*Geophaps scripta scripta*) breeding habitat; d. 6.5 ha of Squatter Pigeon (Southern) (*Geophaps scripta scripta*) foraging habitat; e. 8 ha of Ornamental Snake (*Denisonia maculata*) important habitat; and f. 1 ha of Australian Painted Snipe (*Rostratula australis*) breeding habitat.	Noted. Stage 1 approved impacts are being offset under this OAMP as summarised in Section 1.1.
2.	To compensate for the clearance of listed threatened species habitat as specified in condition 1, the approval holder must provide an environmental offset consistent with the Environmental Offsets Policy.	Table 2.1

Table 1.4 Conditions of approval pertaining to offsets – Water pipeline (EPBC 2017/7868)

Condition	Requirements	Section of report addressed
3.	The approval holder must submit an Offset Area Management Plan (OAMP) prepared by a suitably qualified ecologist for the written approval of the Minister. The approval holder must not commence the action until the OAMP has been approved in writing by the minister. The approved OAMP must be implemented.	Section 2.4
4.	The OAMP must include the following information for the offsets required to compensate for the clearance of listed threatened species habitat as provided for in condition 1 in accordance with the principles of the Environmental Offsets Policy:	
a.	a description of the offset, including location, size, condition, environmental values present and surrounding land uses;	Section 3
b.	baseline data, including results from field validated surveys, and quantifiable ecological data on habitat quality and other supporting evidence that documents the presence of each listed threatened species and the quality of each listed threatened species habitat within the offset area;	Section 3 and supporting documentation
c.	an assessment of site habitat quality using methods agreed to in writing by the Department;	Section 3.2 and supporting documentation
d.	details of how the offset will provide connectivity with other habitats and biodiversity corridors and/or will contribute to a larger strategic offset for each listed threatened species;	Section 3.2.3
e.	maps and shapefiles to clearly define the location and boundaries of the offset area, accompanied by offset attributes;	Figure 3.1 –Figure 6.1 Shapefiles to be provided separately to DAWE
f.	specific offset completion criteria derived from the site habitat quality to demonstrate the improvement in the quality of each listed threatened species habitat in the offset area over the period of effect of this approval;	Table 4.6 Table 6.3
g.	details of the management actions, and timeframes for implementation, to be carried out to meet the offset completion criteria;	Section 4
h.	interim milestones that set targets at 5-yearly intervals for progress towards achieving the offset completion criteria;	Table 6.3
i.	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 offset area is likely to achieve the milestones in adequate time to implement all necessary corrective actions);	Section 6
j.	proposed timing for the submission of monitoring reports which provides evidence demonstrating whether the interim milestones have been achieved;	Sections 7.1 and 7.4
k.	timing for the implementation of corrective actions if monitoring activities indicate the interim milestones will not or have not been achieved;	Section 4, Table 6.2
l.	a risk analysis and a risk assessment and mitigation strategy for all risks to the successful implementation of the OAMP and timely achievement of the offset completion criteria, including a rating of all initial and post-mitigation residual risks in accordance with the risk assessment matrix;	Section 5

Table 1.4 Conditions of approval pertaining to offsets – Water pipeline (EPBC 2017/7868)

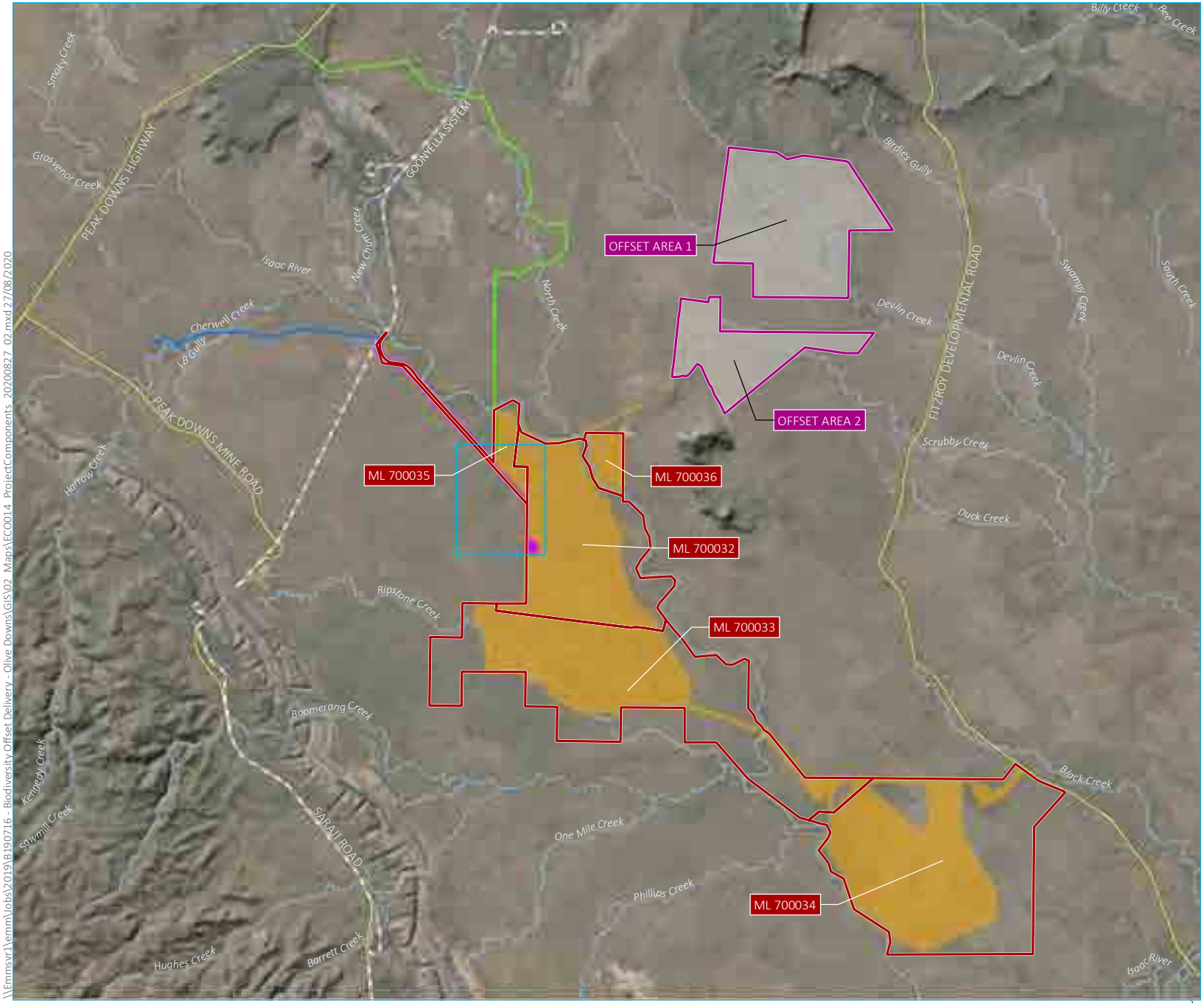
Condition	Requirements	Section of report addressed
m.	evidence of how the management actions and corrective actions take into account relevant approved conservation advices and are consistent with relevant recovery plans and threat abatement plans; and	Section 4 and Table 4.6
n.	details of the legal mechanism for legally securing the offset area, such that legal security remains in force over the offset area for at least the period of effect of this approval.	Section 4.2.9
5.	The approval holder must legally secure the environmental offset within 12 months from the date that the OAMP is approved by the Minister in writing. The approved OAMP must be attached to the legal mechanism used to legally secure the offset area.	Section 4.2.9
6.	The approval holder must notify the Department within 5 business days of the legal mechanism being executed.	Section 4.2.9
7.	The legal mechanism used to legally secure the offset area must remain in force for the period of effect of this approval.	Section 4.2.9

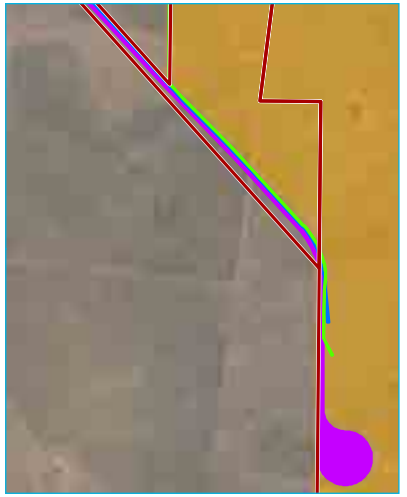
Table 1.5 Conditions of approval pertaining to offsets – Rail spur (EPBC 2017/7870)

Condition	Requirements	Section of report addressed
1.	The approval holder must not clear outside of the project area and must not clear more than: a. 43.5 hectares (ha) of Koala (*Phascolarctos cinereus*) (combined populations of Qld, NSW and the ACT) habitat; b. 43.5 ha of Greater Glider (*Petauroides volans*) habitat; c. 40 ha of Squatter Pigeon (Southern) (*Geophaps scripta scripta*) breeding habitat; d. 0.5 ha of Squatter Pigeon (Southern) (*Geophaps scripta scripta*) foraging habitat; e. 33 ha of Ornamental Snake (*Denisonia maculata*) important habitat; and f. 6.5 ha of Australian Painted Snipe (*Rostratula australis*) breeding habitat.	Noted. Stage 1 approved impacts are being offset under this OAMP as summarised in Section 1.1.
2.	To compensate for the clearance of listed threatened species habitat as specified in condition 1, the approval holder must provide an environmental offset consistent with the Environmental Offsets Policy.	Table 2.1
3.	The approval holder must submit an Offset Area Management Plan (OAMP) prepared by a suitably qualified ecologist for the written approval of the Minister. The approval holder must not commence the action until the OAMP has been approved in writing by the minister. The approved OAMP must be implemented.	Section 2.4
4.	The OAMP must include the following information for the offsets required to compensate for the clearance of listed threatened species habitat as provided for in condition 1 in accordance with the principles of the Environmental Offsets Policy:	
a.	a description of the offset, including location, size, condition, environmental values present and surrounding land uses;	Section 3
b.	baseline data, including results from field validated surveys, and quantifiable ecological data on habitat quality and other supporting evidence that documents the presence of each listed threatened species and the quality of each listed threatened species habitat within the offset area;	Section 3 and supporting documentation

Table 1.5 Conditions of approval pertaining to offsets – Rail spur (EPBC 2017/7870)

Condition	Requirements	Section of report addressed
c.	an assessment of site habitat quality using methods agreed to in writing by the Department;	Section 3.2 and supporting documentation
d.	details of how the offset are will provide connectivity with other habitats and biodiversity corridors and/or will contribute to a larger strategic offset for each listed threatened species;	Section 3.2.3
e.	maps and shapefiles to clearly define the location and boundaries of the offset area, accompanied by offset attributes;	Figure 3.1 –Figure 6.1 Shapefiles to be provided separately to DAWE
f.	specific offset completion criteria derived from the site habitat quality to demonstrate the improvement in the quality of each listed threatened species habitat in the offset area over the period of effect of this approval;	Table 4.6
g.	details of the management actions, and timeframes for implementation, to be carried out to meet the offset completion criteria;	Section 4
h.	interim milestones that set targets at 5-yearly intervals for progress towards achieving the offset completion criteria;	Table 6.3
i.	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 offset area is likely to achieve the milestones in adequate time to implement all necessary corrective actions);	Section 6
j.	proposed timing for the submission of monitoring reports which provides evidence demonstrating whether the interim milestones have been achieved;	Section 7.1 and 7.4
k.	timing for the implementation of corrective actions if monitoring activities indicate the interim milestones will not or have not been achieved;	Section 4, Table 6.2
l.	a risk analysis and a risk assessment and mitigation strategy for all risks to the successful implementation of the OAMP and timely achievement of the offset completion criteria, including a rating of all initial and post-mitigation residual risks in accordance with the risk assessment matrix;	Section 5
m.	evidence of how the management actions and corrective actions take into account relevant approved conservation advices and are consistent with relevant recovery plans and threat abatement plans; and	Section 4 and Table 4.6
n.	details of the legal mechanism for legally securing the offset area, such that legal security remains in force over the offset area for at least the period of effect of this approval.	Section 4.2.9
5.	The approval holder must legally secure the environmental offset within 12 months from the date that the OAMP is approved by the Minister in writing. The approved OAMP must be attached to the legal mechanism used to legally secure the offset area.	Section 4.2.9
6.	The approval holder must notify the Department within 5 business days of the legal mechanism being executed.	Section 4.2.9
7.	The legal mechanism used to legally secure the offset area must remain in force for the period of effect of this approval.	Section 4.2.9





KEY

- Stage 1 offset area
- Mining lease boundary
- Rail line
- Major road
- Named watercourse

EPBC Act assessment areas

- Olive Downs project mine site and access road (EPBC 2017/7867)
- Olive Downs project rail spur (EPBC 2017/7870)
- Olive Downs project electricity transmission line (EPBC 2017/7869)
- Olive Downs project water pipeline (EPBC 2017/7868)

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

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Project components

Olive Downs
Stage 1 offset area management plan
Figure 1.1

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2 Legal framework

Summary of key legislation and policies pertaining to the design and implementation of the Stage 1 offset area is summarised below.

2.1 EPBC Act

Under the EPBC Act approvals for the Project Pembroke are required to offset the significant, residual impacts to MNES. Delivery of the offsets in stages has been approved by DAWE with the Stage 1 OAMP required to be approved by the Minister prior to the Project commencing. For Stages 2 to 4 of the Project, a biodiversity offset would be provided and applicable OAMP approved by the Minister before the commencement of each stage.

The Stage 1 offset area is designed to be consistent with the EPBC Act Environmental Offsets Policy and compensate for residual impacts for the first five years of the Project (referred to as Stage 1). A summary of the residual impacts to MNES required be offset in Stage 1 are summarised in Table 1.1.

The OAMP is required to be prepared by a suitably qualified ecologist and submitted for the written approval of the Minister. The approved OAMP must be implemented.

Applicable conditions of approval associated with the Stage 1 offsets, and where these requirements have been addressed, are summarised in Section 1.2.

2.2 Environmental Offsets Policy

Environmental offsets proposed have been assessed using the framework under the EPBC Act Environmental Offsets Policy (DSEWPC 2012a) (the Policy). Offset assessment methodologies have applied the criteria within the *How to use the offsets assessment guide* which supports the Policy.

The key components of the guide are the Impact Calculator and Offset Calculator (Plate 2.1). Once the inputs have been provided for the Impact Calculator and Offset Calculator, the Offset Assessment Guide provides the results as a percentage of impact offset, where >100% indicates that all of the impact is achieved through a direct offset.

The habitat quality scores on both impact site and offset site have been determined applying the Queensland 'Guide to determining terrestrial habitat quality' (DES 2017) which is an endorsed method of deriving a habitat quality score for ecological communities and species listed under EPBC Act. BioCondition assessments are the basis for these scores plus consideration of site context and species habitat.

Habitat Quality scoring for the impact areas and proposed offset areas, and EPBC Act offset calculators have been provided separately to this OAMP in supporting documentation.

Details on ecological surveys of the proposed offset area including habitat mapping for each MNES species and habitat quality assessments are provided in the 'Olive Downs Project – Baseline Offset Survey Investigation Report' dated July 2018. Further information on justification for EPBC calculator inputs are provided in the 'Olive Downs Coking Coal Project – Additional Information to the Assessment of MNES' prepared by DPM Enviros ciences dated September 2019 (DPM Enviros ciences 2019). Calculator inputs are in accordance with the *EPBC Act Offset Assessment Guide* (DSEWPC 2012b) whereby multiple attributes are assessed for each impacted matter and have been refined for the purposes of finalising this OAMP. Offset calculator inputs for each MNES are detailed in Appendix F. This includes assessments of predicted time to ecological benefits of the offset, projected habitat quality with the offset management actions, and projected habitat quality without the implementation of the proposed Stage 1 offset area.

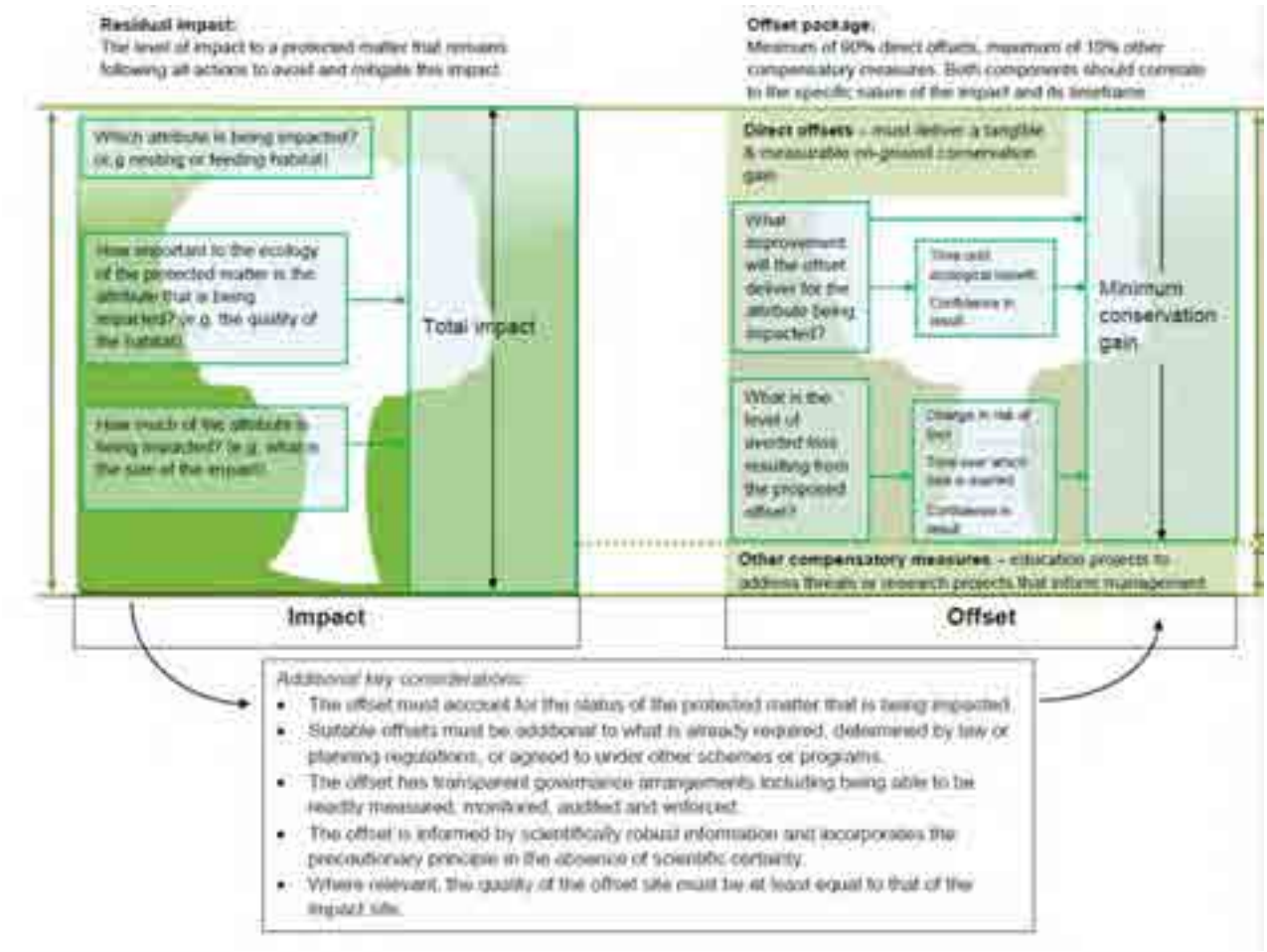


Plate 2.1 Determining suitable offsets under EPBC Act

2.3 Compliance with Environmental Offsets Policy

The key principles that underpin the Environmental Offsets Policy have been addressed in the development of the Stage 1 offset area, management actions proposed, and overarching governance framework as summarised in this OAMP. Key offset principles and how they have been addressed are summarised in Table 2.1.

Table 2.1 Overarching principles to determine offset suitability

Suitable offsets must	Section of report addressed
1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action	• Each impacted MNES for Stage 1 has a direct land-based offset area proposed (Section 3 and Table 3.3) that currently provides suitable habitat for the species, and/or areas that will be restored and rehabilitated to improve habitat quality for the species. • Restoration techniques are detailed in Section 3.2.7 and monitoring and interim targets as to how those habitat quality gains will be achieved are summarised in Section 4 and 6. • Overall viability for each MNES will also be increased as recognised threats to each MNES will be reduced including pest animals, weeds, fire and improved connectivity. • All proposed land based offset areas will be actively managed to improve habitat quality over the specified timeframe, and habitat quality gains are set out for each MNES. How these gains will be achieved are addressed in Section 4, including Section 4.2, and Section 6.3. • The Stage 1 offset area will be legally secured in perpetuity, actively managed over the life of Project to increase MNES habitat extent, increase habitat quality and reduce threats to improve the species viability. • All impacted MNES have been identified on or adjacent to the proposed Stage 1 offset area and habitat suitability has been demonstrated in Section 3.3. As such the identified matters are known and likely to utilise the Stage 1 offset area. • Habitats of the Stage 1 offset area will be available to the impacted matters permanently rather than over the period of the proposed action alone. • Management and mitigation will be designed and implemented to achieve the ecological characteristics and functions required for each MNES. For example the offset will result in an overall increase in the number of Koala food trees, increased extent of habitat, reduced threats from wild dogs and improved connectivity to adjacent habitats. Specific outcomes for each MNES are detailed in Table 6.3.
2. be built around direct offsets but may include other compensatory measures	The proposed offsets deliver 100% of offset requirement through land-based offsets. Each impacted MNES in Stage 1 has a direct land-based offset area (Table 3.3) proposed that currently provides suitable habitat for the species, or will be restored and rehabilitated to provide suitable habitat for the species. The direct, land-based offsets for Stage 1 will meet 100% of offset policy requirement) and conservation gains for each impacted matter will be measured through detailed field assessments and reporting of Habitat Quality. The results of interim Habitat Quality reports will also be reviewed by a suitable third-party. Key threats to be addressed by the offset proposal include threats specified in conservation/listing advice and recovery plans for each MNES species (e.g. prevention of clearing, fire protection, pest animal control, weed control and removal/reduction of grazing pressure). In addition to these direct offsets Pembroke also propose to undertake some supplementary research and monitoring programs as part of the offset delivery for Stage 1. This includes a supplementary nest box research and monitoring program to determine use by Greater Gliders and most effective nest box design. Details are provided in Section 4.2.6.
3. be in proportion to the level of statutory protection that applies to the protected matter	The land-based offsets proposed have been assessed in accordance with the EPBC Environmental Offsets Policy and Offsets Assessment Guide which considers the status of each impacted matter. The proposed offset areas, management actions and prescribed outcomes are in proportion to the status of MNES impacted and meet the policy requirements.

Table 2.1 Overarching principles to determine offset suitability

Suitable offsets must	Section of report addressed
4. be of a size and scale proportionate to the residual impacts on the protected matter	• The land-based offsets proposed have been assessed in accordance with the EPBC Environmental Offsets Policy and Offsets Assessment Guide. This included the quantification of baseline (ie starting) Habitat Quality and the predicted final Habitat Quality associated with each impacted matter in the offset area. Impact area Habitat Quality scores were also assessed. A summary of Habitat Quality Scoring for impact and offset areas is provided in supporting documentation. • These Habitat Quality scores were developed applying the Qld Guide to determining terrestrial habitat quality (2017) using specific attributes for each impacted matter. The Habitat Quality scoring results across different areas were derived for each MNES and input into the EPBC offsets calculator to determine size and scale requirements. Individual survey sites and Habitat Quality scoring is summarised in supporting documentation. • Offset calculators have been provided in supporting documentation including offset calculator inputs and justification. • The scoring process also identified size requirements for the Stage 1 offset area. The total offset areas to be legally secured and actively managed are of a larger size than those impacted, are situated in close proximity to the impacted areas and the offset areas will also enhance patch size of habitats and connectivity for the impacted species.
5. effectively account for and manage the risks of the offset not succeeding	• Threats to the offset area are managed through the implementation of the management measures discussed in Section 5 and 6. • Risks to the offset failing have been identified and assessed. The DAWE risk matrix has been applied and risks have been scored separately both with and without offset management actions. Risk matrix is provided in Table 5.4. • Relevant actions to manage risk include: – legally securing the offset area on title; – restricting access; – weed monitoring and control; – grazing management; – pest fauna management; – fuel load management and fire management; – habitat restoration through managing natural regeneration and other active techniques such as direct seeding and revegetation. • The risk assessment (Table 5.4.) identifies potential risks, management measures to reduce risk probability, and proposed timeframes for corrective actions to be undertaken. • If the proposed Stage 1 offset area fails to meet interim targets corrective actions will be implemented. This may include implementing further management actions in the Stage 1 offset area such as additional soil preparations and direct seeding, additional weed control, changes to grazing regime etc. Only if it is found that these additional corrective actions have not been successful Pembroke will consider seeking out supplementary offset areas for habitat restoration areas that are not on track to meet performance outcomes in Table 6.3. Options for alternate offsets include those currently identified for subsequent Stage 2 offset areas. Risks and mitigation measures are set out in Section 5, Table 5.4 and corrective actions associated with management activities are outlined in Section 4.

Table 2.1 Overarching principles to determine offset suitability

Suitable offsets must	Section of report addressed
6. be additional to what is already required, determined by law or planning regulations or agreed to under schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action, see section 7.6 of offsets policy)	The land-based offsets and supplementary research and funding that are to be delivered by Pembroke provide significant 'additionality' to what is required by law or planning regulation. The additional actions include installation of nest boxes targeting Greater Glider as summarised in Section 4.2.6, monitoring of threatened fauna populations, monitoring of Greater Glider use of nest boxes and revegetation areas as summarised in Section 6.3. Additionality of proposed management actions is further discussed in supporting documentation as part of the offset calculator inputs. Currently the proposed offset properties are being grazed and advanced regrowth woodlands can be lawfully cleared. Gilgai habitat for Ornamental Snake (as they occur in non-remnant areas) can continue to be degraded by livestock or ploughed and cropped. Wetlands for Australian Painted Snipe will continue to be degraded by feral pigs and landholders could also graze and alter the hydrology of these areas through agricultural activities. A number of weeds and pest animals are also not required to be managed under Qld legislation and therefore would continue to degrade ecological condition of the site. Grazing and agricultural activities would also continue and prevent further regeneration of native vegetation communities and native grasses which provide habitat for the MNES species. In Queensland there are no existing land management obligations that prescribe or exclude fire. Hot fires and too frequent fires have the potential to degrade and destroy MNES habitat values including hollow-bearing trees and regenerating trees. By removing or reducing grazing levels, actively improving condition of remnant vegetation, promoting regeneration and restoration of vegetation communities, undertaking supplementary tree plantings and installing nest boxes are all 'additional' actions to be implemented.

Table 2.1 Overarching principles to determine offset suitability

Suitable offsets must	Section of report addressed
7. be efficient, effective, timely, transparent, scientifically robust and reasonable	The proposed offsets and governance framework are efficient, effective, timely, scientifically robust and transparent in their design. Justification is provided in Sections 6 and 7. Efficient/effective/reasonable. The offset proposal is a cost-effective approach to providing a direct offset, achieved through implementing widely applied and verified management strategies that are consistent with Conservation Advice statements as to threats which require intervention. Timely. The offset outcomes will be delivered progressively over 20 years, and maintained for at least the period of effective approval (i.e. 4 December 2123). Legal security of the Stage 1 offset area will occur within 12 months of OAMP being approved. Management outcomes are described in Section 4.3, Table 4.6 and interim milestones to be reached over 20 years outlined in Table 6.3. Transparent/scientifically robust. Implementation of the OAMP will be monitored and reported in annual compliance reports. Management of the offset will be undertaken by appropriately qualified persons with experience in land restoration and species conservation to ensure management activities are scientifically robust and appropriate, and can be monitored to track habitat quality improvements. Management actions are set out in Section 4, monitoring is outlined in Section 6 and reporting in Section 7. There will be annual monitoring and reviews of the offset activities and an annual report prepared. More detailed five yearly performance reviews will be undertaken to assess progress towards performance outcomes which include a requirement (Condition 8; EPBC 2017/7867) to ensure each assessment of the effectiveness of the management actions in the Stage 1 OAMP is: a. subject to a peer-review completed within 6 months of the completion of each interim assessment; and b. published on its website with the findings of the peer-review within 6 months of the completion of the peer-review and for the duration of this approval.
8. have transparent governance arrangements including being able to be readily measured monitored, audited and enforced.	Extensive monitoring and reporting is proposed. Monitoring will occur every year and at other key intervals as specified in Section 6. All annual monitoring reports will be made available to DAWE upon request. Condition 7 (EPBC 2017/7867) of mine approval require some additional auditing as below: To assess the effectiveness of the management actions in the Stage 1 OAMP to increase Greater Glider (*Petauroides volans*) habitat connectivity in the riparian zones within the Stage 1 environmental offset, the approval holder must engage an independent suitably qualified expert to undertake an assessment every 5 years from the implementation date of the approved Stage 1 OAMP until the approved Stage 1 OAMP offset completion criteria are achieved. Condition 8 (EPBC 2017/7867) also requires ensuring each 5 yearly assessment of the effectiveness of the management actions in the Stage 1 OAMP is: a. subject to a peer-review completed within 6 months of the completion of each such assessment; and b. published on its website with the findings of the peer-review within 6 months of the completion of the peer-review and for the duration of this approval.

2.4 Suitably qualified ecologists

It is a requirement that the approval holder submits a Stage 1 OAMP prepared by a 'suitably qualified ecologist' for the written approval of the Minister (Condition 5 under EPBC 2017/7867 and Condition 3 under EPBC 2017/7868, EPBC 2017/7869, and EPBC 2017/7870). A 'suitably qualified ecologist' is defined under EPBC Act approval as "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".

Pembroke commissioned EMM Consulting Pty Ltd (EMM) to prepare this OAMP. The authors have qualifications in environmental management, extensive experience in natural resource management, threatened species conservation including designing and implementing surveys for listed species and communities and preparation of management plans. Berlinda Ezzy and Nathan Garvey are also specialists in biodiversity offsets at a State and Commonwealth level and completed numerous environmental offset assessments.

Key authors and their experience are summarised below. Curriculum vitae (CVs) are provided in Appendix A.

i Berlinda Ezzy

Berlinda is an Associate Ecologist with 20 years' 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 led the Koala Conservation Unit and Threatened Species Unit in the Queensland government for a number of years and has a comprehensive understanding of threatened species management and legislative framework under EPBC Act and NC Act.

Berlinda has prepared a number of threatened species management plans and offset management plans over the past 10 years. Berlinda's experience for the past 10 years includes designing and coordinating surveys for Koalas, Ornamental Snake, Greater Glider, Australian Painted Snipe and Squatter Pigeon. Recently this has been for Blackwater Mine expansion in central Qld, two proposed wind farms near Gladstone and Rockhampton, and a quarry expansion in South East Qld.

ii Chris Beavon

Chris is an Associate Ecologist with 15 years' professional experience throughout Queensland, New South Wales, Northern Territory and Victoria.

Chris has delivered environmental assessments, monitoring and management projects across a range of sectors including energy, mining, renewables, urban development, infrastructure, and natural resource management. His diverse project experience includes terrestrial ecology assessment, environmental impact statements, protected plant surveys, translocation and monitoring of threatened species, biosecurity assessment and management, compliance assessment, and vegetation rehabilitation.

Chris has experience designing and implementing surveys including for threatened species such as Koalas, Squatter Pigeon, Greater Glider and Ornamental Snake. Recent experience includes two proposed wind farms and Carmichael Rail in Qld.

iii Nathan Garvey

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.

Nathan has prepared a large number of biodiversity management plans for offset sites and also threatened species management plans.

iv Patrick Finnerty

Patrick is an ecologist with 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 monitoring, management plans and offset feasibility studies. Patrick has project managed and has been the technical lead on major biodiversity monitoring projects within NSW and has a wide range of skills including complex survey logistics and planning, data management and report writing along with biodiversity assessments.

3 Biodiversity offset area

3.1 Regional context and location

The Stage 1 Offset Area, shown in Figure 3.1, is situated directly east of the Olive Downs Coal Project, on eastern side of the Isaac River, and south-east of Moranbah within the Isaac Regional Council area. The offset areas are situated on the Twenty Mile property (Lot 5 SP 113322) and the Iffley property (Lot 11 KL135) (Figure 3.1). Pembroke own these properties on freehold title.

The Stage 1 Offset Area is located in the Brigalow Belt North bioregion, and the Isaac-Comet Downs sub-region. It is located in the Isaac-Connors River catchment.

The Brigalow Belt North bioregion has a semi-arid to tropical climate with predominantly summer rainfall. Maximum temperatures are typically in the mid-30s in summer, getting up to as high as 45°C, and mid 20s in winter. The nearest Bureau of Meteorology (BoM) weather station to the Project is Moranbah Airport (34035) for rainfall and temperature data. For the region, rainfall is greatest in summer months, with highest mean rainfalls recorded in December, January and February (Plate 3.1). Annual rainfall in the 2 years prior to 2020 totalled 366.2 millimetres (mm) and 324.8 mm, which is marginally lower than the 5 year average of 519.13 mm (Plate 3.2). However, the region has recently experienced good falls of rain in January 2020 (100.2 mm total), February 2020 (76.4 mm total) and March 2020 (53.2 mm total) (BOM 2020). Mean minimum temperature in winter averages around 9°C and mid to low 20s in summer (Plate 3.2).

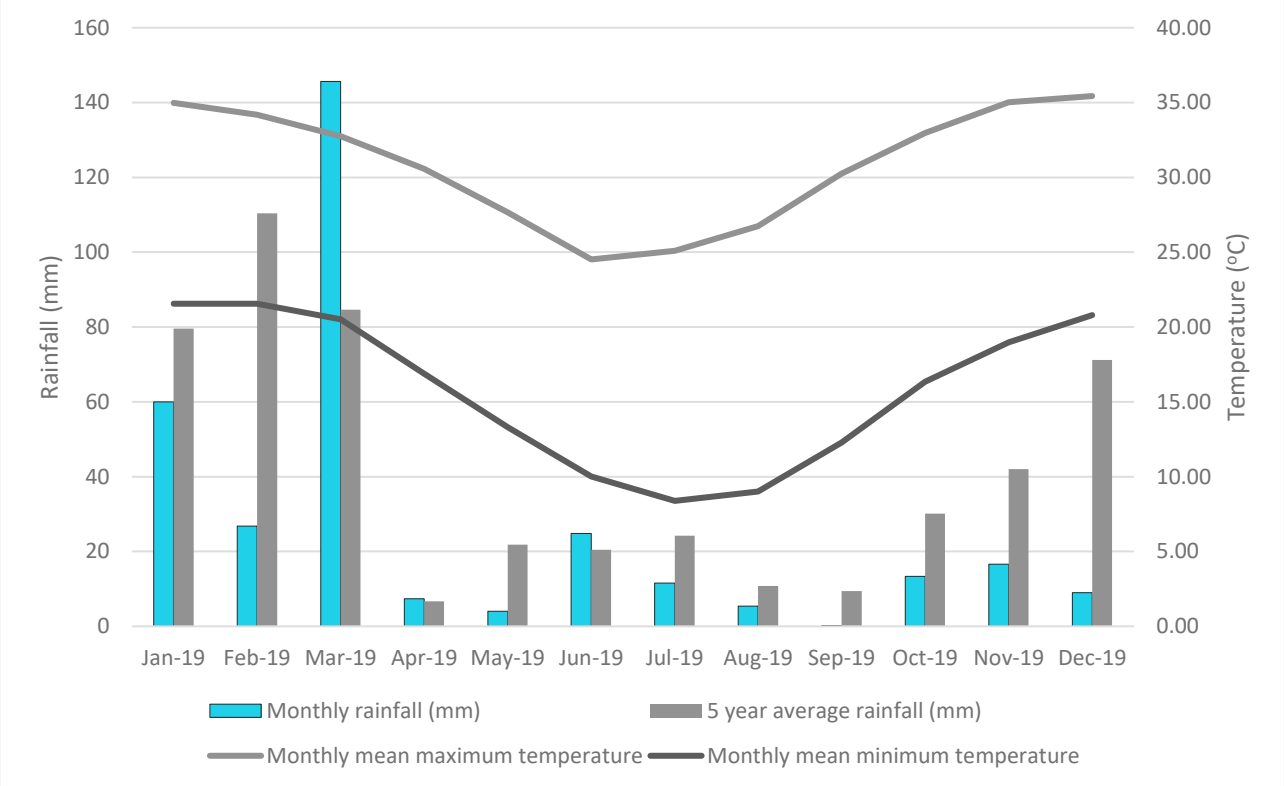


Plate 3.1 Rainfall and temperature at Moranbah, QLD

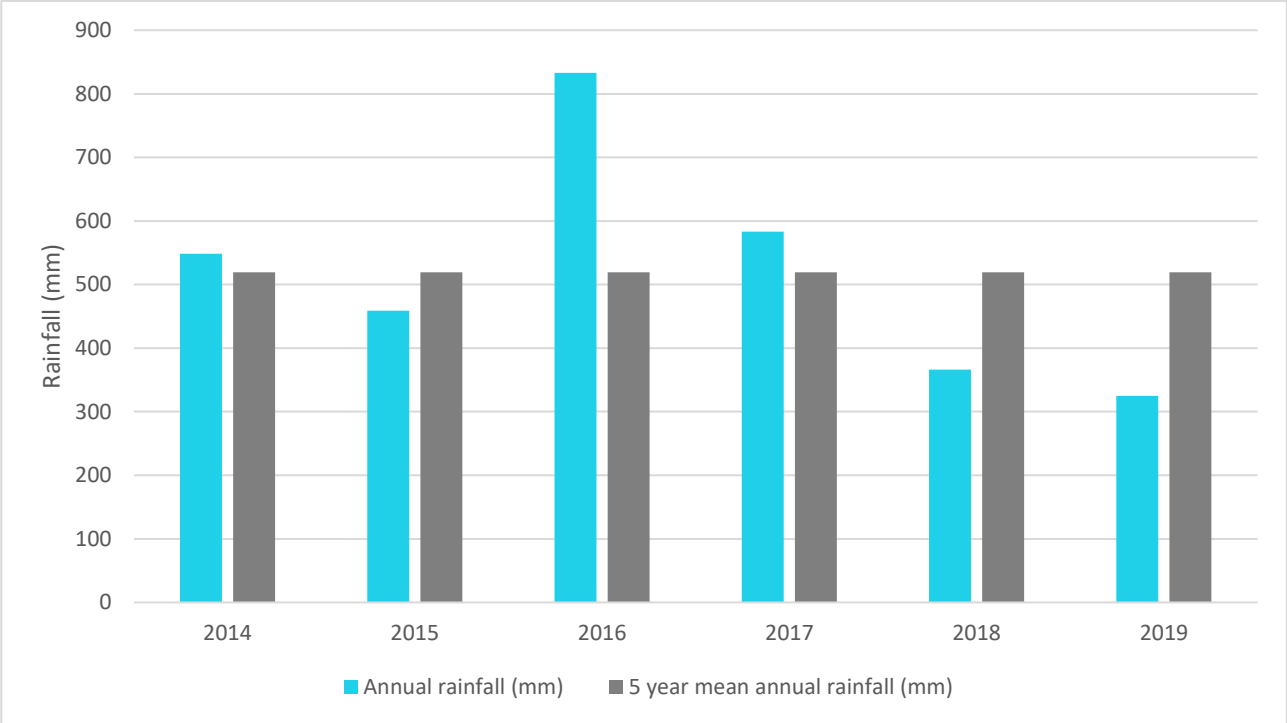


Plate 3.2 Mean Rainfall at Moranbah, QLD

Surrounding land uses are predominantly grazing land and coal mining (Figure 3.2). Mines in the area include Coppabella and Moorvale to the north, Daunia, Caval Ridge and Peak Downs to the west and south-west and Lake Vermont mine to the south. Land directly to the north, north-east and south is grazing land, with areas supporting remnant vegetation. Dipperu National Park (Scientific) is situated approximately 20 km north-east of the offset area.

The Codrilla Mining Lease (ML70450) is situated to the east but is not developed (Figure 3.2) and there are constraints with development of this area resulting in the mine being unlikely to be developed.

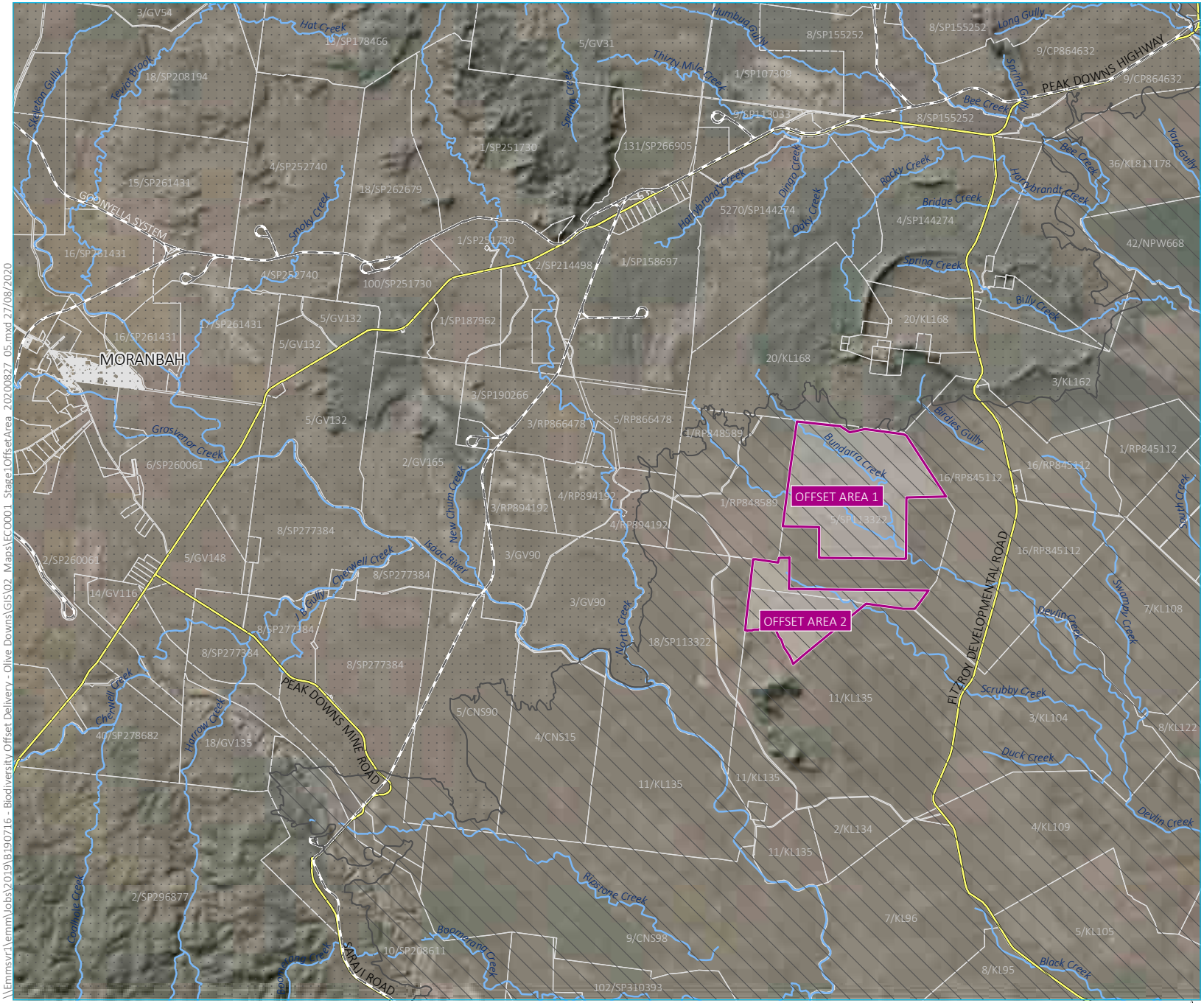
There are no registered interests under the Qld *Land Act 1994* (freehold land) on the offset properties. There are a number of Mineral Development Lease (MDL), Authority to Prospect (ATP) and Exploration Permits (EPC and EPM) in the region due to being in the Bowen Basin where a lot of coal and gas resources occur. These exploration tenements do not have legal rights to undertake activities in the offset area without Pembroke's consent as they are the landowner. Pembroke will not grant consent to undertake any exploration in the offset areas, and future development in adjacent areas will need to take into consideration the approved offset as a MSES value and MNES values in future approval processes.

Those tenements that overlap with the properties in which Stage 1 Offset Area is proposed are:

- MDL3023 (Peabody – coal) – the MDL has been excluded from offset area to avoid potential future conflict. It is not considered likely to be developed and at present only permits exploration. Any proposed mine in this area will need to go through an EIS and approval. The offset area and MNES will need to be taken into consideration as part of this. Pembroke own this land and believe this MDL is highly unlikely to be developed and it will be due to expire in future if they do not progress with an EIS;

- ATP 759 (Arrow Energy – coal seam gas) – no gas exploration can occur in offset area if Pembroke don't approve it to occur;

- Exploration Permit Mineral (EPM) 26991 (HB Base Metals Pty Ltd) – no mineral exploration can occur in offset area if Pembroke don't approve it to occur;
- EPM 26499 (Kenex Pty Ltd) - no mineral exploration can occur in offset area if Pembroke don't approve it to occur;
- EPC 952 (Fitzroy - coal) - no coal exploration can occur in offset area if Pembroke don't approve it to occur;
- EPC 649 (Peabody Coppabella P/L) - no coal exploration can occur in offset area if Pembroke don't approve it to occur ;
- ATP1103 (CH4 P/L) - no exploration can occur in offset area if Pembroke don't approve it to occur;
- PCA 152 (CH4 P/L); no exploration can occur in offset area if Pembroke don't approve it to occur; and
- PCA 259 (Arrow Energy P/L) no gas exploration can occur in offset area if Pembroke don't approve it to occur.



KEY

- Stage 1 offset area
- Rail line
- Major road
- Named watercourse
- Cadastral boundary

Brigalow Belt North bioregion - sub-region

- Isaac - Comet Downs
- Northern Bowen Basin

INSET KEY

- National park/nature reserve
- State forest
- Main road

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

0 5 10 km

GDA 1994 MGA Zone 55

N

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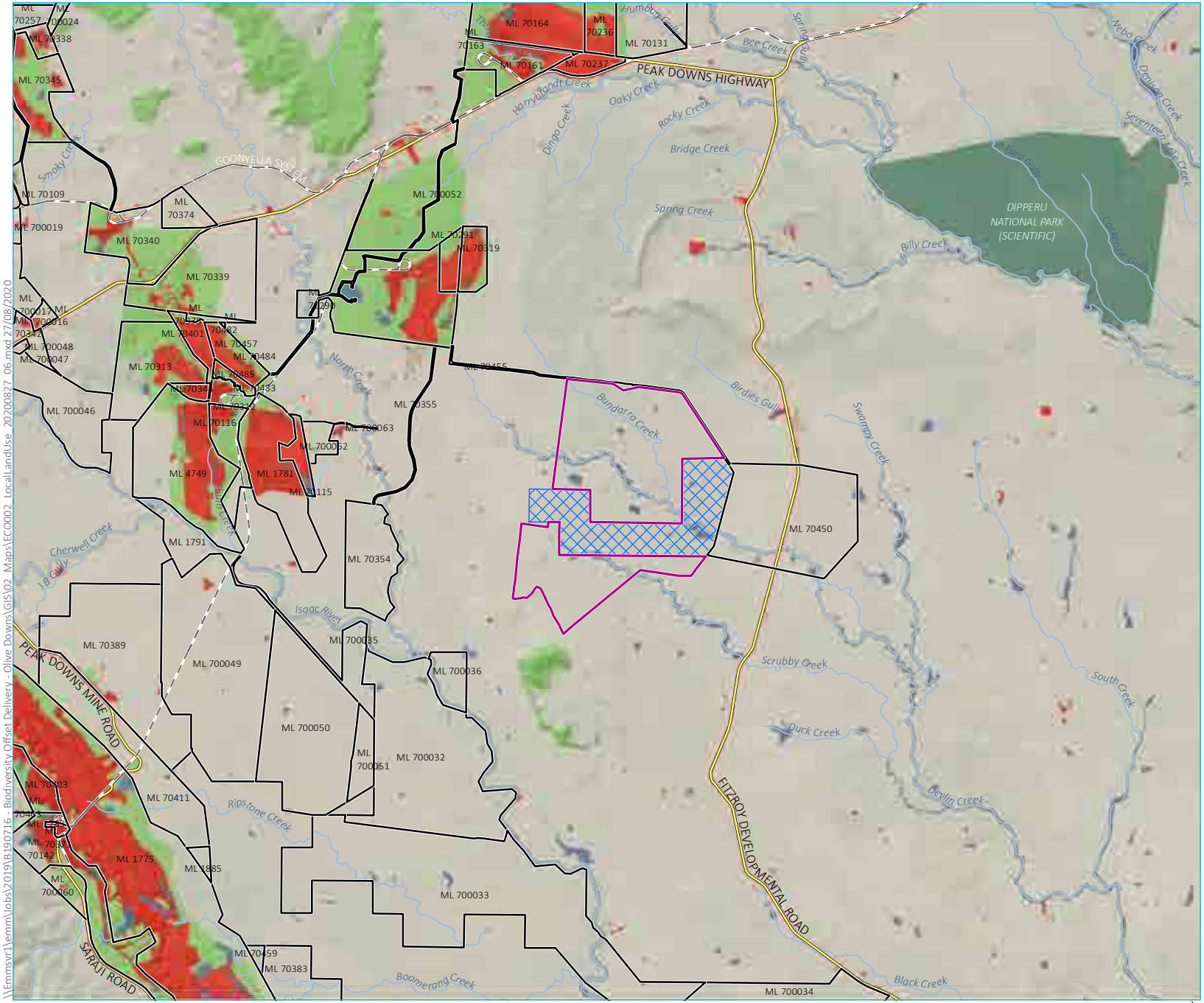
Stage 1 offset area locality

Olive Downs
Stage 1 offset area management plan
Figure 3.1



KEY

- Stage 1 offset area
- Mining lease
- Mineral Development Licence 3023
- Rail line
- Major road
- Named watercourse
- National park (scientific)

Primary land use mapping (DES, 2017)

- Conservation and Natural Environments
- Production from Relatively Natural Environments
- Production from Dryland Agriculture and Plantations
- Production from Irrigated Agriculture and Plantations
- Intensive Uses
- Water

Source: EMM (2020); Pembroke (2020); DNRME (2020); DES (2019)

0 5 10 km

GDA 1994 MGA Zone 55

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Surrounding land uses

Olive Downs
Stage 1 offset area management plan
Figure 3.2

EMM

3.2 Offset area values

The Stage 1 Offset Area is a large area of land being a total of 7,992.5 ha. It is comprised of two separate areas as shown in Figure 3.1 and summarised in Table 3.1.

Table 3.1 Olive Downs Stage 1 offset areas

Offset area	Area (ha)
Area 1	5,421.70
Area 2	2,570.80

These areas were selected based on identifying suitable habitats for the target threatened fauna species on land owned by Pembroke, using existing property boundaries and fencelines to help define the extent of offset areas. The presence of MNES species and suitable habitat areas were informed by on-ground ecological surveys conducted in 2018 as described in Olive Downs Project – Baseline Offset Survey Investigation Report (DPM Enviroscienses 2018).

Field ecology surveys included:

- Vegetation community surveys in accordance with *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland Version 4.0* (Neldner et al. 2017);
- BioCondition surveys applying *Guide to Determining Terrestrial Habitat Quality* (DEHP 2017);
- Fauna surveys in accordance with applicable survey guidelines being:
    a) *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al. 2018);
    b) *EPBC Act survey guidelines for Australia's threatened reptiles* (DSEWPC 2011a);
    c) *EPBC Act survey guidelines for Australia's threatened birds* (DEWHA 2010);
    d) *EPBC Act survey guidelines for Australia's threatened mammals* (DSEWPC 2011b);
    e) *EPBC Act draft referral guidelines for the nationally listed Brigalow Belt reptiles* (DSEWPC 2011c); and
    f) *EPBC Act Referral Guidelines for the Vulnerable Koala* (*combined populations of Queensland, New South Wales and the Australian Capital Territory*) (DoE 2014a).

Further information on survey locations and methods are provided in Section 3 of the Olive Downs Project – Baseline Offset Survey Investigation Report (DPM Enviroscienses 2018). Baseline offset site surveys and investigations were undertaken across a broader area than that proposed for Stage 1, including areas further to the south. Offset calculator assessments were then undertaken to support finalisation of the Stage 1 Offset Area, taking into consideration updates that occurred to Stage 1 impacts in early 2020, which was after these offset baseline surveys were completed.

The offset was also designed to exclude MDL3023 (Figure 3.2). MDL3023 held by Peabody has been excluded from the offset at present. It is not considered likely to be developed and at present the MDL only permits exploration in this area. The MDL will expire at a time in the future and this area may then become available to be used as environmental offsets for future stages of the Olive Downs Project. The land is owned by Pembroke.

Should Peabody submit an application to mine this area it will need to go through an EIS and obtain Federal and State approval. The Stage 1 offset areas (become a MSES) and any potential impacts will need to be taken into consideration. Pembroke believe this MDL is highly unlikely to be proposed to be developed. Should a resource project be approved it is still considered the offset is viable due to connectivity to north for Area 1, and south for Area 2 where future offsets will be placed for the Project (Figure 3.4).

3.2.1 Habitat quality assessments (BioCondition)

The size of offset area required for each MNES species has been determined through application of EPBC offset calculators, including an analysis of start and end habitat quality for each species on the offset site, and a starting habitat quality on the impact site. Habitat quality scores were developed applying the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2017) and results for each survey site, as well as final scores for each MNES, are summarised in Appendix B.

All MNES offset calculators are provided in supporting documentation to this OAMP including Appendix B. justification for each offset calculator inputs..

Habitat quality (HQ) assessments were completed at 24 survey sites across Stage 1 impact areas (Figure 3.5), which were each within a mapped RE type and assessment unit, using the methodologies described in DEHP (2017). Within the Stage 1 Offset Area 18 survey sites have been completed (Figure 3.5) in mapped RE types and assessment units. The HQ assessment sites were completed during the Olive Downs EIS phase and at that time covered a broader area than what is being proposed for Stage 1 as final offset areas were being determined. As additional impacts were added to Stage 1 just prior to Project approval, the Stage 1 Offset Area was extended and at present there are no HQ sites in Area 2 (as shown in Figure 3.1). There is a commitment that 16 additional HQ (BioCondition) assessment sites will be completed in Area 2 in Year 1 of offset implementation. Further detail is provided in Table 6.2 and the additional proposed sites are illustrated in Figure 6.1.

Habitat quality assessments include three elements: a site condition assessment, based on the BioCondition methodologies described by Eyre et al. (2015); a site context assessment of vegetation patch size and connectivity; and a fauna species habitat index score (DEHP 2017).

Further detail on habitat quality scoring is provided in Section 3.5.3 of the Olive Downs Project – Baseline Offset Survey Investigation Report (DPM Envirosciences 2018).

3.2.2 Current land use

Land within the Stage 1 Offset Area is presently used for cattle grazing, and small areas show signs of being opportunistically cropped after adequate rainfall. Portions of the land have been historically cleared through past agricultural practices however there are large tracts of native woody regrowth coming back, and remnant vegetation patches that have been retained. These remnant and advanced regrowth areas are show on Figure 3.3.

Based on historical aerial imagery, it is estimated that the 'advanced regrowth areas' are approximately 21 years old (cleared circa 1999) and are establishing well with canopy trees >10m height (Pembroke 2019). There are then areas across the proposed offset that are grasslands which have some paddock trees, small clusters of mature paddock trees, some native grasses and younger regenerating canopy trees. These are classified as 'restoration areas' as they are supporting some MNES habitat features now (eg paddock trees that could be used by Koalas, native grasses as foraging resources for Squatter Pigeon and gilgai for Ornamental Snake) and with active management can be restored to provide additional habitat features and improve habitat quality.

3.2.3 Connectivity values

Connectivity values have been assessed using the methods of the Biodiversity Planning Assessment (BPA) for the Brigalow Belt Bioregion (DES 2018). The published BPA's provide a consistent approach to mapping biodiversity values using vegetation mapping while incorporating various habitat related factors to determine biodiversity significance across landscape scale such as patch size. The outcome of the BPA method is a map displaying the biodiversity significance of remnant vegetation in specific bioregions and locations of terrestrial and riparian landscape corridors.

The designation of bioregional corridors in BPAs is primarily established to:

- distinguish and conserve ecological and evolutionary processes at a landscape scale;
- maximize connectivity between remnant vegetation areas; and
- identify important areas for rehabilitation and offset opportunities.

State significant corridors have been defined across Queensland. These are designated by broad links between landscapes and typically follow large tracts of remnant vegetation with identified biodiversity values and connect protected areas. Regional biodiversity corridors also consist of connections between remnant vegetation areas, can often follow riparian corridors, but can also include non-remnant vegetation areas recognised to have high rehabilitation potential for habitat restoration (DES 2018). The state and regional corridors in proximity to the offset areas are shown in Figure 3.4.

Connectivity on a broader scale predominantly occurs through the north into large tracts of vegetation (>20,000 ha in total) classified as vegetation of state and regional biodiversity significance (Figure 3.4). These areas are then connected to a large State significant biodiversity corridor that intersects with Dipperu National Park to the east. The vegetation immediately to the north of the Stage 1 Offset Area consists primarily of eucalypt woodlands including areas dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*) or Poplar box (*E. populnea*), with smaller areas of Semi-evergreen Vine thicket communities. Vegetation west of this area consists primarily of Poplar box woodlands or Brigalow (*Acacia harpophylla*) dominated communities. Dipperu National Park itself is a large tract (11,210 ha) of remnant vegetation consisting primarily of Dawson gum (*Eucalyptus cambageana*) and Brigalow communities, as well as areas of SEVT.

Offset Area 1 is an important habitat area between regional significant biodiversity corridors to the east and a state significant corridor to the west associated with the Isaac River (Figure 3.4). These areas consist primarily of riparian eucalypt woodlands such as RE 11.3.25, 11.3.7, 11.3.27b. To the south of Offset Area 2 are other areas of remnant vegetation mapped as state and regional biodiversity significance, and these areas are proposed to be assessed as offsets for future stages of the Olive Downs Project. These areas will be protected under a conservation agreement as part of Stage 2 and will be further rehabilitated thereby increasing connectivity values to the south and connecting to Isaac River in west and south-west.

These identified corridors and habitats are considered likely to be utilised by all matters associated with the Stage 1 Offset Area known for dispersal traits. Habitats in the broader area include diverse, remnant eucalypt woodlands to provide foraging and sheltering habitat for Koalas and Greater Glider, riparian vegetation corridors where Koala and Greater Glider records have been confirmed, as well as open grassy woodlands for Squatter Pigeon dispersal. Offset Area 1 (total 5,421.70 ha in area) is the largest offset area and includes large patches of existing remnant woodlands and advanced regrowth. The remnant woodlands are situated along riparian corridors, in patches between riparian corridors and there are quite large patches of remnant regional ecosystem (RE) 11.5.9 along the eastern boundary. There is a total area of 1,964.9 ha of remnant vegetation and 834.2 ha of advanced regrowth in Offset Area 1 (Figure 3.3).

The identified advanced regrowth areas are adjacent to these remnant woodlands supplementing their patch size and connectivity. The advance regrowth was cleared approximately 20 years ago and has been advancing in height and canopy cover since this historical clearing. Canopy heights in these areas are over >10 m (Photograph 3.1).

By increasing habitat size, foraging resources, overall habitat quality and connectivity to adjacent habitats particularly the Isaac River where multiple records of Koalas and Greater Glider have been observed will be a significant conservation outcome.

Photograph 3.1 Advanced regrowth woodlands supporting multiple *Eucalyptus* species

With active management and time both identified advanced regrowth and regenerating grasslands across Offset Area 1 will eventually advance to remnant classified woodlands increasing the total patch size and connectivity for the site. Habitat and connectivity improvement of these areas will also be accelerated by selective revegetation that will include direct seeding and tubestock. Areas targeted for revegetation will predominately include areas along riparian corridors adjacent to existing remnant and advanced regrowth communities (ie RE 11.3.2 *Eucalyptus populnea* woodland on alluvial plains) (Figure 3.6). This will accelerate the growth and width of the existing primary corridors and improve resilience of the remnant vegetation.

Offset Area 2 (total 2,570.80 ha in area) includes some existing remnant vegetation including along Scrubby Creek and advanced regrowth. There is 206.6 ha of remnant and 610.3 ha of advanced regrowth. Ground-truthed remnant REs and advanced regrowth are mapped in Figure 3.3.

Connectivity values according to each MNES species are summarised below, and supporting figures provided in Appendix B.

i Koala

- Koala habitat occurs along major watercourses through the Stage 1 Offset Area including Devlin Creek and Scrubby Creek.
- Koala were recorded predominantly along these riparian corridors as shown in Figure 3.6 and the species is known to move through the landscape along these riparian corridors including through fragmented landscapes.
- Koalas will move from Isaac River in the west (where a significant number of Koalas have been found) east to the offset area and north up into larger tracts of remnant eucalypt woodlands.
- These Koala habitats consist of remnant eucalypt woodlands and advanced regrowth woodlands. There are also large tracts of woodlands with Koala food trees.
- The broadening of the riparian zone with revegetation (Figure 3.6) will facilitate an increase in Koala habitat and greater opportunities for movement along the existing corridors.

ii Greater Glider

- Primary Greater Glider habitat exists predominately as riparian vegetation along Bundarra, Devlin and Scrubby Creek within the Stage 1 Offset Area.
- Most Glider records were from within these riparian corridors (Figure 3.10) within the Stage 1 Offset Area, as well as along the Isaac River to the west.
- Like Koalas, Gliders have the ability to disperse from Isaac River north-east into Offset Area 1 and 2 and continue along the riparian corridors. Greater Gliders can also disperse into habitat areas to the south of Offset Area 2 which are proposed for future offset stages.
- The broadening of the riparian zone with revegetation (Figure 3.10) will facilitate greater opportunities for Greater Glider movement along the existing corridors.
- Habitat improvement and restoration of habitat across larger areas of Offset Area 1 and 2 adjacent to existing established habitat will also facilitate lateral movement between habitats in the offset areas and adjacent vegetation.

iii Ornamental Snake

- Ornamental Snake has been recorded near the northern boundary of Offset Area 1.
- All records were associated with gilgai depressions.
- Although the species is not known for high dispersion traits, the numerous watercourses, and gilgai offer suitable connectivity habitats, particularly during and post rainfall events.
- The improvement of gilgai habitats and reductions of introduced predators within the Stage 1 Offset Area will further increase the species ability to disperse successfully.
- To south of Offset Area 2 are additional large areas of gilgai that have potential to support the species and over time will provide dispersal opportunities for the species.

iv Squatter Pigeon

- Squatter Pigeon records exist within and adjacent to the offset areas.
- Records of this species are from both restoration areas (non-remnant), but also remnant riparian vegetation, with all records being in close proximity to watercourses.
- This species is known to utilise degraded habitats for both breeding and foraging, and dispersal habitat can be any area with sparse vegetation between foraging and breeding habitat or suitable waterbodies.
- Squatter Pigeons are likely to utilise the current habitats within the Stage 1 Offset Area as breeding, foraging and dispersal habitat. With management the overall habitat quality will be improved.
- Adjacent areas also support Squatter Pigeon habitat including to north of Offset Area 1 and west and south of Offset Area 2.

v Australian Painted Snipe

- No records of this species exist within the offset area. However, there is a record to the north of Offset Area 1 and habitats within the offset boundary are suitable for the species.
- The species is likely to utilise the wetland ecosystems within Offset Area 1 (ie RE11.5.17 Palustrine wetland - Eucalyptus tereticornis woodland in depressions on Cainozoic sand plains and remnant surfaces) during typical conditions, as well as gilgai supporting soils during wet conditions.
- Movements of the species are relatively poorly known. However, they are likely to disperse at night and can utilise any suitable wetland including flooded gilgai and wet drainage lines during passage.
- Improvements to the gilgai habitat will further increase the likelihood of the site being used by birds on passage moving through the area due to temporal conditional status throughout the region and state.
- Species has potential to disperse into adjacent habitats including in north where a record occurs, and west and south of Offset Area 2 where gilgais occur and dams which provide suitable habitat for species in right seasonal conditions.

3.2.4 Summary of vegetation condition types

The Stage 1 Offset Area has been categorised into three broad vegetation condition types being:

- remnant vegetation;
- advanced regrowth woodlands; and
- habitat restoration areas.

The extent of these vegetation condition types are summarised in Table 3.2 and shown in Figure 3.3.

Table 3.2 Vegetation condition types across the offset areas

Vegetation condition type	Area 1 (ha)	Area 2 (ha)	Total (ha)
Remnant vegetation	1,758.3	206.6	1,964.9
Advanced regrowth woodlands	834.2	610.3	1,444.5
Habitat restoration areas	3,663.4	2,364.2	6,027.6

3.2.5 Remnant woodlands

Within the offset area there are tracts of remnant mature woodlands, including along watercourses and adjacent alluvial flats as well as the eastern boundary of Offset Area 1. Remnant vegetation also occurs as linear patches within Offset Area 2. Distribution of remnant REs is illustrated in Figure 3.3.

Remnant woodlands are generally in moderate to good condition, supporting a complex set of vegetation aligned with 10 regional ecosystems (REs):

- RE 11.3.1 Brigalow (*Acacia harpophylla*) and/or Belah (*Casuarina cristata*) open forest on alluvial plains;
- RE 11.3.2 Poplar Box (*Eucalyptus populnea*) woodland on alluvial plains;
- RE 11.3.25 Forest Red Gum (*Eucalyptus tereticornis*) or River Red Gum (*E. camaldulensis*) woodland fringing drainage lines;
- RE 11.3.27f Palustrine wetland, Coolabah (*Eucalyptus coolabah*) and/or Forest Red Gum (*E. tereticornis*) open woodland to woodland fringing swamps;
- RE 11.4.8 Dawson Gum (*Eucalyptus cambageana*) woodland to open forest with Brigalow (*Acacia harpophylla*) or blackwood (*A. argyrodendron*) on Cainozoic clay plains;
- RE 11.4.9 Brigalow (*Acacia harpophylla*) shrubby woodland with Yellowwood (*Terminalia oblongata*) on Cainozoic clay plains;
- RE 11.5.3 *Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces;
- RE 11.5.9 *Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains and/or remnant surfaces;
- RE 11.5.17 Palustrine swamp with fringing Forest Red Gum (*Eucalyptus tereticornis*) woodland in depressions on Cainozoic sand plains and remnant surfaces;
- RE 11.11.1 *Eucalyptus crebra* +/- *Acacia rhodoxylon* woodland on old sedimentary rocks with varying degrees of metamorphism and folding; and
- RE 11.12.7 *Eucalyptus crebra* woodland with patches of semi-evergreen vine thicket on igneous rocks (boulder-strewn hillsides).

Some patches of RE 11.3.1, RE11.4.8 and RE 11.4.9 align with the Brigalow TEC listed under the EPBC Act, while some patches of RE 11.3.2 may align with the Poplar Box Grassy Woodland on Alluvial Plains TEC listed under the EPBC Act. Remnant woodlands are shown in Photograph 3.2 and Photograph 3.3.

Photograph 3.2 ***E. populnea*** **woodland (RE11.3.2)** **Photograph 3.3** ***E. tereticornis*** **wetland (RE11.3.27f)**

3.2.6 Advanced regrowth woodlands

Advanced regrowth woodlands (approximately 21 years old) occur across significant areas of the Stage 1 Offset Area. In total there is 1,444.50 ha of advanced regrowth eucalypt woodlands in Stage 1 Offset Area. These woodlands occur as regrowth overstorey species interspersed with mature trees that have been retained by previous landowners. A native shrub layer persists with a moderate diversity of native ground cover/grasses. Canopy heights vary according to site and vegetation type ranging between 6.5 m and 9 m for RE 11.5.3, and 9.5 m to 11 m in RE 11.4.8.

Advanced regrowth vegetation occurs as:

- regrowth Poplar Box (*Eucalyptus populnea*) with native shrub species (RE 11.5.3); or
- regrowth Dawson gum (*Eucalyptus cambageana*) woodland with Brigalow (*Acacia harpophylla*) (RE 11.4.8).

Examples of advanced regrowth woodlands are shown in Photograph 3.4 and Photograph 3.5.

Photograph 3.4 Regrowth *E. populnea* and native shrubs

Photograph 3.5 Regrowth eucalypt woodland

3.2.7 Habitat restoration areas

Cleared grasslands occur within the Stage 1 Offset Areas. These areas occur in various conditional states, some of which are dominated by exotic grasses (such as Buffel Grass (*Cenchrus ciliaris*)), while others have been noted as supporting a mix of native and exotic grass species, as well as regenerating native shrub and tree species. Native grasses present include *Eragrostis elongata, Enteropogon ramosus, Panicum effusum, Bothriochloa bladhii, Heteropogon contortus, Themeda triandra, Chrysopogon fallax* and *Aristida calycina.*

A number of these grassland areas are providing some habitat values at present for MNES species such as Squatter Pigeon. This has been confirmed as the species has been observed in the offset area within these grasslands (mapped as restoration areas in Figure 3.6, Figure 3.9 and Figure 3.10) in close proximity to watercourses. Where there are regenerating tree species, and mature paddock trees these also have potential to support Koalas foraging and dispersal.

Overall ecological condition is reduced in most areas due to presence of weeds, impacts from grazing and erosion. Scattered weeds occur throughout the site including Parthenium (*Parthenium hysterophorus*), Velvety Tree Pear (*Opuntia tomentosa*), Rubber Vine (*Cryptostegia grandiflora*), Mimosa Bush (*Acacia farnesiana*) and Shrubby Stylo (*Styloanthes scabra*). Examples of these restoration areas are shown in Photograph 3.6 and Photograph 3.7.

These areas of the Stage 1 Offset Area will undergo restoration through various management actions such as encouraging natural regeneration through weed control to reduce competition on native species recruitment, pest animal control, reducing and changing grazing regime to encourage further growth of native species, ripping if required to encourage seed germination, and revegetation of nominated areas along creeklines with direct seeding and tubestock. Prior to clearing it is believed the majority of these restoration areas were eucalypt woodlands dominated by RE11.5.3 *Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces.

Photograph 3.6 Open grasslands adjacent to remnant patches

Photograph 3.7 Cleared grasslands currently grazed

3.2.8 Biodiversity values

The Stage 1 Offset Area supports a number of significant biodiversity values at a Commonwealth and State level. These include:

- Endangered and Of Concern REs;
- Brigalow TEC;
- breeding and foraging habitat for threatened fauna species;
- watercourse vegetation and wetlands; and
- supporting protection and enhancement of habitats and movement corridors for wildlife through remnant and riparian corridors through to other state significant biodiversity corridors to the north and west associated with the Isaac River.

The Stage 1 Offset Area supports existing habitat for five threatened fauna species listed under the EPBC Act and impacted by the Project, four of which have been observed on site during targeted fauna surveys being:

- Ornamental Snake;
- Squatter Pigeon;
- Koala; and
- Greater Glider.

It is anticipated the Stage 1 Offset Area also provides habitat for the Australian Painted Snipe. There is suitable habitat present for the species and it has been recorded in the surrounding areas west of the offset along a tributary of Isaac River. The threatened species, and extent of area for each value across the offset, is summarised in Table 3.3.

Table 3.3 Stage 1 offset area – MNES values

MNES value	Description	Area 1 (ha)	Area 2 (ha)	Total area (ha)
Ornamental Snake	Known important habitat	997.8	1,009.9	2,007.7
Australian Painted Snipe	Breeding habitat	73.8	0.0	73.8
Squatter Pigeon	Breeding and foraging habitat	1,356.3	220.0	1,576.3
	Restoration habitat (breeding and foraging habitat)	1,779.2	1,043.3	2,822.5
Koala	Known habitat (remnant woodland)	1,516.2	204.5	1,720.7
	Known habitat (regrowth woodland)	860.8	586.6	1,447.4
	Restoration habitat	1,071.9	550.0	1,621.9
Greater Glider	Known habitat (remnant woodland including breeding)	1,516.7	204.5	1,721.2
	Known habitat (regrowth woodland)	26.5	0.0	26.5
	Restoration habitat	2,542.2	1,195.5	3,737.7

The habitat and ecosystem values for each of these species is discussed further below.

3.2.9 Habitat Quality

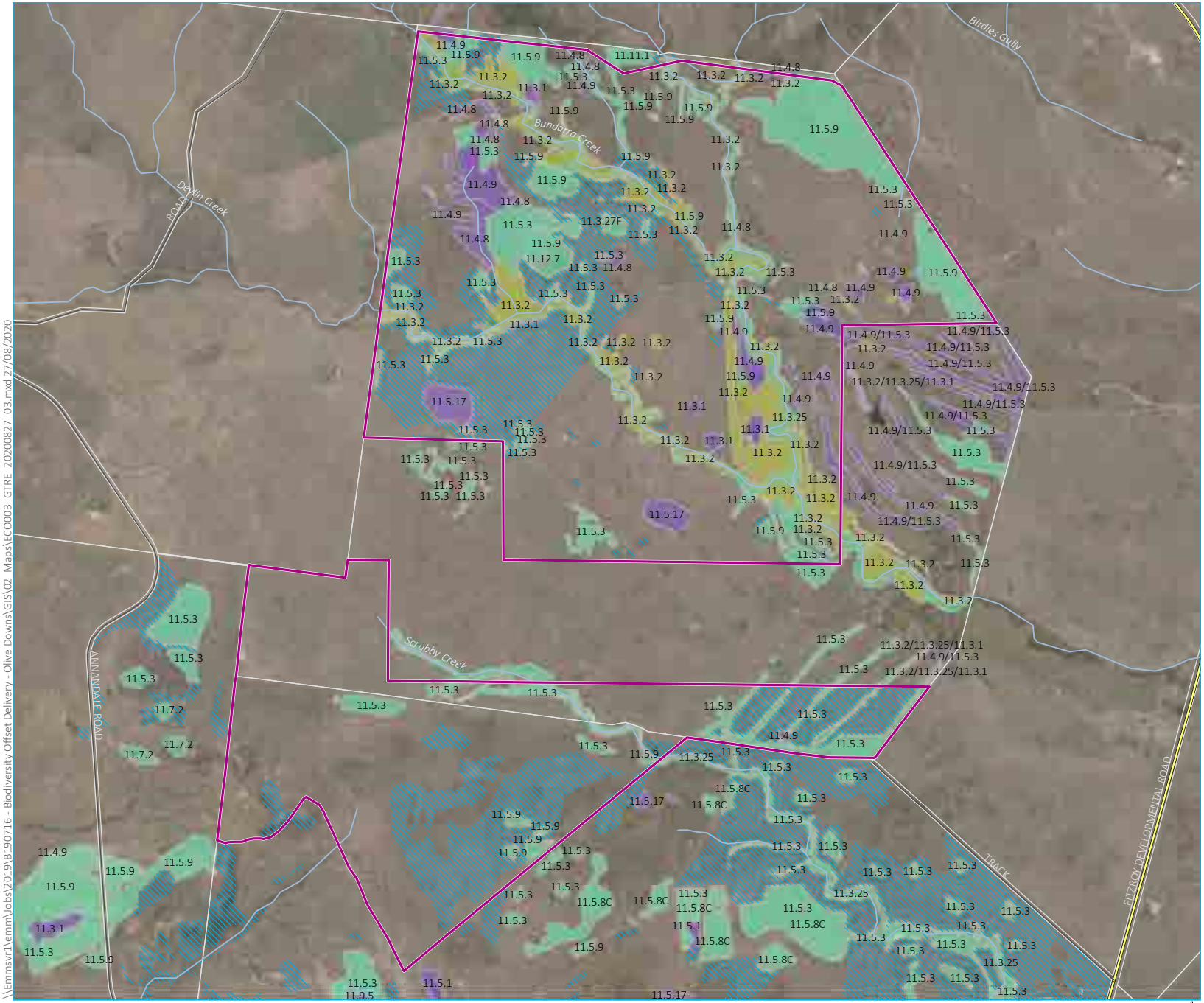
Habitat Quality assessments were undertaken in accordance with the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2017) whereby sites were designated within ground-truthed vegetation types (REs) and field data was compared to state government provided benchmarks specific to each RE. These benchmarks are representative of high quality, intact sites of each vegetation type. Location of habitat quality assessment transects (BioCondition) are shown in Figure 3.5 and results are summarised in Appendix B.

Table 3.4 below summarises mean Habitat Quality totals from the site-specific scores according to impacted matters and vegetation type where applicable. These mean scores also represent offset calculator inputs for starting habitat quality.

Table 3.4 Mean Habitat Quality scores

MNES value	Impact (Starting score)	Offset (Starting score)	
	Habitat Quality means	Remnant Habitat Quality means	Regrowth Habitat Quality means
Ornamental Snake	5*	6	No sites in regrowth
Australian Painted Snipe	7	6	No sites in regrowth
Squatter Pigeon	8	7	6#
Koala	7	7	5
Greater Glider	7	7	4

*Includes both remnant and regrowth vegetation
#starting average score of 7 has been used across remnant and regrowth



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

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Ground-truthed regional ecosystems

Olive Downs
Stage 1 offset area management plan
Figure 3.3

KEY

- Stage 1 offset area
- Rail line
- Major road
- Named watercourse
- Existing habitat
- Habitat restoration area

Biodiversity corridors

- State
- Regional

Biodiversity significance

- State Habitat for EVNT taxa
- State
- Regional
- Local or Other Values

Threatened species records

- Australian Painted Snipe
- Greater Glider
- Greater Glider scats
- Koala
- Koala scratches and scats
- Ornamental Snake
- Squatter Pigeon

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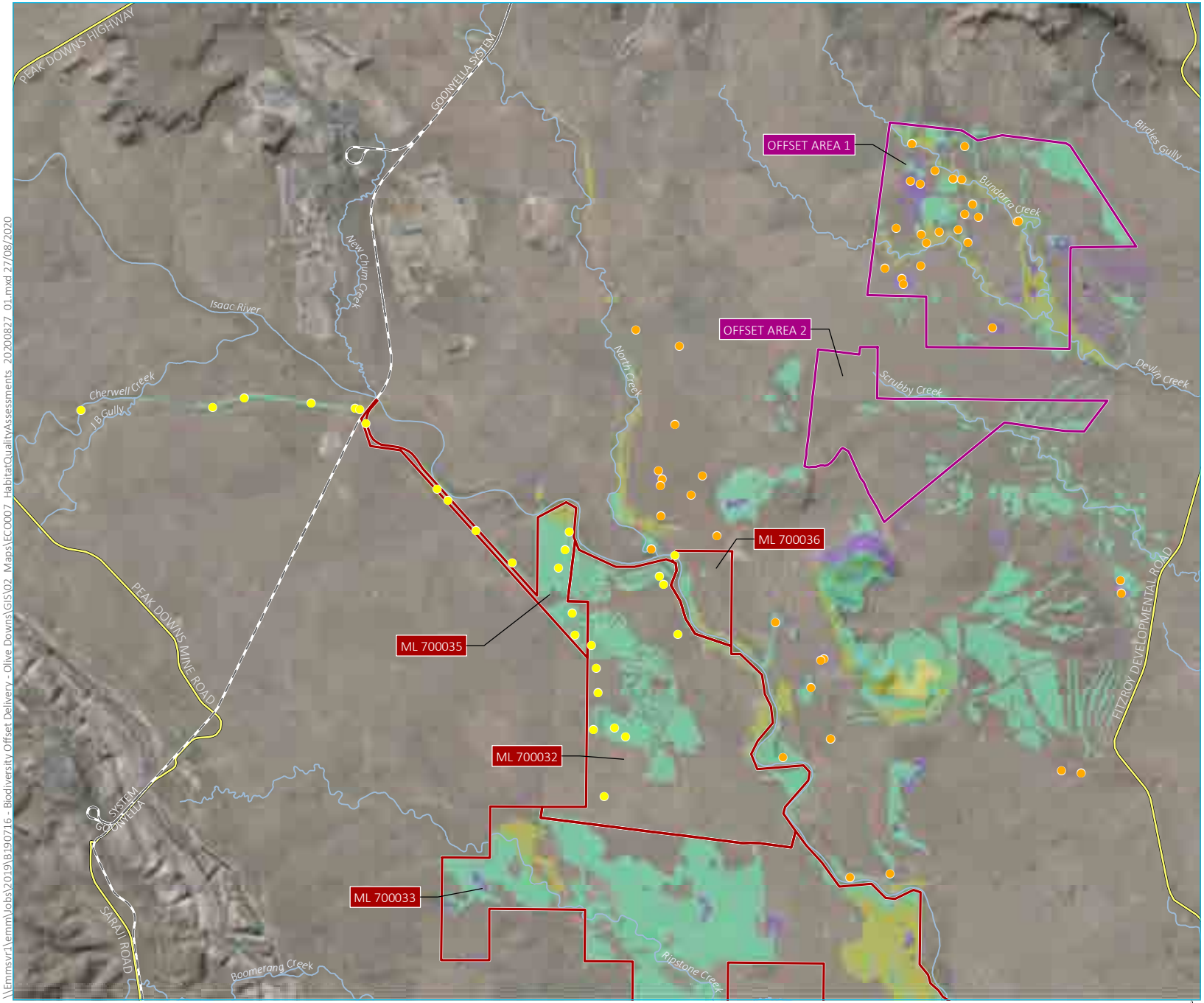
Connectivity

Olive Downs
Stage 1 offset area management plan
Figure 3.4



Stage 1 offset area
Mining lease
Rail
Major road
Named

Ground-truthed regional ecosystems
Remnant endangered - dominant
Remnant endangered - subdominant
Remnant of concern - dominant
Remnant of concern - subdominant
Remnant least concern

Habitat quality survey sites
Impact area
Offset area

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

0 5 10 km
GDA 1994 MGA Zone 55
N

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Habitat quality survey sites

Olive Downs
Stage 1 offset area management plan
Figure 3.5

EMM

3.3 Values for MNES

3.3.1 Koala

The Koala has one of the largest distributions of any terrestrial threatened species listed under the EPBC Act. It occupies a variety of vegetation types across this large distribution, can move long distances and is variably affected by a range of threats. Several records of Koala exist within the Stage 1 Offset Area. Koala habitat is defined by the vegetation community present and the vegetation structure (DoE 2014a). Any forest or woodland containing species that are known Koala food trees, or shrubland with emergent food trees can be considered as 'potential Koala habitat' (DAWE 2020a). This can include remnant and non-remnant vegetation in natural, agricultural, urban and peri-urban environments. Koala food trees are considered to be those within the genera of *Angophora*, *Corymbia*, *Eucalyptus*, *Lophostemon* and *Melaleuca* above 10 cm diameter at breast height (DBH) and 1.3 m in height (DAWE 2020a).

Koala surveys comprised of terrestrial habitat quality assessments within the Stage 1 Offset Area conducted by DPM Envirosciences (DPM Envirosciences 2018). Assessments were conducted in accordance with the *Guide to Determining Terrestrial Habitat Quality Version 1.2* (DEHP 2017).

Within the Stage 1 Offset Area, Koalas were recorded on numerous occasions along drainage features and within woodland habitats. 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 Envirosciences 2018) (Figure 3.6).

Within the Stage 1 Offset Area it was determined that Koala habitat includes all areas of remnant woodland with known Koala food trees or regrowth woodland with emergent Koala food trees. This includes all areas of eucalypt open forests to woodlands on floodplains (i.e. RE 11.3.25), eucalypt dry woodlands on inland depositional plains (ie REs 11.3.2, 11.5.3, 11.5.9, 11.11.1 and 11.12.7), the vegetation surrounding and within the lacustrine and palustrine wetlands (ie REs 11.3.27f and 11.5.17), and regrowth woodland or shrubland which meet the definition provided above.

Koala habitat within the Stage 1 offset area comprises: Remnant Woodlands (1,720.7 ha), shown in Photograph 3.8, Suitable Regrowth Woodlands (1,447.4 ha), shown in Photograph 3.9, and habitat restoration areas (1,621.9 ha) (Figure 3.6).

The habitat restoration areas for the Koala (DPM Envirosciences 2018):

- excludes remnant vegetation (RE);
- includes cleared or regrowth areas (that are not yet Koala habitat) where a combination of ground observations, aerial imagery and State pre-clear mapping suggest that Koala food trees are likely to regenerate or establish with suitable tree plantings;
- excludes areas of cracking clays with gilgai, where Koala food trees are not likely to establish;
- excludes regrowth of RE 11.4.8 *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains due to lack of Koala food trees; and
- includes existing regrowth RE 11.5.9 as habitat restoration areas (although some of these areas are currently dominated by regrowth *Corymbia clarksoniana* or Acacia spp., the slower growing *E. crebra* is expected to become more prominent over time).

Starting Koala habitat quality scores are; Remnant Woodland (7 out of 10), Regrowth Woodland (5 out of 10) and habitat restoration areas (1 out of 10). Koala habitat mapping is shown in Figure 3.6.

Photograph 3.8 Remnant Koala habitat

Photograph 3.9 Advanced regrowth Koala habitat

3.3.2 Ornamental Snake

Two Ornamental Snakes were recorded during nocturnal spotlighting adjacent and to the north of the Stage 1 Offset Area. Desktop mapping identified areas of gilgai relief, which are the most accurate reflection of potential habitat for this species.

Within the Stage 1 Offset Area, it was determined that all areas of remnant Brigalow and mapped gilgai represent potential 'known important habitat' for the Ornamental Snake (Photograph 3.10), as do all wetland REs (11.3.27f and 11.5.17) and REs known to be associated with this species (REs 11.4.8 and 11.4.9) (DSEWPC 2011a). In the Stage 1 Offset Area, the gilgai landform is associated primarily with cleared agricultural grasslands/shrublands. Any habitat that allows connectivity between gilgai depressions is also considered 'important' in accordance with DSEWPC (2011a).

The Stage 1 Offset Area contains areas of agricultural grassland without gilgai soils between patches of important habitat, similar to that within the Project area. The agricultural grassland without gilgai soils do not form part of the proposed Ornamental Snake offset areas, but some are within the proposed offset due to providing habitat for other species including Squatter Pigeon. The areas mapped as potential habitat for the Ornamental Snake also contain woody debris (which would provide sheltering habitat for the Ornamental Snake when cracks are not available), are low-lying, and during the wet season would hold water long enough for frogs to inhabit them, providing a food source for the Ornamental Snake.

There is 2,007.7 ha of known important habitat for the Ornamental Snake in the Stage 1 Offset Area with a starting habitat quality of 6 out of 10. It is projected that without active management and legally securing the area for conservation purposes, the habitat quality score would decrease to 4 out of 10. This loss of habitat quality is projected based on a number of threats and degrading pressures continuing and/or increasing. Factors that will degrade Ornamental Snake habitat include:

- grazing pressure and feral pigs will continue to degrade gilgai and wetlands, particularly post rainfall events;
- reduction in water quality and increased turbidity through disturbance from cattle and feral pigs, reducing prey populations (primarily amphibians) and in turn foraging opportunities and carrying capacity for the species;
- grazing pressures and landowners ability to rake the ground of all woody debris to improve pasture will decrease or completely remove microhabitats for the species;
- without active management weed cover will increase and reduce native ground cover and native tree species recruitment; and
- unmanaged cane toad populations have potential to reduce Ornamental Snake populations.

Ornamental Snake habitat is shown in Figure 3.7.

Photograph 3.10 Known important Ornamental Snake habitat

3.3.3 Australian Painted Snipe

No Australian Painted Snipe were observed during the field surveys. Records of this species within the broader locality are from waterways or wetlands (including gilgai), with the closest being approximately 5 km north.

Within the Stage 1 Offset Area, it was determined that all areas of lacustrine and palustrine wetlands (including wetland REs 11.3.27f and 11.5.17) represent potential breeding and foraging habitat for the Australian Painted Snipe, particularly as water levels are expected to change seasonally, with islands or mounds and bare earth exposed. Available habitat in the Stage 1 Offset Area is shown in Photograph 3.11.

There is approximately 73.8 ha of potential breeding habitat for the Australian Painted Snipe in the Stage 1 offset area with a starting habitat quality score of 6 out of 10. It is projected that without active management and legally securing the area for conservation purposes, the habitat quality score would decrease to 4 out of 10. This loss of habitat quality is projected based on a number of threats and degrading pressures continuing and/or increasing. Factors that will degrade Australian Painted Snipe habitat include:

- grazing pressure and feral pigs will continue to degrade gilgai and wetlands, particularly post rainfall events;
- cattle and feral pigs will continue to reduce wetland suitability for this species through water edge disturbance and capacity as suitable weed vectors restricting the successful germination of native aquatic and semi-aquatic plants critical for sheltering and foraging activities of the species;

- increases of feral cat and wild dog populations will also increase chances of predation and reduction of Australian Painted Snipe populations; and
- without active management weed cover will increase and reduce native ground cover and native tree species recruitment reducting ecological function of gilgai and wetland areas.

Australian Painted Snipe habitat is shown in Figure 3.8.

Photograph 3.11 Potential Australian Painted Snipe breeding and foraging habitat

3.3.4 Squatter Pigeon

The Squatter Pigeon was identified in various habitats on two occasions within the Stage 1 Offset Area and a further four locations within close proximity (Figure 3.9).

The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open forests that are dominated by eucalypts (DAWE 2020b). Within the Stage 1 Offset Area all areas of eucalypt dry woodlands on inland depositional plains and eucalypt open forests to woodlands on floodplains are considered potential habitat for this species. Potential habitat (stratified into breeding, foraging and dispersal habitat), shown in Photograph 3.12, and habitat restoration areas shown in Photograph 3.13, were mapped across the Stage 1 Offset Area in accordance with the habitat definitions outlined in Table 3.5.

Within the Offset Study Area, REs, 11.5.3 and 11.5.9 provide Squatter Pigeon breeding habitat (where within 1 km of a waterbody) because they contain suitable soils, vegetation structure and composition. In addition, alluvial RE 11.3.2 is also considered suitable for Squatter Pigeon (southern) breeding based on site observations of habitat usage in the Project area (including REs 11.3.2 and 11.3.7) and Offset Study Area (including RE 11.3.2, DPM Envirosciences 2018).

Table 3.5 Squatter Pigeon habitat definitions

Habitat type	Maximum distance from nearest waterway	Restricted to	Excludes (overrides the "restricted to" column)	Characteristic Regional Ecosystems (REs) within the Stage 1 offset area
Potential Breeding habitat	1 km	Land Zone 5 and selected areas on Land Zone 3	N/A	11.5.3, 11.5.9, 11.5.17, 11.3.1, 11.3.25 and 11.3.2.
		<33% groundcover		
		Patchy native groundlayer*		
Potential Foraging habitat	3 km	Land Zone 5 and selected areas on Land Zone 3	N/A	11.5.3, 11.5.9, 11.5.17, 11.3.1 and 11.3.2.
		<33% groundcover		
		Patchy native groundlayer*		
Potential Dispersal habitat	N/A	Any grassy-woodland/woodland/forest linking potential breeding and foraging habitat.	Cleared land >100 m across.	Unknown
Future Potential habitat	N/A	Land Zone 5 and 3.	Potential Dispersal, Breeding or Foraging habitat	Regrowth vegetation on Land Zones 3 and 5.
		Cleared and regrowth areas	Wetlands	

* either: patchy, native, perennial tussock grasses, or mixed-native perennial tussock grasses and low shrubs/forbs.

The Stage 1 Offset Area contains 1,576.3 ha of potential breeding and foraging habitat that is made up of remnant and regrowth woodlands, and 2,822.5 ha of habitat restoration areas for the Squatter Pigeon, which over time will become breeding and foraging habitats. Squatter Pigeon breeding habitat is also foraging habitat for the species, it is just within a closer distance to water where the species is more likely to nest (refer Table 3.5).

In the Stage 1 Offset Area, potential habitat comprises:

- breeding habitat (which includes foraging) (1,465.8 ha); and
- foraging habitat (110.5 ha).

In the Stage 1 Offset Area, habitat restoration areas comprise 2,822.50 ha of breeding, foraging and dispersal habitat. In total there will be 4,398.80 ha of habitat for Squatter Pigeon. In time with management these areas are likely to provide a mix of breeding, foraging and dispersal habitat. The difference between breeding habitat and foraging habitat is only their distance to permanent water sources. Breeding habitat is within 1 km of water and foraging 3 km from water. Management actions will be the same.

It is projected that without active management and legally securing the area for conservation purposes, the habitat quality score would decrease to 5 out of 10. This loss of habitat quality is projected based on a number of threats and degrading pressures continuing and/or increasing. Factors that will degrade Squatter Pigeon habitat include:

- grazing pressure will continue to degrade the grassy woodlands through pressures on native grass and tree recruitment and groundcover;
- landholder has ability to crop and/or clear the non-remnant (restoration areas) within the offset area which will result in a loss of habitat for the species;
- without active management weed cover, including buffel grass, will increase and reduce native ground cover and native tree species recruitment;
- increase in feral cat and fox populations will result in reduction of Squatter Pigeon populations; and
- reduction in water quality and increased turbidity through disturbance from cattle and feral pigs would have an impact on Squatter Pigeon breeding habitat due to reduced access to water.

Squatter Pigeon habitat mapping is shown in Figure 3.9

Photograph 3.12 Remnant and advanced regrowth Squatter Pigeon habitat

Photograph 3.13 Potential Squatter Pigeon within habitat restoration areas

3.3.5 Greater Glider

The Greater Glider was recorded on four occasions within the Stage 1 Offset Area along drainage features and within wetland habitats, within Eucalypt dry woodlands on inland depositional plains and Eucalypt open forest to woodlands on floodplains (Figure 3.10).

Within the Stage 1 Offset Area it was determined that suitable habitat for the Greater Glider includes both remnant and advanced regrowth forest or woodland which contain suitable hollow bearing trees. This includes:

- all areas of remnant Eucalypt open forests to woodlands on floodplains (ie RE 11.3.25);
- Eucalypt dry woodlands on inland depositional plains (ie REs 11.3.2, 11.5.3, 11.5.9, 11.11.1 and 11.12.7);
- vegetation surrounding and within the lacustrine and palustrine wetlands (ie REs 11.3.27f and 11.5.17);
- acacia woodland dominated/co-dominated by *E. cambageana* (ie RE 11.4.8); and

- patches of eucalypt regrowth field-verified as containing hollow-bearing trees (primarily stags). These habitat types contain Greater Glider food trees (*Eucalyptus* spp.), which are less likely to be found or not in high abundance (as suggested in the Conservation Advice) within other habitat types (that are cleared or Acacia communities) in the Stage 1 offset area.

As per condition 4 and condition 7 of the approval (2017/7867), habitat connectivity within riparian zones of the Stage 1 Offset Area must increase. The riparian corridors are a mix of remnant vegetation (mapped as 'habitat') and habitat restoration areas. The increase in connectivity must be appropriately assessed with results and management actions to be peer-reviewed every 5 years to ensure improvements are achieved, or management short-comings are identified and corrected in due course. Assessments and reviews of Greater Glider habitat connectivity will be undertaken until completion criteria are achieved. Monitoring for Greater Glider including habitat connectivity is described in Section 6 and completion criteria are defined in Table 6.3.

Habitat connectivity will be improved for Greater Glider through protection and management of existing remnant vegetation along watercourses, reduction of threats such as weed management and preventing hot bushfires, active revegetation to expand the existing riparian corridors, and managing natural regeneration of eucalypt woodlands across much broader areas identified as 'habitat restoration areas' (Figure 3.10). This will ensure these important riparian corridors are maintained and widened over time, and edge effects minimised, to improve habitat connectivity

Management actions to achieve improved habitat connectivity will include the following:

- supplementary tree plantings and direct seeding in riparian corridors over 120 ha, starting from Year 3 and will be completed by end of Year 6 (Figure 3.10) (refer Section 4.2.1);
- installation of nest boxes in advanced regrowth vegetation and remnant vegetation where existing hollow-bearing trees are limited to provide additional denning resources and encourage their movement through these areas in first five years (refer Section 4.2.6);
- installation of nest boxes in restoration habitat areas (including revegetation sites) when canopy trees are mature enough to hold a nest box and Greater Gliders start to utilise these areas to provide additional denning resources and support movement into these additional habitats (refer Section 4.2.6);
- control of weeds to increase natural recruitment rates;
- reduction of fuel loads and active fire management to reduce intense fires;
- management of grazing to ensure natural regeneration isn't impeded;
- increase in canopy height and cover to improve their ability to move through these habitat areas; and
- removal of barbed wire fencing to avoid injury and/or mortality.

These management actions will allow the vegetation to regenerate and develop naturally with limited disturbance. This will enhance Glider habitat through increased food tree abundance as well as enhanced vegetative structural form for Glider mobility through increased canopy heights and cover. Nest boxes will also provide interim shelter and denning/breeding habitat until further natural hollows develop.

Field assessments to measure success will include the following methods:

- active spotlighting surveys to determine usage of Greater Glider and relative abundance across these main riparian corridors, including revegetated areas;

- structural vegetation assessments including numbers of large trees, suitable hollows, median canopy heights and canopy cover;
- monitoring of next box utilisation; and
- results from Habitat Quality assessments.

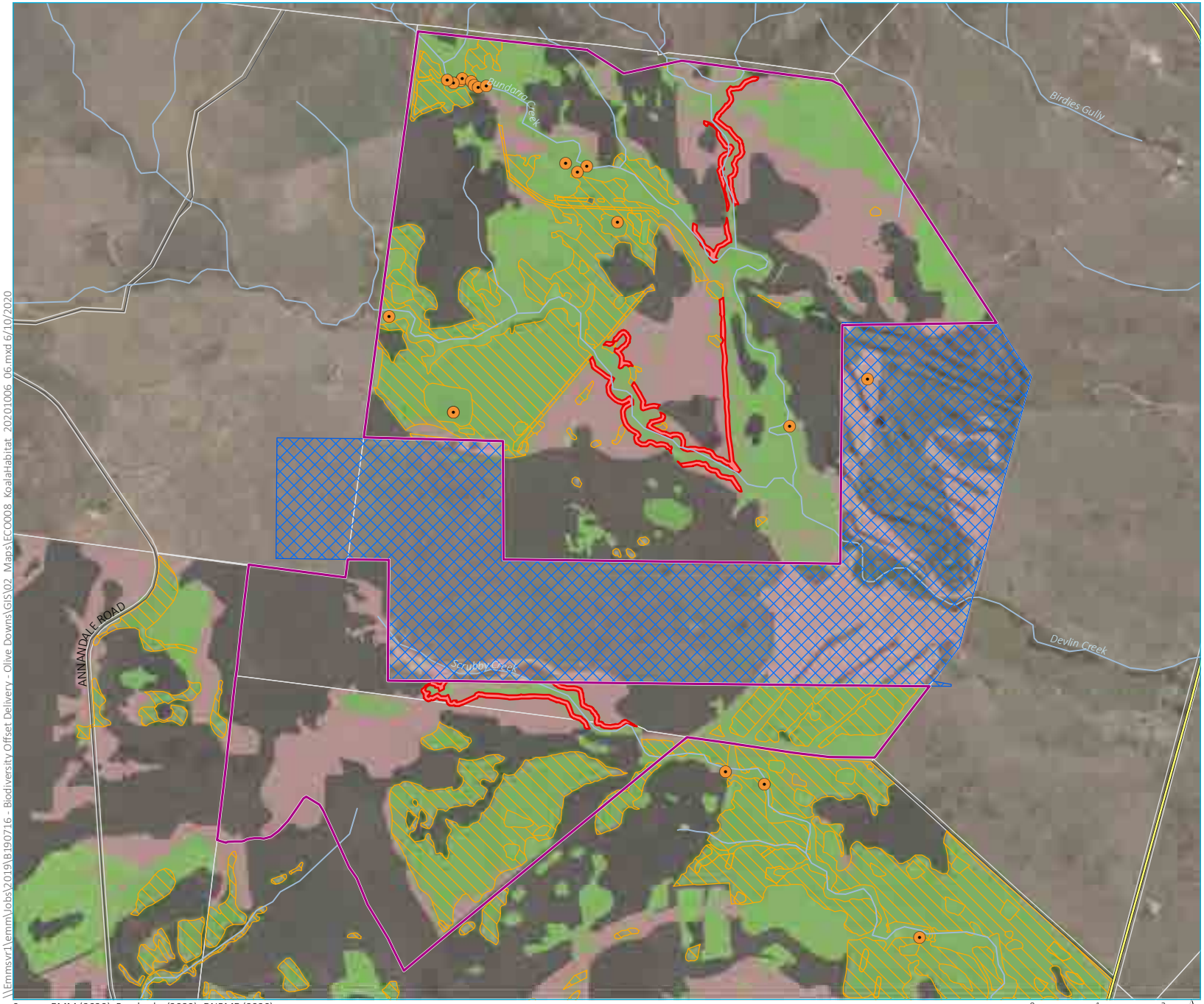
Restoration areas (Figure 3.10) would provide suitable habitat characteristics (hollows) over time with the implementation of appropriate management measures proposed to be implemented under this OAMP. These naturally regenerating areas will be actively managed so that over time they will provide additional foraging resources for Gliders. These areas are situated adjacent to remnant areas so this will increase patch size of Greater Glider habitats, making them more resilient to edge effects and will also improve connectivity between patches for Gliders. Once these restoration areas are maturing and canopy trees reach adequate height (estimated between Years 5 to 10) additional nest boxes will be installed across these areas. Further detail is provided in Section 4.2.6.

There is approximately 1,721.2 ha of remnant Eucalypt woodland with suitable hollow bearing trees for the Greater Glider that provides known habitat. These areas have a starting habitat quality score of 7 out of 10. There is a separate 26.5 ha of Eucalypt woodland advanced regrowth with suitable hollow bearing trees for the Greater Glider that provides known habitat. These areas have a starting habitat quality score of 4 out of 10. There is a further 3,737.7 ha of habitat restoration areas in the Stage 1 offset area. These areas have a starting habitat quality score of 1 out of 10.

Greater Glider habitat mapping is shown in Figure 3.10.

Photograph 3.14 Remnant Greater Glider habitat (breeding and foraging)

Photograph 3.15 Restoration areas of Greater Glider habitat



KEY

- Koala record
- Koala habitat (breeding or foraging)
- Koala habitat restoration area
- Advanced regrowth
- Not suitable habitat
- Proposed revegetation area
- Stage 1 offset area
- Mineral Development Licence 3023

Existing environment

- Major road
- Minor road
- Named watercourse
- Cadastral boundary

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO008 KoalaHabitat 20201006 06.mxd 6/10/2020

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

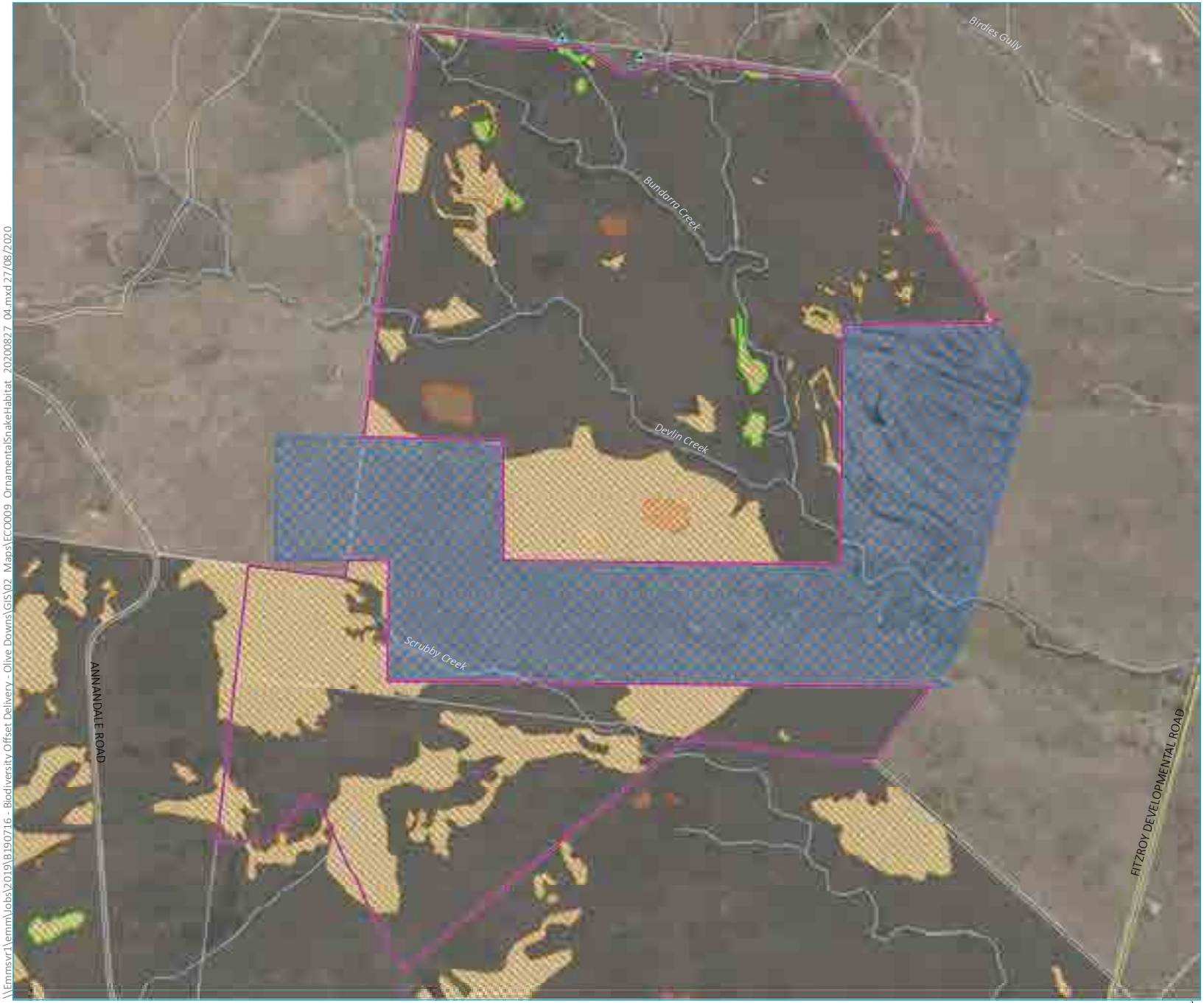
0 1 2 km

GDA 1994 MGA Zone 55

N

Koala habitat mapping

Olive Downs
Stage 1 offset area management plan
Figure 3.6



KEY

- Ornamental Snake record
- Known important habitat (including suitable and dispersal habitat)
- Regional ecosystems associated with the Ornamental Snake (RE 11.4.8, 11.4.9, 11.11.1)
- Palustrine and Lacustrine wetlands (potential frog habitat)
- Gilgai Soils (DPM Enviroscience, 2019)
- Not suitable habitat
- Brigalow TEC
- Stage 1 offset area
- Mineral Development Licence 3023

Existing environment

- Minor road
- Major road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

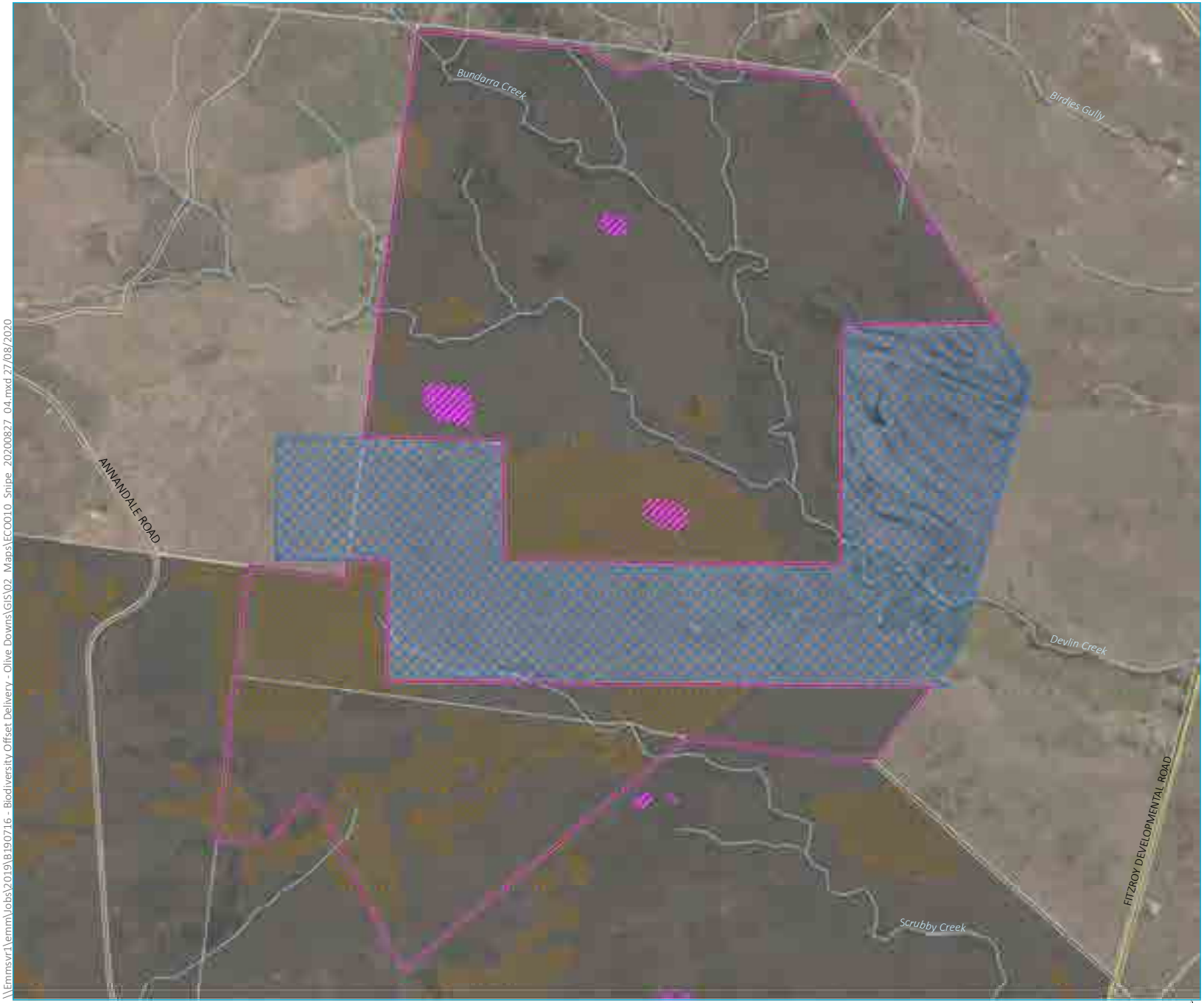
N

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO009 OrnamentalSnakeHabitat 20200827 04.mxd 27/08/2020

Ornamental Snake habitat mapping

Olive Downs
Stage 1 offset area management plan
Figure 3.7

EMM



KEY

- Australian Painted Snipe habitat (potential breeding and foraging)
- Palustrine and Lacustrine wetlands with suitable habitat features for breeding
- Gilgai Soils (DPM Enviroscienses, 2019)
- Not suitable habitat
- Stage 1 offset area
- Mineral Development Licence 3023

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO010 Snipe 20200827 04.mxd 27/08/2020

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

0 1 2 km

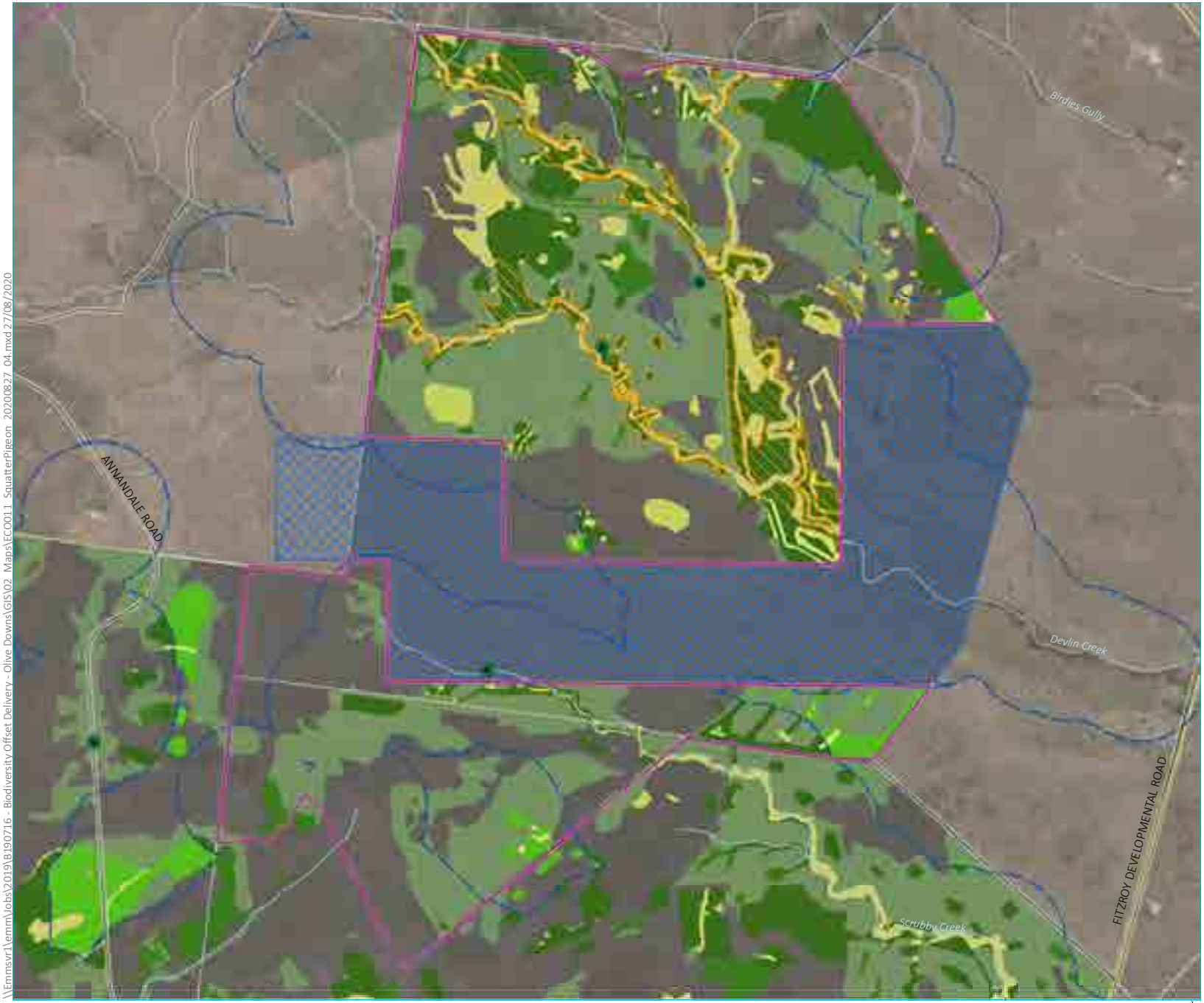
GDA 1994 MGA Zone 55

N

Australian Painted Snipe habitat mapping

Olive Downs
Stage 1 offset area management plan
Figure 3.8

EMM



KEY

- Squatter Pigeon record
- Potential breeding habitat
- Potential foraging habitat
- Potential dispersal habitat
- Habitat restoration area
- Regional Ecosystem 11.3.2 and 11.3.7
- Not suitable habitat
- 1 km boundary from seasonal waterbody/watercourse
- 3 km boundary from seasonal waterbody/watercourse
- Stage 1 offset area
- Mineral Development Licence 3023

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO011 SquatterPigeon 20200827 04.mxd 27/08/2020

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

0 1 2 km

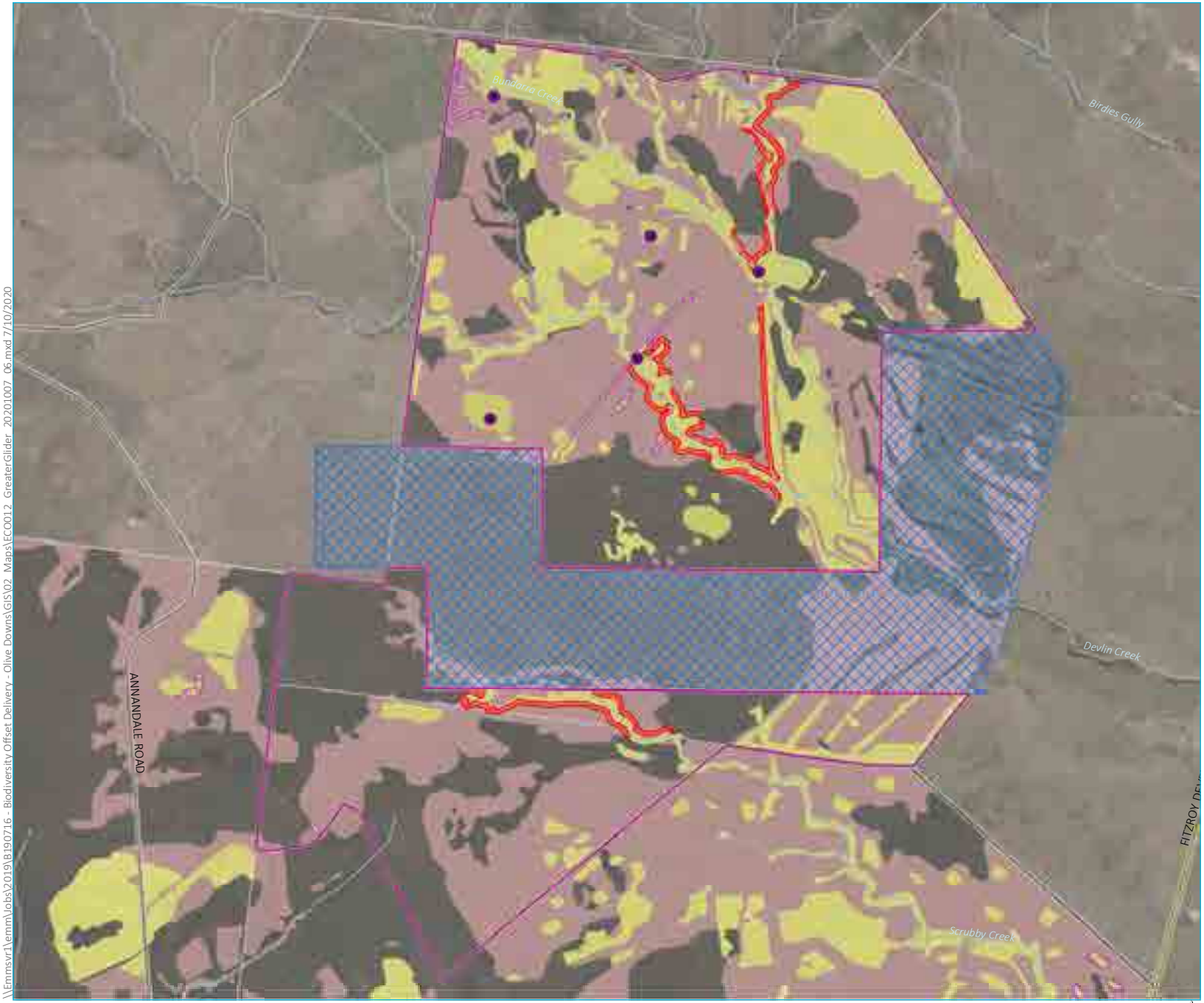
GDA 1994 MGA Zone 55

N

Squatter Pigeon habitat mapping

Olive Downs
Stage 1 offset area management plan
Figure 3.9

EMM



\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO012 GreaterGlider 20201007 06.mxd 7/10/2020

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

Greater Glider habitat mapping

Olive Downs
Stage 1 offset area management plan
Figure 3.10

4 Management actions

4.1 Overall approach to management of Stage 1 offset area

This section describes the overarching management actions and measures necessary to meet the final habitat quality scores for each MNES and offset completion criteria for the Stage 1 Offset Area over a 20-year period (Section 6.3). Interim milestones set at 5-yearly intervals will assess the management plans ability to achieve these performance outcomes in the longer term which are described in Table 6.3. Should any of the interim milestones not be achieved at the set time, the management plan will be reviewed, effectiveness of management evaluated and corrective actions agreed and implemented to ensure the offset area is tracking towards completion. Corrective actions and triggers are set out in Table 4.1.

Section 4.2 outlines management measures required across the entire Stage 1 Offset Area that will result in improvements in habitat quality for all MNES, reduce key threatening processes, and ensure the overarching management objectives will be achieved. Species specific management objectives, demonstrating how the management actions and corrective actions take into account relevant approved listing advices, conservation advices and are consistent with relevant recovery plans and threat abatement plans, are outlined in Section 4.3.

The key threatening processes that need to be managed across the entire offset are:

- spread and introduction of weeds, pest animal species and pathogens;
- land clearing and habitat fragmentation; and
- inappropriate grazing and fire regimes.

The overarching management actions for the offset that will address the above threatening processes and support the increase in habitat quality and extent of vegetation communities across the site are summarised in Section 4.2.

Year 1 of offset implementation will commence in the year that the Olive Downs Mine Project commences construction. This includes construction on one or more of the following Project components: Olive Downs Project Water Pipeline (EPBC 2017/7868), Olive Downs Project Electricity Transmission Line (EPBC 2017/7869), Olive Downs Project Rail Spur (EPBC 2017/7870) and Olive Downs Mine Site and Access Road (EPBC 2017/7867). Timeframes for implementation of the OAMP will be updated accordingly, if required.

4.2 Proposed management measures

The general management measures to be employed across the Stage 1 offset areas have been developed to address key threats, management measures and priority actions identified in the various conservation and listing advice for the threatened species. Table 4.1 summarises how each of the proposed general management measures will benefit the threatened species within the Stage 1 Offset Area, and the applicable conservation advice statements for each MNES species.

Table 4.1 Management measures and corrective actions

Management measure	Management implementation	Location	Timing	Responsible party	Trigger for corrective action	Corrective actions	Species benefiting
Regeneration of native vegetation communities	• Improve existing habitat in remnant woodlands. • Expand habitat in regrowth woodlands and cleared agricultural grasslands (restoration areas). • Active revegetation (seeding/planting) in identified revegetation areas (Figure 3.6). • Manage natural regeneration of woodlands in restoration areas.	• Riparian corridors to improve connectivity. • Regrowth woodlands and cleared agricultural grasslands to restore MNES habitats. • Wetland habitats. • Areas where extensive weed management is undertaken.	• Year 1 of offset implementation will commence when the Project commences construction. • Tree planting and seeding will commence within Year 3 of OAMP implementation, and be completed by end of Year 6.	• Third party contractor with appropriate experience in bush regeneration and revegetation.	• Tree mortality >5%. • Disease in trees and saplings. • Weed species inhibiting native growth. • Animal predation on native growth. • Natural regeneration not occurring at rates required to meet interim performance targets for restoration areas in Table 6.3.	• Assess fencing structures to ensure there is no unauthorised access by stock or large numbers of native herbivores • Increased controls of pest flora and fauna species • Assess soil health and suitability for successful regeneration • Increase watering of planted tubestock. • Dead trees to be replaced so average of 300 trees/ha is achieved in active revegetation areas. • Additional direct seeding is undertaken across larger areas in the restoration habitats. • Manage disease through application of suitable herbicides.	• Ornamental Snake - long term regeneration increases coarse woody debris[2] • Australian Painted Snipe - loss of wetland habitat is identified as a key threat to the species[3,4,5] and the species will benefit from regeneration of wetland habitats. • Koala - habitat loss is identified as a key threat to this species[6,7,8], with regeneration and revegetation resulting in increased availability of foraging resources and improved shelter and connectivity. • Squatter Pigeon - vegetation clearing is identified as a threat to the species[9,10] with regeneration of open woodlands and native grasses this increases areas of suitable habitat and food resources. • Greater Glider - habitat loss is identified as a catastrophic threat to this species[11] Regeneration and revegetation will increase foraging resources and connectivity in shorter term and denning resources in longer term.
Weed control	• Baseline weed mapping surveys. • Weeds will be managed in accordance with the project's weed management action plan. The weed action plan is to be developed post baseline surveys being completed in Year 1. The weed action plan will be prepared by Pembroke and a suitably qualified contractor identifying specific weed control methods, areas to be targeted and timing for each year. • Targeted weed control measures (see Table 4.2 for further details).	• Areas where weeds exist across all offset areas.	• Weed mapping surveys to be undertaken in Year 1. • Weed control at least annually. • Species dependent (see Table 4.2 for further details).	• Pembroke Land Manager or third party contractor with appropriate experience in weed management.	• New areas of weed outbreaks have been noted from the baseline surveys. • Increase in weed abundance. Average increase in 20% of non-native cover from previous baseline surveys at the HQ monitoring sites. • New weed species identified.	• Alter weed management strategy to target problematic species and/or outbreaks. • Increase frequency of weed management events. • Assess weed control methods and change methods if required. • Review hygiene protocols to ensure they are effective in preventing vehicles and people spreading or introducing weeds across offset area.	• Ornamental Snake - invasive weeds are identified as a key threat[2] • Australian Painted Snipe - replacement of native vegetation by invasive weeds is identified as a threat[3,4,5], and control of weeds is identified as a priority action[5] • Squatter Pigeon – invasion by weed species that do not provide natural food plants, particularly Buffel Grass, is identified as a threat to the species[9,10]

Table 4.1 Management measures and corrective actions

Management measure	Management implementation	Location	Timing	Responsible party	Trigger for corrective action	Corrective actions	Species benefiting
Biomass control and grazing management	• Minimise fuel loads through crash grazing, slashing and/or hazard reduction burns and cool burns. • Exclude grazing in certain areas. Grazing is excluded from 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. • During set times of year (wet season) or following significant rainfall (>50 mm in 7 days), grazing will be excluded in gilgai areas to ensure gilgai habitats are protected.	• Riparian corridors. • Gilgai landforms. • Remnant woodland. • Regrowth woodland. • Cleared areas.	• Dependent on location (see Table 4.3 for further details).	• Pembroke Environmental Manager. • Third party contractor with appropriate experience in grazing management.	• Increase in weed abundance Average increase in 20% of non-native cover from previous baseline surveys at the HQ monitoring sites. • Fuel loads exceed specified thresholds. • Evidence of livestock in exclusion areas.	• Alter timing and frequency of selective grazing. • Implement better exclusion mechanisms. • Alter weed management strategy to target problematic species and/or outbreaks. • Increase frequency of weed management events. • Assess weed control methods and change methods if required. • Review hygiene protocols to ensure they are effective in preventing vehicles and people spreading or introducing weeds across offset area.	• Ornamental Snake - grazing has potential to degrade wetland/gilgai areas through pugging and compaction of soil cracks. • Squatter Pigeon – the species does not inhabit areas with dense grass cover[9] and requires bare ground for foraging and bathing[10]
Fire management	• Educate employees and contractors on general fire awareness and response procedures. • Create and maintain fire tracks (fire breaks) for fire control. • Reduce fuel load (see biomass control above). • Hazard reduction burns. • Mosaic burning.	• Across offset areas.	• Key fire tracks to be created within 12 months of the biodiversity offset commencing. • Access tracks and fire breaks to be maintained at least every 12 months. • Fuel load management dependent on location (see Table 4.3 for further details). • Hazard reduction burns prior to the dry season (when necessary). • Controlled and mosaic burning when necessary.	• Pembroke Environmental Manager.	• Fuel loads exceed specified thresholds. • An unplanned bushfire occurs.	• Review effectiveness of fuel load management and monitoring techniques. • If controlled burning is implemented review effectiveness of that cool burn and monitor any changes post event.	• Ornamental Snake - inappropriate fire regimes can result in loss of coarse woody debris. • Australian Painted Snipe - altered fire regimes are identified as a threat to this species, with development of a fire management strategy a priority action[3,4,5] • Koala - fire can be a significant threat to the Koala, with significant loss of habitat during recent bushfires across eastern Australia. • Squatter Pigeon - inappropriate fire regimes are identified as a threat to this species[9] and may exacerbate other threats[10] • Greater Glider - too intense or frequent fires are identified as a severe threat to this species[11]
Pest fauna management	• Baseline feral animal surveys in Year 1. • Species specific management controls (see Table 4.4 for further detail). • Pest fauna to be targeted include; feral pigs, foxes, rabbits, wild dogs, feral cats and cane toads.	• Across offset area. Targeting areas where feral animals have been recorded during baseline surveys. • Wetland areas with food sources for Ornamental Snake, where possible.	• Species dependent (see Table 4.3 for further details).	• Third party contractor with appropriate experience and licences in pest fauna management.	• Observed increase in incidental sightings of feral animals. Increase in 10% of feral animal abundance from previous monitoring event. • Observation of any MNES species mortality from pest animals such as dog attack on Koala. • Evidence of pest animal degradation on MNES species habitats, such as feral pigs in gilgai.	• Increase frequency of pest control events. • Review and alter pest control methods. • Adopt pest control across a broader area if it is likely pest animals are breeding in adjacent areas. • Look to install pest fauna exclusion fencing in ecologically sensitive areas.	• Ornamental Snake - impacts to wetland habitat from feral pigs is considered a threat[2] along with predation or poisoning by feral species[1] • Australian Painted Snipe - predation by Foxes and feral Cats is identified as a key threat[4,5] • Koala - predation, particularly by Dogs, is identified as a threat[6] • Squatter Pigeon - overgrazing by feral herbivores such as the Rabbit, or predation by feral Cats and Foxes is identified as a threat[9,10]

Table 4.1 Management measures and corrective actions

Management measure	Management implementation	Location	Timing	Responsible party	Trigger for corrective action	Corrective actions	Species benefiting
Fencing	• Fencing to be maintained to allow grazing to be managed. • Fences with barbed wire to be replaced with top strands with no barbed wire.	• Existing fencelines to be maintained.	• Barbed wire to be removed within 6 months of the biodiversity offset commencing. • Fences to be maintained annually.	• Pembroke Environmental Manager.	• Evidence of damage to fences. • Livestock entering areas they should be excluded from. • Wildlife injury on any fences.	• Repair damaged fencing. • Change design of fence to minimise wildlife injuries. • Intall additional fencing to further restrict access by pest fauna, eg feral pigs in gilgai or rabbits in revegetation areas.	Ornamental Snake - ensure livestock are kept out of wetland/gilgai areas post rain events. Australian Painted Snipe - ensure livestock are kept out of wetland/gilgai areas post rain events. Greater Glider - barbed wire fences are identified as a minor threat to the species[11]

Notes:
1. DoE 2014b - Approved Conservation Advice for Denisonia maculata.
2. DAWE 2020c - *Denisonia maculata* Species Profile and Threats Database.
3. DSEWPC 2013 - Approved Conservation Advice for *Rostratula australis* (Australian painted snipe)
4. TSSC 2013 - Commonwealth Listing Advice on *Rostratula australis* (Australian Painted Snipe).
5. DAWE 2020d - *Rostratula australis* Species Profile and Threats Database
6. DSEWPC 2012c - Approved Conservation Advice for *Phascolarctos cinereus* (combined populations in Queensland, New South Wales and the Australian Capital Territory).
7. TSSC 2012 - Listing advice for *Phascolarctos cinereus* (Koala)
8. DAWE 2020a - *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT) Species Profile and Threats Database
9. TSSC 2015 - Conservation Advice *Geophaps scripta scripta* squatter pigeon (southern).
10. DAWE 2020b - *Geophaps scripta scripta* Species Profile and Threats Database.
11. TSSC 2016 - Conservation Advice *Petauroides volans* greater glider.

Further details of each management measure are provided below.

4.2.1 Regeneration works

Loss of habitat is identified as a key threatening process in the conservation and listing advice for all species to be managed within the Stage 1 offset area (Table 4.1). Regeneration works will provide long-term benefits for these species through improvements in existing habitat in remnant woodlands and expansion of habitat in regrowth woodlands and cleared agricultural grasslands.

The land within the Stage 1 Offset Area is considered to have moderate to high resilience despite the past disturbance, as evidenced by natural regrowth of native trees and understorey species occurring. Therefore, the primary method for regenerating non-remnant areas within the Stage 1 offset area will be through actively managing natural regeneration and reducing threatening processes that inhibit this process (e.g. weeds, feral animals, grazing livestock and soil condition).

Active revegetation (seeding/planting of tubestock) will be implemented along riparian corridors to improve habitat connectivity, with a primary focus on Koalas and Greater Glider. These revegetation areas are highlighted in Figures 3.6 and 3.10. It is presently proposed that approximately 120 ha will be revegetated across these riparian areas commencing in Year 3 and being completed by end of Year 6. Active revegetation works will largely focus on restoration areas (non-remnant) adjacent to riparian corridors where there is remnant or advanced regrowth to supplement these habitats, and some cleared creek banks may also be planted to reduce potential for erosion of creekbanks and improve connectivity between habitat patches.

The following actions will be considered when undertaking active revegetation:

- The ground-truthed REs (GTREs) identified near the revegetation areas include REs 11.3.25, 11.5.3, 11.5.9 and 11.3.2 (Figure 3.3). Revegetation will include dominant canopy species from these REs such as *Eucalyptus populnea, E. melanophloia, E. crebra*, *E. tereticornis,* other Eucalyptus species and Corymbia species to reflect the surrounding area.

- Preparation works will be undertaken including soil preparation, weed and biomass control. Preparation works likely to commence in Year 2.

- Revegetation may include direct seeding and/or tubestock plantings. Overstorey species will be planted which are consistent with applicable RE that would occur in that area, and which are key feed species for Koala and/or Greater Glider.

- Trees will be planted at a density consistent with the applicable RE benchmarks. This will be an average of 300 trees per hectare and will be protected with tree guards. Seeding will also be done at a rate where 300 canopy trees per hectare will be sought to be achieved.

- Supplementary watering will be undertaken during and after planting.

- All regeneration works will be undertaken by a qualified bush regenerator.

- The revegetation works will be implemented from Year 3 and be completed by end of Year 6. 30 ha will be revegetated each year due to the large areas required, and to ensure it occurs under the right seasonal conditions. By completing smaller areas per year, and commencing maintenance, this will increase success rate.

- Monitoring of revegetation works will commence immediately and continue for a minimum of 5 years post the area being seeded and/or planted. Any mortality (>5%) will be replaced on an annual basis to maintain tree density.

Active revegetation may be required where extensive weed management is undertaken (such as in area of extensive Buffel Grass control) to ensure other weed species do not establish. This will be determined during monitoring works. If required, active revegetation will be undertaken in accordance with the process outlined above, with additional planting of understorey and groundcover species endemic to the probable RE at a rate of 500 plants per hectare.

If required, active revegetation works surrounding wetlands may also be undertaken to provide benefits for the Australian Painted Snipe. This would include removal of key weed species (see Section 4.2.2) followed by supplementary planting of key wetland species.

Triggers for corrective actions include:

- evidence of tree mortality >5% of planted tubestock;
- evidence of disease in trees and saplings;
- evidence of weed species inhibiting native growth; and
- evidence of pest animal predation on native growth.

Corrective actions to be implemented where natural regeneration success is low will include:

- assessments of fencing structures to ensure there is no unauthorised access by stock or large numbers of native herbivores (ie eastern grey kangaroo) browsing on saplings;
- implement increased controls of pest flora and fauna species, increasing intensity of weed management where weeds are confirmed as key cause for lack of regeneration;
- increase watering regime if dry conditions are occurring and cause for some losses;
- assess soil health and suitability for successful regeneration; and
- dead trees to be replaced with tube stocks.

4.2.2 Weed control

Invasive weeds are identified as a key threat to the Ornamental Snake, Australian Painted Snipe and Squatter Pigeon. Weed invasion is likely to lead to loss of habitat for the Ornamental Snake (DAWE 2020c, DoE 2014b) and Squatter Pigeon (DAWE 2020b, TSSC 2015), with invasion by Buffel Grass identified as a key threat for these species. Invasion of weeds is likely to result in replacement of endemic wetland vegetation providing habitat for the Australian Painted Snipe (DAWE 2020d, TSSC 2013) with management of weeds identified as a priority action in the conservation advice (DSEWPC 2013).

Management of weeds will be a key management action to address ongoing loss and degradation of habitat for these species within the Stage 1 offset area.

Surveys identified five Weeds of National Significance (WONS) and six which are listed under Qld's *Biosecurity Act 2014* (BS Act) as Category 3 restricted invasive plants. Category 3 plants must not be given away, sold, or released into the environment. The BS Act requires everyone to take all reasonable and practical steps to minimise the risks associated with invasive plants under their control. Ten additional environmental weeds have been observed and are proposed to be actively managed due to their potential to degrade habitats and ecological condition of offset area.

Table 4.2 provides a summary of the weed species present in the in the Stage 1 Offset Area, the proposed control method and control period and intensity. For most species a minimum of one control event per year is required, and active management and monitoring under this OAMP will continue for the 20 years. For other species at least two control events will be undertaken due to follow up weed control being required. It is expected that primary weed control would be undertaken in years 1 to 5, with secondary control in years 6 to 10 and follow up control in years 11 to 20. Pembroke will continue to undertake weed control and maintenance of the offset post 20 years until the remainder of the approval.

Year 1 it is proposed a comprehensive baseline weed survey will be completed. This will confirm weed species present, and their distribution and percentage cover across the offset area. Large infestations will be mapped and permanent photo monitoring points established. Management outcomes for weed cover are prescribed in Table 6.3 for each 5-year interval as to the reduction in cover being sought across the offset. A more detailed weed management action plan will be prepared post the baseline survey being completed. The weed management action plan will be for a 12-month period with specific detail as to weeds to be targeted, control methods and timing. Weed management will be implemented by suitably qualified persons. Weed mapping will be a key part of this baseline survey and will form an appendix to the refined OAMP that will be conducted after the first year.

Triggers for corrective actions include:

- new areas of weed outbreaks are identified from the baseline surveys;
- weed abundance increases by average of 20% from previous baseline surveys across HQ monitoring sites; and
- new weed species are identified.

Corrective actions to be implemented for weed control will include:

- alter weed management strategy to target problematic species and/or outbreaks;
- increase frequency of weed management events, which may include greater focus on areas showing increase in weed outbreaks;
- review hygiene protocols to ensure weeds are not being introduced and/or spread by vehicles, people, etc; and
- change weed control methods and evaluate if they are more effective in managing the particular weed species.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Bellyache Bush *Jatropha gossypiifolia* QLD Biosecurity Act: Cat 3 National Status: WONS	Scatted small populations, mainly on water courses.	*General controls* Mechanical control: For small infestations mechanical control will be used. As bellyache bush is shallow rooted, grubbing the plant by hand is effective. Grazing management: Pasture management to maintain ground cover post treatment significantly reduces seedlings survival through competition. Fire: If deemed suitable fire may be used to control larger infestations. Fire wouldn't be suitable along watercourses, but more if there is a larger infestation in an open grassland or open woodland. This would only occur as part of an approved fuel reduction burn. *Chemical control* Many herbicides are currently or about to be registered for bellyache bush. Below are just two examples of registered chemicals. In native pastures, apply Mtsulfuron-methyl 600g/kg, at a rate of 10 g/100 L + penetrant. Thoroughly wet plants and apply when actively growing.	Annually. September to April* At least one control event per year. * As Bellyache bush flowers throughout the year when moisture is adequate control can also occur at these times. The proposed months are designed to maximise weed-control efficiency across the entire Stage 1 offset area.	No new weed infestations. Key focus is to reduce infestations along watercourses. Reduction in weed cover across offset area.	Dense infestations can occur on river flats and other areas of good loamy soil. It can take over these riparian areas reducing biodiversity values and prohibiting fauna use of the area. Fruits of bellyache bush are poisonous to humans and animals.
Brazilian Nightshade *Solanum seaforthianum* QLD Biosecurity Act: N/A National Status: N/A	Scattered throughout all areas.	*Chemical control* Cut and dab method followed by the Foliar spray method. Apply herbicide immediately to a stump that has been cut to within 15 cm of the ground. Cut-stump method. Spray herbicide to cover all leaves and stems, and ensure the area is not disturbed for 24 hours to allow herbicide uptake. *Mechanical control* For larger infestations mechanical control can be used including slashing. This will only be conducted where it won't impact on native vegetation communities.	Annually. September to April. At least one control event per year.	No new weed infestations. Reduction in weed cover across offset area.	Species is classified as an environmental weed as it can take over bushland and riparian areas. Fruit and leaves are toxic to humans.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Buffel Grass *Cenchrus ciliaris* QLD Biosecurity Act: N/A National Status: N/A	Dominates many clearings.	*Strategy* Buffel Grass is a pervasive species that is drought tolerant and grows quickly after summer rainfall. Buffel Grass has proved useful for pasture and soil retention in a wide range of environments due to its drought tolerance, high biomass, deep roots, rapid response to summer rains, relative palatability and resistance to overgrazing. However, it can outcompete native grasses and trees regenerating and increase fuel loads substantially therefore increasing risk of hot fires occurring. Therefore, the approach will be to target the reduction of Buffel Grass where it occurs in forested areas or where it is outcompeting regeneration of native grasses and trees. *Smaller outbreaks in forested areas* For small outbreaks physical removal or herbicide, or combined treatment will be undertaken. Follow-up treatment is essential. *Larger outbreaks in forested areas or regenerating areas* For mixed native-buffel pasture: manage grazing and fire to maintain diversity, eg allow native plants to recruit seedlings and set seed in good seasons. Don't graze these areas while native plants are seeding. For cleared/improved pasture: manage seed production and minimise spread into adjacent areas, remove seedlings from outside planted area. Prevent fires spreading from pastures. Apply herbicide after heavy rain to impact both mature plants and seedlings. Plants must be actively growing. Plants may be flowering but must not be seeding. Herbicide should be applied to as much of the green leaf as possible. This is best achieved through spot spraying. Repeated treatment is often required. Slashing of old foliage followed by spraying after effective rainfall can be very effective. It may be desirable to leave slashed material on the ground to protect the soil from erosive rainfall. Follow up with further spraying or grubbing of surviving plants and seedlings when actively growing. Slashing will only be done if native saplings are not impacted.	Two events per year. This is due to follow up treatment being required. Control most effective after summer rains when in growth phase.	Reduction in Buffel Grass extent in remnant bushland. Fuel loads are managed to specified levels to reduce risk of hot bushfires occurring.	Buffel Grass has spread well beyond planted areas and can dominate the ground layer in many native plant communities. It reduces native plant diversity and can affect vegetation structure by changing fire regimes. It has potential to outcompete regeneration of native grasses and trees and increase risk of hot bushfires.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Castor Oil Plant *Ricinus communis* QLD Bio Act: N/A National Status: N/A	Along watercourse and wetland areas. Scattered to dense infestations.	*Manual control* Individual plants or small infestations may be removed by cut stump and foliar spray. *Chemical controls* Fluroxypyr 333 g/L (eg Starane Advanced) applied at a rate of 30 mL/10 L water. This requires PVMA permit PER11463; the permit expires 30/06/2023. Method: Foliar spray (backpack). Read permit and label carefully. Fluroxypyr is suitable for native and exotic areas (DoAF 2020a).	Annually. September to April. At least one control event per year.	No new weed infestations. Key focus is to reduce infestations on watercourses. Reduction in weed cover across offset area.	It is regarded as an environmental weed due to its ability to dominate understorey of bushland areas. In particular along watercourses.
Green Panic *Megathyrsus maximus* QLD Biosecurity Act: N/A National Status: N/A	Dominates many clearings.	*Strategy* Green Panic (or Guinea Grass) is a pervasive grass species that that can dominate understorey in bushland areas and riparian vegetation. Therefore, the approach will be to target the reduction of green panic where it occurs in forested areas or where it is outcompeting regeneration of native grasses and trees. *Grazing* Grazing is an effective method to manage green panic as it is a palatable species. *Chemical controls* There are no products specifically registered for the control of guinea grass in Queensland. However, a permit held by the Department of Agriculture and Fisheries allows people generally to use some herbicide products to control guinea grass as an environmental weed in various situations. Understand permit PER11463 before using these herbicides. Use either: • Glyphosate 360 g/L at 360 g/L water (either foliar spray, or cut and dab); or • Fluazifop 212 g/L, at a rate of 2–4 L per ha. Spray young vegetative growth with 3–6 leaves per shoot when growing actively. Use up to 4 L per ha for well-established infestations or where greater control is required in one season.	Annually. September to April. At least one control event per year.	Reduction in Green Panic extent in remnant bushland and riparian vegetation.	Regarded as an environmental weed. It is common and widespread in bushland and riparian vegetation in the tropical, sub-tropical, warmer temperate and semi-arid regions of Australia.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Harrisia Cactus *Harrisia martini* QLD Biosecurity Act: Cat 3 National Status: N/A	Scattered, observed along fence lines.	Control of this plant is difficult as it has a deep underground tuberous root system and use of a combination of physical, biologic and herbicide controls is recommended. *Manual control* Dig out plants completely and burn. Ensure all tubers are removed and destroyed. Spot spray with registered herbicide. *Biological control* Biological control includes two introduced insects: • a stem-boring longicorn beetle (*Alcidion cereicola*); and • a mealybug (*Hypogeococcus festerianus*). Stem-boring beetle only attacks older woody stems. In Collinsville area, large beetle colonies developed and contributed to collapse of dense areas of cactus. Populations of *Alcidion cereicola* have declined with reduction in cactus in recent years. More successful biological control agent is mealybug *Hypogeococcus festerianus*, which is now present in most areas infested with harrisia cactus. Mealybug is considered more effective in more northern areas of central Queensland. *Herbicide* Triclopyr as tea 200 g/L + Picloram as tipa 100 g/L (eg Slasher) or Triclopyr as tea 200 g/L + Picloram as tipa 100 g/L + Aminopyralid 25 g/L (eg Tordon RegrowthMaster) (eg Tordon DSH®).	Annually. September–March (Herbicide). September–December (Biological).	No new weed infestations. Reduction in weed cover across offset area.	Highly invasive species. Produces large quantities of seed that is highly viable and easily spread by birds and other animals. Any broken-off portions of the plant will take root and grow.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Lantana *Lantana camara* QLD Biosecurity Act: Cat 3 National Status: WONS	Scattered throughout all areas, some dense infestations.	*Manual control* For single-stemmed lantana, basal bark spraying and cut-stump methods give good results at any time of year (but best when the plant is actively growing). For large Lantana infestations, treatment with herbicides by foliar spraying is usually not economically feasible. However, fire and slashing/cutting, can reduce dense infestations, making follow-up spot treatments with chemicals more economically viable. Lantana seed banks remain viable for at least four years, so follow-up control to kill seedlings before they mature is vital to ensure initial management efforts to control the parent bush are not wasted. *Herbicide control* On multi-stemmed varieties, best results by carefully applying herbicide to each stem. When treating actively growing plants less than 2-m tall, spray foliage overall to the point of run-off. Splatter gun techniques are effective and particularly useful in hard-to-access areas. This is best done in autumn, when sap-flows draw the poison down into the root stock, but before night temperatures get too cold.	Annually Manual removal any time of year. March–May for herbicide control.	No new weed infestations. Reduction in weed cover across offset area.	It forms dense thickets that smother and kill native vegetation and are impenetrable to animals, people and vehicles. Research indicates more than 1400 native species are negatively affected by lantana invasion, including many endangered and threatened species. As lantana is a woody shrub that has thin, combustible canes, its presence can also create hotter bushfires, altering native vegetation communities and pastures.
Mimosa Bush *Acacia farnesiana* QLD Bio Act: N/A National Status: N/A	Scattered individuals.	*Chemical controls* Basal bark spray: For stems up to 15 cm diameter, carefully spray completely around base of plant to a height of 30 cm above ground level. Thoroughly spray into all crevices. Larger trees may be controlled by spraying to a greater height, up to 100 cm above ground level. The best time for treatment is during autumn when plants are actively growing, and soil moisture is good. Cut and dab treatment: At any time of year, cut stems off horizontally as close to the ground as possible. Immediately (within 15 seconds) swab cut surface with herbicide mixture.	Annually March–May for basal bark spray treatment. Any time of year for cut and dab treatment.	No new weed infestations. Reduction in weed cover across offset area	Mimosa Bush is an environmental weed. Seeds sprout readily and plants grow rapidly. Mimosa bush does well in dry localities and on loamy or sandy soils, forming thickets along watercourses.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Noogoora Burr *Xanthium orientalis* QLD Bio Act: N/A National Status: N/A	Along watercourse and wetland areas. Scattered to dense infestations.	*Biological control* Some level of control has been achieved with biological control agents including stem-boring and stem-galling insects, and a rust fungus (Puccinia xanthii). This form of control has been more effective in tropical areas where temperatures and moisture conditions are favourable. *Mechanical control* Cultivation or hand pulling isolated plants is effective if performed before flowering or burr formation. *Chemical control* Few chemicals approved for use in native vegetation. Therefore, use chemical control as a last resort. Spraying with 2,4-D or MCPA before flowering will give favourable results. As plants mature, higher rates are necessary (DoAF 2020b).	Annually Any time of year for manual control. If chemical control to be done before flowering.	No new weed infestations. Key focus is to reduce infestations along watercourses and in wetlands.	Species is an environmental weed. It can be found along river and creek flats, on roadsides and in pasture land. Noogoora burr spreads by seed in burrs. Burrs are spread by attaching to animals, clothing and bags. Burrs can also float on water.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Parthenium *Parthenium hysterophorus* QLD Bio Act: Cat 3 National Status: WONS	Observed throughout all areas, some scattered patches and dense infestations	*Management through grazing* Grazing management is the most useful method of controlling large-scale parthenium infestations. Objective is to maintain high levels of grass crown cover, which will limit parthenium colonisation. *General controls* No manual method because of the health hazard from allergic reactions and the danger of mature seeds dropping and increasing the infestation area. *Chemical control* Spot spray with registered herbicide early before plants can set seed. Keep a close watch on treated areas for at least 2 years. Preferred method for smaller infestations. Treat small and/or isolated infestations immediately. Herbicide control will involve a knockdown herbicide to kill plants that are present and a residual herbicide to control future germinations. Repeated spraying may be required even within a single growing season to prevent further seed production. Extensive infestations will require herbicide treatment in conjunction with pasture management. Timing of spraying is critical so that parthenium is removed when plants are small and before seeding has occurred.	Two events per year. This is due to follow up treatment being required. Spray before seeding occurs.	No new weed infestations. Key focus is to reduce species cover in remnant woodlands. Reduction in weed cover across offset area. Groundcover maintained to reduce spread.	Parthenium can colonise brigalow, gidgee and softwood scrub soils. It will take over pastures with sparse ground cover. Parthenium is also a health problem as contact with the plant or the pollen can cause serious allergic reactions such as dermatitis and hay fever.
Phasey Bean, Siratro *Macroptilium lathyroides* QLD Bio Act: N/A National Status: N/A	Throughout all areas, dense infestations in some wetland areas.	*Manual control* Phasey Bean can be hand pulled, chipped or mowed. Removing the whole crown by grubbing is the most effective manual/mechanical control method. Tangled growth may need to be cleared using a brush cutter. Cannot tolerate grazing. Manual removal suited to small infestations. *Chemical control* Two herbicides are currently registered for the control of Phasey Bean in non-crop situations in Queensland: 2,4-D amin and Glufosinate. Glufosinate ammonium is non-selective and needs to be used with care. Use the foliar spray method. Use chemical control as a last resort (DoAF 2020c).	Annually. Manual control any time of year.	No new weed infestations. Reduction in weed cover across offset area. Key focus is to reduce infestations in wetland areas.	An environmental weed. Can dominate groundcover of open woodland and riparian areas.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Purple Top Grass *Chloris inflata* QLD Bio Act: N/A National Status: N/A	Dominates many clearings.	Otherwise known as Rhodes Grass. *Mechanical control* Slashing or mowing. This would only be appropriate where it is in large infestations in cleared areas where native vegetation won't be impacted. *Chemical control* Foliar spray with herbicide – water mixture.	Annually. Any time of year.	No new weed infestations. Reduction in weed cover across offset area.	Environmental weed. Aggressive invader of degraded land and coastal sites, spreading from roadsides and pastures into natural habitats, where it out-competes native species.
Red Natal Grass *Melinis repens* QLD Bio Act: N/A National Status: N/A	Dominates many clearings.	*Chemical control* Foliar spray with herbicide – water mixture, or Complete removal via weed lifting (should have their major root structures lifted out entirely to prevent re-shooting). All plant material should be hung up as leaving plants on the ground can lead to them re-shooting.	Annually.	No new weed infestations. Reduction in weed cover across offset area.	Environmental weed.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Rhodes Grass *Chloris gayana* QLD Bio Act: N/A National Status: N/A	Dominates many clearings.	*Chemical control* Foliar spray with Glyphosate – water (1L per 100 L of water) mixture. *Manual control* Complete removal via weed lifting (should have their major root structures lifted out entirely to prevent re-shooting). All plant material should be hung up as leaving plants on the ground can lead to them re-shooting.	Annually.	No new weed infestations. Reduction in weed cover across offset area.	Environmental weed. It was recently listed among the top 50 invasive plants in south-eastern Queensland, where it spreads from roadsides and pastures to invade native bushland and rainforest margins. Its tolerance of a wide range of conditions and its ability to rapidly reproduce, combined with its capacity to smother native ground cover species and form almost pure stands, has led to its developing reputation as an invasive species.

Table 4.2 Weed management

Species details	Presence on site	Control method (s)	Control period	Management outcomes	Threat to biodiversity
Rubber Vine *Cryptostegia grandiflora* QLD Bio Act: Cat 3 National Status: WONS	Likely scattered along water courses.	Effective control of rubber vine can be achieved by a number of methods, alone or in combination depending on the situation and the severity of infestation. All areas treated must be periodically checked and any regrowth treated or the initial treatment efforts will be wasted. Any isolated plants located should be treated promptly. *Chemical control* Basal bark treatment - For single stem plants, thoroughly spray around the base of the plant to a height of 20−100 cm above ground level, spraying higher on larger plants. Cut stump treatment - This is the most successful method, but also the most labour intensive. The following should be followed carefully: Cut stems off horizontally as close to ground as possible and immediately swab or spray cut surface and stem with herbicide mixture. *Mechanical control* Scattered or medium-density infestations: Where possible, repeated slashing close to ground level is recommended. Slashing will only occur where native vegetation won't be impacted.	Two events per year. This is due to follow up treatment being required. Optimal when plant is actively growing in summer months.	No new weed infestations. Reduction in weed cover across offset area. Key focus is to reduce infestations along watercourses.	Rubber Vine generally invades waterways first, where the seeds germinate in moist silt layers after rain. The plant smothers riparian vegetation and forms dense, sometimes impenetrable, thickets. Prevents movement of animals within riparian corridors.
Velvety Tree Pear *Opuntia tomentosa* QLD Bio Act: Cat 3 National Status: WONS	Scattered throughout all areas.	*Chemical control* Spot spray with registered herbicide. *Biological control* Includes eight insects and the mite in Queensland. These species are: • Stem-boring moths: Cactoblastis cactorum; • Cochineal scale insects: Dactylopius ceylonicus, D. opuntiae, D. confuses and D. austrinus; • Cell-sucking bugs: Chelinidea tabulate; • Stem-boring moths: Tucumania tapiacola; • Stem-boring beetles: Archlagocheirus funestus; • Prickly pear red spider mites: Tetranychus opuntiae; and • Catoblastis spp. and Dactylopius spp. provide the most success.	Annually September−April.	No new weed infestations. Reduction in weed cover across offset area.	Dense infestations compete with native vegetation, limiting the growth of small shrubs and groundcover species. The plant's sharp spines or barbs can cause injury to stock and native animals.

4.2.3 Weed and fuel/biomass load management through grazing, slashing and fire

Weeds and/or increased biomass are identified as key threats for the Australian Painted Snipe, Squatter Pigeon and Ornamental Snake, resulting in loss and degradation of habitat, loss of feed plants and loss of bare ground important to foraging (Squatter Pigeon). Undertaking weed and biomass control is a key action to be undertaken to provide benefits for these threatened species.

Weed and fuel/biomass load will be managed through a combination of the following:

- crash grazing which involves high stocking density in an area for short durations, and excluding stock from the area once grass cover and fuel loads reach the required level;
- slashing which involves mowing areas along boundaries or in areas where grazing is not practical; and/or
- where relevant, hazard reduction burns, including controlled burning, mechanical clearing and fuel load management, and cool burns, involving burning at cooler times of the day (see Section 4.2.4).

Land within the Stage 1 Offset Area is currently used predominately for cattle grazing, with small areas showing some evidence of opportunistic cropping. Quite large areas have been historically cleared through past agricultural practices (DPM Enviroscienses 2018); however, some tracts of remnant vegetation and significant advanced regrowth occur across the site.

Weed and fuel/biomass load management will differ between the types of habitat available across the Stage 1 Offset Area. Management strategies have been developed based on the following habitat types:

- 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;
- advanced regrowth woodland areas; and
- restoration habitat for threatened species – consisting of cleared agricultural grasslands which will be restored for future habitat and may include active seeding/supplementary plantings.

Table 4.3 outlines the weed and fuel/biomass load management strategies to be implemented across each of these habitat types, including background information to inform the strategy, what strategy will be undertaken and triggers for grazing.

Table 4.3 Weed and fuel/biomass load management strategies

Grazing management area	Background information	Management strategy	Trigger for control
Riparian areas along watercourses	Riparian areas are considered sensitive habitats. Trees, shrubs and grasses are all important for the stability, productivity and filtration capacity of riparian and wetland areas. The grass layer slows the flow of water, reducing erosion and increasing infiltration as well as filtering soil and nutrients from the run-off. Trees and shrubs along a stream and within wetlands help cycle nutrients, provide shade and habitat, reinforce the banks by holding soil together and also dry out the soil helping to prevent soils from becoming saturated and slumping. The riparian areas in the Stage 1 offset area support critical habitat for Greater Glider, Koalas and other fauna species as well as provide important connectivity corridors. The objective is to improve the habitat quality of these riparian areas which includes allowing regeneration of native grasses, shrubs and trees. Control methods need to consider the sensitivity of these environments. For example, livestock have the potential to cause stream bank erosion (particularly where there is a lack of vegetation) and stir up sediments and cause pugging within the waterway which can then, in turn, reduce water quality.	*Grazing is excluded* 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. As riparian environments are susceptible to erosion, control utilising fire would also be avoided. *Slashing* 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.	For biomass control: • 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. • Slashing to occur immediately prior to flowering and seeding period of key weed species to reduce seed set.
Gilgai landforms	Gilgai (otherwise referred to as melon holes) are known habitat for the threatened Ornamental Snake. These gilgai occur on deep cracking clay soils. In dry periods Ornamental Snake live down the soil cracks and are less susceptible to grazing impacts. However, after rain the clay soils swell, and gilgai fill up with water. When grazing occurs at this time, they can degrade the gilgai by compacting the ground and causing pugging, compromising soil structure. Habitat degradation through overgrazing by stock is identified as a threat to the Ornamental Snake (DoAWE 2020c).	*Grazing is excluded at certain times of year* 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. 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.	Following significant rainfall (>50 mm in 7 days), grazing will be excluded in these gilgai areas to ensure gilgai habitats are protected. Where grazing is permitted in these areas for biomass control refer to triggers set out below based on type of vegetation.

Table 4.3 Weed and fuel/biomass load management strategies

Grazing management area	Background information	Management strategy	Trigger for control
Remnant woodland	Remnant woodlands within the Stage 1 offset area provide significant high-quality habitat for threatened species across ten REs. These areas are generally in good condition. Weed cover ranges from minimal (5%) to high (90%). These areas provide existing, high quality habitat for all threatened species (dependent on predominant RE and/or overstorey species and/or groundcover). Grazing can provide a useful tool for managing weed loads and/or biomass in certain areas. Any grazing strategy will need to consider the underlying weed and biomass cover and species composition of these areas. Fire will be of limited utility for weed control, except where recommended for particular weed species. Fire may be an important measure for fuel load/biomass control.	*Grazing permitted to reduce biomass* 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. 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. Grazing should be excluded from any areas with low levels of weed cover (<50%) or low biomass (<70%). *Cool mosaic burns to reduce biomass* Fire will be implemented to control fuel load/biomass in line with recommendations in Section 4.2.4.	For weed control: • Restricted to areas with weed cover of >50% or areas with high threat weed (WONS or Bio Act listed). • 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. For biomass control: • 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: – 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 4.2.4.

Table 4.3 Weed and fuel/biomass load management strategies

Grazing management area	Background information	Management strategy	Trigger for control
Regrowth woodland	Regrowth woodlands occur across significant areas of the Stage 1 offset area. These areas are showing significant signs of natural regeneration of the overstorey, and support significant areas of native shrub layer with a moderate diversity of native ground cover/grasses. These areas currently provide suitable habitat for a number of threatened species, including the Ornamental Snake and Squatter Pigeon. They also provide existing and future potential habitat of the Koala and Greater Glider, subject to maturing of overstorey species. Grazing can provide a useful tool for managing weed loads and/or biomass in certain areas. However, regrowth areas are incredibly susceptible to impacts from grazing, with livestock capable of trampling young vegetation. Fire will be of limited utility for weed control, except where recommended for particular weed species. Fire may be an important measure for fuel load/biomass control.	*Grazing excluded from young saplings/planted tubestock* Areas of existing naturally regenerating native vegetation (ie naturally occurring areas of saplings or 'suckers') should be fenced off and grazing excluded. Grazing may not occur in these areas until the saplings are of a size to withstand grazing and browsing from stock (approximately 2−3 years). 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. 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. Grazing should be excluded from any areas with low levels of weed cover (<50%) or low biomass (<70%). *Cool mosaic burns to reduce biomass* Fire will be implemented to control fuel load/biomass in line with recommendations in Section 4.2.4.	Exclude all grazing in naturally regenerating areas until saplings are capable of withstanding impacts from livestock (approximately 2−3 years). For weed control: • Restricted to areas with weed cover of >50% or areas with high threat weed (WONS or Bio Act listed). • 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. For biomass control: • 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: – 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 4.2.4.

Table 4.3 Weed and fuel/biomass load management strategies

Grazing management area	Background information	Management strategy	Trigger for control
Restoration areas	Cleared agricultural grasslands are the predominant vegetation type across the Stage 1 offset area, representing 60% of the total area. These areas occur in various condition states, with some dominated by weeds (90% cover) while other shown a strong cover of native grasses. These areas have potential to provide significant areas of future potential habitat for all threatened species, subject to suitable management. Grazing will provide a key tool for managing weed loads and/or biomass in these areas to allow regeneration to occur. However, grazing will need to consider state of regeneration along with underlying weed and biomass cover and species composition of these areas. Fire will be of limited utility for weed control, except where recommended for particular weed species. Fire may be an important measure for fuel load/biomass control.	*Grazing permitted to reduce biomass* 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. 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. Grazing should be excluded from any areas with low levels of weed cover (<50%) or low biomass (<70%). Once evidence of natural regeneration is occurring, the grazing management strategy for regrowth woodlands outlined above should be applied. *Cool mosaic burns to reduce biomass* Fire will be implemented to control fuel load/biomass in line with recommendations in Section 4.2.4.	For weed control: • Restricted to areas with weed cover of >50% or areas with high threat weed (WONS or Bio Act listed). • 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. For biomass control: • 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: – 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 4.2.4. • Once regeneration is evident, exclude all grazing in naturally regenerating areas until saplings are capable of withstanding impacts from livestock (approximately 2-3 years).

Table 4.3 outlines strategies for management of weed and fuel/biomass load that are reliant on triggers related to weed and biomass cover. For example, the trigger point to implement biomass control will be when biomass exceeds 70% ground cover (ie less than 30% bare ground). The trigger point will be measured using the following quadrat sampling method for ground cover and herbage mass (Lang & McDonald 2005) by the grazier/appointed biodiversity auditor:

- Using a wooden or metal square (quadrat) of at least 0.5 m x 0.5 m internal dimensions, undertake the following steps.
- Walk at random path within each area to be assessed and throw the quadrat a short distance.
- For each throw look only at the area within the quadrat and assess and record the following:
    A. the percentage of total cover (living and dead);
    B. the percentage cover of live native plants;
    C. the percentage cover of live non-native plants; and
    D. measure height of pasture cover using Meat and Livestock Australia Pasture Ruler to estimate herbage mass.
- Take at least 10 random samples for each assessment area (the number of samples will be increased by 1 for each additional 5 ha for areas greater than 50 ha).
- Calculate the percentage of the assessment area covered by vegetation (living or dead): Sum of A / Number of samples.
- Calculate the percentage of the living vegetation that is live native ground coved by: (Sum of B x 100) / (Sum of B + Sum of C).
- Calculate average mass by: Sum of D / Number of samples.

This quadrat data will be provided for the commencement, and at the completion of grazing in the annual reports along with the following information:

- livestock movement including dates of entry and removal from the grazing area;
- a map of the grazed offset area;
- number of livestock, type and condition;
- quantity of supplement (if any);
- any livestock health or other management issues; and
- daily rainfall data.

Quadrat sampling method should occur monthly to determine trigger levels, and then once a week when grazing is occurring.

Triggers for corrective actions include:

- weed abundance increases;
- fuel loads exceed the specified thresholds; and
- evidence that livestock have entered exclusion areas.

Corrective actions to be implemented for biomass management will include:

- assessing the management strategy and alter timing and frequency of selective grazing;
- create smaller paddock areas to manage stocking levels better;
- exclude grazing from additional areas; and
- evaluate effectiveness of fencing and alter fence design.

4.2.4 Fire management

Management of bushfire regimes in the Stage 1 offset area (and surrounds on adjacent land owned by Pembroke) would reduce the likelihood of threatened species mortality because of uncontrolled bushfire and prevent hot bushfires as they are a threat to foraging and breeding habitat. Fire management will also be used as a method to control biomass of native and invasive species, and may be used as a part of an integrated management approach for key weed species (eg Buffel Grass).

Bushfire preventative measures would include:

- Educating employees and contractors on general fire awareness and response procedures.
- Creation and maintenance of fire tracks (fire breaks) for fire control.
- Ground fuel loads will be monitored and, where required, reduced through crash grazing to prevent thick grass biomass from accumulating over time (see Section 4.2.3). Reducing the fuel load will minimise the impact of uncontrolled fires (eg from lightning strike).
- When necessary, fuel management (eg hazard reduction burns prior to the dry season) will be undertaken in consultation with the Qld Rural Fire Service.
- Local fire wardens will be consulted, and fire permits will be obtained prior to hazard reduction burns.
- Mosaic burning for certain species at appropriate intervals to promote regeneration and germination of native vegetation communities and species may be undertaken.

The creation of key fire tracks will occur in the first 12 months of the biodiversity offset commencing and will be maintained each year thereafter. Other essential fire tracks may be added in following years if required. Hazard reduction burns prior to the dry season will be undertaken in those years where deemed necessary and conditions are appropriate.

Pembroke will undertake visual inspections of fire tracks and will ensure they are maintained. Pembroke will visually inspect and monitor ground fuel loads, will liaise on potential strategic rotational grazing and will reassess fuel loads after such grazing has occurred. The overall objective is to prevent uncontrolled fires, in particular hot fires, occurring.

Triggers for corrective actions include:

- fuel loads exceed specified thresholds; and
- an unplanned bushfire occurs.

Corrective actions to be implemented for fire management will include:

- review effectiveness of fuel load management and monitoring techniques. Thresholds may need to be reduced if fuel loads get too high; and
- if controlled burning is implemented review effectiveness of that cool burn and monitor any changes post event. Ensure any learnings are adopted for next round.

4.2.5 Pest fauna management

Pest animal species represent key threats to a number of threatened species to be managed within the Stage 1 offset area. Feral pigs result in degradation of gilgai habitat for the Ornamental Snake (DAWE 2020c), while feral herbivores such as the Rabbit result in degradation of habitat for the Squatter Pigeon (TSSC 2015). Predation by species such as Foxes, feral Cats and wild Dogs is considered a key threat to the Ornamental Snake (DoE 2014b), Australian Painted Snipe (TSSC 2013, DAWE 2020d), Koala (DSEWPC 2012b) and Squatter Pigeon (TSSC 2015, DAWE 2020b).

Feral Cats, Foxes, Wild Dogs, Rabbits and Pigs are the main pest vertebrate species found on the Stage 1 offset area that have the potential to damage or destroy native flora and fauna or their habitat. This damage is usually transient and isolated rather than widespread. Cane toads have been identified in the offset areas and are potential threat to Ornamental Snake. Effective management of Cane toads is challenging and not always cost effective. In Queensland the control of cane toads is not enforced as there is currently no available effective broad scale control (DAF 2020). Control methods proposed to be trialled for Cane toads will be the removal of eggs from water bodies such as dams and creeks. They lay eggs in slow-moving or still water and their eggs are easily distinguished as long, gelatinous strings often attached to water plants or debris (DAF 2020). Waterbodies that may harbour Cane toad breeding will be identified during Year 1 baseline surveys. These waterbodies will then be surveyed quarterly and if eggs are observed will be removed.

The complete eradiation of fauna pest species within the Stage 1 Offset Area is considered unfeasible, due to the cost of erecting and maintaining a pest-proof fence around the entire area or significant effort could be expended to eradicate pests in the offset, but they are likely to re-enter from adjoining properties. Therefore, the objective will be to reduce pest fauna populations which will in turn reduce threats on MNES species and their habitats.

Control of pest fauna within the Stage 1 Offset Area will be undertaken via several methods that are:

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

Triggers for corrective actions include:

- an observed increase in incidental sightings of feral animals;

- greater than 10% increase in a pest animals abundance from previous baseline survey. Baseline surveys will be completed for Feral pigs, Wild dogs, Feral cats, Rabbits and Foxes;
- observations of any MNES species mortality from pest animals such as dog attack on Koala; and
- evidence of pest animal degradation on MNES species habitats, including through Habitat Quality scoring.

Corrective actions to be implemented for pest fauna management will include:

- increase frequency of pest control events;
- change pest control methods where possible and in consultation with experienced professionals;
- look to adopt pest control across a broader area if it is likely pest animals are breeding in adjacent areas; and
- look to install pest fauna exclusion fencing in ecologically sensitive areas (eg gilgais if feral pigs are causing significant damage).

Pest fauna specific control methods, timing, monitoring and corrective actions are outlined in Table 4.4. All pest fauna management would be undertaken by suitably qualified and experienced contractors.

Table 4.4 Pest fauna management

Pest species	Control method	Frequency and timing
Feral Cats	The control of feral cat numbers within the Stage 1 offset area will be achieved though several methods, including: • Trapping - cage traps , focusing on territorial markers. Attractants, such as Tuna oil, may be used to attract feral Cats. • Shooting - night shooting programs over the Stage 1 offset area. • Baiting - Curiosity® and more recently the History bait uses an acid-soluble encapsulated pellet known as the 'hard shell delivery vehicle' (HSDV) (Johnston et al. 2011). Baiting would be undertaken throughout the Stage 1 offset area in conjunction with other programs as a part of an integrated control program. May not be as effective if there is a lot of prey around. All feral cat control will comply with the *Code of practice for the humane control of feral cats* (Sharp & Saunders 2010). Feral Cat control will be undertaken across all habitat types within the Stage 1 offset area.	Feral Cat control will be undertaken on an annual basis in late autumn, prior to breeding occurring. Control using shooting will be undertaken over a minimum of five days and nights. Baiting will be undertaken for a month, with baits laid out and collected to determine take.
Wild Dogs	The control of wild Dog numbers within the Stage 1 offset area will be achieved though several methods, including: • Trapping - rubber-jawed leg-hold trapping will be undertaken in conjunction with other programs as a part of an integrated control program. • Shooting - day-time and night-time shooting will be used for opportunistic control where appropriate. • Poisoning – 1080 targeted baiting programs will be undertaken throughout the Stage 1 offset area as the primary method for control of wild Dogs. Wild Dog control will be undertaken across all habitat types within the Stage 1 offset area.	Wild Dog control will be undertaken on an annual basis in late autumn, prior to breeding occurring. Control using trapping or shooting will be undertaken over a minimum of five days and nights. Baiting with 1080 will be undertaken for a month, with baits laid out and collected to determine take.
Foxes	The control of Fox numbers within the Stage 1 offset area will be achieved though several methods, including: • Trapping - rubber-jawed leg-hold trapping and/or snare trapping will be undertaken in conjunction with other programs as a part of an integrated control program. • Shooting - day-time and night-time shooting will be used for opportunistic control where appropriate. • Poisoning – 1080 targeted baiting programs will be undertaken throughout the Stage 1 offset area as the primary method for control of Foxes. Fox control will be undertaken across all habitat types within the Stage 1 offset area.	Fox control will be undertaken on an annual basis in late autumn, immediately prior to breeding occurring. Control using trapping or shooting will be undertaken over a minimum of five days and nights. Baiting with 1080 will be undertaken for a month, with baits laid out and collected to determine take.

Table 4.4 Pest fauna management

Pest species	Control method	Frequency and timing
Feral Pigs	The control of feral Pig numbers within the Stage 1 offset area will be achieved though several methods, including: • Poisoning - 1080 targeted baiting programs will be undertaken throughout the Stage 1 offset area as the primary control method. Pre-feeding is an important step in success of this control measure. To maximise effectiveness, feral Pigs must be free fed with non-poisoned bait for several days before laying poisoned baits. Pig-specific feeding stations (eg Hoghopper) will help reduce access to bait by non-target species. • Shooting - day-time and night-time shooting will be used for opportunistic control where appropriate, eg isolated males, in conjunction with other programs. Feral Pig control will be undertaken across the Stage 1 offset area with a focus on wetland areas and gilgai habitats where feral Pigs are most likely to be active.	Feral Pig control will be undertaken on an annual basis in conjunction with other control programs. Pre-feeding before annual baiting efforts will be carried out by the land holder/Pembroke for a minimum of three days prior. Control via shooting will be opportunistic and done in conjunction with other control programs.
Rabbits	An integrated control approach, combining different control methods with land management practices will be undertaken for Rabbits. Control methods to be implemented include: • Harbour destruction - where there is abundant surface harbour, high proportion of rabbits may live above ground rather than in underground warrens. Rabbits can make homes in windrows, dense shrubs (eg blackberries, lantana) and old machinery. To eliminate above-ground breeding areas any windrows, large weedy shrubs and foreign objects such as machinery will be removed from the Stage 1 offset area. • Warren ripping - as many rabbits as possible should be chased inside warren by Dogs before ripping starts. A tractor should be used with tyned (sharp-pronged) implement, one tyne or many, that rips through warren and collapses it. All warrens within 1km of permanent water should be ripped. • Poisoning - targeted baiting programs using 1080 or Pindone will be undertaken throughout the Stage 1 offset area. Pre-feeding can increase bait uptake and prove more effective and will be undertaken at least three times over a one-week period prior to baiting. • Trapping – trapping undertaken via cage and barrel traps can be labour intensive but may be used to ‘mop up’ after other control methods have been enforced. • Shooting - day-time and night-time shooting will be used to ‘mop up’ after other control methods have been enforced.	Harbour destruction will be undertaken in the first year of the implementation of this OAMP and largely as a one-off program. Warren ripping will be undertaken by the land holder and/or Pembroke on an as needs basis when warrens are identified. Trapping and shooting will be undertaken opportunistically to mop up following harbour destruction and/or warren ripping. Poisoning will be undertaken on an annual basis in conjunction with other control programs. Poisoning should occur when green pick is low to ensure uptake and when Rabbits are not breeding.

Table 4.4 Pest fauna management

Pest species	Control method	Frequency and timing
Cane Toads	Although not a direct predator of the Ornamental Snake, Cane Toads are likely to present a threat by poisoning. Cane toad eggs will be removed from waterbodies likely to support their breeding such as creeks with slow moving water and dams. Eggs will be removed with a suitably designed net. Use of Cane Toad tadpole traps will also be trialled. These traps have been developed by the University of Queensland and are being used by a number of entities in Queensland (such as Seqwater and catchment groups) to remove Cane Toad tadpoles from streams with high cane toad activity. The trap uses a natural toad pheromone to lure toad tadpoles into the trap. Trials have shown in some instances that traps have become filled with hundreds of toad tadpoles. https://www.seqwater.com.au/news/cane-toads-own-toxins-being-used-fight-back-against-pest Field studies have shown the baits are very effective in attracting Cane Toad tadpoles whilst not impacting on native frog tadpoles. Targeting the tadpoles is a far more efficient and effective means of eradicating Cane Toads on a local scale, as many thousands of tadpoles can be removed from a water body within a 24-48 hour period, as opposed to several dozen adult toads in an evening http://www.qldfrogs.asn.au/cane-toad-challenge/. Up to 20 Cane Toad traps will be installed in suitable waterbodies in the Stage 1 Offset Area where Cane Toad eggs are noted as prevalent. These will be different sites to those where eggs are being netted.	Egg removal and installation of cane toad traps will be undertaken quarterly for the first 5 years. A review of the effectiveness and any associated reduction in cane toad numbers will then be undertaken to determine control methods going forward.

4.2.6 Nest box research program (Greater Glider)

The offset areas for Greater Glider which are classified as 'habitat restoration areas' it is recognised will not result in the creation of additional trees with natural forming hollows within a 20-year timeframe. Hollow formation is dependent on a tree's history, its species and location. Generally, small hollows with narrow entrances suitable for small animals such as the brush-tailed phascogale (*Phascogale tapoatafa*) and the eastern pygmy-possum (*Cercartetus nanus*), take about 100 years to form. Hollows of a medium size and suitable for animals such as parrots will take around 200 years to form, and the larger and deeper hollows occupied by glossy black cockatoos (*Calyptorhynchus lathami*) and other larger animals such as Australian masked owls (*Tyto novaehollandiae*) can take a longer (NPWS 1999).

The advanced regrowth and restoration areas in Stage 1 Offset Area would be on a trajectory towards creating hollows in the future as the offset land will be secured in perpetuity and continue to mature beyond 20 years of this OAMP and life of Project management. In recognition of this, a supplementary nest box program is proposed that will supplement denning and breeding habitat for the Greater Glider as hollows are forming and research will be undertaken to evaluate the success of these nest boxes for the species. It will take approximately five to eight years for tree plantings within the 'restoration areas' to reach a size to support Greater Glider nest boxes and to provide potential breeding habitat. Therefore, in the first five years some supplementary nest boxes will be installed into existing remnant and regrowth habitat that is low in suitable sized hollows.

Measures to offset the loss of hollow- bearing trees due to development are largely focused on installing nest boxes, with successful delivery based on the number of boxes installed rather than the number of threatened species that use and successfully breed in them. To date, little research has examined the effectiveness of nest boxes as an offset conservation tool (Threatened Species Recovery Hub 2018). A case study is the Qld Glider Network (QGN) installed 18 nest boxes in a bushland reserve north of Brisbane in December 2017 to learn more about Greater Glider nest box use. The project design included two nest boxes per tree (5 m and 10 m installation heights) on nine trees, including regular monitoring. Greater Gliders were observed in nest boxes installed at 10 m; no evidence of occupation by any glider species has been observed in nest boxes at 5 m. Consultation is proposed to occur with QGN to gain information on their nest box design and monitoring program during further development of this program.

Pembroke propose to implement a nest box research programme, for the 26.5 ha of 'woodland regrowth' and 1,721.2 ha of 'remnant Eucalypt woodland' in the first five years, and 3,737.69 ha of 'habitat restoration areas' post six years, once the revegetation and naturally regenerating canopy trees arelarge enough to support nest boxes.

This research programme will include the installation and monitoring of up to six nest boxes within the 'woodland regrowth' offset areas (one nest box across one Greater Glider home range (approximately 4 ha home range per individual (Conservation advice (TSSC 2016)). Up to 50 nest boxes will be installed into 'remnant woodland' where existing hollows are low and priority given to areas adjacent to proposed revegetation areas to support encouraging gliders into these areas. An estimated 250 nest boxes will be trialled across the 3,737.69 ha of 'habitat restoration areas' with nest box installation staggered over 20 years; 20 being installed by Year 10, another 100 by Year 15 and another 130 by Year 20. The nest boxes will be installed under the direction of a suitably qualified person. There is also possibility to trial using the naturally formed hollows from the impact site to be placed into the offset site as part of this research and monitoring program. Adaptive management is proposed and results of monitoring of nest boxes will inform how future phases will be implemented and any changes that may be required.

The Brisbane City Council Conservation Action Statement: Gliders September 2010 (Brisbane City Council 2010) provides suggested dimension for purpose built Greater Glider-specific nest boxes which Pembroke could use as a guide for the design of suitable nest boxes (Table 4.5). Pembroke will also investigate new materials being used to build nest boxes including CYPLAS boxes made from 100% recycled high density polyethylene (HDPE) that have an estimated 30+ year lifespan and termite and rot proof (Hollow Log Homes 2015).

Table 4.5 Greater Glider nest box dimensions (Brisbane City Council 2010)

Species	Inside Measurement (mm)	Depth of box from bottom of entrance hole (mm)	Entrance diameter (mm)
Greater Glider	250 x 250	400	80 Jagged spout entrance

The location in which the nest box will be installed will take into account the following factors:

- the tree on which it is being installed (ie healthy living trees with existing hollows and some without existing hollows);
- the existing tree hollow density of the surrounding area in which they will be installed (ie with a preference for a location with low tree hollow density);
- to provide shelter from rain and, if possible, excessive sun; and
- camouflage from potential predators.

The recommended attachment method for nest boxes is the Habisure system (Frank and Franks 2006) which allows for at least one metre growth in the diameter 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. This is a recommendation of NSW Roads and Maritime who have extensive experience in nest box installation.

In Year 1 a survey will be completed to confirm the location for nest boxes, have the nest boxes produced and/or obtain naturally formed hollows from trees on the impact site, and confirm their installation process. The installation of nest boxes should then commence in Year 2 within the 'remnant woodlands' and 'regrowth woodlands'. The placement of the nest boxes within the 'habitat restoration areas' will require at least five years of growth of planted or regenerating canopy trees to ensure these trees are large enough to support nest boxes and to provide potential foraging habitat for the Greater Glider. Therefore nest box installation in 'habitat restoration areas' will be monitored and is anticipated from Year 8.

Monitoring (by Appropriately Qualified Person(s)) will include quarterly inspections during the first year which will enable occupation timing to be documented. Following the first year, monitoring will occur annually in spring and winter for the next two years, and may then be reduced to biennial monitoring following a review of the monitoring results.

Regular maintenance of the nest boxes will be completed. Regular inspection of the condition of the box and presence of pest animals is essential. Nest box materials can deteriorate over time, and parts such as lids may become damaged. Maintenance may be needed to keep nest boxes in a usable condition. The security of attachment of the nest box should also be checked regularly. Pests, such as Common Myna and feral bee, may need to be controlled if they occupy the nest box. It is recommended that such inspections take place from the outside to avoid disturbing animals that are using the box.

By collecting good quality nest box data we can determine:

- whether the target species is using the box over time, including for breeding;
- occupancy rates, frequency of use, proportion of use by different species, pattern and timing of use;
- whether boxes are only supporting common species or are also used by target threatened species;
- use of the nest boxes by pests (e.g. European honeybees, Common Myna); and

- suitability of designs, and maintenance needs and cost.

In order to facilitate monitoring of nest boxes all nest boxes should be assigned a unique identification code referencing the nest box zone and number. Aluminium identification tags with the nest box code are to be placed at eye level on the recipient tree. At the time of installation the ecologist is to record the following information:

a) Identification number;

b) Nest box type;

c) GPS location;

d) Tree species;

e) DBH of host tree;

f) Nest box height; and

g) Orientation.

All the above help to inform how effective nest boxes are at contributing to the conservation of a species.

Corrective actions to be implemented for the supplementary nest box program will include:

- increased maintenance of nest box structures if monitoring is finding they are being used by pest species;
- alter design, height and location of nest boxes if monitoring is showing a low success rate of occupancy; and
- increase frequency of monitoring in case Greater Gliders are only using nest boxes at certain months of the year.

4.2.7 Other general management measures

i Fencing design

Fencing is an integral part of land management. Fences delineate legal boundaries and control access, restrict stock movements, and often provide access routes for land managers with tracks along fencelines. 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). Many species fail to see the fence or cannot clear the height under windy conditions. Most of those rescued are too severely damaged to return to the wild. Most entanglements occur on the top one or two strands of a barbed wire fence.

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 can 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. Remember to keep the hot wire 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.

ii Track establishment and maintenance

A number of access tracks, to enable management fire control, will be established as a part of the Stage 1 offset areas. Largely, these management tracks will use the existing track network. Annual maintenance of access tracks will be undertaken, including grading and erosion control measures, using graders and road base materials where required. Access tracks/fire breaks will be no wider than 3 metres in width.

iii Pathogen management

Two noteworthy and potential pathogens include *Phytophthora cinnamomi* and Myrtle rust (*Austropuccinia psidii*) both of which are classified as Key Threatening Processes (KTP) under the EPBC Act. The former is a soil fungus that attacks the root (and sometimes stem) systems of plants, destroying the ability of the plant to uptake water and nutrients (DoEE 2018). The latter is also a fungus however, it primarily attacks foliage of plants, namely those within the Myrtaceae family.

Both pathogens can severely reduce plant health and cause heavy defoliation, limited reproduction, deformed growth, dieback and plant mortality. Currently, no evidence of *P. cinnamomi* or Myrtle rust has been recorded on site. Therefore, specific management measures are not required. However, preventative measures such as requiring vehicle wash downs prior to entering the Stage 1 Offset Area will limit the risk of pathogens spreading onto site.

If any areas are reasonably suspected to be infected with pathogens over the life of the offset (for example, areas of unexplained vegetation death), a targeted sampling, diagnosis and management strategy will be designed to address impacts and limit further spread.

iv Erosion management

Erosion within the site is limited to the edges of waterways, such as creeks and dams.

Erosion will be further limited through fencing stock out, maintaining and enhancing existing riparian vegetation and groundcover, and managing pigs. Where those controls are not adequate to maintain or improve erosion, appropriate erosion-control measures will be implemented, such as sandbags and planting riparian vegetation along watercourses.

4.2.8 Prohibited activities

The following activities are not permitted to occur under this OAMP unless express written permission is received from Pembroke and DAWE:

- No clearing of native woody vegetation is permitted within the offset area unless it is required for maintaining 3 m wide fencelines and fire breaks. Clearing of large trees will be avoided to greatest extent possible.

- No clearing of hollow-bearing trees will be permitted.

- Existing or future habitat mapped within the offset known important habitat, connecting habitat or adjacent patches of suitable habitat would not be cleared, unless essential for management purposes (eg fire breaks).
- The following practices will be prohibited in the Stage 1 offset area:

    a) ploughing;

    b) fertiliser application;

    c) aerial application of pesticide from planes or helicopters;

    d) continuous grazing;

    e) use of livestock feed;

    f) littering or dumping foreign waste;

    g) removal of firewood, native plants or animals;

    h) removal of rocks, sand or gravel;

    i) logging;

    j) hunting;

    k) trapping or shooting (unless approved under this OAMP for controlling pest animals); and

    l) keeping of European beehives and domestic cats and/or dogs.

4.2.9 Securing the offset areas through a legally binding mechanism

The Stage 1 Offset Area is required to be legally secured in perpetuity.

Pembroke, who currently own the proposed offsets, recommend the Stage 1 Offset Area will initially be legally secured through a Voluntary Declaration under the *Vegetation Management Act 1999* (VM Act) within 12 months of the OAMP being approved by Commonwealth DAWE. This is consistent with conditions of approval. This will protect the vegetation on the title, and require land management is undertaken in accordance with the OAMP. This is legally binding on current and future landowners.

Pembroke then propose to commence discussions with Queensland DES regarding protecting the Stage 1 Offset Area, and possibly future biodiversity offset stages for Olive Downs, under a Nature Refuge Agreement under *Nature Conservation Act 1992* (NC Act). The Nature Refuges Program is the Queensland Government's primary voluntary conservation covenanting program. Key aspects of the program are:

- each nature refuge is negotiated directly with the landholder through a nature refuge agreement;
- it can apply to a whole property or a portion of the property, depending on the conservation values and the landholder's wishes;
- perpetual, registrable on title and binds successive owners or lessees of the land. A nature refuge is the best way landholders can ensure the good land management practices and conservation works they have initiated will be continued when future generations or new owners take over. So, if a property changes hands, responsibility for the nature refuge rests with the new owners or lessees;

- when a landholder signs a nature refuge agreement they are supported by nature refuge officers located in key locations across the state. These officers support landholders through one-on-one specialist advice on how to best protect the conservation values on their nature refuge; and
- a nature refuge is a Category C Environmentally Sensitive Area under *Environmental Protection Act 1992* and a Matter of State Environmental Significance (MSES) which provides greater protection to the offset.

Nature refuge declarations can take over 12 months to finalise hence the reason to use a Voluntary Declaration to initially secure the offset.

4.3 Threatened fauna management objectives

The management measures outlined above have been informed by key threats, recovery actions and management priorities from each species listing advice, conservation advice, recovery plan and threat abatement plan. Table 4.6 provides a summary of how the proposed management measures address key threats and will provide a positive conservation outcome for these MNES species.

It demonstrates how the proposed Stage 1 Offset Area will compensate for the clearance of listed threatened species habitat at the Olive Downs Coking Coal project.

Table 4.6 Summary of threatened fauna management objectives

Key threats	Management outcome	Management action/s to address key threats
Koala		
Habitat loss, fragmentation and/or degradation	• Overall improvement in Koala habitat quality. • Increase in Koala habitat extent through natural regeneration and active revegetation. • Increased Koala habitat connectivity in riparian areas including through revegetation.	Habitat loss is identified as a key threat to the Koala, particularly in the Brigalow Belt Bioregion due to historical land clearing (DSEWPC 2012b, TSSC 2012, DAWE 2020a). A total of 4,790 ha of existing and future Koala habitat will be protected and managed within the Stage 1 offset area. Existing grazing practices will be reduced and managed across the site, allowing natural regeneration to occur across the site, with some active revegetation in riparian areas. Active revegetation is detailed in Section 4.2.1. Weed control works and weed and fuel/biomass control will be implemented across the 1,720.6 ha of remnant woodland, resulting in a net improvement in condition through reduction of weeds and control of biomass and ongoing growth and recruitment of Koala feed trees and resting trees. Weed control works and weed and fuel/biomass control will be implemented across the 1,447.5 ha of regrowth woodland, resulting in continued regeneration of these areas and a net increase in availability of Koala habitat. In other regions of Australia (eg Gunnedah in NSW) revegetation work resulted in regional population increases against an overall decline in population numbers across Australia (Lunney et al. 2009). Weed control works, weed and fuel/biomass control and, if required, active revegetation will be implemented across the 1,621.9 ha of potential future habitat resulting in regeneration of these areas and a net increase in availability of Koala habitat. As outlined above, these works have the capacity to result in population increases at a local and regional scale. Koala habitat connectivity in riparian areas will be improved by increasing the height and cover of remnant vegetation and regrowth vegetation along riparian corridors. Up to 120 ha will be revegetated by end of Year 6 to enhance Koala movement through riparian zones. Non-remnant areas will then start to develop in their regrowth vegetation making these riparian corridors larger and providing improved foraging resources for the species. These measures, combined, address a key threat of habitat loss and will have a positive impact on the local and regional population of the Koala.

Table 4.6 Summary of threatened fauna management objectives

Key threats	Management outcome	Management action/s to address key threats
Predation by wild Dogs	• Reduced likelihood of predation by wild Dogs.	Predation, particularly by Dogs, is identified as a threat to the Koala and may lead to localised declines (DSEWPC 2012b, TSSC 2012, DAWE 2020a). Whilst much of the available data is from urban and peri-urban environments Dogs will prey on Koalas in rural and regional settings and may lead to significant local declines, particularly when coupled with other impacts. Predator control works, focusing on Dogs, Cats and Foxes, will be undertaken across the Stage 1 offset area using a variety of methods (Table 4.4). Predator control works will be undertaken on an annual basis across the Stage 1 offset area. Reductions in predator numbers, particularly wild Dogs, will reduce overall population pressure, providing positive benefits for the local Koala population.
Climate change and drought	• Enhancing drought-resistant habitat. • Create water stations for fauna.	Drought and incidences of extreme heat are identified as a threat to the Koala and may cause significant mortality in the populations (TSSC 2012). Seabrook et al. (2012) identified that drought significantly reduced populations in south-east Queensland and Koalas contracted to critical riparian habitats. The offset area will enhance drought-resistance and connectivity known to drought refugia, such as riparian woodlands, to increase the resilience of koala populations across the area. Water stations will also be placed in the offset area as water supplementation has found to be critical to the species during periods of drought (Mella et al. 2019).
Mortality and injury from wildfires	• Reduce frequency and intensity of fires within Koala habitat. • Increased survival of extreme fire events.	Climate change and resultant increased risk of fire is identified as an increasing threat to the Koala, resulting in mortality and range reductions (TSSC 2012). The recent 2019/2020 bushfire season have resulted in significant losses of Koala habitat and the Koala is identified as needing urgent, emergency action to address an increased risk of extinction. This event demonstrates that capacity of increased fire risk to impact this species. Weed and fuel/biomass control will be undertaken across the Stage 1 offset area to reduce fuel loads and risk of high intensity to catastrophic fires. Further, these measures are designed to ensure they do not have negative impact on other habitat features such as regeneration. Hazard reduction burns will be undertaken in consultation with the Qld Rural Fire Service to further reduce this risk. These measures will provide an increased level of protection for the Koala within the Stage 1 offset area, reducing the risk of both mortality and habitat loss because of fire. This will provide benefits for local populations as well the regional population through ensuring an available source population should fires have detrimental impact on regional populations.

Table 4.6 Summary of threatened fauna management objectives

Key threats	Management outcome	Management action/s to address key threats
Ornamental Snake		
Habitat loss and fragmentation	• Overall improvement in existing Ornamental Snake habitat quality. • Increase in Ornamental Snake habitat through natural regeneration or active restoration. • Increase in available shelter through increases in coarse woody debris.	Past and ongoing clearing of habitat for the Ornamental Snake, particularly broad-scale land clearing, has had a significant effect on the species (DoE 2014b, DAWE 2020c). In turn, this has led to restricted reptile dispersal, isolated populations and genetic fragmentation as well as increased habitat degradation from edge effects (DSEWPC 2011a). A total of 2,007.7 ha of known important habitat for the Ornamental Snake will be protected and managed within the Stage 1 offset area. Existing grazing practices will be removed from the site, removing impacts resulting from grazing (see below). Weed control works and weed and fuel/biomass control will be implemented in the Stage 1 offset area resulting in a net improvement in condition through reduction of weeds and control of biomass and ongoing growth and recruitment of trees, that will result in long-term increases in coarse woody debris which provides shelter for this species. Livestock will not be permitted access to Ornamental Snake habitat post rainfall events to ensure gilgais are not degraded. These measures, combined, address a key threat of habitat loss and will have a long-term benefit for the species. Cane toads have also been identified as a potential threat however management of Cane Toads is highly difficult and costly therefore is not proposed to be included in OAMP.
Habitat degradation resulting from grazing leading to soil compaction and compromising of soil structure	• Reduce habitat degradation resulting from stock grazing.	Grazing by stock has resulted in degradation of habitat for the Ornamental Snake, particularly in sensitive wetland and gilgai habitats (DoE 2014b, DAWE 2020c). Grazing leads to soil compaction and compromising of soil structures, impacting on key habitats for the Ornamental Snake including cracking clay soils. This, in turn, reduces habitat quality and function leading to reduced resilience of populations to adverse environmental change (DSEWPC 2011s). Grazing will largely be removed from site, with crash grazing (short-term) undertaken to control weeds and fuel load/biomass. Sensitive gilgai habitats will be protected from grazing through the implementation of additional controls during the wet season and following significant rainfall events. These measures are anticipated to result in all impacts to key habitat from grazing being removed from the site, with resultant increases in habitat quality across the Stage 1 offset area.
Destruction of wetland habitat by feral Pigs	• Reduce the likelihood of habitat degradation by feral pigs.	Destruction of wetland habitats, including gilgai, by feral Pigs is highlighted as a key threat to the species (DoE 2014b) likely to result in ongoing habitat loss and degradation, as well as mortality. This type of impact is also likely to reduce the suitability of this habitat for key prey species for the Ornamental Snake, further exacerbating impacts. Control of feral Pigs will, will be undertaken across the Stage 1 offset area using a combination of baiting (for broad control) and shooting (for opportunistic control). Feral Pig control will focus on wetland areas and gilgai habitats where feral Pigs are most likely to be active. Ongoing control of feral Pigs will result in reduced degradation of known important habitat, addressing habitat loss and increasing availability of prey items.

Table 4.6 Summary of threatened fauna management objectives

Key threats	Management outcome	Management action/s to address key threats
Predation by feral species	• Reduce the likelihood of predation by feral cats, European Red Fox and feral pigs. • Reduce likelihood of poisoning from ingestion of Cane toads.	The Ornamental Snake has undergone a decline in abundance in the past few decades due to a number of impacts on the species, one of which is predation by feral species (DAWE 2020c). Predator control works will be undertaken across the Stage 1 offset area using a variety of methods such as trapping and shooting programs (Table 4.4). Predator control works will be undertaken on an annual basis across the Stage 1 offset area. Although not a direct predator, Cane Toads are likely to adversely impact Ornamental Snakes by poisoning. Cane Toad eggs will be identified and removed from waterbodies on a quarterly basis as well as deployment of Cane Toad traps for the first 5 years.
Invasion by weeds	• Reduce invasion of weed species (Buffel Grass).	The degradation of habitat by invasive weeds, such as Buffel Grass, is considered a potential contributing factor the decline of the Ornamental Snake (DAWE 2020c). Weed control will be undertaken across the Stage 1 offset area using a variety of methods (Table 4.3). Methods of removal and control for Buffel Grass include physical removal and/or use of herbicide. Weed control events will be completed at least once a year between October to April.
Australian Painted Snipe		
Predation by feral species	• Reduce the likelihood of predation by feral cats and European Red Fox.	Predation, particularly nest predation by feral cats and foxes, is identified as a potential threat to the Australian Painted Snipe (DSEWPC 2013). However, there is no evidence to suggest predation has caused a decline of the species. Predator control works, focusing on feral cats and foxes, will be undertaken across the Stage 1 offset area using a variety of methods such as trapping and shooting programs (Table 4.4). Predator control works will be undertaken on an annual basis across the Stage 1 offset area.
Habitat degradation resulting from grazing leading to soil compaction and compromising of soil structure	• Reduce habitat degradation resulting from stock grazing.	Grazing and associated trampling by stock has resulted in degradation of wetland vegetation, nutrient enrichment and disturbance to substrate (DSEWPC 2013). Grazing will largely be removed from site with crash grazing (short-term) undertaken to control weeds and fuel load/biomass. Riparian vegetation and natural re-generative native vegetation will be protected from grazing using fencing. Planted areas will be fenced off and excluded from grazing within the first 2 to 3 years. Further detail on planting is outlined in Section 4.2.1. Stock use around dams will be managed to ensure banks are not degraded and water quality reduced. These measures are anticipated to result in all impacts to key habitat from grazing being removed from the site, with resultant increases in habitat quality across the Stage 1 offset area. Rotation of livestock will occur during years with sufficient rainfall (dependent on seasonal conditions).
Invasion by weeds	• Reduce invasion of weed species.	Wetland vegetation is critical to the survival of the Australian Painted Snipe. The replacement of native wetland vegetation by invasive, noxious weeds could render the species habitats less suitable or unsuitable (DAWE 2020d). Weed control will be undertaken across the Stage 1 offset area using a variety of methods (Table 4.2). Vegetation around dams will also be managed to ensure they don't become choked by weeds and therefore not suitable for use by the species.

Table 4.6 Summary of threatened fauna management objectives

Key threats	Management outcome	Management action/s to address key threats
Greater Glider		
Habitat loss, fragmentation and/or degradation	• Overall improvement in Greater Glider habitat quality. • Increase in Greater Glider habitat through natural regeneration and/or revegetation. • Increased denning habitat for the Greater Glider, including through installation of nest boxes. • Increased Greater Glider habitat connectivity in riparian areas including through revegetation.	Habitat loss and fragmentation is identified as a key threat to the Greater Glider (TSSC 2016). The species is known to occur within tall forests with a diversity of eucalypt species and an abundance of hollow bearing trees (TSSC 2016). A total of 1,721.2 ha of remnant woodland, 26.56 ha of regrowth woodland and 3,737.7 ha of potential future habitat for the Greater Glider will be protected and managed within the Stage 1 offset area. Existing grazing practices will be managed and at times reduced or removed allowing natural regeneration to occur across the site, with active revegetation proposed in nominated riparian areas. . Weed control works and weed and fuel/biomass control will be implemented across the Stage 1 offset area, resulting in a net improvement in condition through reduction of weeds and control of biomass and ongoing growth and recruitment of Greater Glider feed trees and resting trees. Greater Glider habitat connectivity in riparian areas will be improved by increasing the height and cover of remnant vegetation and regrowth vegetation along riparian corridors. Up to 120 ha will be revegetated by end of Year 6 to enhance Glider connectivity in riparian zones. Revegetated areas will be appropriately fenced where required to protect young saplings from grazing pressures and feral animals. Existing hollow-bearing trees will be retained and new large hollows will develop over time. Non-remnant areas will then start to develop in their regrowth vegetation making these riparian corridors larger and providing improved foraging resources for the species. Supplementary nest boxes will be installed within remnant, advanced regrowth woodlands and over time will be installed into regeneration/revegetated areas. This will provide more denning opportunities for the species and improve their connectivity through these habitats. Section 4.2.6 includes further details of the nest box installation and research program.
Climate change and drought	• Enhancing drought-resistant habitat.	Higher temperatures due to climate change may cause heat stress to Greater Gliders and reduce the availability of foraging habitat (TSSC 2016). Greater Gliders occupy sites where vegetation is lush and wet (TSSC 2016). The offset area will enhance drought-resistance and connectivity known to drought refugia, such as riparian woodlands, to increase the resilience of Greater Glider populations across the area.
Mortality and injury from wildfires	• Reduce frequency and intensity of fires within Greater Glider habitat. • Increased survival of extreme fire events.	The Greater Glider is sensitive to wildfire and is slow to recover following major disturbance (TSSC 2016). High intensity and frequent fires are considered a severe threat to the Greater Glider (TSSC 2016). Weed and fuel/biomass control will be undertaken across the Stage 1 offset area to reduce fuel loads and risk of high intensity to catastrophic fires. Further, these measures are designed to ensure they do not have negative impact on other habitat features such as regeneration. Hazard reduction burns and/or cool burns will be undertaken in consultation with the Qld Rural Fire Service to further reduce this risk. These measures will provide an increased level of protection for the Greater Glider within the Stage 1 offset area, reducing the risk of both mortality and habitat loss because of fire. This will provide benefits for local populations as well the regional population through ensuring an available source population should fires have detrimental impact on regional populations.

Table 4.6 Summary of threatened fauna management objectives

Key threats	Management outcome	Management action/s to address key threats
Squatter Pigeon		
Habitat and resource loss	• Reduce competition of food source by rabbits. • Improve Squatter Pigeon habitat extent and connectivity.	Overgrazing of habitat and competition of food sources by feral herbivores such as rabbits is a threat to the Squatter Pigeon (TSSC 2015). Pest fauna management controls for rabbits will be undertaken across the Stage 1 offset area using a variety of methods such as warren ripping, harbour destruction, baiting, trapping and shooting. Warren ripping and harbour destruction should be completed monthly. Trapping, baiting and shooting programs will occur annually. Reduction in feral herbivores, particularly rabbits, will reduce pressures from competition of food source, providing positive benefits for the local Squatter Pigeon population.
Habitat degradation resulting from grazing leading to soil compaction and compromising of soil structure	• Reduce habitat degradation resulting from stock grazing.	The degradation of Squatter Pigeon habitat by overgrazing by stock has contributed to the decline of the species (DAWE 2020b). Within Queensland much of the species original habitat has been replaced with improved pasture for cattle-grazing (TSSC 2015). However, grazing by sheep is identified as more destructive to the species (TSSC 2015). Grazing will largely be removed from site with crash grazing (short-term) undertaken to control weeds and fuel load/biomass. Riparian vegetation, existing and future habitat will be protected from grazing using fencing. Planted areas will be fenced off and excluded from grazing within the first 2 to 3 years. Further detail on planting is outlined in Section 4.2.1. Management measures are the same across Squatter Pigeon breeding and foraging habitat as the only difference is their distance to permanent water. These measures are anticipated to result in all impacts to key habitat from grazing being removed from the site, with resultant increases in habitat quality across the Stage 1 offset area. Rotation of livestock will occur during years with sufficient rainfall (dependent on seasonal conditions).
Invasion by weeds	• Reduce invasion of weed species (Buffel Grass).	The degradation of habitat by invasive weeds, such as Buffel Grass, is one of the main threats to the Squatter Pigeon (DAWE 2020b). Weed control will be undertaken across the Stage 1 offset area using a variety of methods (Table 4.3). Methods of removal and control for Buffel Grass include physical removal and/or use of herbicide. Weed control events will be completed at least once a year between October to April.
Predation by feral cats and the European Red Fox	• Reduce likelihood of predation by feral cats and the European Red Fox.	Predation, particularly by feral cats and foxes, is identified as having the greatest impact upon the Squatter Pigeon (southern) population (DAWE 2020b). Predator control works, focusing on feral cats and foxes, will be undertaken across the Stage 1 offset area using a variety of methods such as trapping and shooting programs (Table 4.4). Predator control works will be undertaken on an annual basis across the Stage 1 offset area.
Climate change and drought	• Enhancing drought-resistant habitat. • Create water stations for fauna.	Higher temperatures due to climate change may cause heat stress to Squatter Pigeon and reduce the availability of foraging habitat. The offset area will enhance drought-resistance and connectivity known to drought refugia, such as riparian woodlands, to increase the resilience of Squatter Pigeon populations across the area. Water stations placed out for Koalas may also be utilised by Squatter Pigeons.

Table 4.6 Summary of threatened fauna management objectives

Key threats	Management outcome	Management action/s to address key threats
Mortality and injury from wildfires	• Reduce frequency and intensity of fires within Squatter Pigeon habitat. • Increased survival of extreme fire events.	It is suggested that drought and bushfires may exacerbate the impacts of other threatening processes and contribute to the decline of the species (DAWE 2020b). Weed and fuel/biomass control will be undertaken across the Stage 1 offset area to reduce fuel loads and risk of high intensity to catastrophic fires. Further, these measures are designed to ensure they do not have negative impact on other habitat features such as regeneration. Hazard reduction burns will be undertaken in consultation with the Qld Rural Fire Service to further reduce this risk. These measures will provide an increased level of protection for the Squatter Pigeon within the Stage 1 offset area, reducing the risk of both mortality and habitat loss because of fire. This will provide benefits for local populations as well the regional population through ensuring an available source population should fires have detrimental impact on regional populations.

5 Risk assessment

This section of the OAMP performs a risk analysis and a risk management and mitigation strategy for the successful implementation of the OAMP and timely achievement of the offset management outcomes. It includes a rating of all initial and post-mitigation residual risks in accordance with the risk assessment matrix provided by DAWE.

The key risks have been assessed using qualitative likelihood (Table 5.1) and qualitative consequence ratings (Table 5.2) with the interaction of likelihood and consequence determining the overall resultant risk. The risk assessment matrix is presented as Table 5.3.

Table 5.1 Qualitative measure of likelihood[1]

Score	Definition / rationale
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

Notes: 1. Likelihood is defined by how likely is it that this event/circumstances will occur after management activities are implemented

Table 5.2 Qualitative measure of consequence

Score	Definition / rationale
Minor	Minor incident of environmental damage that can be reversed (eg short-term delays to achieving plan objectives, implementing low-cost, well-characterised corrective actions)
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts (eg short-term delays to achieving plan objectives, implementing well-characterised, high-cost/effort corrective actions)
High	Substantial instances of environmental damage that could be reversed with intensive efforts (eg medium-long term delays to achieving objectives, implementing uncertain, high-cost/effort corrective actions)
Major	Major loss of environmental amenity and real danger of continuing (eg plan objectives are unlikely to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies)
Severe	Severe widespread loss of environmental amenity and irrecoverable environmental damage (eg plan objectives are unable to be achieved, with no evidenced mitigation strategies)

Table 5.3 Risk assessment matrix

Risk Assessment		Consequence				
		Minor (C1)	Moderate (C2)	High (C3)	Major (C4)	Severe(C5)
Likelihood	Highly likely (L5)	Medium	High	High	Severe	Severe
	Likely (L4)	Low	Medium	High	High	Severe
	Possible (L3)	Low	Medium	Medium	High	Severe
	Unlikely (L2)	Low	Low	Medium	High	High
	Rare (L1)	Low	Low	Low	Medium	High

Table 5.4 outlines the key identified risks which will influence the ability of the offset to achieve the final completion criteria set at the end of the OAMP, and effectiveness of identified management actions achieving the set management objectives. It outlines feasible mitigation measures to reduce the overall risk and failure of the offset.

The ratings assume that the risks are untreated, ie have not been addressed by specific risk mitigation measures other than routine design and operational practice. The residual risk resulting from corrective actions applied to each risk event is then applied.

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Impacts to offset from conflicting land uses					
Impacts to the offset from resource tenements and/or future development.	The offset is proposed on land that is freehold tenure, owned by Pembroke, and not encumbered by easements or other interests under Qld Land Act. The Stage 1 offset area is not constrained by any mining leases. There is an area directly to the south of the offset area which has an approved mining tenement. An adjacent property in east has a mining lease granted. Pembroke and resource holders will have agreements in place to ensure future development activities do not impact on offset values.	**High** (L3/C4)	Legally secure Stage 1 offset area through declaration as a reserve under NC Act declaration or legally binding covenant. A Voluntary Declaration under the Vegetation Management Act (1999) will be the initial securement mechanism, until the reserve is declared. This will remain on the title binding future owners and constrain future development occurring. Should Pembroke sell the offset land once performance outcomes are achieved the offset protection mechanism is still legally binding and they need to comply with the accompanying conservation agreement. If future mining or development is proposed over the offset area the proponent would need to offset the offset. They would also need to submit a referral under EPBC Act for impacts to MNES. Fencing the offset boundary will occur to ensure the offset land is clearly delineated from the mining tenement and there is no unauthorised access.	The Stage 1 offset area will be legally secured on title within 12 months from the date that the OAMP is approved by the Minister in writing. This meets conditions of approval being condition 5 of 2017/7869, 2017/7868, 2017/7870) and condition 9 of 2017/7867.	**Medium** (L1/C4)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Impacts to the offset from unauthorised access	Unauthorised access and activities have potential to degrade the ecological values of the offset. These activities could include: • 4WD access - degrade wetlands and gilgais, erode tracks particularly after rain, introduce weed species and/or spread weeds. • Shooting/hunting. • Timber harvesting. • Release of cattle/horses for grazing. • Dumping of rubbish. • Poaching of wildlife.	**Medium** (L3/C2)	Property will be appropriately fenced, and gates installed and locked. Only the landholder and approved contractors will be granted access. Property regularly monitored and patrolled looking for unauthorised access. If access restrictions are not successful, implementation of camera monitoring to identify perpetrators.	Installation of boundary fencing and locked gates within the first year of offset management commencing. Regular monitoring during life of offset. Notification to police and DAWE if suspected/substantiated unlawful access.	**Low** (L2/C2)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Expanding available habitat and increasing Habitat Quality					
Woodland regeneration and habitat quality scores are not achieved in timeframes set.	Natural regeneration is proposed to be actively managed to increase extent of remnant woodland and habitats across the offset site. Natural regeneration is preferred method due to the size of areas containing regrowth and non-remnant areas. Up to 120 ha of woodland is proposed to be revegetated within riparian corridors. Other management actions are also proposed to improve habitat quality including weed management, fire management, grazing management and pest animal control.	**High** (L4/C4)	Revegetation areas will be maintained for five years and losses will be replaced to maintain 300 canopy trees/ha. The plantings will be staggered over four years (commencing in Year 3 and being completed by end of Year 6) and maintenance will include watering, weeding, removing grazing and pest animals. Natural regeneration will be encouraged through reduced grazing pressure, some ripping if required, reducing weed cover and pest animal degradation. If natural regeneration is not shown to be progressing to set targets additional intervention will be undertaken. This may include further ripping and seeding, supplementary planting of tubestock, reducing and/or excluding grazing and increasing weed control efforts.	Revegetating 120 ha and managing natural regeneration and other habitat quality management measures such as weed control will be the focus in the first six years. Additional intervention may then be undertaken from Year 7 such as ripping, further direct seeding, increased intensity of weed control and changes to grazing regime to encourage further regeneration. Monitoring of the progress of the offset and habitat quality benchmarks will occur and every five years the outcomes will be formally assessed against interim targets for each MNES. Where objectives are not being met corrective actions will be applied (refer Section 4).	**Medium** (L3/C2)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Micro habitat features for target MNES species do not develop appropriately during OAMP life	Coarse woody debris (CWD) is insufficient relative to RE benchmarks to provide micro-habitat for Ornamental Snake. Squatter Pigeon require adequate foraging resources and native grass species diversity. Australian Painted Snipe require wetlands and gilgai for foraging and breeding. Greater Gliders require tree hollows for breeding.	**High** (L4/C4)	If CWD is not developing based on set benchmarks investigate introducing CWD into Ornamental Snake habitats salvaged from impact site. If native grass species are not regenerating investigate increasing weed control as weeds may be outcompeting native grasses and reducing or removing grazing. Cool burns may also encourage native grass regeneration. Deployment of supplementary nest boxes for Greater Glider is going to be undertaken. This recognises the fact some habitats will take a long time to develop naturally forming hollows. Trials of using salvaged tree hollows from impact site will be undertaken and monitoring to determine if Greater Gliders are using nest boxes. Undertake feral pig management to reduce impacts on wetland and gilgai areas. Do not allow grazing in wetland and gilgai areas after rain events when compaction is likely to occur.	Monitoring will occur annually to evaluate effectiveness of management actions, and track progress of habitat quality objectives. Corrective actions and adaptive management will be applied over the life of the offset (refer Section 4).	**Medium** (L3/C2)
Wetland and riparian habitat regeneration fails	Wetlands and riparian areas are important habitats for the target MNES species (e.g. Painted Snipe and Ornamental Snake utilise wetlands, gilgais and Koalas and Greater Gliders key habitats are found along watercourses). Increased activity by site personnel, unauthorised access, stock access or feral animals (pigs) can supress natural regeneration and erode creek banks.	**Medium** (L3/C2)	Measures to reduce/eliminate access and impacts to these areas will include: • Contractor management plans restricting access of contractors to certain areas. • Keeping vehicles to designated access tracks. • Stock being fenced out of riparian areas with off-stream watering points. • Restrictions on unauthorised access (4WD and hunting). • Pest animals (active reduction in feral pig numbers).	Monitoring will occur annually to evaluate effectiveness of management actions, and track progress of habitat quality objectives. Corrective actions and adaptive management will be applied over the life of the offset (refer Section 4).	**Low** (L3/C1)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Weed management					
Introduction, establishment and spread of weeds as a result of access to offset. Weed populations do not reduce or increase.	Weeds carried on vehicles, plant, machinery and equipment may be introduced/further spread and subsequently colonise disturbed ground, leading to increased risk of competition with regenerating native plants / increased biomass resulting in heightened bushfire risk. Weeds may outcompete regenerating native grasses and tree species. Weeds can reduce fauna movement through the offset area.	**High** (L4/C3)	Baseline weed survey will occur in Year 1 across Stage 1 offset area. The survey will clearly document weed species present, distribution and any larger infestations. Weed control will be undertaken as a minimum annually. The following actions will also reduce risks associated with weeds and increase effectiveness of management: • Access only to authorised personnel. • Mapping infestations and areas of exclusions (weed baseline). • Weed treatment schedule addressing method of control, pesticides, location and timing of treatments. • Develop hygiene control program including vehicle washdown – machinery to arrive and depart from site in a clean condition (general biosecurity obligation), free from seed or mud. • Any introduced mulch, soil or plants are to be weed free and disease free. • Weed control to be implemented by suitably qualified and appropriately permitted pest control personnel. • Ongoing monitoring conducted for weed species and location. If weed populations are not decreasing or new weed species have been introduced a review of measures will be undertaken. Different control methods will be trialled and weed control effort may need to be increased.	Monitoring will occur annually to evaluate effectiveness of management actions, and track progress of weed populations and reduction in distribution. Corrective actions and adaptive management will be applied over the life of the offset.	**Medium** (L3/C2)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Biomass control					
Biomass increases, thus increasing likelihood of hot fires occurring. Hot fires can remove habitat features such as CWD, tree hollows and kill native vegetation, as well as threatened species. Too frequent fires can also reduce CWD, reduce regeneration of saplings and increase certain weed species.	Biomass (i.e. fuel load) is proposed to be managed through a combination of control methods such as: • Grazing • Cool/mosaic burns • Weed control	**High** (L4/C3)	Biomass will be regularly monitored throughout the year. Once it reaches set levels grazing will be permitted to keep fuel loads to manageable levels. In areas where grazing isn't appropriate cool burns or manual slashing can be used to reduce fuel load. Fire breaks will also be put in place and maintained to reduce likelihood of hot fires occurring and improve access around offset for fire management activities.	Monitoring will occur throughout the year to identify when grazing can and can't occur based on biomass levels. A formal annual monitoring program (Section 6) will also be completed to evaluate effectiveness of management actions, and track progress of weed populations and reduction in distribution. Corrective actions and adaptive management will be applied over the life of the offset (refer Section 4).	**Low** (L2/C2)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Loss of Squatter Pigeon habitat due to too dense ground cover, and exotic grasses and weeds outcompeting native grass regeneration.	Utility of potential breeding and foraging habitat for Squatter Pigeon decreases when ground cover exceeds >33% and requires bare ground for foraging and dust bathing. Weed establishment/expansion in potential habitats, especially by Buffel Grass, is a significant threat. Encroachment by woody native species is also an issue and the species may benefit from the presence of light grazing by livestock.	**Medium** (L3/C3)	Implement biomass control activities including grazing. Implement the Squatter Pigeon monitoring plan (Table 6.2) to track habitat quality improvements are being achieved including increase in native grass species diversity. Weed control will be undertaken to reduce competition with native grass species recruitment.	Monitoring will occur throughout the year to identify when grazing can and can't occur based on biomass levels. A formal annual monitoring program (Section 6) will also be completed to evaluate effectiveness of management actions, and track progress of weed populations and reduction in distribution. Corrective actions and adaptive management will be applied over the life of the offset (refer Section 4).	**Low** (L2/C2)
Pest animal management					
Uncontrolled or increasing feral pig activity which degrades Ornamental Snake and Australian Painted Snipe habitats.	Impacts to wetland habitat from feral pigs is considered a threat to wetland and habitat values for Ornamental Snake and Australian Painted Snipe.	**High** (L4/C3)	Feral pig control to be undertaken annually to reduce feral pig numbers and ecological impacts. Measures must consider humane measures to destroy pigs, and in the case of poisoned baits, consider poisoning of target animal. If monitoring is showing feral pig populations are not decreasing, or wetland impacts are increasing, feral pig control will be increased. Feral pig control in adjacent properties may also need to be undertaken.	A formal annual monitoring program (Section 6) will also be completed to evaluate effectiveness of management actions, and track reduction in feral pig populations. Corrective actions and adaptive management will be applied over the life of the offset (refer Section 4).	**Low** (L2/C2)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Uncontrolled feral animal activity	Feral predators (e.g. cats, foxes and wild dogs) pose a serious threat to native fauna (including MNES species). Uncontrolled these fauna pose a serious threat to native animals in the offset. For example, feral cats predate on Squatter Pigeon and wild dogs on Koalas. Cane Toads are present in the offset area and can impact Ornamental Snake by poisoning.	**High** (L4/C3)	Feral animal control to be undertaken annually to reduce feral animal numbers and impacts on MNES. Except for Cane Toad control which is quarterly for first 5 years. Focusing on egg removal from creeks, wetlands and dams. Measures must consider humane measures of destruction, and in the case of poisoned baits, consider poisoning of target animals. Pest management efforts if shown not to be effective other corrective actions will be implemented such as changing control methods, increasing efforts and broadening areas of control.	A formal annual monitoring program (Section 6) will be completed to evaluate effectiveness of management actions, and track reduction in feral animal populations. Corrective actions and adaptive management will be applied over the life of the offset (refer Section 4).	**Low** (L2/C2)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Fire management					
Increasing intensity, duration or frequency of fires. Hot fires can remove habitat features such as coarse woody debris (CWD), tree hollows and kill native vegetation, as well as threatened species. Too frequent fires can also reduce CWD, reduce regeneration of saplings and increase certain weed species.	Excessive/uncontrolled establishment of exotic weeds (e.g. Buffel Grass) create fire risks through increased fuel loads. These often result in fires of greater intensity and duration and impact upon natural regenerative processes affecting structural and floristic change to habitats. A drying climate can also stimulate greater frequency (and intensity) of fire.	**Severe** (L5/C4)	Fire management activities will be undertaken on an annual basis. This will include establishment of fire breaks and fuel load reduction. Fire management will look to: • Reduce fuel loads primarily through grazing, weed control and cool burns. • Mosaic burn patterns will take into account the vegetation community type, maturity and developmental stage of the regenerating areas. • Appropriate burn times including cool burns to influence a variety of ecological responses by conducting a variety prescribed burn responses that do not favour any one species.	Fire breaks and fuel loads will be regularly monitored throughout the year. A formal annual monitoring program (Section 6) will be completed to evaluate effectiveness of management actions, including reducing risk of hot bushfires occurring. Corrective actions and adaptive management will be applied over the life of the offset (refer Section 4).	**Moderate** (L3/C3)

Table 5.4 Risk Assessment

Risk	Description	Inherent Risk (Likelihood / Consequence)	Mitigation measures	Timing	Residual risk (Likelihood/ Consequence)
Fencing					
Death or injury of native animals due to barbed wire fencing.	Some existing fencing has barbed wire on the top strand for livestock control. Barbed wire poses a significant threat to native fauna especially bats, owls, birds and gliders (ie greater gliders in this instance). Such animals become entangled, usually on top wires in the case of gliders, and are serious injured and perish. Ground fauna can be injured when fleeing predators or other threats., such as wallabies trying to cross the fence.	**Medium** (L3/C3)	• Existing barbed wire fencing will be replaced with a high tensile wire. The top strand will also have reflectors added. • New fencing will have the top three strands as high tensile wire. Reflectors on top strand. New fencing will be designed to allow fauna to safely move underneath leaving a gap of 40cm between ground and bottom wire. • Electric fencing can be used with caution. Electric fencing has shown to be effective in keeping cattle out and not injuring wildlife. Remember to keep the hot wire 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.	Barbed wire will be replaced in the first year of offset commencing. Fences will be regularly monitored and maintained throughout the year to ensure they are not damaged and keeping livestock out of certain areas.	**Low** (L4/C1)

6 Monitoring program

6.1 Monitoring program objectives

Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced. The monitoring program is designed to support operational decision-making, in particular to:

- inform and report 'early-control', i.e. to demonstrate that management actions are effective in achieving interim performance targets, and therefore in time completion criteria; and
- Support an 'early warning' function, ie to inform timely decisions on corrective actions to ensure performance and completion criteria are achieved/maintained.

The Monitoring Program will:

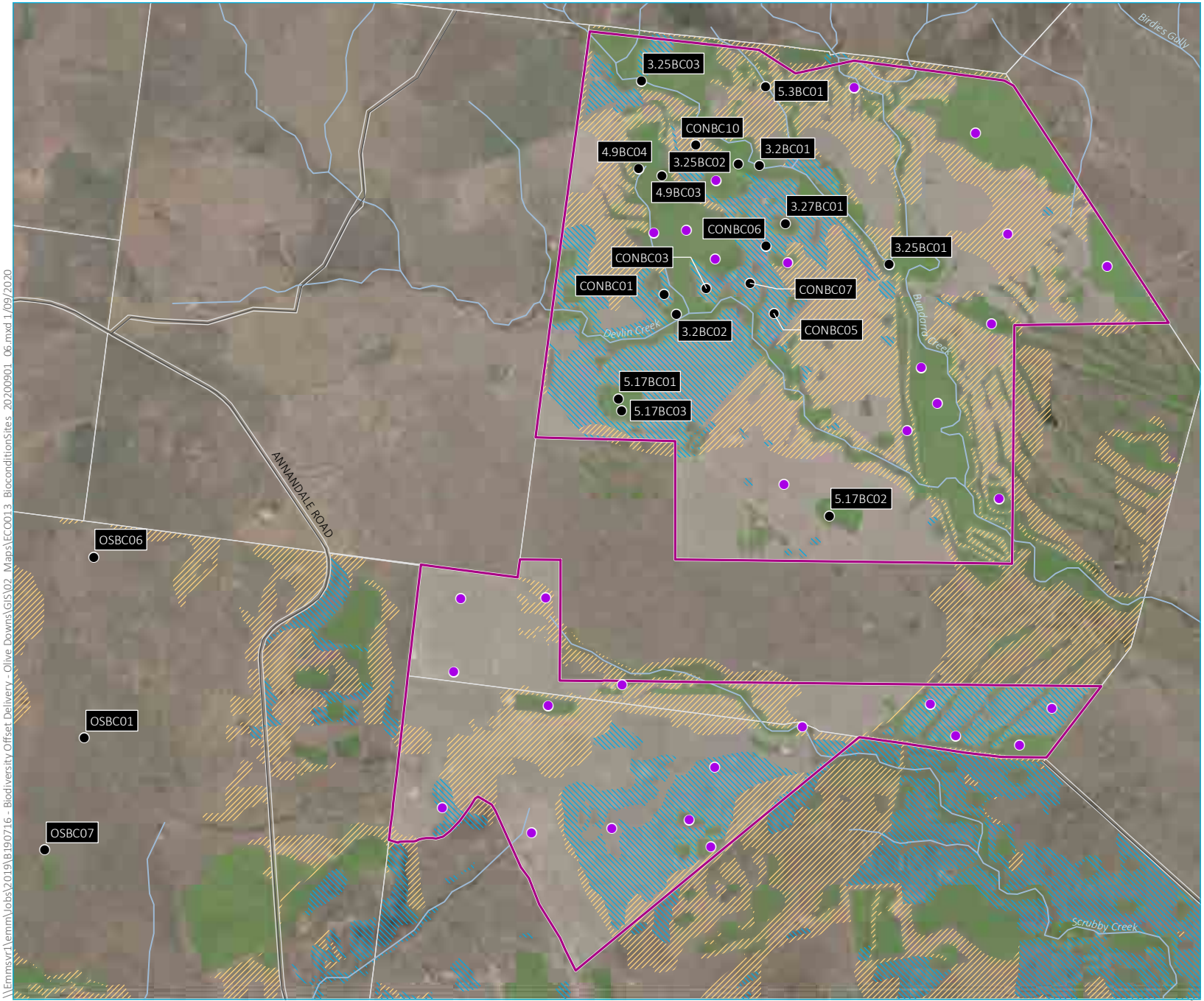
- confirm all prescribed management actions have been completed in timeframes set for that 12 month period (refer to Section 7.1);
- identify trends and areas for improvement through early control and early warning functions;
- assess effectiveness of environmental controls implemented;
- where necessary, identify modifications required to the monitoring program and methods;
- assess vegetation community growth, health and extent;
- assess habitat quality for each MNES including interim performance outcomes are being achieved;
- determine that the final habitat quality is on track to being achieved;
- assess presence, abundance and habitat utilisation by target MNES species; and
- confirm performance objectives have been met at end of 20-year management period. Reduced management will continue for the duration of the Project approval.

Habitat Quality (BioCondition) assessments will also be undertaken in the early stages of the monitoring program at both new and previously established sites. This is to ensure baseline data is sufficient to inform ongoing offset management strategies and measure temporal changes in habitat quality from the onset of the monitoring program. This will also ensure habitat quality levels are measured and required gains are achieved over the course of the program.

Existing and additional BioCondition sites are summarised below in Table 6.1 according to vegetation community and offset value. BioCondition sites are illustrated in Figure 6.1.

Table 6.1 Habitat Quality assessment sites

Regional Ecosystem	Offset Area 1		Offset Area 2		Totals		Associated MNES species habitat
	Existing sites	Additional sites	Existing sites	Additional sites	BioCondition sites	Area (ha)	
11.3.2	2	3	RE not present	RE not present	**5**	**497.7**	Koala, Greater Glider, Squatter Pigeon
11.3.25	3	0	0	1	**4**	**223.0**	Koala, Greater Glider, Squatter Pigeon
11.3.27f	1	0	RE not present	RE not present	**1**	**10.0**	All MNES species
11.4.8	0	2	RE not present	RE not present	**2**	**70.2**	Ornamental Snake, Squatter Pigeon
11.4.9	2	2	0	1	**5**	**151.2**	Ornamental Snake, Squatter Pigeon
11.5.17	3	0	RE not present	RE not present	**3**	**63.9**	All MNES species
11.5.3	0	1	0	3	**4**	**446.5**	Koala, Greater Glider, Ornamental Snake, Squatter Pigeon
11.5.9	0	4	0	4	**8**	**469.7**	Koala, Greater Glider, Squatter Pigeon
11.12.7	0	1	RE not present	RE not present	**1**	**2.0**	Koala, Greater Glider, Squatter Pigeon
Non-remnant/regrowth	7	2	0	9	**18**	**7,472.1**	All MNES species



KEY

- Stage 1 offset area
- Minor road
- Watercourse/drainage line
- Cadastral boundary

Vegetation condition

- Remnant
- Advanced regrowth
- Habitat restoration area

Biocondition site

- Existing
- Proposed

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

0 1 2 km

GDA 1994 MGA Zone 55

N

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Habitat quality assessment sites (BioCondition transects)

Olive Downs
Stage 1 offset area management plan
Figure 6.1

6.2 Monitoring methods

The specific monitoring methods and frequency to address the Monitoring Program objectives in Section 6.1 are summarised in Table 6.2. The implementation schedule for each of the management measures and monitoring method is outlined in Appendix C.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
Offset Administration			
1. Confirm all prescribed management actions have been completed in timeframes set for that 12 month period	All set management actions in each 12 month period will be evaluated to confirm they have been completed. These are outlined in further detail below including: • Weed management • Fire management • Fence and access track maintenance • Fuel load and grazing management	A suitably qualified person will be engaged by Pembroke Resources to inspect the offset area and confirm work has been completed. The appointed person will consult with applicable parties engaged to do the work and seek evidence tasks were completed in accordance with the approved OAMP. This may be Pembroke employees, grazing manager or suitably qualified contractors. A report will be prepared summarising the audit completed and findings. Report will be issued to Pembroke.	Audit will occur annually (estimated around April). Report will be finalised at least one month prior to the Annual Report being due on 30 June.
2. Assess effectiveness of environmental controls implemented	Post each monitoring event the results will be evaluated and measured against the specific management outcomes for that particular matter, and habitat quality objectives set out in Table 6.3.	A range of monitoring methods will be implemented. These are outlined below in Table 6.2 from monitoring activities 5 to 14.	Effectiveness of management actions and any corrective actions put in place will be assessed annually. This will be as part of the Annual Report process described in Section 7.
	All management actions	The approval holder must ensure each assessment of the effectiveness of the management actions in the Stage 1 OAMP is: a. subject to a peer-review completed within 6 months of the completion of each such assessment; and b. published on its website with the findings of the peer-review within 6 months of the completion of the peer-review and for the duration of this approval.	Every five years
3. Timing of corrective actions and evaluation of effectiveness	All management actions	The monitoring actions from monitoring activities 5 to 14 will be implemented to confirm if the management actions are effective.	Implement corrective actions within three months of identifying a corrective action is required (refer Section 4).

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
4. Identify modifications required to the monitoring program and methods	All management actions	Pembroke will undertake a review of the monitoring program. The review will consider: • Are the monitoring methods effective and providing the information required? • Are the monitoring frequencies suitable? • Is the monitoring program efficient or are there improvements that could be made? • What changes may be justified and why?	At the end of the first 5 years (and every 5 years post that) a review of the monitoring program will occur. As per the approval conditions for 2017/7867, a report summarising key findings and any recommendations for refinement will be prepared. The report will also be submitted to DAWE for review. If changes are proposed and agreed the OAMP will be updated and new revision approved.
Ecosystem Health			
5. Weeds	Weed species present. Weed species abundance. Weed species distribution.	Undertake weed baseline survey across offset area. Document weed species present, locations observed, and larger infestations. Map results. Establish permanent weed monitoring transects at large infestations to document weed populations, and percentage weed cover. Weed cover will also be measured and monitored at established HQ monitoring sites. Establish permanent photo monitoring points at large weed infestations.	Weed baseline survey will occur in Year 1. Weed monitoring surveys will then occur annually Year 2–Year 10. Weed monitoring will then occur every 2 years from Year 11–Year 20. Pembroke will continue to undertake weed control and maintenance for the duration of the approval. Post-20 years, this will include reduced general maintenance and management including weed control.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
6. Feral animals	Feral animal species present. Feral animal abundance. Feral animal distribution.	Undertake feral animal baseline survey across offset area. The survey will be to confirm presence of feral animal species, their abundance, distribution and document evidence of impacts. The baseline survey will establish an abundance of each target species being Feral pigs, Wild dogs, Foxes, Rabbits and Feral Cats. The survey will then be replicated to be able to compare changes in abundance. Waterbodies for cane toads will also be surveyed and locations for egg control finalised. Estimated abundance of cane toad eggs will be ascertained. Establish baited camera trap locations and assessment sites to determine their presence eg wetland and gilgai areas for feral pigs. The same camera trap locations will be repeated each monitoring event to gauge presence of feral animal species and any change in numbers. Minimum of 20 cameras would be deployed. The baited camera traps will be set up across the offset area in particular key habitats. Camera traps will be left out for four weeks. Spotlighting looking for presence of feral animals will also be undertaken. This will coincide with spotlighting being undertaken for Ornamental Snake and Koalas.	Feral animal baseline survey will occur in Year 1. Feral animal surveys will occur annually between Years 2–Year 5. Then every 2 years from Years 6−20.
7. Fire	Fire track maintenance. Fuel loads. Fire regimes.	Survey all fire tracks and confirm they are adequately being maintained. Monitor fuel loads and seasonal conditions. Fuel reduction burns may be used if required. If a cool or mosaic fuel reduction burn is applied monitoring post the event will be undertaken to evaluate no damage to native trees, habitat values occurred.	Survey fire tracks annually. Monitor fuel load and fire conditions quarterly. Low intensity fires may be permitted at intervals recommended by a qualified ecologist over the life of the offset. Cool burns will need to take into account reducing impacts to regrowth/replanted vegetation, fallen woody debris, fauna species, etc.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
8. Grazing	Fuel loads. Fence maintenance. Evaluate stock numbers, timing of grazing and impact on fuel load.	Monitor fuel loads via biomass method using quadrats and assessing groundcover and grass height. This is to be completed by the grazing manager. Survey fences and confirm they are adequately being maintained. Assess grazed areas for effectiveness in managing fuel load and that no degradation to environmental values is occurring. Checklist to be filled out by grazing manager that will include: • Weather conditions • Grazing intensity and stock rotation • Fuel load levels at commencement of grazing and completion of grazing and duration including photos • General property maintenance activities such as fencing, access track maintenance	Quadrat sampling method should occur monthly to determine trigger levels, and then once a week when grazing is occurring. Survey fences and access tracks every year. Assess grazed areas and evaluate effectiveness of rotational grazing every year. Checklist to be completed quarterly by grazing manager.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
Habitat Quality			
9. Track changes in habitat quality scores for each MNES. Confirm they are on track to achieve interim milestones and final milestone. Refer Appendix B for further detail on MNES Habitat Quality Scores and Table 6.3 for habitat quality improvements being sought.	Complete Habitat Quality Assessments. This will include measuring: • Canopy species • Canopy height • Canopy cover • Number of large trees • Groundcover species • Total tree species richness • Grass species richness • Weed species and cover • Litter cover • Coarse woody debris • Recruitment of woody perennial species • Photo points • Patch size • Connectivity • Hollow bearing trees and size of hollows (to be added to all BioCondition).	Baseline BioCondition transects will be established in Year 1 across the offset areas. 18 BioCondition transects have been established to date, and an additional 31 will be established in all offset areas including remnant, regrowth and restoration areas. This will ensure adequate representation of vegetation communities and habitat types. Refer Figure 6.1. In Year 3 BioCondition transects will be re-assessed and habitat quality scores prepared for each MNES species. An analysis of changes will be undertaken including those elements tracking well, and any that haven't improved or worsened. Results will be assessed against interim habitat quality scores set out in Table 6.3 for each MNES species. The BioCondition transects and habitat quality scores will be repeated every second year (eg Year 5, 7, 9, 11, etc) to assist to track progress against habitat quality objectives, and identify if corrective actions need to be taken. Permanent photo point monitoring will occur at each BioCondition site.	Year 1 will be finalising all baseline BioCondition transects. BioCondition assessments and habitat quality scoring will then occur in the following years to ensure regular progress is evaluated, and to coincide with the 5 yearly milestones. Years 3, 5, 7, 10, 12, 15, 17 and 20. Once completion criteria are achieved Pembroke will manage the offset for duration of Project approval. This will be general maintenance activities such as weed control, fire management, grazing management and pest control to maintain habitat quality.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
Target MNES species presence, abundance and habitat utilisation			
10. Ornamental Snake	Condition of gilgai (through BioCondition assessment, weed surveys and feral animal surveys).	Habitat assessments to evaluate gilgai ecological condition. Considering presence of cracking clays, grass cover, woody debris, weeds, etc. Baseline BioCondition transects will be established in Year 1 across the offset areas. 18 BioCondition transects have been established to date, and an additional 31 will be established in all offset areas. This will ensure adequate representation of vegetation communities and habitat types. Refer Figure 6.1. In Year 3 BioCondition transects will be re-assessed and habitat quality scores prepared for each MNES species. An analysis of changes will be undertaken including those elements tracking well, and any that haven't improved or worsened. Results will be assessed against interim habitat quality scores set out in Table 6.3 for each MNES species. Photo monitoring points in gilgai. Assess presence of feral pigs in gilgai, and evaluate any negative impacts being caused. Assess presence of Cane Toad eggs in waterbodies (such as creeks and dams) and remove their eggs and tadpoles. Monitor for any reduction in presence of eggs and/or tadpoles at those sites.	Year 1 will be finalising all baseline BioCondition transects. BioCondition assessments and habitat quality scoring will then occur in the following years to ensure regular progress is evaluated, and to coincide with the 5 yearly milestones (refer Section 4 and Table 4.1 for corrective actions). Years 3, 5, 7, 10, 12, 15, 17 and 20. Feral animal baseline survey will occur in Year 1. Feral animal surveys will occur annually between Years 2–Year 5. Then every 2 years from Years 6−20. Cane Toad monitoring will occur annually for first 5 years. Effectiveness of these measures will then be reviewed as part of the 5 yearly interim review phase and OAMP updated if required.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
	Species presence and abundance	Spotlighting in warmer months is the most effective survey method to identify the species. Spotlighting will be completed by suitably qualified ecologist/s. Spotlighting will be completed across representative areas of the Ornamental Snake habitats to confirm presence of Ornamental Snake. Spotlighting will target gilgai, wetlands, riparian habitats. Those areas where species has historically been recorded will be resurveyed (refer Figure 3.7). Permanent transects will be established across the habitat areas. These will be surveyed at each survey period to support an estimate of population numbers, and how these are changing over time. Each spotlighting survey will be at least 5 consecutive nights for a team of three ecologists, being a minimum of 120 hours. These will be planned to be undertaken post rain events where possible to coincide with increased amphibian activity.	The first targeted surveys for Ornamental Snake is proposed to occur in Year 2 between late September through to late March when weather conditions are warm, not too dry and maximum temperatures are greater than 25°C on most survey days (Brigalow Belt Reptile Guideline). This is to allow BioCondition transects to be established in Year 1 and suitable locations for Ornamental Snake spotlighting and transects can be assessed. The targeted Ornamental Snake surveys will then be completed every second year being Years 4, 6, 8 and 10. Then targeted Ornamental Snake surveys would be undertaken in Years 13, 16 and 19 as habitat areas will be more established and less change is occurring.
	Habitat utilisation and dispersal	Based on spotlighting survey results an evaluation of habitats the species are found in will be undertaken and their location. This is to gain a greater understanding of the habitats they are occurring in including remnant, regrowth and non-remnant, condition and any other relevant factors such as climatic conditions. Habitat quality will be monitored through implementation of habitat quality scoring (refer Section 3.2.9). It will also support an understanding of the species distribution across the offset area.	As part of above surveys.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
11. Koalas	Condition of Koala habitats (through BioCondition assessment, weed surveys)	Baseline BioCondition transects will be established in Year 1 across the offset areas. 18 BioCondition transects have been established to date, and an additional 31 will be established in all offset areas. This will ensure adequate representation of vegetation communities and habitat types. Refer Figure 6.1. In Year 3 BioCondition transects will be re-assessed and habitat quality scores prepared for each MNES species. An analysis of changes will be undertaken including those elements tracking well, and any that have not improved or worsened. Results will be assessed against interim habitat quality scores set out in Table 6.3 for each MNES species. Photo monitoring points in Koala habitats including representation of remnant, advanced regrowth and cleared areas. Weed surveys will be conducted to determine weed species present, abundance and distribution.	Year 1 will be finalising all baseline BioCondition transects. BioCondition assessments and habitat quality scoring will then occur in the following years to ensure regular progress is evaluated, and to coincide with the 5 yearly milestones. Years 3, 5, 7, 10, 12, 15, 17 and 20. Weed baseline survey will occur in Year 1. Weed monitoring surveys will then occur annually Year 2–Year 10. Weed monitoring will then occur every 2 years from Year 11–Year 20.
	Species presence and abundance	Complete Koala surveys to determine the presence of the species within the offset area. Koala surveys will include: • SAT surveys (permanent transects are chosen and replicated) • Indirect survey methods such as looking for scratches and scats (particularly focused along riparian corridors) • Spotlighting (sampling all habitat types) • Call playback (done during spotlighting) • Koala detection dogs (will look to trial this survey method to confirm presence of individuals)	The first targeted survey for Koalas is proposed to occur in Year 2 between August and January when koala activity is at a peak. This is to allow BioCondition transects to be established in Year 1 and suitable Koala habitat survey locations to be evaluated. The targeted Koala surveys will then be completed every 2 years being Years 4, 6, 8 and 10. Koala monitoring surveys will occur between August and January.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
	Population numbers and health	Where koalas are detected on site assessments of individual health will be carried out. This will include size, estimated age, sex, colouring, any young present, health such as any signs of chlamydia. Results of koala surveys will be used to help determine population numbers and changes over time on the offset site and their dispersal across the offset.	Then targeted Koala surveys would be undertaken in Years 13, 16 and 19. Feral animal baseline survey will occur in Year 1. Feral animal surveys will occur annually between Years 2–Year 5. Then every 2 years from Years 6−20.
	Habitat utilisation and dispersal	When koalas are detected, their location and trees they are present in will be recorded. This will help to assess habitat utilisation and dispersal across the offset site.	
	Increase habitat connectivity along riparian corridors	Monitoring of the revegetation areas will occur to assess the health and growth of the revegetated species. This will involve BioCondition transects to measure increase in canopy cover, canopy height, groundcover, tree health and photo monitoring to show progress of plantings and woodland maturing. Any threats to revegetated species, such as pest animals, weed species, cattle, will be monitored and any losses of tubestocks will be recorded.	Monitoring of revegetation areas will occur annually for five years. This will be from the time the area is planted. So if an area is planted in year 4, annual monitoring will occur for another 5 years post that. This is to ensure the trees are self-sustaining at this time.
	Evidence of predation	During koala surveys any deceased koalas will be noted. Signs of dog attack will be looked for. Feral animal surveys will also note any wild dogs observed. Feral animal monitoring will occur through deployment of baited camera traps to determine their presence, eg wetland and gilgai areas for feral pigs. The same camera trap locations will be repeated each monitoring event to gauge presence of feral animal species and any change in numbers. Minimum of 20 cameras would be deployed. The baited camera traps will be set up across the offset area in particular key habitats. Camera traps will be left out for four weeks. Spotlighting looking for presence of feral animals will also be undertaken.	

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
12. Squatter Pigeon	Condition of Squatter Pigeon habitat including foraging resources	Baseline BioCondition transects will be established in Year 1 across the offset areas. 18 BioCondition transects have been established to date, and additional 31 will be established in all offset areas. This will ensure adequate representation of vegetation communities and habitat types. In Year 3 BioCondition transects will be re-assessed and habitat quality scores prepared for each MNES species. An analysis of changes will be undertaken including those elements tracking well, and any that haven't improved or worsened. Results will be assessed against interim habitat quality scores set out in Table 6.3 for each MNES species. Photo monitoring points in Squatter Pigeon habitat. Weed surveys will be conducted to determine weed species presence, abundance and distribution.	Year 1 will be finalising all baseline BioCondition transects. BioCondition assessments and habitat quality scoring will then occur in the following years to ensure regular progress is evaluated, and to coincide with the 5 yearly milestones. Years 3, 5, 7, 10, 12, 15, 17 and 20. Feral animal baseline survey will occur in Year 1. Feral animal surveys will occur annually between Years 2–Year 5. Then every 2 years from Years 6−20.
	Species presence and abundance	Complete targeted surveys to determine the presence of the species within the offset area. Squatter Pigeon surveys will include: • Diurnal bird surveys between sunrise and 9 am and between 3:30 pm and sunset over minimum of four days. • Camera traps (set up near waterbodies and left out for minimum of 4 weeks). • Driving surveys along dirt tracks.	The first targeted survey for Squatter Pigeon is proposed to occur in Year 2 between May to October when the species is most actively foraging for grass seed. Squatter Pigeon targeted surveys will occur annually between Years 3 and 5. Followed by every two years for the following 5 years. Then Year s10, 15 and 20.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
	Habitat utilisation and dispersal	Based on targeted survey results an evaluation of habitats the species are found in will be undertaken and their location. This is to gain a greater understanding of the habitats they are occurring in including remnant, regrowth and non-remnant, condition and any other relevant factors such as proximity to water, land zone and other climatic conditions. Habitat quality will be monitored through implementation of habitat quality scoring (refer Section 3.2.9).It will also support an understanding of the species distribution across the offset area. The field surveys will confirm presence of Squatter Pigeon within breeding and foraging habitats.	
13. Australian Painted Snipe	Condition of Australian Painted Snipe habitats (through BioCondition assessment, weed surveys)	Baseline BioCondition transects will be established in Year 1 across the offset areas. 18 BioCondition transects have been established to date, and additional 31 will be established in all offset areas. This will ensure adequate representation of vegetation communities and habitat types. Refer Figure 6.1. In Year 3 BioCondition transects will be re-assessed and habitat quality scores prepared for each MNES species. An analysis of changes will be undertaken including those elements tracking well, and any that haven't improved or worsened. Results will be assessed against interim habitat quality scores set out in Table 6.3 for each MNES species. Photo monitoring points in Australian Painted Snipe habitats including representation of remnant, advanced regrowth and cleared areas. Weed surveys will be conducted to determine weed species present, abundance and distribution.	Year 1 will be finalising all baseline BioCondition transects. BioCondition assessments and habitat quality scoring will then occur in the following years to ensure regular progress is evaluated, and to coincide with the 5 yearly milestones. Years 3, 5, 7, 10, 12, 15, 17 and 20. Weed baseline survey will occur in Year 1. Weed monitoring surveys will then occur annually Year 2–Year 10. Weed monitoring will then occur every 2 years from Year 11–Year 20.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
	Species presence and abundance	Targeted surveys for the Australian Painted Snipe will be undertaken to confirm presence of the species within the offset area and population numbers. Targeted surveys will be undertaken by suitably qualified ecologist/s. Monitoring will look to detect the species by the third round of monitoring surveys (i.e. Year 6). Surveys will include daytime searches in preferred habitats flushing species out from shrubs/long grasses etc. Spotlighting is also effective in detecting the species. Spotlighting will be completed across representative areas of the Australian Painted Snipe habitats to confirm presence of the species. The same wetland areas will be surveyed each monitoring survey period to support an estimate of population numbers, and how these are changing over time. The daytime searches are proposed over two days and spotlighting survey will be at least 5 consecutive nights for a team of three ecologists, being a minimum of 120 spotlight hours.	Targeted surveys will occur over warmer months between October to March. Surveys will be timed where possible to occur after rainfall event as species requires shallow wetlands, dams with water, etc for foraging.
	Habitat preferences and seasonal use of area	Based on targeted survey results an evaluation of habitats the species are found in will be undertaken and their location. This is to gain a greater understanding of the habitats they are occurring in including remnant, regrowth and non-remnant, condition and any other relevant factors such as climatic conditions. What are the habitat factors and climatic conditions determining their presence? It will also support an understanding of the species distribution across the offset area.	Targeted surveys will occur over warmer months between October to March. Surveys will be timed where possible to occur after rainfall event as species requires shallow wetlands, dams with water, etc for foraging.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
14. Greater Glider	Condition of Greater Glider habitats (through BioCondition assessment, weed surveys).	Baseline BioCondition transects will be established in Year 1 across the offset areas. 18 BioCondition transects have been established to date, and additional 31 will be established in all offset areas. This will ensure adequate representation of vegetation communities and habitat types. Refer Figure 6.1 and Section 3.3.5. In Year 3 BioCondition transects will be re-assessed and habitat quality scores prepared for each MNES species. An analysis of changes will be undertaken including those elements tracking well, and any that haven't improved or worsened. Results will be assessed against interim habitat quality scores set out in Table 6.3 for each MNES species. Photo monitoring points in Greater Glider habitats including representation of remnant, advanced regrowth and cleared areas. Weed surveys will be conducted to determine weed species present, abundance and distribution.	Year 1 will be finalising all baseline BioCondition transects. BioCondition assessments and habitat quality scoring will then occur in the following years to ensure regular progress is evaluated, and to coincide with the 5 yearly milestones. Years 3, 5, 7, 10, 12, 15, 17 and 20. Weed baseline survey will occur in Year 1. Weed monitoring surveys will then occur annually Year 2–Year 10. Weed monitoring will then occur every 2 years from Year 11–Year 20.
	Greater Glider connectivity	To assess the effectiveness of the management actions in the Stage 1 OAMP to increase Greater Glider *(Petauroides volans)* habitat connectivity in the riparian zones within the Stage 1 environmental offset, the approval holder must engage an independent suitably qualified expert to undertake an assessment every 5 years from the implementation date of the approved Stage 1 OAMP until the approved Stage 1 OAMP offset completion criteria are achieved (refer Section 3.3.5).	Every 5 years from the implementation date of the approved Stage 1 OAMP an independent expert will be engaged to review the offset outcomes and confirm if connectivity has been improved for Greater Glider. This will occur until the approved Stage 1 OAMP offset completion criteria are achieved.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
	Increase habitat connectivity along riparian corridors	Monitoring of the revegetation areas will occur to assess the health and growth of the revegetated species. This will involve BioCondition transects to measure increase in canopy cover, canopy height, groundcover, tree health and photo monitoring to show progress of plantings and woodland maturing. Any threats to revegetated species, such as pest animals, weed species, cattle, will be monitored and any losses of tubestocks will be recorded. This will be augmented by monitoring of Greater Glider use of these revegetation areas through establishment of permanent transects. Linear transects will be established that are 500m long in representative sections of the planting areas. At least 6 permanent transects will be established. These transects will be spotlighted to determine presence of Greater Glider. To show an increase in their presence and therefore increase in connectivity the transects will be spotlighted prior to plantings being undertaken in that area. The permanent linear transects will be spotlighted at the same time each year to determine presence of Greater Glider. Over time as trees grow Greater Glider will come into these areas to forage, particularly if there are denning hollows nearby. To supplement riparian connectivity nest boxes are also proposed to be installed as outlined in Sectoin 4.2.6. Nest box usage will also be monitored.	Monitoring of revegetation areas will occur annually for five years. This will be from the time the area is planted. So if an area is planted in year 4, annual monitoring will occur for another 5 years post that. This is to ensure the trees are self-sustaining at this time. The spotlighting transects in revegetation areas will occur at same frequency as other Greater Glider population monitoring. The first targeted surveys for Greater Glider is proposed to occur in Year 2. The targeted Greater Glider surveys will then be completed every 2 years being Years 4, 6, 8 and 10. Surveys will then go to Years 13, 16 and 19. Timing would be around start of Spring.

Table 6.2 Monitoring for threatened species and offset effectiveness

Monitoring activity	Variables monitored	Monitoring Method	Frequency
	Species presence and abundance	Complete targeted surveys to determine the presence of the species within the offset area. Greater Glider surveys will be primarily focused on spotlighting as this is the most effective survey technique. All habitat types will be surveyed, in particular riparian communities that support hollows. Locations where the species have been previously recorded will be surveyed as shown in Figure 3.10, as well as additional areas of remnant, advanced regrowth and restoration areas. Each spotlighting survey will be at least 5 consecutive nights for a team of three ecologists, being a minimum of 120 hours.	The first targeted survey for Greater Glider is proposed to occur in Year 2. This is to allow BioCondition transects to be established in Year 1 and suitable Greater Glider habitat survey locations to be evaluated. The targeted Greater Glider surveys will then be completed every 2 years being Years 4, 6, 8 and 10. Then targeted Greater Glider surveys would be undertaken in Years 13, 16 and 19. Timing would be around start of Spring.
	Habitat utilisation and dispersal	When Greater Gliders are detected their location and trees in which they are present within will be recorded. This will help to assess habitat utilisation and dispersal across the offset site.	
	Nest box usage	Cameras will be used to determine if Greater Gliders are using nest boxes, or if other species are competing for nest boxes. Direct observations will also be used as a survey method using extended poles with cameras, as well as watching hollows at dusk for species to come out of nest boxes.	Monitoring by suitably qualified persons will include quarterly inspections during the first year which will enable occupation timing to be documented. Following the first year, monitoring of installed nest boxes will occur annually in spring and winter for the next two years, and will then be reduced to biennial monitoring (every 2 years) following a review of the monitoring results. Refer Section 4.2.6 for details on nest box installation and monitoring program.

6.3 Completion criteria and interim milestones

Table 6.3 provides a summary of the habitat quality score increases for each MNES species that are sought to be achieved over the course of the 20 year management timeframe. Pembroke will continue to monitor habitat quality for the duration of the Project approval however these are targets for the first 20 years under which more intensive management will be undertaken. Post-20 years, this will include reduced general maintenance and management.

It includes interim milestones every five years. Interim scores and measurements are identified (applying BioCondition methods) to demonstrate where gains can be achieved, and how progress will be tracked to ensure final habitat quality scores are achieved. Details informing the starting scores for habitat quality can be found in supplementary information provided to DAWE.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
Koala	Remnant woodland	7	7 • A reduction of average non-native plant cover to below 50 % across all HQ monitoring sites - average score increase from 4/10 to 5.2/10. • Improved native shrub canopy cover to >20% across all HQ monitoring sites. • Reduction in wild dog populations by 10% from established baseline. • Evidence of Koalas utilising remnant woodlands during monitoring surveys. This may be through scats, scratches and individuals observed.	7.4 • A reduction of average non-native plant cover to below 25 % across all HQ monitoring sites - average score increase from 5.2/10 to 6/10. • Improved native shrub canopy cover to >40% across all HQ monitoring sites. • Reduction in wild dog populations by 20% from established baseline. • Evidence of Koalas utilising remnant woodlands during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 10% from baseline survey.	7.7 • A reduction of average non-native plant cover to below 5 % across all HQ monitoring sites - average score increase from 6/10 to 10/10. • Improved native shrub canopy cover to >50% across all HQ monitoring sites. • Reduction in wild dog populations by 30% from established baseline. • Evidence of Koalas utilising remnant woodlands during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 15% from baseline survey.	8.2 • Maintenance of average non-native plant cover to below 5 % across all HQ monitoring sites - average score remains 10/10. • Increased Koala mobility due to reduction in non-native plant cover (above) and increase in number of large Koala habitat trees to 15/15 (>100% benchmark score). • Maintaining native shrub canopy cover to >50% across all HQ monitoring sites getting average of 5/5. • Reduction in wild dog populations by 50% from established baseline. • Evidence of Koalas utilising remnant woodlands during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 20% from baseline survey.
	Regrowth woodland	5	5.3 • A reduction of average non-native plant cover to below 50 % across all HQ monitoring sites - average score increase from 4/10 to 5.2/10. • Improved native shrub canopy cover to >20% across all HQ monitoring sites.	5.8 • A reduction of average non-native plant cover to below 25 % across all HQ monitoring sites - average score increase from 5.2/10 to 6/10. • Improved native shrub canopy cover to >40% across all HQ monitoring sites.	6 • A reduction of average non-native plant cover to below 5 % across all HQ monitoring sites - average score increase from 6/10 to 10/10. • Improved native shrub canopy cover to >50% across all HQ monitoring sites.	7.2 • Maintenance of average non-native plant cover to below 5 % across all HQ monitoring sites - average score remains 10/10. • Maintaining native shrub canopy cover to >50% across all HQ monitoring sites getting average of 5/5.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores			
	0 years (starting score)	5 years	10 years	15 years	20 years (final score)
		• Increased Koala foraging habitat quality by increase in native tree species richness (>50% of benchmark). Average score of 3/5. • Improvement of Koala habitat by increase in tree height (>50% of benchmark). Average score of 3/5. • Reduction in wild dog populations by 10% from established baseline. • Evidence of Koalas utilising regrowth woodlands during monitoring surveys. This may be through scats, scratches and individuals observed.	• Increased Koala foraging habitat quality by increase in native tree species richness (>70% of benchmark). • Improvement of Koala habitat by increase in tree height (>60% of benchmark). Average score of 3/5. • Reduction in wild dog populations by 20% from established baseline. • Evidence of Koalas utilising regrowth woodlands during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 10% from baseline survey.	• Increased Koala foraging habitat quality by increase in native tree species richness (>90% of benchmark). Average score of 5/5. • Improvement of Koala habitat by increase in tree height (>70% of benchmark). Average score of 5/5. • Reduction in wild dog populations by 30% from established baseline. • Evidence of Koalas utilising regrowth woodlands during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 15% from baseline survey.	• Maintaining Koala foraging habitat quality by native tree species richness (>90% of benchmark). Average score of 5/5. • Improvement of Koala habitat by tree height reaching benchmark or above (>100% of benchmark). Average score of 5/5. • Reduction in wild dog populations by 50% from established baseline. • Evidence of Koalas utilising regrowth woodlands during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 20% from baseline survey.
Restoration area	1	1.5 • A reduction of average non-native plant cover to below 60 % across HQ monitoring sites in restoration areas - average score increase from 0/10 to 2/10. • Increase in extent of Koala habitat seeding and/or planting 120 ha of locally endemic native Koala food by trees within mapped restoration areas along watercourses by end of first 5 years.	3.1 • A reduction of average non-native plant cover to below 50 % across HQ monitoring sites in restoration areas - average score increase from 2/10 to 3/10. • Increase in extent of Koala habitat by achieving 90% success rate of all planted Koala food trees surviving and being self-sustaining. Average of 300 Koala	4.2 • A reduction of average non-native plant cover to below 30 % across HQ monitoring sites in restoration areas - average score increase from 3/10 to 4/10. • Increase in extent of Koala habitat by achieving 90% success rate of all planted Koala food trees surviving and being self-sustaining. Average of 300 Koala	5.5 • A reduction of average non-native plant cover to below 25 % across HQ monitoring sites in restoration areas - average score increase from 4/10 to 5/10. • Increase in extent of Koala habitat by achieving 90% success rate of all planted Koala food trees surviving and being self-sustaining. Average of 300 Koala food trees per hectare has been achieved.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
			• Increase in recruitment of Koala food tree species to 10% of the benchmark. Average score of 0/5 across HQ monitoring sites in restoration areas. • Reduction in wild dog populations by 10% from established baseline.	food trees per hectare has been achieved. • Increase in recruitment of Koala food tree species to >20% of the benchmark. Average score of 3/5 across HQ monitoring sites in restoration areas. • Increase in tree canopy cover to 15% of benchmark. Average score of 2 out of 5 across HQ monitoring sites in restoration areas. • Increase in tree canopy height to >25% of benchmark. Average score of 3 out of 5 across HQ monitoring sites in restoration areas. • Reduction in wild dog populations by 20% from established baseline. Evidence of Koalas utilising revegetation areas (post 5 years) during monitoring surveys.	food trees per hectare has been achieved. • Increase in recruitment of Koala food tree species to >50% of the benchmark. Average score of 3/5 across HQ monitoring sites in restoration areas. • Increase in tree canopy cover to 30% of benchmark. Average score of 2 out of 5 across HQ monitoring sites in restoration areas. • Increase in tree canopy height to >30% of benchmark. Average score of 3 out of 5 across HQ monitoring sites in restoration areas. • Reduction in wild dog populations by 30% from established baseline. • Evidence of Koalas utilising revegetation areas during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 15% from baseline survey.	• Increase in recruitment of Koala food tree species to >75% of the benchmark. Average score of 5/5 across HQ monitoring sites in restoration areas. • Increase in tree canopy cover to 50% of benchmark. Average score of 5 out of 5 across HQ monitoring sites in restoration areas. • Increase in tree canopy height to >50% of benchmark. Average score of 3 out of 5 across HQ monitoring sires in restoration areas. • Reduction in wild dog populations by 50% from established baseline. • Evidence of Koalas utilising revegetation areas during monitoring surveys. Koala utilisation (eg number fresh scats, individuals observed) has increased 20% from baseline survey.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
Squatter Pigeon	Existing habitat	7	7 • A reduction of average non-native plant cover to below 50 % across all HQ monitoring sites - average score increase from 4/10 to 5.2/10. • Increased foraging resources by native grass cover increasing to over 25% across all HQ monitoring sites – 1.75/5 to 3/5. • Reduction in feral cat populations by 10% from established baseline. • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped existing habitats.	7.2 • A reduction of average non-native plant cover to below 25 % across all HQ monitoring sites - average score increase from 5.2/10 to 6/10. • Increased foraging resources by native grass cover increasing to over 50% across all HQ monitoring sites – 3/5 to 3.5/5. • Reduction in feral cat populations by 20% from established baseline • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped existing habitats. Squatter pigeon utilisation (eg number individuals observed) has increased 10% from baseline survey.	7.9 • A reduction of average non-native plant cover to below 5 % across all HQ monitoring sites - average score increase from 6/10 to 10/10. • Increased foraging resources by native grass cover increasing to over 80% across all HQ monitoring sites – 3.5/5 to 4/5. • Reduction in feral cat populations by 30% from established baseline. • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped existing habitats. Squatter pigeon utilisation (eg number individuals observed) has increased 15% from baseline survey.	8.3 • Maintenance of average non-native plant cover to below 5 % across all HQ monitoring sites - average score remains 10/10. • Increased foraging resources by native grass cover increasing to over 90% across all HQ monitoring sites – 4/5 to 5/5. • Reduction in feral cat populations by 50% from established baseline. • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped existing habitats. Squatter pigeon utilisation (eg number individuals observed) has increased 20% from baseline survey.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
	Restoration area	1	1.5 • A reduction of average non-native plant cover to below 60 % across HQ monitoring sites in restoration areas - average score increase from 0/10 to 2/10. • Increased foraging resources by native grass cover increasing to over 15% across all HQ monitoring sites – 0/5 to 1/5. • Reduction in feral cat populations by 10% from established baseline. • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped restoration habitats. • Improvement in sheltering and habitat quality for species by increase in canopy cover to over 10% of benchmark – 0/5 to 2/5.	2.1 • A reduction of average non-native plant cover to below 50 % across HQ monitoring sites in restoration areas- average score increase from 2/10 to 3/10. • Increased foraging resources by native grass cover increasing to over 30% across all HQ monitoring sites. • Reduction in feral cat populations by 15% from established baseline. • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped restoration habitats. Squatter pigeon utilisation (eg number individuals observed) has increased 10% from baseline survey. • Improvement in sheltering and habitat quality for species by increase in canopy cover to over 30% of benchmark – 2/5 to 2/5.	3.5 • A reduction of average non-native plant cover to below 30% across HQ monitoring sites in restoration areas - average score increase from 3/10 to 4/10. • Increased foraging resources by native grass cover increasing to over 50% across all HQ monitoring sites 1/5 to 3/5. • Reduction in feral cat populations by 30% from established baseline. • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped existing habitats. Squatter pigeon utilisation (number individuals observed) has increased 15% from baseline survey. • Improvement in sheltering and habitat quality for species by increase in canopy cover to over 50% of benchmark – 2/5 to 2/5.	5 • A reduction of average non-native plant cover to below 25 % across HQ monitoring sites in restoration areas - average score increase from 4/10 to 5/10. • Increased foraging resources by native grass cover increasing to over 60% across all HQ monitoring sites – maintain 3/5. • Reduction in feral cat populations by 50% from established baseline. • Maintenance of water resources and water quality by excluding stock from major watercourses. Dams will be maintained to provide additional water sources. • Evidence of Squatter pigeon utilising mapped existing habitats. Squatter pigeon utilisation (eg number individuals observed) has increased 20% from baseline survey. • Improvement in sheltering and habitat quality for species by increase in canopy cover to over 70% of benchmark 2/5 to 5/5.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
Greater Glider	Remnant woodland	7	7.2 • A reduction of average non-native plant cover to below 50 % across HQ monitoring sites - average score increase from 4/10 to 5.2/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 30 %. • Canopy height increase to 30 % across sites - average score from 3/5 to 3.5/5. Maturing of foraging habitat and improved connectivity between patches. • Canopy cover increase to 30 % across sites - average score from 3/5 to 4/5. Improved movements between trees and habitat patches. • Increased denning resources available through installation of 50 nest boxes in Greater Glider habitats. • Evidence of Greater Glider utilising mapped remnant habitats. • Removal of barbed wire fences prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 10% from established baseline.	7.4 • A reduction of average non-native plant cover to below 25 % across HQ monitoring sites - average score increase from 5.2/10 to 6/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 50 %. • Canopy height increase to 50 % across sites - average score from 3.5/5 to 4/5. Maturing of foraging habitat and improved connectivity between patches. • Canopy cover increase to 40 % across sites - average score from 4/5 to 4.5/5. Improved movements between trees and habitat patches. • Evidence of Greater Glider utilising mapped remnant habitats and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 5% from baseline survey. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality.	7.7 • A reduction of average non-native plant cover to below 5 % across HQ monitoring sites - average score increase from 6/10 to 10/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 80 %. • Canopy height increase to 70% across sites - average score from 4.5/5 to 5/5. Maturing of foraging habitat and improved connectivity between patches. • Canopy cover increase to 50 % across sites - average score from 4.5/5 to 4.8/5. Improved movements between trees and habitat patches. • Evidence of Greater Glider utilising mapped remnant habitats and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 10% from baseline survey. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality.	8 • Maintenance of average non-native plant cover to below 5 % across HQ monitoring sites - average score remains 10/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 90 %. • Canopy height increase to 80 % across sites – maintaining score of 5/5. Maturing of foraging habitat and improved connectivity between patches • Canopy cover increase to 60 % across sites - average score from 4.8/5 to 5/5. Improved movements between trees and habitat patches. • Increase in number of tree hollows from the baseline survey. • Evidence of Greater Glider utilising mapped remnant habitats and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 15% from baseline survey. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
				• Reduction in wild dog and cat populations by 20% from established baseline	• Reduction in wild dog and cat populations by 30% from established baseline.	• Number of large trees increased to over 100% of community benchmarks - average score of 15/15. • Reduction in wild dog and cat populations by 50% from established baseline.
	Regrowth woodland	4	4.8 • A reduction of average non-native plant cover to below 50 % across HQ monitoring sites - average score increase from 4/10 to 5.2/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 30 %. • Increased Glider foraging habitat quality by increase in native tree species richness (>50% of benchmark). Average score of 3/5. • Canopy height increase to 20 % across sites - average score from 1.5/5 to 2/5. Maturing of foraging habitat and improved connectivity between patches. • Canopy cover increase to 10% across all sites - average score from 1.5/5 to 2/5. Improved movements between trees and habitat patches. • Increased denning resources available through installation of 6	5.1 • A reduction of average non-native plant cover to below 25 % across HQ monitoring sites - average score increase from 5.2/10 to 6/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 50 %. • Increased Glider foraging habitat quality by increase in native tree species richness (>70% of benchmark). • Canopy height increase to 40 % across all sites - average score from 2/5 to 3/5. Maturing of foraging habitat and improved connectivity between patches. • Canopy cover increase to 30% across all sites - average score from 2/5 to 3/5. Improved movements between trees and habitat patches.	6 • A reduction of average non-native plant cover to below 5 % across HQ monitoring sites - average score increase from 6/10 to 10/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 80 %. • Increased Glider foraging habitat quality by increase in native tree species richness (>90% of benchmark). • Canopy height increase to 60 % across all sites - average score from 3/5 to 3.5/5. Maturing of foraging habitat and improved connectivity between patches. • Canopy cover increase to 50% across all sites - average score from 3/5 to 3.5/5. Improved movements between trees and habitat patches.	7 • Maintenance of average non-native plant cover to below 5 % across HQ monitoring sites - average score remains 10/10. • Fuel loads managed, and cool burns implemented to reduce occurrence of intense fires by 90 %. • Maintain Glider foraging habitat quality by native tree species richness (>90% of benchmark). Average score of 5/5. • Canopy height increase to 70 % across all sites - average score from 3.5/5 to 5/5. Maturing of foraging habitat and improved connectivity between patches. • Canopy cover increase to 60% across all sites - average score from 3.5/5 to 4/5. Improved movements between trees and habitat patches. • Evidence of Greater Glider utilising regrowth habitats and installed nest boxes. Greater Glider utilisation (eg

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores			
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
			nest boxes in Greater Glider regrowth habitats. • Evidence of Greater Glider utilising mapped regrowth habitats. • Removal of barbed wire fences prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 10% from established baseline.	• Evidence of Greater Glider utilising mapped regrowth habitats and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 5% from baseline survey. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 20% from established baseline.	• Evidence of Greater Glider utilising mapped regrowth habitats and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 10% from baseline survey. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 30% from established baseline.	number individuals observed) has increased 15% from baseline survey. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality. • Number of large trees increased to over 50% of community benchmarks - average score of 10/15. • Reduction in wild dog and cat populations by 50% from established baseline.
	Restoration area	1	1.2 • Increase in extent of Glider habitat - seeding and/or planting 120 ha of locally occurring eucalypt spp. within mapped restoration areas along watercourses by end of first 5 years. • A reduction of average non-native plant cover to below 60 % across HQ monitoring sites in restoration areas - average score increase from 4/10 to 5.2/10. • Canopy height increase to 20 % across all sites - average score from 0/5 to 1/5. Maturing of foraging habitat and improved connectivity between patches.	2 • Increase in extent of Glider habitat by achieving 90% success rate of all planted food trees surviving and being self-sustaining. Average of 300 eucalypt trees per hectare has been achieved. • A reduction of average non-native plant cover to below 50 % across HQ monitoring sites in restoration areas - average score increase from 5.2/10 to 6/10. • Canopy height increase to 25% across all sites- average score from 2/5 to 3/5. Maturing of	2.5 • Increase in extent of Glider habitat by achieving 90% success rate of all planted food trees surviving and being self-sustaining. Average of 300 eucalypt trees per hectare has been achieved. • A reduction of average non-native plant cover to below 30 % across HQ monitoring sites in restoration areas - average score increase from 6/10 to 10/10. • Canopy height increase to 35% across all sites - average score from 3/5 to 3.5/5. Maturing of	3 • Increase in extent of Glider habitat by achieving 90% success rate of all planted food trees surviving and being self-sustaining. Average of 300 eucalypt trees per hectare has been achieved. • Maintenance of average non-native plant cover to below 25 % across HQ monitoring sites in restoration areas - average score remains 10/10. • No barbed wire fences occur to prevent any Greater Glider injuries or mortality.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores			
	0 years (starting score)	5 years	10 years	15 years	20 years (final score)
		• Canopy cover increase to 10 % across all sites - average score from 0/5 to 2/5. Improved movements between trees and habitat patches. • Evidence of Greater Glider utilising restoration areas. • Removal of barbed wire fences prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 10% from established baseline.	foraging habitat and improved connectivity between patches. • Canopy cover increase to 20% across all sites - average score from 2/5 to 2.5/5. Improved movements between trees and habitat patches. • Increased denning resources available through installation of 20 nest boxes in Greater Glider restoration/revegetation habitats by Year 10. • Evidence of Greater Glider utilising mapped restoration/revegetation areas and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 5% from baseline survey. One Greater Glider has been observed using a nest box. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 20% from established baseline.	foraging habitat and improved connectivity between patches. • Canopy cover increase to 30% across all sites - average score from 2.5/5 to 3/5. Improved movements between trees and habitat patches. • Increased denning resources available through installation of 100 nest boxes in Greater Glider restoration habitats by Year 15. • Evidence of Greater Glider utilising mapped restoration/revegetation areas and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 10% from baseline survey. Two Greater Gliders have been observed using a nest box. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 30% from established baseline.	• Canopy height increase to 50% across all sites - average score from 3.5/5 to 4/5. Increase in gliding mobility. • Canopy cover increase to 50% across all sites - average score from 3/5 to 5/5. Improved movements between trees and habitat patches. • Increased denning resources available through installation of 180 nest boxes in Greater Glider restoration habitats by Year 18. • Evidence of Greater Glider utilising restoration/revegetation areas and installed nest boxes. Greater Glider utilisation (eg number individuals observed) has increased 15% from baseline survey. Five Greater Gliders have been observed using a nest box. • No barbed wire fence installations to prevent any Greater Glider injuries or mortality. • Reduction in wild dog and cat populations by 50% from established baseline.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
Ornamental Snake	Known important habitat	6	6.7 • A reduction of average non-native plant cover to below 5 % across Ornamental Snake HQ sites - average score increase from 7.5/10 to 10/10. • Improve native perennial grass cover to over 50% of benchmark (3/5). • Improve coarse woody debris to provide sheltering habitat for species. Coarse woody debris is over 40% of benchmark (2/5). • Evidence of Ornamental Snake utilising mapped habitats. • Reduction in feral cat populations by 10% from established baseline. • Reduction in cane toad eggs and tadpoles from established baseline.	7.5 • Maintain non-native plant cover to below 5 % across Ornamental Snake HQ sites - average score maintained at 10/10. • Improve native perennial grass cover to over 60% of benchmark (3/5). • Improve coarse woody debris to provide sheltering habitat for species. Coarse woody debris is over 50% of benchmark (5/5). • Evidence of Ornamental Snake utilising mapped habitats. Ornamental Snake utilisation (eg number individuals observed) has increased 5% from baseline survey. • Reduction in feral cat populations by 15% from established baseline. • Continued reduction in cane toad eggs and tadpoles from established baseline.	7.8 • Maintain non-native plant cover to below 5 % across Ornamental snake HQ sites - average score maintained at 10/10. • Improve native perennial grass cover to over 80% of benchmark (3/5). • Improve coarse woody debris to provide sheltering habitat for species. Coarse woody debris is over 60% of benchmark (5/5). • Evidence of Ornamental Snake utilising mapped habitats. Ornamental Snake utilisation (eg number individuals observed) has increased 10% from baseline survey. • Reduction in feral cat populations by 30% from established baseline. • Continued reduction in cane toad eggs and tadpoles from established baseline.	8 • Maintain non-native plant cover to below 5 % across Ornamental Snake HQ sites - average score increase from 7.5/10 to 10/10. • Improve native perennial grass cover to over 90% of benchmark (3/5 to 5/5). • Improve coarse woody debris to provide sheltering habitat for species. Coarse woody debris is over 80% of benchmark (5/5). • Evidence of Ornamental Snake utilising mapped habitats. Ornamental Snake utilisation (eg number individuals observed) has increased 15% from baseline survey. • Reduction in feral cat populations by 50% from established baseline. • Continued reduction in cane toad eggs and tadpoles from established baseline.

Table 6.3 Habitat quality milestones

Species	Habitat quality	Habitat quality scores				
		0 years (starting score)	5 years	10 years	15 years	20 years (final score)
Australian Painted Snipe	Potential breeding habitat	6	6.9 • Improve native shrub layer cover to 20 % of the benchmark from a score of 1.25/5 to 2.5/5. Increased ground cover for sheltering and foraging opportunities. • Improve native shrub richness to 25% of the benchmark from a score of 3.25/5 to 3.5/5. Additional sheltering opportunities. • Evidence of Australian Painted Snipe utilising mapped habitats. • Reduction in wild dog and cat populations by 10% from established baseline. • Improvement of habitat and water quality by excluding stock from wetland areas.	7.3 • Improve native shrub layer cover to 30 % from a score of 2.5/5 to 3/5. Increased ground cover for sheltering and foraging opportunities. • Improve native shrub richness to 50% from a score of 3.5/5 to 4.5/5. Additional sheltering opportunities. • Evidence of Australian Painted Snipe site utilisation during monitoring surveys. Snipe utilisation (eg number individuals observed) has increased 5% from baseline survey. • Reduction in wild dog and cat populations by 20% from established baseline. • Maintenance of habitat and water quality by excluding stock from wetland areas.	7.8 • Improve native shrub layer cover to 40 % from a score of 3/5 to 4/5. Increased ground cover for sheltering and foraging opportunities. • Improve native shrub richness to 60% maintaining a score of 4.5/5. Additional sheltering opportunities. • Evidence of Australian Painted Snipe site utilisation during monitoring surveys. Snipe utilisation (eg number individuals observed) has increased 10% from baseline survey. • Reduction in wild dog and cat populations by 30% from established baseline. • Maintenance habitat and water quality by excluding stock from wetland areas.	8 • Improve native shrub layer cover to 50 % from a score of 4/5 to 5/5. Increased ground cover and sheltering opportunities. • Improve native shrub richness to 90% from a score of 4.5/5 to 5/5. Additional sheltering opportunities. • Evidence of Australian Painted Snipe site utilisation during monitoring surveys. Snipe utilisation (eg number individuals observed) has increased 15% from baseline survey. • Reduction in wild dog and cat populations by 50% from established baseline. • Maintenance habitat and water quality by excluding stock from wetland areas.

7 Reporting

7.1 Annual reporting

Environmental offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced. To support transparent governance arrangements, and demonstrate compliance with the OAMP, regular compliance and monitoring reporting is proposed to occur as per Conditions 4i-k (EPBC 2017/7868, 2017/7896 and 2017/7870).

An Annual Report will be prepared and submitted to DAWE for their information.

The Annual Report is proposed to be submitted by 30 June each year. This date is to allow for the main monitoring periods in late Summer – early Autumn each year to be completed, and adequate time for report preparation to occur.

The Annual Report will be prepared by suitably qualified personnel with experience in offset management and threatened species, and will be signed off by Pembroke.

The Annual Report will include:

- description of all management actions that have been completed in that 12 month period;
- description of the monitoring activities that were completed and results (Approval conditions for 2017/7867);
- habitat quality scores, using the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2017), (for those years when they are required) for each MNES species and how they are tracking against relevant interim 5-yearly goal (refer Section 3.2.9 and Table 6.3; see also Appendix C);
- identification of any constraints to monitoring and management actions over that timeframe (eg high rainfall event therefore inability to access some areas due to flooding, etc);
- how any risks or threats have impacted on the area (eg drought period therefore lack of growth);
- photos from photo monitoring points;
- identification of any risks or potential threats to the offset and offset values that have become apparent and how they will be addressed;
- any corrective actions implemented during the 12 month period;
- any learnings from implementation of the OAMP and monitoring; and
- any changes to the OAMP that may be proposed and justification.

7.2 Data management

Pembroke will ensure that all data collected as part of the OAMP implementation is managed and stored appropriately. A data management framework will be established to ensure proper data quality assurance, storage and protection occurs.

Key features of the data management will be:

- spatial data collection proformas for use in the field to ensure robust data is collected, and in a consistent manner;
- establishment of a geodatabase for management of spatial data;
- standardised data collection methods by qualified personnel, particularly for monitoring so that it is completed consistently each year to enable comparison of results;
- quality assurance review process by suitably qualified persons;
- version control of data and reports; and
- appropriately stored information for future use and reference.

7.3 Audits

In addition to any audit required under EPBC conditions of approval, self-auditing will be undertaken over the life of the offset to verify OAMP implementation is occurring, and progress towards the management outcomes and completion criteria are being achieved. Pembroke will commission this self-auditing to occur as part of the ongoing monitoring program as detailed in Section 6 and every five years as part of a more formal review of the success of management actions and effectiveness of the OAMP. This is to meet Condition 7 (EPBC 2017/7867) for monitoring reporting. Corrective actions will be undertaken if standards are not met (Section 4 and Table 4.1).

Systems for recording management action implementation and performance will be auditable, and include details of who, what, where and how implementation and performance were identified and/or assessed. This will include Pembroke keeping records of information such as:

- contractors expense claims for chemicals and materials for actions such as weed management, fence construction and maintenance, pest animal control, establishing and maintaining fire breaks;
- engagement of contractors to complete particular tasks such as feral animal control, direct seeding and tree planting, fire management and associated invoices;
- engagement of contractors to undertake ecological monitoring, spatial data and associated reports; and
- any internal staff conducting an internal audit and inspection of the offset site and key findings.

7.4 Five yearly report

At the completion of every five years a report will be prepared to assess how the offset is tracking for each MNES against the completion criteria, set out in Table 6.3. The report will include recommendations for any changes to the OAMP that may be required and justification. This may include discussion on progress against set interim milestones, corrective actions implemented and adaptive management changes that may be justified.

To meet conditions of approval (2017/7867 – conditions 7 and 8) the following will be undertaken and included as part of the 5 yearly reports:

1. To assess the effectiveness of the management actions in the Stage 1 OAMP to increase Greater Glider (*Petauroides volans*) habitat connectivity in the riparian zones within the Stage 1 environmental offset, the approval holder must engage an independent suitably qualified expert to undertake an assessment every

5 years from the implementation date of the approved Stage 1 OAMP until the approved Stage 1 OAMP offset completion criteria are achieved.

2. The approval holder must ensure each assessment of the effectiveness of the management actions in the Stage 1 OAMP is:

   a) subject to a peer-review completed within 6 months of the completion of each such assessment; and

   b) published on its website with the findings of the peer-review within 6 months of the completion of the peer-review and for the duration of this approval.

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DoE 2014b, *Approved Conservation Advice for Denisonia maculata*. Commonwealth of Australia.

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TSSC 2016, *Conservation Advice Petauroides volans greater glider*. Threatened Species Scientific Committee.

Appendix A

Curriculum vitaes

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)

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- 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.
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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

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- 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)

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Chris Beavon

Associate Ecologist

Curriculum vitae

Chris is an Associate Ecologist with 15 years' professional experience throughout Queensland, New South Wales, Northern Territory and Victoria.

Chris has delivered environmental assessments, monitoring and management projects across a range of sectors including energy, mining, renewables, urban development, infrastructure, and natural resource management. His diverse project experience includes terrestrial ecology assessment, environmental impact statements, protected plant surveys, translocation and monitoring of threatened species, biosecurity assessment and management, compliance assessment, and vegetation rehabilitation.

Qualifications

- Bachelor of Science, University of Queensland, 2010
- BioCondition v2.2 Application, Assessment and Scoring, Oberonia Botanical Services, 2016
- Regional Ecosystem Training, Oberonia Botanical Services, 2016
- Certificate IV in Small Business Management, Sarina Russo, 2014
- Conservation and Land Management, Certificate I & II (in progress), Hortus Australia, 2004

Career

- EMM Consulting, 2019–present
- Director/Senior Ecologist, E2M Consulting, 2014–2019
- Director/Senior Ecologist, Terrestrial Ecology Co, 2013
- Senior Ecologist, AMEC Environment & Infrastructure, 2011–2012
- Ecologist, Mining and Engineering Technical Services, 2010–2011
- Ecologist/Senior Bush Regenerator, Ecosure, 2007–2010
- Senior Bush Regenerator, Bushcare Services, 2005–2007
- Bush Regenerator/Nursery Hand, Barung Landcare, 2003–2005

Representative experience

Ecological monitoring and management

- Australia Pacific LNG Pipeline Network, rehabilitation photo-monitoring assessment program, biosecurity monitoring/mapping, and reporting, (Origin Energy)
- KABAN Green Power Hub Wind Farm Project, vegetation management plans, fauna management plans, and bird and bat management plans, Ravenshoe Qld, (Neoen Australia)
- Directlink and Murraylink Electricity Transmission lines, review of biosecurity management plans and operational environmental management plans, gap analysis, and facilitation of team specific workshops, Mullumbimby and Berri NSW (APA Group)

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- Berwyndale Wallumbilla Pipeline, review of biosecurity management plans and operational environmental management plans, gap analysis, and facilitation of team specific workshops, Berwyndale to Wallumbilla Qld (APA Group)
- Carpentaria Gas Pipeline, review of biosecurity management plans and operational environmental management plans, gap analysis, and facilitation of team specific workshops, Ballera and Mount Isa Qld (APA Group)
- Reedy Creek Wallumbilla Pipeline, review of biosecurity management plans and operational environmental management plans, gap analysis, and facilitation of team specific workshops, Reedy Creek and Wallumbilla Qld (APA Group)Roma Brisbane Pipeline, review of biosecurity management plans and operational environmental management plans, gap analysis, and facilitation of team specific workshops, Wallumbilla gas hub, near Roma, to Brisbane Qld (APA Group)South West Queensland Pipeline, review of biosecurity management plans and operational environmental management plans, gap analysis, and facilitation of team specific workshops, Wallumbilla in South East Queensland to Moomba NSW (APA Group)
- 'Wipe Out Weeds' Biosecurity Surveys, biosecurity survey of various reserves managed by Brisbane City Council, in accordance with the State legislation and local council weed and pest management plan, Brisbane (Brisbane City Council)

Ecological impact assessments

- Australia Pacific LNG, detailed ecological assessment, watercourse determinations and threatened species searches, Surat Basin Qld (Origin Energy)
- Rodds Bay Solar Farm, ecological survey, identify fauna habitat values and potential advanced offset areas, Bororen Qld (Renew Estate)
- Targinnie Solar Farm, preliminary environmental constraints assessment, Yarwun Qld (Renew Estate)
- Carmichael Coal Mine, pre-clearance surveys including biocondition assessment, animal breeding places, threatened species assessment and vegetation ground-truthing, Galilee Basin Qld (Adani Australia)
- QCLNG Pipeline, pre-clearance environmental surveys, Surat Basin Qld (Queensland Gas Company)
- Kevin's Corner Coal Mine Project, off lease rail and road survey report, survey and assessment for Black-throated Finch supplementary MNES report, Galilee Basin Qld (GVK/Hancock Coal)

Biodiversity assessments

- Snowy Hydro 2.0, Adit closure and microbat monitoring, targeted Booroolong frog (*Litoria booroolongensis*), arboreal fauna trapping and targeted bird surveys, Kosciuszko National Park NSW (Snowy Hydro Limited)
- KABAN Green Power Hub Wind Farm Project, protected plants surveys and association documentation for preliminary geotechnical works, Ravenshoe Qld (Neoen Australia)
- Inland Rail geotechnical Investigations, protected plant surveys, protected plants reporting, Toowoomba Qld (Australian Rail Track Corporation)
- Roma to Brisbane Pipeline Toowoomba replacement section, ecological assessment and protected plants surveys with associated documentation for clearing permits, Toowoomba Qld (APA Group)
- Carmichael Coal Mine, targeted Black-throated Finch (southern sub-species) (*Poephila cincta cincta*) monitoring surveys and habitat assessment, Galilee Basin Qld (Adani Australia)
- Alcan Gove, bauxite mine pre-clearance surveys, management and monitoring of protected species translocation program, Gove NT (Rio Tinto)
- South Galilee Coal Project, vegetation verification, detailed flora and fauna assessments, preparation of terrestrial ecology flora and fauna chapters for EIS, Alpha Qld (AMCI Pty Ltd)
- M1/M3 Merge Project, vegetation survey and mapping, koala habitat and offset assessment, fauna and flora survey, Eight Mile Plains to Rochedale Qld (Jacobs)
- Boondooma Dam, ecological assessment and targeted flora surveys, South Burnett Region Qld (Fulton Hogan)
- Wiggins Island Balloon Loop, design monitoring and evaluation, fish surveys, and surface water quality sampling, Gladstone Qld (Aurizon)
- Environmental vegetation community's assessment, detailed assessment of Environmental Vegetation Communities (utilising Victoria's Habitat Hectare Assessment technique), threatened flora surveys, data entry and analysis, throughout Victoria (Department of Sustainability and Environment Victoria)

Servicing projects throughout Australia and internationally

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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)

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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 expierience

- 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.

creating opportunities

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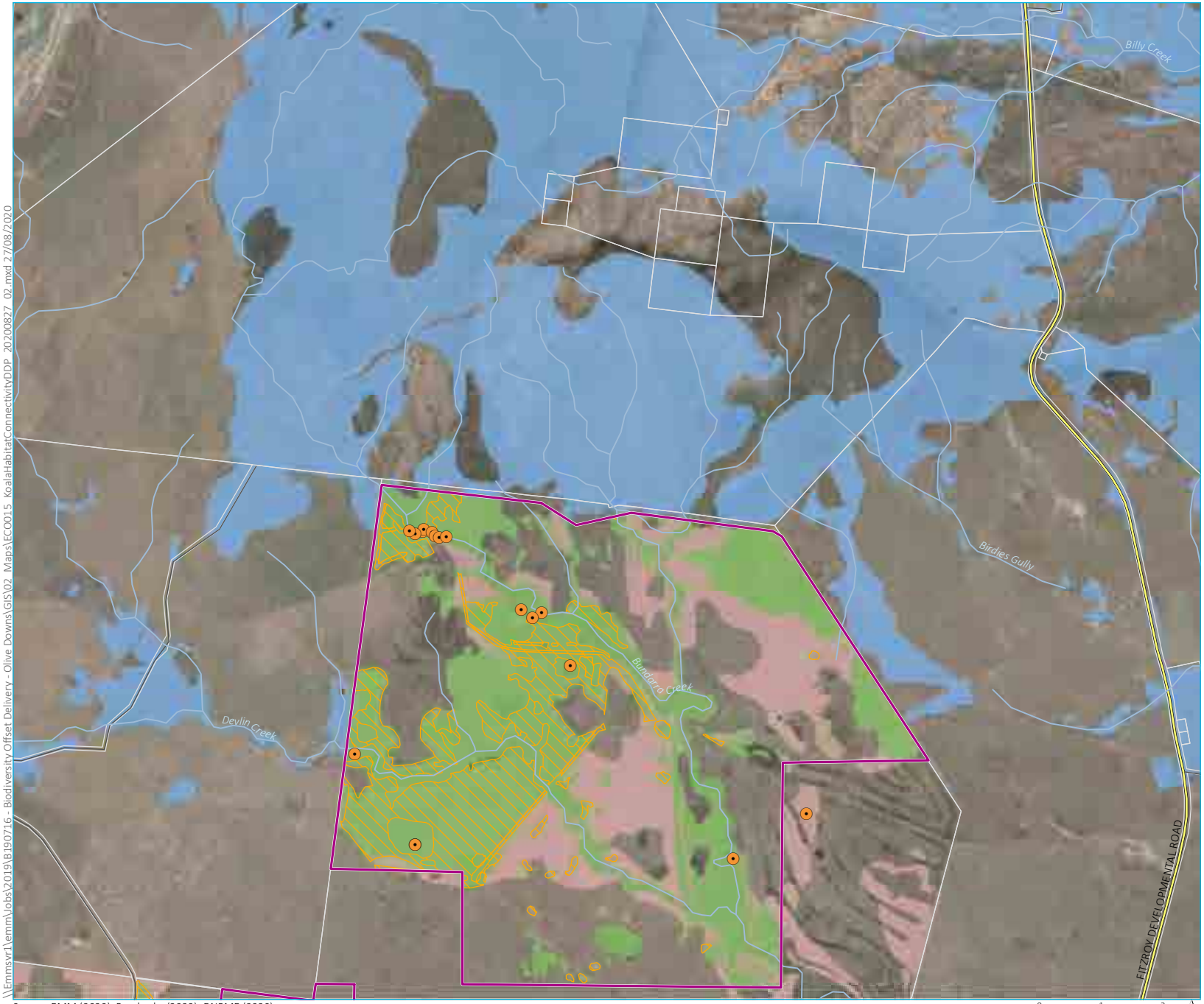
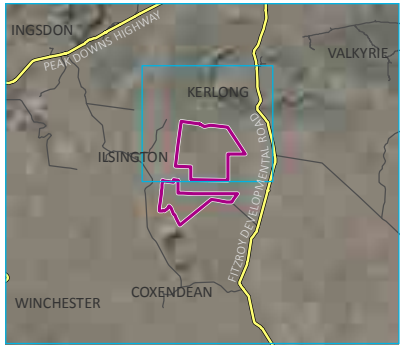
Appendix B

Connectivity values





KEY

- Koala record
- Koala habitat (breeding or foraging)
- Koala habitat restoration area
- Koala suitable habitat
- Advanced regrowth
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Named watercourse
- Cadastral boundary

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

0 1 2 km

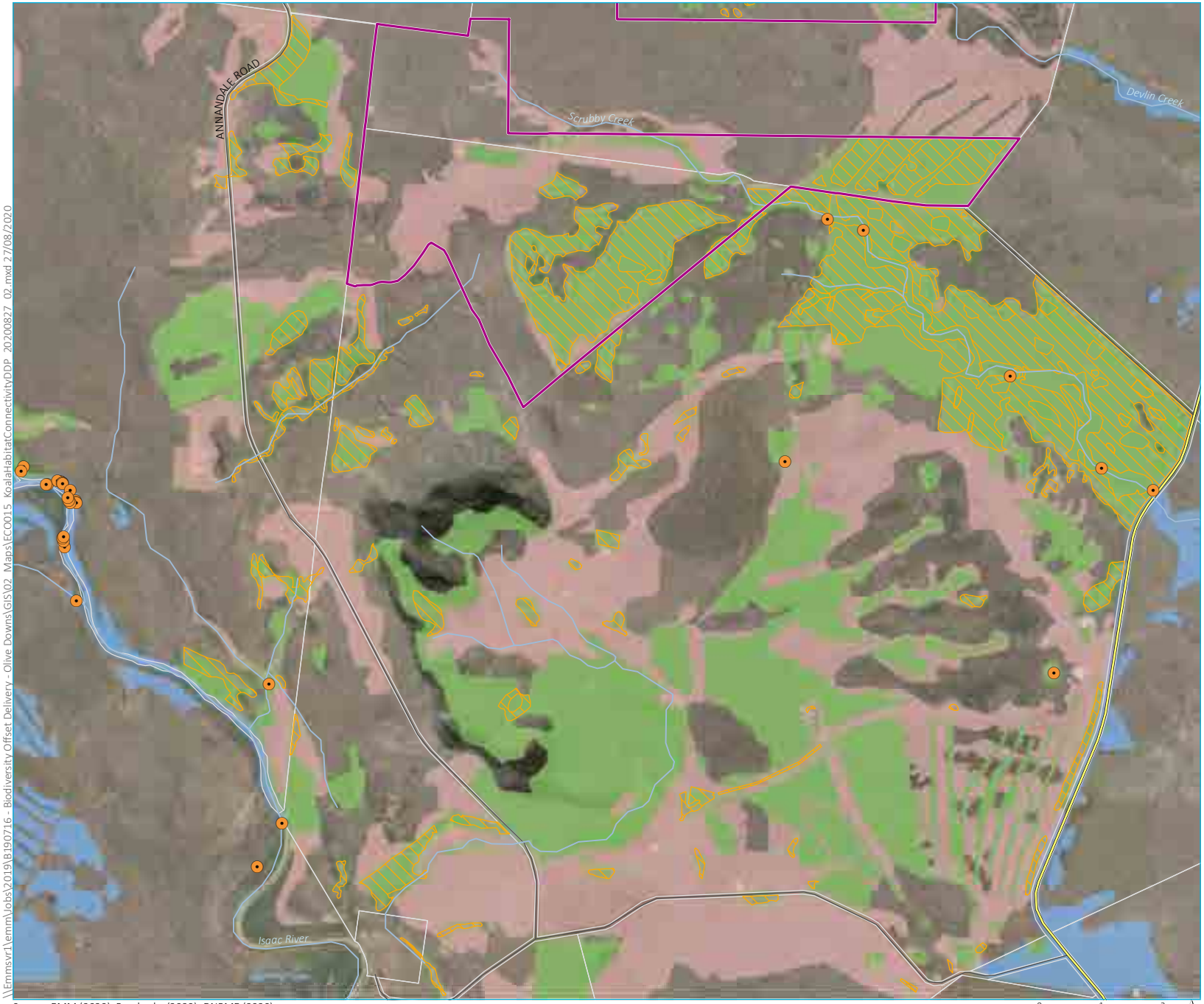
GDA 1994 MGA Zone 55

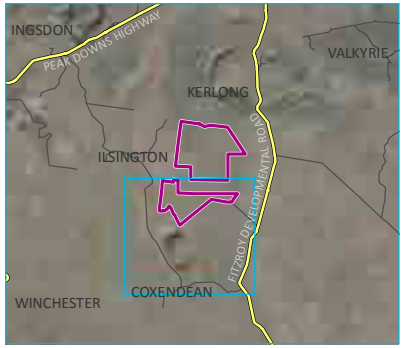
N

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO015 KoalaHabitatConnectivityDDP 20200827 02.mxd 27/08/2020

Koala connectivity values map 1 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.1





KEY

- Koala record
- Koala habitat (breeding or foraging)
- Koala habitat restoration area
- Koala suitable habitat
- Advanced regrowth
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Named watercourse
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

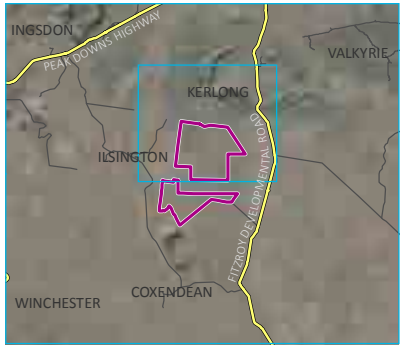
N

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO015 KoalaHabitatConnectivityDDP 20200827 02.mxd 27/08/2020

Koala connectivity values map 2 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.1

EMM



KEY

- Greater Glider record
- Greater Glider habitat (potential breeding and foraging)
- Greater Glider habitat restoration area
- Greater Glider suitable habitat
- Advanced regrowth
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

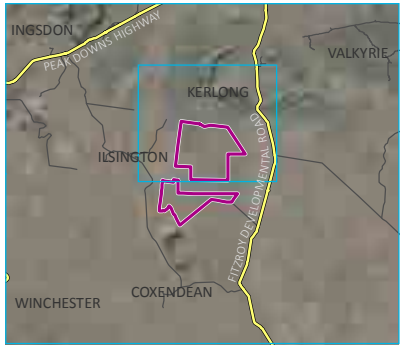
N

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO019 GreaterGliderHabitatConnectivityDDP 20200827 02.mxd 27/08/2020

Greater Glider connectivity values map 1 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.2

EMM



KEY

- Greater Glider record
- Greater Glider habitat (potential breeding and foraging)
- Greater Glider habitat restoration area
- Greater Glider suitable habitat
- Advanced regrowth
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

N

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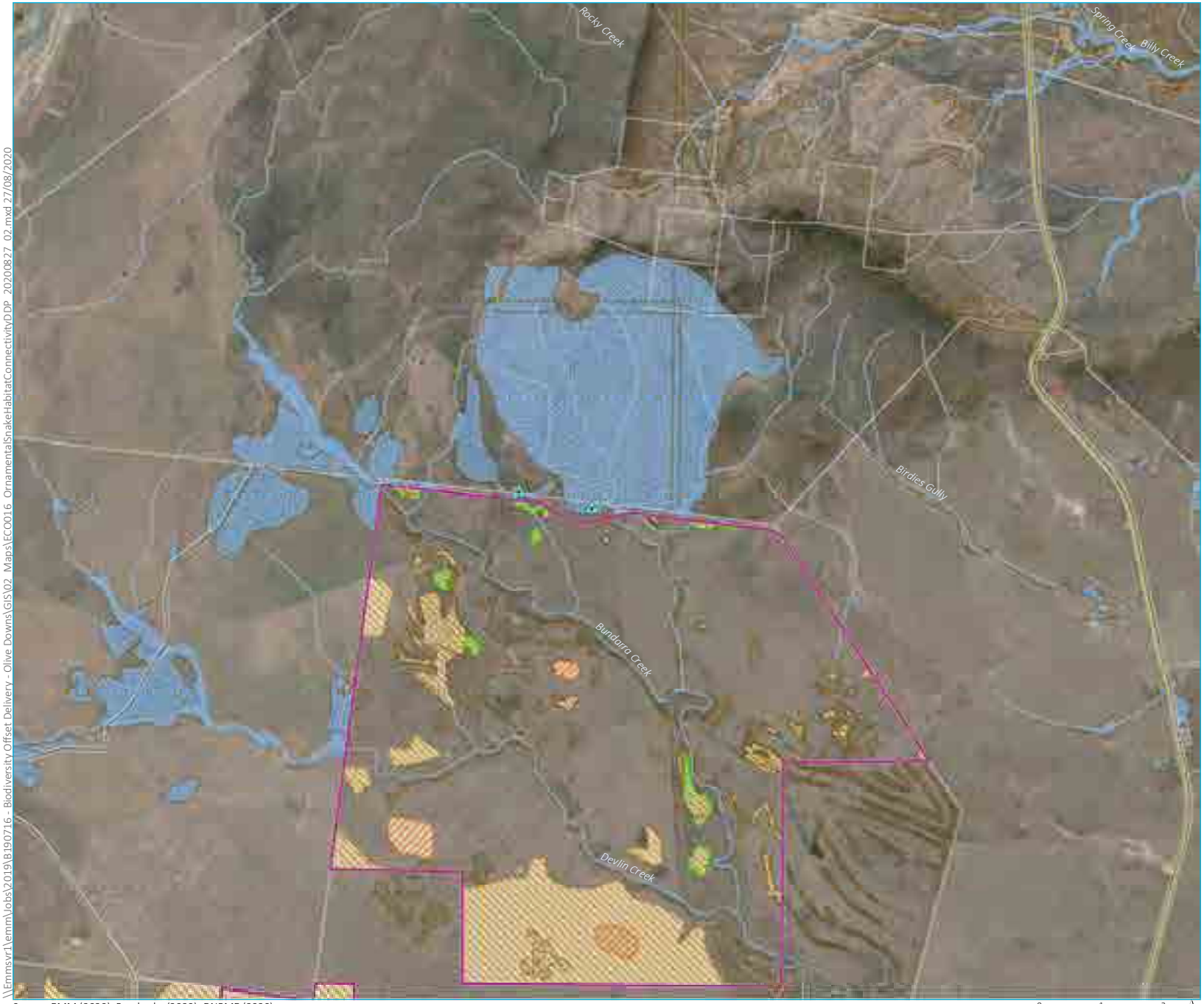
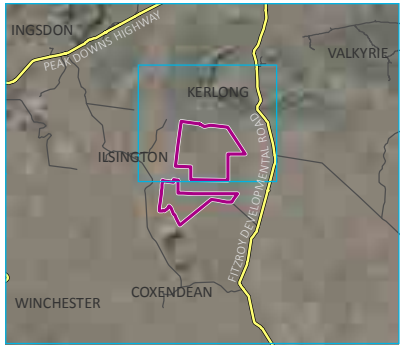
Greater Glider connectivity values map 2 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.2





KEY

- Ornamental Snake record
- Known important habitat (including suitable and dispersal habitat)
- Suitable habitat
- Regional ecosystems associated with the Ornamental Snake (RE 11.4.8, 11.4.9, 11.11.1)
- Palustrine and Lacustrine wetlands (potential frog habitat)
- Gilgai Soils (DPM Enviroscienses, 2019)
- Brigalow TEC
- Stage 1 offset area

Existing environment

- Minor road
- Major road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

N

Ornamental Snake connectivity values map 1 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.3

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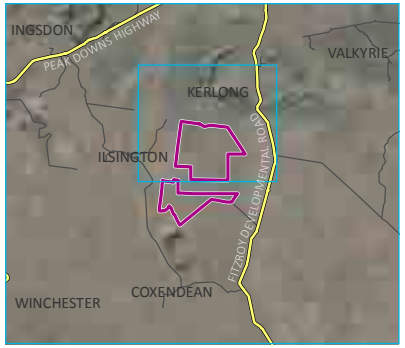
\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO016 OrnamentalSnakeHabitatConnectivityDDP 20200827 02.mxd 27/08/2020



KEY

- Ornamental Snake record
- Known important habitat (including suitable and dispersal habitat)
- Suitable habitat
- Regional ecosystems associated with the Ornamental Snake (RE 11.4.8, 11.4.9, 11.11.1)
- Palustrine and Lacustrine wetlands (potential frog habitat)
- Gilgai Soils (DPM Enviroscienses, 2019)
- Brigalow TEC
- Stage 1 offset area

Existing environment

- Minor road
- Major road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

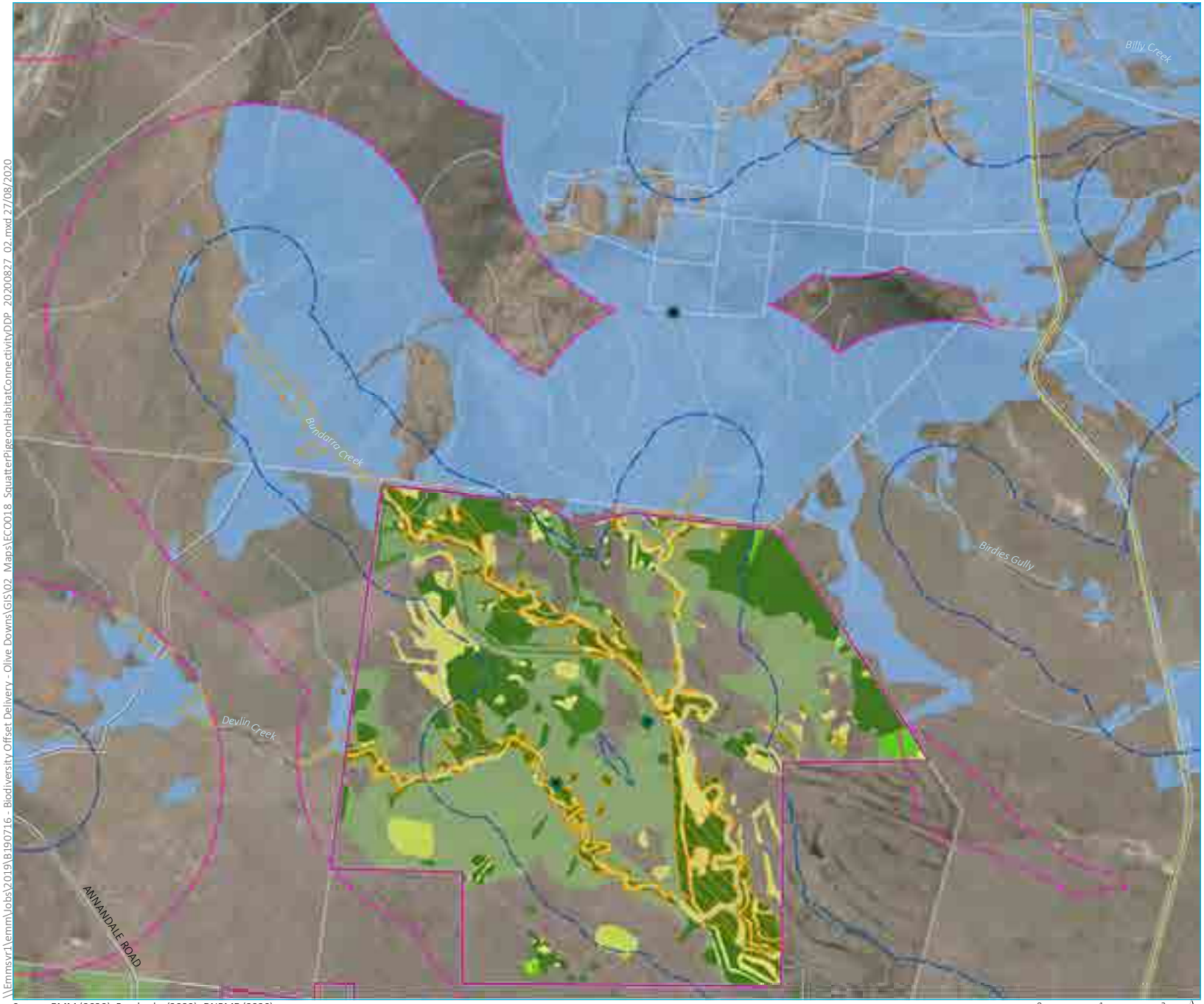
N

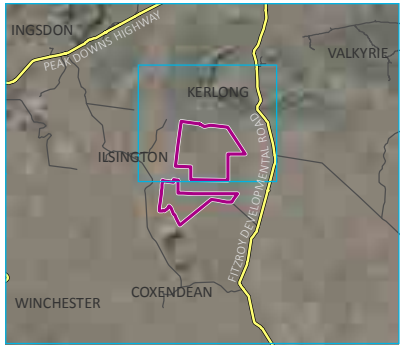
\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO016 OrnamentalSnakeHabitatConnectivityDDP 20200827 02.mxd 27/08/2020

Ornamental Snake connectivity values map 2 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.3

EMM





KEY

- Squatter Pigeon record
- Potential breeding habitat
- Potential foraging habitat
- Potential dispersal habitat
- Habitat restoration area
- Suitable habitat
- Regional Ecosystem 11.3.2 and 11.3.7
- 1 km boundary from seasonal waterbody/watercourse
- 3 km boundary from seasonal waterbody/watercourse
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

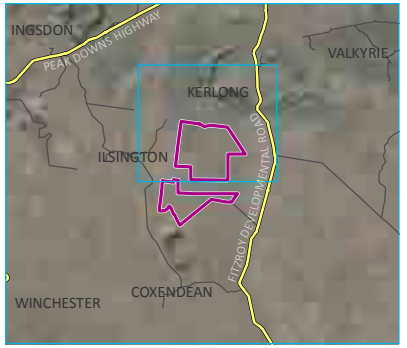
N

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO018 SquatterPigeonHabitatConnectivityDDP 20200827 02.mxd 27/08/2020

Squatter Pigeon connectivity values map 1 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.4

EMM



KEY

- Squatter Pigeon record
- Potential breeding habitat
- Potential foraging habitat
- Potential dispersal habitat
- Habitat restoration area
- Suitable habitat
- Regional Ecosystem 11.3.2 and 11.3.7
- 1 km boundary from seasonal waterbody/watercourse
- 3 km boundary from seasonal waterbody/watercourse
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

N

Squatter Pigeon connectivity values map 2 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.4

EMM

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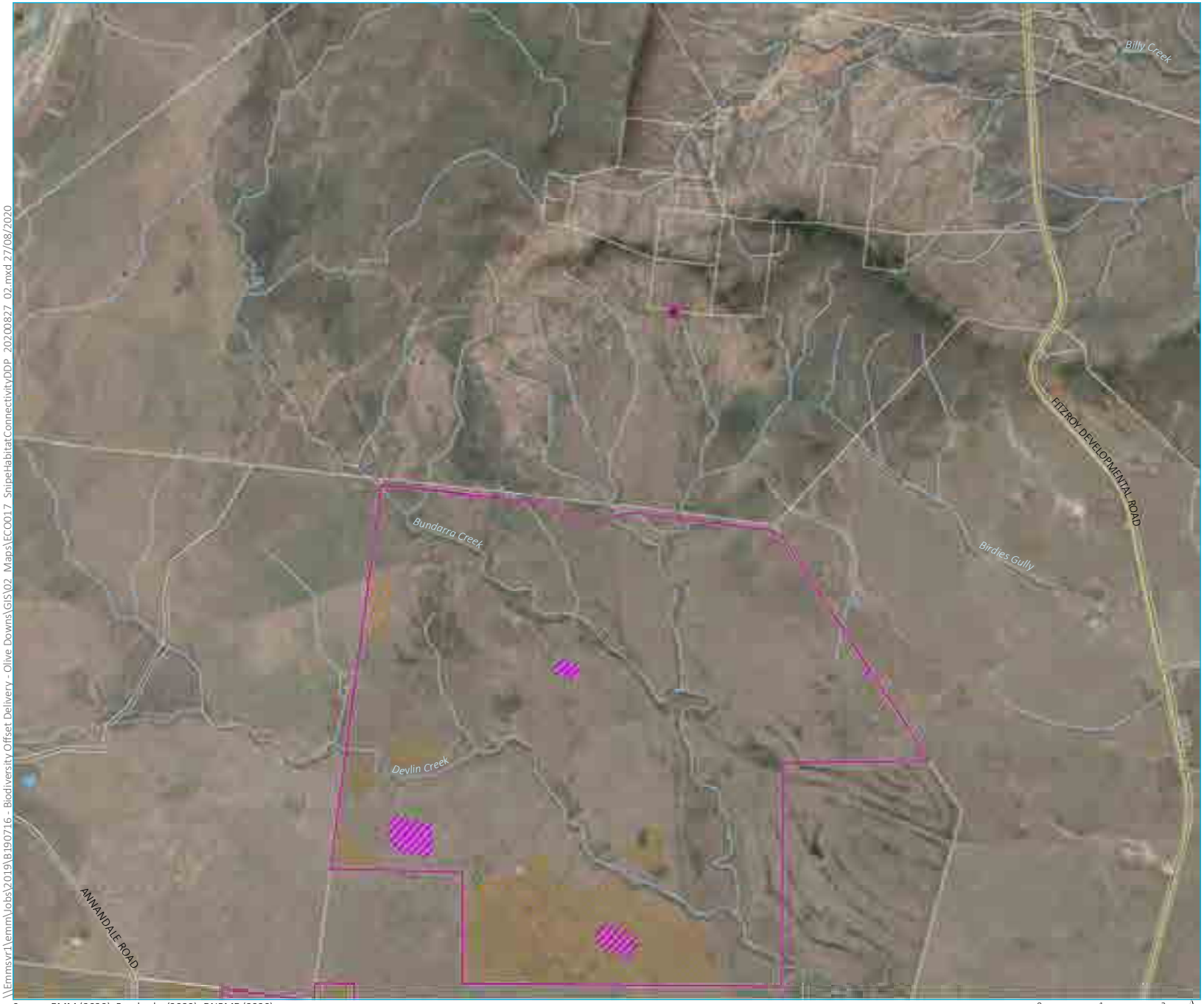
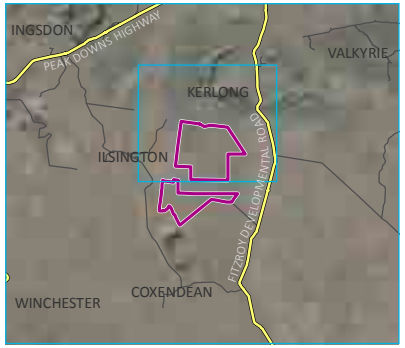




KEY

- Australian Painted Snipe record
- Australian Painted Snipe habitat (potential breeding and foraging)
- Australian Painted Snipe suitable habitat
- Palustrine and Lacustrine wetlands with suitable habitat features for breeding
- Gilgai Soils (DPM Enviroscience, 2019)
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

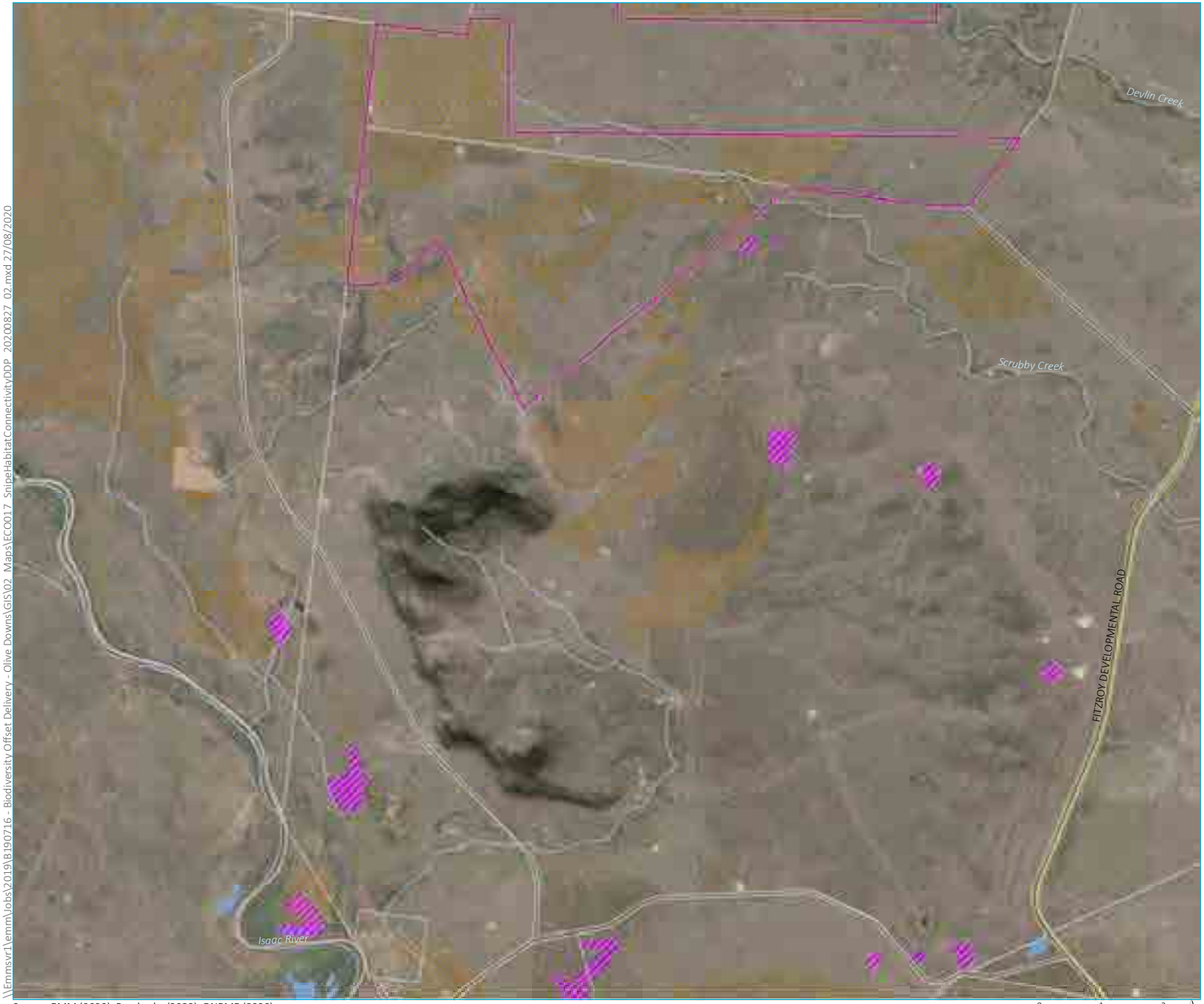
GDA 1994 MGA Zone 55

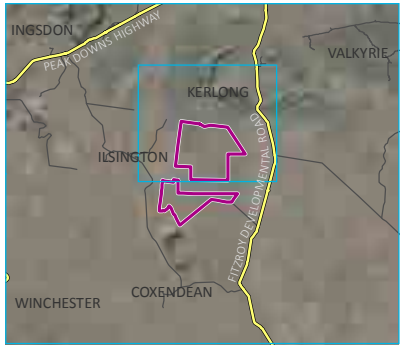
N

\\Emmsvr1\emm\Jobs\2019\B190716 - Biodiversity Offset Delivery - Olive Downs\GIS\02 Maps\ECO017 SnipeHabitatConnectivityDDP 20200827 02.mxd 27/08/2020

Australian Painted Snipe connectivity values map 1 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.5





KEY

- Australian Painted Snipe habitat (potential breeding and foraging)
- Australian Painted Snipe suitable habitat
- Palustrine and Lacustrine wetlands with suitable habitat features for breeding
- Gilgai Soils (DPM Envirosciences, 2019)
- Stage 1 offset area

Existing environment

- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary

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

0 1 2 km

GDA 1994 MGA Zone 55

N

Australian Painted Snipe connectivity values map 2 of 2

Olive Downs
Stage 1 offset area management plan
Figure D.5

EMM

Appendix C

Implementation schedule

Table C.1 Implementation schedule

Activity	Management actions	Management years																				Timing	Related monitoring
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Post 20 years - Remainder of Project duration	
Offset admin	Audits of management actions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Around March/April. Prior to June.	Assess tasks have been completed with the approved OAMP Audit report prepared See Table 6.2 monitoring activity 1
	Corrective actions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Within 3 months of identifying corrective action is required.	Implement corrective actions when required See Table 6.2 monitoring activity 3
	Review monitoring programs, assess effectiveness of management actions and corrective actions against completion criteria.					✓					✓					✓					✓		End of each 5 years. Formal review of OAMP.	Review of monitoring programs See Table 6.2 monitoring activity 2 and 4
Weed management	Weed baseline survey	✓																					During Year 1	Establish permanent weed monitoring transects and photo points. See Table 6.2 activity 5
	Weed monitoring surveys		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓		✓		✓	✓	Annually for first 10 years. Every second year 10-20. Post year 20 weed mg't will continue and surveys will be done every second year.	
Feral animal management	Feral animal baseline survey	✓																					During Year 1	Establish baited camera traps Spotlighting in conjunction with Ornamental Snake and Koala monitoring See Table 6.2 activity 6
	Feral animal surveys		✓	✓	✓	✓	✓		✓		✓		✓		✓		✓		✓		✓	✓	Annually Years 2-5. Every second year 6-20. Post year 20 feral animal mg't will continue.	
Fire management	Monitor fuel loads	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Quadrat sampling monthly, then weekly when grazing is occurring. Post year 20 grazing will continue as per OAMP.	Fuel reduction burns if required See Table 6.2 activity 7
	Assess firebreaks (fences and tracks)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Annually	
	Cool/mosaic burning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	As required	
Grazing management	Monitor fuel loads	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Quadrat sampling monthly, then weekly when grazing is occurring Post year 20 grazing will continue as per OAMP to assist manage fuel loads	Monitor fuel loads, survey fences and assess grazed areas for effectiveness See Table 6.2 activity 8
	Maintaining fences	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Annually	
	Assess grazed areas	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	As required	
	Grazing management checklist	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Quarterly	

Table C.1 Implementation schedule

Activity	Management actions	Management years																			Timing	Related monitoring
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Post 20 years - Remainder of Project duration		
Habitat quality	Habitat quality assessments (Permanent BioCondition transects)	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓			Baselines to be established in Year 1. Habitat quality/BioCondition to be scored every two years to track progress against Table 6.3.	BioCondition assessments and habitat quality scoring. Habitat assessment for each MNES See Table 6.2 activity 9
Ornamental Snake surveys	Targeted surveys		✓		✓		✓		✓		✓			✓			✓			✓			Between late September to late March	Spotlighting along permanent transects See Table 6.2 activity 10
Koala surveys	Targeted surveys		✓		✓		✓		✓		✓			✓			✓			✓			Between August and January	SAT surveys (permanent transects are chosen and replicated) Indirect survey methods such as looking for scratches and scats (particularly focused along riparian corridors) Spotlighting (sampling all habitat types) Call playback (done during spotlighting) Health assessments and location assessments See Table 6.2 activity 11
Squatter Pigeon surveys	Targeted surveys		✓	✓	✓	✓		✓		✓	✓					✓					✓		Between May and October	Diurnal surveys and camera traps See Table 6.2 activity 12
Australian Painted Snipe surveys	Targeted surveys		✓		✓		✓		✓		✓			✓			✓			✓			Between October and March	Diurnal surveys and spotlighting See Table 6.2 activity 13
Greater Glider surveys	Targeted glider surveys		✓		✓		✓		✓		✓			✓			✓			✓			Every second year up to Year 10. Then every 3 years to Year 20.	Spotlighting Nest box monitoring See Table 6.2 activity 14
	Surveys of revegetation areas				✓	✓	✓	✓	✓	✓	✓	✓											Annually for five years post plantings. This will be from the time the area is planted. Revegetation to commence year 3	
	Survey of Greater Glider connectivity in revegetation areas				✓		✓		✓		✓			✓			✓			✓			Linear spotlighting transects. Every second year up to Year 10. Then every 3 years to Year 20.	
	Nest boxes	✓	✓	✓		✓		✓		✓		✓		✓		✓		✓		✓			Quarterly during Year 1, then in Spring and Winter for Years 2 and 3. Then every two years in Spring.	
Reporting	Annual Report	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		By June 30 each year	Section 7.1
	5 Yearly Reports (includes peer reviews)					✓					✓					✓					✓		Every 5 years	Section 7.4