



MIDDLEMOUNT COAL MINE OFFSET MANAGEMENT PLAN/ VEGETATION MANAGEMENT PLAN

NOVEMBER 2013



MIDDLEMOUNT COAL MINE
 OFFSET MANAGEMENT PLAN/
 VEGETATION MANAGEMENT PLAN



Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	Approval Date
All	1	Original (Middlemount Coal [Stage 2] Project offset area)	SEWPaC	30 November 2012
All	2	Inclusion of: <ul style="list-style-type: none"> • Middlemount Coal Mine Rail Loop and Spur offset areas; • Parrot Quarry offset areas; • Thirteen Mile Gully Diversion offset areas; • Amendments to the Middlemount Coal (Stage 2) Project offset area; • VDec Requirements; and • DNRM comments. 	DNRM (August 2013)	25 November 2013 (Refer to the VDec Notice)
			DotE (February 2014) (plan dated November 2013 to reflect VDec Notice)	18 March 2014

November 2013
 Project No. GCL-12-21
 Document No. 00583449.docx

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This Offset Management Plan has been approved for issue by Middlemount Coal Pty Ltd.

A handwritten signature in black ink, appearing to read 'Gerrie Jordaan', is enclosed within a large, hand-drawn circle.

Gerrie Jordaan
Chief Executive Officer
Middlemount Coal Pty Ltd
100 Edward Street
Brisbane QLD 4000
P: 07 3179 2010
F: 07 3179 2098
E: gjordan@middlemountcoal.com.au

Date: 19 April 2013

EXECUTIVE SUMMARY

This Offset Management Plan/Vegetation Management Plan has been prepared to describe how Middlemount Coal Pty Ltd (MCPL) will manage offset areas established for various components of the Middlemount Coal Mine, namely the Middlemount Coal (Stage 2) Project, Middlemount Coal Mine Rail Loop and Spur, Parrot Quarry and Thirteen Mile Gully Diversion.

The Middlemount Coal Mine is located in the central Bowen Basin approximately 270 kilometres (km) north-west of Rockhampton and approximately 6 km south-west of Middlemount in central Queensland (Qld). The offset areas are located immediately west of the existing Middlemount Coal Mine on freehold land owned by MCPL. The land is currently used for grazing livestock. The offset areas will be secured for enduring conservation purposes through a legally binding mechanism.

Middlemount Coal (Stage 2) Project

MCPL is required to develop/implement this Offset Management Plan/Vegetation Management Plan for the Middlemount Coal Mine (Stage 2) under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) Approval (EPBC Act 2010/5394 – the Commonwealth Approval). This Offset Management Plan/Vegetation Management Plan addresses the conditions of the Commonwealth Approval and is intended to facilitate the management of the Stage 2 Offset Area for conservation purposes.

The Stage 2 Offset Area comprises a mix of woodland, forest and derived (Buffel Grass [*Cenchrus ciliaris*] dominated) grassland habitat, the latter of which is a result of past land clearance and agricultural land management. Two main ephemeral watercourses traverse the Stage 2 Offset Area. Thirteen Mile Gully is in the north of the Stage 2 Offset Area, and Roper Creek is in the south.

Multiple patches of Brigalow (*Acacia harpophylla* dominant and co-dominant), a threatened ecological community under the EPBC Act, occur in the Stage 2 Offset Area as well as areas of Brigalow regrowth. The Stage 2 Offset Area also provides habitat for conservation significance species, including the Ornamental Snake (*Denisonia maculata*) and Squatter Pigeon (southern race) (*Geophaps scripta scripta*), both of which are vulnerable under the EPBC Act. This plan specifically describes how the Stage 2 Offset Area will be managed to protect and enhance the extent and condition of the habitat for these threatened species and the Brigalow community.

Qld State Significant Biodiversity Values are also recognised within this plan (e.g. threatened and near threatened species under the Qld *Nature Conservation Act, 1992* [NC Act] and endangered and of concern vegetation under the Qld *Vegetation Management Act, 1999* [VM Act]). The EPBC Act listed threatened species mentioned above are also listed under the NC Act. Additionally, the Native Frangipani (*Cerbera dumicola*) and Large-podded Trefoil (*Desmodium macrocarpum*) occur in the Stage 2 Offset Area and are both listed as near threatened plants under the NC Act. Brigalow is present as a component of a number of endangered and of concern regional ecosystems listed under the VM Act.

Middlemount Coal Mine Rail Loop and Spur

In 2010, approval was obtained for the construction and operation of a rail spur and balloon loop to the coal handling and preparation plant at the mine (herein referred to as the Rail Project). On the 12 November 2010, MCPL entered into a written Deed of Agreement whereby MCPL, in seeking consent to clear native vegetation for the Rail Project, agreed to obtain and secure a vegetation offset.

The Rail Project offset areas comprise six individual Rail Project offset areas, totalling 86.2 hectares (ha), a significantly larger area than that which would be cleared. The size of the individual areas varies from 2 to 41.6 ha.

This Offset Management Plan/Vegetation Management Plan addresses the relevant voluntary declaration of an area of high nature conservation value (VDec) requirements for the Rail Project and is intended to facilitate the management of the Rail Project offset areas for conservation purposes.

Parrot Quarry

In 2010, approval was sought for a quarry (referred to as Parrot Quarry) to supply material to the Middlemount Coal Mine. On the 17 August 2010, MCPL entered into a written Deed of Agreement whereby MCPL, in seeking consent to clear native vegetation for the Parrot Quarry, agreed to obtain and secure a vegetation offset.

There are two individual Parrot Quarry offset areas, totalling 15.37 ha. The offset areas contain 11 ha of Regional Ecosystem (RE) 11.3.4 and 4.37 ha of RE 11.5.18 (both listed as Of Concern).

This Offset Management Plan/Vegetation Management Plan addresses the relevant VDec requirements for the Rail Project and is intended to facilitate the management of the Parrot Quarry offset areas for conservation purposes.

Thirteen Mile Gully Diversion

A development application for the Thirteen Mile Gully Diversion was submitted under the Qld *Sustainable Planning Act, 2009* on the 17 August 2012. Since the final design of the Thirteen Mile Gully Creek Diversion was assessed by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities as part of the Middlemount Coal (Stage 2) Project, the same offset applies (i.e. the impacts from construction of the Thirteen Mile Gully Diversion were offset within the Stage 2 Offset Area).

Offset Management, Monitoring and Reporting

The various offset areas will be managed under the same regime and management of the offset area commenced after November 2012. This Offset Management Plan/Vegetation Management Plan provides details of management measures including regeneration, weed management, pest animal management, fire management, erosion and sediment control, and management of livestock. The management measures will be implemented by suitability qualified person(s) in accordance with relevant licences where required.

A monitoring plan is included and will be used to assess the success of the management measures against identified performance criteria. The performance criteria and monitoring requirements will conclude once the completion criteria have been achieved.

MCPL will publish a report on their website every 12 months, addressing compliance with each of the conditions of the EPBC Act approval. The reporting will also describe the outcome of management measures and any need for modified management to improve the performance of the offset area.

This Offset Management Plan/Vegetation Management Plan provides a description of the potential risks to successful management of the offset areas, and a description of the contingency measures that will be implemented to mitigate those risks.

1 INTRODUCTION

1.1 BACKGROUND

The Middlemount Coal Mine Offset Management Plan was originally approved by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) on 30 November 2012. In early 2013, the plan was revised to describe how Middlemount Coal Pty Ltd (MCPL) will manage offset areas established for various components of the Middlemount Coal Mine, namely the Middlemount Coal (Stage 2) Project, Middlemount Coal Mine Rail Loop and Spur, Parrot Quarry and Thirteen Mile Gully Diversion.

The Middlemount Coal Mine, which has been operating since 2009, is located in the central Bowen Basin approximately 270 kilometres (km) north-west of Rockhampton and approximately 6 km south-west of Middlemount in central Queensland (Qld) (Figures 1 and 2). The offset areas are located immediately west of the existing Middlemount Coal Mine on freehold land owned by MCPL (Figures 3 and 4).

1.2 OBJECTIVES AND DESIRED OUTCOMES (MANAGEMENT INTENT)

The desired outcome of the offsets are that the extent and condition of the habitat values of threatened species and communities within the offset areas are protected and enhanced. The land in the offset areas to be enhanced so as the currently degraded areas reach remnant status through increasing the structural integrity and extent of vegetation in the area. The purpose of the offset is to offset clearing associated with development approvals as further discussed below.

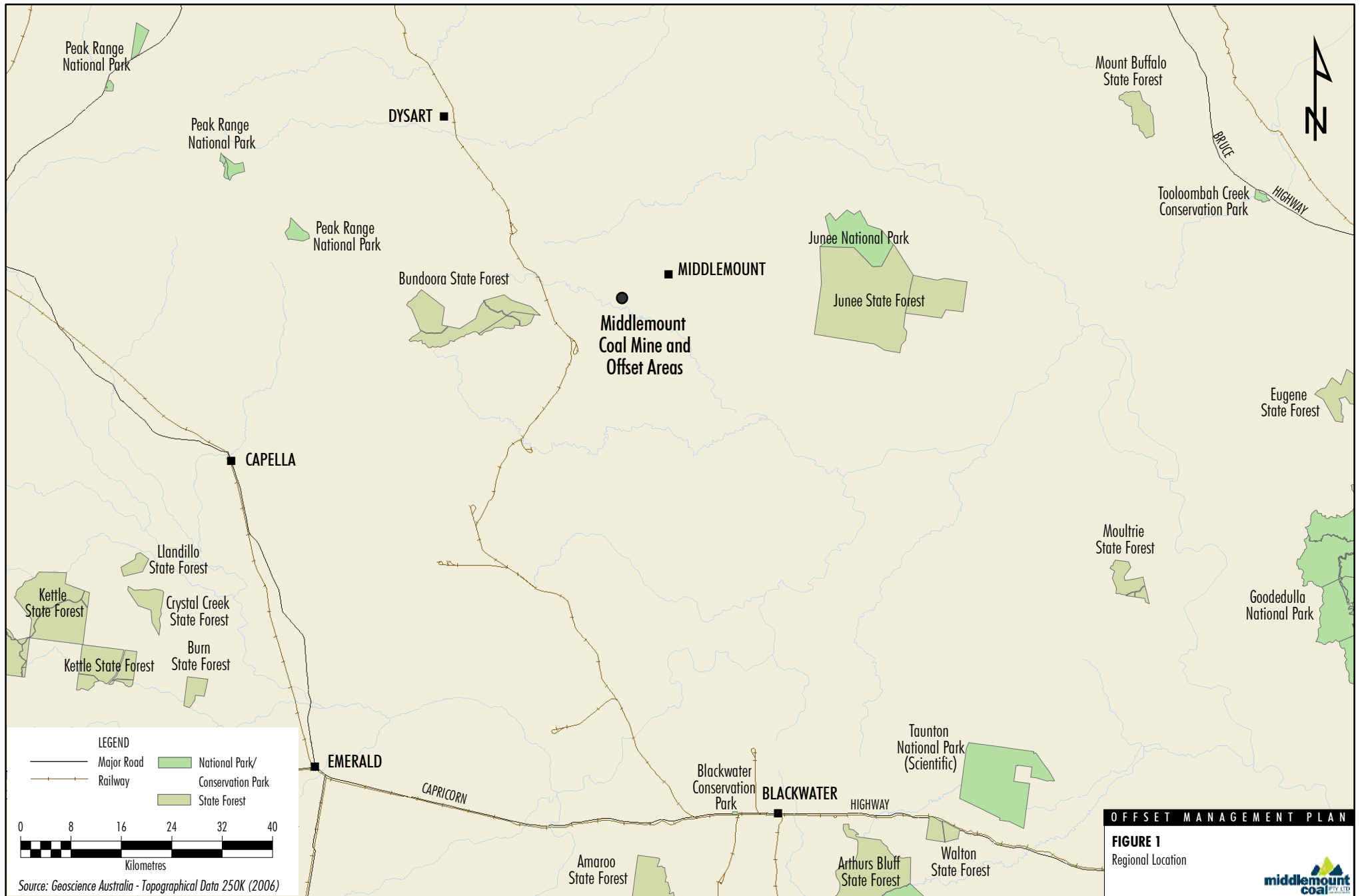
1.2.1 Middlemount Coal (Stage 2) Project

An offset strategy was developed for the Middlemount Coal (Stage 2) Project in accordance with the Qld Department of the Environment and Water Resources (2007) *Use of Environmental Offsets under the Environment Protection and Biodiversity Conservation Act 1999* and SEWPaC (2011a) *Consultation Draft: EPBC Act Environmental Offsets Policy, 2011*. The offset strategy was provided to SEWPaC on 1 August 2012. MCPL was subsequently granted approval for the Middlemount Coal (Stage 2) Project under the Commonwealth *Environment Protection and Biodiversity Act, 1990* (EPBC Act) on 7 September 2012 (Commonwealth Approval [EPBC Act 2010/5394]). MCPL notified SEWPaC that the referred action (Middlemount Coal Mine [Stage 2 Project]) was to commence on the 17 September 2012.

The Middlemount Coal (Stage 2) Project was approved under the Qld *Environmental Protection Act, 1994* on 29 June 2012 (Qld Project Approval [Permit Number MIN100646307]). The Qld Project Approval does not include any approval conditions relevant to the Stage 2 Offset Area. Notwithstanding, Qld State Significant Biodiversity Values are also recognised and the *Queensland Policy for Vegetation Management Offsets (Version 3)* (Qld Department of Environment and Resource Management [DERM], 2011a) has been considered where relevant.

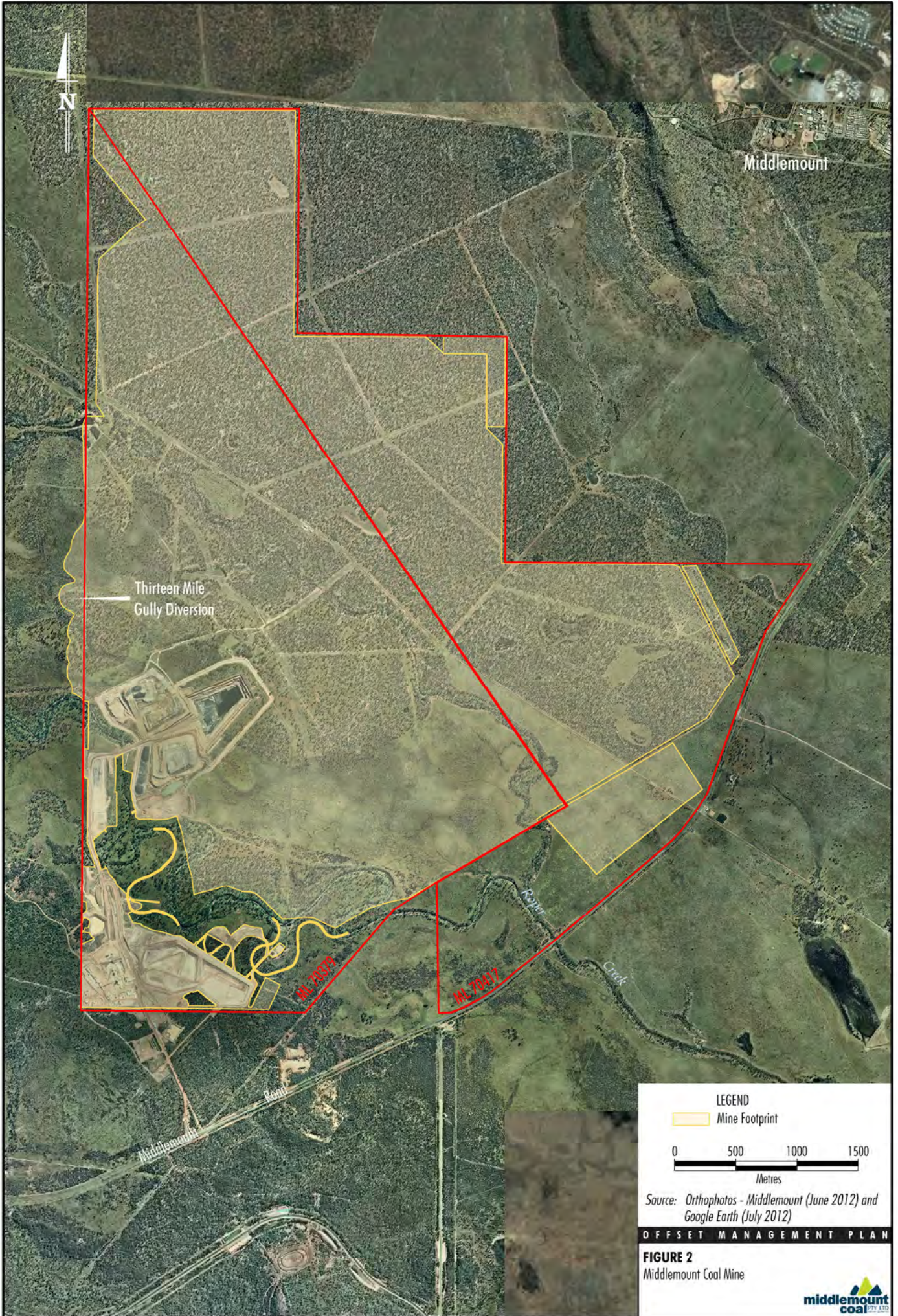
Table 1 provides the relevant Commonwealth Approval conditions and the corresponding Offset Management Plan/Vegetation Management Plan sections that meet such conditions. There are three Matters of National Environmental Significance which are directly relevant to the conditions outlined in the Commonwealth Approval:

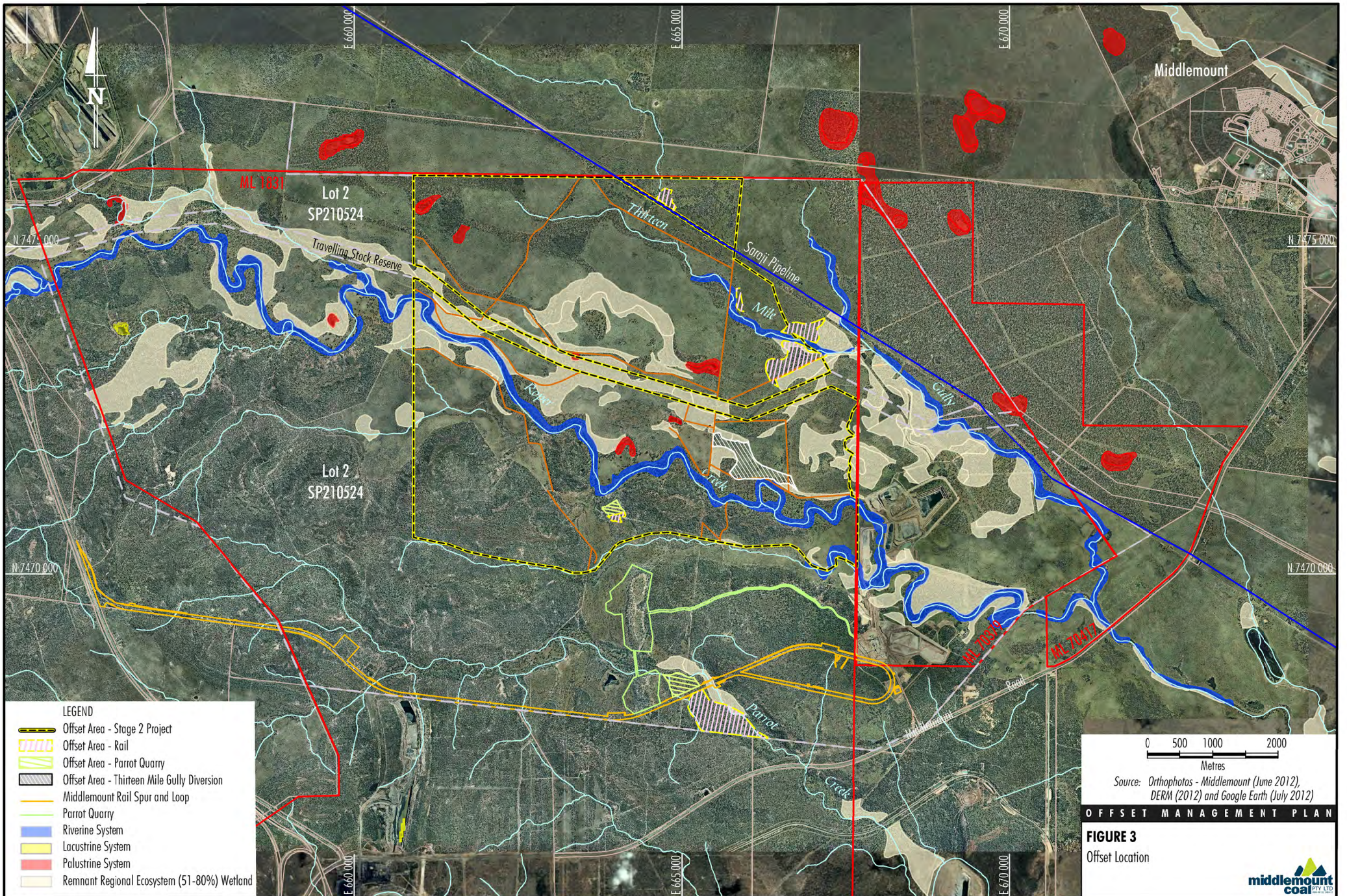
- Ornamental Snake (*Denisonia maculata*);
- Squatter Pigeon (southern race) (*Geophaps scripta scripta*); and
- Brigalow (*Acacia harpophylla* dominant and co-dominant) community.

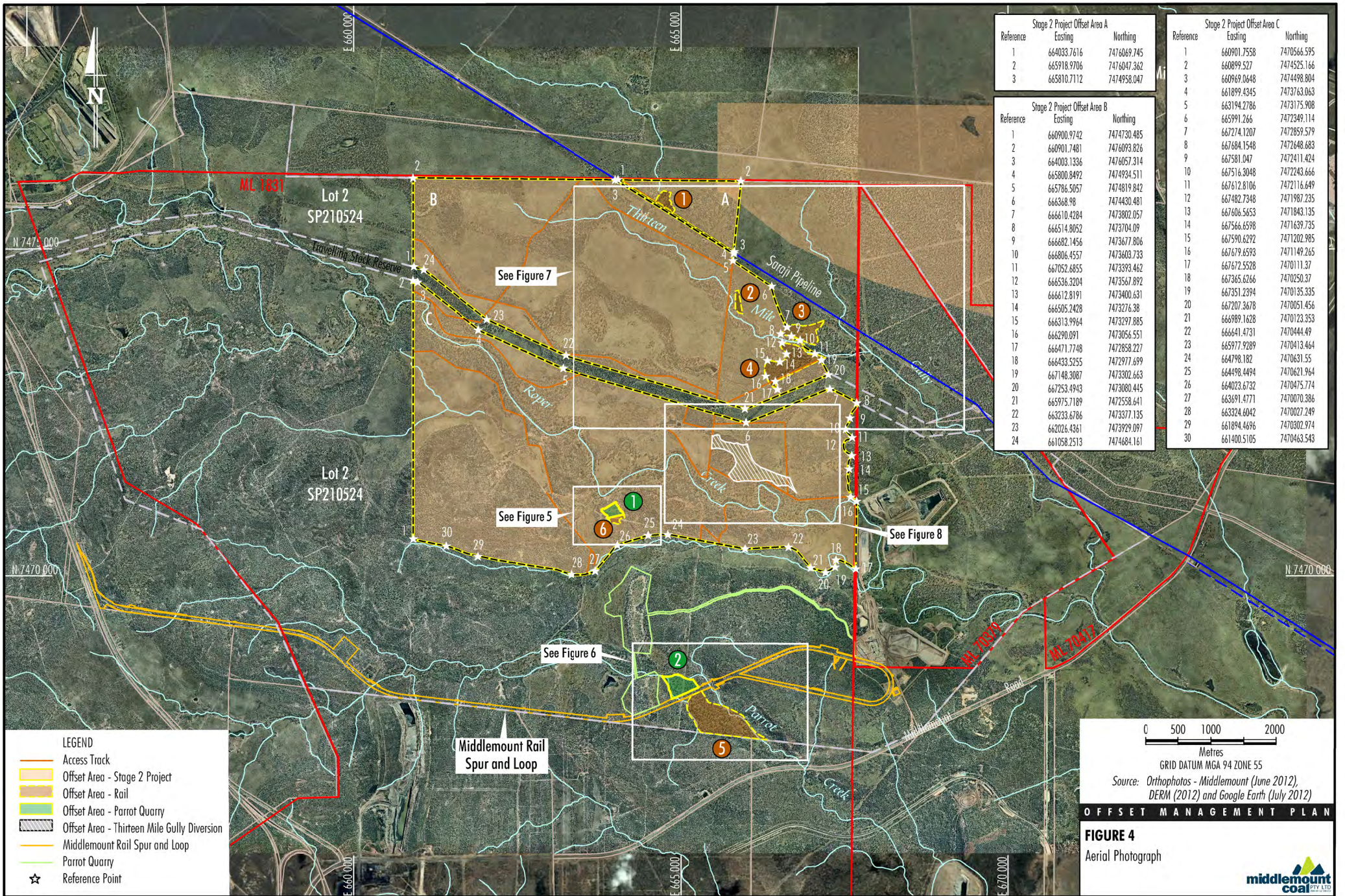


OFFSET MANAGEMENT PLAN

FIGURE 1
Regional Location







Stage 2 Project Offset Area A		
Reference	Easting	Northing
1	664033.7616	7476069.745
2	665918.9706	7476047.362
3	665810.7112	7474958.047

Stage 2 Project Offset Area C		
Reference	Easting	Northing
1	660901.7558	7470566.595
2	660899.527	7474525.166
3	660969.0648	7474498.804
4	661899.4345	7473763.063
5	663194.2786	7473175.908
6	665991.2666	7472349.114
7	667274.1207	7472859.579
8	667694.1548	7472648.683
9	667581.047	7472411.424
10	667516.3048	7472243.666
11	667612.8106	7472116.649
12	667482.7348	7471987.235
13	667406.5653	7471843.135
14	667566.6598	7471639.735
15	667590.6292	7471202.985
16	667679.6593	7471149.265
17	667672.5528	7470111.37
18	667365.6266	7470250.37
19	667351.2394	7470135.335
20	667207.3678	7470051.456
21	666989.1628	7470123.353
22	666641.4731	7470444.49
23	665977.9289	7470413.464
24	664798.182	7470631.55
25	664498.4494	7470621.964
26	664023.6732	7470475.774
27	663691.4771	7470070.386
28	663324.6042	7470027.249
29	661894.4696	7470302.974
30	661400.5105	7470463.543

Stage 2 Project Offset Area B		
Reference	Easting	Northing
1	660900.9742	7474730.485
2	660901.7481	7476093.826
3	664003.1336	7476057.314
4	665800.8492	7474934.511
5	665786.5057	7474819.842
6	666368.98	7474430.481
7	666610.4284	7473802.057
8	666514.8052	7473704.09
9	666682.1456	7473677.806
10	666806.4557	7473603.733
11	667052.6855	7473393.462
12	666536.3204	7473567.892
13	666612.8191	7473400.631
14	666505.2428	7473276.38
15	666313.9964	7473297.885
16	666290.091	7473056.551
17	666471.7748	7472858.227
18	666433.5255	7472977.899
19	667148.3087	7473302.663
20	667253.4943	7473080.445
21	665975.7189	7472558.641
22	662333.6786	7473377.135
23	662026.4361	7473929.097
24	661058.2513	7474684.161

- LEGEND**
- Access Track
 - Offset Area - Stage 2 Project
 - Offset Area - Rail
 - Offset Area - Parrot Quarry
 - Offset Area - Thirteen Mile Gully Diversion
 - Middlemount Rail Spur and Loop
 - Parrot Quarry
 - Reference Point

0 500 1000 2000
Metres
GRID DATUM MGA 94 ZONE 55
Source: Orthophotos - Middlemount (June 2012),
DERM (2012) and Google Earth (July 2012)

OFFSET MANAGEMENT PLAN

FIGURE 4
Aerial Photograph



**Table 1
Commonwealth Approval Conditions Relevant to this Offset Management Plan/Vegetation Management Plan**

Offset Management Plan Condition	Relevant Section that Addresses the Condition
<p>Offsets</p> <p><i>Offset management plan</i></p> <p>1. To offset the impacts to EPBC listed threatened species and ecological communities, the person taking the action must submit to the Minister for approval an Offset Management Plan within 12 months of the date of this approval. Operations within Area B cannot commence unless the <i>Offset Management Plan</i> has been approved by the Minister.</p>	Section 1.1
<p>The <i>Offset Management Plan</i> must include, but not be limited to the following:</p> <p>a. details of management actions to protect and enhance the extent and condition of the threatened species habitat values including rehabilitation, weed control, fire management, erosion and sediment control, management of livestock and restrictions to access of no less than:</p> <p>i. 1670 ha of Ornamental Snake (<i>Denisonia maculata</i>) habitat;</p> <p>ii. 3280 ha of Squatter Pigeon (<i>Geophaps scripta scripta</i>); and</p> <p>iii. 150 ha of Brigalow ecological community;</p>	Sections 2.11 and 3
<p>b. the desired outcomes/objectives of implementing the plan;</p>	Section 1.2
<p>c. the timing, responsibilities and performance criteria for such actions;</p>	Sections 4.1 and 7
<p>d. a monitoring plan including ecological surveys that must be undertaken to assess the success of the management measures against identified milestones and objectives;</p>	Section 5.1
<p>e. a clear definition of the location and boundaries of the offset area, through maps and/or textual descriptions as well as accompanying shapefiles;</p>	Section 2.1 and Figures 3 to 14
<p>f. a process to report to the Department the management actions undertaken in the offset areas and the outcome of those actions, including identifying any need for improved management;</p>	Section 5.2
<p>g. a description of the potential risks to successful management and rehabilitation in the offset areas, and a description of the contingency measures that would be implemented to mitigate these risks;</p>	Section 6
<p>h. details of parties responsible for monitoring, reviewing and implementing the plan; and</p>	Section 7
<p>i. what would be the contingency strategy in the event that a third party impacts upon the offset site.</p> <p>The approved <i>Offset Management Plan</i> must be implemented.</p>	Section 6.2
<p><i>Mechanism to secure offsets</i></p> <p>2. To offset the impacts to EPBC listed threatened species and ecological communities, the person taking the action must register a legally binding conservation mechanism over a minimum of 1670 ha of Ornamental Snake (<i>Denisonia maculata</i>) habitat, 3280 ha of Squatter Pigeon (<i>Geophaps scripta scripta</i>) and 150 ha of Brigalow ecological community (the offset area) as identified in the offset management plan referred to in condition 1. The mechanism/s must provide enduring protection for protection for the offset areas and be registered within 12 months of the date of this approval.</p> <p>The conditions of the conservation mechanism must ensure that management actions are undertaken for the protection and enhancement of the EPBC listed threatened species and ecological communities. The person taking the action must obtain agreement from any third parties responsible for management actions and provide details of the responsible parties, including their position or status as a separate contractor, to the Department.</p>	Section 1.4
<p>Reporting and auditing</p> <p>7. Within three months of every 12 month anniversary of the Commencement of the action, the person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the Department at the same time as the compliance report is published.</p>	Section 5.2
<p>8. Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the Commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.</p>	Section 5.3

Table 1 (Continued)
Commonwealth Approval Conditions Relevant to this Offset Management Plan/Vegetation Management Plan

Offset Management Plan Condition	Relevant Section that Addresses the Condition
9. If the person taking the action wishes to carry out any activity otherwise than in accordance with the plan referred to in condition 1, the person taking the action must submit for the Minister's written approval a revised version of any such plan. The varied activity shall not commence until the Minister has approved the varied plan in writing. If the Minister approves such a revised plan, that plan must be implemented in place of the plan originally approved. Unless the Minister has approved the revised plan, then the person taking the action must continue to implement the plan originally approved, referred to in condition 1.	Section 5.4
10. If the Minister believes that it is necessary or convenient for the better protection of listed threatened species and communities to do so, the Minister may request that the person taking the action make specified revisions to the plan pursuant to condition 1. and submit the revised plan for the Minister's written approval. The person taking the action must comply with any such request. The revised approved plan must be implemented. Unless the Minister has approved the revised plan then the person taking the action must continue to implement the plan originally approved, referred to in condition 1.	Section 5.4
Publication of plans 12. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the above conditions of approval, including measures taken to implement the management plans required by this approval, and make them available upon request to the Department . Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act , or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	Section 5.2
13. Unless otherwise agreed to in writing by the Minister , the person taking the action must publish the management plan, referred to in condition 1, of approval on their website. Each plan must be published on the website within one month of being approved.	Section 5.2

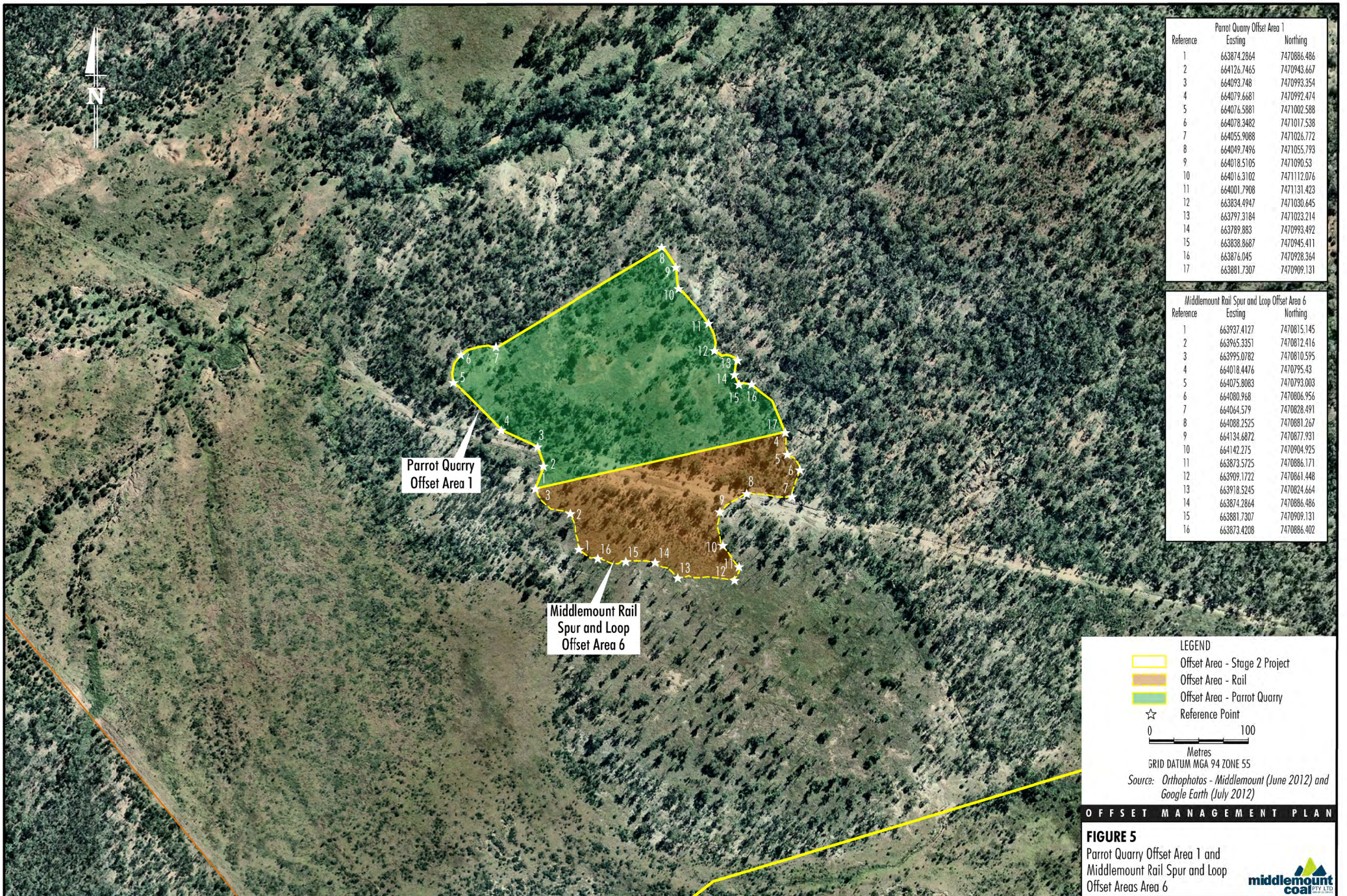
ha = hectares.

1.2.2 Middlemount Coal Mine Rail Loop and Spur

In 2010, approval was sought for the construction and operation of a rail spur and balloon loop to the coal handling and preparation plant at the mine (here in referred to as the Rail Project).

The Rail Project was approved on 31 August 2010 by the decision notice for material change of use issued by Isaac Regional Council (IC0410MKY003). Following further rail design and prior to commencement of construction activities, the vegetation clearing extents were refined and reduced. This change to the development approval was processed by the DERM on 19 November 2010. Construction of the Rail Project commenced in 2011.

On the 12 November 2010, MCPL entered into a written Deed of Agreement whereby MCPL, in seeking consent to clear native vegetation for the Rail Project, agreed to obtain and secure a vegetation offset. A variation of the Deed of Agreement (i.e. a Deed of Variation) was entered into for an extension of time in which MCPL has to secure the vegetation offset. The offset area is to contain vegetation and values that offset the clearing shown in Table 2.



Parrot Quarry Offset Area 1		
Reference	Easting	Northing
1	663874.2864	7470886.486
2	664126.7465	7470943.667
3	664093.748	7470993.354
4	664079.6681	7470992.474
5	664076.5881	7471002.588
6	664078.3482	7471017.538
7	664055.9088	7471026.772
8	664049.7496	7471055.793
9	664018.5105	7471090.53
10	664016.3102	7471112.076
11	664001.7908	7471131.423
12	663834.4947	7471030.645
13	663797.3184	7471023.214
14	663789.883	7470993.492
15	663838.8687	7470945.411
16	663876.045	7470928.364
17	663881.7307	7470909.131

Middlemount Rail Spur and Loop Offset Area 6		
Reference	Easting	Northing
1	663937.4127	7470815.145
2	663965.3351	7470812.416
3	663995.0782	7470810.595
4	664018.4476	7470795.43
5	664075.8083	7470793.003
6	664080.968	7470806.956
7	664064.579	7470828.491
8	664088.2525	7470881.267
9	664134.6872	7470877.931
10	664142.275	7470904.925
11	663873.5725	7470886.171
12	663909.1722	7470861.448
13	663918.5245	7470824.664
14	663874.2864	7470886.486
15	663881.7307	7470909.131
16	663873.4208	7470886.402

Parrot Quarry
Offset Area 1

Middlemount Rail
Spur and Loop
Offset Area 6

LEGEND

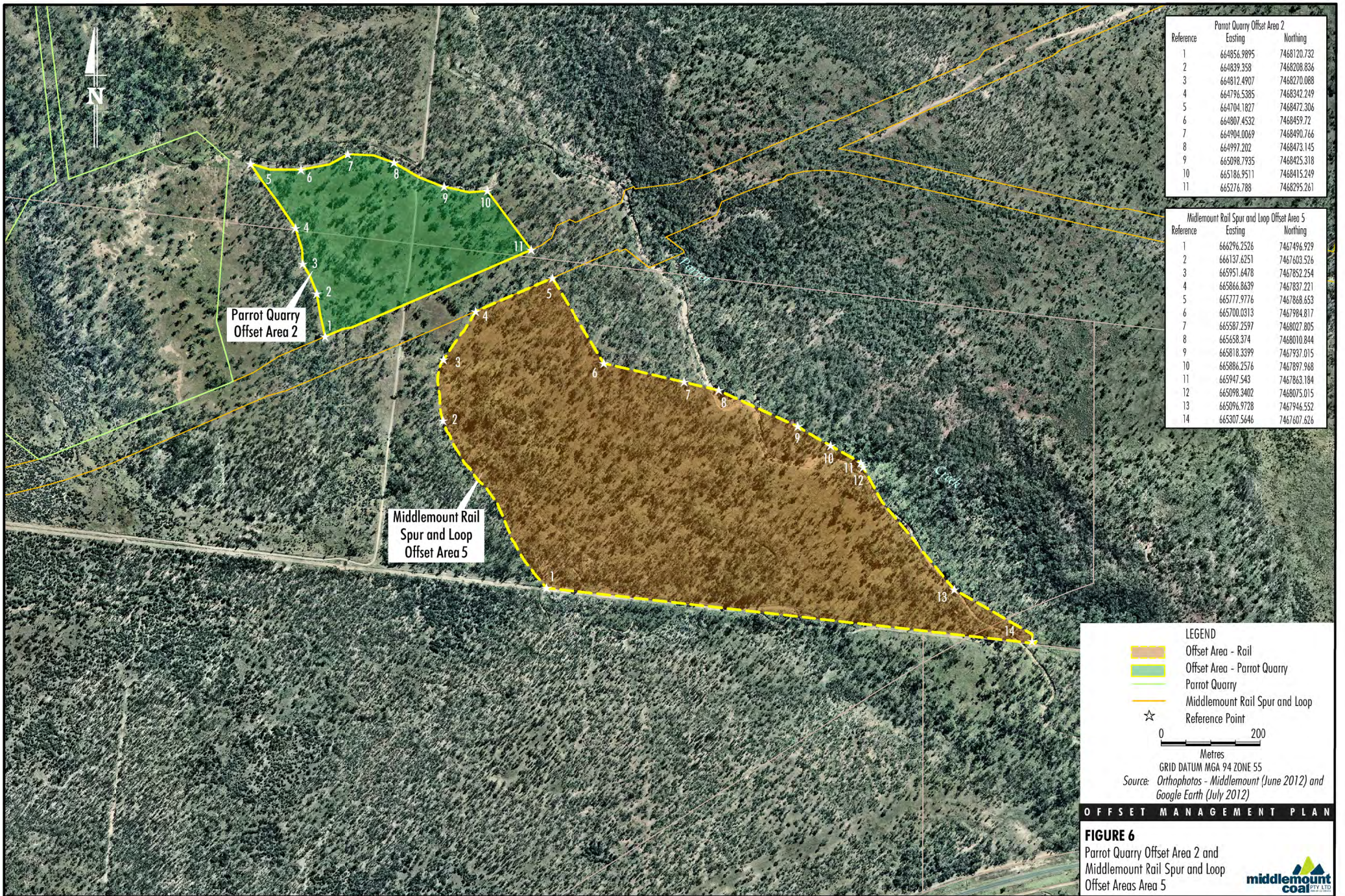
- Offset Area - Stage 2 Project
- Offset Area - Rail
- Offset Area - Parrot Quarry
- ☆ Reference Point

0 100
Metres
GRID DATUM MGA 94 ZONE 55
Source: Orthophotos - Middlemount (June 2012) and Google Earth (July 2012)

OFFSET MANAGEMENT PLAN

FIGURE 5
Parrot Quarry Offset Area 1 and Middlemount Rail Spur and Loop Offset Areas Area 6

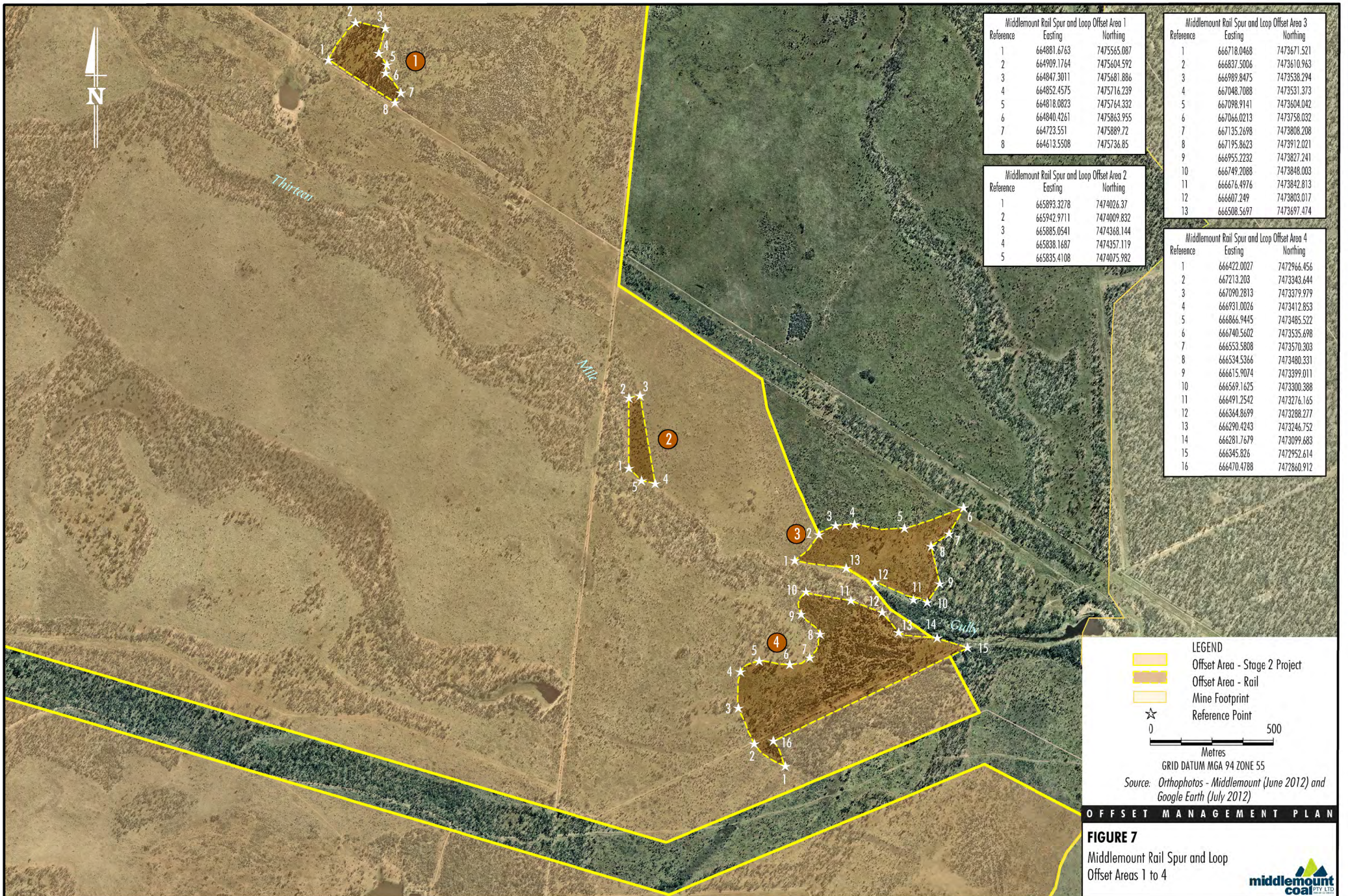




OFFSET MANAGEMENT PLAN

FIGURE 6
Parrot Quarry Offset Area 2 and Middlemount Rail Spur and Loop Offset Areas Area 5





Reference	Easting	Northing
1	664881.6763	7475565.087
2	664909.1764	7475604.592
3	664947.3011	7475681.886
4	664852.4575	7475716.239
5	664818.0823	7475764.332
6	664840.4261	7475863.955
7	664723.551	7475889.72
8	664613.5508	7475736.85

Reference	Easting	Northing
1	666778.0468	7473671.521
2	666837.5006	7473610.963
3	666989.8475	7473538.294
4	667048.7088	7473531.373
5	667098.9141	7473604.042
6	667066.0213	7473758.032
7	667135.2698	7473808.208
8	667195.8623	7473912.021
9	666955.2232	7473827.241
10	666749.2088	7473848.003
11	666676.4976	7473842.813
12	666607.249	7473803.017
13	666508.5697	7473697.474

Reference	Easting	Northing
1	665893.3278	7474026.37
2	665942.9711	7474009.832
3	665885.0541	7474368.144
4	665838.1687	7474357.119
5	665835.4108	7474075.982

Reference	Easting	Northing
1	666422.0027	7472966.456
2	667213.203	7473343.644
3	667090.2813	7473379.979
4	666931.0026	7473412.853
5	666866.9445	7473485.522
6	666740.5602	7473535.696
7	666553.5808	7473570.303
8	666534.5366	7473480.331
9	666615.9074	7473399.011
10	666569.1625	7473300.388
11	666491.2542	7473276.165
12	666364.8699	7473288.277
13	666290.4243	7473246.752
14	666281.7679	7473099.683
15	666345.826	7472952.614
16	666470.4788	7472860.912

LEGEND

- Offset Area - Stage 2 Project
- Offset Area - Rail
- Mine Footprint
- Reference Point

0 500
Metres

GRID DATUM MGA 94 ZONE 55
Source: Orthophotos - Middlemount (June 2012) and Google Earth (July 2012)

OFFSET MANAGEMENT PLAN

FIGURE 7
Middlemount Rail Spur and Loop
Offset Areas 1 to 4



Table 2
Middlemount Coal Mine Rail Loop and Spur Clearing Area

Regional Ecosystem	Vegetation Management Status	Brief Regional Ecosystem Description	Broad Vegetation Group*	Area (ha)
Performance Requirement – Watercourse PR P3 – 1st Stream Order				
11.5.2	Least Concern	<i>Eucalyptus crebra</i> Woodland	18b	1.142
11.5.2a	Least Concern	<i>Allocasuarina leuhmannii</i> Woodland	24a	0.055
11.5.3	Least Concern	<i>Eucalyptus populnea</i> Woodland	17a	1.585
Performance Requirement – Watercourse PR P3 – 2nd Stream Order				
11.10.12	Least Concern	<i>Eucalyptus populnea</i> Woodland	17a	0.405
11.3.4	Of Concern	<i>Eucalyptus tereticornis</i> Open Forest	16c	0.703
11.4.8	Endangered	<i>Eucalyptus cambageana</i> / <i>Acacia harpophylla</i> Woodland	25a	0.009
Performance Requirement – Watercourse PR P3 – 3rd Stream Order				
11.7.2	Least Concern	<i>Acacia shirleyi</i> Woodland	24a	0.369
11.3.25	Least Concern	<i>Eucalyptus camuldelensis</i> Open Forest	16a	0.376
11.3.2	Of Concern	<i>Eucalyptus populnea</i> Woodland	17a	1.562
Performance Requirement – Connectivity PR P4				
11.7.2	Least Concern	<i>Acacia shirleyi</i> Woodland	-	1.519
11.5.3	Least Concern	<i>Eucalyptus populnea</i> Woodland	-	0.987
Performance Requirement – Conserving remnant Endangered and Of Concern Regional Ecosystems PR P7				
11.5.18	Of Concern	<i>Micromyrtus capricornii</i> Shrubland	29b	3.190
11.3.4	Of Concern	<i>Eucalyptus tereticornis</i> Open Forest	16c	0.703
11.3.2	Of Concern	<i>Eucalyptus populnea</i> Woodland	17a	2.225
11.4.8	Endangered	<i>Eucalyptus cambageana</i> / <i>Acacia harpophylla</i> Woodland	25a	0.795
Total				15.625

Source: MCPL (2013a).

* Broad vegetation groups are a higher-level grouping of vegetation units or regional ecosystems (REs).

The *Middlemount Coal Mine Rail Loop and Spur Vegetation Offset Proposal* (MCPL, 2013a) was provided to the Qld Department of Natural Resources and Mines (DNRM) on 1 March 2013. There are six individual offset areas for the Rail Project, totalling 86.2 ha (Table 3). The boundaries of the Rail Project offset areas are shown on Figures 5 to 7.

Table 3
Middlemount Coal Mine Rail Loop and Spur Offset Areas

Offset Area	Regional Ecosystem ID	Vegetation Management Status	Broad Vegetation Group	Reason for Inclusion - Performance Requirement	Area (ha)
1	11.4.9b	Endangered	25a	Endangered Regional Ecosystem (RE)	4.5
2	11.3.2/11.5.3	Least Concern	17a	Watercourse	2
3	11.3.2	Of Concern	17a	Of Concern RE	10
4	11.3.1	Endangered	25a	Watercourse	26
5	11.3.4	Of Concern	16c	Watercourse, and Of Concern RE	41.6
6	11.5.18	Of Concern	29b	Of Concern RE	2.1
Total					86.2

Source: MCPL (2013a).

1.2.3 Parrot Quarry

In 2010, approval was sought for a quarry (referred to as Parrot Quarry) to supply material to the Middlemount Coal Mine (Figure 2). Development Approval for the quarry was granted by the DERM on 20 August 2010 (DERM Permit number: 2010/003611). On 17 August 2010, MCPL entered into a written Deed of Agreement whereby MCPL, in seeking consent to clear native vegetation for the Parrot Quarry, agreed to obtain and secure a vegetation offset (Figure 2).

Following further design work, the access road to the quarry was realigned and the vegetation clearing extents were refined and reduced. A request to change the approval (relating to the alignment of the access road) was submitted on the 5 May 2011 (DERM Permit number: 2011/002831). A variation of the Deed of Agreement (i.e. a Deed of Variation) was entered into for the modification (14 July 2011). The offset area is to contain vegetation and values that offset the clearing shown in Table 4.

**Table 4
Parrot Quarry Clearing Area**

Regional Ecosystem ID	Vegetation Management Status	Brief Regional Ecosystem Description	Broad Vegetation Group	Area Cleared Requiring Offsetting (ha)
11.3.4	Of Concern	<i>Eucalyptus tereticornis</i> forest	16c	1.266
11.5.18	Of Concern	<i>Micromyrtus capricornis</i> Shrubland on Cainozoic sand plains/remnant surfaces	29b	1.9 [^]
Total				3.166

Source: MCPL (2013b).

[^] Note the area of RE 11.5.18 was overestimated in the Deed of Variation as it is a mixed polygon containing both Of Concern (40 percent [%]) (RE 11.5.18) and Least Concern REs (60%) (RE 11.5.9). The actual clearing area of RE 11.5.18 is therefore 1.9 ha, instead of 4.57 ha.

The *Parrot Quarry Vegetation Offset Proposal* (MCPL, 2013b) was provided to DNRM on 1 March 2013. Table 5 provides an overview of the Parrot Quarry offset areas and the boundaries are shown on Figures 5 and 6. There are two individual offset areas, totalling 15.37 ha.

**Table 5
Parrot Quarry Offset Areas**

Offset Area	Regional Ecosystem ID	Vegetation Management Status	Broad Vegetation Group	Area (ha)
1	11.3.4	Of Concern	16c	11
2	11.5.18	Of Concern	29b	4.37
Total				15.37

Source: MCPL (2013b).

1.2.4 Thirteen Mile Gully Diversion

MCPL propose to divert a portion of the Thirteen Mile Gully as part of the Middlemount Coal (Stage 2) Project. The Thirteen Mile Gully Diversion was assessed in the *Middlemount Coal Project (Stage 2) Environmental Impact Statement* (Parsons Brinkerhoff, 2010). However, the design was revised following comments received from the Qld Department of Environment and Heritage Protection (DEHP). The revised design more closely mimics a natural watercourse as it meanders along its length (Figure 2). A portion of the Thirteen Mile Gully diversion occurs outside of the western boundary of Mining Lease (ML) 70379 and is subject to environmental approvals under the Qld *Sustainable Planning Act, 2009*.

A development application for the Thirteen Mile Gully Diversion was submitted under the *Sustainable Planning Act, 2009* on the 17 August 2012. Approximately 7.8 ha¹ of REs which are Of Concern (RE 11.3.2 dominant) will be impacted for the Thirteen Mile Gully Diversion (MCPL, 2012a).

In accordance with Criteria 1b of the *Queensland Policy for Vegetation Management Offsets (Version 3)* (DERM, 2011a), an offset proposal may be used to satisfy multiple offset requirements under the State and Commonwealth legislation. Since the final design of the Thirteen Mile Gully Creek Diversion was assessed by SEWPaC as part of the Middlemount Coal (Stage 2) Project, the same offset applies (i.e. the impacts from construction of the Thirteen Mile Gully Diversion were offset within the Middlemount Coal [Stage 2] Project Offset Area).

A specific location within the overall Middlemount Coal (Stage 2) Project Offset Area which offsets the impacts from the Thirteen Mile Gully Diversion has been identified for the purpose of the environmental approval under the *Sustainable Planning Act, 2009*. This has been requested by DNRM in its role as a concurrence agency reviewer of the development application.

The *Thirteen Mile Gully Diversion Vegetation Offset Proposal* (MCPL, 2013c) was provided to DNRM on 5 March 2013. The boundary of the Thirteen Mile Gully Diversion Offset Area is shown on Figure 8. Table 6 provides an overview of its characteristics.

Table 6
Thirteen Mile Gully Diversion Clearing Area and Offset Area

	Regional Ecosystem ID	Vegetation Management Status	Broad Vegetation Group	Area (ha)
Clearing Area	11.3.2	Of Concern	17a	7.8
Offset Area	11.3.2	Of Concern	17a	31

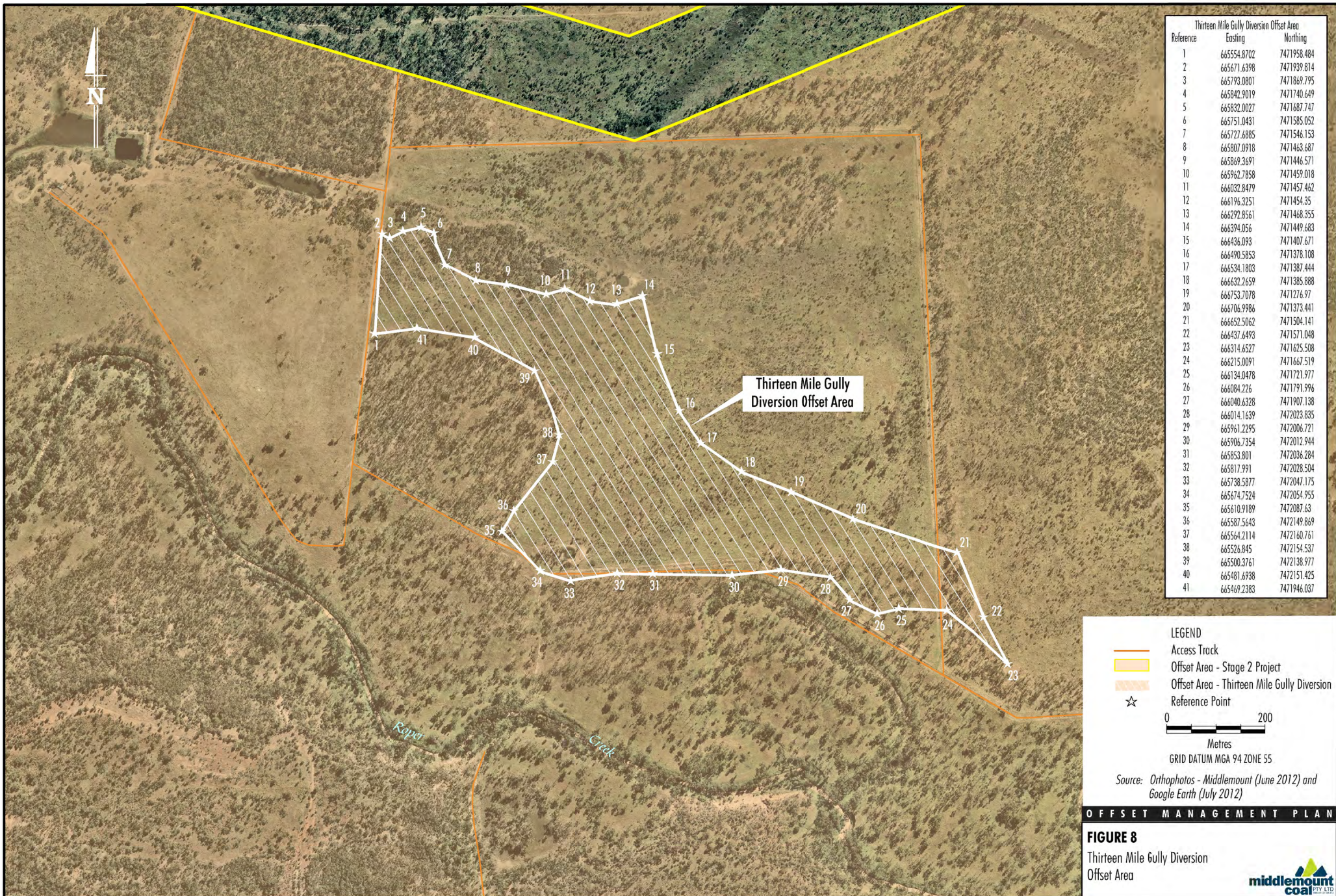
Source: MCPL (2013c).

1.3 REQUIREMENTS UNDER THE POLICY FOR VEGETATION MANAGEMENT OFFSETS

The *Queensland Policy for Vegetation Management Offsets (Version 3)* (DERM, 2011a) is relevant to the offsets for development applications approved by the State (Middlemount Coal Mine Rail Loop and Spur offset areas, Parrot Quarry offset areas and Thirteen Mile Gully Diversion Offset Area) but not to the Commonwealth Stage 2 offset area. The vegetation offset proposals for the relevant developments (MCPL, 2013a, b and c) explain how the offsets meet the requirements of the *Queensland Policy for Vegetation Management Offsets (Version 3)* (DERM, 2011a).

This Offset Management Plan/Vegetation Management Plan addressed the relevant requirements for management as outlined in the *Queensland Policy for Vegetation Management Offsets (Version 3)* (DERM, 2011a) (Table 7).

¹ Please note that this number has been rounded up to be conservative.



Thirteen Mile Gully Diversion Offset Area		
Reference	Easting	Northing
1	665554.8702	7471958.484
2	665671.6398	7471939.814
3	665793.0801	7471869.795
4	665842.9019	7471740.649
5	665832.0027	7471687.747
6	665751.0431	7471585.052
7	665727.6885	7471546.153
8	665807.0918	7471463.687
9	665869.3691	7471446.571
10	665962.7858	7471459.018
11	666032.8479	7471457.462
12	666196.3251	7471454.35
13	666292.8561	7471468.355
14	666394.056	7471449.683
15	666436.093	7471407.671
16	666490.5853	7471378.108
17	666534.1803	7471387.444
18	666632.2659	7471385.888
19	666753.7078	7471276.97
20	666706.9986	7471373.441
21	666652.5062	7471504.141
22	666437.6493	7471571.048
23	666314.6527	7471625.508
24	666215.0091	7471667.519
25	666134.0478	7471721.977
26	666084.226	7471791.996
27	666040.6328	7471907.138
28	666014.1639	7472023.835
29	665961.2295	7472006.721
30	665906.7354	7472012.944
31	665853.801	7472036.284
32	665817.991	7472028.504
33	665738.5877	7472047.175
34	665674.7524	7472054.955
35	665610.9189	7472087.63
36	665587.5643	7472149.869
37	665564.2114	7472160.761
38	665526.845	7472154.537
39	665500.3761	7472138.977
40	665481.6938	7472151.425
41	665469.2383	7471946.037

LEGEND

- Access Track
- Offset Area - Stage 2 Project
- Offset Area - Thirteen Mile Gully Diversion
- Reference Point

0 200
Metres
GRID DATUM MGA 94 ZONE 55

Source: Orthophotos - Middlemount (June 2012) and Google Earth (July 2012)

OFFSET MANAGEMENT PLAN

FIGURE 8
Thirteen Mile Gully Diversion
Offset Area



Table 7
Offset Management Plan Requirements from the Queensland Policy for Vegetation Management Offsets (Version 3)

Requirement	Relevant Section that Addresses the Requirement		
	Middlemount Coal Mine Rail Loop and Spur	Parrot Quarry	Thirteen Mile Gully Diversion
<i>A map that clearly defines the proposed offset area with Global Positioning System points, including any areas subject to specific management actions</i>	Figures 4 to 7 and 14	Figures 4 to 6 and 14	Figures 4, 8 and 14
<i>The proposed clearing regional ecosystem/s and essential habitat, and those on the proposed offset area</i>	Section 1.2.2	Section 1.2.3	Section 1.2.4
<i>The ecological equivalence assessment of the offset area and the date it was undertaken</i>	Section 2.7 and Appendix B, Table B1	Section 2.7 and Appendix B, Table B2	Section 2.7 and Appendix B, Table B3
<i>The offset area management objectives and outcomes</i>	Section 1.2		
<i>Activities to be undertaken on the offset area to achieve the management objectives and outcomes.</i>	Section 3		
<i>Restrictions imposed to the use of the offset area to achieve the management objectives and outcomes</i>	Section 3		
<i>An analysis of the risk to achieving the management objectives and outcomes, actions to minimise the risks and remedial action that will undertaken if any of the risks occur</i>	Section 6.1		
<i>A yearly schedule of management actions, to ensure achievement of the management objectives and outcomes, for the period until the offset area is mapped as remnant regional ecosystem or essential habitat</i>	Section 3.13, Table 14		
<i>A monitoring and reporting program</i>	Section 5		
<i>The estimated time until the offset management objectives and outcomes will be achieved</i>	Section 4.2		
<i>Identification of all registered interests including mortgages, leases, subleases, covenants, profit a prendes, easements and building management statements, that have been registered on title under the Land Act 1994 or the Land Title Act 1994.</i>	Section 2.2		

1.4 ENDURING PROTECTION OF THE OFFSET AREAS - VOLUNTARY DECLARATION

The offset areas are all located on freehold land owned by MCPL (Lot 2, SP248577). By 7 September 2013, the offset areas will be secured through a legally binding mechanism such as a voluntary declaration of an area of high nature conservation value (VDec) under the *Qld Vegetation Management Act, 1999* (VM Act).

This mechanism of securing the offset areas is consistent with the *Queensland Policy for Vegetation Management Offsets (Version 3)* (DERM, 2011a). In accordance with Commonwealth Approval Condition 2 (Table 1, Appendix A), the mechanism/s will provide enduring protection for the offset areas. The conditions of the conservation mechanism will ensure that management measures are undertaken for the protection and enhancement of the EPBC Act listed threatened species and ecological communities.

The *Guide to Voluntary Declarations under the Queensland Vegetation Management Act, 1999* (DERM, 2008) provides requirements for Vegetation Management Plans under a VDec. Table 8 provides the relevant requirements and the corresponding sections of this plan that meet such requirements.

Table 8
Vegetation Management Plan Requirements from the *Guide to Voluntary Declarations*

Requirement	Relevant Section that Addresses the Requirement
<i>The management plan must be signed by the proponent.</i>	Following the table of contents.
<i>The management plan must include sufficient information to allow DERM to map the boundary of the stated area.</i>	Figures 4 to 8
<i>The management plan must state the proponent's management intent and proposed outcome for the conservation of the high nature conservation value of the area or the prevention of land degradation in the area.</i>	Section 1.2
<i>The management plan must state the activities that the proponent intends to carry out or refrain from carrying out to achieve the management outcomes for the conservation of the high nature conservation value of the area or the prevention of land degradation in the area.</i>	Section 3
<i>The management plan must state the restrictions, if any, to be imposed on the use of, or access to, the area by other persons to achieve the management outcomes for the conservation of high nature conservation value of the area or the prevention of land degradation in the area.</i>	Section 3.9

Allens have provided MCPL with legal advice regarding the VDec under the VM Act.

1.5 CONSULTATION

As stated earlier, an offset strategy was developed for the Middlemount Coal (Stage 2) Project and provided to SEWPaC on 1 August 2012. MCPL undertook consultation with SEWPaC in regard to the offset strategy on 1 and 2 August 2012. The offset strategy detailed the location, size, composition, proposed management and timing of the offset. SEWPaC provided conditions of approval (Appendix A) consistent with the offset strategy.

Resource Strategies (on behalf of MCPL) undertook consultation with the DNRM (Rockhampton) in regard to the revision of this Offset Management Plan and security of the offsets under a VDec on 1 November 2012.

On the 15 April 2013, DNRM (Rockhampton) confirmed that MCPL could prepare a single management plan for the offset areas and that one VDec application may be made to cover the offset areas.

The revised Offset Management Plan/Vegetation Management Plan was submitted to DRNM on the 11 July 2013. Comments were received from DRNM on the 12 August 2013 and were subsequently addressed by MCPL.

1.6 REPORT STRUCTURE

The structure of this plan is as follows:

- Section 2 Existing environment of the offset areas.
- Section 3 Management of the offset areas.
- Section 4 Performance and completion criteria.
- Section 5 Monitoring, reporting and reviewing.
- Section 6 Contingency measures.
- Section 7 Timing and responsibilities.

- Section 8 Cost of activities.
- Section 9 Trust fund.
- Section 10 References cited in this Offset Management Plan/Vegetation Management Plan.

The following appendices are attached to this plan:

- Appendix A Commonwealth Approval (EPBC Act 2010/5394).
- Appendix B Ecological Equivalence.
- Appendix C Ecological Investigations within the Offset Area for Stage 2 of the Middlemount Coal Mine, Queensland.
- Appendix D Declared Plants of Queensland.
- Appendix E Declared Animals of Queensland.
- Appendix F Weed Management Guide for Buffel Grass.
- Appendix G Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas.

2 EXISTING ENVIRONMENT

2.1 LOCATION

The offset areas are located in the Isaac Regional Council area of the Brigalow Belt Bioregion. The closest reserves are Bundorra State Forest located approximately 10 km south-west and Junee National Park located approximately 20 km north-east (Figure 1). The offset areas are located within the Brigalow Belt Corridor (DERM, 2008).

2.2 PROPERTY AND OWNERSHIP DETAILS AND REGISTERED INTERESTS

The offset areas are located on freehold land owned by MCPL (Lot 2, SP248577 – Booroodarra Station). There are no other registered interest holders under the *Land Act 1994* or *Land Title Act 1994*.

2.3 LAND USES

The offset areas has a history of clearing and cattle grazing. There is no Strategic Cropping Land mapped in the vicinity of the offset areas (DERM, 2011b).

MCPL own the property bordering all sides of the offset areas. The land outside of the offset areas is currently agisted and will be subject to grazing. A travelling stock reserve and pipeline easement occur outside of the offset areas (Figure 3).

The offset areas are overlying ML 1831 held by Anglo Coal (German Creek) Pty Ltd (Anglo), however there is no current proposal to mine (underground or open cut) within the offset area. Anglo does not hold surface rights over the northern part of ML 1831, where the offset areas are located. Anglo's ML 1831 is for sub-surface rights only in the vicinity of the offset areas. Any future mining proposals from Anglo will need to account for the impacts to the offset areas (Section 6.2).

2.4 CLIMATE

Climate can influence restoration programmes, however the offset areas are in a relatively high rainfall area located approximately 120 km inland from the Qld coast. The closest Commonwealth Bureau of Meteorology (BoM) weather station to the offset areas are the Emerald Post Office (035027). Mean maximum temperature at the offset areas ranges from 22.4 degrees Celsius (°C) in July to 34.8°C in December (BoM, 2012). Mean minimum temperature ranges from 6.9°C in July to 21.4°C in January (BoM, 2012). Mean rainfall is approximately 640.1 millimetres (mm), with the most rain occurring in January (mean rainfall 103.4 mm) and the least amount of rainfall occurring in August (mean rainfall 20.7 mm) (BoM, 2012).

2.5 HYDROLOGY

Two main ephemeral watercourses traverse the offset areas. Thirteen Mile Gully is in the north of the Stage 2 Offset Area and Roper Creek is in the south (Figure 3). The Stage 2 Offset Area contains approximately 9.3 km of Roper Creek, a large ephemeral watercourse with a defined channel (Plate 1). Roper creek is a 4th order (Strahler ordering system) water course with an incised main channel that is perched above a wide flat floodplain. The floodplain extends to the north to Thirteen Mile Gully and includes a number of oxbows created by erosion cutting off meanders. The substrate is predominantly sandy. The riparian zone is well vegetated but the understorey is mostly Buffel Grass (*Cenchrus ciliaris*) where the canopy is open. Riparian habitat along Roper Creek within the Stage 2 Offset Area generally occurs as tall open riparian woodlands dominated by Forest Red Gum (*Eucalyptus tereticornis*).



Plate 1 - Roper Creek

The Stage 2 Offset Area contains approximately 4.9 km of Thirteen Mile Gully (Figure 3). This gully is a much smaller ephemeral watercourse than Roper Creek and does not have a well defined channel or riparian zone (Plate 2).

Wetland areas in the Stage 2 Offset Area include palustrine systems (wetlands dominated by vegetation) and remnant RE 51-80% wetland (mosaic units) (DEHP, 2012) (Figure 3).



Plate 2 - Thirteen Mile Gully

2.6 GEOLOGY AND SOILS

There are six major geological units surrounding the offset areas. These are:

- Late Permian feldspathic and lithic sandstone, silty sandstone, calcareous sandstone, ashstone and cherty mudstone, carbonaceous mudstone and coal;
- Early Tertiary mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt;
- Early Tertiary intrusive rhyolite, trachyte and microsyenite;
- Late Tertiary – Quaternary clay, silt, sand, gravel, soil (colluvial and residual deposits);
- Quaternary sand, gravel, clay (floodout sheets and small fans); and
- Quaternary mud, sand and minor gravel, alluvium.

2.7 VEGETATION

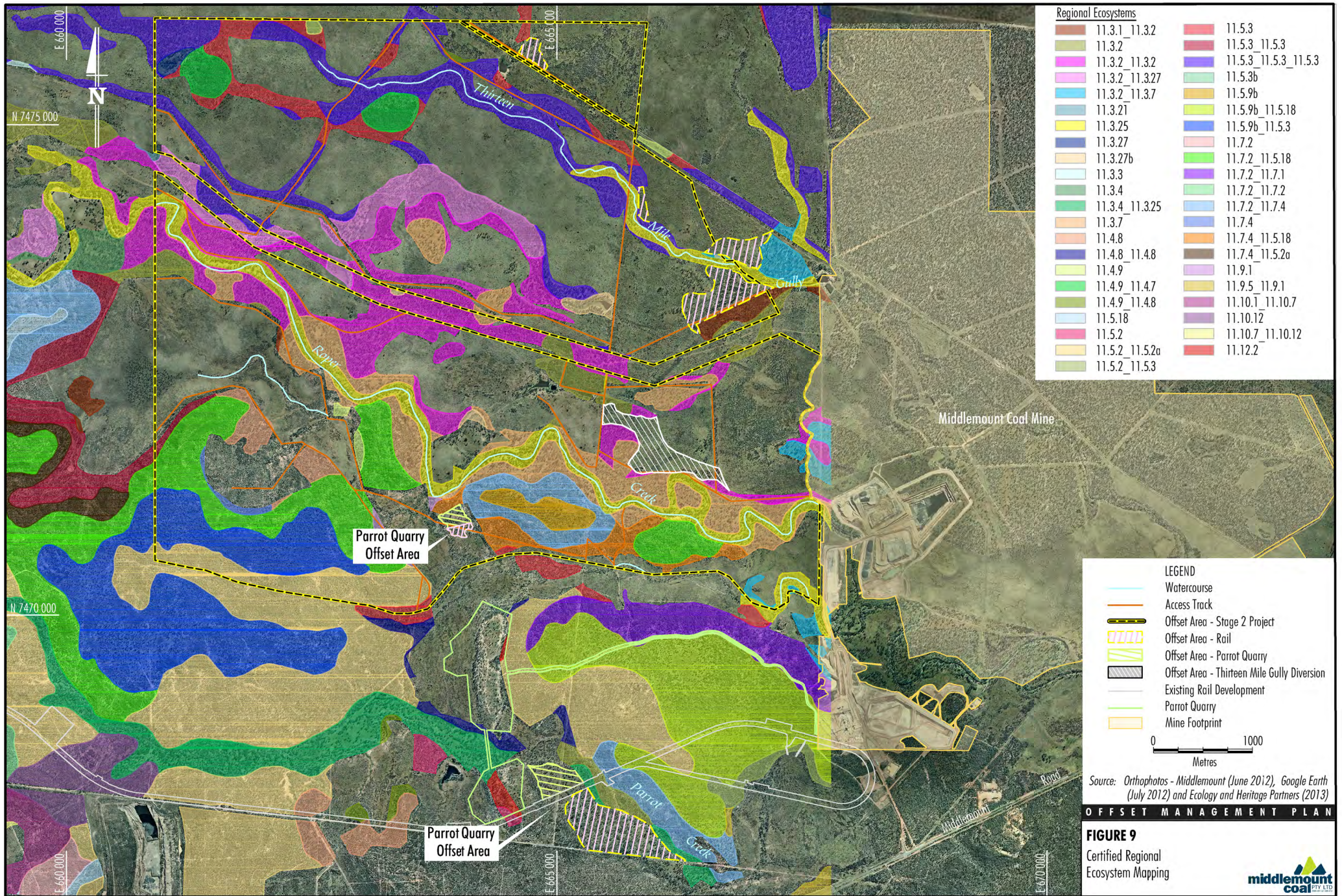
The Qld government mapping (Figure 9) has been ground-truthed by Ecology and Heritage Partners Pty Ltd (2012a) (Figure 10). The native vegetation within the offset areas are a mixture of mature woodland and forest (Plate 3) with some native *Astrelba* sp. grassland areas (Figure 10). Eucalypt woodland is dominated by Silver Leaved Ironbark (*Eucalyptus melanophloia*) and Poplar Box (*E. populnea*).

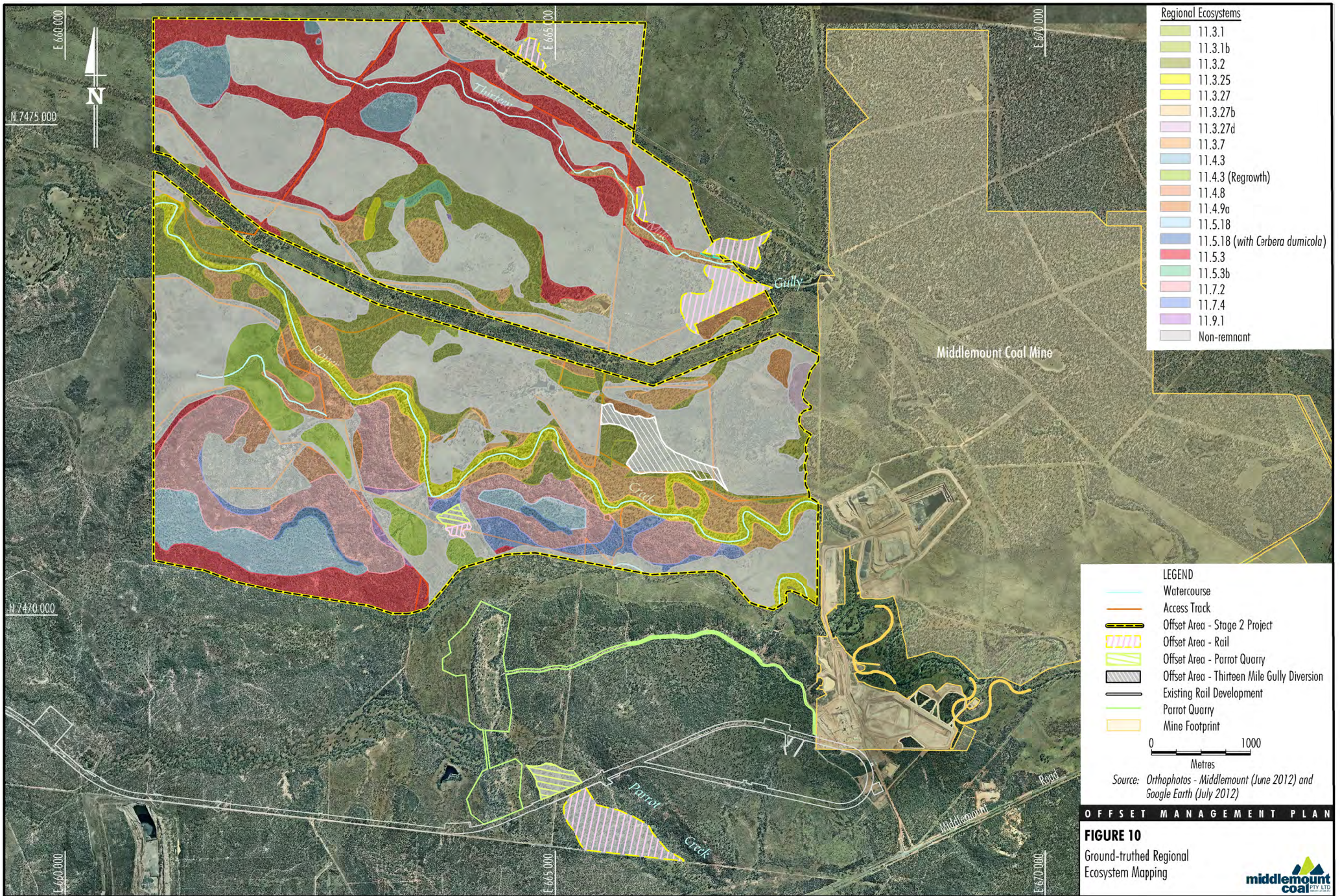


Plate 3 - Examples of Woodland/Forest Areas

Multiple patches of Brigalow (*Acacia harpophylla* dominant and co-dominant), a threatened ecological community under the EPBC Act, occur in the offset areas as well as areas of Brigalow regrowth (Figures 10 and 11) (Section 2.9). Brigalow is present as a component of a number of endangered and Of Concern REs listed under the VM Act.

The vegetation is comprised of various age classes. The non-remnant vegetation (as defined by the RE mapping system), comprises land which has been cleared in the past and is now at various stages of regeneration (Plate 4). These areas are considered to have a moderate to high resilience despite livestock grazing. Buffel Grass is dominant and is quite extensive in these regenerating areas but is notably lower in denser regrowth areas. There is evidence of past fire in the offset areas and in some areas it has resulted in tree death and regrowth. Erosion is prevalent on less travelled access tracks in the offset area.





Regional Ecosystems	
11.3.1	
11.3.1b	
11.3.2	
11.3.25	
11.3.27	
11.3.27b	
11.3.27d	
11.3.7	
11.4.3	
11.4.3 (Regrowth)	
11.4.8	
11.4.9a	
11.5.18	
11.5.18 (with <i>Carbera dumicola</i>)	
11.5.3	
11.5.3b	
11.7.2	
11.7.4	
11.9.1	
Non-remnant	

LEGEND

- Watercourse
- Access Track
- Offset Area - Stage 2 Project
- Offset Area - Rail
- Offset Area - Parrot Quarry
- Offset Area - Thirteen Mile Gully Diversion
- Existing Rail Development
- Parrot Quarry
- Mine Footprint

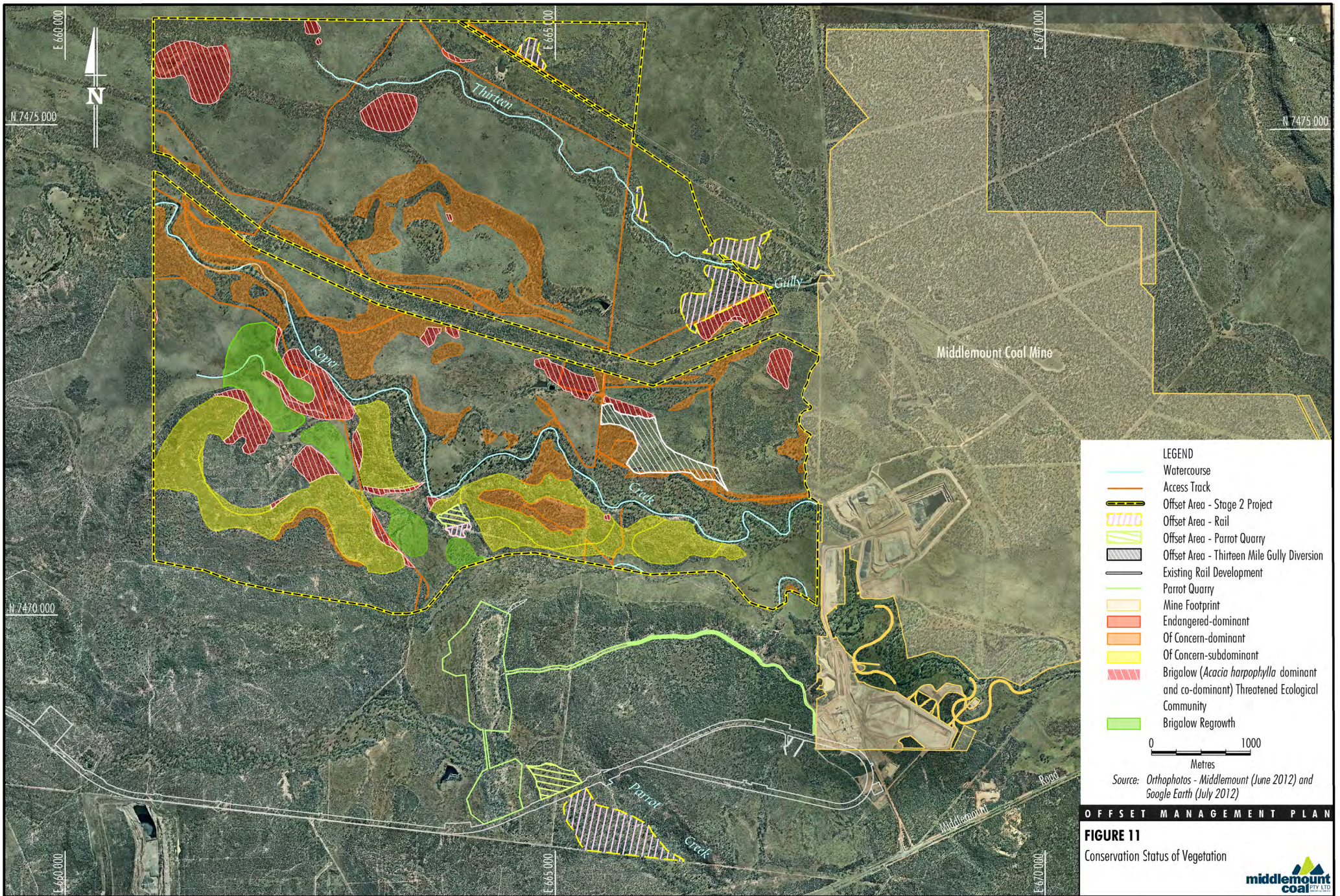
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Source: Orthophotos - Middlemount (June 2012) and Google Earth (July 2012)

OFFSET MANAGEMENT PLAN

FIGURE 10
Ground-truthed Regional Ecosystem Mapping





OFFSET MANAGEMENT PLAN

FIGURE 11

Conservation Status of Vegetation





Plate 4 - Examples of Previously Cleared Areas that are Regenerating

A total of 13 REs were recorded within the offset areas (Figure 10; Table 9).

**Table 9
Regional Ecosystems**

RE ID	Description	Status ¹		
		VM Act	Biodiversity Status	EPBC Act
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	E	E	E
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	OC	OC	-
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	LC	OC	-
11.3.27	Freshwater wetlands	LC	OC	-
11.3.7	<i>Corymbia</i> spp. woodland on alluvial plains, sandy soils	LC	OC	-
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	E	E	E
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains	E	E	E
11.4.9	<i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	E	E	E
11.5.18	<i>Micromyrtus capricornia</i> shrubland on Cainozoic sand plains/remnant surfaces	OC	OC	-
11.5.3	<i>Eucalyptus populnea</i> and/or <i>E. melanophloia</i> and/or <i>Corymbia clarksoniana</i> on Cainozoic sand plains/remnant surfaces	LC	NC	-
11.7.2	<i>Acacia</i> spp. woodland on lateritic duricrust, scarp retreat zone	LC	NC	-
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> on lateritic duricrust	LC	NC	-
11.9.1	<i>Acacia harpophylla</i> - <i>Eucalyptus cambageana</i> open forest to woodland on fine-grained sedimentary rocks	E	E	E

Source: After Ecology and Heritage Partners (2012a).

¹ Conservation status of REs listed under the VM Act and/or EPBC Act (current at 9 April 2013).

E = Endangered, OC = Of Concern, LC = Least Concern, NC = No Concern at Present.

GHD (2012) undertook ecological equivalence measurements within the clearing area and in Rail Project Offset Areas 1, 3, 4 and 5 in March 2012 (MCPL, 2013a; Appendix B). Ecology and Heritage Partners (2013a) undertook ecological equivalence measurements within Rail Offset Areas 2 and 6 in December 2012 (MCPL, 2013a; Appendix B).

Ecology and Heritage Partners (2013b) undertook ecological equivalence measurements within the Parrot Quarry clearing area and offset areas (MCPL, 2013b; Appendix B) and within the Thirteen Mile Gully Diversion clearing area and offset areas in December 2012 (MCPL, 2013c; Appendix B).

2.8 DECLARED PLANTS (WEEDS)

Declared plants are listed under the Qld *Land Protection (Pest and Stock Route Management) Act, 2002* (LP Act) and are targeted for control because they have, or could have, serious economic, environmental or social impacts. Landowners have a legal responsibility for the control of declared plants.

Ecology and Heritage Partners (2012a) (Appendix C) recorded three declared plants in the offset areas:

- *Harrisia Cactus (Eriocereus martinii)* is a perennial plant with spiny, fleshy-jointed stems that grow to around 0.5 metres (m) high. This species forms dense infestations that chokes out other species if left unchecked (Department of Agriculture, Fisheries and Forestry, 2013).
- *Parthenium (Parthenium hysterophorus)* is an annual herb with a deep taproot and an erect stem that becomes woody with age. This species grows to approximately 1 to 1.5 m in height and develops several branches in its top half when mature. *Parthenium* invades disturbed bare areas (e.g. along roadsides) (Department of Agriculture, Fisheries and Forestry, 2013).
- *Velvety Tree Pear (Opuntia tormentosa)* is a leafless succulent shrub that has spiny pear-shaped fruit. This species invades pastures and thrives in hot, dry conditions and causes other plants to lose vigour or die (Department of Agriculture, Fisheries and Forestry, 2013).

Harrisia Cactus, *Parthenium* and *Velvety Tree Pear* were sparsely distributed in low densities across the entire offset areas (Ecology and Heritage Partners, 2012a) (Appendix C). *Parthenium* was most commonly recorded as small plants sparsely distributed along Roper Creek in RE 11.3.25 (Ecology and Heritage Partners, 2012a) (Appendix C).

During nearby surveys of the mine site, Parsons Brinkerhoff (2010) recorded three weed species listed under the LP Act not recorded during the recent surveys conducted within the offset areas:

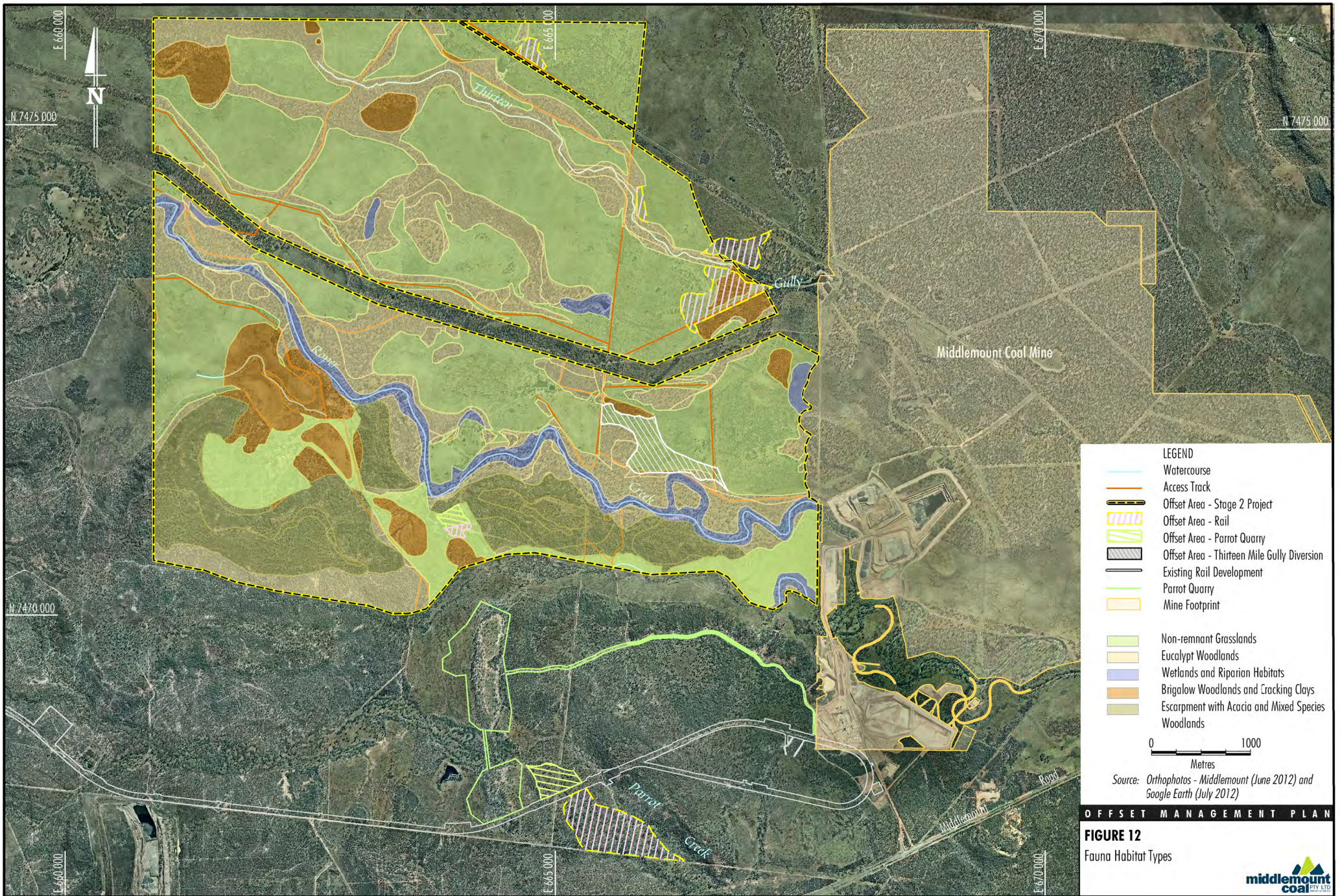
- *Prickly Acacia (Acacia nilotica)*;
- *Tiger Pear (Opuntia aurantiaca)*; and
- *Prickly Pear (Opuntia stricta)*.

These species all have the potential to occur in the offset areas. Information on other declared plants in Qld is provided in Appendix D.

2.9 FAUNA HABITAT

Five broad fauna habitat types were recorded by Ecology and Heritage Partners (2012a) (Appendix C) as occurring within the offset areas. These comprised: non-remnant grasslands; eucalypt woodlands; wetlands and riparian habitats; Brigalow woodland and cracking clays; and escarpment with *Acacia* and mixed species woodlands (Figure 12). A summary of the habitat types are provided below.

The non-remnant grasslands habitat type comprises land which has been cleared in the past and is now at various stages of regeneration (Plate 4). Apart from this habitat, Eucalypt woodlands was one of the most common fauna habitat types and is dominated by Silver Leaved Ironbark (*Eucalyptus melanophloia*) and Poplar Box (*E. populnea*). Ground debris, particularly fallen timber, and bare ground was common throughout this habitat type. Thick leaf litter occurred beneath bushes or under trees and the soil was typically alluvial or clay.



Riparian habitat generally occurred as tall open riparian woodlands dominated by Forest Red Gum (*Eucalyptus tereticornis*) along Roper Creek within the offset area. Several hollow-bearing trees were present within this habitat type and the ground layer contained grass and bare ground. Debris, such as fallen timber and leaf litter was abundant. Artificial waterbodies were generally small to moderate in size and highly disturbed, particularly around the edges due to cattle activity.

Brigalow woodlands and cracking clays habitat contained few hollows, however, exfoliating bark was common and could potentially provide shelter for fauna species. The cracking clay soils on which this habitat type was found provide dry-season refugia for many terrestrial vertebrates. The ground layer was relatively open and dominated by native grasses. Few weeds occurred within this habitat type.

Acacia woodland consisted of a moderately dense, tall canopy dominated by Lacewood (*Acacia shirleyi*). Few hollows were present due to a lack of Eucalypt species and shrubs, where present, were typically regrowth canopy species. Groundcover was dominated by short native grasses, separated by patches of bare ground and fallen debris, particularly moderately sized logs.

2.10 DECLARED ANIMALS (PESTS)

Declared animals are listed under the LP Act and are targeted for control because they represent a threat to primary industries, natural resources and the environment. Landowners have a legal responsibility for the control of declared animals.

Ecology and Heritage Partners (2012a) (Appendix C) recorded four pest animal species within the offset areas listed under the LP Act:

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

During nearby surveys of the mine site, Parsons Brinkerhoff (2010) recorded the European Fox (*Vulpes vulpes*). This species also has the potential to occur in the offset areas. Information on other declared animals in Qld is provided in Appendix E.

Other potentially occurring pests (non-declared animals) include the House Mouse (*Mus musculus*) and Cane Toad (*Bufo marinus*).

2.11 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Ecology and Heritage Partners Pty Ltd (2012b) ground-truthed areas of threatened ecological communities listed under the EPBC Act and map potential habitat for the Ornamental Snake and Squatter Pigeon (southern race) within the offset areas. Matters of National Environmental Significance relevant to the Stage 2 Offset Area are listed in Table 10.

Table 10
Matters of National Environmental Significance for Stage 2 Offset Area

Scientific Name	Common Name	EPBC Act Status ¹	Current Extent and Condition
Threatened Ecological Community			
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) community		E	Approximately 150 ha of Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) community occurs within the Stage 2 Offset Area (Figure 11; Plate 5). Brigalow regrowth woodland is also present in the Stage 2 Offset Area and is shown on Plate 6. Ecology and Heritage Partners (2012b) report that the Brigalow community is in good ecological condition (for the most part). There are few to no weeds within the patches and the only existing disturbance is from cattle grazing, which will be managed as part of the offset management plan.
Fauna			
<i>Denisonia maculata</i>	Ornamental Snake	V	Approximately 1,670 ha of potential habitat for the Ornamental Snake occurs within the Stage 2 Offset Area. Potential habitat lies predominantly along Thirteen Mile Gully and Roper Creek on or adjacent to REs in Landzone 4 with cracking clay soils on gilgai microrelief. This species inhabits moist or seasonally moist areas such as floodplains, clay pans or waterbodies that contain shelter in the form of deep cracking soils or fallen timber close to a source of water (Curtis <i>et al.</i> , 2012). This species preferred habitat is within or close to habitat that is abundant in frogs (its prey) (SEWPaC, 2012). This species is found in areas with natural cover (such as coarse litter, rocks, etc.) or human-made litter (such as galvanised iron sheets) and can tolerate relatively simple habitat structures such as grasslands, cleared paddocks and woody regrowth (Curtis <i>et al.</i> , 2012).
<i>Geophaps scripta scripta</i>	Squatter Pigeon (southern race)	V	The entire Stage 2 Offset Area (3,280 ha) contains potential habitat for Squatter Pigeons (southern race). Squatter Pigeons (southern race) are able to use a range of vegetation associations including non-remnant vegetation (SEWPaC, 2012). Locations where this species has been recorded are shown on Figure 13. This species occurs mainly in dry grassy eucalypt woodlands and open forests in sandy areas near a source of permanent water (Curtis <i>et al.</i> , 2012). This species has also been recorded in sown grasslands with scattered remnant trees, disturbed habitats (such as stockyards, roads, railways, settlements, etc.), scrub, Acacia growth and heavily-grazed country (SEWPaC, 2012).
<i>Merops ornatus</i>	Rainbow Bee-eater	M	The Rainbow Bee-eater (<i>Merops ornatus</i>) was incidentally observed during the surveys (Ecology and Heritage Partners Pty Ltd, 2012a). Locations where this species has been recorded are shown on Figure 13. This species inhabits a range of habitats including open forests and woodlands, shrublands, cleared or semi-cleared habitats (including farmland and areas inhabited by humans) (SEWPaC, 2012). This species is generally located in areas that are close to a permanent source of water within open, cleared or lightly-timbered areas (SEWPaC, 2012). Also has been recorded in other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (SEWPaC, 2012).
<i>Phascolarctos cinereus</i>	Koala	V	The most important habitat characteristics for this species is the type and presence of Eucalyptus tree species and the extent of tree cover (Curtis <i>et al.</i> , 2012). This species inhabits a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities (SEWPaC, 2012). The distribution of this species is also affected by soil fertility, water regimes, altitude (limited to <800 m Australian Height Datum), temperature and leaf moisture (Curtis <i>et al.</i> , 2012; SEWPaC, 2012). Locations where this species has been recorded are shown on Figure 13.

¹ Conservation status under the EPBC Act (current at 11 September 2012).

V = Vulnerable, E = Endangered, M= Migratory.

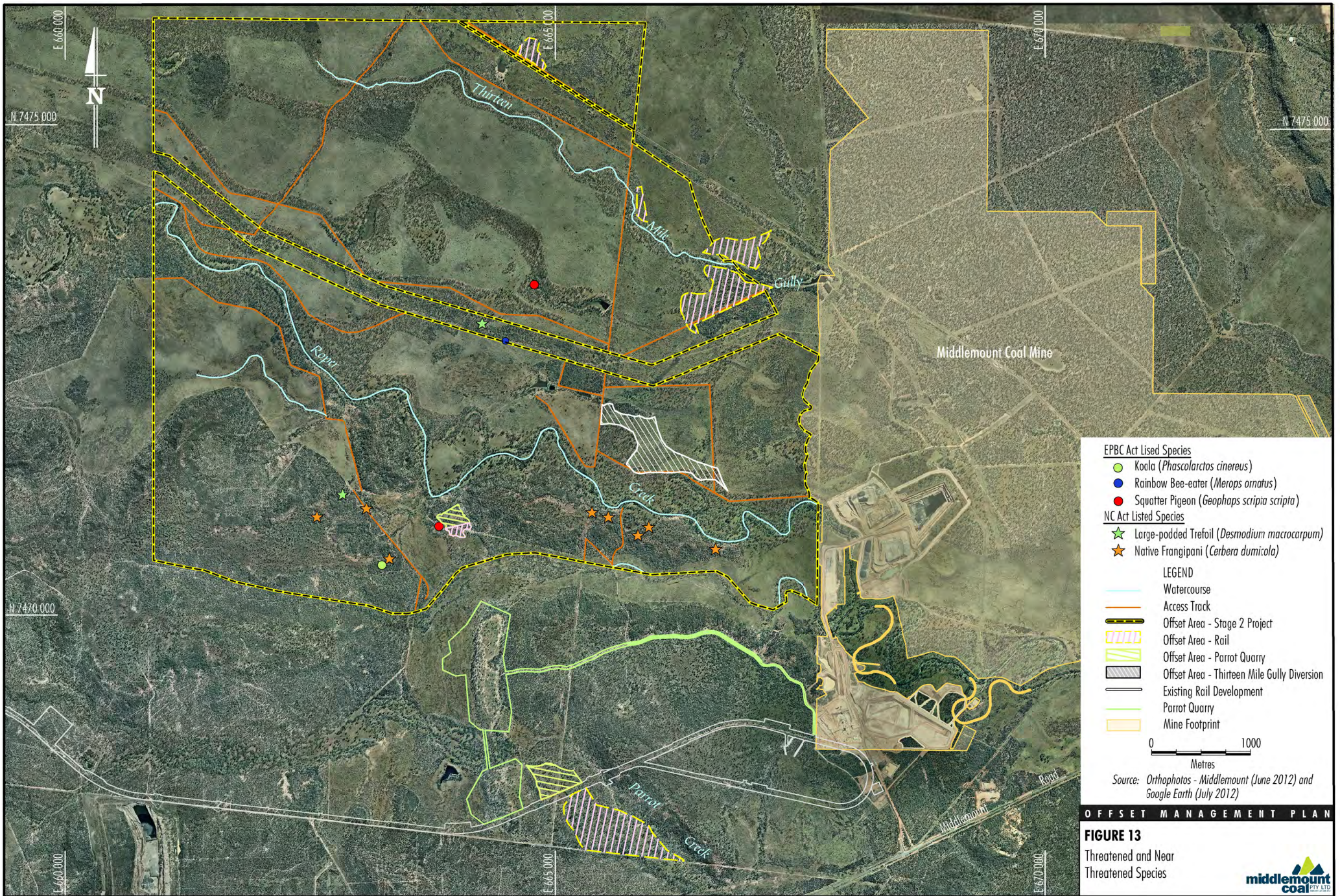
The Stage 2 Offset Area also provides potential habitat for a number of other threatened species listed under the EPBC Act, such as the Brigalow Scaly-foot (*Paradelma orientalis*), Yakka Skink (*Egernia rugosa*) and South Eastern Long-eared Bat (*Nyctophilus timoriensis*). These species may occur in the offset areas.



Plate 5 - Brigalow (*Acacia harpophylla* Dominant and Co-dominant) Community



Plate 6 - Brigalow Regrowth Woodland



OFFSET MANAGEMENT PLAN

FIGURE 13
Threatened and Near
Threatened Species



2.12 STATE SIGNIFICANT BIODIVERSITY VALUES

State Significant Biodiversity Values (DERM, 2011a) relevant to the offset areas are listed in Table 11.

Table 11
State Significant Biodiversity Values

State Significant Biodiversity Values ¹	Relevance to the Offset Area
Remnant Endangered REs	RE 11.3.1, RE11.4.3, RE11.4.8 and RE11.4.9 and RE11.9.1 (Figure10)
Remnant Endangered grassland REs	None.
Remnant Of Concern REs	RE 11.3.2.
Remnant Of Concern grassland REs	None.
High value regrowth vegetation containing Endangered REs	Figure 10.
High value regrowth vegetation containing Of Concern REs	None.
Threshold REs	None.
Critically limited REs	None.
Essential habitat	No essential habitat has been mapped in the offset areas.
Essential regrowth habitat	No essential regrowth habitat has been mapped in the offset areas.
Wetland (<i>Vegetation Management Act 1999</i>)	Wetlands are mapped on Figure 3.
Significant wetland (<i>Vegetation Management Act 1999</i>)	No significant wetlands are mapped.
Watercourses	Watercourses are mapped on Figure 3.
Connectivity	The offset areas are located within the Brigalow Belt Corridor (DERM, 2008b).
Protected animals	Squatter Pigeon (southern race), listed as vulnerable under the <i>QLD Nature Conservation Act, 1992</i> (NC Act).
Legally secured offset areas under State legislation	Section 1.4.
Protected plants	Native Frangipani (<i>Cerbera dumicola</i>) and Large-podded Trefoil (<i>Desmodium macrocarpum</i>), both of which are near threatened under the NC Act.
Wetland protection areas	No wetland protection areas occur in the offset areas.

¹ DERM (2011a).

2.13 CURRENT THREATS

Current threats in the offset areas are as follows:

- weeds;
- pest animals;
- uncontrolled wild fire;
- land degradation;
- over grazing; and
- inappropriate use of barbed wire.

The management of these threats are described in Section 3.

3 MANAGEMENT ACTIONS

Management measures applicable to each of the offset areas are listed in Table 12.

**Table 12
Management Measures**

	Stage 2 Offset Area (including the Thirteen Mile Gully Diversion Offset Area)	Rail Project Offset Areas	Parrot Quarry Offset Areas
Management of EPBC Act listed threatened species (Section 3.1)	•	-	-
Setting up the offset areas on the ground (Section 3.2)	•	•	•
Regeneration (Section 3.3)	•	•	•
Weed management strategy (Section 3.4)	•	•	•
Pest animal management strategy (Section 3.5)	•	•	•
Fire management (Section 3.6)	•	•	•
Erosion and sediment control (Section 3.7)	•	•	•
Management of livestock (Section 3.8)	•	•	•
Restrictions to access (Section 3.9)	•	•	•
Additional habitat features (Section 3.10)	•	-	-
Removal of barbed wire (Section 3.11)	•	•	•
Education (Section 3.12)	•	•	•
Management schedule (Section 3.13)	•	•	•

3.1 MANAGEMENT OF EPBC ACT LISTED THREATENED SPECIES

Management measures relevant to Matters of National Environmental Significance were presented in the Offset Strategy (MCPL, 2012). Table 13 provides management measures relevant to Matters of National Environmental Significance as described in this Offset Management Plan/Vegetation Management Plan. The section of this Offset Management Plan/Vegetation Management Plan that addresses the management measure is also provided.

The management measures provided in this Offset Management Plan/Vegetation Management Plan consider the threat abatement and recovery information on the SEWPaC (2012) website and relevant recovery plans (Butler, 2007; Richardson, 2008).

Table 13
Specific Management Measures Relevant to Matters of National Environmental Significance

Matter of National Environmental Significance	Management Measures	Section
Ornamental Snake (<i>Denisonia maculata</i>)	<ul style="list-style-type: none"> • Livestock will be managed in the offset areas. • Relocation of transportable habitat features such as large logs and boulders in adjacent retained areas to allow their continuation as potential fauna refuge sites. • A pest animal management strategy will be developed to control pest animals (such as feral pigs). 	<p>Section 3.8</p> <p>Section 3.10</p> <p>Section 3.5</p>
Squatter Pigeon (southern race) (<i>Geophaps scripta scripta</i>)	<ul style="list-style-type: none"> • Livestock will be managed in the offset areas. • A pest animal management strategy will be developed to control pest animals (such as rabbits, cats, pigs, dogs and foxes). • Regeneration of already cleared land will be allowed by preventing regrowth clearing, minimising fire and by managing grazing in the offset areas. 	<p>Section 3.8</p> <p>Section 3.5</p> <p>Section 3.3</p>
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) Community	<ul style="list-style-type: none"> • Livestock will be managed in the offset areas. • A weed management strategy will be developed. • A pest animal management strategy will be developed to control pest animals (such as rabbits, cats, dogs, pigs and foxes). • Fire management. 	<p>Section 3.8</p> <p>Section 3.4</p> <p>Section 3.5</p> <p>Section 3.6</p>

3.2 SETTING UP THE OFFSET AREAS

After enduring protection of the offset areas has been established (Section 1.4), the offset areas will be set-up on the ground by:

- identifying/establishing fire trails/access tracks required for fire management or other management purposes (Sections 3.6 and 3.9, Figure 14);
- fencing the perimeter of the Stage 2 Offset Area, Rail Project Offset Areas 3 and 5 and Parrot Quarry Offset Area 2 to manage grazing livestock in the offset areas (Section 3.8);
- installing locks on gates into the Stage 2 Offset Area, Rail Project Offset Areas 3 and 5 and Parrot Quarry Offset Area 2 (Section 3.9); and
- installing signage along main access roads which recognised that the area is protected for conservation purposes to deter third party access into the area (Section 3.9).

An operational review of road and fire trail construction is to be completed in order to set up the offset areas. Access into the offset areas is currently limited. The main access is along an access track associated with the travelling stock route (Figure 3). The rough locations of tracks in the offset areas are shown on Figure 4 based on air photo interpretation. The design of any new tracks will consider the location of conservation significant vegetation and flora (Figures 11 and 13).

Any existing access tracks not necessary for management purposes will be ripped and revegetated (Section 3.3). Excess fencing inside of the offset areas which is not required will be removed and recycled where practicable. Access tracks across drainage lines in the offset areas will be repaired and stabilised.

3.3 REGENERATION

Two main types of management areas are relevant to the offset area, namely, Enhancement Areas and Regeneration Areas (Figure 14²). The management areas are described in Table 14.

**Table 14
Management Areas**

Management Area	Description
Enhancement Areas	Approximately 1,590 ha of existing woodland/forest habitats will be managed to improve its condition.
Regeneration Areas	Approximately 1,790 of cleared land will be allowed to regenerate.

The Enhancement Areas comprise existing woodland/forest habitats and will not need specific revegetation measures. On the other hand, the Regeneration Areas comprise land which has been cleared in the past and is now at various stages of regeneration (Plate 4, Section 2.7). The vegetation in these areas are likely to contain varying quantities of the surrounding vegetation communities, including Brigalow.

The land is considered to have moderate to high resilience despite the past disturbance, evidenced by regrowth of trees and native understorey. Therefore, the primary method for regenerating the offset areas will be through management of threatening processes that inhibit natural regeneration (e.g. weeds [Section 3.4], pest animals [Section 3.5], erosion [Section 3.7] and grazing livestock [Section 3.8]). Specific monitoring of these areas are described in Section 5.1.

Access tracks not necessary for management purposes will be ripped and revegetated according to the method in Section 6.1.1. Areas of excessive erosion will be treated according to the method outlined in Section 3.7.

In the unlikely event that natural regeneration is not readily occurring or species composition is poor, contingency measures are described in Section 6.1, including further active seeding/planting or disturbance to reduce competition.

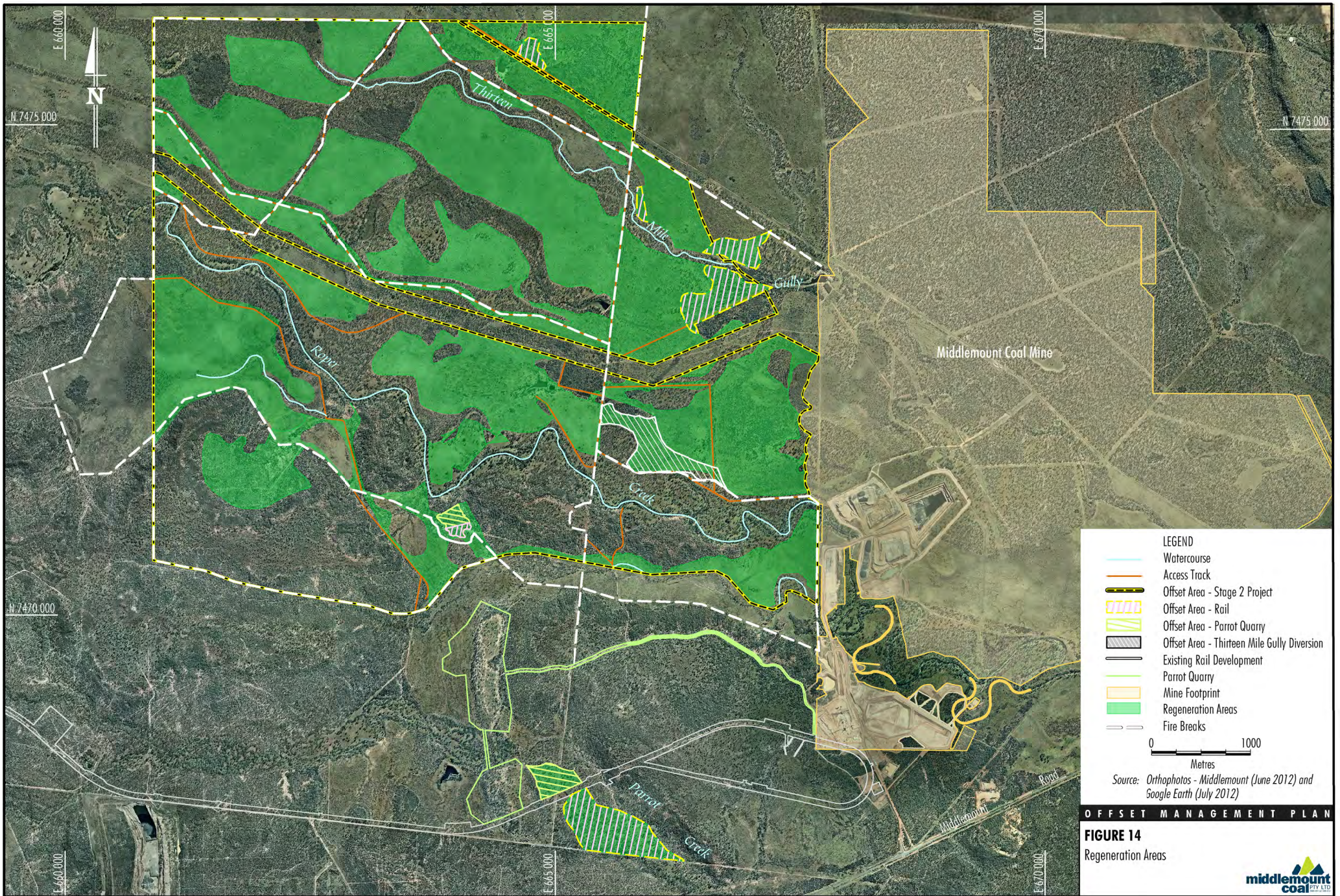
3.4 WEED MANAGEMENT STRATEGY

The purpose of the weed management strategy is to improve the condition of the habitat by reducing the presence of weeds/declared plants.

3.4.1 Weed Prevention

The spread and introduction of weeds/declared plants to and within the offset areas can be minimised by restricting vehicles to designated access tracks. The implementation of measures that favour the restoration of healthy native vegetation is also an effective method of weed management. The introduction, establishment and spread of non-native weeds will be minimised through regular monitoring and treatment activities.

² Enhancement areas are areas of the offset which are not mapped as Regeneration Areas.



3.4.2 Weed Control

The presence of weeds/declared plants will be identified via monitoring (Section 5.1.3) and regular site inspections (Section 5.1.5). In regard to weed management measures, physical removal and chemical application are the main weed control methods available. Appropriately qualified persons will be engaged to undertake weed control.

Control methods will target the following species listed under the LP Act:

- Cactus (*Harrisia* sp.) (Class 1);
- Parthenium (*Parthenium hysterophorus*) (Class 2);
- Velvety Tree Pear (*Opuntia tormentosa*) (Class 1);
- Prickly Acacia (*Acacia nilotica*) (Class 2);
- Tiger Pear (*Opuntia aurantiaca*) (Class 2); and
- Prickly Pear (*Opuntia stricta*) (Class 2).

Category descriptions are as follows:

- Class 1 - not generally established in Qld and has potential to cause adverse economic, environmental or social impacts.
- Class 2 - established in Qld and can cause significant adverse economic, environmental or social impacts (including in another State).

Information on other declared plants in Qld is provided in Appendix D. Specific weed control methods will be in accordance with those specified by the Qld Department of Agriculture, Fisheries and Forestry (2013).

As described in Section 2.8, Cactus (*Harrisia* sp.), Parthenium and Velvety Tree Pear were found to be sparsely distributed in low densities across the entire offset areas (Ecology and Heritage Partners, 2012a) (Appendix C). On the 12 August 2013, DNRM requested weed control methods for Cactus, Parthenium and Velvety Tree Pear to be outlined in this plan. These species will be controlled in accordance with Department of Agriculture, Fisheries and Forestry (2013) weed control specifications (Table 15).

**Table 15
Weed Control Methods**

Species	Control Methods*
Cactus (<i>Harrisia</i> sp.)	<ul style="list-style-type: none"> • Mechanical control to dig out plants (including tubers) and destroyed. • Herbicide control with chemicals and application rates in accordance with the <i>Harrisia</i> Cactus fact sheet.
Parthenium	<ul style="list-style-type: none"> • Herbicide control with chemicals and application rates in accordance with the Parthenium fact sheet. • Spray in a time of year before Parthenium sets seed. • 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.
Velvety Tree Pear	<ul style="list-style-type: none"> • Herbicide control with chemicals and application rates in accordance with the prickly pear identification and control fact sheet.

* Source: Department of Agriculture, Fisheries and Forestry (2013)

One or multiple combination of treatments may be applied. The selected treatments employed will be documented and monitored. Any clearing of native vegetation to control non-native weeds will be conducted in a way that prevents soils erosion, and maintains banks stability if clearing is associated with a watercourse.

3.4.3 Buffel Grass Management

Buffel Grass is a widespread introduced pasture species which is dominant over large areas of remnant and non-remnant vegetation in the offset areas and surrounds (Appendix C). Buffel Grass is readily spread by the wind, overland water flow, animals and human activities. Buffel Grass has an extensive root system that enables the grass to bind soil particles to reduce erosion and dust generation. Uncontrolled Buffel Grass growth suppresses regrowth of native plant species (Franks, 2002; Grice *et al.*, 2012; Marshall *et al.*, 2012; Appendix F) which can hinder the performance of the Regeneration Areas. The objective of the Regeneration Areas is that they progressively change from a grassland dominated system to woodland/forest.

Buffel Grass can also present a significant fire risk as studies have shown the wildfires through overgrown Buffel Grass are more intense and can damage native vegetation communities (such as Brigalow [*Acacia harpophylla* dominant and co-dominant] community) (Franks, 2002; Butler and Fairfax, 2003; Butler, 2007; Miller *et al.*, 2010; Appendix F). For this reason, the interaction between Buffel Grass and fire has been identified as an important target for management (Butler and Fairfax, 2003). Further information on Buffel Grass can be found in CRC Weed Management (2008) *Weed Management Guide for Buffel Grass* (Appendix F).

Buffel Grass in the offset areas will be managed to suppress its dominance and reduce the fire risk posed by high fuel loads. Buffel Grass growth in the offset areas can be managed by the following options:

- Encouraging growth of overstorey vegetation (to form a canopy and shade-out Buffel Grass).
- Mapping Buffel Grass infestations for management purposes (extent and approximate ground cover).
- Segmentation of the offset areas into Buffel Grass management zones where appropriate with different treatments trailed in different areas.

Possible treatments include:

- Strategic grazing in the offset areas to control biomass and reduce fuel load (Section 3.8).
- Mosaic fire management to reduce Buffel Grass cover/old growth fuel load.

These possible treatments are further discussed below. One or multiple combination of treatments may be applied. The selected treatments employed will be documented and monitored.

The Offset Management Plan previously included options to slash and spray Buffel Grass, however these options were removed as requested by DNRM (12 August 2013).

Strategic Grazing

Rotational livestock grazing may be used as a method of managing Buffel Grass and reducing fuel loads in the offset management area. It is noted that inappropriate livestock grazing can pose a risk to native vegetation, though strategic grazing is likely to be an effective method of reducing Buffel Grass fuel loads over large areas (Butler and Fairfax, 2003). Further information on livestock grazing in the offset areas are described in Section 3.8.

Mosaic Fire Management

Buffel Grass is also relatively resilient to fire, however a cool fire may provide a safe and useful means of fuel reduction and could be achieved when moisture levels are relatively high (Butler and Fairfax, 2003). Marshall, *et al.* (2012) described that burning followed by the application of herbicides and sowing of native grasses has been highly effective at suppressing Buffel Grass while promoting the regeneration of other flora.

Fires in pastures (i.e. the Regeneration Areas) should be generally prevented from escaping into adjacent areas of native vegetation woodland/forest as they can open them up to Buffel Grass invasion (Appendix F). Fire management guidelines for each of the REs recorded within the offset areas are provided in Appendix G as sourced from the DEHP (2012).

3.4.4 Weed Monitoring and Reporting

The control techniques used will be documented and areas subject to weed control will be mapped for follow-up inspection and management. Follow-up site inspections will occur to determine the effectiveness of weed control. Weed management and monitoring results will be reported annually. Weed monitoring is described in Section 5.1.3 and reporting requirements are outlined in Section 5.2.

3.5 PEST ANIMAL MANAGEMENT STRATEGY

The purpose of the pest animal management strategy is to improve the condition of the habitat by reducing the presence of pest animals. Feral Pigs (*Sus scrofa*) and the Cane Toad (*Bufo marinus*) are recognised threats to the Ornamental Snake (Richardson, 2008; Curtis *et al.*, 2012). The European Fox (*Vulpes vulpes*), European Rabbit (*Oryctolagus cuniculus*) and Feral Cats (*Felis catus*) are threats to the Squatter Pigeon (southern race) (Curtis *et al.*, 2012). Multiple pest animals can degrade occurrences of the Brigalow (*Acacia harpophylla* dominant and co-dominant) community.

3.5.1 Pest Animal Prevention

Removing available feed and maintaining a clean, rubbish-free environment in order to discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna (e.g. introduced rodents, predators and birds) will be undertaken.

3.5.2 Pest Animal Control

Appropriately qualified persons will be engaged to undertake pest animal control. Control measures will consider the guidelines found on the Qld Agriculture, Fisheries and Forestry website: http://www.daff.qld.gov.au/4790_8262.htm. A control programme is to be implemented according to relevant legislation.

Control methods will target the following species listed under the LP Act:

- Feral Pigs (*Sus scrofa*) (Class 2);
- Wild Dogs (*Canis lupus familiaris*) (Class 2);
- European Rabbit (*Oryctolagus cuniculus*) (Class 2);
- Feral Cats (*Felis catus*) (Class 2); and
- European Fox (*Vulpes vulpes*) (Class 2).

Information on other declared animals in Qld is provided in Appendix E. The Cane Toad is not a declared animal under the LP Act (presumably because there is no cost-effective, broad scale control measures available), but it will be controlled if encountered in the offset areas. The *biological effects, including lethal toxic ingestion, caused by Cane Toads (Bufo marinus)* is a key threatening process listed under the EPBC Act. As mentioned above, Cane Toads are recognised threats to the Ornamental Snake (Richardson, 2008; Curtis *et al.*, 2012).

3.5.3 Pest Animal Monitoring and Reporting

Monitoring of pest animals is to be undertaken every 3 years by a suitably qualified practitioner (Section 5.1.4). If the results of these surveys indicate that a control programme is necessary, such a control programme is to be implemented and monitored according to relevant legislation.

Follow-up site inspections will occur to determine the effectiveness of pest animal control (Section 5.1.4). Pest animal management and monitoring results will be reported annually.

3.6 FIRE MANAGEMENT

Inappropriate fire regimes has been recognised as presenting a threat to the habitat of the Ornamental Snake, which relies upon logs, coarse woody debris and ground litter for shelter (Brigalow Belt Reptiles Workshop, 2010). Fire would also impact the grass nests and the grass habitat of the Squatter Pigeon. Brigalow regrowth is often killed by fire and intense fires can alter the structure of Brigalow vegetation (Butler and Fairfax, 2003).

After enduring protection of the offset areas has been established (Section 1.4), the offset areas will be set-up on the ground by identifying/establishing fire trails required for fire management. Fire management guidelines for each of the REs recorded within the offset areas are provided in Appendix G as sourced from the DEHP (2012).

Ground fuel loads may be controlled through the strategic rotational grazing of cattle to prevent thick grass biomass from accumulating over time. It is anticipated that growth of overstorey vegetation will gradually shade-out/reduce Buffel Grass in the offset area. As stated in Section 3.8, livestock will be excluded from the offset areas once it is no longer required for strategic management of Buffel Grass.

Bushfire preventative measures will include:

- Educating employees and contractors on general fire awareness and response procedures (Section 3.12).
- Fire track maintenance for fire control.
- Ground fuel loads may be controlled through the strategic rotational grazing of cattle to prevent thick grass biomass from accumulating over time. Reducing the fuel load will minimise the impact of uncontrolled fires (e.g. from lightning strike), which could cause damage to Brigalow regeneration and enhancement areas, plus also impact the ground dwelling Squatter Pigeon (southern race) and Ornamental Snake.
- When necessary, fuel management (e.g. hazard reduction burns) 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.
- Land managers adjacent to the offset areas are to be contacted annually to discuss fire issues and burning programmes on adjacent land.

In the event of a wild fire occurring within the offset management area, back burning from the established fire breaks will be undertaken to prevent the spread of the wild fire. If the established fire breaks do not provide effective suppression of the wild fire then additional fire management lines will be installed to control the wild fire. Proposed locations of the established fire breaks are provided in Figure 14.

The Qld Rural Fire Service will be called for assistance if a significant bushfire was to occur within or move towards the offset area. Access to farm dams will be maintained for fire fighting equipment.

The known locations of Native Frangipani (*Cerbera dumicola*) and Large-podded Trefoil (*Desmodium macrocarpum*) (Figure 13) will be protected from hazard reduction burns where practicable.

3.7 EROSION AND SEDIMENT CONTROL

Erosion potential in the offset areas will be reduced by grazing management (Section 3.8), restricting vehicle access to the offset areas (Section 3.9) and control of animal pests (such as the European Rabbit) (Section 3.5).

Erosion control may be required in areas observed to be displaying relevant characteristics (e.g. gullyng), through visual monitoring (Section 5.1.5). Visual observations will focus on drainage areas and disturbed areas (e.g. access tracks including creek crossings).

The following measures may be used to control erosion within the offset area:

- selective plantings/direct seeding of local endemic species to stabilise the soil; and/or
- surface water management structures (e.g. contour banks and temporary sediment traps [such as hay bales]).

3.8 MANAGEMENT OF LIVESTOCK

Extended periods of Intense grazing of livestock can suppress regeneration of native plant species which can hinder the performance of the Regeneration Areas. Long-term Intense grazing of livestock is a recognised threat to Brigalow (*Acacia harpophylla* dominant and co-dominant) community (SEWPaC, 2012).

The perimeter of the offset areas will be fenced so that grazing activities can be managed in the offset area. Ultimately, it is intended to exclude grazing from the offset areas in the long-term, however in the interim, strategic grazing may be used to manage Buffel Grass fuel load in the offset management area.

Strategic Grazing

Livestock grazing will be strategically used in the offset area. Rotational livestock grazing may be used as a method of managing Buffel Grass and reducing fuel loads in the offset management area. Rotational grazing is where a period of grazing is followed by an extended period of rest which, depending on pasture growth and season conditions, rest may be up to a few months (DERM, 2011c). Rotating livestock will provide periods throughout the year when there will be no grazing pressure in selected areas.

It is intended that the Regeneration Areas progressively change from a grassland dominated system to woodland/forest. Grazing would be used in a way to still enable regeneration of native plant species in the Regeneration Areas. This would be achieved by maintaining high ground cover (i.e. greater than 60% [or as dictated by future monitoring]).

The Offset Management Plan previously included ‘wet season spelling’, however this management tool was removed as requested by DNRM (12 August 2013). The rotation of stock will be undertaken in association with the livestock owner and will be dependent upon seasonal conditions, maintaining ground cover above 60%.

Ground cover above 60% is considered “high cover”, which minimises soil loss from erosion and prevents declines in land condition (Fitzroy Basin Association, 2006). Maintaining ground cover above 60% will prevent the offset areas from being overgrazed, which is a known threat to Brigalow regrowth plus the habitat of the Squatter Pigeon (southern race) and the Ornamental Snake.

Fencing and appropriate stock water would need to be in place to enable areas to be strategically grazed (e.g. short duration, heavy grazing of Buffel Grass). Excess fencing inside of the offset areas which is not required will be removed and recycled where practicable.

The areas grazed would be mapped annually and the intensity of grazing (number of cattle and duration) would be recorded. Regeneration Areas would be monitored as described in Section 5 and the grazing regime revised as necessary.

Stocking rates in the offset areas will be highly dependent upon seasonal conditions and will fluctuate from year to year, so a precise set stocking rate cannot be established. Publically available literature indicates set stocking rates may not be the best tool for managing grazing pressure, due to the variability in seasonal conditions. During years with above average rainfall in the offset areas, higher stocking rates will be required for Buffel Grass and fire fuel load management. Conversely, lower stocking rates will be utilised during years with below average rainfall when buffel pasture growth has been limited (e.g. grazing a sustainable/safe level of pasture utilisation). At no time will stocking rates exceed 1 adult equivalent animal per 10 acres (annualised) and the stocking rate will be dependent upon maintaining the ground cover above 60%, the Fitzroy Basin Association recommendations (Fitzroy Basin Association, 2006).

Exclusion of Grazing

As described above, it is intended that the Regeneration Areas progressively change from a grassland dominated system to woodland/forest. Livestock will be excluded from the offset areas once it is no longer required for strategic management of Buffel Grass.

3.9 RESTRICTIONS TO ACCESS

Access into the offset areas will be restricted to authorised personnel. Locks will be installed on gates into the offset areas.

Vehicles will be restricted to designated access tracks. Access tracks through the offset areas will be maintained for fire management. Speed limits of 60 km per hour will be imposed on vehicles using access tracks.

Signage will be installed along main access roads which recognised that the area is protected for conservation purposes. The signs will describe:

- the area is a conservation area;
- access is restricted to authorised personnel only; and
- contact details for MCPL (Environmental Officer).

3.10 ADDITIONAL HABITAT FEATURES

Select habitat features (e.g. small hollow trunks/logs) will be salvaged during vegetation clearance activities at the Middlemount Mine and stockpiled for relocation to areas undergoing regeneration. These features would mainly be used in rehabilitation at the mine in accordance with Parsons Brinckerhoff (2010). These features can potentially provide habitat resources for a range of invertebrate and ground dwelling fauna.

Select habitat features may also be added into the Regeneration Areas of the offset areas (currently cleared areas) without suitable ground habitat, but only done if the habitat features can be placed into the Regeneration Areas without disturbance to native vegetation or the existing ground habitats currently present in the regeneration areas.

3.11 REMOVAL OF BARBED WIRE

Barbed wire use in fencing is a recognised threat to a range of fauna (e.g. bats), and is particularly hazardous when used in new fences and across fauna movement paths.

Barbed wire fencing within the offset areas will be removed upon exclusion of grazing. Where practical, the top two wires will be replaced with plain wire. Visual inspections of the fencing would be undertaken and any breaches rectified. If livestock from outside the offset areas are found to be eluding the fence, the design of the fence would be modified as required.

3.12 EDUCATION

MCPL own the property bordering all sides of the offset areas. MCPL will consult with the leasee regarding the rotational grazing livestock in the offset area.

Contractors/MCPL staff entering the offset areas will receive an induction in regard to:

- threatened and near threatened species present and their conservation value (Sections 2.11 and 2.12);
- requirement of vehicles to stay on designated tracks;
- fire awareness and response procedures; and
- prohibition of smoking in the offset areas (fire risk).

3.13 MANAGEMENT SCHEDULE

A management schedule is provided in Table 16.

**Table 16
Management Schedule**

Action	Management Type	Section	Timeframe
Enduring protection to be provided for the offset areas.	Enduring Protection	1.4	November 2012 to November 2013
Operational review of road and fire trail construction to be completed.	Setup	3.2	
Additional access tracks to be constructed/repaired.	Setup	3.2	
Signage of the offset areas to be provided.	Setup	3.2 and 3.9	
Appropriate fencing of the offset areas to be provided.	Setup	3.2 and 3.8	
Excess fencing inside of the offset areas to be removed.	Setup	3.2 and 3.8	
Gates with locks to be installed to restrict entry into the offset areas.	Setup	3.2 and 3.9	
Access tracks not necessary for management purposes to be ripped and revegetated.	Setup	3.2 and 3.3	
Access tracks across drainage lines in the offset areas to be repaired and stabilised.	Setup	3.2	
Barbed wire to be removed where practicable.	Management	3.11	
Initial pest animal study to be undertaken.	Management	3.5	
Initial mapping of declared weeds and Buffel Grass infestations for management purposes.	Management	3.4.3	
Erosion areas to be identified.	Management	3.7	
Baseline monitoring to measure the effectiveness of the regeneration and reporting to be undertaken.	Monitoring/Reporting	5.1.1 and 5.2	
Visual inspection and reporting to be undertaken.	Monitoring/Reporting	5.1.5 and 5.2	
An inspection for bushfire control requirements.	Monitoring	3.6	
Assessment of the requirement for restoration thinning to be undertaken.	Monitoring	5.1.6	
MCPL to publish a report on their website addressing compliance with the EPBC Act conditions.	Reporting	5.2	
Maintenance of all access tracks, fences and gates to be undertaken as required.	Management	3.6, 3.8 and 3.9	November 2013 to November 2014
Weed control initiated.	Management	3.4	
Animal pest control initiated.	Management	3.5	
Fire management activities to be undertaken as required.	Management	3.6	
Restoration thinning to be undertaken if required.	Management	5.1.6	
Monitoring the effectiveness of the regeneration and reporting to be undertaken.	Monitoring	5.1.1 and 5.2	
Monitoring the usage of the offset areas by fauna and reporting to be undertaken.	Monitoring	5.1.2 and 5.2	
Monitoring and reporting to be undertaken to evaluate the effectiveness of weed control.	Monitoring	5.1.3 and 5.2	
Monitoring and reporting to be undertaken to evaluate the effectiveness of pest control.	Monitoring	5.1.4 and 5.2	
Visual inspection and reporting to be undertaken.	Monitoring	5.1.5 and 5.2	
An inspection for bushfire control requirements.	Monitoring	3.6	
MCPL to publish a report on their website addressing compliance with the EPBC Act conditions.	Reporting	5.2	

**Table 16 (Continued)
Management Schedule**

Action	Management Type	Section	Timeframe
Maintenance of all access tracks, fences and gates to be undertaken as required.	Management	3.6, 3.8 and 3.9	Annually from November 2014 until the completion criteria are met
Weed control to be undertaken as required.	Management	3.4	
Animal pest control to be undertaken as required.	Management	3.5	
Fire management activities to be undertaken as required.	Management	3.6	
Monitoring the effectiveness of the regeneration and reporting to be undertaken.	Monitoring	5.1.1 and 5.2	
Monitoring and reporting to be undertaken to evaluate the effectiveness of weed control.	Monitoring	5.1.3 and 5.2	
Monitoring and reporting to be undertaken to evaluate the effectiveness of pest control.	Monitoring	5.1.4 and 5.2	
Visual inspection and reporting to be undertaken.	Monitoring	5.1.5 and 5.2	
An inspection for bushfire control requirements.	Monitoring	3.6	
Assessment of the requirement for restoration thinning to be undertaken.	Monitoring	5.1.6	
MCPL to publish a report on their website addressing compliance with the EPBC Act conditions.	Reporting	5.2	

The following activities will be undertaken on an ongoing basis as required:

- weed prevention (Section 3.4.1);
- animal pest prevention (Section 3.5.1);
- bushfire prevention (Section 3.6);
- restricting access (Section 3.9); and
- education (Section 3.12).

A management activities schedule is provided in Table 17 as outlined in the DEHP *Vegetation Management Plan Template*.

**Table 17
Management Activities Schedule**

Management Activity	How the Activity will be Undertaken	Where the Activity will be Undertaken	When the Activity will be Undertaken	Who will Undertake the Activity
Control of non-native weeds	Physical removal, chemical application	Within the offset areas as required	Annual	MCPL
Control of pest animals	As required, depending on pest animal, in consideration with animal ethics. Control methods are available at: http://www.daff.qld.gov.au/4790_8262.htm	Within the offset areas as required	Annual	MCPL
Fire management	Section 3.6	Within the offset areas as required	Annual	MCPL
Erosion and sediment control	Section 3.7	Within the offset areas as required	Annual	MCPL

4 PERFORMANCE AND COMPLETION CRITERIA

4.1 PERFORMANCE CRITERIA

The performance of the offset will be monitored against the performance criteria provided in Table 18 for each monitoring period. The performance criteria have been developed to meet the objectives for the offset (Section 1.2). All criteria link to management measures listed in Section 3 and monitoring/reporting specifications in Section 5. If performance criteria are not being met, the contingency measures in Section 6 will be considered.

Table 18
Performance Criteria

Criteria	Management Type	Section	Timeframe
Enduring protection has been provided for the offset areas.	Enduring Protection	1.4	November 2012 to November 2013
Operational review of road and fire trail construction has been completed.	Setup	3.2	
Additional access tracks have been constructed/repared.	Setup	3.2	
Signage of the offset areas has been provided.	Setup	3.2 and 3.9	
Appropriate fencing of the offset areas has been provided.	Setup	3.2 and 3.8	
Excess fencing inside of the offset areas has been removed.	Setup	3.2 and 3.8	
Gates with locks have been installed to restrict entry into the offset areas.	Setup	3.2 and 3.9	
Access tracks not necessary for management purposes have been ripped and revegetated.	Setup	3.2 and 3.3	
Access tracks across drainage lines in the offset areas have been repaired and stabilised.	Setup	3.2	
Initial pest animal study has been undertaken.	Management	3.5	
Initial mapping of declared weeds and Buffel Grass infestations for management purposes has been undertaken.	Management	3.4.3	
Erosion areas have been identified.	Management	3.7	
Monitoring and reporting has been undertaken as per Management Schedule.	Monitoring/Reporting	Table 16	
Maintenance of all access tracks, fences and gates have been undertaken as required.	Management	3.6, 3.8 and 3.9	November 2013 to November 2014
Weed control has been initiated.	Management	3.4	
Animal pest control has been initiated.	Management	3.5	
Fire management activities have been undertaken as required.	Management	3.6	
Restoration thinning has been undertaken if required.	Management	5.1.6	
Monitoring and reporting has been undertaken as per Management Schedule.	Monitoring/Reporting	Table 16	
Maintenance of all access tracks, fences and gates have been undertaken as required.	Management	3.6, 3.8 and 3.9	Annually from November 2014 until the completion criteria are met.
Weed control has been undertaken as required.	Management	3.4	
Animal pest control has been undertaken as required.	Management	3.5	
Fire management activities have been undertaken as required.	Management	3.6	
Monitoring and reporting has been undertaken as per Management Schedule.	Monitoring/Reporting	Table 16	

4.2 COMPLETION CRITERIA

The management plan is binding on current and future owners and occupiers, under the terms of the VDec. The management plan will continue to have effect until the objectives have been achieved. The management plan and monitoring requirements would conclude once the completion criteria in Table 19 have been achieved. MCPL will demonstrate to the Commonwealth Minister that the completion criteria have been met prior to concluding management and monitoring outlined in this Offset Management Plan/Vegetation Management Plan.

Table 19
Completion Criteria

Aspect	Criteria
Enduring Security	Enduring protection for protection for the offset areas has been provided as described in Section 1.4.
Regeneration Areas (Non-remnant Areas) (Figure 14)	Non-remnant areas have achieved RE remnant status ¹ .

¹ For non-remnant vegetation to achieve woody vegetation remnant status the dominant canopy must have greater than 70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy (DEHP, 2012).

As described in Section 1.2, the desired outcome of the offsets is that the land in the offset areas to be enhanced so as the currently degraded areas reach remnant status through increasing the structural integrity and extent of vegetation in the area. It is estimated that the offset management objectives and outcomes could be achieved in 20 years.

Once the requirements of the development approval (if applicable), legally binding mechanism and offset area management plan have been achieved, the offset areas would be mapped by the Qld administering authority as remnant vegetation on a region map.

5 MONITORING, REPORTING AND REVIEWING

A programme will be undertaken to monitor and report the effectiveness of the measures and the performance of the regeneration in the biodiversity offset areas, with summary reporting to be carried out annually. The monitoring will be undertaken by a suitably qualified person(s).

5.1 MONITORING PLAN

5.1.1 Ecological Surveys - Monitoring the Effectiveness of Regeneration in the Offset Areas

Monitoring activities are linked to the performance criteria defined in Section 4.1. They measure the progression of the offset areas towards achieving those outcomes. Monitoring is to be undertaken following the first year of approval of this plan (i.e. after 30 November 2013) and each subsequent year.

Permanent Photo Monitoring

Permanent photo monitoring across representative REs and cleared areas are to be installed within the offset area. Photos will be taken in a consistent direction, location (at global positioning system [GPS] points), height above the ground and time of day. These aspects and the date will be recorded for each photo taken (north, south, east and west). Photos will be taken on a biannual basis, during the wet and dry seasons. After the photographic monitoring event the photos will be compared to the photos from the previous monitoring periods. Natural regeneration of native understorey and overstorey species, the occurrence of habitat complexity (e.g. logs, litter), plant establishment and the status of weeds will all be noted. Aerial photographs may also be used to show enhancement of vegetation connectivity.

Permanent Transect Monitoring

Permanent transect monitoring are to be installed within the offset areas across representative REs and cleared areas (i.e. Regeneration Areas). Transect monitoring is to be undertaken within representative areas to assess the effectiveness of restoration and to assess performance, focusing on:

- canopy cover;
- average stem diameter at breast height (DBH) of canopy species (existing trees over 20 centimetres DBH cannot be utilised for this assessment);
- signs of canopy and shrub layer recruitment present outside a minimum 40 m from adjacent vegetation;
- average height (and species composition) of each vegetation stratum;
- native plant species richness for four life-forms (trees, shrubs, grasses, forbs/other);
- native sub-canopy species encountered within one meter of the transect;
- non-native (weed) cover;
- recruitment of woody perennial species; and
- correct labelling with date, location, GPS points for end points of transect and any other observations.

5.1.2 Ecological Surveys - Usage of the Offset Areas by Fauna

Fauna usage of the offset areas will be documented over time. Fauna surveys will be conducted before the second year after approval of this plan and every three years thereafter. The surveys will occur across representative REs and cleared areas (i.e. Regeneration Areas) to assess the success of the offset in providing habitat for a range of vertebrate fauna. The surveys will include an assessment of habitat complexity and species richness and abundance. The monitoring results from each monitoring period are to be compared as part of the reporting.

Targeted searches will be undertaken for the Ornamental Snake and Squatter Pigeon (southern race) as part of the survey work, in consideration of the relevant survey guidelines (e.g. SEWPaC, 2011b; Commonwealth Department of the Environment, Water, Heritage and the Arts, 2010).

5.1.3 Ecological Surveys - Effectiveness of the Weed Control

Weed control will be undertaken within the offset areas (Section 3.4). Follow-up inspections will be undertaken to assess the effectiveness of the weed management measures implemented and the requirement for any additional management measures.

5.1.4 Ecological Surveys - Effectiveness of the Exotic Animal Control

Pest animal control will be undertaken within the offset areas (Section 3.5). Monitoring of pest animals is to be undertaken every three years by a suitably qualified practitioner.

5.1.5 Visual Inspections

The offset areas are to be inspected with relevant comments provided for the following:

- performance of the offset area against performance criteria;
- risks to achieving the management outcomes;
- implementation difficulties;
- weed control success (also covered by Section 5.1.3);
- requirements for pest animal control (also covered by Section 5.1.4);
- current fire fuel loads and the risk they present to the offset;
- erosion or sedimentation as an impediment to meeting offset areas objectives;
- effectiveness of erosion or sediment control (if used);
- fencing and track maintenance;
- uncontrolled presence of livestock in the offset areas;
- illegal access and vandalism;
- effects of flood and fire events if they occur; and
- general notes regarding enhancing success and reducing failure.

5.1.6 Assessment of the Requirement for Restoration Thinning

An assessment of the regrowth and the requirement for restoration thinning will be made by a suitably qualified ecologist in the first year and after 3 years. The assessment will consider:

- tree density; and
- species diversity.

If thinning is to occur, secondary suckering will be monitored and controlled.

5.1.7 Impacts of Grazing on Management Objectives

In accordance with the DEHP *Vegetation Management Plan Template*, where an offset area contains grazing, monitoring must be undertaken to assess the impacts of grazing on achieving management outcomes. The outcomes of the ecological surveys and visual inspections will be used to assess the impacts of grazing on achieving management outcomes.

5.2 REPORTING

5.2.1 Commonwealth

MCPL notified SEWPaC that the referred action (Middlemount Coal Mine [Stage 2 Project]) was to commence on the 17 September 2012. In accordance with Commonwealth Approval Condition 7, within 3 months of every 12 month anniversary of the commencement of the action, MCPL will publish a report on their website addressing compliance with each of the conditions of the Commonwealth Approval, including implementation of any management plans.

Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of the Commonwealth Approval will be provided to the SEWPaC at the same time as the compliance report is published.

In accordance with Commonwealth Approval Condition 12 (Table 1; Appendix A), MCPL will maintain accurate records of all activities associated with or relevant to the Commonwealth Approval (EPBC Act 2010/5394), and make them available on request by SEWPaC. Such documents may be subject to audit by SEWPaC and used to verify compliance with the conditions of approval. Summaries of audits will be posted on the SEWPaC website. The results of audits may also be publicised through the general media.

In accordance with Commonwealth Approval Condition 13 (Table 1; Appendix A), unless otherwise agreed to in writing by the Commonwealth Minister, MCPL will publish this Offset Management Plan/Vegetation Management Plan on their website within 1 month of being approved.

Monitoring reports for the offset areas should contain, at a minimum:

- Name and contact details of company/persons undertaking management activities.
- Name and contact details of company/persons undertaking monitoring activities.
- Results of monitoring the effectiveness of the regeneration in the offset areas as outlined in Section 5.1.
- An analysis of the monitoring data over time (Section 5.1).

- Data collected from monitoring (Section 5.1). All data should be correctly labelled with date, location, GPS points for end points of transect and any other observations.
- An overview of the progress of achieving the performance criteria (Section 4).
- An indication of any risks or potential threats that have become apparent, and activities to be undertaken to manage these threats and/or risks.
- Identification of any need for improved management.

5.2.2 State

In accordance with the DEHP *Vegetation Management Plan Template*, a monitoring report for the offset areas will be provided annually to DNRM (Rockhampton) for the first 5 years, commencing on the 30 June 2014. After 5 years, reports will be provided every 2 years until the completion criteria have been met. These monitoring reports will contain, at a minimum:

- Name and contact details of landholder. If someone other than the landholder is undertaking management activities (i.e. a contractor) then their details must also be provided.
- eLVAS case number [if known].
- Lot on Plan property description and postal address.
- Photo monitoring results.
- If transects required, revegetation/restoration data collected from transects, outlining species present, average canopy cover and height of vegetation. All data should be correctly labelled with date, location, GPS points for end points of transect and any other observations.
- Annexure A - Management Activities Schedule with the progress section completed.
- An overview of the progress of the management area in achieving the management outcomes and how any risks or threats have impacted on the area.
- An indication of any risks or potential threats that have become apparent to the management area since the development of the management plan, and activities to be undertaken to manage these threats and/or risks.
- Where the proponent is proposing that the management outcomes have been achieved and the report is being submitted as the final report, the proponent must provide evidence that all management outcomes have been achieved in full.

The monitoring report required under Section 5.2.1 can be the same report required under Section 5.2.2, if both requirements are met.

5.3 INDEPENDENT COMPLIANCE AUDIT

In accordance with Commonwealth Approval Condition 8 (Table 1, Appendix A), upon the direction of the Commonwealth Minister, MCPL will ensure that an independent audit of compliance with the Commonwealth Approval (EPBC Act 2010/5394) is conducted and a report is submitted to the Commonwealth Minister. The independent auditor will be approved by the Commonwealth Minister prior to the commencement of the audit. Audit criteria will be agreed to by the Commonwealth Minister and the audit report will address the criteria to the satisfaction of the Commonwealth Minister.

5.4 REVIEW/REVISION OF THIS PLAN

In accordance with Commonwealth Approval Condition 9 (Table 1, Appendix A), if MCPL wishes to carry out any activity otherwise than in accordance with this Offset Management Plan/Vegetation Management Plan, MCPL will submit for the Commonwealth Minister's approval a revised version of this Plan. If the Commonwealth Minister approves such a revised plan, that plan will be implemented in place of the plan originally approved.

In accordance with Commonwealth Approval Condition 10 (Table 1, Appendix A), if the Commonwealth Minister believes that it is necessary or convenient for the better protection of listed threatened species and threatened ecological communities to do so, the Commonwealth Minister may request that MCPL make specified revisions to the plan approved under the Commonwealth Approval and submit the revised plan for the Commonwealth Minister's approval. MCPL will comply with any such request. The revised approved plan will be implemented in place of the plan originally approved.

Once a VDec is established over the offset areas, any amendments to this Offset Management Plan/Vegetation Management Plan are to be made by agreement between MCPL and the chief executive of DERM (now DNRM). The *Guide to Voluntary Declarations under the Vegetation Management Act, 1999* (DERM, 2008a) states:

To maintain flexibility and ensure that the plan remains up to date, the management plan can be changed...The amendment provision provides flexibility and ensures the management plan remains up to date and relevant to achieving the purpose of the VDec.

6 CONTINGENCY MEASURES

6.1 POTENTIAL RISKS AND CONTINGENCY MEASURES

Table 20 outlines risks to successful management of the offset areas and a description of possible contingency measures that could be implemented to mitigate the risk. Risk management has been built into management specifications, but some unforeseen events may still restrict prescribed management outcomes.

Table 20
Potential Risks and Contingency Measures

Risk	Contingency
Unplanned fires	<ul style="list-style-type: none"> The Qld Rural Fire Service will be called for assistance if a significant bushfire was to occur within or move towards the offset areas. Inspect and remedy issues with fences, gates or access.
Inappropriate grazing regimes	<ul style="list-style-type: none"> Modify fencing. Incorporate electric fencing. Inspect and remedy issues. Modify rotational grazing regime
Illegal access and potential vandalism	<ul style="list-style-type: none"> Inspect and remedy issues.
Natural regeneration not occurring	<ul style="list-style-type: none"> Further active revegetation (Section 6.1.1).
Lock regrowth in Brigalow	<ul style="list-style-type: none"> Restoration thinning (Section 6.1.2).
Poor access for management/monitoring	<ul style="list-style-type: none"> Wait until access is possible.

All of the risks are relevant to the protection and enhancement of the Ornamental Snake, Squatter Pigeon (southern race) and Brigalow (*Acacia harpophylla* dominant and co-dominant) community.

6.1.1 Active Seeding/Planting

Active seeding/planting is also a contingency measures in the event that natural regeneration is not readily occurring. Active revegetation will be undertaken using appropriate plantings or seeding of local seed sources. The procedure is provided in Table 21.

Table 21
Revegetation Methods

Method	Description
Seed Collection	<p>A key aim of seed collection is to collect local provenance seed stock for propagation purposes. Required approvals are identified, sought and obtained from relevant authorities.</p> <p>All seed collection is to be conducted under the framework of the 'Florabank Guidelines'. This includes best practice in collection activities, cleaning, data collection, germination testing and storage.</p>
Site Preparation	<p>Site preparation involves stabilising and preparing the surface of the rehabilitation area so that it can absorb water and nutrients. A large proportion of weeds are also removed during site preparation to allow space for new seedlings and plantings. Weed removal may have to occur more than once to reduce the weed management measures needed during implementation of the revegetation programme.</p>
Revegetation Method	<p>The revegetation method will change site to site depending on the structure and floristic characteristics of each site.</p> <p>A combination of tubestock and seeding may be used, depending on the circumstances.</p>
Timing	<p>Revegetation will be undertaken during suitable climactic conditions, such as during and immediately after sufficient rainfall.</p>

6.1.2 Brigalow Regrowth Restoration Thinning

Brigalow trees are capable of prolific resprouting after clearing which can result in regrowth with high stem densities (e.g. greater than 10,000 stems per hectare (stems/ha) [University of Queensland, 2011]). These densely spaced trees have slower growth and structural development as they compete for resources. With less resources for other plant species (light, water, etc.), Brigalow regrowth monocultures can have a lower floral diversity than mature Brigalow. A recent study has shown that restoration thinning can accelerate structural development in Brigalow as well as improve carbon sequestration (Dwyer *et al.*, 2010).

Approximately 90 ha of Brigalow regrowth occurs in the offset areas (Figure 11) and does not currently meet the criteria of the Brigalow (*Acacia harpophylla* dominant and co-dominant) community under the EPBC Act. An assessment of the Brigalow regrowth (RE 11.4.9) and the requirement for restoration thinning will be made by a suitably qualified ecologist in the first year and after three years (Section 5.1.6).

If required, Brigalow regrowth (RE 11.4.9) restoration thinning will involve:

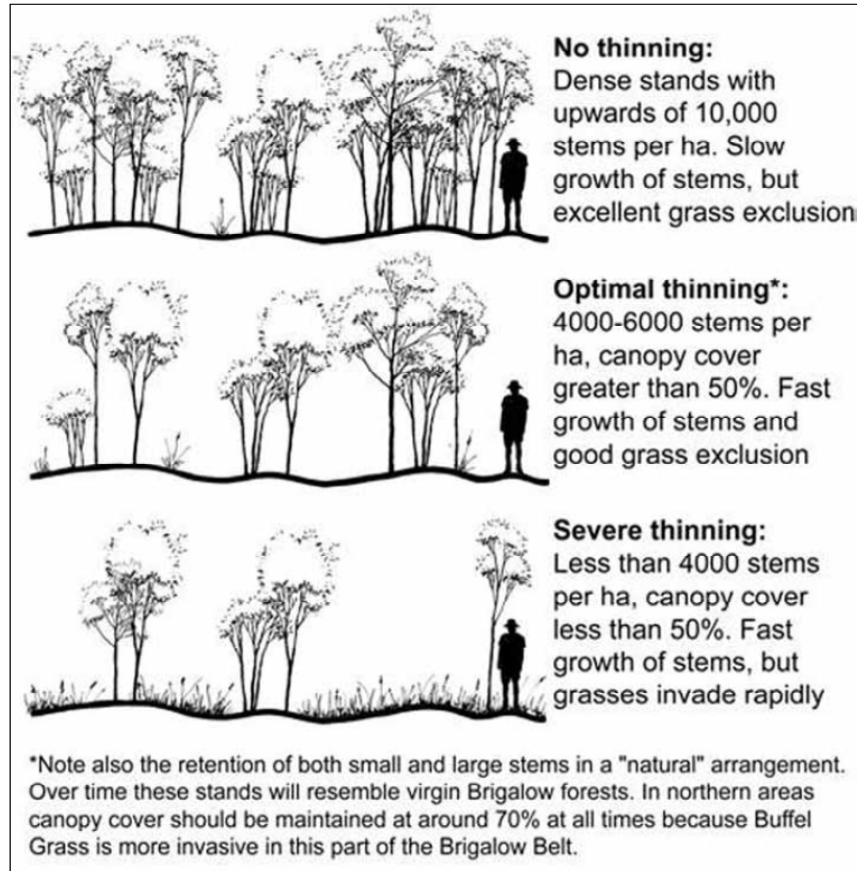
- Select thinning of Brigalow trees via ringbarking.
- Thinning Brigalow regrowth to a density of approximately 6,000 stems/ha (predicted to be the optimal thinning density for structural development [after Dwyer *et al.*, 2010] [Figure 15]).
- Thinning random Brigalow stems to mimic a natural ecosystem.
- Thinning Brigalow regrowth when the soil moisture is high to reduce the risk of prolific secondary suckering.
- Retaining buffers of dense stems (approximately 10 m wide) along boundaries of existing cleared areas to help reduce the spread of Buffel Grass, as required (after Dwyer *et al.*, 2010).
- Retaining dead stags *in-situ*.
- Monitoring (Section 5.1.6) and controlling secondary suckering via this method.

Grass cover is another aspect that needs to be considered. Less tree canopy provides greater sunlight to the understorey and higher grass growth (Figure 15). High grass cover can increase the risk of grass fires that present a risk to the Brigalow (*Acacia harpophylla* dominant and co-dominant) community. Dwyer *et al.* (2010) indicates that from their studies, the canopy cover should maintain at least 50% cover, but higher cover may be required to manage thick grass growth.

Any Brigalow regrowth restoration thinning will be conducted in accordance with relevant Qld environmental approvals. The following will be documented:

- the area that has been selectively thinned;
- species diversity prior to thinning;
- rate of selectively thinning and the density (stems/ha);
- method of thinning (i.e. mechanical methods).

Restoration thinning of other vegetation communities is not proposed at this time and would only be considered if it can be demonstrated that there is a need for thinning and relevant Qld environmental approvals are obtained.



Source: University of Queensland (2011).

Figure 15 - Restoration Thinning Guide

6.2 IMPACTS FROM A THIRD PARTY

The offset areas will be fenced (Section 3.8), locks will be installed on the gates and signage will be installed along main access roads (Section 3.9). These provisions will deter third party access into the offset areas.

In the event that a third party impacts the offset areas, MCPL will notify SEWPaC with the following details (where known):

- who has impacted the offset areas;
- the nature and extent of the impact;
- when the impact occurred;
- why the impact occurred; and
- if there is a proposal from the third party to remedy the impact.

In accordance with Commonwealth Approval Condition 9 (Table 1, Appendix A), if MCPL wishes to carry out any activity otherwise than in accordance with this Offset Management Plan/Vegetation Management Plan, MCPL will submit for the Commonwealth Minister's approval a revised version of this Offset Management Plan/Vegetation Management Plan as described in Section 5.4.

The offset areas are overlying ML 1831 held by Anglo. There is no current proposal to mine (underground or open cut) within the offset area. Any future mining proposals within the offset areas will need to account for the impacts to the offset areas.

Within 6 months of SEWPac approval of this Offset Management Plan/Vegetation Management Plan, MCPL will advise Anglo of the location of the offset areas and request prior notification of any future proposal to mine (underground or open cut) within the area. MCPL will notify SEWPac of any future mining proposal received from Anglo or other party.

7 TIMING AND RESPONSIBILITIES

A schedule of timing for the offset and the relevant responsible party is provided in Table 22.

Table 22
Timing of the Offset

Aspect	Section	Timing	Responsibilities
Enduring protection of the offset areas	1.4	By 7 September 2013, the offset areas will be secured through a legally binding mechanism.	MCPL
Commencement of active management	3	By November 2013, the active management of the offset areas will commence.	MCPL
Implementing the management measures	3 and 4	Refer to the timing in the management schedule (Section 3.13).	MCPL
Monitoring the effectiveness of regeneration	5.1.1	Annually.	MCPL
Monitoring the fauna usage of the offset areas	5.1.2	Twice in a year (in different seasons) every 3 years.	MCPL
Monitoring the effectiveness of weed control	5.1.3	Annually.	MCPL
Monitoring the effectiveness of pest control	5.1.4	Annually.	MCPL
Visual monitoring	5.1.5	Annually and as required.	MCPL

MCPL will be responsible for contingency measures (Table 20). If MCPL elect a third party to take on responsibilities for the management measures, in accordance with Commonwealth Approval Condition 2 (Table 1, Appendix A), MCPL will obtain agreement from the third parties responsible for management measures and provide details of the responsible parties, including their position or status as a separate contractor, to SEWPaC.

The MCPL Environmental Manager will be responsible for the monitoring, reviewing and implementation of this Offset Management Plan. The MCPL Environmental Manager will be responsible for the implementation of any revisions of this Offset Management Plan/Vegetation Management Plan in consultation with the SEWPaC.

8 COST OF ACTIVITIES

In accordance with the *Queensland Policy for Vegetation Management Offsets (Version 3)* (DERM, 2011) the management costs associated with achieving the objectives, actions and outcomes of the offset areas are to be estimated. To this end, MCPL have commissioned Greening Australia to undertake a costing model for the MCPL offset areas (Middlemount Coal Mine Rail Loop and Spur offset areas, Parrot Quarry offset areas and Thirteen Mile Gully Diversion Offset Area).

9 TRUST FUND

In accordance with the *Queensland Policy for Vegetation Management Offsets (Version 3)* (DERM, 2011a), since the management of the offset areas (Middlemount Coal Mine Rail Loop and Spur offset areas, Parrot Quarry offset areas and Thirteen Mile Gully Diversion Offset Area) area required for more than three years, the trust account details (financial institution, bank account number and name) for the holding of funds for the ongoing management actions of the offset areas and details of any milestone payments are to be provided to DNRM.

Annual management costs for the Thirteen Mile Gully offset area, Rail loop and Spur offset areas and the Parrot Quarry offset areas will be transferred to the nominated trust account within four months of the relevant development permit being issued (for direct offsets [e.g. Thirteen Mile Gully Diversion Offset Area]) or at the time the offset areas is legally secured (offset transfers [e.g. Middlemount Coal Mine Rail Loop and Spur offset areas and the Parrot Quarry offset areas]). For every year thereafter, annual management costs (Thirteen Mile Gully offset area, Rail loop and Spur offset areas, Parrot Quarry offset areas) will be calculated and then transferred to the nominated trust account on the anniversary date of the first payment.

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APPENDIX A

COMMONWEALTH APPROVAL (EPBC ACT 2010/5394)



Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Approval

MIDDLEMOUNT COAL PROJECT STAGE 2, MIDDLEMOUNT COAL Pty Ltd, QUEENSLAND (EPBC 2010/5394)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

person to whom the approval is granted Middlemount Coal Pty Ltd

proponent's ACN (if applicable) 49 122 348 412

proposed action To expand existing open cut coal mining operations (Stage 2) at Middlemount Coal Mine, Bowen Basin, Middlemount, Queensland (see EPBC Act referral 2010/5394).

Approval decision

Controlling Provision	Decision
Listed threatened species and communities (sections 18 & 18A)	Approved

conditions of approval

This approval is subject to the conditions specified below.

expiry date of approval

This approval has effect until 1 November 2042.

Decision-maker

name and position Adrienne Lea
Assistant Secretary
Queensland & South Australia Assessment Branch

signature *Adrienne Lea*

date of decision 7 September 2012

Conditions attached to the approval

Offsets

Offset management plan

1. To offset the impacts to **EPBC listed threatened species and ecological communities**, the person taking the action must submit to the **Minister** for approval an *Offset Management Plan* within 12 months of the date of this approval. Operations within **Area B** cannot commence unless the *Offset Management Plan* has been approved by the **Minister**.

The *Offset Management Plan* must include, but not be limited to the following:

- a. details of management actions to protect and enhance the extent and condition of the threatened species habitat values including rehabilitation, weed control, fire management, erosion and sediment control, management of livestock and restrictions to access of no less than:
 - i. 1670 ha of Ornamental Snake (*Denisonia maculata*) habitat;
 - ii. 3280 ha of Squatter Pigeon (*Geophaps scripta scripta*); and
 - iii. 150 ha of Brigalow ecological community
- b. the desired outcomes/objectives of implementing the plan;
- c. the timing, responsibilities and performance criteria for such actions;
- d. a monitoring plan including ecological surveys that must be undertaken to assess the success of the management measures against identified milestones and objectives;
- e. a clear definition of the location and boundaries of the offset area, through maps and/or textual descriptions as well as accompanying shapefiles;
- f. a process to report to the **Department** the management actions undertaken in the offset areas and the outcome of those actions, including identifying any need for improved management;
- g. a description of the potential risks to successful management and rehabilitation in the offset areas, and a description of the contingency measures that would be implemented to mitigate these risks;
- h. details of parties responsible for monitoring, reviewing and implementing the plan; and
- i. what would be the contingency strategy in the event that a third party impacts upon the offset site.

The approved *Offset Management Plan* must be implemented.

Mechanism to secure offsets

2. To offset the impacts to **EPBC listed threatened species and ecological communities**, the person taking the action must register a legally binding conservation mechanism over a minimum of 1670 ha of Ornamental Snake (*Denisonia maculata*) habitat, 3280 ha of Squatter Pigeon (*Geophaps scripta scripta*) and 150 ha of Brigalow ecological community (the offset area) as identified in the offset management plan referred to in condition 1. The mechanism/s must provide enduring protection for the offset area and be registered within 12 months of the date of this approval.

The conditions of the conservation mechanism must ensure that management actions are undertaken for the protection and enhancement of the **EPBC listed threatened species and ecological communities**. The person taking the action must obtain

agreement from any third parties responsible for management actions and provide details of the responsible parties, including their position or status as a separate contractor, to the **Department**.

Other Matters of National Environmental Significance

3. As a precautionary approach, the person taking the action must within 6 months of the date of this approval, and prior to the **Commencement** of operations in **Area B**, provide to the **Minister** the water management plan and erosion and sediment control plan. The plans are identified in conditions W31 and W39 of the Queensland Government Environment Authority dated 29 June 2012 (Permit Number: MIN100646307 on ML70379 and ML70417).
4. The person taking the action must within 6 months of the date of this approval, and prior to the **Commencement** of operations in **Area B**, provide to the **Minister** a report on how the water management plan and erosion and sediment control plan addresses possible erosion, sediment control and release of waters and their potential impacts to nationally listed threatened species and ecological communities.
5. If, after receiving the water management plan, the **Minister** is not satisfied that the water management plan and erosion and sediment control plan adequately address impacts on listed threatened species and ecological communities, the **Minister** may require in writing that the person taking the action provide additional information within a specified timeframe.

Reporting and auditing

6. Within 14 days from the **Commencement** of the action, the person taking the action must advise the **Department** in writing of the actual date of **Commencement**.
7. Within three months of every 12 month anniversary of the **Commencement** of the action, the person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** at the same time as the compliance report is published.
8. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor must be approved by the **Minister** prior to the **Commencement** of the audit. Audit criteria must be agreed to by the **Minister** and the audit report must address the criteria to the satisfaction of the **Minister**.
9. If the person taking the action wishes to carry out any activity otherwise than in accordance with the plan referred to in condition 1, the person taking the action must submit for the **Minister's** written approval a revised version of any such plan. The varied activity shall not commence until the **Minister** has approved the varied plan in writing. If the **Minister** approves such a revised plan, that plan must be implemented in place of the plan originally approved. Unless the **Minister** has approved the revised plan, then the person taking the action must continue to implement the plan originally approved, referred to in condition 1.

10. If the **Minister** believes that it is necessary or convenient for the better protection of listed threatened species and communities to do so, the **Minister** may request that the person taking the action make specified revisions to the plan pursuant to condition 1. and submit the revised plan for the **Minister's** written approval. The person taking the action must comply with any such request. The revised approved plan must be implemented. Unless the **Minister** has approved the revised plan then the person taking the action must continue to implement the plan originally approved, referred to in condition 1.
11. If, at any time after five years from the date of this approval, the person taking the action has not **Substantially Commenced** the action, then the person taking the action must not **Substantially Commence** the action without the written agreement of the **Minister**.

Publication of plans

12. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the above conditions of approval, including measures taken to implement the management plans required by this approval, and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act**, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the **Department's** website. The results of audits may also be publicised through the general media.
13. Unless otherwise agreed to in writing by the **Minister**, the person taking the action must publish the management plan, referred to in condition 1, of approval on their website. Each plan must be published on the website within one month of being approved.

Definitions

Area B—includes all areas in Appendix A labelled as “B”. These areas are for the temporary protection of Ornamental Snake habitat and remain in force until a suitable Offset Management Plan has been approved by the **Minister**.

Commencement – includes the construction of infrastructure and the clearance of native vegetation (including cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning of native vegetation) related to the construction of the Middlemount Coal Project Stage 2. Excludes construction of fences and signage or the installation of environmental monitoring equipment and services.

Department - the Australian Government Department administering the *Environment Protection and Biodiversity Conservation Act 1999*.

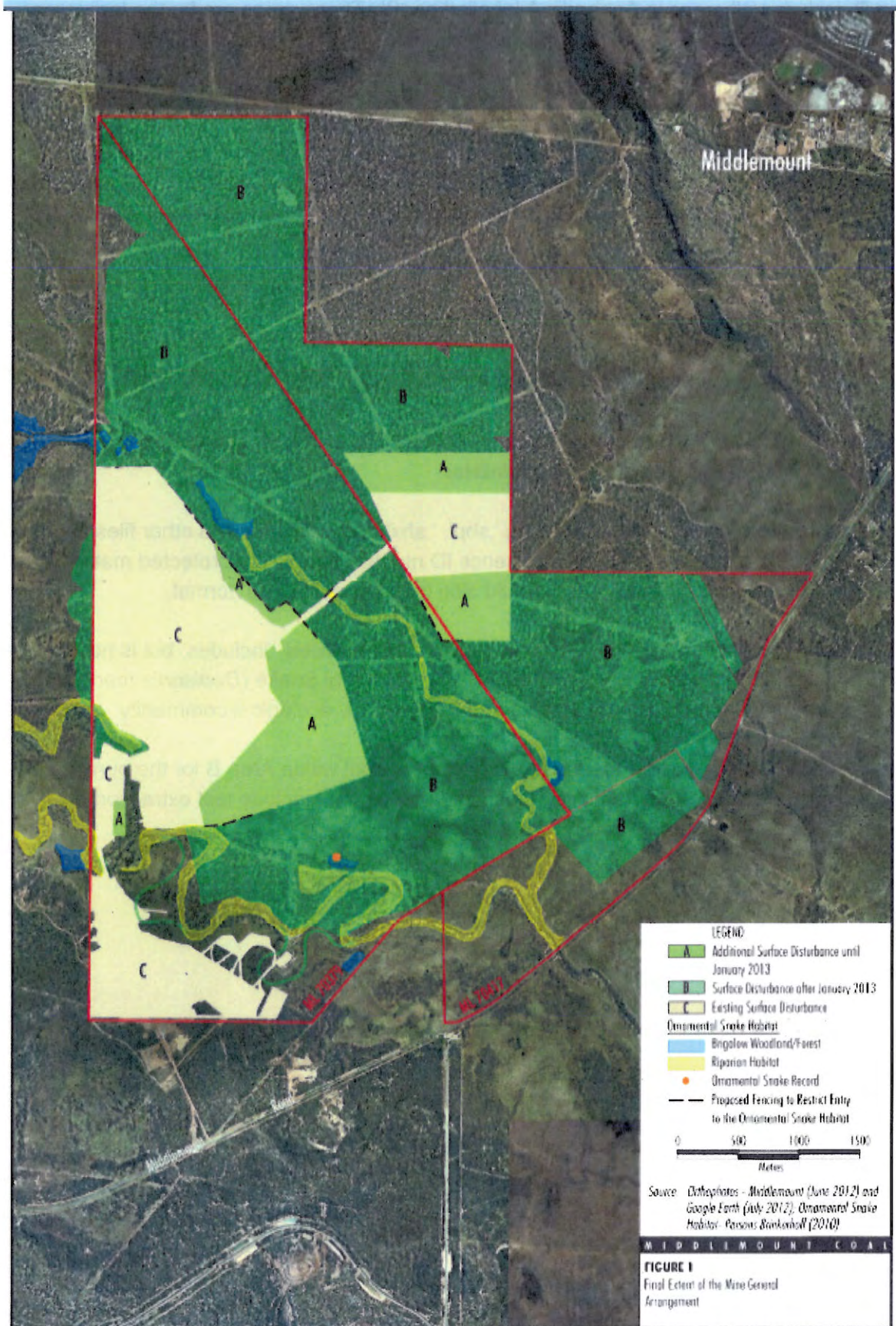
EPBC Act – The *Environment Protection and Biodiversity Conservation Act 1999*.

Minister - the **Minister** administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the **Minister**.

Shapefile – an ESRI Shapefile, containing '.shp', '.shx' and '.dbf' files and other files capturing attributes including at least the EPBC reference ID number and EPBC protected matters present at the relevant site. Attributes should also be captured in '.xls' format.

EPBC listed threatened species and ecological communities— includes, but is not limited to, the following matters listed under the **EPBC Act**: Ornamental Snake (*Denisonia maculata*), Squatter Pigeon (*Geohaps scripta scripta*) and the Brigalow ecological community

Substantially Commenced – means the extraction of coal within Area B for the purpose of commercial production. Substantial commencement does not include test extraction or extraction of coal samples for quality assurance.



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APPENDIX B
ECOLOGICAL EQUIVALENCE

Table B1
Ecological Equivalence for the Middlemount Coal Mine Rail Spur and Loop Offset Areas

Ecological Condition Indicators ¹	Offset Areas					
	Site	AU1*	AU2 [#]	AU3*	AU4*	AU5*
Regional Ecosystem	Offset Area 1 RE 11.4.9b (Site 1)	Offset Area 2 RE 11.3.2/ 11.5.3 (Site EEM01)	Offset Area 3 RE 11.3.2 (Site 3)	Offset Area 4 RE 11.3.1 (Site 4)	Offset Area 5 RE 11.3.4 (Site 5a)	Offset Area 6 RE 11.5.18 (Site EEM05)
1. Recruitment of woody perennial species	5	5	5	5	5	5
2. Native plant species richness						
- Trees	2.5	5	5	2.5	5	5
- Shrubs	2.5	5	5	2.5	5	5
- Grasses	0	2.5	0	0	2.5	2.5
- Forbs	5	2.5	2.5	2.5	0	5
3. Tree canopy height	1.5	3	3	1.5	2.5	5
4. Tree canopy cover	2.5	2	5	2.5	2.5	5
5. Shrub canopy height	3	5	5	3	3	3
6. Native perennial grass cover	0	5	1	1	1	3
7. Organic litter	0	3	0	3	5	5
8. Large trees	0	5	5	0	7.5	15
9. Coarse woody debris	0	5	2	0	5	5
10. Weed cover	0	3	0	0	0	10
11. Size of patch (fragmented landscapes)	0	0	2	5	5	2
12. Connectivity (fragmented landscapes)	0	2	2	2	4	2
13. Context (fragmented landscapes)	2	2	4	2	2	4
14. Distance from water (intact landscapes)	-	-	-	-	-	-
Sum of Score	24	55	46.5	32.5	55	81.5
Area (ha)	4.5	2	10	26	41.6	2.1
Assessment Unit Ecological Condition Score	1.08	1.1	4.6	8.4	22	1.71
Ecological Condition Score	38.9					
Assessment Unit Special Features Score	2	0.82	8	9	11	1.85
Special Features Score	32.67					

* # Source: Middlemount Coal Pty Ltd (2013a) Middlemount Coal Mine Rail Loop and Spur Vegetation Offset Proposal.

¹ Department of Environment and Resource Management (2011) *Managing Grazing Lands in Queensland*. June 2011.

Table B2
Ecological Equivalence for Parrot Quarry Offset Areas

Ecological Condition Indicators ¹	Clearing Area		Offset Areas	
	AU1	AU2	AU3	AU4
	RE11.3.4	RE11.5.18 (Assessment Site EMM06)	RE11.3.4 (Assessment Site EMM04)	RE11.5.18 (Assessment Site EMM05)
1. Recruitment of woody perennial species	-	5	3	5
2. Native plant species richness	-	-	-	-
- Trees	-	5	2.5	5
- Shrubs	-	5	5	5
- Grasses	-	5	2.5	2.5
- Forbs	-	5	5	5
3. Tree canopy height	-	5	5	5
4. Tree canopy cover	-	5	5	5
5. Shrub canopy height	-	5	5	3
6. Native perennial grass cover	-	3	0	3
7. Organic litter	-	5	5	5
8. Large trees	-	15	10	15
9. Coarse woody debris	-	5	2	5
10. Weed cover	-	5	0	10
11. Size of patch (fragmented landscapes)	-	2	2	2
12. Connectivity (fragmented landscapes)	-	5	2	2
13. Context (fragmented landscapes)	-	5	2	4
14. Distance from water (intact landscapes)	-	-	-	-
Sum of Score	67*	85	56	81.5
Area (ha)	1.266	1.9	11	4.37
Assessment Unit Ecological Condition Score	0.85	1.6	6.16	3.56
Ecological Condition Score	2.45		9.72	
Assessment Unit Special Features Score	0.47	0.86	5.28	3.84
Special Features Score	1.33		9.12	

Source: Middlemount Coal Pty Ltd (2013b) Parrot Quarry Vegetation Offset Proposal.

¹ Department of Environment and Resource Management (2011) *Managing Grazing Lands in Queensland*. June 2011.

* Refer Middlemount Coal Pty Ltd (2013b) Parrot Quarry Vegetation Offset Proposal.

**Table B3
Ecological Equivalence for Thirteen Mile Gully Diversion Offset Areas**

Ecological Condition Indicators ¹	Clearing Area	Offset Area	
	AU1	AU2 [#]	
	Assessment Site EEMA	Assessment Site EEM02	Assessment Site EEM03
1. Recruitment of woody perennial species	5	5	5
2. Native plant species richness	-	-	-
- Trees	5	5	5
- Shrubs	5	5	5
- Grasses	2.5	5	5
- Forbs	5	5	5
3. Tree canopy height	3	3	3
4. Tree canopy cover	2	2	2
5. Shrub canopy height	3	3	3
6. Native perennial grass cover	5	5	0
7. Organic litter	5	5	1
8. Large trees	0	5	3
9. Coarse woody debris	2	2	2
10. Weed cover	3	3	0
11. Size of patch (fragmented landscapes)	5	5	5
12. Connectivity (fragmented landscapes)	4	4	4
13. Context (fragmented landscapes)	4	4	4
14. Distance from water (intact landscapes)	-	-	-
Sum of Score	58.5	66	52
Area (ha)	7.8	31	31
Ecological Condition Score	4.56	18.29	
Special Features Score	3.28	29.86	

Source: Middlemount Coal Pty Ltd (2013c) Thirteen Mile Gully Diversion Vegetation Offset Proposal.

the two scores were averaged for this assessment unit.

¹ Department of Environment and Resource Management (2011) *Managing Grazing Lands in Queensland*. June 2011.

APPENDIX C

ECOLOGICAL INVESTIGATIONS WITHIN THE OFFSET AREA FOR STAGE 2 OF THE MIDDLEMOUNT COAL MINE, QUEENSLAND

Ecological Investigations within the Offset Area for Stage 2 of the Middlemount Coal Mine, Queensland

PREPARED FOR:

Middlemount Coal Pty Ltd

OCTOBER 2012



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Acknowledgments

We thank the following people for their contribution to the project:

- Mark Jacobs (Middlemount Coal) for project and site information;
- Shaun Collins (Middlemount Coal) for project, site information and GIS layers
- Wayne Pidgeon (Polylogics) for site access and logistic help
- The Department of Environment and Heritage Protection for access to the data on Regional Ecosystems

The following Ecology and Heritage Partners Pty Ltd employees
contributed to the preparation of this report:

Scott van Barneveld, Liza James, Matt Hatton, Shannon LeBel
Monique Elsley and Amanda Feetham

Project number: 4166

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EXECUTIVE SUMMARY

Middlemount Coal Pty Ltd (MCPL) have established an offset area as part of the approval conditions under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) for the Stage 2 expansion of their coal-mining operations. The offset area is located on freehold land owned by MCPL approximately 270 kilometres (km) north-west of Rockhampton and 6 km south-west of Middlemount, Queensland (QLD).

Ecology and Heritage Partners Pty Ltd were engaged by MCPL to undertake ecological investigations within a study area within the offset area as part of Stage 2 works for the Middlemount Project, the results of which are contained within this report. Field assessments were conducted by a team of four botanists 10-14 July, 29 July - 3 August and 13-17 August 2012. Quaternary field assessments were conducted within each homogeneous patch of a Regional Ecosystem (RE). REs were identified and mapped in accordance with Neldner *et al.* (2005).

The study area contains 17 distinct REs. Of the approximate 3,289 hectares (ha) contained within the study area, approximately 50% (1,646 ha) is remnant vegetation. The remainder of the study area (approximately 50%) is non-remnant vegetation (1,643 ha).

Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community (listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* [EPBC Act] and *Vegetation Management Act 1999* [VM Act]) occurs over approximately 171.63 ha of the study area. Two REs listed under the VM Act as „Of Concern“ occur in the study area. Six REs with a Biodiversity Status Of Concern were recorded within the study area.

Two flora species of conservation significance, the Large-podded trefoil (*Desmodium macrocarpum*) and *Cerbera dumicola* (listed as Near Threatened under the *Nature Conservation Act 1992* [NC Act]) were recorded during the surveys.

Three fauna species of conservation significance were recorded during surveys, namely the: Koala (*Phascolarctos cinereus*) (listed as Vulnerable under the EPBC Act), Squatter Pigeon (*Geophaps scripta scripta*) (listed as Vulnerable under the EPBC Act and NC Act) and Rainbow Bee-eater (*Merops ornatus*) (listed as Migratory under the EPBC Act). Five broad fauna habitat types occur within the study area: non-remnant woodlands; Eucalypt woodlands; wetlands and riparian habitats; Brigalow woodlands and cracking clays; and escarpment with *Acacia* and mixed species woodlands.

Four pest animals (Pig [*Sus scrofa*], Dog [*Canis lupus familiaris*], Rabbit [*Oryctolagus cuniculus*] and Cat [*Felis catus*]) and three weed species (Harrisia Cactus [*Eriocereus martinii*], Velvety Tree Pear [*Opuntia tormentosa*] and Parthenium [*Parthenium hysterophorus*]) listed under the *Land Protection (Pest and Stock Route Management) Act 2002* were recorded during surveys.

1 INTRODUCTION

1.1 Background

Middlemount Coal Pty Ltd (MCPL) have established an offset area as part of the approval conditions under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) for the Stage 2 expansion of their coal-mining operations. The offset area is located on freehold land owned by MCPL approximately 270 kilometres (km) north-west of Rockhampton and 6 km south-west of Middlemount, Queensland (QLD) (Figure 1). It is positioned immediately west of the Middlemount Coal Mine (Figure 1).

Ecology and Heritage Partners Pty Ltd were engaged by Middlemount Coal Pty Ltd (MCPL) to undertake ecological investigations within a study area in the offset area as part of Stage 2 works for the Middlemount Project, the results of which are contained within this report. Scope of Assessment

The scope of works for this report includes:

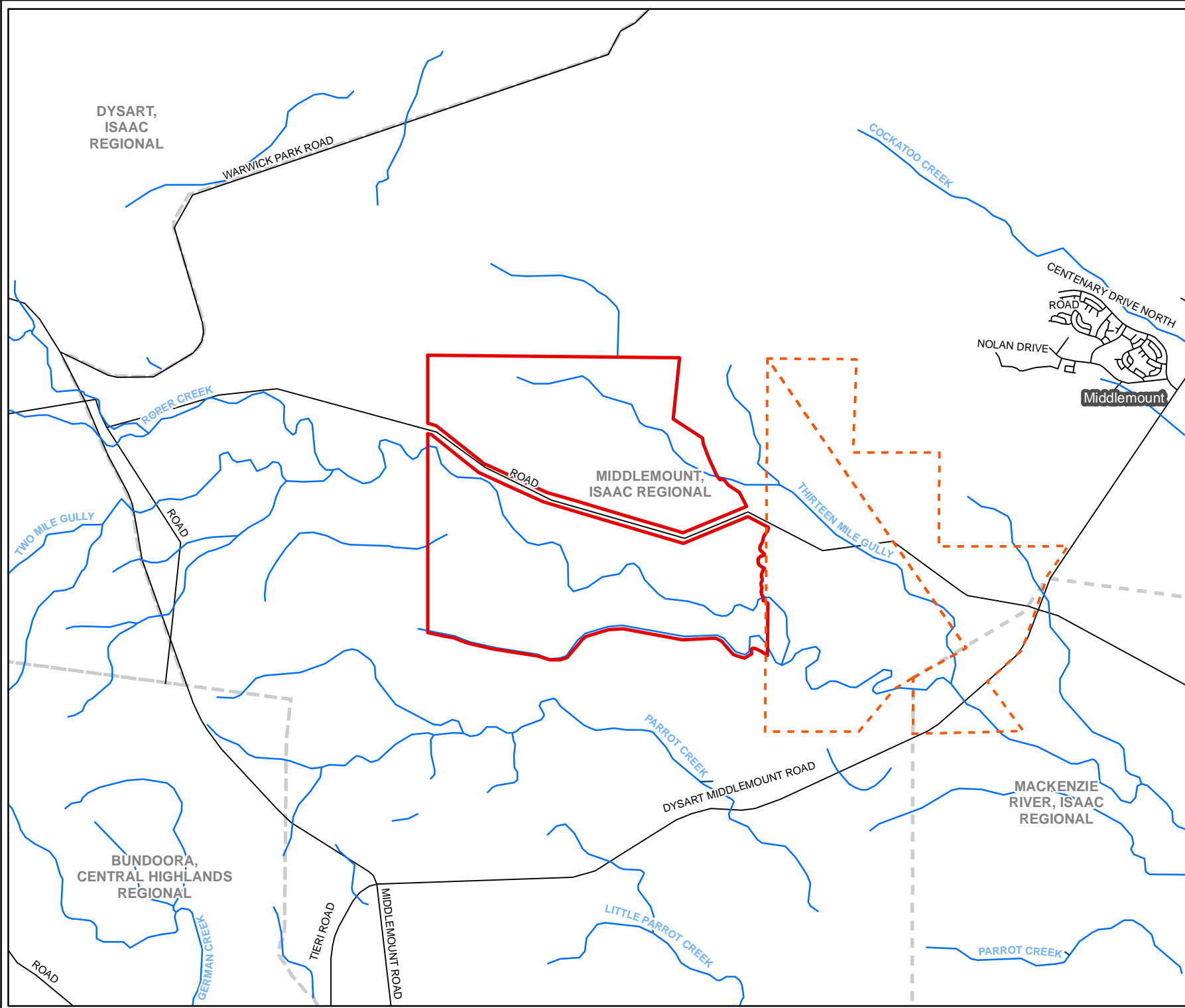
1. Mapping Regional Ecosystems (REs) and High Value Regrowth Vegetation, including:

- Field validating the presence and mapping of REs in the study area in accordance with Neldner *et al.* (2005).
- Ground truthing the QLD Department of Environment and Heritage Protection's (DEHP's) „high value regrowth vegetation“ mapping and identifying other areas of regrowth in the study area.
- Quantifying the area of each RE in the study area.
- Identifying the status of the REs in the study area under the QLD *Vegetation Management Act 1999* (VM Act) (particularly Endangered and Of Concern REs) and DEHP Biodiversity Status.

2. Surveys for flora species of conservation significance and recording all locations of species of conservation significance (including *Cerbera dumicola* and Large-podded Trefoil [*Desmodium macrocarpum*]).

3. Surveys for weeds and pest animals, including:

- Describing weeds in the study area, including declared plants under the QLD *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act).
- Describing and mapping locations of pest animals in the study area, including declared animals under the LP Act.

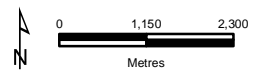


Legend

- Study Area
- Middlemount Coal Mine Mining Lease



Figure 1
Location of the Approved Middlemount Coal Mine and Study Area
Middlemount Coal Mine Stage 2 - Offset Area Report



4. Incidental sightings, including recording:

- Other ecological values (e.g. other Matters of National Environmental Significance) that are relevant to the Project.
- Opportunistic sightings of threatened and migratory species made during the field work.

1.2 Study Area

The study area consists of approximately 3,289.5 hectares (ha) of predominantly native vegetation, modified by grazing pressures and exotic plant species. The study area lies within the Isaac-Comet Downs subregion. The study area is part of a State-significant wildlife corridor under the Brigalow Belt Biodiversity Planning Assessment Version 1.3 (Environmental Protection Agency 2008a). Roper Creek, which bisects the study area approximately west-east is listed in the Brigalow Belt North Landscape Expert Panel Report (Environmental Protection Agency 2008b).

Land use within the study area is cattle grazing. The area is presently stocked.

2 METHODS

2.1 Desktop Assessment

The following resources were reviewed prior to undertaking the site assessment:

- current RE mapping, Biodiversity Planning Assessment: Brigalow Belt (v1.3) and descriptions of the environment within the study area (DEHP 2012);
- relevant flora and fauna databases (QLD Herbarium HERBRECS, Queensland Museum, Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) Protected Matters Search Tool, Wildlife Online [WildNet], Atlas of Living Australia and Birds Australia Atlas [1998-2008]);
- aerial photography of the study area;
- previous reports on environmental values in the region; and
- relevant federal and state legislation and policies.

2.2 Field Assessments

Field assessments were conducted by a team of four botanists on 10 - 14 July, 29 July - 3 August and 13-17 August 2012. The weather was unseasonably wet during the weeks preceding the surveys with over 80 millimetres (mm) of rain in the month of July, exceeding the monthly average of approximately 30 mm (Commonwealth Bureau of Meteorology 2012). This led to high amounts of grass cover, facilitating identification and detection of species. Due to cold weather conditions (0 °C - 20 °C daily) most reptile and amphibian species were inactive and not detectable.

Regional Ecosystem Mapping

The entire study area was traversed on foot and by vehicle in accessible areas within the study area. Quaternary field assessments were conducted within each homogeneous patch of an RE. REs were identified and mapped in accordance with Neldner *et al.* (2005) (with reference to the certified mapping and RE descriptions [DEHP 2012]).

Threatened Ecological Communities

Potentially occurring threatened ecological communities (TECs) listed under the EPBC Act were surveyed on foot and by off road vehicles. The extent of the communities was verified using the relevant listing and conservation advices on the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) website (SEWPaC, 2012a). TECs were identified following field-verification of REs.

Targeted Searches for Flora Species of Conservation Significance

Targeted searches were undertaken for flora species of conservation significance. Surveys were undertaken on foot either along randomly selected 50 metre (m) transects or involved thorough examination of potential habitat of threatened flora species. All locations of significant species were recording using a hand held global positioning system (GPS) unit.

Fauna Species

Conservation significant fauna species were opportunistically searched for and the locations of any threatened fauna species or migratory species seen during the surveys were recorded. No systematic surveys were conducted for fauna species (i.e. trapping, transect searches). A qualified zoologist was present during all flora and RE surveys to identify any incidental sightings of fauna species.

Fauna Habitat Assessment

Habitats were recorded within the entire study area which was traversed on foot and by vehicle in accessible areas. Habitats were determined according to structural components of the landscape and vegetation.

3 RESULTS

3.1 Field Verified Regional Ecosystems

The majority of mapped certified REs for the study area (DEHP 2012) were correct, however several refinements were made to the certified mapping following field survey verification (Table 1, Figures 2 and 3).

The five Land Zones contained within the study area are:

- Land zone 3: alluvial plains;
- Land zone 4: gently undulating clay;
- Land zone 5: uniform sand plains;
- Land zone 7: duricrusts and footslopes; and
- Land zone 9: fine-grained sedimentary rocks.

The study area contains 17 distinct REs (Table 1). Non-remnant and non-regrowth vegetation communities within the area consisted of grasslands typically dominated by exotic Buffel Grass (*Cenchrus ciliaris*) and a mixture of native and exotic grasses. The condition of these grasslands varied with grazing pressure, but each typically had good ground cover and dense grass due to recent heavy rainfall.

Of the approximate 3,289 ha contained within the study area, approximately 50% (1,646 ha) is remnant vegetation (Figure 3). The remainder of the study area (approximately 50%) is non-remnant vegetation (1,643 ha). Brigalow non-remnant regrowth occurs over approximately 2.9% (94 ha) of the study area (Figure 4).

Changes to DEHP Certified Mapping

As a result of field verification of DEHP certified mapping a number of changes to the RE mapping were made. Nine REs not mapped as homogenous patches were added to the verified RE mapping and 11 REs mapped in certified mapping were not found during verified mapping fieldwork. The predominant changes to certified mapping involved REs that were mapped as mosaics. Many of these mosaic REs were homogeneous REs and were thus remapped as a single RE unit, particularly within Landzone 3. Within Landzone 3 there were three RE mosaics that were remapped as homogenous patches: 11.3.1/11.3.2, 11.3.2/11.3.27 and 11.3.2/11.3.7. In Landzone 3 there were four REs that were not represented in certified mapped but were identified during field verification, these are 11.3.1, 11.3.1b, 11.3.21 and 11.3.27d.

Other changes resulted from assessing understorey and midstorey composition within REs, particularly within Landzone 4. The absence of *Terminalia oblongata* and presence of *Lysiphylum carronii* in areas mapped as 11.4.9 resulted in changing these REs to either 11.4.3

or 11.4.9a. Other substantial changes included remapping mosaics of 11.7.2 and 11.5.18 as homogenous patches.

REs that were mapped in DEHP certified mapping but not confirmed by field verification are: 11.3.1/11.3.2 mosaic, 11.3.2/11.3.27 mosaic, 11.3.2/11.3.7 mosaic, 11.3.21, 11.4.9, 11.4.9/11.4.7 mosaic, 11.4.9/11.4.8 mosaic, 11.5.9b, 11.5.9b/11.5.3 mosaic, 11.7.2/11.5,18 mosaic, 11.7.2/11.7.4 mosaic and 11.7.4/11.5.18 mosaic.

REs not mapped by DEHP certified mapping but mapped during field verification were 11.3.1, 11.3.1b, 11.3.27d, 11.4.3, 11.5.18, 11.5.3b and 11.7.2.

Table 1: Certified and Field Verified Regional Ecosystems and Conservation Status within the Study Area

Regional Ecosystem	Short Description	Status ¹			DEHP Certified Areas (ha)	Field Verified RE's (ha)
		VM Act	Biodiversity Status	EPBC Act		
Land zone 3: Alluvial Plains						
11.3.1/11.3.2	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains and <i>Eucalyptus populnea</i> woodland on alluvial plains.	E/OC	E/OC	E	13.72	0.00
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains.	E	E	E	0.00	16.60
11.3.1b	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains (Palustrine Wetland).	E	E	E	0.00	0.39
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains.	OC	OC	–	236.22	302.17
11.3.2/11.3.27	<i>Eucalyptus populnea</i> woodland on alluvial plains and Freshwater wetlands.	OC/LC	OC	–	73.19	0.00
11.3.2/11.3.7	<i>Eucalyptus populnea</i> woodland on alluvial plains and <i>Corymbia</i> spp. woodland on alluvial plains. Sandy soils	OC/LC	OC	–	7.87	0.00
11.3.21	<i>Dichanthium sericeum</i> and/or <i>Astrebla</i> spp. grassland on alluvial plains. Cracking clay soils.	E	E	E	0.41	0.00
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.	LC	OC	–	159.24	127.34
11.3.27	Freshwater wetlands.	LC	OC	–	5.32	3.73
11.3.27b	Freshwater wetlands: Lacustrine wetland (e.g. lake). Vegetation ranges from open water +/- aquatics and emergents such as <i>Potamogeton crispus</i> , <i>Myriophyllum verrucosum</i> , <i>Chara</i> spp., <i>Nitella</i> spp., <i>Nymphaea violacea</i> , <i>Ottelia ovalifolia</i> , <i>Nymphoides indica</i> , <i>N. crenata</i> , <i>Potamogeton tricarlinatus</i> , <i>Cyperus difformis</i> , <i>Vallisneria caulescens</i> and <i>Hydrilla verticillata</i> . Often with fringing woodland, commonly <i>Eucalyptus camaldulensis</i> or <i>E. coolabah</i> but also a wide range of other species including <i>Eucalyptus platyphylla</i> , <i>E. tereticornis</i> , <i>Melaleuca</i> spp., <i>Acacia holosericea</i> or other <i>Acacia</i> spp. Occurs on billabongs no longer connected to the channel flow.	LC	OC	–	11.00	11.00

Regional Ecosystem	Short Description	Status ¹			DEHP Certified Areas (ha)	Field Verified RE's (ha)
		VM Act	Biodiversity Status	EPBC Act		
11.3.27d	Freshwater wetlands: Palustrine wetland (e.g. vegetated swamp). <i>Eucalyptus camaldulensis</i> and/or <i>E. tereticornis</i> woodland. A range of sedges and grasses occur in the ground layer including <i>Fimbristylis vagans</i> , <i>Myriophyllum striatum</i> , <i>Nitella pseudoflabellata</i> and <i>Pseudoraphis</i> spp. Occurs fringing large lakes.	LC	OC	–	0.00	11.50
11.3.7	<i>Corymbia</i> spp. woodland on alluvial plains. Sandy soils.	LC	OC	–	196.35	203.01
Land zone 4: Gently undulating clay						
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains.	E	E	E	0.00	56.06
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains.	E	E	E	25.24	47.56
11.4.9	<i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains.	E	E	E	6.27	0.00
11.4.9a	<i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains: <i>Acacia harpophylla</i> , <i>Lysiphyllum carronii</i> +/- <i>Casuarina cristata</i> open-forest to woodland.	E	E	E	0.00	43.92
11.4.3 (Regrowth)	<i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains: <i>Acacia harpophylla</i> , <i>Lysiphyllum carronii</i> +/- <i>Casuarina cristata</i> open-forest to woodland.	-	-	-	0.00	94.47
11.4.9/11.4.7	<i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains and Open forest to woodland of <i>Eucalyptus populnea</i> with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on Cainozoic clay plains.	E	E	E	35.81	0.00

Regional Ecosystem	Short Description	Status ¹			DEHP Certified Areas (ha)	Field Verified RE's (ha)
		VM Act	Biodiversity Status	EPBC Act		
11.4.9/11.4.8	<i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains and <i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains	E	E	E	1.29	0.00
Land zone 5: Uniform sand plains						
11.5.2/11.5.2a	<i>Eucalyptus crebra</i> , <i>Corymbia</i> spp., with <i>E. moluccana</i> on lower slopes of Cainozoic sand plains/remnant surfaces: <i>Allocasuarina luehmannii</i> low tree layer with or without emergent woodland.	LC	NOC	–	68.97	0.00
11.5.18	<i>Micromyrtus capricornia</i> shrubland on Cainozoic sand plains/remnant surfaces.	OC	OC	–	0.00	85.02
11.5.18 (with <i>Cerbera dumicola</i>)	<i>Micromyrtus capricornia</i> shrubland on Cainozoic sand plains/remnant surfaces with <i>Cerbera dumicola</i> .	OC	OC	–	0.00	11.08
11.5.3	<i>Eucalyptus populnea</i> and/or <i>E. melanophloia</i> and/or <i>Corymbia clarksoniana</i> on Cainozoic sand plains/remnant surfaces.	LC	NOC	–	263.54	324.53
11.5.3b	<i>Eucalyptus populnea</i> and/or <i>E. melanophloia</i> and/or <i>Corymbia clarksoniana</i> on Cainozoic sand plains/remnant surfaces: Palustrine wetland (e.g. vegetated swamp). <i>Eucalyptus populnea</i> on closed depressions.	LC	NOC	–	0.00	6.79
11.5.9b	<i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests: <i>E. crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia</i> spp. Woodland.	LC	NOC	–	23.01	0.00

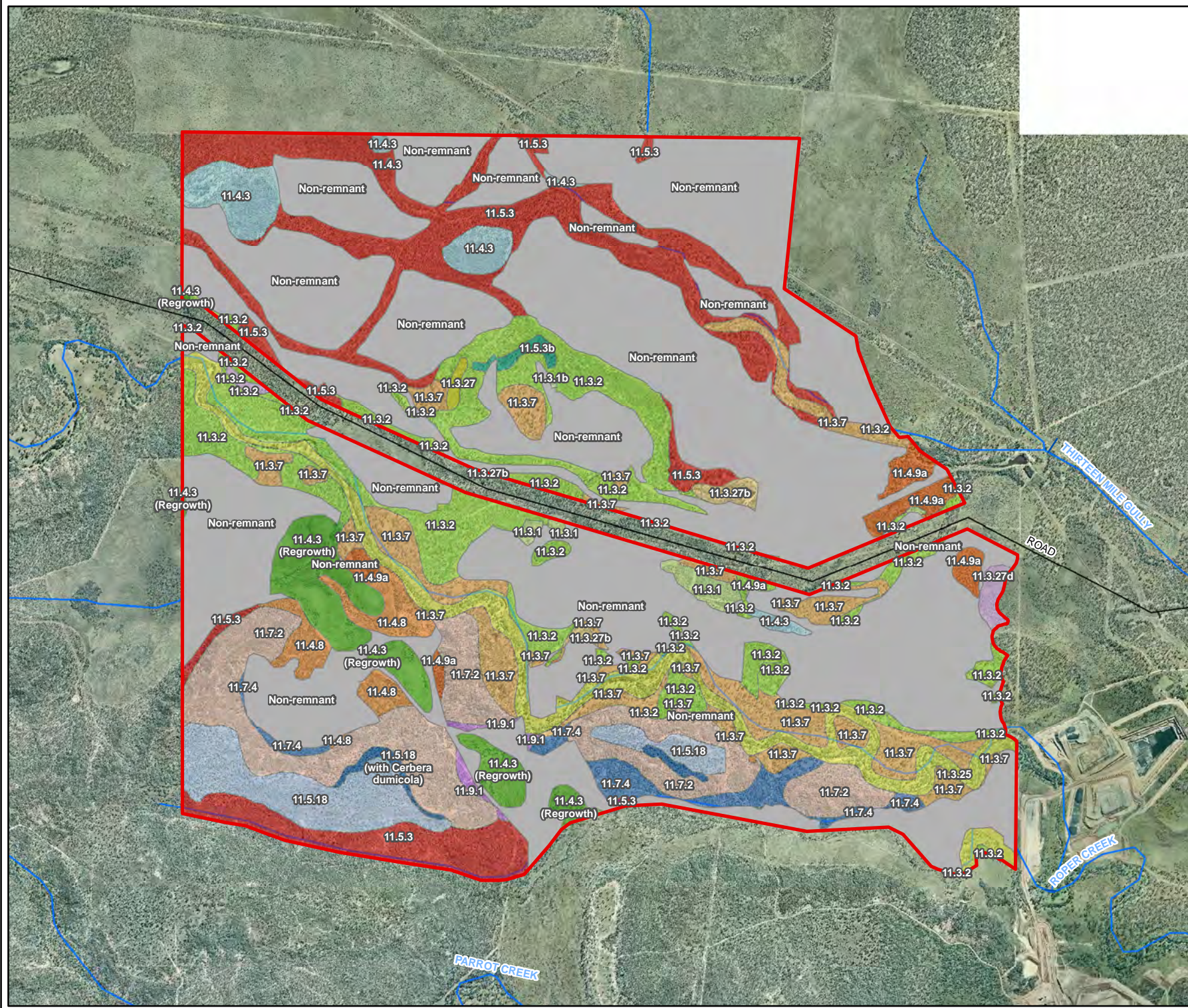
Regional Ecosystem	Short Description	Status ¹			DEHP Certified Areas (ha)	Field Verified RE's (ha)
		VM Act	Biodiversity Status	EPBC Act		
11.5.9b/11.5.3	<i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests: <i>E. crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia</i> spp. woodland. (BVG1M: 18b) and <i>Eucalyptus populnea</i> and/or <i>E. melanophloia</i> and/or <i>Corymbia clarksoniana</i> on Cainozoic sand plains/remnant surfaces.	LC	NOC	–	92.24	0.00
Land zone 7: Duricrusts and fotslopes						
11.7.2/11.5.18	<i>Acacia</i> spp. woodland on lateritic duricrust. Scarp retreat zone and <i>Micromyrtus capricornia</i> shrubland on Cainozoic sand plains/remnant surfaces.	LC	NOC	–	179.33	0.00
11.7.2/11.7.4	<i>Acacia</i> spp. woodland on lateritic duricrust. Scarp retreat zone and <i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> on lateritic duricrust.	LC	NOC	–	53.19	0.00
11.7.2	<i>Acacia</i> spp. woodland on lateritic duricrust. Scarp retreat zone.	LC	NOC	–	0.00	231.29
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> on lateritic duricrust.	LC	NOC	–	4.77	43.68
11.7.4/11.5.18	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> on lateritic duricrust and <i>Micromyrtus capricornia</i> shrubland on Cainozoic sand plains/remnant surfaces.	LC	NOC	–	38.91	0.00
Land zone 9: Fine-grained sedimentary rocks						
11.9.1	<i>Acacia harpophylla</i> - <i>Eucalyptus cambageana</i> open forest to woodland on fine-grained sedimentary rocks.	E	E	E	4.69	7.10
Total Area Remnant (ha)					1500.57	1645.73
Total Area Endangered VM Act, Biodiversity Status and EPBC Act (ha)					80.75	171.63
Total Area Of Concern VM Act (ha)					317.28	398.27

Regional Ecosystem	Short Description	Status ¹			DEHP Certified Areas (ha)	Field Verified RE's (ha)
		VM Act	Biodiversity Status	EPBC Act		
Total Area Of Concern Biodiversity Status (ha)					681.19	754.85
Total Area Non-Remnant (ha)					1788.91	1645.73
Total Study area Size					3289.50	3289.50

Note: Numbers may not add up due to rounding.

¹RE conservation status under the VM Act, its Biodiversity status and status under the EPBC Act (current at 11 September 2012).

E = Endangered, OC = Of Concern, LC = Least Concern, NOC = Not of Concern.



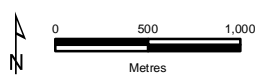
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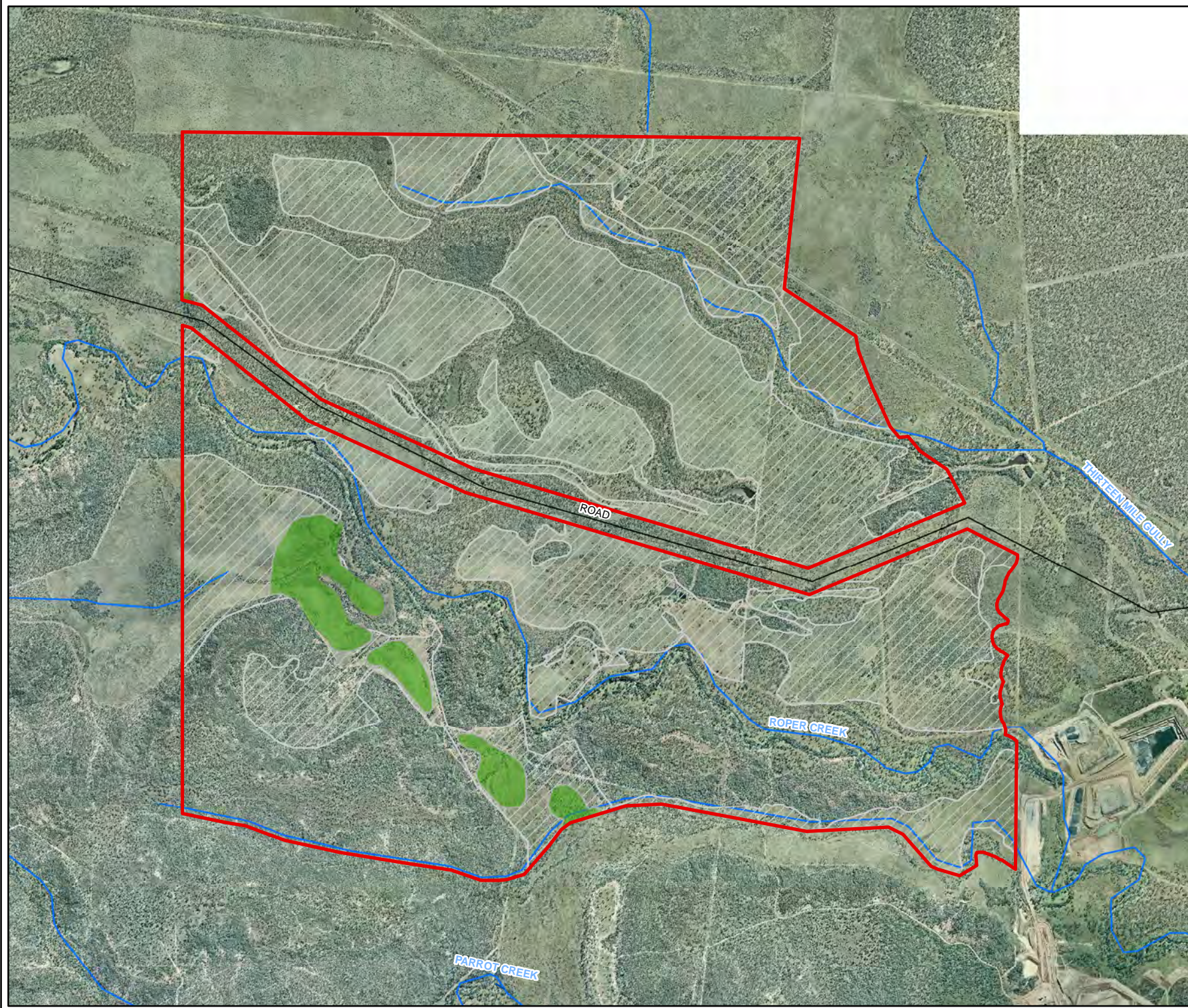
Study Area

Regional Ecosystems

- 11.3.1
- 11.3.1b
- 11.3.2
- 11.3.25
- 11.3.27
- 11.3.27b
- 11.3.27d
- 11.3.7
- 11.4.3
- 11.4.3 (Regrowth)
- 11.4.8
- 11.4.9a
- 11.5.18
- 11.5.18 (with *Cerbera dumicola*)
- 11.5.3
- 11.5.3b
- 11.7.2
- 11.7.4
- 11.9.1
- Non-remnant

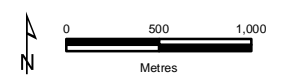
Figure 3
Field-verified Regional Ecosystems
 Middlemount Coal Mine
 Stage 2 - Offset Area Report

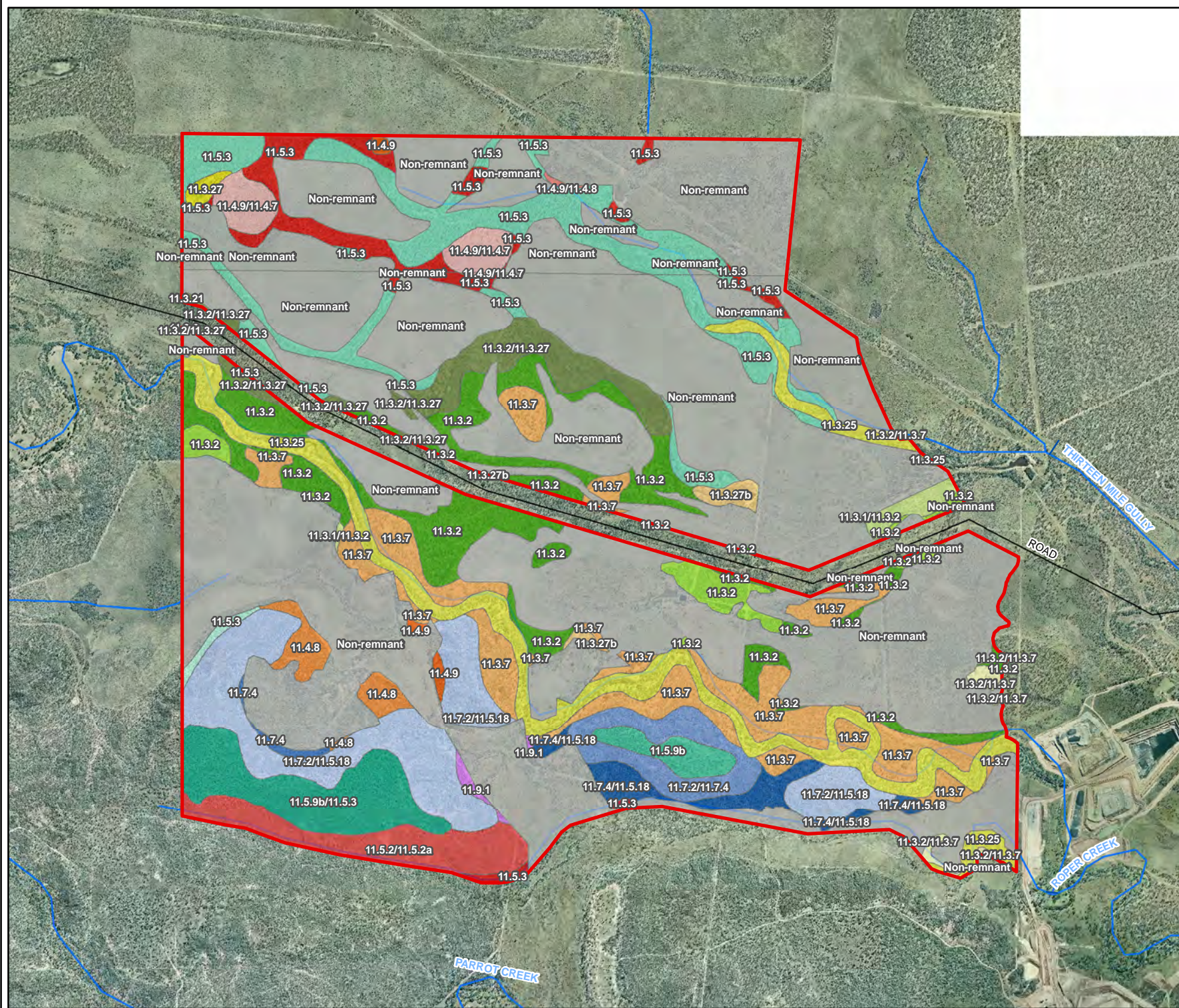




- Legend**
- Study Area
 - Regional Ecosystem**
 - 11.4.3 - Regrowth Area
 - Non-remnant

Figure 4
Non-remnant and Brigalow Regrowth within the Study Area
Middlemount Coal Mine Stage 2 - Offset Area Report





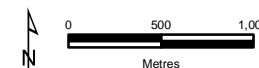
Legend

Study Area

Regional Ecosystems

- 11.3.1/11.3.2
- 11.3.2
- 11.3.2/11.3.2
- 11.3.2/11.3.27
- 11.3.2/11.3.7
- 11.3.21
- 11.3.25
- 11.3.27
- 11.3.27b
- 11.3.7
- 11.4.3
- 11.4.8
- 11.4.9
- 11.4.9/11.4.7
- 11.4.9/11.4.8
- 11.5.2/11.5.2a
- 11.5.3
- 11.5.3/11.5.3
- 11.5.3/11.5.3/11.5.3
- 11.5.9b
- 11.5.9b/11.5.3
- 11.7.2/11.5.18
- 11.7.2/11.7.4
- 11.7.4
- 11.7.4/11.5.18
- 11.9.1
- Non-remnant

Figure 2
 Department of Environment
 and Heritage Protection
 Certified Regional
 Ecosystems
 Middlemount Coal Mine
 Stage 2 - Offset Area Report



3.2 Regional Ecosystems of Conservation Significance

The Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC (listed as an EEC under the EPBC Act – described below in Section 4.4), comprised of six REs (REs 11.3.1, 11.3.1b, 11.4.3, 11.4.8, 11.4.9a and 11.9.1) was confirmed in the study area. Brigalow occurred over approximately 171.63 ha of the study area (Table 1, Figures 3 and 5). The areas of Brigalow occur as small isolates typically within areas of Eucalyptus-dominated or non-remnant REs.

Two REs listed under the VM Act as „Of Concern“ occur in the study area (RE 11.3.2 and RE 11.5.18). An area of RE 11.5.18 occurs with co-dominant *Cerbera dumicola* growing to >6 m high. While this area is approximately 11 ha and therefore not large enough to comprise a distinct RE, it is an area of distinct vegetation and is labelled “11.5.18 (with *Cerbera dumicola*)” for the purposes of this report to facilitate later reference (Table 1).

Five REs (including one RE with three variations) with a Biodiversity Status Of Concern were recorded within the study area (11.3.2, 11.3.7, 11.3.25, 11.3.27, 11.3.27b, 11.3.27d and 11.5.18) (Table 1; Figures 3 and 5).

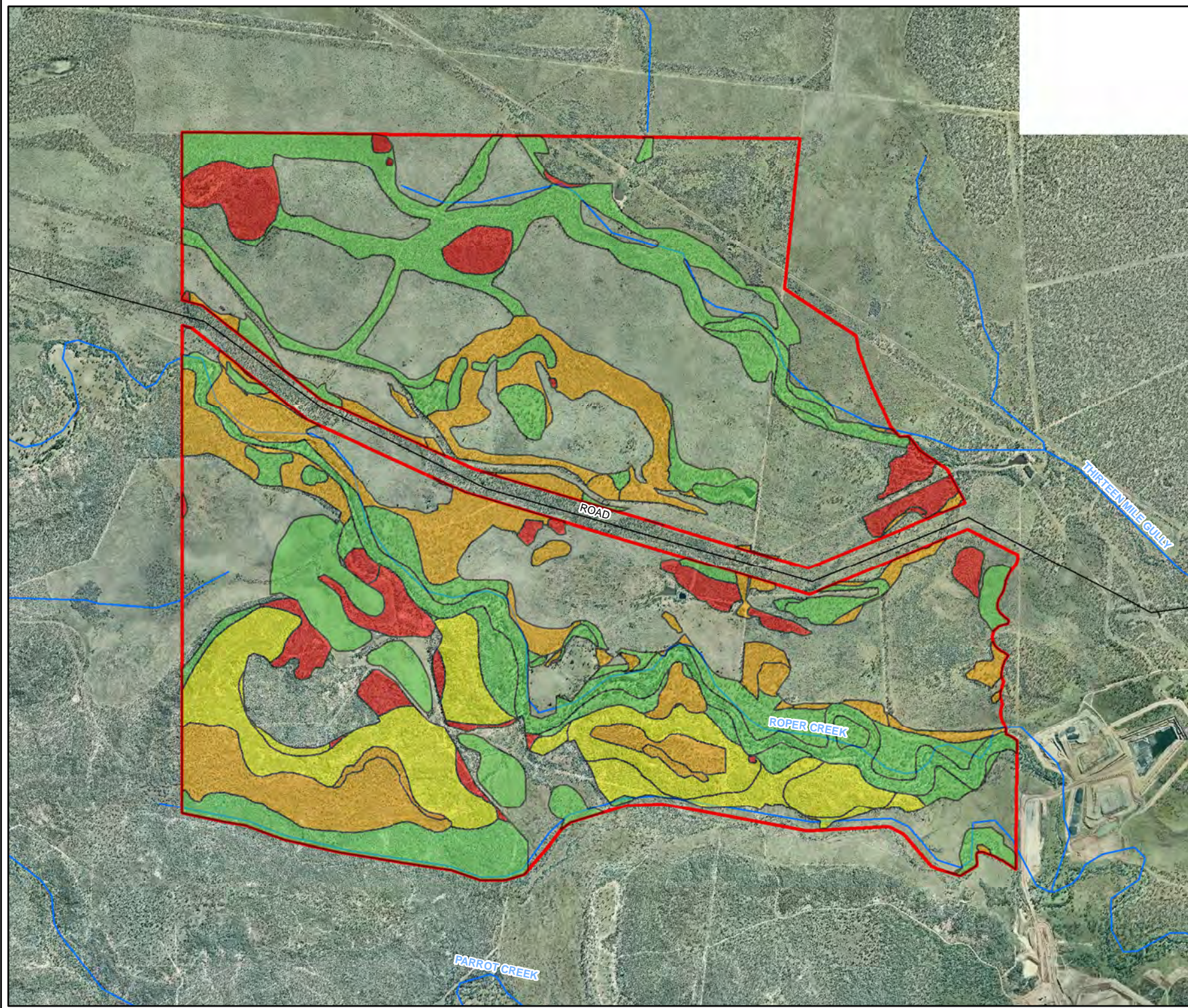
3.3 Threatened Ecological Communities

One TEC listed under the EPBC Act was identified in the study area, namely the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC.

A total of approximately 171.63 ha of Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC occurs within the study area (Table 1; Figures 3 and 5). Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC within the study area is comprised of six REs (Table 1; Figure 3). Each of these communities is in good ecological condition (for the most part) where they occur within the study area. There are few to no weeds within the patches and the only existing impact is from cattle grazing. Approximately 90 ha of Brigalow regrowth occurs in the study area, but does not meet the condition criteria for the Brigalow TEC because it is recent regrowth (after Butler [2007] in SEWPaC, 2012b). Although this Brigalow Open Forest currently does not meet the criteria for the Brigalow TEC, it is likely that these patches could meet the Brigalow TEC condition thresholds in the future (specifically the management of grazing and management of the area for conservation purposes).

3.4 Broad Fauna Habitat Types

Five broad habitat types occur within the study area (Table 2, Figure 6): non-remnant woodlands; Eucalypt woodlands; wetlands and riparian habitats; Brigalow woodlands and cracking clays; and escarpment with Acacia and mixed species woodlands.



Legend

- Study Area
- Conservation Status**
- Endangered-dominant / EBPC Act-listed Brigalow TEC
- Of Concern-dominant
- Of Concern-subdominant
- Not Of Concern

Figure 5
Field-verified Regional Ecosystems - Conservation Status
Middlemount Coal Mine Stage 2 - Offset Area Report

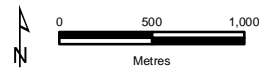





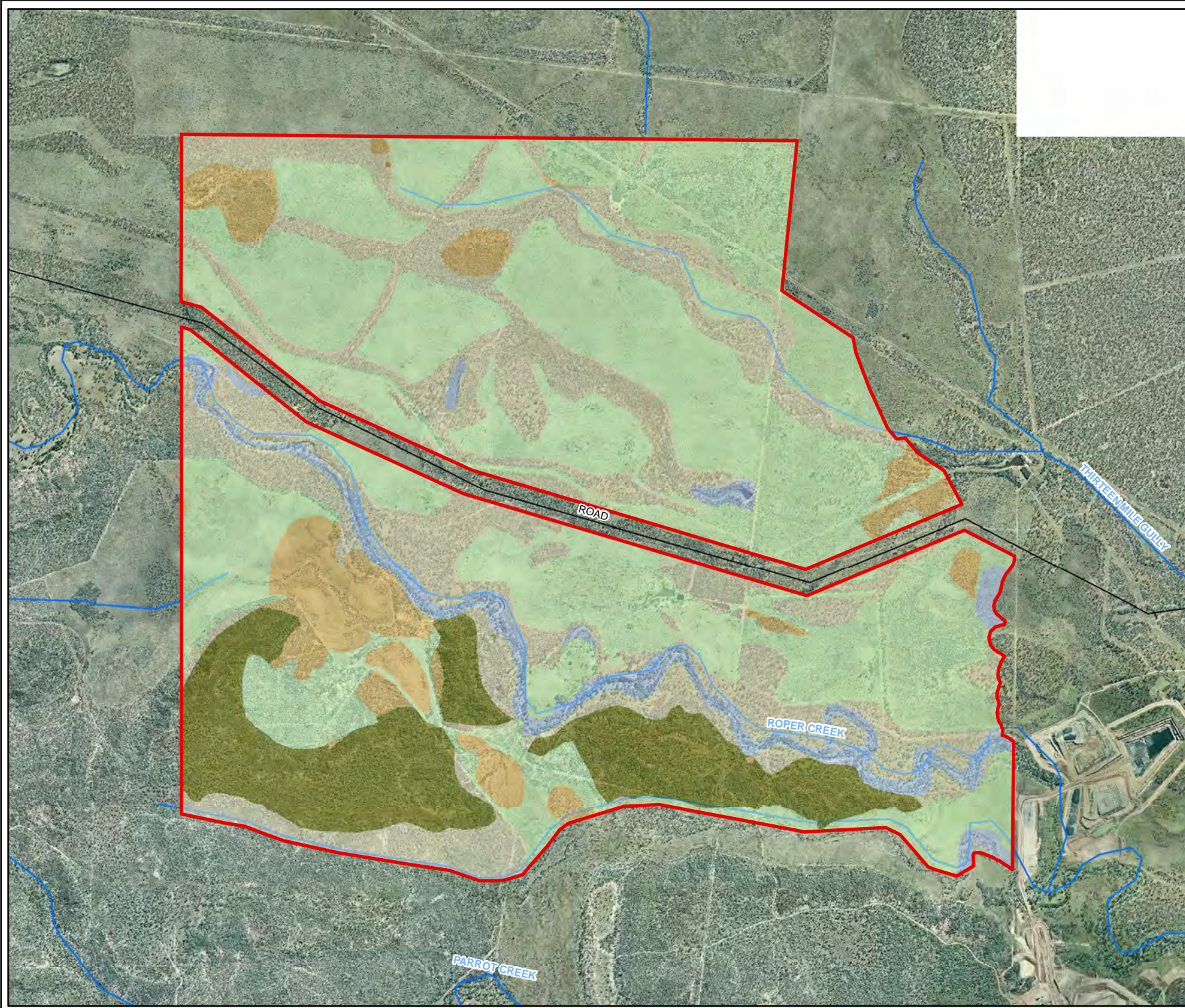


Table 2: Fauna Habitats within the Study Area.

Habitat Type and Description	Representative Photograph	Potential Threatened or 'Near Threatened' Taxa
<p>Non-remnant grasslands</p> <p>Non-remnant grasslands are dominated predominantly by the exotic Buffel Grass (<i>Cenchrus ciliaris</i>). Buffel grass reduces the biodiversity value of areas where it is the dominant groundcover. The non-remnant grasslands are a degraded habitat that occur due to the removal of native vegetation cover and as such have low value as habitat and support lower biodiversity than remnant habitats.</p> <p>Many species will use non-remnant grasslands in a transitory manner while moving between higher quality remnant habitats.</p>		<p>Brigalow scaly-foot (<i>Paradelma orientalis</i>)</p> <p>Ornamental snake (<i>Denisonia maculata</i>)</p>
<p>Eucalypt woodlands</p> <p>These habitats are dominated by Silver-leaved Ironbark (<i>Eucalyptus melanophloia</i>) and Poplar Box (<i>E. populnea</i>), although in some locations a mix of eucalypt species (<i>Eucalyptus</i> and <i>Corymbia</i> spp.) occur. The canopy species include abundant hollows of a variety of sizes, providing good habitat opportunities for arboreal species.</p> <p>Native grass species were common between shrubs, although Buffel Grass (<i>Cenchrus ciliaris</i>) occurred in the community in some areas.</p> <p>Ground debris, particularly fallen timber, was common throughout these habitats. Bare ground was also common, with a mosaic formed of open ground and grass cover, while thick leaf litter occurred beneath bushes or under trees. The soil was typically alluvial or clay.</p> <p>Eucalypt woodland with shrubs is one of the most common vertebrate habitat type within the study area.</p>		<p>Brigalow scaly-foot (<i>Paradelma orientalis</i>)</p> <p>Ornamental snake (<i>Denisonia maculata</i>)</p> <p>Dunmall's snake (<i>Furina dunmalli</i>)</p> <p>Yakka skink (<i>Egernia rugosa</i>)</p> <p>Little pied bat (<i>Chalinolobus picatus</i>)</p>

Habitat Type and Description	Representative Photograph	Potential Threatened or 'Near Threatened' Taxa
<p>Wetlands and riparian habitats</p> <p>Tall open riparian woodlands dominated by Forest Red Gum (<i>Eucalyptus tereticornis</i>) occur along Roper Creek within the study area. Little midstorey existed, restricted largely to regrowth canopy species.</p> <p>Numerous hollow-bearing trees were present within the habitat and arboreal species are likely to be well represented.</p> <p>The ground layer consisted predominantly of grasses, separated by open areas of ground. Debris, such as fallen timber and leaf litter was abundant.</p> <p>In most cases artificial waterbodies were small to moderate in size and highly disturbed, particularly around the edges due to cattle activity. These waterbodies provide important dry-season water sources for mobile species such as birds and mammals and are habitat for waterbirds.</p>		<p>Brigalow scaly-foot (<i>Paradelma orientalis</i>)</p> <p>Dunmall's snake (<i>Furina dunmalli</i>)</p> <p>Ornamental snake (<i>Denisonia maculata</i>)</p> <p>Yakka skink (<i>Egernia rugosa</i>)</p> <p>Squatter pigeon (<i>Geophaps scripta scripta</i>)</p> <p>Little pied bat (<i>Chalinolobus picatus</i>)</p> <p>Cotton pygmy-goose (<i>Nettapus coromandelianus</i>)</p>

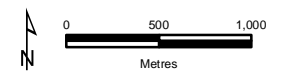
Habitat Type and Description	Representative Photograph	Potential Threatened or 'Near Threatened' Taxa
<p>Brigalow woodlands and cracking clays</p> <p>Distinguished by a tall Brigalow canopy, this habitat type was distinct within the study area. Within the canopy, hollows were rare; however, exfoliating bark was common and provided a different sheltering opportunity. Small arboreal vertebrates such as geckos are likely to use these shelter sites. The cracking clay soils on which Brigalow habitats were found provide excellent dry-season refugia for many terrestrial vertebrates. The ponded water in the gilgais provides an important wet-season water resource and frog habitat.</p> <p>The shrub layer, while present, was typically limited to Currant Bush (<i>Carissa ovata</i>).</p> <p>The ground layer was relatively open and dominated by native grasses. Few weeds occur within the Brigalow woodlands.</p>		<p>Brigalow scaly-foot (<i>Paradelma orientalis</i>)</p> <p>Dunmall's snake (<i>Furina dunmalli</i>)</p> <p>Ornamental snake (<i>Denisonia maculata</i>)</p> <p>Yakka skink (<i>Egernia rugosa</i>)</p> <p>Little pied bat (<i>Chalinolobus picatus</i>)</p>
<p>Escarpments with Acacia and mixed species woodlands</p> <p>Acacia woodland consisted of a moderately dense, tall canopy dominated by Lancewood (<i>Acacia shirleyi</i>). Only a few emergent eucalypts were present, resulting in few hollows. Arboreal species are therefore not likely to be abundant. Shrubs were not common, but where present were typically regrowth canopy species.</p> <p>The ground stratum was dominated by short native grasses, separated by the occasional patch of bare ground. Fallen debris, particularly moderately sized logs, was common.</p>		<p>Brigalow scaly-foot (<i>Paradelma orientalis</i>)</p> <p>Dunmall's snake (<i>Furina dunmalli</i>)</p> <p>Yakka skink (<i>Egernia rugosa</i>)</p> <p>Little pied bat (<i>Chalinolobus picatus</i>)</p> <p>Koala (<i>Phascolarctos cinereus</i>)</p>



Legend

- Study Area
- Fauna Habitats**
- Eucalypt woodlands
- Wetlands and riparian habitats
- Brigalow woodlands and cracking clays
- Escarpment with Acacia and mixed species woodlands
- Non-remnant grasslands

Figure 6
Fauna Habitats
 Middlemount Coal Mine
 Stage 2 - Offset Area Report



3.5 Flora Species

A total of 140 flora species were recorded within the study area during the recent surveys. A complete list of flora species recorded during the surveys is provided in Attachment 1.

3.6 Species of Conservation Significance

Two flora species and three fauna species of conservation significance were recorded during the surveys (Table 3, Figure 7).

Table 3: Location of Conservation Significant Flora and Fauna Species Recorded Within the Study Area.

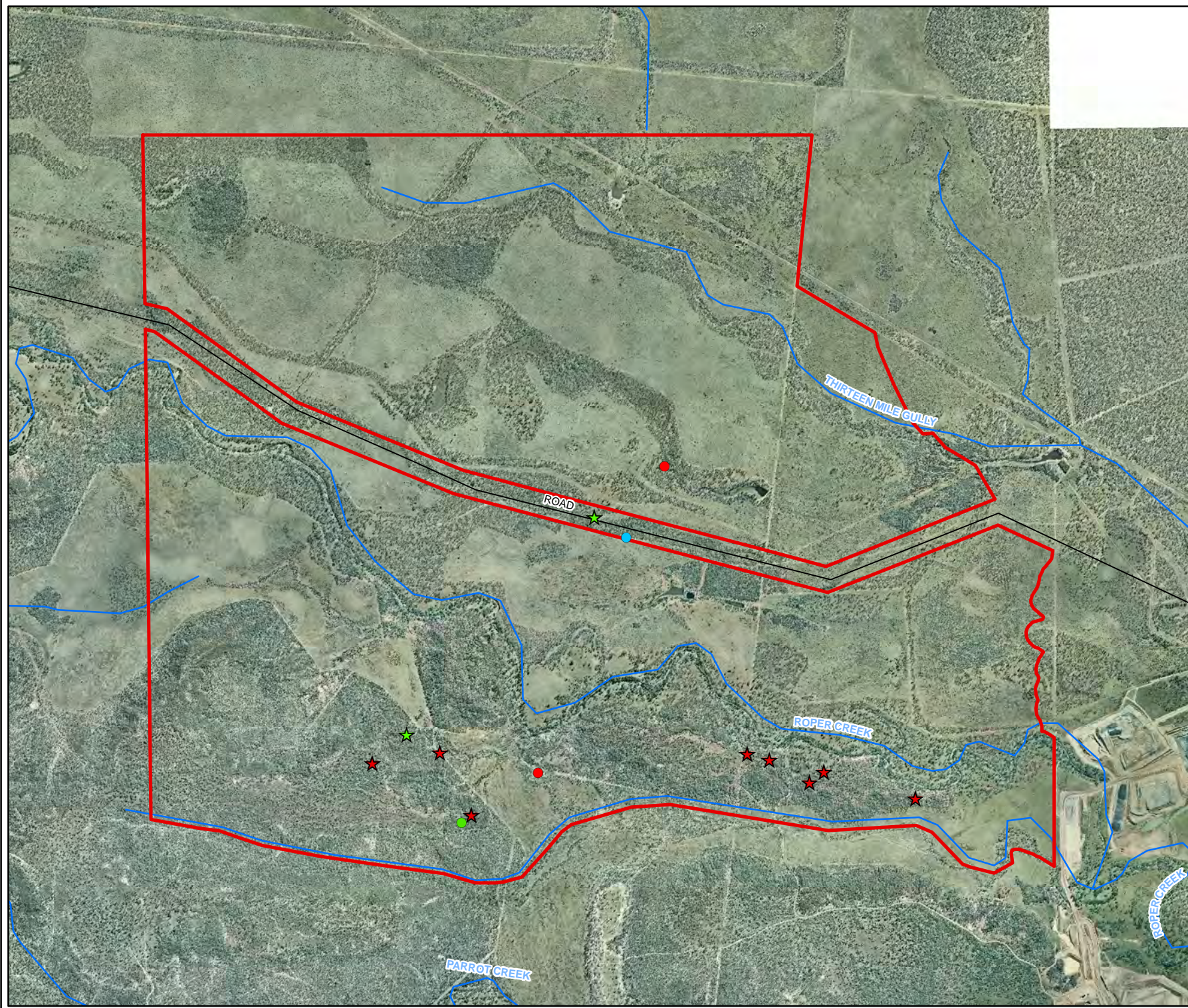
Scientific Name	Common Name	Status ¹		Count	Latitude	Longitude
		NC Act	EPBC Act			
Flora						
<i>Cerbera dumicola</i>	-	NT	-	> 100	-22.86	148.62
<i>Cerbera dumicola</i>	-	NT	-	> 100	-22.86	148.61
<i>Cerbera dumicola</i>	-	NT	-	20	-22.86	148.61
<i>Cerbera dumicola</i>	-	NT	-	30	-22.86	148.59
<i>Cerbera dumicola</i>	-	NT	-	20	-22.86	148.62
<i>Cerbera dumicola</i>	-	NT	-	20	-22.86	148.62
<i>Cerbera dumicola</i>	-	NT	-	> 100	-22.86	148.59
<i>Cerbera dumicola</i>	-	NT	-	> 100	-22.86	148.58
<i>Desmodium macrocarpum</i>	Large-podded trefoil	NT	-	100	-22.86	148.59
<i>Desmodium macrocarpum</i>	Large-podded trefoil	NT	-	5	-22.84	148.60
Fauna						
<i>Phascolarctos cinerius</i>	Koala	-	V	1	-22.87	148.59
<i>Geophaps scripta scripta</i>	Squatter Pigeon	V	-	2	-22.86	148.60
<i>Geophaps scripta scripta</i>	Squatter Pigeon	V	-	2	-22.84	148.61
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M	2	-22.84	148.60
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M	4	-22.84	148.65

¹ Conservation significant flora or fauna species listed under the QLD *Nature Conservation Act, 1992* (NC Act) and/or EPBC Act (current at 11 September 2012).

NT = Near Threatened, V = Vulnerable, E = Endangered, M = Migratory.

Flora Species

Two flora species of conservation significance, the Large-podded trefoil (*Desmodium macrocarpum*) and *Cerbera dumicola* were recorded during the surveys. A description of these two species is provided below.



Legend

Study Area

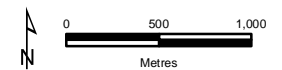
EPBC Act Listed Species

- Koala (*Phascolarctos cinereus*)
- Rainbow Bee-eater (*Merops ornatus*)
- Squatter Pigeon (*Geophaps scripta scripta*)

NC Act Listed Species

- Large-podded Trefoil (*Desmodium macrocarpum*)
- Cerbera dumicola*

Figure 7
Species of Conservation Significance
 Middelmount Coal Mine
 Stage 2 - Offset Area Report



Desmodium macrocarpum

Large-podded trefoil (*Desmodium macrocarpum*) is listed as near threatened under the NC Act. Small areas of *Desmodium macrocarpum* were found within REs 11.5.18 and 11.3.2. One patch of *Desmodium macrocarpum* contained over 100 individuals, while the other patch contained five individuals (Plate 1). The patch of *Desmodium macrocarpum* consisting of five individuals lies just outside the study area within the narrow stock route corridor that bisects the study area (Figure 7).

Cerbera dumicola

Cerbera dumicola is listed as Near Threatened under the NC Act. The species is abundant in scarp retreat zones and on remnant surfaces, particularly in association with Lancewood (*Acacia shirleyi*) woodlands (RE 11.7.2 and RE 11.5.18). Where *Cerbera dumicola* was recorded, there were between 100 and >1,000 individual plants (Plate 2).



Plate 1: *Desmodium macrocarpum* in RE 11.5.18.



Plate 2: *Cerbera dumicola* in RE 11.5.18.

Fauna Species

Three fauna species of conservation significance were opportunistically recorded during the surveys within the study area and are described below (Table 3, Figure 7).

Koala *Phascolarctos cinerius*

One Koala was sighted in *Acacia shirleyi*-dominated woodland (RE 11.7.2) (Plate 3). Koalas are listed as Vulnerable under the EPBC Act.



Plate 3: Koala in RE 11.7.2.

Squatter Pigeon *Geophaps scripta scripta*

Squatter Pigeons were recorded from two locations within the study area. Both sightings were of two individuals. Squatter pigeons are listed as Vulnerable under the EBPC Act and NC Act.

Rainbow Bee-eater *Merops ornatus*

Two Rainbow Bee-eaters were recorded within the study area along an access track. Rainbow Bee-eaters are listed as Migratory under the EPBC Act.

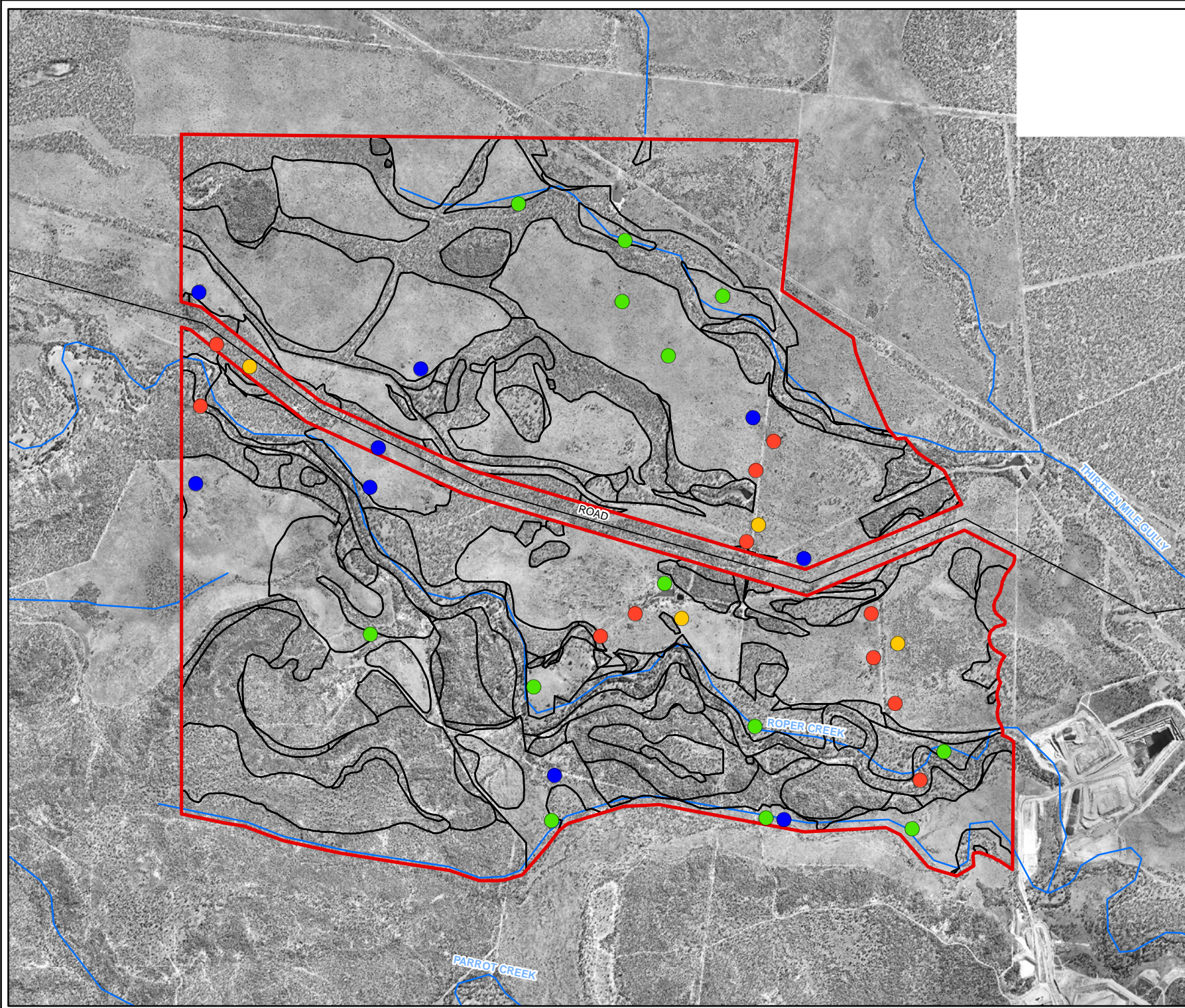
3.7 Weed Species

Three weed species listed as Class 1 and 2 weeds under the LP Act were detected within the study area. Harrisia Cactus (*Eriocereus martinii*) and Velvety Tree Pear (*Opuntia tormentosa*) (Class 1) and Parthenium (*Parthenium hysterophorus*) (Class 2) are sparsely distributed in low densities across the entire study area. No major infestations of any weed species were detected.

Parthenium is listed as a Weed of National Significance. Parthenium was most commonly recorded as small plants sparsely distributed along Roper Creek in RE 11.3.25.

3.8 Pest Animals

Four pest animal species were recorded within the study area. Signs of Pigs (*Sus scrofa*), Dogs (*Canis lupus familiaris*), Rabbits (*Oryctolagus cuniculus*) and Cats (*Felis catus*) were seen in all habitat types. Signs of each species included scats and tracks. Feral pigs appear to be the most prevalent of the pest animals within the study area. Signs of all four species are common and widespread across the entire study area (Figure 8).



Legend

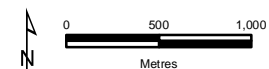
Study Area

Pest Animals*

- Cat
- Dog
- Pig
- Rabbit

* Presence of animals indicated by tracks, scats and diggings.

Figure 8
Pest Animals
 Middlemount Coal Mine
 Stage 2 - Offset Area Report



4 REFERENCES

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Attachment 1: Flora Species Recorded During the Survey

Family and Species	Common Name	Status under the NC Act ¹
Acanthaceae		
<i>Rostellularia adscendens</i>	Pink Tongues	-
Ameranthaceae		
<i>Alternanthera denticulata</i>	Lesser Joyweed	-
<i>Alternanthera pungens</i> *	Khaki Weed	-
Amaryllidaceae		
<i>Crinum flaccidum</i>	Darling lily	-
Apocynaceae		
<i>Alstonia constricta</i>	-	-
<i>Carissa ovata</i>	Currant bush	-
<i>Cerbera dumicola</i>	-	NT
<i>Parsonsia lanceolata</i>	Northern Silkpod	-
Asteraceae		
<i>Arctotheca calendula</i> *	Cape Weed	-
<i>Bidens bipinnata</i> *	Spanish Needles	-
<i>Calotis hispidula</i>	Bogan Flea	-
<i>Calotis lappulacea</i>	Yellow Burr-daisy	-
<i>Centipeda cunninghamii</i>	Common Sneezeweed	-
<i>Cirsium vulgare</i> *	Spear Thistle	-
<i>Cotula australis</i>	Common Cotula	-
<i>Epaltes australis</i>	Spreading Nutheads	-
<i>Parthenium hysterophorus</i> *	Parthenium Weed	-
<i>Pterocaulon redolens</i>	-	-
<i>Pterocaulon sphacelatum</i>	Fruit Salad Plant	-
<i>Senecio lautus</i>	Fireweed	-
<i>Vittadenia</i> spp.	New-Holland Daisy	-
<i>Xanthium pungens</i>	Noogoora Burr	-
Boraginaceae		
<i>Heliotropium amplexicaule</i> *	Blue Heliotrope	-
Cactaceae		
<i>Eriocereus martinii</i> *	Harrisia Cactus	-
<i>Opuntia tormentosa</i> *	Prickly Pear	-
Caesalpiniaceae		
<i>Cassia brewsteri</i>	(Leichardt) Bean tree	-
<i>Lysiphylum hookeri</i>	White-flowered Bauhinia	-
<i>Senna occidentalis</i> *	Coffee Senna	-
Capparaceae		
<i>Capparis canescens</i>	Wild Orange	-

Family and Species	Common Name	Status under the NC Act ¹
<i>Capparis lasiantha</i>	Wait-a-while	-
<i>Capparis loranthifolia</i>	-	-
Casuarinaceae		
<i>Allocasuarina luehmannii</i>	Bull Oak	-
<i>Casuarina cristata</i>	Belah	-
Chenopodiaceae		
<i>Atriplex semibaccata</i>	Creeping Saltbush	-
<i>Einadia hastata</i>	Berry Saltbush	-
<i>Einadia nutans</i> subsp. <i>linifolia</i>	Saltbush	-
<i>Einadia polygonoides</i>	-	-
<i>Enchylaena tomentosa</i>	Ruby Saltbush	-
<i>Maireana microphylla</i>	Small-leaved Cottonbush	-
<i>Salsola kali</i>	Prickly Saltwort	-
<i>Sclerolaena muricata</i>	-	-
Combretaceae		
<i>Terminalia oblongata</i>	Yellow Wood	-
Convolvulaceae		
<i>Evolvulus alsinoides</i>	Tropical Speedwell	-
Crassulaceae		
<i>Bryophyllum delagoense</i> *	Mother of Millions	-
Cyperaceae		
<i>Cyperus</i> spp.	Sedge	-
<i>Eleocharis</i> spp.	Spike-rush	-
Droseraceae		
<i>Drosera indica</i>	Flycatcher Sundew	-
Euphorbiaceae		
<i>Euphorbia drummondii</i>	Caustic Weed	-
<i>Petalostigma pubescens</i>	Quinine Tree	-
Erythroxylaceae		
<i>Erythroxylum australis</i>	-	-
Fabaceae		
<i>Crotalaria dissitiflora</i>	Grey Rattlepod	-
<i>Desmodium macrocarpum</i>	Large-podded Trefoil	NT
<i>Glycine tabacina</i>	Glycine Pea	-
<i>Hardenbergia violacea</i>	Native Sarsaparilla	-
<i>Rhynchosia minima</i>	Rhynchosia	-
<i>Stylosanthes scabra</i> *	Shrubby Stylo	-
<i>Vigna lanceolata</i>	Maloga Bean	-
Goodeniaceae		
<i>Goodenia heteromera</i>	Spreading Goodenia	-

Family and Species	Common Name	Status under the NC Act ¹
<i>Goodenia rotundifolia</i>	-	-
Hydrocharitaceae		
<i>Ottelia ovalifolia</i>	Swamp Lily	-
Lamiaceae		
<i>Ajuga australis</i>	Austral Bugle	-
Loranthaceae		
<i>Amyema quandang</i>	Grey Mistletoe	-
<i>Dendrophthoe glabrescens</i>	Orange Mistletoe	-
Malvaceae		
<i>Abutilon oxycarpum</i>	Flannel Flower	-
<i>Malva parviflora</i> *	Small-flowered Mallow	-
<i>Sida cordifolia</i> *	Flannel weed	-
Mimosaceae		
<i>Acacia catenulata</i>	Bendee	-
<i>Acacia excelsa</i>	Ironwood	-
<i>Acacia harpophylla</i>	Brigalow	-
<i>Acacia leiocalyx</i>	Black Wattle	-
<i>Acacia rhodoxylon</i>	Rosewood	-
<i>Acacia salicina</i>	Sally Wattle	-
<i>Acacia shirleyi</i>	Lancewood	-
<i>Archidendropsis basaltica</i>	Dead Finish	-
<i>Neptunia gracilis</i>	Native Sensitive-plant	-
Meliaceae		
<i>Owenia acidula</i>	Emu Apple	-
Menyanthaceae		
<i>Nymphoides indica</i>	Water Snowflake	-
Myoporaceae		
<i>Eremophila deserti</i>	Turkey Bush	-
<i>Eremophila mitchellii</i>	False Sandalwood	-
<i>Myoporum montanum</i>	-	-
Myrtaceae		
<i>Corymbia dallachiana</i>	Ghost-gum	-
<i>Corymbia clarksoniana</i>	Long-fruited Bloodwood	-
<i>Corymbia tessellaris</i>	Moreton Bay Ash	-
<i>Eucalyptus cambageana</i>	Dawson Gum	-
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	-
<i>Eucalyptus exserta</i>	-	-
<i>Eucalyptus populnea</i>	Poplar Box	-
<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	-

Family and Species	Common Name	Status under the NC Act ¹
<i>Eucalyptus tereticornis</i>	Forest Red-gum	-
<i>Melaleuca leucadendra</i>	Weeping Paperbark	-
<i>Micromyrtus capricornia</i>	-	-
Onagraceae		
<i>Ludwigia octovalvis</i>	-	-
Orchidaceae		
<i>Cymbidium canaliculatum</i>	Black Orchid	-
Poaceae		
<i>Aristida calycina</i>	Dark Wiregrass	-
<i>Aristida latifolia</i>	Feathertop Wiregrass	-
<i>Aristida personata</i>	Purple Wiregrass	-
<i>Astrebla squarrosa</i>	Bull Mitchell-grass	-
<i>Bothriochloa bladhii</i> subsp. <i>bladhii</i>	Forest Bluegrass	-
<i>Bothriochloa pertusa</i>	Creeping bluegrass	-
<i>Calyptochloa gracillima</i>	Tableland Couch	-
<i>Cenchrus ciliaris</i>	Buffel Grass	-
<i>Chloris divaricata</i>	Slender Chloris	-
<i>Chloris inflata</i> *	Purple-top Chloris	-
<i>Chloris truncata</i>	Windmill Grass	-
<i>Chloris virgata</i> *	Feathertop Rhodes-grass	-
<i>Cynodon dactylon</i> *	Couch	-
<i>Dicanthium sericeum</i> subsp. <i>sericeum</i>	Queensland Bluegrass	-
<i>Eragrostis sororia</i>	Woodland Lovegrass	-
<i>Heteropogon contortus</i>	Black Spear Grass	-
<i>Hyparrhenia rufa</i>	Thatch Grass	-
<i>Leptochloa digitata</i>	Umbrella Canegrass	-
<i>Melinis repens</i> *	Red Natal Grass	-
<i>Panicum</i> spp.	Panic Grass	-
<i>Paspalidium caespitosum</i>	Brigalow Grass	-
<i>Phragmites australis</i>	Common reed	-
<i>Sporobolus caroli</i>	Fairy Grass	-
<i>Themeda australis</i>	Kangaroo Grass	-
Phyllanthaceae		
<i>Phyllanthus virgatus</i>	Spurge	-
Polygonaceae		
<i>Persicaria orientalis</i>	Prince's Plum	-
<i>Rumex crispus</i>	Curled Dock	-
Portulacaceae		
<i>Portulaca pilosa</i> subsp. <i>pilosa</i>	Hairy Pigweed	-

Family and Species	Common Name	Status under the NC Act ¹
Proteaceae		
<i>Grevillea parallela</i>	Silver Oak	-
<i>Grevillea striata</i>	Beefwood	-
<i>Hakea lorea</i>	Gnarled Corkwood	-
Rhamnaceae		
<i>Alphintonia excelsa</i>	Red Ash	-
Rubiaceae		
<i>Canthium attenuatum</i>	Myrtle	-
<i>Larsenaikia ochreatea</i>	Native Gardenia	-
Rutaceae		
<i>Citrus glauca</i>	Limebush	-
<i>Flindersia dissosperma</i>	Scrub Leopardwood	-
<i>Phebalium</i> spp.	Phebalium	-
Sapindaceae		
<i>Atalaya hemiglauca</i>	Whitewood	-
<i>Dodonaea viscosa</i>	Hop Bush	-
Sinopteridaceae		
<i>Cheilanthes sieberi</i>	Rock Fern	-
<i>Marsilae hirsuta</i>	Short-fruit Nardoo	-
Solanaceae		
<i>Solanum ellipticum</i>	Potato Bush	-
<i>Solanum ferocissimum</i>	Spiny Potato Bush	-
Sparrmanniaceae		
<i>Grewia latifolia</i>	-	-
Xanthorrhoeaceae		
<i>Lomandra longifolia</i>	Spiny-headed Matrush	-
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Matrush	-
<i>Lomandra patens</i>	Irongrass	-

Notes:

No threatened species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* were recorded during the surveys.

* Denotes introduced species.

¹ Threatened flora species status under the Queensland *Nature Conservation Act, 1992* (current at 3 October 2012).

NT = Near Threatened.

APPENDIX D

DECLARED PLANTS OF QUEENSLAND

(SOURCE: THE STATE OF QUEENSLAND, DEPARTMENT OF AGRICULTURE,
FISHERIES AND FORESTRY, 2013)

Declared plants of Queensland

What is a declared plant?

Pest plants targeted for control under state legislation are species that have, or could have, serious economic, environmental or social impacts. Pest management legislation aims to help protect Queensland's economy, biodiversity and people's lifestyles by:

- preventing the introduction and establishment of new pest plants in Queensland
- preventing the spread of established pest plants into new areas
- reducing the extent of existing infestations where feasible.

Declaration under the *Land Protection (Pest and Stock Route Management) Act 2002* imposes a legal responsibility for control by all landowners on land under their management. This includes all landowning state agencies. Large landowning state agencies are also required to develop and implement pest management plans.

Other than the above requirements, declaration does not mean that management of declared species becomes the responsibility of the state, although the state may engage in supplemental publicity and awareness activities, research, coordination of control activities, or assistance with some pests in strategic areas.

The Australian Quarantine and Inspection Service (AQIS) of the Department of Agriculture, Forestry and Fisheries (DAFF) has complementary legislation to restrict the importation of potential weeds not yet found in Australia. All plant nurseries and individuals should ensure they have an up-to-date list of declared plants of Queensland and prohibited plants in Australia.

Declared plants are listed under three different categories.

Categories

Class 1

A Class 1 pest is one that has the **potential** to become a very serious pest in Queensland in the future. We need to prevent the introduction, possession and sale of these species so that they can't escape to become pests.



Class 1 declared pest plant—Mexican feather grass (*Nassella tenuissima*)

All landholders are required by law to keep their land free of Class 1 pests. It is a serious offence to introduce, keep, release or sell Class 1 pests without a permit.

Class 2

A Class 2 pest is one that has **already spread** over substantial areas of Queensland, but its impact is so serious that we need to try and control it and avoid further spread onto properties that are still free of the pest.

By law, all landholders must try to keep their land free of Class 2 pests and it is an offence to possess, sell or release these pests without a permit. Fines apply.





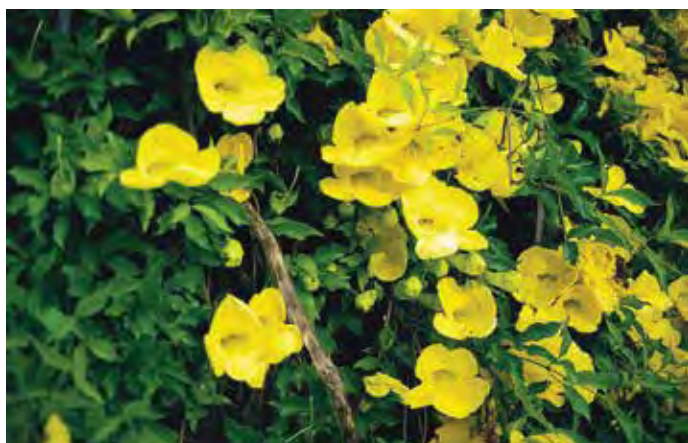
Class 2 declared pest plant—parthenium
(*Parthenium hysterophorus*)

Class 3

A Class 3 pest is one that is **commonly established** in parts of Queensland but its control by landowners is not deemed to be warranted unless the plant is impacting, or has the potential to impact, on a nearby 'environmentally significant area' (e.g. a national park).

It is an offence to sell, introduce, release or supply a Class 3 pest. Fines apply.

Species not declared under the *Land Protection (Pests and Stock Route Management) Act 2002* may still be declared at a local government level under local laws.



Class 3 declared pest plant—cat's claw creeper
(*Macfadyena unguis-cati*)

Reporting Class 1 plants

Please report the sale or presence of any Class 1 plants. Phone 13 25 23 to contact Biosecurity Queensland (part of the Department of Agriculture, Fisheries and Forestry).

Prompt action by everyone will protect our agricultural industries, natural resources and the environment from further destruction by introduced plants.

Fines apply to the introduction of any Class 1 plant.

Declared plants list

Plants in Queensland that are declared under the *Land Protection (Pest and Stock Route Management) Act 2002* are listed alphabetically on the following pages. Categories apply to the entire state unless otherwise specified.

Class 1 pest plants

- acacias non-indigenous to Australia ((*Acaciella* spp., *Mariosousa* spp., *Senegalia* spp. (other than *Senegalia albizoides*) and *Acacia* spp. (syn. *Vachellia* spp.) other than *Acacia nilotica* and *Acacia farnesiana*))
- alligator weed (*Alternanthera philoxeroides*)
- anchored water hyacinth (*Eichhornia azurea*)
- badhara bush (*Gmelina elliptica*)
- bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*)
- bridal creeper (*Asparagus asparagoides*)
- candleberry myrth (*Myrica faya*)
- Chilean needle grass (*Nassella neesiana*)
- cholla cactus (*Cylindropuntia* spp. and their hybrids, other than *C. spinosior*, *C. fulgida* and *C. imbricata*)
- Christ's thorn (*Ziziphus spina-christi*)
- Eurasian water milfoil (*Myriophyllum spicatum*)
- fanwort (*Cabomba* spp. other than *C. caroliniana*)
- floating water chestnuts (*Trapa* spp.)
- gorse (*Ulex europaeus*)
- harrisia cactus (*Harrisia* spp. syn. *Eriocereus* spp. other than *H. martinii*, *H. tortuosa* and *H. pomanensis* syn. *Cereus pomanensis*)

- honey locust (*Gleditsia* spp. including cultivars and varieties)
- horsetails (*Equisetum* spp.)
- hygrophila (*Hygrophila costata*)
- kochia (*Bassia scoparia* syn. *Kochia scoparia*)
- Koster's curse (*Clidemia hirta*)
- lagarosiphon (*Lagarosiphon major*)
- limnocharis or yellow burrhead (*Limnocharis flava*)
- Madras thorn (*Pithecellobium dulce*)
- mesquites (all *Prosopis* spp. and hybrids other than *Prosopis glandulosa*, *Prosopis pallida* and *Prosopis velutina*)
- Mexican bean tree (all *Cecropia* spp.)
- Mexican feather grass (*Nassella tenuissima*)
- miconia (*Miconia* spp.)
- mikania vine (*Mikania* spp.)
- mimosa pigra (*Mimosa pigra*)
- Peruvian primrose bush (*Ludwigia peruviana*)
- prickly pear (*Opuntia* spp. other than *O. ficus-indica*, *O. stricta*, *O. aurantiaca*, *O. monacantha*, *O. tomentosa* and *O. streptacantha*)
- red sesbania (*Sesbania punicea*)
- salvinia (*Salvinia* spp. other than *S. molesta*)
- Senegal tea (*Gymnocoronis spilanthoides*)
- serrated tussock (*Nassella trichotoma*)
- Siam weed (*Chromolaena* spp.)
- spiked pepper (*Piper aduncum*)
- thunbergia
 - annual thunbergia (*Thunbergia annua*)
 - fragrant thunbergia (*T. fragrans*)
 - laurel clockvine (*T. laurifolia*)
- water mimosa (*Neptunia oleracea* and *N. plena*)
- water soldiers (*Stratiotes aloides*)
- willow (*Salix* spp. other than *S. babylonica*, *S. humboldtiana* (syn. *S. chilensis*), *S. matsudana*, *S. × calodendron* and *S. × reichardtii*)
- witch weeds (*Striga* spp. other than native species).
- yellow ginger (*Hedychium flavescens*)

Class 2 pest plants

- African boxthorn (*Lycium ferocissimum*)
- annual ragweed (*Ambrosia artemisiifolia*)
- bellyache bush (*Jatropha gossypifolia* and hybrids)
- cabomba (*Cabomba caroliniana*)
- chinee apple (*Ziziphus mauritiana*)
- cholla cactus
 - coral cactus (*Cylindropuntia fulgida*)
 - devil's rope pear (*C. imbricata*)
 - snake cactus (*C. spinosior*)
- fireweed (*Senecio madagascariensis*)
- gamba grass (*Andropogon gayanus*)
- giant sensitive plant (*Mimosa diplotricha* var. *diplotricha*)
- groundsel bush (*Baccharis halimifolia*)
- harrisia cactus (*Harrisia martinii* syn. *Eriocereus martinii*, *H. tortuosa* and *H. pomanensis* syn. *Cereus pomanensis*)
- hymenachne or Olive hymenachne (*Hymenachne amplexicaulis*)
- kudzu (*Pueraria montana* var. *lobata*, syn. *P. lobata*, *P. triloba*) other than in the Torres Strait Islands
- mesquites (*Prosopis glandulosa*, *P. pallida* and *P. velutina*)
- mother of millions (*Bryophyllum delagoense* syn. *B. tubiflorum*, *Kalanchoe delagoensis*)
- mother of millions hybrid (*Bryophyllum* × *houghtonii* (syn. *B. daigremontianum* × *B. delagoense*, *Kalanchoe* × *houghtonii*))
- parkinsonia (*Parkinsonia aculeata*)
- parthenium (*Parthenium hysterophorus*)
- pond apple (*Annona glabra*)
- prickly acacia (*Acacia nilotica*)
- prickly pear:
 - common pest pear, spiny pest pear (*O. stricta*; syn. *O. inermis*)
 - tiger pear (*O. aurantiaca*)
 - Westwood pear (*O. streptacantha*)
 - tree pears:
 - drooping tree pear (*O. monacantha* syn. *O. vulgaris*)
 - velvety tree pear (*O. tomentosa*)

- rat's tail grasses
- American rat's tail grass (*Sporobolus jacquemontii*)
 - giant Parramatta grass (*Sporobolus fertilis*)
 - giant rat's tail grass (*Sporobolus pyramidalis* and *S. natalensis*)
 - Parramatta grass (*Sporobolus africanus*)
- rubber vine (*Cryptostegia grandiflora*)
- salvinia (*Salvinia molesta*)
- sicklepods
 - sicklepod (*Senna obtusifolia*)
 - foetid cassia (*Senna tora*)
 - hairy cassia (*Senna hirsuta*)
- telegraph weed (*Heterotheca grandiflora*)
- thunbergia or blue thunbergia (*Thunbergia grandiflora*)
- tobacco weed (*Elephantopus mollis*)
- water hyacinth (*Eichhornia crassipes*)
- water lettuce (*Pistia stratiotes*)
- Captain Cook tree or yellow oleander (*Cascabela thevetia* syn. *Thevetia peruviana*)
- cat's claw creeper (*Macfadyena unguis-cati*)
- Chinese celtis (*Celtis sinensis*)
- harungana (*Harungana madagascariensis*)
- kahili ginger (*Hedychium gardnerianum*)
- lantanas
 - lantana or common lantana (*Lantana camara*)
 - creeping lantana (*L. montevidensis*)
- Madeira vine (*Anredera cordifolia*)
- ornamental rubber vine (*Cryptostegia madagascariensis*)
- privets
 - broad-leaf privet or tree privet (*Ligustrum lucidum*)
 - small-leaf privet or Chinese privet (*L. sinense*)
- Singapore daisy (*Sphagneticola trilobata*; syn. *Wedelia trilobata*)
- white ginger (*Hedychium coronarium*)
- willows
 - pencil willow (*Salix humboldtiana* syn. *S. chilensis*)
 - tortured willow (*Salix matsudana*)
- yellow bells (*Tecoma stans*)

This list is current at July 2012, but new declarations of plants and/or changes in plant declaration can occur at any time.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

Class 3 pest plants

- African fountain grass (*Pennisetum setaceum*)
- African tulip tree (*Spathodea campanulata*)
- aristolochia or Dutchman's pipe (*Aristolochia* spp. other than native species)
- asparagus fern (*Asparagus aethiopicus* 'Sprengeri', *A. africanus* and *A. plumosus*)
- athel pine (*Tamarix aphylla*)
- balloon vine (*Cardiospermum grandiflorum*)
- blackberry (*Rubus anglocandicans*, *Rubus fruticosus* agg.)
- broad-leaved pepper tree (*Schinus terebinthifolius*)
- camphor laurel (*Cinnamomum camphora*)

Fact sheets are available from Department of Agriculture, Fisheries and Forestry (DAFF) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, DAFF does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

APPENDIX E

DECLARED ANIMALS OF QUEENSLAND

(SOURCE: THE STATE OF QUEENSLAND, DEPARTMENT OF AGRICULTURE,
FISHERIES AND FORESTRY, 2013)

Declared animals of Queensland



Several animals are declared as Class 1 or Class 2 pests under Queensland's *Land Protection (Pest and Stock Route Management) Act 2002*. Class 1 and 2 animals represent a threat to primary industries, natural resources and the environment.

A Class 1 pest is one that is not commonly present in Queensland, and if introduced would cause an adverse economic, environmental or social impact. Class 1 pests established in Queensland are subject to eradication from the state. Landowners must take reasonable steps to keep land free of Class 1 pests. Other powers of the Act apply.

A Class 2 pest is one that is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact. The management of these pests requires coordination and they are subject to local government-, community- or landowner-led programs. Landowners must take reasonable steps to keep land free of Class 2 pests. Other powers of the Act apply.

There is a third class of pests under the Act. Class 3 pests are established in Queensland and have, or could have, an adverse economic, environmental or social impact. A pest control notice can only be issued for these pests on land that is, or is adjacent to, an environmentally significant area. Thus, the adverse impact of species in this Class is primarily environmental. Only some of the other powers of the Act apply.

Declaration imposes a responsibility upon landowners to control pests—this includes all landowning state agencies. Large landowning state agencies are also required to develop and implement pest management plans.

Other than the above requirements, declaration does not mean that management of declared species becomes the responsibility of the state, although the state may engage in publicity and awareness activities, research, coordination of control activities, or assistance with some pests in strategic areas.

Powers are provided for Biosecurity Queensland and local governments to request landowner control and to carry out enforcement activities where necessary.

Species not declared under the *Land Protection (Pests and Stock Route Management) Act 2002* may still be declared at a local government level under local laws. Species declared as Class 3 may be subject to local law and control outside environmentally significant areas.

The *Land Protection (Pest and Stock Route Management) Act 2002* also describes certain activities relating to Class 1 and 2 pest animals that are offences under the Act.

These activities relate to:

- introducing a pest animal to the state
- feeding a declared pest animal
- keeping a declared pest animal (except under permit by bona fide zoos and wildlife parks)
- releasing a declared pest animal.

The Chief Executive of Biosecurity Queensland may make an emergency declaration for an animal for a period of up to three months. An emergency declaration could be activated in the event of a mouse plague, for example, or the discovery of a new and serious pest in Queensland.



Declared animals of Queensland

The following are classified as declared animals in Queensland:

Class 1 declared pest animals

All mammals, reptiles and amphibians are Class 1 pests except:

1. Class 2 declared pest animals
2. mammals, reptiles and amphibians indigenous to Australia, including marine mammals of the orders Pinnipedia, Sirenia or Cetacea
3. and the following non declared animals:
 - alpaca (*Lama pacos*)
 - Asian house gecko (*Hemidactylus frenatus*)
 - axolotl (*Ambystoma mexicanum*)
 - Bali cattle (*Bos javanicus* and *B. sondaicus*)
 - bison or American buffalo (*Bison bison*)
 - black rat (*Rattus rattus*)
 - camel (*Camelus dromedarius*)
 - cane toad (*Bufo marinus*)
 - cattle (*Bos* spp.)
 - chital (axis) deer (*Axis axis*) other than feral chital deer
 - domestic cat (*Felis catus*)
 - domestic dog (*Canis familiaris*)
 - domestic goat (*Capra hircus*)
 - domestic pig (*Sus scrofa*)
 - donkey (*Equus asinus*)
 - European hare (*Lepus capensis*)
 - fallow deer (*Dama dama*) other than feral
 - guanicoe (*Lama guanicoe*)
 - guinea pig (*Cavia porcellus*)
 - horse (*Equus caballus*)
 - house mouse (*Mus musculus*)
 - llama (*Lama glama*)
 - mule (*Equus caballus* x *Equus asinus*)
 - red deer (*Cervus elaphus*) other than feral red deer
 - rusa deer (*Cervus timorensis*) other than feral rusa deer
 - sewer rat (*Rattus norvegicus*)
 - sheep (*Ovis aries*)
 - wapiti deer (*Cervus canadensis*)
 - water buffalo (*Bubalus bubalis*)

Class 2 declared pest animals

- Australian plague locust (*Chortoicetus terminifera*)
- cat, other than a domestic cat (*Felis catus*)
- dingo (*Canis familiaris dingo*)
- dog, other than a domestic dog (*Canis familiaris*)
- European fox (*Vulpes vulpes*)
- European rabbit (domestic and wild breeds) (*Oryctolagus cuniculus*)
- feral chital deer (*Axis axis*)
- feral rusa deer (*Cervus timorensis*)
- feral pig (*Sus scrofa*)
- goat, other than a domestic goat (*Capra hircus*)
- migratory locust (*Locusta migratoria*)
- spur-throated locust (*Austracris guttulosa*)

Class 3 declared pest animals

- feral fallow deer (*Dama dama*)
- feral red deer (*Cervus elaphus*)

Introduction and keeping of declared animals

The Act provides for permits to be issued for the introduction and keeping of some declared animals under certain conditions. Most declared animals can only be kept at universities and bona fide zoos and wildlife parks. The keeping of most species of declared animals as pets is illegal and subject to penalty.

Control

The responsibility for controlling a declared animal rests with the landholder. However, Biosecurity Queensland and local governments provide expertise and technical information to assist landowners.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

Fact sheets are available from Department of Employment, Economic Development and Innovation (DEEDI) service centres and our Business Information Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, DEEDI does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

APPENDIX F

WEED MANAGEMENT GUIDE FOR BUFFEL GRASS

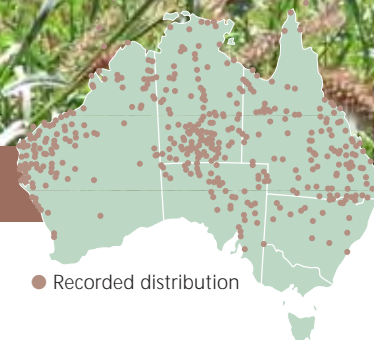
(SOURCE: CRC WEED MANAGEMENT, 2008)

This document was originally published on the website of the CRC for Australian Weed Management, which was wound up in 2008.

To preserve the technical information it contains, the department is republishing this document. Due to limitations in the CRC's production process, however, its content may not be accessible for all users. Please contact the department's Weed Management Unit if you require more assistance.

Weed Management Guide

Managing weeds for biodiversity



Buffel grass (*Cenchrus ciliaris*)

The problem

Buffel grass (*Cenchrus ciliaris*) is an introduced, perennial pasture grass that is found across much of the Australian continent, including arid and semi-arid regions. For many decades it has been widely planted for livestock production and land rehabilitation. Its palatability is moderate but it is well regarded as pasture because it grows rapidly under warm, moist conditions and persists under heavy grazing and drought. Buffel grass has spread well beyond planted areas and dominates the ground layer in many native plant communities. It reduces native plant diversity and can affect vegetation structure by changing fire regimes. In arid Australia, buffel grass invades some of the wetter, more

fertile parts of the landscape, important for the survival of native plant and animal populations in this highly variable climate. Although it was planted for dust control in central Australia, it also imposes economic costs through the need to manage fire risks and to protect biodiversity assets and infrastructure. Some pastoralists are also concerned that productivity of buffel grass-dominated pastures can decline in the longer term.

Buffel grass has been identified as a major threat to biodiversity in regional natural resource management strategies across Australia (SA Arid Lands, Rangelands (WA), Fitzroy (Qld) and the NT). It is becoming recognised that new policies are needed to

address the problem of weeds that are also considered useful.

Buffel grass is just one of many perennial grasses invading Australia's native vegetation, particularly grassy plant communities, rangelands and coastal areas. Grasses introduced as pastures, such as gamba grass (*Andropogon gayanus*), mission grass (*Pennisetum polystachion*) and Birdwood grass (*Cenchrus setiger*) are a particular threat to tropical savannas in northern Australia.

Key points

- Buffel grass is widespread in central and northern Australia and has invaded a range of native plant communities.
- It can dominate the ground layer, displacing native grasses and other plants.
- Its rapid regrowth and high biomass may alter the intensity, frequency and extent of fires, changing vegetation structure and composition.
- Buffel grass is still spreading, assisted by continued planting and new cultivars.
- Its seed is readily dispersed by wind, water and animals.
- Control measures can reduce impacts at sites of high conservation significance.
- Mature plants are difficult to remove physically. Herbicide can be effective if applied when plants are actively growing and follow-up action is undertaken. Correct timing is essential.
- The value of buffel grass as a pasture species is well recognised and it is not a declared weed. Public policy issues arising from its positive and negative aspects need to be resolved.



Buffel grass (*Cenchrus ciliaris*) can dominate the understorey in arid regions. Central Australia, NT. Photo: R. Davies

The weed

Numerous forms of buffel grass have been imported to Australia from across its native range. They differ in their drought, temperature and soil tolerance, growth form, palatability, and in quantity and timing of seed production. Eleven have been registered as cultivars in Australia. Two closely related species, *Cenchrus pennisetiformis* (Cloncurry grass) and *C. setiger* (Birdwood grass), have also been planted as pastures in Australia and are naturalised. Their range is similar, but they are less common than *C. ciliaris*.

The most common uses of buffel grass in Australia are:

- as a pasture for livestock production in semi-arid and arid lands (where sowing often follows native vegetation clearing)
- to stabilise areas disturbed by mining, infrastructure development or overgrazing.

Buffel grass is a long-lived tussock grass with a deep, tough root system. While some cultivars can grow up to



Birdwood grass (*Cenchrus setiger*) seed head lacks long, fine bristles.
Photo: Jose Hernandez @ USDA-NRCS PLANTS Database

1.5 m tall, others are less than 1 m tall. Some have rhizomes up to 0.5 m long. The tough, branched stalks have swollen bases and produce leaves at the basal and higher nodes. Leaves are rough-textured downwards, hairless or with fairly sparse, long hairs. Leaf blades have prominent midribs and leaf sheaths are keeled. The ligule at the junction of the leaf blade and sheath is a row of hairs, 0.2–2 mm long.

The flower head is cylindrical, erect, dense, spike-like, 2.5–15 cm long and varies in colour from straw-coloured to purple. It consists of bristly burrs borne on a zigzag central axis. The burr has whorls of flexible bristles, a thin outer whorl and a ciliate (hairy) inner whorl

with one longer bristle, 8–16 mm long. The bristles are joined at the very base into a disc. Mature burrs contain a small seed (<2 mm long) and are dispersed by wind, water, animals, clothing, boots and vehicles.

Advantages, disadvantages and broader impacts of buffel grass

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. It produces viable seed so that stands can be self-replacing and pastures may not need to be reseeded. These same characteristics also make it an environmental weed.

Like any pasture species, buffel grass has limitations, such as:

- Through competition with native species, it reduces diversity of pasture including native grasses that are highly valued fodder after rain. The effect may be exacerbated by selective grazing of more palatable species.
- The initial increase in productivity when buffel grass pasture is established is not always maintained, and pastures may run down over time (10 years or less in some soils), especially where environmental conditions do not favour legumes. This problem is difficult to address in a cost-effective manner, especially on less productive lands.
- Once buffel grass has been established as the dominant ground cover, conversion to an alternative pasture would be prohibitively expensive.
- Some cultivars are more palatable than others. The less palatable forms may gradually become dominant in grazing lands through selective grazing.

Buffel grass (*Cenchrus ciliaris*)



Flowering head.
Image: M.Robertson



Shedding seed head, with zigzag axis.
Image: M.Robertson



Burr.
Image: M.Robertson



Ligule at the junction of leaf blade and sheath is a fringe of hairs, 0.2–2 mm long.
Image: M.Robertson

- Old leaves and stalks may persist for several years and are of no value to stock but may restrict their access to fresh growth.

Broader environmental impacts of buffel grass include the following:

- Dry buffel grass foliage forms a relatively continuous flammable ground layer that can carry extensive and intense fires. It recovers its biomass very rapidly when moisture is sufficient and can burn when partly green. Therefore it can carry fire at much shorter intervals than native understorey. More frequent hot fires alter native plant community structure because established trees and shrubs can be killed and young ones destroyed before they have produced seed.
- Patch burning is needed in some native vegetation types such as hummock (*Triodia*) grasslands to maintain biodiversity and bush food resources, and to reduce the risk of large wildfires. It becomes more difficult to manage after buffel grass has invaded the landscape.
- Food sources and habitat for native fauna may be altered. In particular, native grass seed that is eaten by granivorous birds can be depleted, and habitat patchiness and diversity of invertebrates reduced. Loss of trees and shrubs to fire reduces habitat diversity.
- Native plants affected by invasion of buffel grass provide a diminished resource for traditional indigenous livelihoods including bush food, timber and medicine.
- Where buffel grass pasture occurs adjacent to fire-sensitive native vegetation, it can burn hot enough to carry fire into the remnants, opening up the canopy. The edges are then more prone to degradation, including by weed invasion. In this way, the area and integrity of habitat can be progressively reduced.



Mature buffel grass (*Cenchrus ciliaris*) tussocks grow rapidly after summer rains. Uluru NT. Photo: R. Davies

- Restoration of native vegetation on previously cleared lands may be needed for recovery of threatened species or ecological communities. Buffel grass can be a major constraint to such efforts.

Weed identification and similar native species

A number of grasses in the genus *Cenchrus* and the closely related genus *Pennisetum* occur in Australia, including native and introduced, annual and perennial species. Most have flower heads that are spike-like, consisting of a central axis bearing numerous hairy, bristly or spiny burrs that are actually very short floral branches.

How to identify *Cenchrus* species

The introduced perennial pasture species, buffel grass (*Cenchrus ciliaris*), Birdwood grass (*C. setiger*) and Cloncurry, white or slender buffel grass (*C. pennisetiformis*) have burrs that lack sharp, rigid spines. They are closely related—in fact *C. pennisetiformis* and *C. ciliaris* are sometimes considered to be the same species. Alternative species names for the buffel grasses are *Pennisetum ciliare*, *P. setigerum* and



Mossman River grass (*Cenchrus echinatus*) is a spiny annual weed in both northern and southern Australia. Photo: C. Wilson

P. pennisetiforme. Burrs of buffel grass and Cloncurry buffel grass have soft, ciliate bristles but these are lacking in Birdwood grass. Other *Cenchrus* species in Australia are native perennials and introduced annuals.

Annual *Cenchrus* species with spiny burrs can be a nuisance and are often declared noxious. Mossman River grass (*C. echinatus*) is the most widespread in Australia. Innocent weed or gentle Annie (*C. longispinus*) is most prevalent in the south, especially along the Murray River. Indian sandburr or Gallon's curse (*C. biflorus*) is naturalised in northern Australia. *C. brownii* occurs along the northern coast and offshore islands and spiny burr-grass (*C. incertus*) occurs mainly in eastern Australia.



Native species: black bottle-washers
(*Enneapogon nigricans*).
Photo: T. Reynolds

Similar native species

The native *Cenchrus* species (*C. elymoides*, *C. robustus* and *C. caliculatus*) are perennial, with various burrs, but lacking the long flexible bristles of buffel grasses and most *Pennisetum* species. *C. elymoides* is confined to the tropics of northern Australia (Kimberley, northern NT and Cape York regions). *C. robustus* and *C. caliculatus* mainly occur in the eastern districts of Qld and NSW. The flower head of *C. caliculatus* is loosely packed, 4–24 cm long; its burrs have rigid inner bristles (4–11 mm long) and are often dark purplish. *C. robustus* has 45–60 rigid, 9–13 mm long bristles in a single whorl.

Other native grasses with spike-like heads include annual and perennial nine-awn grasses or bottle-washers (*Enneapogon* species), smaller grasses that have florets crowned with a ring of nine hairy awns.

How it spreads

Buffel grass has been spread throughout the dry tropics, subtropics and arid lands of the world by human activities. It is thought to have been introduced inadvertently to Australia in the 1870s in camel harness from western Asia. Camel trains were major means of transport through inland Australia and it is likely that buffel grass became

locally established along their routes. Some of its early spread may have been deliberate. From 1910 buffel grass was actively distributed for planting as pasture, initially in WA, then more widely. Introductions of new forms from Africa began in the 1920s and were evaluated by government agencies, mainly in NSW and Qld. From the 1940s seed was imported from around the world for trials. There is evidence that buffel grass had been planted in central Australia before systematic planting for land rehabilitation began there in the 1960s. Prior to 1972, nine introduced forms had been registered as cultivars in Australia and their seed produced commercially. Buffel grass pastures have been sown in a range of environments across Australia, on land cleared for the purpose, or into native vegetation.

Buffel grass spreads through dispersal of its fluffy burrs by wind, water and animals, particularly along drainage lines and roads. Its spread along roads can also be assisted by vehicle draughts and movement of soil by graders and other vehicles. Buffel grass may be slow to establish initially but it may then spread readily beyond planted areas under favourable seasonal conditions. In the arid zone, it has spread extensively during infrequent episodes when summer rainfall was well above average for several years. This has been documented in the Ashburton River catchment in WA, from 1978 to 2002.

Where it grows

Buffel grass is native to Africa, the Middle East and Asia and naturalised elsewhere, including the USA and Mexico where it is planted for cattle pasture. In Arizona it invades fire-sensitive plant communities and the increased risk of fire poses a threat to the distinctive Saguaro cactus communities.

Buffel grass can survive in areas with average rainfall of more than 200 mm annually (or 170 mm in summer). It occurs naturally in regions having up to 1000 mm annual rainfall. Under higher rainfall, tropical conditions or in regions with winter rainfall of 400 mm or more, buffel grass is less competitive with other plant species, including perennial grasses.

In northern and central Australia buffel grass occurs mainly in the semi-arid to arid zone. In arid regions it is most common along ephemeral watercourses, on alluvial plains, other run-on sites and calcareous rises. It thrives in sandy loam but may be slow to establish on heavy clay and prefers neutral to alkaline soils. It is not highly tolerant of severe frost or prolonged water logging.

At the local scale, studies in central Australia have found that buffel grass is most likely to be found nearer to drainages and tracks, in less rugged terrain, with lower hummock grass cover and on soils with greater clay content than rocky slopes or sand plains. Drainage lines and tracks provide opportunities for dispersal and also favourable sites for establishment (disturbed or bare ground, higher fertility, moisture and lack of plant competition). In fragmented landscapes, small or narrow remnants of native vegetation are more vulnerable to buffel grass invasion than larger patches with an intact canopy.

Native plant communities invaded by buffel grass include:

- Poplar box (*Eucalyptus populnea*) and silver-leaved ironbark (*E. melanophloia*) woodlands in Qld.
- Mountain coolabah (*Eucalyptus orgadophila*) woodlands in Qld.
- Brigalow (*Acacia harpophylla* dominant and subdominant) listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

- Gidyea / gidgee (*Acacia cambagei*) shrublands in central west Qld.
- Riparian and floodplain woodlands throughout the semi-arid and arid zones, eg river red gum (*Eucalyptus camaldulensis*) and teatree (*Melaleuca* species) woodlands on ephemeral rivers in central Australia.
- Vegetation on alluvial plains and other sites of relatively fertile soils in central Australia (eg *Acacia* woodlands and ghost gum (*Corymbia aparrerinja*) and bloodwood (*Corymbia opaca*) open woodlands).
- Coastal vegetation and islands off the Pilbara coast (WA), riparian zones and wetlands, alluvial plains; tussock grasslands, eucalypt woodlands, chenopod shrublands and overgrazed hummock grasslands.
- Mulga (*Acacia aneura*) open / woodlands and shrublands are sometimes invaded at sites of higher moisture and soil fertility.
- Dry rainforest or 'softwood scrub' remnants dominated by species such as bottle tree *Brachychiton rupestris*, belah *Casuarina cristata*, vines etc can be invaded along edges adjacent to pasture if burnt, including semi-evergreen vine-thickets listed as Endangered under the EPBC Act.

Potential distribution

Buffel grass is still spreading within and between regions, unassisted and through planting. Modelling based on climatic and soil requirements has predicted that 25% of Australia is potentially 'highly suitable and 43% suitable for buffel grass growth'.

Extensive areas were mapped as suitable or highly suitable, where buffel grass has not yet been recorded or records are sparse. These included northern SA and adjoining areas. Soil and climate data were classified at a broad scale for the continental mapping. Modelling at finer spatial scales is needed to predict with more certainty where areas of high biodiversity value are under threat.

Mapping of current buffel grass distribution is largely based on accumulated records, particularly herbarium specimens, though the collection of such records has not been comprehensive in space or time. Field surveys are needed to determine how accurately existing records represent the current limits of distribution.

Genetic studies suggest that forms of buffel grass that are not genetically

identical to the main cultivars are naturalised in central Australia. Forms other than registered cultivars may have been introduced to the region or new types may be arising in the field. Research is also underway into breeding new types to extend its use as pasture in heavier soils and cooler regions. New forms of buffel grass may have potential to invade a wider range of habitats.

There is inherent uncertainty in predicting the potential limits of distribution due to the wide range of conditions in which buffel grass already occurs; imprecise knowledge of the current range, genetic variation, breeding system and ecology of naturalised populations; and the unknown effects of factors such as future land management changes, cultivar development programs and long-term climatic variation.

Growth cycle

Buffel grass is summer-active. Established plants can respond rapidly to small rains in spring to autumn but make little growth during winter in the inland non-tropics. Seeds germinate rapidly, but will not germinate on light falls of rain. Generally, at least 20–25 mm of rain is required for germination and establishment, as buffel grass seeds need to be moist for about 3–5 days in order to germinate. Plants can germinate from seed, mature and flower within 6 weeks of a significant rainfall event.

Buffel grass seed may survive for up to an estimated 4 years in the soil, but plants can live for many years (possibly up to about 20 years). In drier locations, moisture levels sufficient for high seed production, or for widespread germination and plant establishment, may occur infrequently. The variable climate may result in a dynamic distribution of buffel grass across the landscape, with drier sites being recolonised from moist refuges after prolonged drought.



Buffel grass (*Cenchrus ciliaris*) infestation on calcareous loamy soil along a creek in Karijini NP, WA. Photo: S. van Leeuwen



Buffel grass (*Cenchrus ciliaris*) burnt butts resprouting after summer rain. Uluru, NT.
Photo: R. Davies

What to do about it

There is potential for buffel grass to spread within and beyond its current range. In regions where its distribution is limited, it may be feasible to contain its further spread through early intervention. Management options that would significantly reduce the abundance of buffel grass on a broad scale are yet to be developed. To minimise existing and potential threats to biodiversity, a range of strategies is needed.

- **Regional planning:** in many regions, buffel grass is both a pasture plant and a major weed of native ecosystems. Processes are needed to resolve policy issues and enable a co-ordinated approach to vegetation management including weed control. Priority areas for control measures should be identified across the region. These include sites of significance for biodiversity and areas where buffel grass is just starting to invade. Long distance dispersal along roadsides into susceptible habitats is probably assisted by road grading and slashing operations. Strategies will be needed to prevent further spread

along and from roadsides and other infrastructure corridors.

- **Fire:** the rapid build-up of buffel grass after favourable seasonal conditions can fuel fires of increased extent, frequency and / or intensity, which threaten biodiversity. Clumps of buffel grass under trees and shrubs can also increase localised fire intensity and flame height, damaging woody species. Strategies are needed to prevent more frequent, extensive wildfires. Areas dominated by buffel grass may need to be slashed or grazed to reduce buffel grass biomass where other values would not be at risk. Where fire has removed old buffel grass foliage, there is an opportunity to target fresh regrowth with control measures such as herbicides after significant rainfall.
- **Buffel grass pastures:** native vegetation adjacent to pastures is at risk from buffel grass invasion. To contain buffel grass within the pasture, grazing needs to be managed to minimise seed production and dispersal. A buffer zone with intact vegetation provides competition to buffel grass seedlings. It should be monitored and colonising plants

removed. Fires in pastures should be prevented from escaping into native vegetation remnants as they can open them up to buffel grass invasion.

- **Native rangelands containing buffel grass:** it is beneficial for both pastoral and conservation purposes to maintain plant diversity in the long term. Paddocks need to be spelled from grazing to allow native grasses to set seed following rainfall.
- **Areas managed for conservation:** buffel grass is easily the most significant weed in many arid and semi-arid areas of high value for biodiversity conservation. Strategic management is needed to minimise its further spread while mitigating adverse impacts on fire regime, habitat quality, ecosystem processes and plant community restoration. The first step in planning such an approach is often to acquire adequate knowledge about buffel grass distribution patterns and the biodiversity values under threat.
- **Soil stabilisation / rehabilitation:** once buffel grass is established, it persists and may exclude other plant species, prevent recovery of complex vegetation structure in the long term and become an on-going fuel hazard. There are alternative pioneer species and methods for rehabilitation.

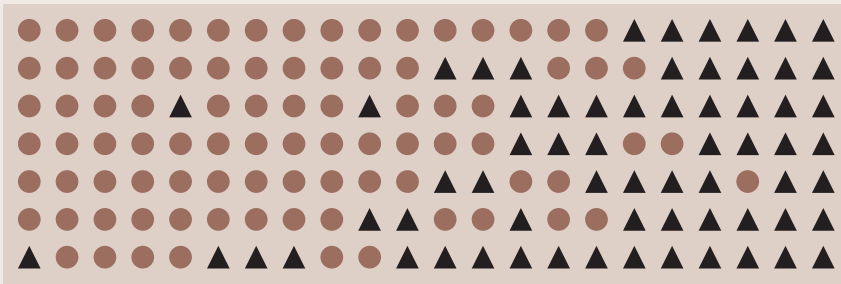
Prevent buffel grass spreading

At regional and local levels, a high priority should be to monitor and control buffel grass in locations where the species is absent or sparse. This requires understanding local seasonal conditions that trigger abundant seedling establishment and local dispersal patterns. Spread is most likely soon after adequate warm season rainfall, especially following drought conditions or fire when other ground cover is sparse. Most resources will be needed at this time.

Strategic weeding in native vegetation

● Native vegetation

▲ Weeds



→ Weed from the least weed-infested bush towards weed-dominated areas

- Locate and remove small, isolated infestations before they seed. Particular vigilance is needed along dispersal routes such as roadsides and drainage lines.
- Practise weed hygiene during slashing and road grading:
 - where possible, slash before seeds develop
 - slash into rather than away from patches of buffel grass
 - clean vehicles and clothing before moving to uninfested areas.

Reduce established infestations

Where buffel grass occurs in native vegetation a planned, strategic approach is essential to ensure that, after treatment, buffel grass is replaced by desirable plant cover rather than buffel grass regrowth, seedlings or other weeds. Sites of high biodiversity value should be identified and targeted first. As well as information on buffel grass biology and control methods, a plan should be based on specific knowledge about the site, including the distribution of other major weeds. It requires assessment of the need for revegetation following removal of buffel grass.

Steps to develop and implement a long-term weed management plan are:

1. Investigate the site

- Identify native plants (including grasses) and weeds.

- **Map weed infestations:** indicate buffel grass density across the site; identify major sources of seed from which re-invasion can occur.
- **Map native vegetation condition:** assess its capacity for recovery after buffel grass is removed and identify sites of high biodiversity values, such as habitats of rare flora and fauna.
- **Values and risks:** identify high risk sites for erosion and other factors.

2. Develop the site action plan

- **Identify goals and priorities** based on the site information.
- **Define priority areas** for control by overlaying maps of buffel grass density, native vegetation, site values and risks.
- **Plan to weed strategically:**
 - protect the better quality native vegetation first and consider the needs of rare fauna and flora
 - work from isolated buffel grass plants towards core infestations
 - control plants from upslope to downslope.
- **Work in stages.** The area targeted at each stage should be of a manageable size so that thorough follow up is possible.
- **Include control of other weeds** so that they do not establish where buffel grass has been removed.
- **Select the most suitable control method** for each buffel grass growth stage in each area to

avoid damage to native vegetation. Plan appropriate disposal of weed material.

- Plan a rapid response to seasonal changes to maximise the effectiveness of control activities.

3. Implement the action plan

- Remove buffel grass from the least infested areas before tackling more infested areas. Ensure that activities do not spread the seeds into clean areas or disturb native ground cover. Adapt to local seasonal conditions to prevent seedlings maturing and seeding.
- **Follow up** by treating buffel grass regrowth in areas previously treated before moving to new areas of infestation.
- **Seek mechanisms for managing spread** from adjacent lands into weed-free or treated areas.

4. Monitor and evaluate outcomes and adapt the plan accordingly

Include monitoring of native plant regeneration. In weed management programs there is often a tendency to focus on the removal of weeds as a goal, but at the site level the ultimate goal is restoration of native vegetation. It is important to monitor native plant regeneration and respond appropriately.

Control methods

Mature buffel grass plants are difficult to kill because they have a tough base and extensive root system and regrow after cutting, grazing or burning. Herbicide treatment is effective only on actively growing foliage. In arid or semi-arid regions the period of active growth may be short and unpredictable. Old, dry growth can shield growing leaves from contact with herbicide and a single application may not be sufficient to kill the plant. Spot spraying or grubbing individual tussocks minimises

chemical wastage and risk of damage to other species. Large-scale mechanical removal favours re-establishment of buffel grass and slashing needs to be combined with other methods to have significant, lasting impact. A combination of physical and chemical treatments may be most effective. Because buffel grass is a valuable forage species, biological control is not an option, but existing organisms affect seed production in some regions.

Physical removal of small or sparse infestations

Small, isolated plants can be dug out from key sites, but mature buffel grass plants have a very tough crown and deep roots. The butt can be more than 30 cm across. Remove the weeds before seeding if possible. Follow up within weeks after rain to check for regrowth and for seedlings.

Foliar spray

To be effective, spraying should be undertaken when the growth rate is



The edge of Mazeppa NP, central Queensland 5 years after a hot fire fuelled by buffel grass damaged the tree canopy, promoting further invasion.
Photo: D. Butler

high (leaves are bright green and glossy), and the herbicide applied to as much green foliage as possible. The period when conditions are suitable may be short. Spot spray using hand-held equipment (handgun and hose or knapsack) to avoid off-target damage. Persistent dry foliage may shield fresh growth. Follow up is essential using the same or other treatment methods.



Buffel grass invasion of intact gidgee / brigalow in Mazeppa NP, central Queensland.
Photo: D. Butler

Combined treatment of extensive infestations

Initial 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.

Contacts

State / Territory	Department	Phone	Email	Website
NSW	Dept of Primary Industries	1800 680 244 or 131555	weeds@dpi.nsw.gov.au	www.dpi.nsw.gov.au/weeds
	Dept of Environment and Climate Change		info@environment.nsw.gov.au	www.environment.nsw.gov.au
NT	Dept of Natural Resources, Environment and the Arts	(08) 8999 4567	weedinfo.nreta@nt.gov.au	www.nt.gov.au/nreta/natres/weeds/index.html
Qld	Environment Protection Authority	1300 130 372	csc@epa.qld.gov.au	www.epa.qld.gov.au
SA	Dept of Water, Land and Biodiversity Conservation	(08) 8303 9620	N/A	www.dwlbc.sa.gov.au
WA	Dept of Agriculture and Food	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
	Dept of Environment and Conservation	(08) 6467 5000	info@dec.wa.gov.au	www.naturebase.net/
Australia-wide	Australian Pesticides and Veterinary Medicines Authority (APVMA)	(02) 6210 4700	N/A	www.apvma.gov.au

Contact details for state and territory agencies with responsibility for weeds are listed above, along with the Australian Pesticides and Veterinary Medicines Authority (APVMA). The APVMA website hosts the PUBCRIS database which contains information on all herbicides that are registered in each Australian state and territory, including minor use permits.

Consult your local natural resource management organisation or council to find local contacts on managing weeds for biodiversity, including community groups working on buffel grass.

Refer to the CRC for Australian Weed Management website (www.weedscrc.org.au) for weed management guides in this series, as well as guides for Weeds of National Significance and Alert List species. The Introductory Weed Management Manual (also available from this website) may assist in developing a plan tailored to your situation.

Success managing buffel grass at Alice Springs Desert Park

Alice Springs Desert Park introduces visitors to central Australia's diversity of habitats, plants and animals and to cultural knowledge and use of the environment. The exhibits and infrastructure occupy a core area of 54 hectares within a wider park area of 1300 hectares of natural vegetation, extensively invaded by buffel grass. The park is situated on the lower slopes of the MacDonnell Ranges and the adjacent plain. Throughout the district, buffel grass typically dominates such habitats, where it has largely replaced native grasses and other herbaceous plants.

A buffel grass control program has been conducted in the park since its inception in 1996. The first goal was to eradicate it from the core area, to enable visitors to see and understand more of the native ecosystem. A further goal is to reduce the level of buffel grass fuel in the wider park area to reduce the risk to biodiversity assets and infrastructure from wildfire.

Early control methods employed in the core area included grubbing out individual plants and following up with herbicide spot spraying whenever green shoots appeared after rain. The project is labour intensive and much assistance has been received from volunteers and community work programs. Follow-up work could be needed more than once a year, but the number of work hours decreased greatly over the first two years, both in dense and light infestations. A large proportion of the core area has now been cleared of buffel grass, in spite of unusually wet conditions in 2000 and 2001 which delayed this achievement.

At the start of the program, it was not known whether removal of buffel grass could be achieved. Also unknown was the likely vegetation response to its removal. In fact, there has been



Chipping individual buffel grass (*Cenchrus ciliaris*) tussocks in Alice Springs Desert Park, NT. Photo: G. Dinham

a transformation from an understorey consisting almost entirely of buffel grass to a remarkable diversity of native grasses and other herbaceous plants, occurring through natural regeneration. These results suggest that even where buffel grass has become dominant, native plants persist in the seedbank for a number of years and can germinate readily after rain, once the weed is removed. Some resilience of the native understorey is not unexpected, given its adaptation to long periods of little rain, but the maximum longevity of the native seedbank is not known. Much of the spread of buffel grass in central Australia has occurred in the past four decades.

Ongoing monitoring will be needed to prevent buffel grass reinvasion of the core area, especially where soil is disturbed or native understorey is very sparse. Since 2005 buffel grass in the wider park has been sprayed or chipped at strategic locations, with larger areas

on relatively flat ground being slashed by machinery. Whipper snippers were used around the base of trees and shrubs. Where possible, the slashing was timed to prevent seed set and the viable seedbank is expected to diminish over time. There has been little recent buffel grass seedling recruitment due to dry conditions.

The slashing has been successful in reducing fuel loads and the threat of wild fire. The reduction in the amount of buffel grass has allowed native plants to grow between the slashed clumps. Slashing has been followed up with spot spraying and grubbing. Slashed clumps are easier to grub when dry and easier to spray after rain events.

The park managers emphasise that there is no point to any treatment unless you have the capacity to do the follow-up spraying after rain events as the buffel grass will return and you will have wasted your time.

Herbicides

Herbicides, including grass-selective chemicals, are registered on labels for controlling buffel grass only in certain crop situations in Australia. A 'Permit to allow minor use of an AGVET chemical product' may be issued to allow registered products to be used for a purpose or in a manner that is not included on the approved label. Permits that include treatment of environmental weeds, including perennial grasses with glyphosate in some non-crop situations exist in NSW, Qld, SA and WA. The Australian Pesticides and Veterinary Medicines Authority website includes the relevant permit for each state. Glyphosate is a non-residual, systemic chemical and affects both broad-leaved plants and grasses. Glyphosate herbicide formulated for aquatic situations has been effective on buffel grass when applied to actively growing foliage and regrowth.

Trials to control buffel grass in non-crop situations with systemic herbicides, both grass-selective and non-selective, have indicated that a range of factors are critical to successful control of both seedlings and regrowth. These include:

- The plants' condition at the time of treatment will determine its effectiveness. They must be actively growing with no sign of senescence and may be flowering but should not be seeding. If timed well, it may be possible to spray both resprouting mature plants and seedlings at the same time when seedlings are sufficiently developed after heavy summer rain.
- Herbicide should be applied to as much of the green leaf as possible. This is best achieved by spot spraying. Reduced contact in the spray shadow may be unavoidable, necessitating repeated treatment. Treatment that combines slashing followed by spraying may be most effective.

- An assessment should be made of native plants and their susceptibility to different herbicides in order to minimise off-target damage. In some situations, grass-selective and non-selective herbicides may be suitable during different phases of the control program.
- Follow up treatment, using the same or different methods, should be applied to actively growing plants and to seedlings.

To address these critical factors, forward planning is needed. A treatment program should be carefully tailored to each situation and responsive to rainfall events. Unpredictable variation in seasonal conditions may reduce treatment effectiveness at times. Perseverance is vital to maintain buffel grass at low density.

When using herbicides, always read the label and follow instructions carefully. Operators should have formal training in the safe storage, handling, preparation and use of the chosen herbicides. Particular care should be taken to ensure that rainfall runoff will not carry herbicide into waterways.

Legislation

Buffel grasses (*Cenchrus ciliaris*, *C. pennisetiformis* and *C. setiger*) are not proclaimed under any Australian weeds legislation. Buffel grass is a prohibited noxious weed in Arizona, USA, due to the threat to the environment and the fire hazard it creates.

Cenchrus species that are declared in one or more Australian states are: *C. biflorus* (Gallon's curse); *C. brownii* (fine-bristled burr grass); *C. echinatus* (Mossman River grass); *C. incertus*, synonym *C. pauciflorus* (spiny burrgrass); and *C. longispinus* (spiny burrgrass or gentle Annie). These species may also be known as innocent weed or hedgehog grass.



Buffel grass (*Cenchrus ciliaris*) plants have extensive roots.
Photo: M. Robertson

Invasion of native plant communities by exotic perennial grasses has been listed as a key threatening process under the NSW *Threatened Species Conservation Act 1995*. Buffel grass is one of the species of special concern. In WA, buffel grass was identified in the 2007 State of the Environment report among the top five environmental weeds in two of the four major biogeographic regions of the state.

Under the Commonwealth EPBC Act, three ecological communities threatened by buffel grass are listed as endangered:

1. Brigalow (*Acacia harpophylla* dominant and co-dominant)
2. Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
3. Bluegrass (*Dichanthium* species) dominant grasslands of the Brigalow Belt Bioregions (North and South).

In most of Australia the clearance of native vegetation for establishment of improved pastures is now regulated. Sowing of non-native pasture species in native vegetation may not be defined as clearance but may be regulated on leasehold land. Introduction of non-native species to pastoral leases has been widely encouraged by some government agencies. However, in South Australia the Pastoral Board's permission would be required. Much of the area under threat from buffel grass is pastoral leasehold, conservation reserve, Aboriginal land or vacant crown land. Containing unwanted buffel grass invasion and rehabilitating key areas where it dominates is becoming a major issue for land managers.



A drainage line in buffel grass (*Cenchrus ciliaris*) pasture on heavy clay alluvium near Springsure, central Queensland.
Photo: D. Butler

Knowledge gaps

Relatively few resources have been directed at assessing the long-term consequences for biodiversity, pastoralism and the human population from buffel grass invasion of vast areas of Australia. Maps of current distribution often lack sufficient detail for planning local or regional management. Knowledge of the long-term sustainability of buffel grass pastures in various climates and soils is lacking. Where buffel grass is already widely established, methods to minimise its spread, and to maintain diversity of native understorey and overstorey plant species and vegetation structure, are required. In vegetation where buffel grass is dominant, the nature of its impacts on native fauna (including invertebrates) and on soil nutrient cycles is largely unknown. Its potential distributional limits and the susceptibility of various native vegetation types to invasion under specific management regimes and future climate change are poorly understood.

The possibility that buffel grass roots exude chemicals that inhibit growth of other plant species needs to be investigated.

Acknowledgments

Information and guide revision: M. Friedel, CSIRO; D. Butler, Qld EPA; S. van Leeuwen, WA DEC; J. Virtue, SA DWLBC; D. Agnew, SA Arid Lands NRMB.

Map: Australia's Virtual Herbarium, (*Cenchrus ciliaris*), via Royal Botanic Gardens Melbourne, Council of Heads of Australian Herbaria. www.rbm.vic.gov.au/cgi-bin/avhpublic/avh.cgi.

Case study: G. Dinham, Alice Springs Desert Park.

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Strategic management of buffel grass

Regional / local status of buffel grass	Not yet established	Small, isolated outbreaks	Widely established
Management goals	Prevent establishment	Eradicate	Contain infestations and mitigate threat
Strategies required	<p>Maintain native vegetation cover and integrity</p> <p>Regulate planting—define zones at greatest risk</p> <p>Practise weed hygiene</p> <p>Monitor, detect and identify new infestations especially drainage lines, floodouts, calcareous rises, roadsides and bare soil areas</p> <p>Where rainfall is variable, extra vigilance will be needed during a sequence of wetter than average summers</p>	<p>Physical removal or herbicide, or combined treatment</p> <p>Follow up is essential</p> <p>Prevent re-establishment or invasion by other weeds through passive or active site restoration</p>	<p>Native vegetation: Identify high priority biodiversity assets under threat from buffel grass and protect them through implementing long-term site management plans</p> <p>Native / buffel pasture: Manage grazing and fire to maintain diversity, eg allow native plants to recruit seedlings and set seed in good seasons</p> <p>Cleared / improved pasture: Manage seed production and minimise spread into adjacent areas, remove seedlings from outside planted area. Prevent fires spreading from pastures.</p> <p>Roadsides and other infrastructure corridors: Map infestations, practise weed hygiene and remove new outbreaks to prevent spread</p>

Apply herbicides during periods of active growth

Herbicide should only be applied when plants are green, leafy and actively growing, generally soon after significant warm season rainfall. In semi-arid and arid climates, the period when spraying can be effective may be quite limited. Plan ahead to take advantage of these times. Follow instructions on the herbicide labels.

Follow up

It is essential to follow up physical or chemical treatment after the next significant rainfall. This will require advance resource planning. Spot spray regrowth from butts while still growing. Consider both physical and chemical treatments as combining them may

increase their effectiveness and minimise off-target damage.

Prevent buffel grass re-establishment

Once mature plants have been killed, the focus is on preventing re-establishment from seeds in the soil seedbank or brought in by wind, water or animals. Buffel grass seeds may retain viability for up to 4 years or so and young plants can set seeds in their first season of growth.

1. Identify patterns of invasion and dispersal agents and manage major seed sources. Slashing can be done at any time but, if undertaken before seed set, it will minimise additions to the buffel grass seedbank.
2. Monitor weed-free areas after wet seasons to detect and remove seedlings before they establish deep roots and produce seed.
3. Restore ground-cover vegetation to areas from which buffel grass has been removed.
4. Avoid large-scale disturbance that would create extensive areas of bare soil and favour buffel grass invasion, such as too-frequent fire or overgrazing.



Buffel grass (*Cenchrus ciliaris*) along the highway near the Flinders Ranges, SA.
Photo: D. Powell

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ISBN: 978-1-920932-74-9

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APPENDIX G

DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION –
FIRE MANAGEMENT GUIDELINES FOR REGIONAL ECOSYSTEMS
IN THE OFFSET AREAS

(SOURCE: DEPARTMENT OF ENVIRONMENT AND HERITAGE
PROTECTION 2012)

**Table G1
Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas**

Regional Ecosystem	Season	Intensity	Interval	Strategy	Issue
11.3.1	-	-	n/a. b, d: Occasional fires 5 - 10 years.	Maintain fire management of surrounding country so that wildfires will be very limited in extent. Frequent fire at the edge of this regional ecosystem (RE) keeps fuel loads low. Protection from fire is necessary.	<i>Casuarina cristata</i> (Belah) is fire sensitive, although germination can be good in bare areas. Brigalow is soft-seeded, so germination is not promoted by fire. Buffel Grass invasion will increase risk from fire. High intensity fires will cause damage to overstorey. Grazing may be an option for reducing fuel loads where exotic grass such as buffel have invaded.
11.3.1b	-	-	n/a. b, d: Occasional fires 5 - 10 years.	Maintain fire management of surrounding country so that wildfires will be very limited in extent. Frequent fire at the edge of this RE keeps fuel loads low. Protection from fire is necessary.	<i>Casuarina cristata</i> is fire sensitive, although germination can be good in bare areas. Brigalow is soft-seeded, so germination is not promoted by fire. Buffel grass invasion will increase risk from fire. High intensity fires will cause damage to overstorey. Grazing may be an option for reducing fuel loads where exotic grass such as buffel have invaded.
11.3.2	Late wet to early dry season when there is good soil moisture. Early storm season or after good spring rains.	Low to moderate.	6-10 years (shorter in BBN: 2 - 7 years).	Restrict to less than 30 percent (%) in any year. Burn under conditions of good soil moisture and when plants are actively growing. Sometimes a small amount of wind may move the fire front quickly so that burn intensity is not too severe to destroy habitat trees.	Burn interval for conservation purposes will differ from that for grazing purposes; the latter being much shorter. Management of this vegetation type should be based on maintaining vegetation composition, structural diversity, fauna habitats (in particular hollow-bearing trees and logs) and preventing extensive wildfire. Maintaining a fire mosaic will help ensure protection of habitat and mitigate against wildfires. Fire can control shrub invasives (e.g. <i>Eremophila</i> spp. and <i>Acacia stenophylla</i> (River Cooba) in the red soil country in particular). Fire will also control cypress. Low to moderate intensity burns with good soil moisture are necessary to minimise loss of hollow trees. Avoid burning riparian communities as these can be critical habitat for some species. Culturally significant (scar) trees may need protection, such as rake removal of ground fuels. Planned burns have traditionally been carried out in the winter dry season; further research required.

Table G1 (Continued)
Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas

Regional Ecosystem	Season	Intensity	Interval	Strategy	Issue
11.3.25	Primarily early dry season.	Low.	3 - 5 years.	Protection relies on broad-scale management of surrounding country with numerous small fires throughout the year so that wildfires will be very limited in extent. Depending on position in the landscape, protection depends on broad-scale management of surrounding country, with numerous small fires throughout the year so that wildfires will be very limited in extent.	Fringing communities are critical habitat. In some situations it may be best not to burn. Intense and extensive fires degrade vegetation structure and destroy fauna habitats. Restrict the extent and intensity of fires. Hollow trees are critical habitat. Green panic may be an issue and an intensive grazing regime for very short periods, may be necessary to limit potential of wildfire. If burning is to occur then implement when water level is deep enough to protect the bases of aquatic plants. Sedges are disadvantaged by repeated fires. Impact of fire on rare and threatened plants associated with mound springs that include <i>Arthraxon hispidus</i> and <i>Dimeria</i> sp. (Salvator Rosa RJ Fensham RFJ 3643) should be considered. Boggomosses/springs can bounce back following fire but care should be taken where a dry peat layer has developed (particularly in degraded situations). Fire is an option for control of weeds (possibly in ungrazed situations). If riparian areas need to be burnt to reduce fuel loads then burning should occur when there is good soil moisture and active growth
11.3.27	-	-	-	Depending on position in the landscape, protection depends on broad-scale management of surrounding country, with numerous small fires throughout the year so that wildfires will be very limited in extent.	If burning is to occur then implement when water level is deep enough to protect the bases of aquatic plants. Sedges are disadvantaged by repeated fires. Impact of fire on rare and threatened plants associated with mound springs that include <i>Arthraxon hispidus</i> and <i>Dimeria</i> sp. (Salvator Rosa RJ Fensham RFJ 3643) should be considered. Boggomosses/springs can bounce back following fire but care should be taken where a dry peat layer has developed (particularly in degraded situations). Fire is an option for control of weeds (possibly in ungrazed situations). If riparian areas need to be burnt to reduce fuel loads then burning should occur when there is good soil moisture and active growth.

Table G1 (Continued)
Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas

Regional Ecosystem	Season	Intensity	Interval	Strategy	Issue
11.3.27b	-	-	-	Depending on position in the landscape, protection depends on broad-scale management of surrounding country, with numerous small fires throughout the year so that wildfires will be very limited in extent.	If burning is to occur then implement when water level is deep enough to protect the bases of aquatic plants. Sedges are disadvantaged by repeated fires. Impact of fire on rare and threatened plants associated with mound springs that include <i>Arthraxon hispidus</i> and <i>Dimeria</i> sp. (Salvator Rosa RJ Fensham RFJ 3643) should be considered. Boggomosses/springs can bounce back following fire but care should be taken where a dry peat layer has developed (particularly in degraded situations). Fire is an option for control of weeds (possibly in ungrazed situations). If riparian areas need to be burnt to reduce fuel loads then burning should occur when there is good soil moisture and active growth.
11.3.27d	-	-	-	Depending on position in the landscape, protection depends on broad-scale management of surrounding country, with numerous small fires throughout the year so that wildfires will be very limited in extent.	If burning is to occur then implement when water level is deep enough to protect the bases of aquatic plants. Sedges are disadvantaged by repeated fires. Impact of fire on rare and threatened plants associated with mound springs that include <i>Arthraxon hispidus</i> and <i>Dimeria</i> sp. (Salvator Rosa RJ Fensham RFJ 3643) should be considered. Boggomosses/springs can bounce back following fire but care should be taken where a dry peat layer has developed (particularly in degraded situations). Fire is an option for control of weeds (possibly in ungrazed situations). If riparian areas need to be burnt to reduce fuel loads then burning should occur when there is good soil moisture and active growth.
11.3.7	Early dry season when there is good soil moisture, with some later fires in the early storm season or after good spring rains.	Primarily low to moderate, with occasional high intensity fires.	Typically 2 - 7 years, with some areas longer unburnt.	A predominance of early dry season fires is recommended, although there is value in occasional late dry season fires, or storm burns, over small areas. Burning should begin very soon after the wet season, to secure boundaries and adjacent fire-sensitive vegetation. Subsequent repeat ignitions can be used within the same section of land weeks or months after the boundaries have been secured by early burning, to produce a mixture of burnt areas with multiple ignition dates. Use topographical features to ignite areas as soon as they dry out.	These woodlands have a diverse native grass and herb layer that is maintained and promoted by regular fire. Burning that starts immediately after the wet season, with follow up small fires ignited progressively over multiple dates can increase the availability of grass and herb seed, which is a critical food source for many birds and small mammals. Recently burnt grass clumps tend to produce more seed than unburnt clumps and the earlier burnt grass usually seeds earlier than later burnt grass.

Table G1 (Continued)
Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas

Regional Ecosystem	Season	Intensity	Interval	Strategy	Issue
11.3.7 (Continued)				This will create a mosaic of areas that were burnt at different dates and unburnt sections within the same area of woodland. Burn away from riparian communities, which can be critical habitat for some species. Approximately 25% of the grassy woodlands within a landscape should receive patchy fires in most years.	Maintaining a fire mosaic will help ensure protection of habitat and mitigate against wildfires. Low to moderate intensity burns with good soil moisture minimise the risk of losing hollow trees. An occasional late season burn will promote grasses and legumes. Ensure a diverse grass layer, maintenance of hollow-bearing trees and vegetation structure.
11.4.3	-	-	-	Maintain fire management of surrounding country so that wildfires will be very limited in extent. Frequent fire at the edge of this RE keeps fuel loads low. Protection from fire is necessary.	<i>Casuarina cristata</i> is fire sensitive, although germination can be good in bare areas. Brigalow is soft-seeded, so germination is not promoted by fire. Buffel grass invasion will increase risk from fire. High intensity fires will cause damage to overstorey. Grazing may be an option for reducing fuel loads where exotic grass such as buffel have invaded.
11.4.3 (High Value Regrowth)	-	-	-	Maintain fire management of surrounding country so that wildfires will be very limited in extent. Frequent fire at the edge of this RE keeps fuel loads low. Protection from fire is necessary.	<i>Casuarina cristata</i> is fire sensitive, although germination can be good in bare areas. Brigalow is soft-seeded, so germination is not promoted by fire. Buffel grass invasion will increase risk from fire. High intensity fires will cause damage to overstorey. Grazing may be an option for reducing fuel loads where exotic grass such as buffel have invaded.
11.4.8	-	-	-	Maintain fire management of surrounding country so that wildfires will be very limited in extent. Frequent fire at the edge of this RE keeps fuel loads low. Protection from fire is necessary.	<i>Casuarina cristata</i> is fire sensitive, although germination can be good in bare areas. Brigalow is soft-seeded, so germination is not promoted by fire. Buffel grass invasion will increase risk from fire. High intensity fires will cause damage to overstorey. Grazing may be an option for reducing fuel loads where exotic grass such as buffel have invaded.
11.4.9a	-	-	-	Maintain fire management of surrounding country so that wildfires will be very limited in extent. Frequent fire at the edge of this RE keeps fuel loads low. Protection from fire is necessary.	<i>Casuarina cristata</i> is fire sensitive, although germination can be good in bare areas. Brigalow is soft-seeded, so germination is not promoted by fire. Buffel grass invasion will increase risk from fire. High intensity fires will cause damage to overstorey. Grazing may be an option for reducing fuel loads where exotic grass such as buffel have invaded.

Table G1 (Continued)
Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas

Regional Ecosystem	Season	Intensity	Interval	Strategy	Issue
11.5.18	Spring to summer after rain, with good soil moisture.	Moderate to high.	6 - 15 years.	This RE will burn when ready with adjacent vegetation. Burn small patches where possible (most are naturally small). Burn when sufficient soil moisture and according to seasonal condition.	This heathland requires long enough fire intervals to allow regrowth to a mature structure. Ensure mature shrubland structure persists for many years in between fire events.
11.5.18 (with Cerbera)	Spring to summer after rain, with good soil moisture.	Moderate to high.	6 - 15 years.	This RE will burn when ready with adjacent vegetation. Burn small patches where possible (most are naturally small). Burn when sufficient soil moisture and according to seasonal condition.	This heathland requires long enough fire intervals to allow regrowth to a mature structure. Ensure mature shrubland structure persists for many years in between fire events.
11.5.3	Late wet to early dry season when there is good soil moisture. Early storm season or after good spring rains.	Various.	6 - 15 years (shorter intervals in BBN: 5 - 10 years). No shrubby woodlands should receive two consecutive burns at intervals of < 6 years.	Once boundaries of the planned burning area are secure, ignite across the landscape in a patchwork, rather than continuous ignition strips. Use topographical features to help create a patchily burnt landscape. Where shrubby woodlands occur within a broader grassy landscape, attempt to burn the shrubby woodland during every second fire rotation in the grassy woodland, by burning early breaks around the shrubby areas. In sites with a history of wildfires recurring within 5 years, patchy burning in a few small strategic locations at 3 or 4 year intervals may reduce the incidence of extensive wildfires, while ensuring most shrubby woodland areas remain unburnt for > 5 years. b: Burn under mild conditions and primarily away from the edge into surrounding vegetation. Low intensity burning may be of benefit within the forests with native grasses and where Para Grass density requires management.	Shrubby woodlands require longer fire intervals than grassy woodlands, because of the presence of fire-killed shrubs and the time required for post-fire regrowth to return to a mature structure. The seedlings of many fire-killed shrubs (such as some wattles) require 5 years or more before they mature. The creation of a fine-scale patchy mosaic can be more difficult to achieve in shrubby compared to grassy woodlands. Criteria for success: ensure seedlings of fire-killed shrubs mature and persist in the woodland; ensure several years of mature shrubby woodland structure before the subsequent fire. Care is needed to ensure a low intensity fire, as high intensity fires can damage trees, e.g. <i>Melaleuca</i> spp. and <i>Brigalow</i> . Native grasses (e.g. <i>Imperata cylindrical</i> [Blady Grass], <i>Sporobolus virginicus</i> [Sand Couch]) and sedges (e.g. <i>Fimbristylis</i> spp) will benefit from occasional burning. Fire, coupled with herbicide spraying, is important for managing exotic wetland plants, such as <i>Olive Hymenachne</i> and <i>Urochloa mutica</i> . Burning temporarily opens gaps within exotic grass patches, allowing native flora to establish. Criteria for success: native grass diversity is maintained, native trees are not damaged by fires.

Table G1 (Continued)
Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas

Regional Ecosystem	Season	Intensity	Interval	Strategy	Issue
11.5.3b	Late wet to early dry season when there is good soil moisture. Early storm season or after good spring rains.	Various.	6 - 15 years (shorter intervals in BBN: 5 - 10 years). No shrubby woodlands should receive two consecutive burns at intervals of < 6 years.	Once boundaries of the planned burning area are secure, ignite across the landscape in a patchwork, rather than continuous ignition strips. Use topographical features to help create a patchily burnt landscape. Where shrubby woodlands occur within a broader grassy landscape, attempt to burn the shrubby woodland during every second fire rotation in the grassy woodland, by burning early breaks around the shrubby areas. In sites with a history of wildfires recurring within 5 years, patchy burning in a few small strategic locations at 3 or 4 year intervals may reduce the incidence of extensive wildfires, while ensuring most shrubby woodland areas remain unburnt for > 5 years. b: Burn under mild conditions and primarily away from the edge into surrounding vegetation. Low intensity burning may be of benefit within the forests with native grasses and where <i>Urochloa mutica</i> density requires management.	Shrubby woodlands require longer fire intervals than grassy woodlands, because of the presence of fire-killed shrubs and the time required for post-fire regrowth to return to a mature structure. The seedlings of many fire-killed shrubs (such as some wattles) require 5 years or more before they mature. The creation of a fine-scale patchy mosaic can be more difficult to achieve in shrubby compared to grassy woodlands. Criteria for success: ensure seedlings of fire-killed shrubs mature and persist in the woodland; ensure several years of mature shrubby woodland structure before the subsequent fire. Care is needed to ensure a low intensity fire, as high intensity fires can damage trees, e.g. <i>Melaleuca</i> spp. and Brigalow. Native grasses (e.g. <i>Imperata cylindrica</i> , <i>Sporobolus virginicus</i>) and sedges (e.g. <i>Fimbristylis</i> spp) will benefit from occasional burning. Fire, coupled with herbicide spraying, is important for managing exotic wetland plants, such as Olive Hymenachne and <i>Urochloa mutica</i> . Burning temporarily opens gaps within exotic grass patches, allowing native flora to establish. Criteria for success: native grass diversity is maintained, native trees are not damaged by fires.
11.7.2	-	-	-	Maintain fire management of surrounding country so that wildfires will be very limited in extent and do not penetrate Lancewood forests.	Although fire promotes the germination of Lancewood seedlings, trees are killed by all but the lowest intensity fires. Lancewood trees require approximately 20 years before seedlings mature. Often the lack of grass layer inhibits fire spread into these forests, and they will regenerate after occasional wildfires. Damaged by repeated fires < 20 years. Manage surrounding woodlands so that wildfires do not burn large areas of Lancewood forest in a single event. Criteria for success: no damage to Lancewood trees from fires; extra protection required to ensure no two fires penetrate Lancewood forests within 20 years.

Table G1 (Continued)
Department of Environment and Heritage Protection - Fire Management Guidelines for Regional Ecosystems in the Offset Areas

Regional Ecosystem	Season	Intensity	Interval	Strategy	Issue
11.7.4	-	-	-	Manage surrounding country. Burn surrounding country only under conditions of good soil moisture and when plants are actively growing. Will be difficult to burn owing to a lack of ground fuel that normally occurs in this RE.	-
11.9.1	-	-	-	Maintain fire management of surrounding country so that wildfires will be very limited in extent. Frequent fire at the edge of this RE keeps fuel loads low. Protection from fire is necessary.	<i>Casuarina cristata</i> is fire sensitive, although germination can be good in bare areas. Brigalow is soft-seeded, so germination is not promoted by fire. Buffel grass invasion will increase risk from fire. High intensity fires will cause damage to overstorey. Grazing may be an option for reducing fuel loads where exotic grass such as buffel have invaded.

Source: Department of Environment and Heritage Protection (2012) *Regional Ecosystems*. Website: http://www.ehp.qld.gov.au/ecosystems/biodiversity/re_introduction.html. Date Accessed: September 2012.

Note: These guidelines have now been updated.