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# Biodiversity Management Plan



Tharbogang Quarry and Landfill

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Lot 181, 182 and 202 // DP 756035, Hillside Drive, Griffith, NSW

Prepared for: Griffith City Council

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<b>PREPARED FOR</b>	Griffith City Council			
<b>AUTHOR/S</b>	Bret Stewart			
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ECOPLANNING PTY LTD | 74 HUTTON AVENUE BULLI NSW 2516 | P: (02) 4244 2736

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## Glossary and abbreviations

Acronym	Description
BAM	Biobanking Assessment Methodology
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BCC	Biobanking Credit Calculator
BMP	Biodiversity Management Plan
BOA	Biodiversity Offset Area
BOS	Biodiversity Offset Strategy
BVT	Biometric Vegetation Type
CMA	Catchment Management Area
CoA	Conditions of Approval
DECCW	NSW Department of Environment, Climate Change and Water (now part of DPIE)
DGRs	Director General's Requirements
DII	NSW Department of Industry and Investment
DNG	Derived Native Grassland
DNR	NSW Department of Natural Resources (now part of DPIE)
DoP	NSW Department of Planning (now part of DPIE)
DPIE	NSW Department of Planning Industry and Environment
DP&I	NSW Department of Planning and Infrastructure (now part of DPIE)
EA	Environmental Assessment Report
ELA	Eco Logical Australia Pty Ltd
EPA	Environment Protection Authority
EP&A Act	NSW <i>Environmental Planning &amp; Assessment Act 1979</i>

EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GCC	Griffith City Council
HBT	Hollow bearing tree
LBMP	Landscape and Biodiversity Management Plan
LLS	Local Land Services
LTMS	Long Term Management Strategy
MZ	Management Zone
NOW	NSW Office of Water
NPW Act	NSW National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service (part of DPIE)
OEH	NSW Office of Environment and Heritage (now part of DPIE)
PCOs	Pesticide Control Orders
PVP	Property Vegetation Plan
QRA	Quarry Rehabilitation Area
RBOSMP	Rehabilitation and Biodiversity Offset Strategy Management Plan
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i> (repealed)

# 1 Introduction

Ecoplanning Pty Ltd has been engaged by Griffith City Council (GCC) to prepare a Biodiversity Management Plan (BMP) for the Tharbogang Quarry and Landfill and associated offset areas which are the subject of Major Project Approval 06\_0334 MOD 2. Lots 181 and 182 DP 756035 together comprise the Biodiversity Offset Area (BOA) which has been conserved in perpetuity via a Conservation Agreement under Part 4 Division 12 of the *National Parks and Wildlife Act 1974*. Lot 202 DP 756035 contains the existing operational quarry and landfill as well as the future quarry site (Quarry Pit 101 and Quarry Pit 103), which together with associated facilities and infrastructure, comprise the impacts which are offset within the BOA. Lot 201 DP 756035 is currently vacant and was the site of two proposed quarry pits which were not approved but formed part of the original Major Project application for the site. The area of Lots 181, 182, and 202 DP 756035 encompassing the quarry and landfill and the BOA are managed under the BMP and are hereafter referred to as the 'site' (**Figure 1.1**: Aerial imagery of Griffith City Council lands, the Biodiversity Offset Area (BOA), and Quarry Rehabilitation Areas (QRA1 and QRA2)).

The impacts within the site are associated with future expansion of an existing quarry and landfill. The existing quarry and landfill is positioned in a natural depression in the centre of Lot 202 and has a direct footprint of 29.6 ha, including associated buildings and roads. The proposed future expansion of the quarry will increase the final direct footprint by 14.1 ha, with indirect impacts due to edge effects, to be equivalent to 3.75 ha. The BOA (referred to in some site documents as the Conservation Area) offsetting these impacts covers an area of 93.51 ha. When the proposed quarry has reached the end of its working life, rehabilitation actions will be required in the quarry area. This Quarry Rehabilitation Area (QRA1) will cover approximately 14.84 ha. The future landfill within the existing quarry will also be remediated (QRA2), occupying a total of 5.66 ha. A new green waste stockpile was approved under Mod 2 and will be located on a capped part of the former landfill. This cap was to be maintained without vegetation, and therefore the green waste stockpile as located does not constitute further biodiversity impact nor require remediation. However, the area of indirect impact associated with the green waste stockpile is to be managed by this BMP. The lands covered under the scope of this BMP total 28.67 ha of rehabilitation, 9.17 ha indirect impact areas and 99.57 ha of offset areas.

The BMP includes two components of the Major Project Approval:

- Rehabilitation and Biodiversity Offset Strategy Management Plan (RBOSMP); and
- Long Term Management Strategy (LTMS).

The Conservation Agreement further specifies management requirements which overlap with the above, and these are included in the BMP.

The lands managed by the BMP contain *Inland Grey Box - Poplar Box - White Cypress Pine Tall Woodland* (hereafter referred to as Poplar Box Woodland), *Dwyer's Red Gum – White Cypress Pine – Currawang Shrubby Woodland* (hereafter referred to as Dwyer's Red Gum Woodland), and existing quarry areas lacking vegetation. Dwyer's Red Gum Woodland currently occupies QRA1 and surrounds the existing quarry area. Poplar Box Woodland comprising three condition classes – Woodland, Open Woodland, and Derived Native



Grassland (DNG) and occupies the BOA and lies to the east and south of the landfill and quarry within Lot 202. Management under this BMP relates to the protection and active management of the Poplar Box Woodland in the BOA and the rehabilitation of the QRAs to approximate the benchmark condition of Dwyer's Red Gum Woodland vegetation community. The BOA and QRAs are presented in **Figure 1.2: Biodiversity Offset Area and Quarry Rehabilitation Areas** and **Figure 1.3: Existing and proposed vegetation types in the BOA and QRAs**.

## 1.1 Approvals background

Planning consent (the Approval) for the expansion and landfilling was issued by the NSW Department of Planning (DoP) under Section 75J of the *Environmental Planning and Assessment Act 1979* (EP&A Act) in July 2010, and twice modified (Mod 1 and Mod 2) under Section 75W of the EP&A Act as approved by the Department of Planning and Infrastructure (DPI) in May 2012 and the Department of Environment (DoE) in July 2014 respectively.

The subject of Mod 1 was the particulars of the offsetting strategy including establishing the total area (95.31 ha) offset as the BOA.

The subject of Mod 2 related to improvements to the quarry design. Of relevance to the BMP is the creation of a new green waste stockpile and the addition of 500 m<sup>2</sup> to the impact area of the landfill and quarry. The additional 500 m<sup>2</sup> of clearing will remove Poplar Box Woodland to accommodate batters for the new landfill wall. The landfilling of the existing quarry was also delayed to allow further quarrying of resources until at least 2021.

## 1.2 Biodiversity management background

This BMP details biodiversity management actions to be undertaken across the site, either as described in this document or as detailed further under existing management plans. A Conservation Agreement was conditioned under the Major Project Approval 06\_0334 MOD 1, Condition 46, with biodiversity management actions within the BOA (referred to as the Conservation Area in the Conservation Agreement) arising under the Conservation Agreement. A Landscape and Biodiversity Management Plan (LBMP) was conditioned under Conditions 48 through 50 of the approval, with biodiversity management actions under the LBMP applying to the entire site. The LBMP is also required to contain two sub-plans, being the Rehabilitation and Biodiversity Offset Strategy Management Plan (RBOSMP) and Long Term Management Strategy (LTMS).

Goulburn City Council (GCC) landholdings in the area surrounding Tharbogang Quarry and Landfill include Lots 181-185, 201 and 202 DP 756035. Of these lands:

- Lots 181 and 182 are managed under the Conservation Agreement;
- Lots 181, 182, and impact and remediation areas of 202 are the subject of a previous LBMP which is superseded by management under this BMP; and
- GCC landholdings including Lots 183-185, 201, and 202, as well as Lots 181 and 182, once management and monitoring under the Conservation Agreement is concluded (scheduled for 2026), are managed under a Weed Control Plan (WCP).

The existing biodiversity management documents are discussed in further detail in Sections 1.2.1 to 1.2.4 below. Where management requirements under the scope of this BMP are

covered under existing management documents, the managing document(s) are referenced herein together with a summary of how any applicable approval conditions are addressed. Where a management document has been superseded by this BMP, management actions are described in detail under this document.

### 1.2.1 Conservation Agreement

A Conservation Agreement between the Minister administering the *National Parks and Wildlife Act 1974* (NSW) and GCC was executed on 12 July 2017 and registered on 17 November 2017 formalising the offset area required under the Approval and specifying how the BOA is to be managed. Management of the BOA is detailed under Annexure C of the Conservation Agreement and is divided into two periods – the first 10 years and year 11 onward.

In the first 10 years, active management of the BOA includes:

- Monitoring Biobanking monitoring plots and photo points
- Establishing weed management thresholds and commence weed management in the BOA
- Pest animal control
- Crash livestock grazing
- Bushfire management
- Access management
- Nest boxes
- Revegetation
- Native vegetation thinning
- Reporting and review

From year 11 onward (long term management), active management of the BOA includes:

- Exotic plant management
- Pest animal control
- Crash livestock grazing
- Bushfire management
- Access management
- Revegetation
- *Callitris glaucophylla* thinning
- Reporting and review

Active management of the BOA under the Conservation Agreement fulfills certain objectives of this BMP, and this is noted where applicable in this document.

### 1.2.2 Offset Monitoring

Monitoring has been carried out within the BOA in compliance with the Conservation Agreement on an annual basis beginning in 2016, with baseline data collected in 2015. Annual monitoring reports each include the following:

- a description of all completed management actions undertaken in the previous 12 month period



- copies of all receipts from third party contractors engaged by the owner to undertake management actions listed in items 1 and 2 of Annexure C to the Conservation Agreement
- completed monitoring data sheets (including photographs) using the template provided in Table 4 of Annexure D to the Conservation Agreement (**Section 1.2.1**) and also including quarterly inspection data and stock impact data collected by the owner
- a discussion of the changes recorded at photo monitoring points and quadrats
- a discussion of the condition of Conservation Values
- a discussion of effectiveness of any management actions implemented
- recommendations and proposed management actions to be performed in following year

Annual monitoring under the Conservation Agreement fulfills certain objectives of this BMP and this is noted where applicable in this document. Annual monitoring also details management actions that have been carried out within the BOA including weed management, pest management, fire trails and vehicle access, and fencing. Quarterly inspections conducted by Riverina Agriconsultants include commentary on erosion, weeds, vegetation cover, litter cover, dieback, soil stability, and feral animals, and these are also summarised in the annual monitoring reports.

### 1.2.3 Landscape and Biodiversity Management Plan (ELA 2013)

A Landscape and Biodiversity Management Plan (LBMP) was prepared by ELA in accordance with the Project Approval (dated 8 July 2010) Condition 48 which required the LBMP to be submitted prior to 30 December 2010. The previous LBMP forms the foundation of the current BMP (this document) and has been revised and updated in accordance with subsequent Section 75J modifications and the Conservation Agreement. This document also provides reference to management actions currently being implemented under separate management plans, which fulfill the management requirements of the relevant conditions of approval.

### 1.2.4 Weed Control Plan (Ecoplanning 2019)

The Weed Control Plan (WCP) provides detailed weed survey requirements? (baseline) of all GCC landholdings, including Lots 183-185, 201, and 202. The WCP expands upon BOA weed management while providing for weed management within the remainder of the site and surrounding GCC lands. The WCP provides for long term weed management on an ongoing basis, with 10 year Key Performance Indicators (KPIs) specified for all known Weeds of National Significance (WoNS) and priority weeds and more general targets for environmental weeds. The WCP is considered to address all required weed control measures under the scope of this BMP.

### 1.2.5 Annual Environmental Management Report

Annual Environmental Management Reports (AEMR) are prepared yearly to comply with Schedule 5, Condition 4 of the Project Approval and to summarise activity, environmental performance, compliance and community relations. The AEMR provides assessment against compliance with the regulatory framework for the site including many of the management actions required under the BMP.

### 1.3 Independent Environmental Audit

An Independent Environmental Audit (IEA) has been prepared by Property Risk Australia (2019) in compliance with Condition 5 Schedule 5 of the Approval. The scope of the IEA includes the following:

- Project approval conditions, including relevant modifications;
- Management plans, required by the approval;
- Environment protection licence;
- The status of the operation, e.g. compliant or non-compliant with the above;
- The key regulatory risks, including past or future risks;
- The performance of the operation compared with the predictions of Environmental Assessment (EA) reports;
- Results from previous audits or inspections (if available);
- Any incidents and community complaints, including feedback from local community consultative committees (if available);
- Feedback from other regulatory agencies on performance of the operation; and
- Given that not all elements covered by the project approval as modified have commenced, the audit aims to clearly identify works commenced and those yet to commence (and identify proposed schedules, where possible).

Recommendations of the IEA in relation to biodiversity have formed the basis of the updates to management actions in this BMP. Appendix A of the IEA tabulates these recommendations together with the findings of the audit.

### 1.4 Aims and objectives

The BMP has been prepared to comply with Schedule 3, Conditions 48 through 50 of the Project Approval. The BMP aims to consolidate the biodiversity management actions applying to the site, including referring to separate documents where management actions are addressed in greater detail, in order to provide a comprehensive management document. The RBOSMP objectives detailed in **Section 1.4.1** are addressed in this document. Biodiversity management actions currently occurring in the offset area (BOAs) under the existing LBMP and the CA are detailed herein to provide a comprehensive management document for biodiversity across the whole site. A consolidated monitoring and reporting framework is provided to address all GCC obligations in relation to biodiversity on the site.

#### 1.4.1 Rehabilitation and Biodiversity Offset Management Plan Objectives

The objectives of the RBOSMP are based on three categories – integrating landscapes, achieving sustainable growth and development, and establishing the final land use.

##### *Integrating Landscapes*

- To provide a vegetated corridor across GCC land holdings and link adjacent sub-regional habitat corridors (including Lake Wyangan, Barren Box Swamp, the McPherson Ranges and the Cocoparra Ranges) (see **Figure 3.1: Regional context of the Biodiversity Offset Area**)



- To reduce the visibility of landfill and quarry operations from adjacent properties, Tharbogang and the local road network
- To blend the created landforms with the surrounding topography
- To provide a low maintenance, geotechnically stable and safe landform with minimal erosion

#### *Sustainable Growth and Development*

- To achieve a soil profile capable of sustaining the specified final land use
- To establish native vegetation with the species diversity commensurate to each relevant ecological community

#### *Final Land Use*

- To re-instate woodland ecological communities commensurate with the remnant woodland vegetation within the BOA and QRA
- Undertake habitat augmentation to improve and promote corridors for fauna movement linking adjacent remnant woodland vegetation with the rehabilitation of the Project Area and BOA

The RBOSMP provides direction to GCC to:

- Identify the land required to be managed in accordance with the RBOSMP
- Provide a clear, concise, staged and instructional working document outlining the management actions for the BOA and QRA
- Provide a management framework that will lead to an improvement in the condition of native vegetation on the site utilising expert knowledge of resilience in natural landscapes and through specific bushland restoration techniques
- Minimise the impacts of key threats to the site through specific management actions. Key threats include the weeds *Echium plantagineum* (Paterson's Curse), *Opuntia aurantiaca* (Tiger Pear), *Hypericum perforatum* (St John's Wort), *Lycium ferocissimum* (African Boxthorn) and *Marrubium vulgare* (White Horehound)
- Outline the monitoring, performance evaluation and reporting procedures that are practical and able to be implemented and understood by the Property Manager

### 1.4.2 Long Term Management Strategy

The objectives for quarry closure and post extraction management of the QRAs include:

- Stabilise soils and prevent erosion
- Restore native plant species to achieve ecological community benchmarks
- Remove safety or environmental hazards
- Manage exotic vegetation to reduce competition or other impacts to native vegetation
- Manage feral pests



## 1.5 Definitions

Several terms and abbreviations are used throughout this BMP. Reference to and familiarisation with the glossary at the front end of this report is important to define terms and to avoid any incongruities during BMP implementation. The following nomenclature has been used in this report:

- **Site** – the area of Lots 181, 182, and 202 DP 756035 covered under the scope of this BMP
- **Biodiversity Offset Area (BOA)** – All of Lots 181 and 182 which contain retained vegetation which is conserved in perpetuity under a Conservation Agreement. Some site documents also referred to these lands as the Conservation Area. These lands are to be protected and managed to compensate for impacts within the Project Area.
- **Project Area** – All of Lot 202 which contains the existing landfill, proposed landfill (and existing quarry), proposed quarry, proposed green waste stockpile site, proposed leachate pond, existing leachate pond, proposed stormwater detention pond, existing sediment trap, proposed waste transfer station, and existing gatehouse, depot, and compound
- **Quarry Rehabilitation Area (QRA)** – the area of quarrying within Lot 202 DP 756035 which will be remediated following the end of its working life. Includes the proposed quarry (QRA1) and the existing quarry and future landfill (QRA2)
- **Proposed landfill** – the future landfill within the existing quarry in Lot 202 which is to be rehabilitated and referred to as QRA2 following the end of its working life
- **Green waste stockpile** – a green waste stockpile site has been approved under 06\_0334 Mod 2 and is located in a disturbed, impermeable pad in Lot 202 to the northwest of an existing stormwater pond and bordering the Conservation Area

## 1.6 Roles and responsibilities

The key stakeholders associated with the BMP are:

- Secretary of the **Department of Planning Industry & Environment** (formerly Department of Planning and Environment) – regulatory authority
- **Griffith City Council** – the proponent
- **Ecoplanning** – the person/ firm preparing this BMP
- **Griffith City Council, Contractors** – the person/ company responsible for BMP implementation

## 1.7 Legislative requirements

Management actions described in this BMP entail works undertaken within the habitat of threatened species. Notwithstanding the fact that these actions are, in general, for conservation purposes, there is a risk that some actions may cause harm or damage to a threatened species or threatened ecological communities. However, the approved consent (PA 06\_0334 and modifications), of which this BMP is a part, provides a defence against prosecution for any impacts associated with the implementation of the management actions outlined herewith. As such, a licence under Part 2 Division 3 of the NSW *Biodiversity*

*Conservation Act 2016* (BC Act) or Sections 120 or 132C of the *NSW National Parks & Wildlife Act 1974* (NPW Act) is not required.



Figure 1.1: Aerial imagery of Griffith City Council lands, the Biodiversity Offset Area (BOA), and Quarry Rehabilitation Areas (QRA1 and QRA2)

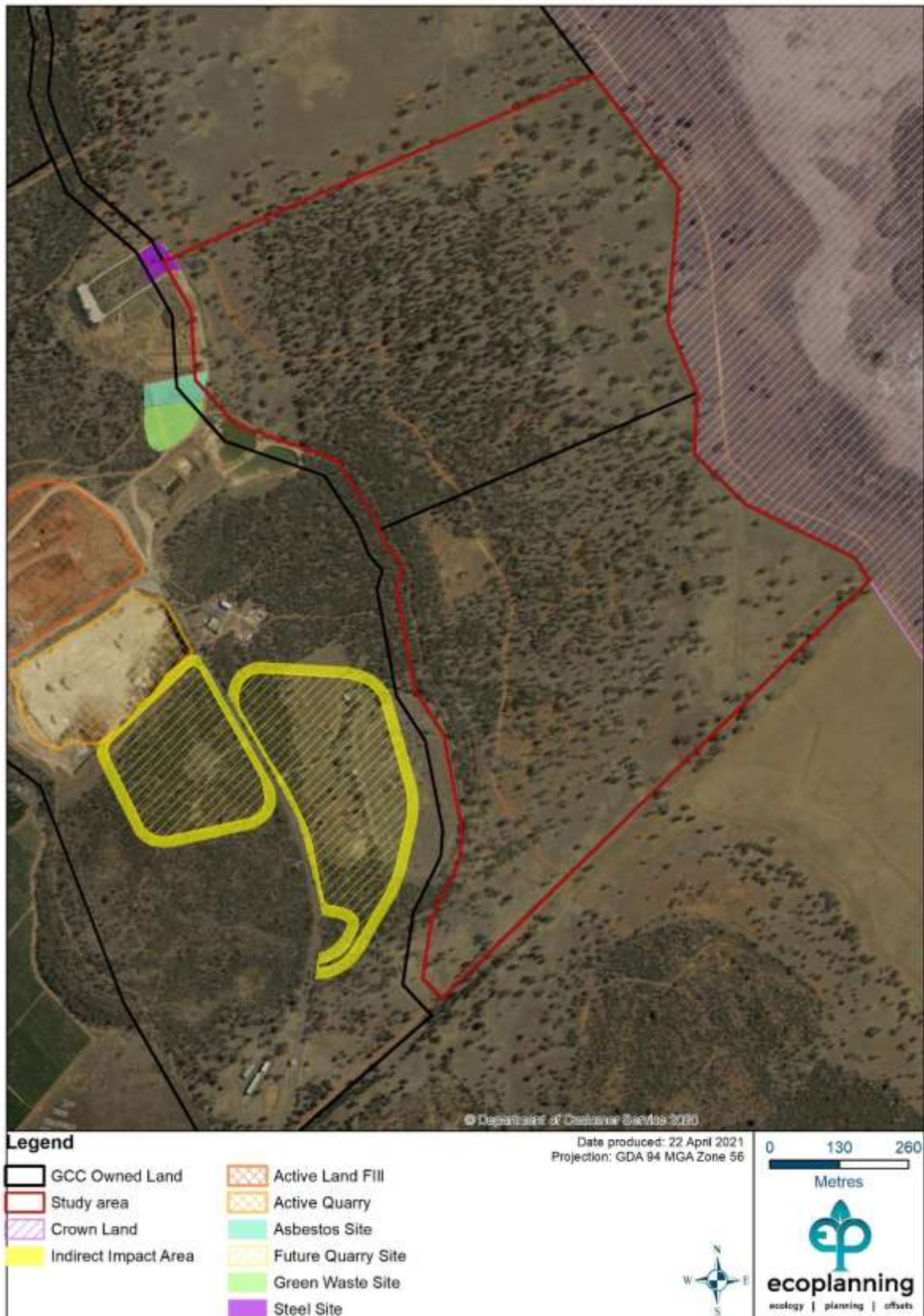


Figure 1.2: Biodiversity Offset Area and Quarry Rehabilitation Areas

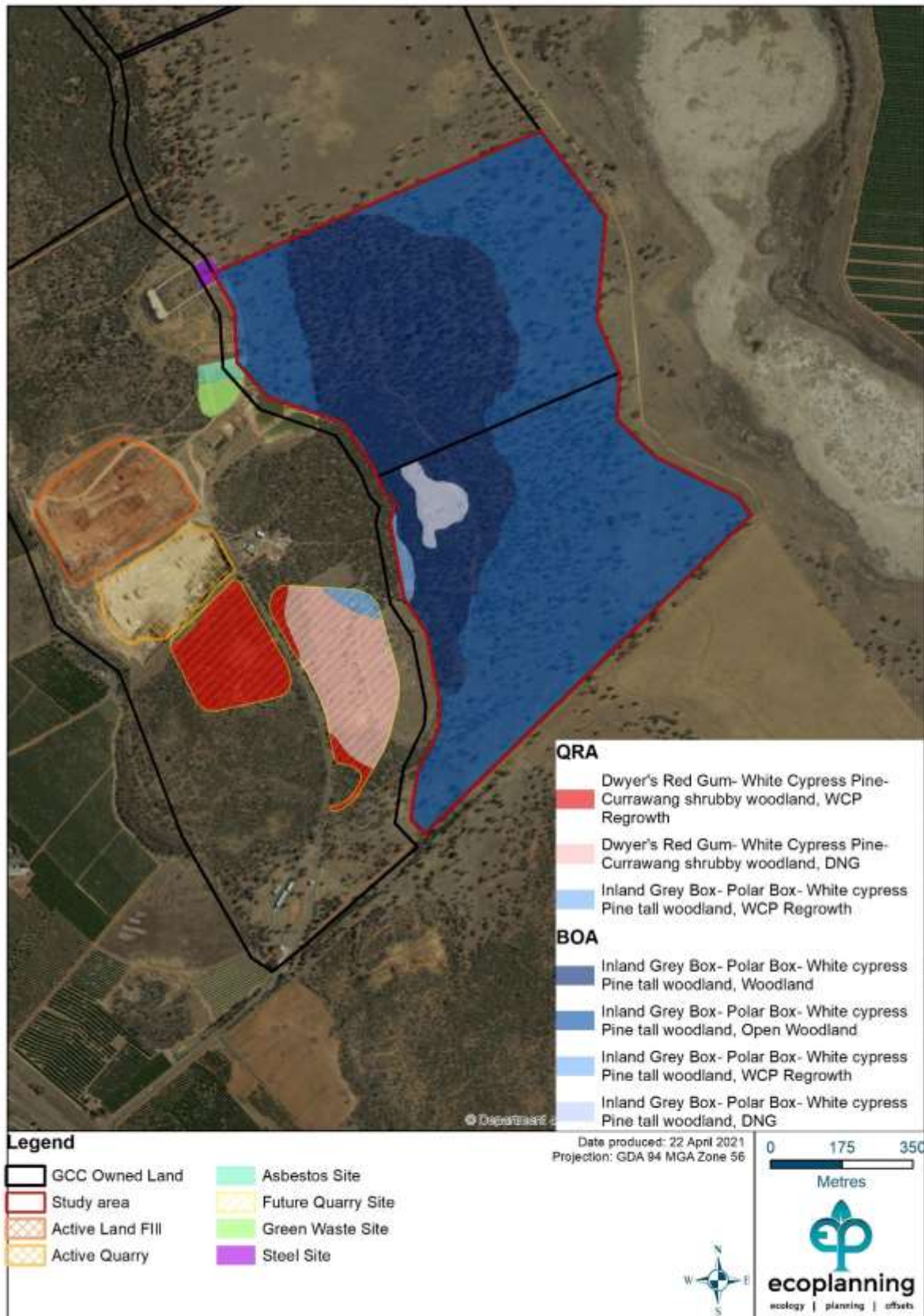


Figure 1.3: Existing and proposed vegetation types in the BOA and QRAs

## 2 Compliance with Conditions of Approval

The Conditions of Approval (CoA) that specify Site management requirements which are the subject of this BMP are listed in **Table 2.1** below, with comment indicating where these requirements are addressed in this report.

**Table 2.1: Conditions of Approval (06\_0334 Mod 2)**

Condition No.	Requirements	Section or document
<b>Biodiversity Offset Strategy</b>		
45.	The Proponent shall implement the Biodiversity Offset Area (BOA) on Lots 181 and 182, DP 756035 including 95.31 ha of 'Inland Grey Box – Poplar Box – White Cypress Pine Tall Woodland', as described in MOD 1 to the satisfaction of the Secretary and in consultation with the EPA, within 1 year of the approval of MOD 1.	Conservation Agreement
46.	<p>Within one year of the approval of MOD 1, unless the Secretary agrees otherwise, Council must provide appropriate long term security for the BOA defined in Condition 45 through one of the following mechanisms:</p> <p>a) a Conservation Agreement under the <i>National Parks and Wildlife Act 1974</i>; or</p> <p>b) a Biobanking Agreement under the <i>Threatened Species Conservation Act 1995</i>.</p> <p>The agreement must remain in force in perpetuity.</p>	Conservation Agreement
47.	The Proponent shall ensure the long term security of the BOA referred to in Conditions 45 and 46, prior to any clearing onsite.	Conservation Agreement
<b>Landscape and Biodiversity Management Plan</b>		
48.	The Proponent shall prepare and implement a Landscape and Biodiversity Management Plan for the project in accordance with Condition 49 to the satisfaction of the Secretary. This plan must:	<i>Tharbogang Landfill and Quarry – Landscape and Biodiversity Management Plan – Rehabilitation and Biodiversity Offset Strategy Management Plan (ELA 2013)</i>

Condition No.	Requirements	Section or document
		<b>Superseded by this document</b>
48. a)	be prepared by suitably qualified person(s), approved by the Secretary;	Delegate for Director-General of the Department of Planning signed letter of approval for ELA on 18 August 2011
48. b)	be submitted to the Secretary for approval within 12 months of the date of MOD 1; and	<i>Tharbogang Landfill and Quarry – Landscape and Biodiversity Management Plan – Rehabilitation and Biodiversity Offset Strategy Management Plan (ELA 2013) submitted on 17 October 2012</i>
48. c)	include a:	
48. c) i.	Rehabilitation and Biodiversity Offset Strategy Management Plan; and	<b>Sections 4 – 11</b>
48. c) ii.	Long Term Management Strategy.  <i>Note: The Department accepts that the initial Landscape and Biodiversity Management Plan may not include the detailed Long Term Management Strategy. However, a conceptual strategy must be included in the initial plan, along with a timetable for augmentation of the strategy with each subsequent review of the plan</i>	<b>Section 12</b>
49.	The Rehabilitation and Biodiversity Offset Management Plan must include:	
49. a)	the rehabilitation objectives for the site and offset areas;	<b>Section 11</b>

Condition No.	Requirements	Section or document
49. b)	description of the measures that would be implemented to:	<b>Section 5</b>
	rehabilitate and stabilise site;	
	minimize the removal of mature trees;	
	implement the Biodiversity Offset Strategy; and	
	manage remnant vegetation and habitat on site and in the offset areas.	
49. c)	detailed performance and completion criteria of the rehabilitation and stabilisation of the site;	<b>Section 2</b>
49. d)	detailed description of how the performance of the rehabilitation of the quarry areas would be monitored over time to achieve the stated objectives;	<b>Section 8, 8 and 9</b>
49. e)	a detailed description of what measures would be implemented to rehabilitate and manage the landscape of the site included the procedures to be implemented for:	<b>Section 5 and Error! Reference source not found.</b>
	progressively rehabilitating and stabilising areas disturbed by quarrying;	
	implementing revegetation and regeneration within the disturbance areas;	
	protecting areas outside the disturbance areas including the Biodiversity Offset Strategy Areas;	
	vegetation clearing protocols, including a protocol for clearing any trees containing hollows and the relocation of hollows from felled trees;	
	managing impacts on fauna, in particular threatened species;	<b>Section 5 – 11</b>

Condition No.	Requirements	Section or document
	controlling weeds and pests;	<b>Section 5</b>  <u>BOA</u> <i>Conservation Agreement</i> Annexure C Table 4, 4a, and 5  <u>BOA and QRAs</u> <i>Weed Control Plan</i> (Ecoplanning 2019)
	controlling access;	<b>Section 5</b>
	bushfire management; and	
	reducing the visual impact of the project.	
49. f)	a description of the potential risks to successful rehabilitation and a description of the contingency measures that would be implemented to mitigate these risks; and	<b>Section 5</b>
49. g)	details of who is responsible for monitoring, reviewing, and implementing the plan.	<b>Section 5, 8 –</b> Error! Reference source not found.

Condition No.	Requirements	Section or document
49(a)	<p>To ensure that the BOA is implemented in accordance with the performance and completion criteria in the Rehabilitation and Biodiversity Offset Strategy Management Plan, Council must secure implementation funds via one of the following mechanisms to the satisfaction of the Secretary:</p> <ul style="list-style-type: none"> <li>a) a Biobanking Agreement under the <i>Threatened Species Conservation Act 1995</i>;</li> <li>b) lodgement of a conservation bond with the Department;</li> <li>c) a Voluntary Planning Agreement under Section 93F of the EP&amp;A Act;</li> </ul> <p>The sum of the funds shall be determined by:</p> <ul style="list-style-type: none"> <li>i. calculating the full cost of implementing the Rehabilitation and Biodiversity Offset Strategy Management Plan, and</li> <li>ii. employing a suitably qualified quantity surveyor to verify the calculated costs.</li> </ul> <p>The funding must be secured within six months of the approval of the Rehabilitation and Biodiversity Offset Strategy Management Plan required by condition 48, unless otherwise agreed to by the Secretary.</p>	<b>Section 7</b>
49(b)	<p>The Department notes that if a Biobanking Agreement is implemented for the BOA defined by Condition 45, the requirements of Conditions 45, 46, 48 and 48 (a) are likely to be satisfied. The Department requests that on approval of any Biobanking Agreement, a copy of the agreement is submitted to the Department which includes management and monitoring plans and funding arrangements.</p>	Not applicable
50.	Long Term Management Strategy must:	
50. a)	define the objectives and criteria for quarry closure post extraction management;	<b>Section 12</b>
50. b)	be prepared in consultation with EPA, NOW and DPI;	
50. c)	investigate and/or describe options for the future use of the site;	

Condition No.	Requirements	Section or document
50. d)	describe the measures that would be implemented to minimise or manage the environmental effects of the project; and	
50. e)	describe how the performance of these measures would be monitored over time.	

## 3 Description of the environment

### 3.1 Regional context

The BOA and QRA are located approximately 10km north of the city of Griffith in western New South Wales (NSW), near the township of Tharbogang (**Figure 3.1**: Regional context of the Biodiversity Offset Area). The BOA is located on Lot 181 and 182, to the east of an existing landfill and quarry operation run, owned and operated by GCC on Lot 202. The QRA is located to the south of this quarry, in Lot 202. The BOA covers approximately 95.31 ha which includes 93.9 ha of Poplar Box Woodland and 1.4 ha of DNG. The QRA covers approximately 14.75 ha, of which 14.10 ha currently comprises Dwyer's Red Gum Woodland and 0.65 ha of cleared land.

The BOA and QRA are located at southern extremity of the McPherson Ranges, a hook shaped range of low hills approximately 40 km long. In addition, they are near a number of other important areas of habitat within the Griffith Local Government Area (LGA), including Tharbogang Swamp (immediately east of the BOA), Lake Wyangan (~4 km east), Barren Box Swamp (~12 km north-west), and the Cocoparra Ranges (~24 km east).



Figure 3.1: Regional context of the Biodiversity Offset Area

### 3.2 Climate

The closest long-term meteorological station to the site is Griffith Airport (8km south east). Data has been collected from this site since 1960. The Griffith area is influenced by a temperate weather system and experiences warm summer and mild winter temperatures. Summer maximums occur in January with an average maximum of 32.8 degrees Celsius (°C) (daily) and average minimum of 16.9°C (nightly). Winter minimums occur in July with an average maximum of 14.5°C (daily) and minimum of 3.5°C (nightly). The average rainfall is 393.7 millimetres (mm) per year (~32.78mm/ month), spread evenly throughout the year with slightly higher levels recorded in December (33.5mm) and slightly lower in April (27.7mm). Trans-evaporation generally exceeds average annual rainfall, resulting in dry conditions (Balance 2009).

**Table 3.1: Climate data for the site**

TEMP (°C)	J	F	M	A	M	J	J	A	S	O	N	D
Mean max temperature	33.2	32.4	28.9	24.2	19.3	15.5	14.6	16.5	20.1	24.3	28.2	31.1
Mean min temperature	17.3	17.5	14.3	10.3	7.1	4.5	3.5	3.8	5.8	9.2	12.8	15.1
Mean rainfall	32.9	29.3	35.3	27.5	35.4	35.2	33.3	34.8	32.6	37.9	34	33.1
Highest monthly rainfall	257.1	138.2	216.8	170.2	136	127.4	88.4	87.6	156.6	143	128	127
Lowest monthly rainfall	0	0	0	0.4	1.2	0.3	1.1	2.2	0	0	0	0

Source: [www.bom.gov.au](http://www.bom.gov.au)

### 3.3 Geology, topography, geomorphology and soils

The Department of Mines and Geological Survey of NSW Services, Sheet 51 55-10 "Narrandera" (Pogson 1977), identifies the site geology as being part of the Griffith Syncline which comprises a succession Upper Devonian sandstones, siltstones and conglomerates that belong to the Cocoparra Group. The Cocoparra Group contains, Mailman Gap Member, coarse pebble sandstone and conglomerate unit along the ridgelines and the Jimberoo Formation, a medium to coarse grained sandstone, along the eastern slopes (Balance 2009). The remainder of the slopes on site are largely obscured by residual and colluvial deposits, but may contain older units such as the Barrat Formation, pebbly sandstone and sandstone. The floodplains to the north, east and west of the ridge line are largely comprised of undefined Quaternary formations of flat to gently undulating plains of red and brown clayey sand, loam and lateritic soils (Pogson 1977).

The Griffith area is largely flat, sloping east to west and relieved primarily by the McPherson Range which extends to the north-east for approximately 30km and north-west, through the BOA, approximately 10km. McPherson Range displays the structural features common to Devonian formations and extensive faulting has resulted in its characteristic rock formations. The Range represents the boundary between the slopes country and the flat riverine plain to

the west. Gaps in the ridgeline occur at Tharbogang, and just north-west of Griffith. These gaps are responsible for directing calcareous clays into the Lake Wyangan area by acting as wind tunnels (Balance 2009). The BOA includes elevations from 125 m on the Australian Height Datum (AHD) along the floodplains up to a maximum 180 m along the ridgeline.

The soils at nearby Scenic Hill have been classified as Gradational; (non-Calcareous) Soils of the McPherson Range. These soils are not calcareous throughout; surface textures commonly range from sandy loam to clay loam, less commonly loamy sand, clayey sand and sand, and occasionally sandy clay, silty clay or light clay; there is a gradual increase in texture grade (clayiness) with depth, sometimes followed by a decrease below B horizon; acid, neutral and alkaline soil trends occur (Balance 2009).

The soils of the McPherson Range have a moderately high permeability which has implications for plant growth. The semi-arid climate and low rainfall events mean that the soils have little chance of retaining water for long periods of time. Most water from rainfall events is leached downwards through the profile where it is transported laterally along the bedrock to the groundwater system. Overland flow is likely to be limited due to the presence of topsoil and native vegetation (Balance 2009). However, the relatively fertile A horizon of the soil profile indicates that some nutrient recycling has occurred so that when leaching moves nutrients through the profile, uptake of nutrients by plants occurs which moves the nutrients up through transpiration. The vegetation cover also protects the soil profile from Aeolian erosion (Balance 2009).

### 3.4 Vegetation

The native vegetation of the BOA, QRA and the surrounding area has been mapped during various previous vegetation assessments by Eldridge (2002), ERC (2003), Ecosurveys (2006), and ELA (2011). The ERC (2003) assessment was confined to Lot 202 and the Ecosurveys (2006) assessment included both Lot 202 and Lot 201. In the intervening period from 2006 to 2011, GCC acquired the neighbouring Lots 181, 182, 183, 184 and 185. These Lots were included in the assessment by ELA (2011). As each survey applied different methodology and determined different vegetation communities, these have been summarised in **Table 3.2** and compared to accepted Biometric Vegetation Types (BVTs) (DECC 2008). It should be noted that the terms Bimble Box and Poplar Box have been used interchangeably in the past as the common name for the species *Eucalyptus populnea* subsp. *bimbil*. Similarly, Dwyer's Red Gum (*E. dwyeri*), is also known by the common names Dwyer's Gum and Dwyer's Mallee Gum.

Eldridge (2002) conducted a survey of the entire Murrumbidgee Irrigation Area which determined that there were five vegetation types within Lot 201. These were:

- Bimble (Poplar) Box
- Dwyer's [Red] Gum/ Currawang
- White Cypress Pine
- Yarran
- Other Remnant Vegetation (mainly consisting of Wilga)

The vegetation of the impact area for which the BOA was required were assessed by ERC (2003). This determined that there were four vegetation types, namely:

*White Cypress Pine Forest;*

- Occasional remnant *Eucalyptus populnea* (Poplar or Bimble Box) and *Eucalyptus dwyeri* (Dwyer's Red Gum) was recorded
- Understorey largely consisted of juvenile *Callitris glaucophylla* (White Cypress Pine) with some *Geijera parviflora* (Wilga) and *Acacia doratoxylon* (Currawang)
- Ground cover in this area was sparse, largely consisting of native forbs with some grasses.

*Bimble Box – White Cypress Pine Woodland;*

- The overstorey consisted of *Eucalyptus populnea* with *Callitris glaucophylla* dominating the lower stratum
- Contained many remnant old growth *Eucalyptus populnea*. Tree health was generally very good, with few trees showing signs of dieback and stress
- Understorey was generally sparse consisting of juvenile *Callitris glaucophylla* regrowth, with the occasional *Acacia doratoxylon*, *Dodonea cuneata* (Wedge-leaf Hop-bush) and *Dodonea viscosa* subsp. *angustissima* (Narrow-leaf Hop-bush)
- Ground cover consisted of native grasses with some introduced species.

*Dwyer's Mallee Gum – White Cypress Pine – Currawang Woodland; and*

- This community was generally associated with rocky outcrops, the ridgeline and upper slope areas
- The overstorey was dominated by *Eucalyptus dwyeri* with some areas dominated by patches of *Callitris glaucophylla*
- *Acacia doratoxylon* and *Callitris glaucophylla* dominated the lower stratum, particularly *Callitris glaucophylla* on lower and south facing slopes
- The understorey consisted largely of juvenile *Callitris glaucophylla* and *Eucalyptus dwyeri*, *Pittosporum angustifolium* (Weeping Pittosporum) and the occasional *Eucalyptus populnea*. *Callitris glaucophylla* became dominant in the lower lying mid-section forming a significant ecotone
- The ground layer was generally sparse and consisted of native grasses and forbs.

*Mixed Bimble Box – White Cypress Pine – Dwyer's Mallee Gum, open forest (not mapped on Lot 201).*

- This community is largely dominated by *Callitris glaucophylla*, well represented throughout all age structures.
- Numerous old growth and mature *Eucalyptus populnea*, *Callitris glaucophylla* and *Eucalyptus dwyeri* were recorded along the gully floors and drainage lines. *Eucalyptus dwyeri* and *Acacia doratoxylon* became dominant as slope increased.
- Early to advanced regrowth of *Callitris glaucophylla* and *Acacia doratoxylon* dominated the understorey stratum. The shrub layer apart from the *Callitris glaucophylla* was patchy.
- Ground cover comprised a mixture of predominately native grasses, with some forbs and introduced species.

The GCC lands (including the BOA site) were surveyed 5th to 9th September 2011 by three ELA ecologists, Bruce Mullins, Lucas McKinnon and Andrew Whitford. The vegetation of the BOA had not been specifically mapped in any previous survey, but was assessed by ELA using Biobanking methodology. This determined there was one main biometric vegetation type in the BOA, '*Inland Grey Box - Poplar Box - White Cypress Pine Tall Woodland*' (Poplar Box Woodland), in three condition classes, Woodland, Open Woodland, and Derived Native Grassland (DNG).

Poplar Box Woodland is characterised by:

- Occurring on the red and brown clayey sand of the gently undulating plains, footslopes and floodplains of the region
- *Callitris glaucophylla* dominance to various degrees
- Dominant myrtaceous overstorey species in this community was *Eucalyptus populnea*
- Midstorey dominance by *Geijera parviflora*
- Areas of DNG containing *Austrostipa scabra* subsp. *scabra* (Speargrass)

The relationship of this community to the communities previously mapped within the GCC lands is shown in **Table 3.2**. Where a previous vegetation community is split by the newer mapping, it has been placed within the group that most accurately describes it. A second BVT '*Dwyer's Red Gum - White Cypress Pine - Currawang Shrubby Woodland*' is located in the QRA and will be impacted by the proposed quarry. This community will represent the final vegetation goal of rehabilitation in the QRA when these works are conducted. A vegetation map of the entire GCC land area at Tharbogang is presented in **Figure 3.2**: BioMetric Vegetation Type map of the GCC owned lands.

**Table 3.2: Relationship between vegetation community classification in previous surveys**

ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011	BIOMETRIC VEGETATION TYPE
Dwyer's Gum / Currawang	Dwyer's Mallee Gum – White Cypress Pine – Currawang Woodland	Dwyer's Red Gum / Currawang Woodland	Dwyer's Red Gum - White Cypress Pine - Currawang Shrubby Woodland	Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly of the NSW South Western Slopes Bioregion (Benson 185)
Bimble Box / White Cypress	Mixed Bimble Box – White Cypress Pine – Dwyer's Mallee Gum, Open Forest	-		
White Cypress Pine	White Cypress Pine Forest	White Cypress Pine Open Forest / Regrowth	Inland Grey Box - Poplar Box - White Cypress Pine Tall Woodland	Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82)
	Bimble Box – White Cypress Pine Woodland	White Cypress Pine - Poplar Box Woodland		
Bimble Box	-	Poplar Box Grassy Woodland		

ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011	BIOMETRIC VEGETATION TYPE
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<sup>1</sup> Bimble Box and Poplar Box = *Eucalyptus populnea*

<sup>2</sup> White Cypress Pine communities recognised by ERC (2003) and Ecosurveys (2006) are considered ser's of the BioMetric vegetation types in ELA (2011), hence the overlap with the BVT's and previous vegetation classifications

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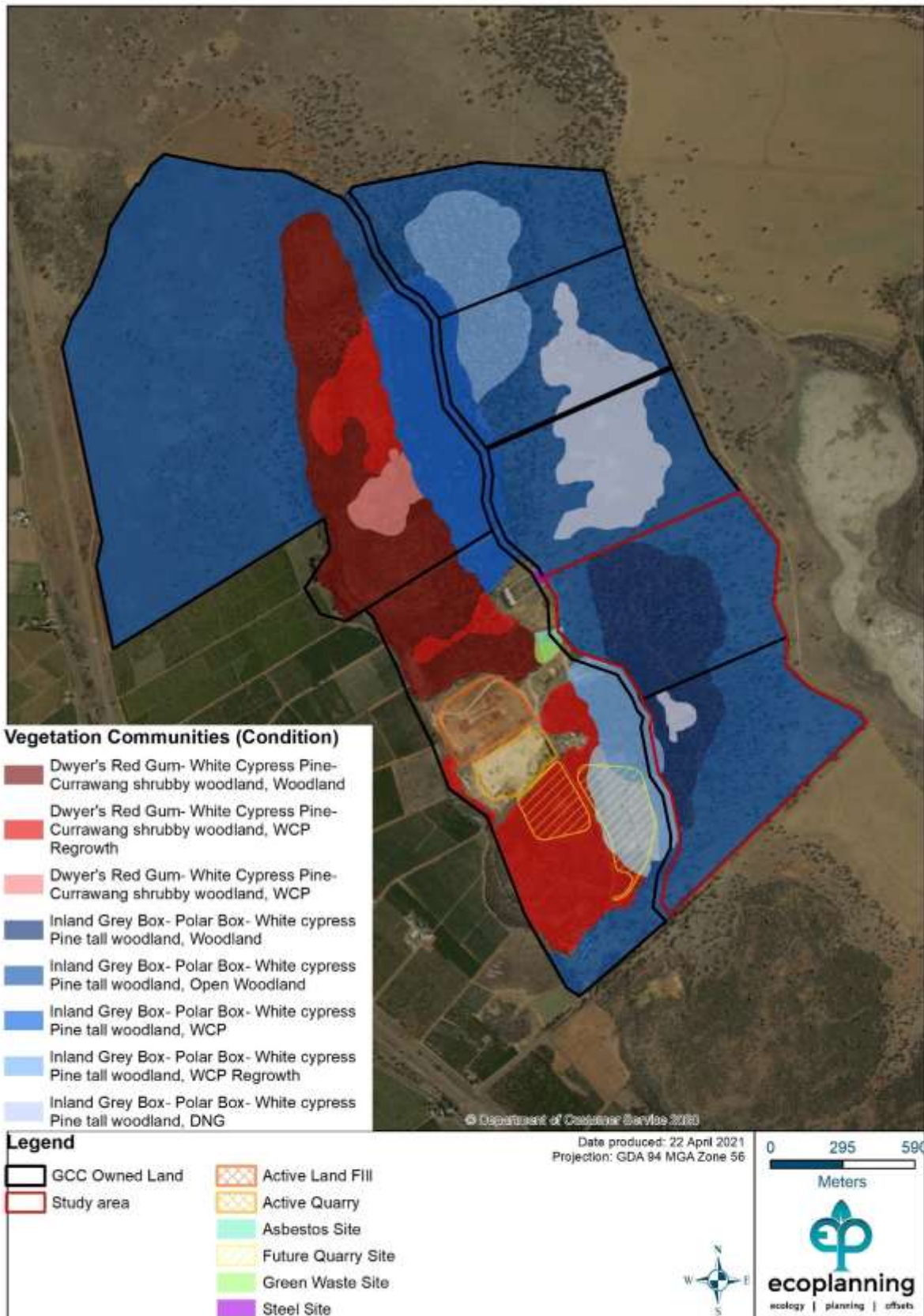


Figure 3.2: BioMetric Vegetation Type map of the GCC owned lands

## 3.5 Vegetation condition

### 3.5.1 Biodiversity Offset Area

The vegetation in the BOA has been mapped in three condition classes, Woodland, Open Woodland and Derived Native Grassland (DNG), reflecting the varying extent of previous land clearing on the floodplain.

The woodland areas are found in a moderate condition when compared against the BioMetric benchmarks (DECC 2008), with the native species richness and groundcover well above the benchmark, though other measures of condition such as over-storey, mid-storey, coarse woody debris and hollow bearing trees are somewhat reduced as would be expected given past management (i.e. clearing, grazing, pasture improvement and firewood collection). Natural regeneration of all canopy species is occurring.

The open woodland areas retain a similar number/proportion of Hollow Bearing Trees (HBTs) per hectare (~10/ha) as the woodland areas, though the over-storey and shrub cover is found to be below the lower benchmark. The mid-storey and understorey (grasses and native forbs etc) are found to be above the benchmark. This natural resilience will respond well to appropriate management and aid the transition of the BOA to a benchmark state. Similarly, to the woodland areas, the species richness of these areas and the amount of cumulated coarse woody debris has been reduced due to the past management practices. Natural regeneration of all canopy species is occurring.

The DNG has had the canopy and mid-storey completely cleared with only the groundlayer of predominantly native grasses intact, with varying occurrences of native and exotic forbs and exotic grasses. There is no coarse woody debris or natural regeneration of the former canopy species occurring in the DNG. Under appropriate conservation management, including the removal of grazing, active weed and feral animal control, and where necessary, assisted regeneration, the area of woodland (canopy and shrub cover) will significantly increase in the short to medium term and species richness can be enhanced over the long term through targeted weed control and species enrichment plantings. This 'improvement' to the biodiversity values of the BOA assists the project in meeting an 'improve or maintain' outcome, as defined in the Biobanking Assessment Methodology (BAM).

### 3.5.2 Quarry Rehabilitation Area

The vegetation in the QRA was mapped with two different condition classes, open woodland and DNG. However, these categories are not as applicable as with the BOA since rehabilitation works will be initiated where vegetation will not be present. Rehabilitation works will aim to achieve BioMetric benchmarks (DECC 2008) for the community, or as near as reasonably possible (**Table 3.3**).

The data from the plots conducted in the BOA (Poplar Box Woodland) and the QRA (Dwyer's Red Gum Woodland) are shown in **Table 3.3**. Observed data for Dwyer's Red Gum Woodland was averaged from the five plots undertaken in the QRA. Observed data for Poplar Box Woodland is taken from the one plot undertaken in the BOA.

**Table 3.3: BioMetric benchmarks for communities in BOA and QRA**

Biometric Vegetation Type		Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly of the NSW South Western Slopes Bioregion (Benson 185)	Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Penneplain Bioregion (Benson 82)
Native plant species richness	BioMetric	27	25
	Observed	28	32
Native over-storey cover (%)	BioMetric	8-30	8-35
	Observed	0.3	3.5
Native mid-storey cover	BioMetric	3-23	3-23
	Observed	9.1	0
Native ground cover (grasses)	BioMetric	3-10	13-50
	Observed	38	50
Native ground cover (shrubs)	BioMetric	5-20	3-5
	Observed	4	0
Native ground cover (other)	BioMetric	3-8	3-15
	Observed	36	42
Number of trees with hollows (per ha)	BioMetric	1	1
	Observed	0	1
Total length of fallen logs (m)	BioMetric	30	75
	Observed	7.8	21

Vegetation types were mapped across the entire property and trimmed to the boundary of the offset site after the mapping was completed (**Figure 3.3**: Detail of BOA vegetation communities). The area and proportion of each vegetation type within the BOA is shown in **Table 3.4**.

**Table 3.4: Area of BioMetric vegetation types in BOA**

INLAND GREY BOX WOODLAND	AREA OF SITE (HA)	AREA OF SITE (%)
Woodland	33.20	34.84
Open Woodland	60.68	63.68
Derived Native Grassland (DNG)	1.41	1.48
<b>Total</b>	<b>95.31</b>	<b>100.0</b>

### 3.6 Vegetation community description

#### **Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Poplar Box Woodland)**

This community occurs on gently undulating plains and footslopes of the relict Cobar Peneplain floodplain. Within the BOA it is found in a variety of structural condition states including derived native grasslands (Figure 6), open woodland (Figure 7) and woodlands with various levels of *Callitris glaucophylla* (White Cypress Pine) dominance (Figure 8). The dominant myrtaceous overstorey species in this community was *Eucalyptus populnea* (Poplar or Bimble Box).

*Geijera parviflora* (Wilga) and *C. glaucophylla* were the most commonly encountered mid-storey species in this community, with a groundcover dominated by the native grasses, *Austrostipa scabra*, *Austrodanthonia bipartita* (a Wallaby Grass) and *Enteropogon acicularis* (Curly Windmill Grass). Common native herbs included *Einadia nutans* (Nodding Saltbush), *Erodium crinitum* (Blue Storksbill), *Atriplex semibaccata* (Berry Saltbush) and *Triptilodiscus pygmaeus* (Common Sunray).

Species characteristic of this vegetation type are provided in **Table 3.5**. A full flora inventory of the site is provided in **Appendix A**.

**Table 3.5: Characteristic flora species of Inland Grey Box – Poplar Box – White Cypress Pine tall woodland present in the BOA**

Dominant canopy spp	Main associated spp	Characteristic mid-storey spp	Characteristic groundcover spp
Poplar or Bimble Box ( <i>Eucalyptus populnea</i> subsp. <i>bimbi</i> ), White Cypress Pine ( <i>Callitris glaucophylla</i> )	Bulloak ( <i>Allocasuarina luehmannii</i> )	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i> , <i>Geijera parviflora</i> (Wilga), <i>Myoporum montanum</i> (Western Boobialla), <i>Parsonsia eucalyptophylla</i>	<i>Austrodanthonia bipartita</i> , <i>Calotis cuneifolia</i> , <i>Austrostipa scabra</i> subsp. <i>scabra</i> (Speargrass), <i>Einadia nutans</i> subsp. <i>nutans</i> , <i>Enteropogon acicularis</i> (Curly Windmill Grass), <i>Eragrostis lacunaria</i> .



**Plate 1: Example of Poplar Box – Derived Native Grassland condition class**



**Plate 2: Example of Poplar Box – Open Woodland condition class**



**Plate 3: Example of Poplar Box – Woodland condition class**



Figure 3.3: Detail of BOA vegetation communities

### 3.7 Flora

While no targeted flora surveys were undertaken for the RBOSMP, surveys have been undertaken for GCC lands in the past. No flora species listed under either the NSW *Biodiversity Conservation Act 2016* (BC Act) or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) have been found on GCC lands, including the BOA. Likewise, no Rare or Threatened Australian Plants (ROTAP) listed plant species have been recorded in the within the GCC lands. Due to nearby records, the ROTAP listed species, *Lomandra patens*, was considered as a potential species (ERC 2002) but was not recorded at the site during field surveys. A full list of threatened species with potential to occur on site either through proximity of sightings or available habitat is listed in Appendix 1 of the RBOSMP.

Thirty-seven (37) weed species were observed in the GCC lands during the site assessment, 12 of which were also recorded in the BOA and 26 of which in the QRA (ELA 2011). A further 62 unique species were recorded by Eldridge (2002), ERC (2003) and EcoSurveys (2006) in the GCC lands and adjacent land to the east and south (**Appendix A**). The most abundant weed species recorded across the site include, *Echium plantagineum* (Paterson's Curse), *Carthamus lanatus* (Saffron Thistle) and *Arctotheca calendula* (Capeweed). Other significant weed species recorded include *Xanthium spinosum* (Bathurst Burr), *Lycium ferocissimum* (African Boxthorn) and *Opuntia* spp. (Prickly Pear and Tiger Pear). These species are generally in very low – low abundance.

Six (6) weed species listed under the NSW *Noxious Weed Act 1993* in the GCC Local Government Area (LGA), were found within the GCC lands during vegetation surveys (**Table 3.6**). The *Biosecurity Act 2015* has superseded the Noxious Weeds Act and reclassified these weeds as priority weeds for the Riverina. These species were recorded in a few scattered localities and are considered rare on the site. Two of these species, *Lycium ferocissimum* and *Rubus fruticosus* spp. agg. are also listed as a Weed of National Significance (WoNS). No priority weeds or WoNS were recorded in the BOA or QRA during surveys (ELA 2011).

**Table 3.6: List of Priority Weeds (formerly Noxious Weeds) and WoNS observed on site**

Species name	Common name	Priority weed category	WoNS
<i>Alternanthera pungens</i>	Khaki Weed	General Biosecurity Duty	-
<i>Lycium ferocissimum</i>	African Boxthorn	General Biosecurity Duty; Prohibition on dealings	Y
<i>Marrubium vulgare</i>	Horehound	General Biosecurity Duty	-
<i>Opuntia aurantiaca</i>	Tiger Pear	General Biosecurity Duty; Prohibition on dealings	-
<i>Rubus fruticosus</i> spp. agg.	Blackberry	General Biosecurity Duty; Prohibition on dealings	Y
<i>Xanthium spinosum</i>	Bathurst Burr	General Biosecurity Duty	-

### 3.8 Fauna habitat

The vegetation of the GCC lands, including the BOA and QRA, forms part of a much larger corridor linking the McPherson Range with remnant vegetation associated with Kidman Way and Griffith-Hillston rail line which eventually connects with remnant vegetation east of Tabbita (including Tabbita State Forest). The McPherson Range corridor is the largest connected area of remnant vegetation within the Griffith LGA and currently allows the movement of fauna species across the region. It maintains the connection between local populations of fauna species and ensures the genetic flow between sub-populations of fauna inhabiting the Griffith LGA (Balance 2009).

The vegetation communities of the BOA and QRA provide various foraging, roosting and breeding opportunities for many species. The site offers a variety of habitats ranging from open woodland with a grassy understorey, to grassland on the flats and areas of dense understory regrowth closer to the lower slopes. Many of the mature trees, particularly *Eucalyptus populneus* subsp. *bimbil*, contain hollows, crevices and bark slabs, which provide suitable nesting and roosting sites for some birds, arboreal mammals and microchiropteran bat species (ERC 2003).

HBT's are present within the BOA and QRA although no formal survey of density has been undertaken. Assessments of Lot 201 adjacent to the Project Area found that the density of HBT's was high, with approximately 300 HBT's identified during surveys (Ecosurveys 2006), and extrapolation from the BioMetric plots undertaken by ELA (2011) found HBT's to occur at ~10/ha in adjacent woodlands. Hollow bearing trees provide nesting sites for many declining woodland bird species and arboreal mammals. Land clearance, agriculture and scraping for surficial gravel has largely removed this habitat feature from surrounding areas in the LGA (Balance 2009).

Standing dead trees and fallen timber were a common occurrence in most areas and provided resting and foraging opportunities for bird species. Fallen timber was found scattered throughout the GCC lands, comprising mainly small logs (Ecosurveys 2006, ELA 2011). This habitat feature provides suitable habitat for reptiles and ground dwelling mammals, and is likely to increase the diversity of insects thus providing a valuable resource for ground foraging birds. The removal of fallen timber from adjoining agricultural land has resulted in a corresponding decline in reptiles and ground foraging, roosting and nesting birds (Ecosurveys, 2006).

Loose bark on the mature *Callitris glaucophylla* and *Eucalyptus populneus* subsp. *bimbil* was identified as suitable roosting habitat for microchiropteran bat species. High bat activity and diversity was recorded along flyways in Lot 202, including the QRA, and many bats were observed leaving roosting trees (ERC 2002). Anabat analysis revealed with varying degrees of confidence the presence of ten bat species including the threatened Southern Myotis (*Myotis macropus*) (probable) and Little Pied Bat (*Chalinolobus picatus*) (possible). No threatened bat species were captured during harp trapping.

The ground layer of the BOA and QRA provides suitable foraging and sheltering habitat for reptiles and small ground dwelling mammals. The ground layer consists of a mixture of native and introduced grasses and forbs, with some herbaceous plants and small shrubs, interspersed with clay patches.

No drainage lines or waterbodies were identified in the BOA or QRA. However, two ephemeral drainage lines and a permanent dam have been identified in the adjacent Lot 201 (Ecosurveys 2006). These drainage lines flow during periods of heavy and /or persistent rainfall by channelling surface sheet flows from the ridgeline, east towards Tharbogang Swamp (Coffey Geotechnics 2007). They may provide temporary habitat for amphibians during wet periods, and reptiles during dry periods. The permanent dam located in Lot 201 provides habitat for ducks and a water resource for other fauna although the quality has been degraded by grazing pressures, poor dam design and weed infestation (Ecosurveys, 2006).

### 3.9 Fauna

While no targeted fauna surveys were undertaken for the RBOSMP, surveys have been undertaken for GCC lands in the past. A total of nine fauna species listed under either the BC Act or EPBC Act have been found on GCC lands, including the BOA and QRA. An additional four species of bird not listed under State or Commonwealth but identified as declining woodland bird species in south-western NSW have also been identified on site (Reid 1999). These species are shown in **Table 3.7**. A full list of threatened species with potential to occur on site either through proximity of sightings or available habitat is listed in **Appendix A**.

The Condition of Approval (CoA) for the provision of offsets do not include any requirements to provide habitat for any specific threatened species, although it is expected that the vegetation types protected in the offset area will provide habitat for a range of threatened species. These species and others are likely to utilise habitat in the offset area as its condition is enhanced, particularly the canopy and shrub layer. Baseline flora and fauna inventories have been undertaken as part of the implementation of this management plan as described in **Section 1**, with annual surveys commencing in 2015.

**Table 3.7: Threatened and rare fauna recorded on GCC land**

Common name	Scientific name	ERC 2000	ERC 2003	Ecosurveys 2006	Ecosurveys 2009	ELA 2011
Birds						
Barking Owl	<i>Ninox connivens</i>		A			
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>		X			
Chestnut-rumped Thornbil#	<i>Acanthiza uropygialis</i>	X	X	X	X	
Dusky Woodswallow	<i>Artamus cyanopterus</i>		X		X	
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>		A			
Grey Falcon	<i>Falco hypoleucos</i>		A			
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	X	X	X	X	X

Common name	Scientific name	ERC 2000	ERC 2003	Ecosurveys 2006	Ecosurveys 2009	ELA 2011
Little Eagle	<i>Hieraaetus morphnoides</i>	X				
Major Mitchell's Cockatoo	<i>Cacatua leadbeateri</i>			X		
Painted Honeyeater	<i>Grantiella picta</i>		A			
Rainbow Bee-eater	<i>Merops ornatus</i>		X			
Red-capped Robin <sup>#</sup>	<i>Petroica goodenovii</i>	X	X	X	X	X
Rufous Whistler <sup>#</sup>	<i>Pachycephala rufiventris</i>			X	X	
Southern White Face <sup>#</sup>	<i>Aphelocephala leucopsis</i>			X		
Superb Parrot	<i>Polytelis swainsonii</i>		A			
White-throated Needletail	<i>Hirundapus caudacutus</i>		X			
<b>Mammals (Microbats)</b>						
Inland Forest Bat	<i>Vespadelus baverstocki</i>		X			
Little Pied Bat	<i>Chalinolobus picatus</i>		X			
Southern Myotis	<i>Myotis macropus</i>		X			

'X' indicates species recorded within GCC lands

'A' indicates species was found adjacent to the Site (i.e. within 5 km)

<sup>#</sup> Species not listed as threatened, endangered, or migratory under State or Commonwealth legislation, but identified as declining woodland bird species in south-western NSW (Reid 1999).

Four introduced mammal species and four introduced bird species were found on and adjacent to the BOA and QRA during surveys (**Table 3.8**). The impacts of all the mammal species identified are listed as Key Threatening Processes under both the NSW BC Act and Commonwealth EPBC Act. They are:

- Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*);
- Competition and habitat degradation by Feral Goats (*Capra hircus*);
- Predation by the European Red Fox (*Vulpes vulpes*); and
- Predation by the Feral Cat (*Felis catus*).

A threatening process is defined as a key threatening process (KTP) if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community or if it could cause species, populations or ecological communities that are not threatened to become threatened.

**Table 3.8: Introduced fauna recorded onsite**

Common name	Scientific name	ERC 2000	ERC 2003	Ecosurveys 2006	Ecosurveys 2009	ELA 2011
<b>Birds</b>						
European Goldfinch	<i>Carduelis carduelis</i>		A			X
House Sparrow	<i>Passer domesticus</i>		X			
European Starling	<i>Sturnus vulgaris</i>	X	X	X	X	X
Common Blackbird	<i>Turdus merula</i>		X		X	X
<b>Mammals</b>						
Feral Goat	<i>Capra hircus</i>			X		X
Feral Cat	<i>Felis catus</i>	X	X			
European Rabbit	<i>Oryctolagus cuniculus</i>	X	X	X	X	X
European Red Fox	<i>Vulpes vulpes</i>	X	X			X

## 4 Management strategies

### 4.1 Resilience categories

The resilience of the site was assessed using the following categories:

- Very high resilience – Three levels of intact native vegetation are present (overstorey, midstorey, and ground cover) throughout the site, with variable density. Soil is undisturbed and there is sufficient native vegetation remaining in-situ to enable the natural regeneration of native vegetation. Very low levels of management are required to facilitate rehabilitation.
- High resilience – At least two levels of intact native vegetation present throughout, with three levels present in some portion. Overstorey should be present in some portion. Low levels of management are required to facilitate restoration.
- Moderate resilience – At least one level of intact native vegetation present throughout, with two or three levels present in some portions. Overstorey should be present in some portion. Some minor soil disturbance present. Moderate levels of management are required to facilitate restoration.
- Low resilience – At least one level of intact native vegetation present in some portion. Overstorey not present. Some soil disturbance. High levels of management are required to facilitate restoration.
- Very low resilience – No intact native vegetation is present on-site. Overstorey not present. Soil is disturbed. Very high levels of management are required to facilitate restoration.

### 4.2 Management Zones

The offset area has been divided into three management zones according to condition and resilience, and the two QRAs comprise two additional zones. These management zones (**Table 4.1**) are briefly described below and illustrated in **Figure 4.1**: Biodiversity Offset Area and Quarry Rehabilitation Area Management Zones. **Section 5** outlines a list of actions and the investment required in each zone to achieve the restoration of a functioning ecosystem and a sustainable landscape in perpetuity.

**Table 4.1: Management Zones**

Management Zone	Description	Condition	Area of Zone (ha)
MZ1	DNG	High	1.69
MZ2	Open Woodland	High	62.31
MZ3	Woodland	Very High	35.57
MZ4	Woodland (projected)	Very Low	14.68
MZ5	Woodland (projected)	Very Low	13.99
<b>Total</b>			<b>128.24</b>



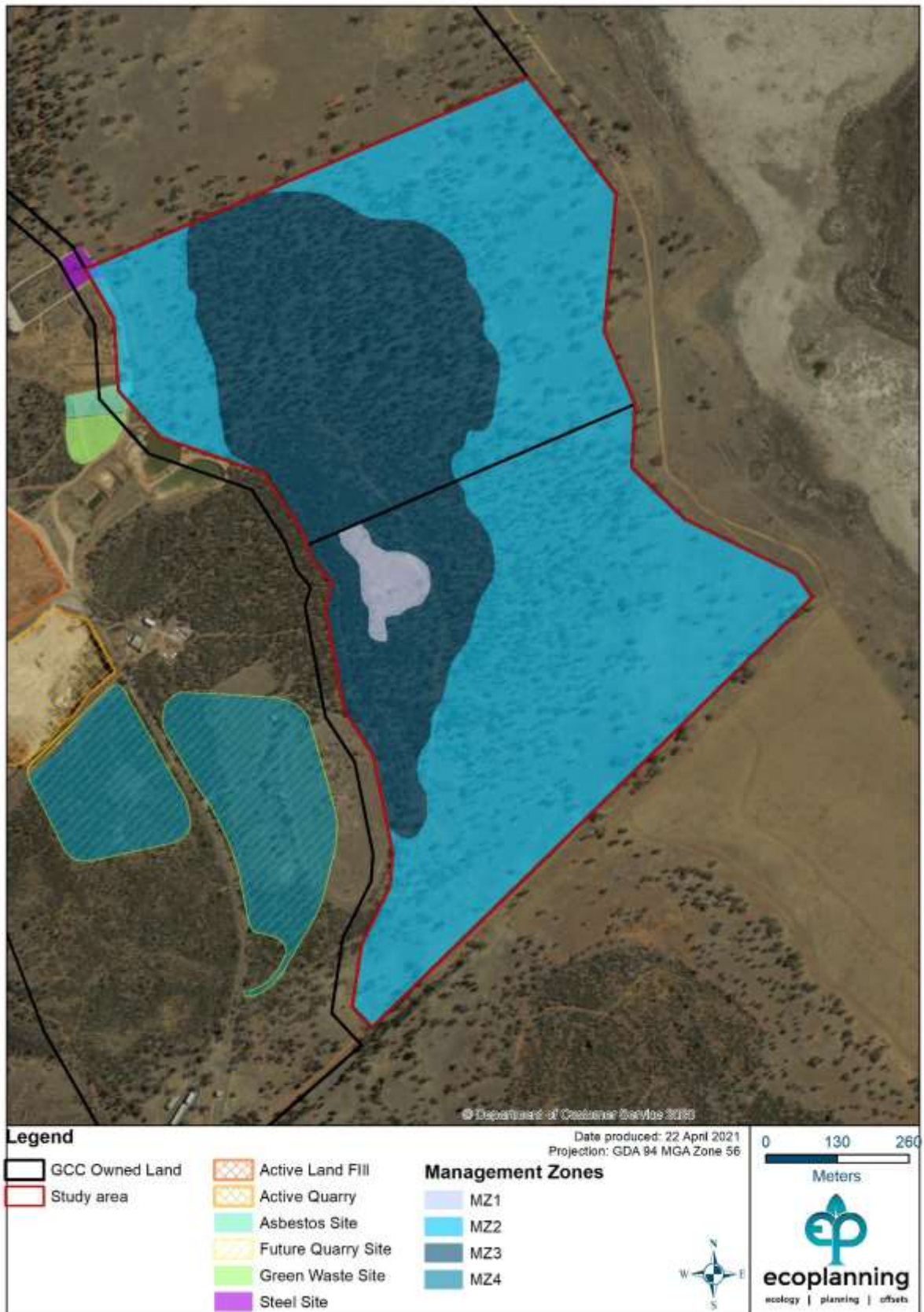


Figure 4.1: Biodiversity Offset Area and Quarry Rehabilitation Area Management Zones

Management Zones 2 and 3 have very high levels of resilience (the ability for native vegetation to naturally regenerate) and only require minor intervention works to control weeds. Management Zone 1 has a high level of resilience but a lower condition class and may require increased intervention. Management Zones 4 and 5 represent QRA1 and QRA2 respectively and as such will be unvegetated and have very low resilience when rehabilitation actions are implemented in the future.

In Management Zones 1, 2 and 3 there are very low levels of weed invasion. Priority species for control include *Hypericum perforatum* (St. Johns Wort) and *Echium plantagineum* (Paterson's Curse). *Lycium ferocissimum* (African Boxthorn), *Rubus fruticosus* sp agg (Blackberry), *Xanthium spinosum* (Bathurst Burr) and *Opuntia* spp. (Prickly and Tiger Pear) are also present in low densities. Refer to **Section 5.6** and **Appendix B** for preferred control measures. Management Zone 4 is likely to have a high level of weed invasion if unmanaged post quarry works and landfilling. More weed species have been found in the QRA than in the BOA, and they are likely to find the soil disturbance and lack of native competition conducive to rapid growth.

Throughout the majority of the BOA, no broadscale revegetation work is required due to its high resilience. However, some supplementary planting may be required to introduce endemic Poplar Box Woodland species that are currently underrepresented. In addition, some areas such as Management Zone 1 may be slow to recover an overstorey and may require planting to accelerate that process. The revegetation methodologies and rate suggested below are indicative only and used as a basis for developing management actions in **Section 5**. The property manager may need to vary the revegetation methodology because of the issues with availability of numbers and diversity of species and/or equipment/labour. Also, opportunities for direct seeding will be undertaken in circumstances that allow and rates/densities may be modified given changes in environmental conditions (either natural regrowth or poor soil moisture etc.). The species to be used for direct seeding and tubestock revegetation within Management Zone 1 are taken from Benson et al. (2008), although only species known from the GCC lands and adjacent areas have been identified for re-seeding (Eldridge 2002, ERC 2003, Ecosurveys 2006, ELA 2011). Species composition and projected foliage cover are compared against BioMetric benchmarks for this vegetation type (DECC 2008).

#### 4.2.1 MZ1 – Derived Native Grassland – High Resilience

Management Zone 1 (MZ1) is 1.41 ha. This area has high levels of resilience with greater than 50% cover of native species in the ground layer, but the overstorey is absent. Management in this zone will focus on removing weeds and increasing native cover and diversity, especially of overstorey and shrub species.

It is anticipated that the natural regeneration of the overstorey will occur once livestock grazing is excluded. If no regeneration of the overstorey is occurring after five years, revegetation with tubestock will be required with species identified in **Table 4.2**.

Regeneration of species composition in the midstorey and understorey will be monitored annually, with species complexity presumed likely to increase with the removal of grazing, as more palatable species begin to recolonise. In the event that species composition does begin to increase and record 75% of benchmark within 5 years, direct seeding should be considered. Revegetation species and proportion seed mix is identified in **Table 4.2**.

Completion criteria for this management zone requires native species composition to 75% of benchmark or more.

**Table 4.2: Management Zone 1 species to be used in revegetation (Benson et al. 2008)**

Common name	Scientific name	% of mix	Approximate numbers required
<b>Overstorey</b>			
Buloke	<i>Allocasuarina luehmanii</i>	30%	22
Kurrajong	<i>Brachychiton populneus</i>	20%	15
Poplar Box	<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	50%	35
<b>Midstorey / Understorey</b>			
Deane's Wattle	<i>Acacia deanei</i> subsp. <i>paucijuga</i>	15%	220
Hakea Wattle	<i>Acacia hakeoides</i>	5%	70
Mallee Wattle	<i>Acacia montana</i>	5%	70
Warrior Bush	<i>Apophyllum anomalum</i>	5%	70
	<i>Bertya cunninghamii</i>	3%	35
Hop-bush	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	15%	200
Tarbush	<i>Eremophila glabra</i> subsp. <i>glabra</i>	3%	35
Berrigan	<i>Eremophila longiflora</i>	3%	35
Budda	<i>Eremophila mitchellii</i>	15%	200
Wilga	<i>Geijera parviflora</i>	10%	150
Leafless Bluebush	<i>Maireana aphylla</i>	3%	35
Western Boobialla	<i>Myoporum montanum</i>	3%	35
Daisy Bush	<i>Olearia pimeleoides</i>	3%	35
Gargaloo	<i>Parsonsia eucalyptophylla</i>	5%	70
Shrubby Rice Flower	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	5%	70
Smoke Bush	<i>Ptilotus obovatus</i>	5%	70

#### 4.2.2 MZ2 – Open Woodland – High Resilience

Management Zone 2 (MZ2) is 60.68 ha and is the largest management zone in the BOA. There is greater than 50% cover of native species in the ground layer with an intact overstorey. However, PFC for the overstorey is below benchmark, and the shrub layer varies from below benchmark standards to exceeding them, reflecting the amount of immature regrowth of *Callitris glaucophylla* present (see **Table 3.3, Section 3**). Management in this zone will focus on removing weeds, especially around the edges of the BOA and increasing diversity of the native vegetation.

With the removal of grazing, this zone will be monitored and compared against benchmarks for species composition. In the event that species composition does begin to increase and record 75% of benchmark within 5 years, direct seeding should be considered. To help facilitate increased diversity in this community, direct seeding would occur in years five - nine if necessary. If satisfactory results are not achieved by year ten, revegetation with tubestock will be required. Indicative numbers and species to be used for direct seeding and tubestock revegetation in MZ2 are identified in **Table 4.3**.

**Table 4.3: Management Zone 2 species to be used in revegetation (Benson et al. 2008)**

Common name	Scientific name	% of mix	Approximate numbers required
<b>Overstorey</b>			
Buloke	<i>Allocasuarina luehmanii</i>	40%	250
Kurrajong	<i>Brachychiton populneus</i>	40%	250
Poplar Box	<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	20%	100
<b>Midstorey / Understorey</b>			
Deane's Wattle	<i>Acacia deanei</i> subsp. <i>paucijuga</i>	10%	1200
Hakea Wattle	<i>Acacia hakeoides</i>	5%	600
Mallee Wattle	<i>Acacia montana</i>	5%	600
Warrior Bush	<i>Apophyllum anomalum</i>	5%	600
	<i>Bertya cunninghamii</i>	5%	600
Hop-bush	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	10%	1200
Tarbush	<i>Eremophila glabra</i> subsp. <i>glabra</i>	5%	600
Berrigan	<i>Eremophila longiflora</i>	5%	600
Budda	<i>Eremophila mitchellii</i>	5%	600

Common name	Scientific name	% of mix	Approximate numbers required
Wilga	<i>Geijera parviflora</i>	10%	1200
Leafless Bluebush	<i>Maireana aphylla</i>	5%	600
Western Boobialla	<i>Myoporum montanum</i>	5%	600
Daisy Bush	<i>Olearia pimeleoides</i>	5%	600
Gargaloo	<i>Parsonsia eucalyptophylla</i>	5%	600
Shrubby Rice Flower	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	10%	1200
Smoke Bush	<i>Ptilotus obovatus</i>	5%	600

#### 4.2.3 MZ3 – Woodland – Very High Resilience

Management Zone 3 (MZ3) is 33.20 ha in size. The overstorey in this management zone is intact and there is greater than 50% cover of native species in the ground layer. This zone represents a climax condition class for this vegetation type and species composition is above benchmark for this community. Management in this zone will focus on retaining the native diversity while removing the few weeds present and preventing reinvasion. It is not anticipated that any revegetation or direct seeding works will be required in this zone.

#### 4.2.4 MZ4 – Woodland (projected) – Very Low Resilience

Management Zone 4 (MZ4) is 14.75 ha in size. This zone encompasses QRA1 and as such will be severely disturbed by quarrying works before rehabilitation works are initiated. When rehabilitation works are initiated no native vegetation layers will be intact. Management in this zone will focus on revegetation and weed control to get this zone as close as reasonably possible to benchmark condition. Indicative numbers and species to be used for direct seeding and tubestock revegetation in MZ4 are identified in **Table 4.4**.

The process for revegetating QRA1 will commence after all landfilling within the QRA has ceased. During operation of the landfill, landfill cells will be filled in a systematic manner, compacted, and covered with an approved capping layer which will include at least 0.15 m of topsoil at the surface. The revegetation of QRA1 will commence only after all cells within the landfill have been filled, capped, covered with topsoil, and stabilised. Stabilisation may require a cover crop, which is not related to the restoration objectives of the BMP and may be selected based on cover species most suitable for stabilising capped landfill cells to achieve objectives of the EPA.

**Table 4.4: Management Zone 4 species to be used in revegetation (Benson et al. 2008)**

Common name	Scientific name	% of mix	Approximate numbers required
<b>Overstorey</b>			
Currawang	<i>Acacia doratoxylon</i>	25%	400
Drooping She-oak	<i>Allocasuarina verticillata</i>	20%	300
Dwyer's Red Gum	<i>Eucalyptus dwyeri</i>	50%	700
Poplar Box	<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	5%	70
<b>Midstorey</b>			
Deane's Wattle	<i>Acacia deanei</i> subsp. <i>paucijuga</i>	30%	4400
Mallee Wattle	<i>Acacia montana</i>	10%	1500
Cough Bush	<i>Cassinia laevis</i>	20%	3000
Hop-bush	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	10%	1500
Seven Dwarfs Grevillea	<i>Grevillia floribunda</i>	20%	3000
Tick Indigo	<i>Indigofera adesmiifolia</i>	10%	1500
<b>Understorey</b>			
Long Greybeard Grass	<i>Amphipogon caricinus</i>	5%	1500
Smallflower Wallaby Grass	<i>Austrodanthonia setacea</i>	10%	3000
	<i>Austrostipa densiflora</i>	5%	1500
Speargrass	<i>Austrostipa scabra</i>	5%	1500
Purple Burr-daisy	<i>Calotis cuneifolia</i>	5%	1500
Hoary guinea flower	<i>Hibbertia obtusifolia</i>	15%	4400
Slender Wire Lily	<i>Laxmannia gracilis</i>	5%	1500
Many-flowered Mat-rush	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	5%	1500
Urn-heath	<i>Melichrus urceolatus</i>	15%	4400
Shrubby Platysace	<i>Platysace lanceolata</i>	15%	4400

Common name	Scientific name	% of mix	Approximate numbers required
	<i>Rytidosperma erianthum</i>	5%	1500
Mulga Mitchell Grass	<i>Thyridolepis mitchelliana</i>	5%	1500
Australian bluebell	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	5%	1500

#### 4.2.5 MZ5 – Woodland (projected) – Very Low Resilience

Management Zone 5 (MZ5) is 13.99 ha in size. This zone encompasses QRA2 and as such is in a severely disturbed state due to ongoing quarrying and landfilling. When these works are complete, the area of QRA2 will be capped. When rehabilitation works are initiated no native vegetation layers will be intact. Management in this zone will focus on revegetation and weed control to get this zone as close as reasonably possible to benchmark condition. Indicative numbers and species to be used for direct seeding and tubestock revegetation in MZ5 are identified in **Table 4.5**.

**Table 4.5: Management Zone 5 species to be used in revegetation (Benson et al. 2008)**

Common name	Scientific name	% of mix	Approximate numbers required
<b>Overstorey</b>			
Currawang	<i>Acacia doratoxylon</i>	25%	480
Drooping She-oak	<i>Allocasuarina verticillata</i>	20%	360
Dwyer's Red Gum	<i>Eucalyptus dwyeri</i>	50%	850
Poplar Box	<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	5%	85
<b>Midstorey</b>			
Deane's Wattle	<i>Acacia deanei</i> subsp. <i>paucijuga</i>	30%	5400
Mallee Wattle	<i>Acacia montana</i>	10%	1800
Cough Bush	<i>Cassinia laevis</i>	20%	4400
Hop-bush	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	10%	1800
Seven Dwarfs Grevillea	<i>Grevillia floribunda</i>	20%	3600
Tick Indigo	<i>Indigofera adesmiifolia</i>	10%	1800
<b>Understorey</b>			

Common name	Scientific name	% of mix	Approximate numbers required
Long Greybeard Grass	<i>Amphipogon caricinus</i>	5%	1800
Smallflower Wallaby Grass	<i>Austrodanthonia setacea</i>	10%	3600
	<i>Austrostipa densiflora</i>	5%	1800
Speargrass	<i>Austrostipa scabra</i>	5%	1800
Purple Burr-daisy	<i>Calotis cuneifolia</i>	5%	1800
Hoary guinea flower	<i>Hibbertia obtusifolia</i>	15%	5300
Slender Wire Lily	<i>Laxmannia gracilis</i>	5%	1800
Many-flowered Mat-rush	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	5%	1800
Urn-heath	<i>Melichrus urceolatus</i>	15%	5300
Shrubby Platysace	<i>Platysace lanceolata</i>	15%	5300
	<i>Rytidosperma erianthum</i>	5%	1800
Mulga Mitchell Grass	<i>Thyridolepis mitchelliana</i>	5%	1800
Australian bluebell	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	5%	1800

## 5 Management actions

The following sections outline the management actions that will be undertaken in the BOA and QRAs to address the requirements of Conditions of Approval 45 to 49.

### 5.1 Agree to conserve offset areas

CoA 46 requires GCC to implement suitable arrangements to provide long term security for the BOA to the satisfaction of the Director-General. A Conservation Agreement has formalised the offset area required under the Approval.

The need for a rehabilitation bond prior to commencing quarrying operations is specified in condition 51, Schedule 3 of the approval. This requires that the sum of the bond be \$1/m<sup>2</sup> for the area to be disturbed. Additionally, within 3 months of each Independent Environmental Audit (IEA), the proponent shall review and if necessary, revise the sum of the rehabilitation bond to the satisfaction of the DG (Condition 52, Schedule 3). This review must consider, inflation, changes to the total area of disturbance and performance of the rehabilitation and revegetation to date.

### 5.2 Management of Human Disturbance

#### 5.2.1 Access management

The management of human disturbances includes managing illegal access to prevent recreational 4WD, trail bikes, horse riding, rubbish dumping and unauthorised grazing and shooting on the BOA.

Recreational four wheel driving, trail bikes, horse riding and rubbish dumping have the ability to damage or destroy native vegetation, introduce invasive species to the site and displace native fauna species potentially reducing the biodiversity of the BOA. These human disturbances may be caused accidentally by the Property Manager/delegate or by illegal trespassers. Minimising disturbances within the BOA is required in order to adequately manage remnant vegetation and habitat on the site.

Human disturbance within the BOA will be managed by maintaining fences and signage as further discussed in **Section 5.3**; community consultation with neighbouring residents to ensure they are aware of the new management objectives of the property and the consequences to GCC if the offset site is not managed in accordance with this management plan; and illegal access will be managed by maintaining boundary fences and locking all boundary gates, including access to/from neighbouring properties, at all times. Gates will be locked using GCC locks and the Biodiversity Offset Property Manager will be responsible for authorising access.

GCC will appoint a Biodiversity Offset Property Manager (GCC Environment Officer) who will be responsible for coordinating the implementation and reporting on all aspects of this management plan. Approval from the Property Manager must be obtained prior to entering or undertaking activities on or in the offset site. Persons will only be permitted into the offset area to undertake management and monitoring actions identified in this RBOSMP.

Following rehabilitation works in the QRAs, access to the QRA will be restricted. Appropriate signage, fencing, and locked gates may be required, and will be managed by an appointed officer (GCC Environment Officer/delegate) to minimise human disturbance within QRAs. The location of signage, fencing, or gates will be determined as part of future reviews of the BMP as rehabilitation of the QRAs is progressed.

### 5.2.2 Access management of the Project Area

Following establishment of the QRAs, fences and signage will be put in place along the QRA boundaries (or surrounding areas within the Project Area but outside of the active quarry and landfill, as appropriate) to minimise potential human disturbance to vegetation rehabilitation areas through authorised and/or unauthorised access, as detailed in **Section 5.3**. As part of the QRA access management, signs will be installed along the boundaries with the QRA as per the specifications in **Appendix C**.

Protocols will be observed during clearing within the disturbance areas of the Project Area. As part of these protocols, areas outside the disturbance areas (i.e. the proposed quarry pits 101 and 103) will be protected as described in **Section 5.4**.

## 5.3 Fencing and Signage

Fences and signage will be utilised to identify the boundaries of the BOA to minimise potential human disturbance through authorised and/or unauthorised access. The fences will also be designed to restrict the access of neighbouring livestock. Ongoing maintenance of fences will be implemented as required to ensure adequate access restrictions are in place at all times.

New fences and replacement fences will incorporate the following 'wildlife friendly' specifications (Rawlings et al. 2010):

- The top two strands of the stock proof fence that are currently barbed wire will be replaced with plain wire;
- A night-visible fencing material (e.g. Borderline®) will be installed along the fence adjacent to high risk areas such as woodlands and wetlands; and
- No permanent internal fencing is to be constructed within the BOA. If internal fencing is required, it should be temporary (e.g. polywire electric).

The total boundary of the BOA is 4.77 km. The perimeter includes 3.91 km of existing fencing to be maintained and 0.86 km of new stock proof fencing to be installed on the northern boundary. Existing ringlock fencing on the south eastern boundary is to be modified with plain wire on the top and bottom strands to minimise harm to fauna. Five gates also exist within the BOA boundary along the southern perimeter. Installations of two new gates at the north-eastern and north-western corners of the site are proposed to facilitate access through the new fenceline. Signs will be installed on all gates of the BOA as per the specifications in **Appendix C**. Appropriate locations for placement of signage include at access gates into the BOA, locations of existing unauthorised bush tracks, and areas of development and high operational activity in the Project Area, such as where the green waste stockpile and stormwater detention pond border the BOA.

**Figure 5.1:** Existing and proposed fences/gates outlines existing fencing, proposed new fencing and installation of two new gates for the BOA boundary. A number of the existing



fencelines are outside the mapped cadastral boundaries of the BOA. However, given that the adjacent land is Crown Land managed by GCC, adjustment of these fencelines or installation of new fencing in these areas is not part of the proposed action.

Specifications or signage, fencing, and gates in the QRAs will be determined as part of future reviews of the BMP as quarrying activities progress ahead of rehabilitation of the QRAs. The boundary of the QRAs and the perimeter to be enclosed by fencing will be identified, and the specifications are to be similar to that used in the BOAs.



Figure 5.1: Existing and proposed fences/gates

## 5.4 Vegetation clearing protocol

Protocols will be observed during vegetation clearing within the proposed quarries of the Project Area, to minimise disturbance outside clearing areas. As part of these protocols, areas outside the disturbance areas (i.e. the proposed quarry pits 101 and 103) will be protected via the following:

- Boundaries including vegetation clearing limits of the proposed quarries are to be clearly identified on all site plans used by personnel conducting clearing works;
- Prior to commencement of clearing, vegetation scheduled for removal will be clearly delineated by the contractor. Flicker tape or similar will be installed at boundaries with retained vegetation;
- Contractors are to be made aware of clearing limits and how they are marked; and
- Contractors are to be informed that they are not to encroach on areas beyond the clearing limits, such encroachment includes, but is not limited to:
  - Vehicle parking
  - Storage of materials and machinery
  - Stockpiling of soil, vegetation, or timber

## 5.5 Management of grazing for conservation

Grazing of the site by livestock has the potential to suppress the regrowth of native vegetation through physical damage causing soil compaction and erosion, though moving from a grazing system to no grazing at all may result in major weed outbreaks. There is also potential that an extended period of wet years may increase vegetative biomass significantly, reducing the inter-tussock spaces and hampering the colonisation of herbs and forbs. As the ecosystem is approaching an equilibrium under a grazing regime, it is recommended that weaning the ecosystem off grazing with careful monitoring will achieve a more desirable outcome.

Stock grazing will be initially excluded from the BOA by maintaining existing stock proof fencing and installing new fencing around the boundaries of the BOA where required. All gates will be locked and accessible only by GCC and/or their representative. At the discretion of the future offset area land manager, there is potential for 'pulse' or 'crash' grazing to be introduced into the BOA depending upon management requirements.

This will be determined after initial works are complete and monitoring is underway. 'Pulse' grazing in the BOA should be undertaken only for ecological purposes. If undertaken, 'pulse' or 'crash' grazing should adhere to the following specifications shown in *Grassy Guide* (Barlow 1998) and *A Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010). Pulse grazing should:

- Only occur with the written permission of DPIE after consultation with DPIE and Local Land Services (LLS)
- Take into account variability within the BOA. Pulse grazing is most effective in grasslands (i.e. MZ1) and less effective in woodlands (i.e. MZ2 and MZ3)
- Be undertaken in such a way as to promote patchiness (i.e. areas of different age, density, and species)



- Take into account the ecological requirements of the native species being targeted for promotion
- Not be undertaken during spring unless for control of annual exotics
- Not be conducted during wet conditions
- Utilise 'clean' (i.e. weed free) stock, e.g., if sheep are used they should be introduced off-shears and with empty stomachs
- Incorporate adequate rest time for the patch after grazing to promote native recovery
- Weed and erosion control may also be required.

If deciding to graze, clear objectives of grazing must be outlined (eg. duration, grazing of exotic species, reduced biomass, creation of inter-tussock spaces). Regular monitoring is then required to identify when the objectives are met, and to allow land managers to respond quickly to rapid changes in grassland condition. The type of livestock used, duration of grazing and stocking rates will vary depending on the ecological objectives and vegetation condition.

Stock grazing will not be permitted within the QRAs. Stock proof fencing will be established surrounding the QRAs as needed to exclude stock.

## 5.6 Weed Control

The establishment and spread of environmental weeds are a threat to native vegetation within the Site. While the weed densities in the BOA are low, the most abundant weed species on GCC lands and adjacent properties include *Echium plantagineum* (Paterson's Curse) and *Arctotheca calendula* (Cape Weed). Other significant weeds include *Rubus fruticosus* sp agg (Blackberry), *Xanthium spinosum* (Bathurst Burr), *Alternanthera pungens* (Khaki Weed), *Marrubium vulgare* (Horehound), *Opuntia* spp. (Prickly and Tiger Pear), *Hypericum perforatum* (St. Johns Wort) and *Lycium ferocissimum* (African Boxthorn).

Weeds are a threat to native vegetation by contributing to the loss of biodiversity as a result of:

- Smothering regenerating native vegetation
- Preventing the regeneration of native vegetation
- Competing for essential resources such as light and water with native vegetation
- Displacing native fauna through the loss of habitat
- Altering ecological and physical processes.

The removal and on-going control of priority and selected environmental weeds on the offset area is required to improve the condition of native vegetation. The control techniques will be undertaken using minimal disturbance and are outlined further in the Weed Control Plan (Ecoplanning 2019a) for GCC lands and **Appendix B** of this BMP. The requirements of Table 4 Appendix C of the Conservation Agreement must also be adhered to within the BOA for 10 years following the execution of the Conservation Agreement, thereafter the BOA will be managed under the Weed Control Plan as per the remainder of GCC lands.

### 5.6.1 Weed control strategy

The weed control strategy for the Site involves the targeted control of priority weeds and Weeds of National Significance (WoNS), particularly Paterson's Curse, Horehound, Prickly and Tiger Pear, St. Johns Wort and African Boxthorn.

Priority weeds are plants that have the potential to pose a biosecurity risk to human health, the economy, community and environment. In New South Wales (NSW) the administration of priority weeds is a State Government responsibility under the *Biosecurity Act 2015* (Biosecurity Act). The Biosecurity Act is implemented and enforced by the Local Control Authority (LCA), in this instance GCC. In accordance with Part 3 (22) of the *Biosecurity Act 2015*, any person who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by biosecurity matter on their land, has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated, or minimised. Priority weed management under the *Biosecurity Act 2015* supersedes management of noxious weeds under the *Noxious Weeds Act 1993*.

A Weed Control Plan (WCP; Ecoplanning 2019a) has been devised for the site that will guide the control of infestations of these species throughout GCC lands. The WCP satisfies weed control objectives of the BMP. Actions of the WCP within the Site are summarised where relevant in **Section 6**. The proposed control strategy for targeted weed species is described further in the WCP, which details management zones relevant to particular weed species, management actions, recommended herbicides, and control techniques.

## 5.6.2 Performance criteria for weed control

Table 5.1: Performance criteria

Applicable to	Preliminary weed control	Secondary weed control		Maintenance		
	Year 1 to 3	Years 3 to 6	End of Year 6	Years 7 to 10	End of Year 10	Year 10 onwards
All zones	Management actions implemented according to Table 4 Annexure C of Conservation Agreement					Management actions implemented according to Section 3 of Weed Control Plan (Ecoplanning 2019a)
				A demonstrated increase in native cover and diversity and a demonstrated decrease in exotic cover and diversity in biometric plots		

Applicable to	Preliminary weed control	Secondary weed control		Maintenance		
	Year 1 to 3	Years 3 to 6	End of Year 6	Years 7 to 10	End of Year 10	Year 10 onwards
	80% of all adult woody weeds to be controlled No plants allowed to set seed and all seeding individuals removed No establishment of new noxious or woody species		All regrowth to be maintained to no greater than 20% coverage No plants allowed to set seed No establishment of new noxious or woody species	All regrowth to be maintained to no greater than 5% coverage No plants allowed to set seed No establishment of new noxious or woody species	Complete eradication of woody weeds from the site	No woody weeds re-establishing on the site
	-	-	Maximum exotic groundcover no greater than 50% of each zone		Maximum exotic groundcover covers no greater than 25% of each zone	Maximum exotic groundcover covers no greater than 25% of each zone
	Minimum native vegetation groundcover no less than 20% of each zone	Minimum native vegetation groundcover no less than 30% of each zone			Minimum native vegetation groundcover no less than 60% of each zone	Minimum native vegetation groundcover no less than 60% of each zone

## 5.7 Bushfire Management

Fire is an integral part of the Australian landscape and much of Australia’s flora is adapted to be able to withstand the impact of fire. Plant species respond to fire differently, including using fire to open woody seed pods or break seed dormancy, a reliance on fire at certain frequencies to provide an environment suitable for seed germination or thick bark that protects plants from heat so the plant can re-sprout vegetatively.

Fire intervals for grassy woodlands have been identified as being a minimum of eight years and a maximum of 40 years for grassy woodlands (NPWS 2004). Given the variable regeneration states of the management zones, various fire intervals within these guidelines will be required. **Table 5.2** identifies the various objectives for the management zones along with some areas where variability is possible. It is also important that current context is taken into account (e.g. drought, local area bushfire history, weed composition and density, condition of neighbouring properties) before embarking on ecological burns. No ecological burns are permitted within the BOA until at least 2022 in accordance with the CA. However, no ecological burns will be undertaken in any zone for a period of six years from the implementation of the RBOSMP in order to better understand the regeneration response and the site context. In addition, all ecological burn regimes will be reassessed at regular intervals (**Section 6**) to ensure correct management.

In the absence of fire, high summer temperatures, grazing and natural breakdown of seed dormancy can achieve similar outcomes to fire.

**Table 5.2: Bushfire management objectives**

Zone	Description	Objectives	Technique	Freq (yrs)
MZ1	DNG – No established canopy or shrub layer. Diverse groundlayer.	<ul style="list-style-type: none"> <li>Establish canopy</li> <li>Increase diversity</li> <li>Maintain existing values</li> </ul>	No burns for maximum interval in the first instance then re-assess based on regeneration.	40
MZ2	Open Woodland – Established canopy and shrub layer, but below benchmark. Diverse groundlayer	<ul style="list-style-type: none"> <li>Increase diversity</li> <li>Maintain existing values</li> </ul>	Patch burning where the following conditions are highly variable: <ul style="list-style-type: none"> <li>Patch size (small/large)</li> <li>Patch shape (not uniform)</li> </ul>	8-20
MZ3	Woodland – Established canopy and shrub layer at benchmark. Diverse groundlayer.	<ul style="list-style-type: none"> <li>Maintain existing values</li> </ul>	<ul style="list-style-type: none"> <li>Timing (spring/autumn)</li> <li>Frequency (within specified range)</li> <li>Intensity (hot/cool)</li> </ul>	8-40
MZ4 & MZ5	Woodland (projected) – areas to be restored to this vegetation community after landfill areas capped	<ul style="list-style-type: none"> <li>Re-establish vegetation to barren/ stabilised capped landfill areas</li> </ul>	No burns for maximum interval beginning after completion of revegetation works in the first instance. Then, re-assess based on regeneration. Exclude prescribed burning until the regeneration response has been determined.	40

Any unplanned wildfires that occur in the BOA in the interim will be managed through an appropriate response from the Rural Fire Service (RFS) to extinguish or contain the spread of the fire.

Small fire breaks will be maintained along existing and/or new fence lines installed as part of this RBOSMP. These breaks will double as access for RFS in the event of fire, and will be maintained quarterly by slashing the fire breaks.

## 5.8 Retention of regrowth and remnant native vegetation

Retention of native vegetation and regrowth/remnant vegetation are important to maintain and improve the biodiversity value of the BOA. Over most of the site, the natural regeneration of overstorey species is occurring. This regrowth is to be retained and similar regrowth will be promoted across the BOA. The clearance of native vegetation, including regrowth, is not permitted.

Exceptions to this rule include the maintenance of fence lines and management tracks in the BOA, and thinning (**Section 5.9**). For example, if a tree or shrub is growing through or falls on the fence line this will damage the fence and potentially provide access for livestock to the offset area. This vegetation will be removed using minimal disturbance techniques. All waste from the clearance of this vegetation will remain in situ in the BOA away from any fence lines or management tracks.

All regrowth and remnant native vegetation will be retained in lands within the Project Area and adjacent to the QRAs (with the exception of operational areas of the quarry and landfill), as native vegetation adjacent to the QRAs will contribute to regeneration in these areas.

## 5.9 Thinning of native vegetation

Regeneration is a sign of healthy woodland that has the capacity to maintain itself well into the future. In the BOA, the regrowth of *Callitris glaucophylla* provides habitat for threatened and rare birds such as the Grey-crowned Babbler and the Red-capped Robin. However, while not currently an issue, this regeneration can become too successful and dense stands of *Callitris glaucophylla* can 'lock up' remnants by suppressing the regeneration of Eucalypt and understory species, that is, stop growing when only a metre or two in height (Rawlings et al. 2010).

There is potential for 'lock up' to happen within the BOA and patchy thinning in some areas may be required in the future. If this were to occur, the following management actions should be undertaken:

- Areas where the regrowth density has caused bare ground underneath should be prioritised.
- When thinning, the larger and stronger saplings should be retained representative of the species diversity.
- Thinning should maintain enough individuals to achieve a future density of approximately 50 trees per hectare (this means that for small trees (less than 10 cm diameter at breast height), leave at least 400 stems per hectare (approximately 5 x 5 m spacing), trees larger than this should not be thinned)

- Trees should be cut by heavy-duty brushcutter and no herbicide needs to be applied as *Callitris glaucophylla* does not re-shoot from the stump.
- Thinning should be followed by weed removal and if deemed necessary revegetation.
- In areas where bare ground is exposed, erosion control measures may be needed.

Thinning of native vegetation in the BOAs is to occur no earlier than the 10<sup>th</sup> year following the execution of the Conservation Agreement. The status of woodland regeneration in the BOAs will be reviewed at this time based on the factors listed above, and a decision will be made as to whether thinning of native vegetation is necessary.

## 5.10 Infill planting

Due to historical land management practices across the offset area, much of the mature overstorey of the BOA and the surrounding land has been cleared. This is especially apparent in MZ1 and to a smaller extent MZ2. The BOA has not been subject to pasture improvement and the native vegetation of the ground layer remains largely intact, albeit modified. To restore the native overstorey it is proposed to remove livestock grazing to promote the natural regeneration of the overstorey. If overstorey species (e.g. *Eucalyptus populneus* subsp. *bimbil*) and midstorey species (e.g. Wilga) do not regenerate after ten years, in fill planting will be required to establish the overstorey.

The following specifications should be met regarding any revegetation that may take place:

- Species selection will be dictated by the remnant vegetation community (see **Section 3.6, 4.2.4, and 4.2.5**)
- The seed for this revegetation will be collected from the BOA, GCC lands and surrounding areas of the same community type and either propagated for planting as tube stock / hiko cells or used in direct seeding.
- Planting method should be 'low impact' such as hand spot planting or mechanical auger plantings.
- Planting hole should be 1.5x the depth of the root ball and at least 2x the width.
- Plants to be planted with one fertiliser pellet per plant.
- Plants to be planted with water crystals as per label specifications.
- Plants are to be planted slightly below the surrounding surface, so that the 'dish' created around the plant collects and pools water.
- Tree-guards are to be installed.
- Planting to occur from autumn and early spring depending on rainfall and will require watering when planted with follow up watering as required (spring plantings may require frequent watering as temperatures increase into summer). Initial irrigation is not needed if plantings are undertaken before sufficient rainfall.

Note that growing or striking of plant stock can take up to nine months before they can be planted and this needs to be factored in to project timeframes, in addition to seed collection requirements.

If natural regeneration does not occur within the management zones within the first five years of this plan the following infill planting is recommended for the BOA (**Table 5.3**):



**Table 5.3: Recommended infill requirements**

Management Zone	Description	Technique
MZ1	Derived Native Grassland	Direct seeding of grass and forb species. If no response from direct seeding, tubestock planting will be required
MZ2	Open Woodland	Direct seeding of ground layer species including grasses and forbs; and tubestock for shrub and canopy species.
MZ3	Woodland	No infill revegetation required
MZ4 & MZ5	Revegetation	Revegetation requirements for MZ4 and MZ5 are provided in <b>Section 4.2.4</b> and <b>4.2.5</b>

Direct seeding will be the first method of revegetation for the management zones. If the direct seeding establishes well it will reduce or negate the requirements for tubestock planting in these areas. Species that usually work best in direct seeding include wattles, peas, some eucalypts, casuarinas, grasses, daisies and ‘pioneer’ species (the first to come up after a disturbance in natural woodlands) (Rawlings et al. 2010). Depending on which seeds are used they can be broadcast on the surface or buried under lightly disturbed soil. Direct seeding should utilise low impact techniques such as brush matting, niche seeding, or hand broadcasting. Seed should be distributed in clumps rather than widely scattered. These ‘nodes’ should contain a diverse assemblage of species.

In MZ1, groundcover species such as forbs and grasses will be planted at a density of 1 plant every 10 m<sup>2</sup> or 1,000 plants per hectare to achieve a final density of one plant per 20 m<sup>2</sup> or 500 plants per hectare (assuming up to 50% loss), to enhance species diversity and densities up to ~40%, as per the benchmark for Poplar Box Woodland vegetation type (**Section 11**).

In MZ2, canopy species will be planted at a rate required to achieve a density of one plant per 400 m<sup>2</sup> or 25 trees per ha (assuming up to 50% loss) or a canopy cover of between 15-25%, which is within the benchmark for Poplar Box Woodland vegetation type (i.e. 14-27%) (**Section 11**). Shrub species will be planted at a rate required to achieve the final density above when taken in context with the existing vegetation (approximately 200 plants per hectare). Shrubs should be planted in clumps rather than scattered individuals. These ‘nodes’ should contain a diverse assemblage of species. The species to be planted and an estimate of the number required are shown in **Section 4.2**. It is assumed that propagation of seed and the raising of tubestock will occur in existing GCC facilities.

Revegetation planting requirements for MZ4 and MZ5 are provided in **Section 4.2.4** and **4.2.5**.

Infill planting within MZ1 and MZ2 is to occur no earlier than seven years following execution of the Conservation Agreement, following assessment of natural regeneration via the monitoring program detailed in **Section 8**. Infill planting within MZ4 and MZ5 will begin as soon as practicable after the capping and installation of topsoil over each of the respective landfill QRAs following closure.

### 5.10.1 Seed collection

Where revegetation or direct seeding is required, seed must be collected from local provenance species. Groundcovers, shrubs and trees should be collected from within 3km of

the site. Should seed not be available within 3 km, this radius can be extended to a maximum of 10 km; any further extension of the seed collection radius requires written approval from DPIE.

Native grasses typically have much larger dispersal ranges and are to be collected from within a 10 km radius of the site. Should seed not be available within this radius, DPIE may provide written approval for seed supply from other areas of the Murrumbidgee CMA.

Where the species identified in this plan cannot be sourced, they may be substituted for other local endemic species as identified in BioMetric Vegetation Types database (DECCW 2010). Trees must be substituted with trees, shrubs with shrubs, etc. Only wild native species are to be used. Plants are not to be substituted with horticultural varieties under any circumstances.

Record keeping of seed collection and planting locations is to be as per the Flora Bank guidelines (Mortlock 2000). The bush regeneration contractor is responsible for recording this information and providing it to DPIE. The bush regeneration contractor must hold a Section 132C licence under the *NSW National Parks and Wildlife Act 1974* (NPW Act) will be required to undertake seed collection works.

Seed collection for revegetation works in MZ1 will only be required if natural recruitment of species within MZ1 is still poor in the seventh year after commencement of CA works. Seed collection for revegetation within MZ4 and MZ5 will be required in advance of rehabilitation works within these areas, and should be begun at least one year prior to the planned closure and capping of the landfill, to allow sufficient time for raising tubestock.

### 5.11 Retention of dead timber

Dead timber refers to standing dead trees and fallen timber on the ground. Dead timber is an important habitat structure in the natural landscape. It provides essential roosting and breeding habitat for many species of fauna and can provide micro-habitats for many species of flora to germinate. Fallen logs also allow for the accumulation of leaf litter, runways for ground dwelling reptiles and mammals, perching habitat for birds, and habitat for a high numbers of insects which fauna forage on. Dead trees often contain tree hollows which are important roosting or breeding habitat for many species of fauna, including mammals, birds, reptiles and frogs.

All fallen timber will be retained on BOA and will not be used for any other purpose other than a habitat feature. It will not be used for the repair of fence posts or for fire wood.

Dead wood from the impact area will be distributed around the BOA as the impact area is cleared. Trees should be left as whole as possible and scattered randomly throughout the BOA, not piled. Heavy machinery should not be used in high quality patches or when the ground is wet, and logs should be lifted rather than dragged. Only woody debris from local native species should be used and care should be taken not to introduce weeds and exotics with the timber.

Where possible, dead wood sourced from disturbed areas within the Project Area is to be utilised in the QRAs as these are rehabilitated.

## 5.12 Nest boxes

Given the absence of HBTs in MZ1, MZ4 and MZ5, nest boxes are recommended to supply shelter for the threatened species that are known to use the area. Nest boxes should be placed in MZ1, MZ4 and MZ5 after regeneration or revegetation has progressed sufficiently to provide trees of sufficient size to hold nest boxes (approximately 10 years). Nest boxes should be placed at a density consistent with the BioMetric benchmarks, as per below.

**Table 5.4: Nest box density requirements in MZ1 (BOA) and MZ4 & MZ5 (QRAs)**

Area	Biometric Vegetation Type	Hollow bearing trees / ha
BOA	Poplar Box Woodland	30
QRA	Dwyer's Red Gum Woodland	10

## 5.13 Erosion and sedimentation control

Soil erosion occurs when native vegetation has been removed exposing bare soils, making them susceptible to erosion where high volumes of water are able to disperse the soil. This often occurs along creek lines but can occur in bare paddocks where vegetation clearance or over grazing exposes the soil. Bare soils are susceptible to high rainfall events where high volumes of water disperse the soil leading to severe soil erosion.

Weed removal may result in the exposure of bare earth. Any weed removal should be done in such a way so that native species are encouraged to colonise the bare earth. This means that the timing of the removal of exotic vegetation should consider what native species are likely to colonise the area and when would allow them to do so most efficiently. In addition, fire management in the future may result in the exposure of bare earth and the same considerations should apply. If rapid native colonisation of bare earth patches is unlikely then physical erosion and sediment control (e.g. coir logs, jute matting, etc.) should be considered.

A Soil and Erosion Management Plan (SEMP) should be prepared for the QRAs upon closure of the quarry and completion of landfilling. It is recommended that this SEMP is consistent with best practice guidelines such as Landcom (2004), and will form a component of the Landfill Closure Plan (LCP).

## 5.14 Retention of rocks

Rocks are an important habitat feature in the landscape and provide essential habitat for fauna, particularly reptiles, mammals and some birds, to roost and breed. Rocks have often been removed from the landscape as they prevent tillage of the soil for agricultural purposes. The retention of rocks or placement of rocks in the BOA is important to provide suitable habitat for the conservation of fauna species.

All rocky habitat in the BOA will be retained in the offset area and will not be removed for any purpose. Where appropriate, bush rock from the impact area can be transferred to the BOA and future QRAs using the same principles as the transfer of dead timber.

## 5.15 Control of feral and overabundant native herbivores

Feral herbivores refer to species such as *Oryctolagus cuniculus* (European Rabbit) and *Capra hircus* (Feral Goat). These species have been introduced to Australia for various reasons, including hunting and agriculture. Overabundant native herbivores in the region include the *Macropus giganteus* (Eastern Grey Kangaroo). Native herbivore species have increased in the landscape due to increased watering points and suitable grazing land in the landscape.

The total grazing pressure of these species can cause significant problems for regenerating native vegetation, to the point that growth and regeneration of native vegetation can be limited or, in extreme cases, prevented. The control of these species in the BOA is required to promote the regeneration and growth of native vegetation.

Feral Goat and European Rabbit were observed on the BOA. Eastern Grey Kangaroo was also observed in moderate numbers on GCC lands. If the numbers of these feral and native herbivores increase, control programs will be implemented.

Flora monitoring (**Section 8.2**) will detect whether grazing pressure is having a detrimental impact on the recovery of native vegetation. Quarterly visual inspections (**Section 8.1**) will detect whether numbers of herbivores are increasing commensurate with the observed increases in grazing pressure in order to determine whether control strategies need to be implemented.

A strategy has been devised for the site that will control feral and over abundant native herbivore species. The proposed control strategy for feral and over abundant native herbivores includes:

- Closing of non-required watering points within the BOA
- Baiting European Rabbit where they are observed.
- Shooting or removing Feral Goat if they are observed on the property.
- Shooting Eastern Grey Kangaroos (following obtaining the necessary permits from DPIE) if they are having a deleterious effect on the BOA.

Specific management techniques applicable to both the BOA and Project Area are discussed in the sections below and in **Appendix D**. Management implementation in the BOA is described in detail Table 4 Annexure C of the Conservation Agreement.

### 5.15.1 Rabbit control

Management of European Rabbits in the BOA will utilise four broad techniques. The exact management approach, which may involve one or more of the techniques outlined below, will be determined by the land manager or their representative before implementation. This final determination will consider factors such as identification of warrens, seasonal and annual Rabbit population variation, changes in vegetation due to the ongoing management of the site and changes in surrounding landuse. It is likely that over the lifetime of this RBOSMP, the exact techniques required for Rabbit control will vary. This should be addressed in the monitoring works undertaken in the BOA and new techniques introduced and justified as part of the required reporting. Consultation with the Livestock Health and Pest Authorities will be required before any Rabbit control is undertaken. Implementation of Rabbit control techniques will only be undertaken by those who possess suitable qualifications. Technical specifications



for management actions described below will be as per Managing Vertebrate Pests: Rabbits (Williams et al. 1995) unless otherwise stated.

Management techniques for Rabbit control include:

1. Destruction of Rabbit warrens. No Rabbit warrens were identified in the BOA, however, if any warrens are found, they are to be mechanically ripped as the first preference;
2. Poised baits. This technique targets Rabbits that are feeding onsite, but can have off-target impacts (e.g. death or illness of predatory birds through bio-accumulation);
3. Rabbit proof fencing. This is a non-lethal and effective method for excluding Rabbits from the site. However, as this technique does not remove Rabbits from the surrounding area, continued maintenance of the fence is required to maintain its integrity; and
4. Opportunistic shooting. This is not effective as a stand-alone strategy, but may be useful when combined with other options as a way of eliminating individuals.

Details of the management techniques for Rabbits are provided in **Appendix D**.

### 5.15.2 Feral Goat control

Where Feral Goats are observed on the property they will be controlled by shooting. Shooting must be undertaken by persons with a fire arm license, using a high powered rifle and as humanely as possible (i.e. a single shot to head or chest).

### 5.15.3 Overabundant native herbivore control

Native herbivore control will only be undertaken when significant numbers of animals occur in the offset site and are having a deleterious effect on the BOA. Appropriate permit applications will be made to DPIE.

The control of native herbivores found on the site will be undertaken by shooting while spotlighting on an as needs basis. Shooting will be required to be undertaken by persons with a fire arm license, using a high powered rifle and as humanely as possible (i.e. a single shot to head or chest).

## 5.16 Vertebrate pest management

*Vulpes vulpes* (European Red Fox) and *Felis catus* (Feral Cats) have been observed within the GCC lands and are likely to occur in the BOA. Potentially, both these species can have a detrimental effect on the biodiversity of the offset site. The European Red Fox preys on native wildlife and has the ability to cause localised extinctions of wildlife species. The European Red Fox also has the ability to spread weed propagules and has been implicated in the spread of weed species such as the African Boxthorn. The Feral Cat also preys on small mammals and reptiles and has been implicated in the decline of many species of native Australian fauna. Specific management techniques are discussed below and in **Appendix D**.

Vertebrate pest management in the BOA over the short term will focus on European Red Fox control. Feral Cat control will be undertaken opportunistically. A strategy has been devised for the BOA that will control vertebrate pest species. Management of the European Red Fox

and Feral Cats within the operational areas of the Tharbogang Waste Management Facility is currently undertaken via opportunistic shooting by licensed and qualified shooters.

Methods for pest animal control can include shooting, trapping and use of poisonous baits consistent with advice from DPIE and LLS. Use control methods identified as 'humane' as defined in the NSW Codes of Practice and Standard Operating Procedures for Humane Pest Vertebrate Control (Control Capture and Destruction of Feral Animals in Australia) as developed by the NSW Department of Primary Industries. Training of GCC staff in baiting techniques may be required. The proposed control strategy for the control of vertebrate pests comprises:

- The use of 1080 poison baits for European Red Fox control; and
- Opportunistic shooting of European Red Fox and Feral Cat.

It must be noted that while the control of these species will have a significant impact on the vertebrate pest present in the BOA, without neighbouring landowners participating in similar programmes the abundance of these predators across the landscape is unlikely to be significantly affected. Integrating vertebrate pest management across several neighbouring properties will yield the greatest success. Any pest management should ideally be undertaken throughout GCC lands, including the Project Area.

Vertebrate pest and feral herbivore species that are likely to occur within the Project Area include European Rabbits, Feral Goats, European Red Fox, and Feral Cats. All of these species may have a detrimental effect on the biodiversity of the adjacent BOA and retained vegetation of the Project Area. If shooting is chosen as a control method within the Project Area, the use of fire arms must carefully consider the operation of the quarry and landfill, with the scope and timing of vertebrate pest control activities adjusted accordingly. Shooting must be undertaken by suitably qualified and experienced persons operating under all relevant licenses and permits. The use of 1080 poison baits as described above is more likely to be feasible in the Project Area. Controlling potential prey species for foxes and cats should also be considered within the Project Area, and can include trapping or baiting for House Mice (*Mus musculus*), Black Rat (*Rattus rattus*), or other pest species to augment other control methods. Control of prey species within the Project Area will benefit the BOA by reducing prey availability for resident feral foxes and cats.

Details of the management techniques for vertebrate pests are provided in **Appendix D**.

## 5.17 Reducing visual impacts

GCC will implement the following mitigation and management commitments to reduce visual impacts of the ongoing quarry and landfill operations:

- The landfill will be rehabilitated and revegetated to replicate areas of open grassy woodland,
- Enhance vegetation in edge areas (landfill, roads, quarry edges etc),
- Cover edges with mulch as a temporary measure,
- Progressively rehabilitate quarry voids to minimise area of disturbance potential for loss/gain of water accession to groundwater,
- Progressively rehabilitate each quarry pit, and



- Cap and rehabilitate the landfill on completion.

GCC will implement the following visual controls to screen or filter views of the landfill from residential areas and public roads following rehabilitation of the QRAs:

- ensuring that all lighting associated with the project complies with Australian Standard AS4282(INT)1995 – Control of Obtrusive Effects of Outdoor Lighting;
- all infrastructure potentially visible to the public to be coloured in suitable natural tones, where practicable;
- progressive rehabilitation of disturbed areas; and
- revegetation will be progressively undertaken within the QRAs beginning with areas of vegetation screening.

## VEGETATION SCREENING

Native vegetation is to be planted within QRAs to screen views of quarrying, landfilling, and rehabilitation operations from public viewing points as part of progressive rehabilitation.

GCC will conduct native tree screening and seeding in the QRAs where the capped landfill areas are visible from a public viewing point. The following provides a general description of the site preparation, tree spacing and other details that are to be considered when establishing tree screen plantings:

- Site preparation - tree lines will be deep ripped to a minimum depth of approximately 400mm prior to planting;
- Spacing layout - taller trees will be alternated with shrubs. Trees will be planted approximately 3 metres apart in rows. Rows will be approximately 3 metres apart.
- Tree planting - trees will be protected by biodegradable mesh hare guards supported by two bamboo stakes (where possible/feasible). Two (2) slow release 21g fertilizer pills will be placed at the base of each root ball. All trees will be watered and weeded as required. Any losses will be replanted within six (6) months.

GCC staff/ contractors are responsible for ensuring that all tree screens are maintained to ensure that they meet their intended purpose. This includes, but is not limited to, the following:

- Controlling weeds that can compete with the “screening” species; and
- Replacing tube-stock that are not successfully established.



## 6 Management implementation

The following management strategy will be implemented on the BOA. Note that management has been staged to occur in four management periods as follows:

- Management Period 1 – Years 1 to 3 (**Table 6.1**)
- Management Period 2 – Years 4 to 6 (**Table 6.2**)
- Management Period 3 – Years 7 to 9 (**Table 6.3**)
- Management Period 4 – Year 10 onwards (**Table 6.4**)

Management actions have been presented as near as possible to a chronological project staging from top to bottom. Many tasks will overlap in their predicted time-frames.

### 6.1 Management Period 1

**Table 6.1: Management strategy years 1 - 3**

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Management of human disturbance	Manage access to site, including reduction of illegal access	Appointment of position formally given the responsibility of managing the Biodiversity offset (e.g. GCC Environment Officer).	Access actively monitored and managed and records kept.
All	Fencing and signage	Erect access fencing and gates	New fencing erected as required and gates with GCC locks.	Fencing and gates must also be suitable for stock exclusion
All		Install signage	Signage installed as per Appendix C	
All	Management of grazing for conservation	Ensure stock proof fencing	New fencing erected as required in the first three years	
All		Maintenance of fencing	Stock proof fencing maintained	1/20th replacement cost
All		Stock exclusion	Exclusion of stock for Period 1, complimented by crash grazing where necessary to reduce vegetative biomass	Stock grazing is removed for a minimum of six years from the implementation of this RBOSMP, unless deemed necessary in accordance with <b>Section 5.5</b>

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Weed control	Primary treatment of weeds	Primary management of target weed species over one year.	Management as per <b>Section 5.6.</b>
All		Secondary treatment of weeds	80 % of all woody weeds to be controlled, no plants allowed to set seed and all seedling individual removed and no establishment of noxious or woody weed species	Management as per <b>Section 5.6.</b>
All	Bushfire management	Fire exclusion	No controlled burns undertaken for Period 1	
All	Infill planting	Seed collection	Collection of seed for direct seeding and propagation	Focus on over and midstorey species. Collection as per <b>Section 5.10.1</b>
MZ1	Weed management	Weed Control	Control weeds within and around the management zone to enable natural regeneration to occur within the first 5 years.	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. management as per the WCP
MZ2	Weed management	Weed Control	Control weeds within and around the management zone to enable natural regeneration to occur within the first 5 years.	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. management as per the WCP
MZ3	Weed management	Weed Control	Control weeds within and around the management zone. No revegetation required.	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community.
All	Retention of timber	Transfer removed timber from the impact area to the BOA	Demonstrated in photo monitoring points	To be undertaken as feasible in accordance with <b>Section 5.11.</b>

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Retention of rocks	Transfer removed rocks from impact area to BOA	Demonstrated in photo monitoring points	To be undertaken as feasible in accordance with <b>Section 5.14.</b>
All		Retain all rocks on site	Demonstrated in photo monitoring points	
All	Control of feral and/or over-abundant native herbivores	Initial Rabbit control	>60% reduction in Rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers killed.	Undertaken as required.
All	Vertebrate pest management	1080 baiting for Fox Control	Fox baiting undertaken twice annually.	Effectiveness of baiting needs to be considered on a landscape scale.
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed.	Undertaken as required.
All	Monitoring	Establish annual monitoring programme.	Monitoring program established following guidelines in <b>Section 8.</b>	
All		Undertake monitoring programme on an annual basis.	Monitoring undertaken and completed following guidelines in <b>Section 8</b>	
All	Reporting	Prepare annual management plan implementation and annual monitoring reports.	Quarterly and annual reports, and annual monitoring report prepared and submitted to DPIE as per <b>Section 8.</b>	

## 6.2 Management period 2

Table 6.2: Management strategy years 4 - 6

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Management of human disturbance	Regular monitoring of fencing, gates, and access	Reduction in illegal access	

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Management of grazing for conservation	Maintenance of fencing	Stock proof fencing maintained	1/20th replacement cost
All		Stock exclusion	Exclusion of stock for Period 2	Stock grazing is completely removed
All	Weed control	Secondary treatment of weeds.	Secondary management of target weed species over three years to achieve minimum native vegetation cover of >30%	Management as per CA (for BOA) or WCP (Project Area)
All	Bushfire Management	Fire exclusion	No controlled burns undertaken for Period 2	All
MZ 1 and MZ 2	Infill planting if natural regeneration has not occurred within 5 years.	Seed collection	Collection of seed for direct seeding and propagation	Focus on over and midstorey species. Collection as per <b>Section 5.10.1</b>
MZ1	Infill planting if natural regeneration has not occurred within 5 years.	Direct seeding and tubestock planting if required.	Seeding and/or planting of groundcover species as required.	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per WCP.
MZ2	Infill planting if natural regeneration has not occurred within 5 years	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover, midstorey and canopy species as required	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per WCP.

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
MZ5	Revegetation planting if closure of existing quarry and landfill has occurred during period 2	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover, midstorey and canopy species as required	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per WCP.
MZ3	Weed management	Weed control	Control weeds within and around the management zone. No revegetation required	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community.
All	Control of feral and/or over-abundant native herbivores	Ongoing Rabbit control	Maintenance of reduced Rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers of Feral Goats killed	Undertaken as required.
All	Vertebrate Pest Management	1080 baiting for Fox control	Fox baiting undertaken twice annually	Effectiveness of baiting needs to be considered on a landscape scale.
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed	Undertaken as required.
All	Retention of timber	Retain on-site timber	Demonstrated in photo monitoring points	
All	Retention of rocks	Retain all rocks on site	Demonstrated in photo monitoring points	
All	Monitoring	Undertake monitoring programme on an annual basis	Monitoring undertaken and completed following guidelines in <b>Section 8</b>	

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All		Preparation of annual management plan implementation and annual monitoring reports	Quarterly and annual reports and annual monitoring report prepared and submitted to DPIE as per <b>Section 9</b>	

### 6.3 Management period 3

Table 6.3: Management strategy years 7 - 9

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Management of human disturbance	Regular monitoring of fencing, gates, and access	Reduction in illegal access	
All	Management of grazing for conservation	Maintenance of fencing	Stock proof fencing maintained	1/20th replacement cost
All		'Pulse' grazing	'Pulse' grazing undertaken as required for ecological outcomes	Management as per <b>Section 5.5</b> . Stock grazing is excluded at all other times
All	Weed Control	Maintenance treatment of weeds	Maintenance management of target weed species over three years	Management as per <b>Section 5.6</b>
All	Bushfire Management	Preparation for controlled burns and monitoring	Control burn management plan	
All	Bushfire Management	Controlled burns	Controlled burns undertaken as required for ecological outcomes	Management as per <b>Section 5.7</b>
MZ1 and MZ2	Infill planting	Seed collection	Collection of seed for direct seeding and propagation	Focus on over and midstorey species. Collection as per <b>Section 5.6</b>

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
MZ1	Infill planting	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover species as required	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per <b>Section 5.6</b>
MZ2	Infill planting	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover, midstorey and canopy species as required	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per <b>Section 5.6</b>
MZ5 if rehabilitation has commenced	Infill planting	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover, midstorey and canopy species as required	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per <b>Section 5.6</b>
MZ3	Weed management	Weed control	Control weeds within and around the management zone. No revegetation required	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community
All	Retention of timber	Retain on-site timber	Demonstrated in photo monitoring points	
All	Retention of rocks	Retain all rocks on site	Demonstrated in photo monitoring points	
All	Control of feral and/or over-abundant native herbivores	Ongoing Rabbit control	Maintenance of reduced rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers of Feral Goats killed	Undertaken as required

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Vertebrate pest management	1080 baiting for Fox Control	Fox baiting undertaken once annually as required	Effectiveness of baiting needs to be considered on a landscape scale
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed	Undertaken as required
All	Monitoring	Undertake monitoring programme on an annual basis	Monitoring undertaken and completed following guidelines in <b>Section 8</b>	
All	Reporting	Preparation of annual management plan implementation and annual monitoring reports	Quarterly and annual reports and annual monitoring report prepared and submitted to DPIE as per <b>Section 9</b>	
All		Periodic review of this RBOSMP	Updated management actions based on the changes found in the monitoring and annual reports	Undertaken every six years, starting in Period 3

## 6.4 Management period 4

**Table 6.4: Management strategy year 10 and onwards**

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Management of human disturbance	Regular monitoring of fencing, gates, and access	Reduction in illegal access	
All	Management of grazing for conservation	Maintenance of fencing	Stock proof fencing maintained	1/20th replacement cost
All		'Pulse' grazing	'Pulse' grazing undertaken as required for ecological outcomes	Management as per <b>Section 5.5</b> . Stock grazing is excluded at all other times
All	Weed control	Maintenance treatment of weeds	Maintenance management of target weed	Management as per <b>Section 5.6</b>

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
			species over three years	
All	Bushfire management	Controlled burns	Controlled burns undertaken as required for ecological outcomes	Management as per <b>Section 5.7</b>
All	Thinning of native vegetation	Thinning of <i>Callitris glaucophylla</i>	Thinning of areas of <i>Callitris glaucophylla</i> as required for ecological outcomes	Management as per <b>Section 5.9.</b>
MZ1	Infill planting	Revegetation	Planting of midstorey and canopy species as required for two years	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per <b>Section 5.6</b>
MZ2	Infill planting	Revegetation	Planting of midstorey and canopy species as required for two years	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per <b>Section 5.6</b>
MZ4 after rehabilitation complete	Infill planting	Revegetation	Planting of midstorey and canopy species as required for two years	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per <b>Section 5.6</b>

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
MZ5 after rehabilitation complete	Infill planting	Revegetation	Planting of midstorey and canopy species as required for two years	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per <b>Section 5.6</b>
MZ3	Weed management	Weed control	Control weeds within and around the management zone. No revegetation required	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community
MZ1	Nest boxes	Installation of nest boxes	Nest box number and location documented for one year	For one year only. As per specifications in <b>Section 5.12.</b>
All	Retention of timber	Retain on-site timber	Demonstrated in photo monitoring points	
All	Retention of rocks	Retain all rocks on site	Demonstrated in photo monitoring points	
All	Control of feral and/or over-abundant native herbivores	Ongoing Rabbit control	Maintenance of reduced rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers of Feral Goats killed	Undertaken as required
All	Vertebrate pest management	1080 baiting for Fox Control	Fox baiting undertaken once annually as required	Effectiveness of baiting needs to be considered on a landscape scale
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed	Undertaken as required
All		Cat control	Implementation and maintenance of a long-term cat control program	To be undertaken in concert with broader cat control on GCC lands

Management Zone	Management Theme	Management Action	Performance Measure (by end of period)	Comments
All	Monitoring	Undertake monitoring programme on an annual basis	Monitoring undertaken and completed following guidelines in <b>Section 8</b>	
All	Reporting	Preparation of annual management plan implementation and annual monitoring reports	Quarterly and annual reports and annual monitoring report prepared and submitted to DPIE as per <b>Section 9</b>	
All		Periodic review of this RBOSMP	Updated management actions based on the changes found in the monitoring and annual reports	Undertaken every six years

## 7 Cost to Implement RBOSMP

Based on a site inspection during September 2011 and ongoing site visits as part of annual monitoring, the management actions, frequency, intensity and duration required to meet the CoA as outlined in **Section 5** and **Section 6**, were costed at the commercial rates of implementation.

To assist in determining the management requirements, large scale, high resolution maps of the BOA were prepared to provide information on the surrounding land use, length of site perimeter, the length of tracks and trails and the area of each vegetation condition class.

The costing for the improvement works for the BOA have been based on the assumption that the completion criteria (**Section 11**) will have been achieved in 10 years subject to satisfactory regeneration of the tree-less areas and weed problems being controlled to a maintenance level. Costs for works undertaken as part of the impact site works (e.g. costs of transferring timber and rocks removed from the new quarry site to the BOA) have not been included.

The cost to implement this management plan will be the responsibility of GCC and are estimated to total approximately \$550,000 over the first 9 years during the active management phase (including Quarterly and Annual Reporting and the Flora & Fauna Monitoring Program Section 7.10) and then approximately \$45,000 per year thereafter until 'completion' (**Section 11**).

GCC have also planned the future management of the BOA after Year 10 in **Table 6.4** when it is expected that the completion criteria have been achieved. Additionally, the obligation to maintain the boundary fences in stock proof condition would be the joint responsibility of the GCC and neighbouring land owners.

### 7.1 Fencing and signage

Stock proof fencing as per the existing external fence has been costed at \$13,000 per km. This expense will be incurred in the first year. Fence maintenance is assumed to be required on an annual basis whereby the entire fence is replaced once in every 20 years.

If Rabbit-proof fencing were to be installed as per **Section 5.15.1** then there would be additional expense. The materials alone for a Rabbit-proof fence have been estimated to cost \$4,000 - \$6,000 per kilometre (Long & Robley 2004). With labour, these costs would likely be in the vicinity of \$20,000-\$30,000 per km. These expenses have not been incorporated in the schedule of costs provided.

### 7.2 Management of grazing for conservation

Costs for stock proof fencing have been incorporated into **Section 7.1**, above. Costs for 'pulse' grazing have been included starting in Period 3, as per **Section 5.5**. Costs for this management action have been estimated at \$1,000 per hectare for MZ1 and \$100 per hectare for MZ2. This difference is due to increased use of this management action in MZ1 over MZ2. The costs include the installation and movement of temporary fences, the movement of stock, and the wear and tear on existing fence lines and infrastructure.

### 7.3 Weed control

Bush regeneration contractors or suitably qualified GCC staff will implement the weed control works outlined in **Section 5.6**. These works have been calculated at \$1,680 for a team of four bush regenerators per day. The cost of bush regeneration works includes the costs of herbicide, vehicles and equipment which are required to implement weed control works.

### 7.4 Bushfire management

The costs of bushfire management as outlined in **Section 5.7** have been estimated to be \$10,000 every five years in the form of a donation to the RFS starting in Period 3. An additional \$1,000 at the same time has been budgeted to prepare for the controlled burns and monitor afterwards.

### 7.5 Thinning of native vegetation

If required, thinning of *Callitris glaucophylla* should be undertaken by bush regeneration contractors or suitably qualified GCC staff as per the specifications in **Section 5.9** and the costs shown in **Section 7.3**. The total for these works is \$5,040 to be undertaken every three years starting in Period 4.

### 7.6 Revegetation treatments

Bush regeneration contractors or suitably qualified GCC staff will implement the infill planting works. Budget for the collection of seed from the site and surrounding area has been included for Period 1 - 3. These costs do not include the propagation of these seeds for revegetation in Period 4, which are included in the revegetation costs. Costs for direct seeding have been estimated at \$2,000 per hectare for MZ1 and \$1,000 per hectare for MZ2, given the different density requirements. These costs are based on the use of a 'niche seeder' and include site preparation.

Costs for revegetation have been budgeted at \$2,800 per hectare for MZ1 and \$460 per hectare in MZ2 to achieve the densities required in outlined in Section 4.9. This rate includes planting, tree guards, water crystals and initial watering for overstorey species. A total of 1,480 plants will be required in MZ1 at a cost of \$4,000. A total of 12,743 plants will be required for MZ2 at a cost of \$28,000. These costs include provision for 30% replacement plantings in MZ1 and 10% in MZ2. Costs for both have been spread over two years (Period 4).

### 7.7 Nest boxes

Arborists or suitably qualified bush regenerators / ecologists / GCC staff will implement the nest box works. It has been estimated that nest boxes will cost \$200 per box to supply and install and will be installed at a density of 30/ha in MZ1 in Period 4 and 10/ha in MZ4, ca. 10 years into rehabilitation of the post mine/landfill landform.

### 7.8 Control of feral and overabundant native herbivores

Feral pest management will be undertaken by suitably qualified staff only. The costs for Rabbit control have been estimated to be \$5,000 per year in Period 1 and \$2,500 per year in Periods 2-4. The cost of Feral Goat control has been estimated to be \$1,000 per year.



## 7.9 Vertebrate pest management

Feral pest management will be undertaken by suitably qualified staff only. The costs for Fox control has been estimated at \$3,000 per baiting session to be conducted twice per year in Periods 1-2 and once per year in Periods 3-4. The cost of opportunistic shooting of Foxes and Cats has been estimated at \$1,000 per year. The cost of a cat control program, the exact form to be determined later has been very roughly estimated at \$5,000 per year starting in Period 4.

## 7.10 Flora and fauna monitoring program

Bush regeneration contractors, ecologists or suitably qualified GCC staff will implement the flora and fauna monitoring program (**Section 8**) as per the rates shown in **Section 7.3**. The costs to establish the annual monitoring program has been estimated at \$3,360 in Period 1. The recurring costs of undertaking the annual monitoring program are estimated to be \$6,720 per year in Periods 1-4.

## 7.11 Annual BOA and rehabilitation report

Bush regeneration contractors, ecologists or suitably qualified GCC staff will implement the flora and fauna monitoring program (**Section 8**). The costs to prepare quarterly and annual monitoring reports have been estimated at \$6,000 per year for Periods 1-4. A periodic review of the RBOSMP every 6 years starting in Period 3 has been estimated at \$5,000.

## 8 Monitoring program

This section of the Management Plan provides an overview of the flora and fauna monitoring requirements in accordance with CoA 49. The completion criteria (Section 12) have been aligned to this monitoring program and made consistent across both the BOA and QRA.

The objective of the monitoring program is to evaluate the restoration progress of the BOA and QRA towards fulfilling successful vegetation restoration objectives and closure criteria. The purpose of monitoring activities across BOA and QRA are to ensure the sustainable management of native flora and fauna, and to guide continual improvement in practices and the management of rehabilitation and biodiversity offset areas.

The monitoring program is, in general, consistent with the standard flora and fauna assessment guidelines (DECC 2004), and has been refined considering the potential future vegetation monitoring requirements outside of the current BOA, should any additional areas of GCC lands be offset in the future to maintain a consistent monitoring methodology)

The monitoring program is broken up into the following components of Quarterly Visual Inspections, Annual Flora Monitoring, and Annual Fauna Monitoring.

### 8.1 Quarterly visual inspections

Visual monitoring is a field based rapid assessment tool that provides an assessment of various landscape contributors and associated remedial actions. Visual inspections will be undertaken by the appropriately qualified GCC staff and include:

- Vegetation components (overstorey, understorey and ground cover where applicable)
- Presence of exotic weed and feral animals species
- Surface stability and erosion issues
- Disturbance factors including fire and unauthorised access e.g. rubbish dumping, off-road vehicle access, shooting, etc.

Any areas of high erosion risk will be visually monitored on a regular basis and particularly after high rainfall events. The Quarterly Visual Inspection template is included in Appendix 5. This template is a working document and modifications to this template should be made as considered appropriate by the land manager to include additional observation or remove tasks.

### 8.2 Flora monitoring

#### 8.2.1 Flora monitoring BOA

Vegetation monitoring will utilise the Biobanking Assessment Methodology (BBAM) to monitor the trajectory of each management zone towards the benchmarks for each vegetation type. Vegetation plots undertaken for the BOS target land to the north of the final BOA, and as such a baseline dataset will need to be established within the BOA. These sites should be:

- A minimum of two plots in each vegetation condition class (i.e. management zone) for patches greater than 5 ha as mapped within BOA and one plot in management zones <5 ha (the number of vegetation monitoring replicates has



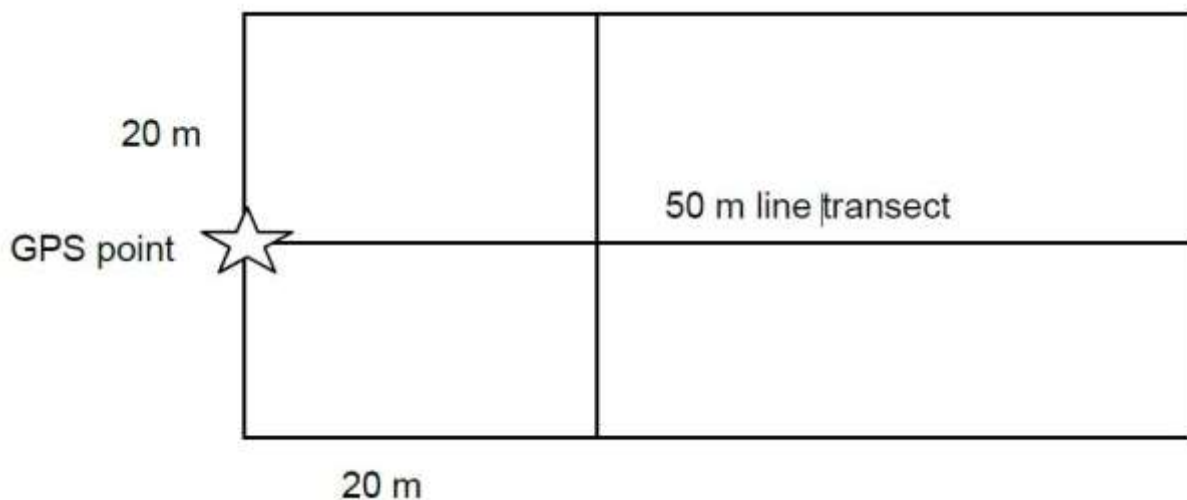
been refined considering the potential future vegetation monitoring requirements outside of the current BOA, should any additional areas of GCC lands be offset in the future to maintain a consistent monitoring methodology)

- Permanently marked by a star picket at the start and end of a 50 m transect established perpendicular to the contour, preferably in an east west or north south orientation.

As a number of vegetation plots have already been established and marked in the northern portion of the GCC lands, three of the plots located within the climax state of each vegetation type should be utilised as a reference site (for baseline BioMetric data and location of these plots see BOS, ELA 2011).

For each transect, flora monitoring will enable a comparative measurement of the vegetation status against the completion criteria in **Section 11**. Using the starting point of each transect, components of the BAM will measure the status of vegetation condition for each replicate against the completion sub-criteria 2.2 to 2.5 in **Table 11.1** from **Section 11**. The additional monitoring using the BAM will be:

- Native plant species number and cover per 400 m<sup>2</sup> (20 m x 20 m quadrat)
- Overstorey cover range measured at 10 points along a 50 m transect
- Midstorey cover range measured at 10 points along a 50 m transect
- Groundcover measured at 50 points along a 50 m transect



**Figure 8.1: Vegetation assessment plot**

The results of monitoring activities across the BOA site are to ensure sustainable management of native flora communities, and to guide the continuous improvement of management strategies. Where necessary, rehabilitation and biodiversity offset area restoration practices will be amended, or as more data becomes available regarding analogue sites or the targeted vegetation type benchmarks; completion criteria can be updated to ensure rehabilitation and biodiversity offset areas are improving on the right trajectory. A Vegetation Monitoring Database will be developed and include a flora species register of potential and recorded species in the BOA and QRA. The condition of the biodiversity offset area and rehabilitated

vegetation identifies any deterioration or improvement in habitat quality will assist in the targeting of resources towards:

- Native seed collection
- Habitat enhancement
- Noxious and environmental weed control
- Vertebrate pest control

The monitoring results will identify particular vegetation components that may not be tracking towards specific closure criteria (**Section 11**). This will allow the GCC to prioritise management actions to address deficiencies and/or amend procedures.

### 8.2.2 Flora monitoring QRAs

Flora monitoring plots are to be established within the QRAs within 1 year after completion of revegetation works within each QRA. The Flora monitoring methodology will be as described in **Section 8.2.1** above, with the number and location of monitoring points to be determined after the QRAs are established.

## 8.3 Fauna monitoring

Fauna monitoring will be undertaken by a person appropriately trained and qualified for bird and microbat survey. Surveys will specifically target threatened species previously recorded, or with potential to occur within the area. The targeted fauna monitoring is directed by the previous fauna survey work with sufficient data indicating that there is limited presence of native ground and arboreal mammals, with no threatened species of these fauna groups considered likely to occur in the BOA or QRA. As such, annual fauna monitoring surveys will target woodland birds and microbats, which represent all of the threatened species previously recorded onsite. These species will provide information on the progress of woodland restoration, particularly in the first 10 years of restoration activity. Group size of bird species will be monitored where possible to determine changes in abundance, with priority given to capturing group size in threatened avifauna.

The first year of monitoring will establish baseline data sets for ongoing comparison (i.e. ongoing data collected will be directly comparable using the same methodology). GCC will maintain a fauna species register based on the likelihood that a species would be present and documenting from previous monitoring programs species recorded onsite.

As with the fauna survey, the number of fauna monitoring replicates has been refined considering the potential extant vegetation monitoring requirements (outside of the current BOA) to maintain a consistent monitoring methodology should the additional areas of GCC lands be utilised as an offset in the future.

Fauna surveys will occur across all condition classes (i.e. management zones), with 2 replicates for each condition class with patches greater than 5 ha in area and one for vegetation condition classes with patches less than 5 ha in area (due to the standard timed/area monitoring methods (DECC 2004), and the mobility of fauna species, it is not possible to replicate monitoring sites in vegetation condition classes where patches of vegetation are only 2-3 ha in size. Similarly, for nocturnal bird monitoring, the standard survey methodology requires separation of 1 km between sites).



**Table 8.1: Fauna monitoring methods in each vegetation community/ condition class**

METHOD	DETAIL	REQUIREMENT PER SITE	FREQUENCY	SEASON
Nest box inspections	Inspection: Upon installation nest boxes will each require a one off inspection to check for use and if possible identify what species are using them.	Inspect nest boxes to be established in rehabilitation areas.	Annually	Early Spring – ideally September each year when the use of boxes by bird species can be detected.
Bat detection	Echolocation recordings to identify microbat species occurring on site. Two nights at each site	One detector for two nights in each management zone, set for a minimum of 4 hrs	Annually	Spring.
Bird survey	Timed, fixed area surveys for diurnal birds, observing and listening, capturing population scores where possible.	20 minutes / 2 ha count morning and dusk over 2 days	Annually	Spring.
Herpetological searches	Timed, fixed area, direct searches for reptiles, scanning surfaces, rolling logs and rocks and raking leaf litter.	30 minutes over 1 ha at each site	In line with other activities	Spring.
Collection of scats	Collect scats and send to laboratory for analysis of predator and prey species.	Opportunistic	In line with other activities	Year round.

The results of monitoring activities across the BOA are to ensure sustainable management of native fauna communities, and to guide the continuous improvement of management strategies. Where necessary, rehabilitation and biodiversity offset area restoration practices will be amended, or as more data becomes available regarding analogue sites or the vegetation benchmarks; completion criteria can be updated to ensure rehabilitation and biodiversity offset areas are improving on the right trajectory. Fauna surveys aim to target threatened species previously recorded, or with potential to occur within the area. The results of monitoring will be analysed and compared to previous survey results to determine general population trends. In the event that negative trends are identified indicating the decline of particular threatened species, appropriate amelioration measures must be recommended.

If new populations of threatened species or additional threatened species are identified through the course of monitoring or other observations, records will be assessed by a qualified ecologist to advise if any changes to the management of the offset area are required. This may result in:

- Certain planned activities being postponed or modified
- Modification of the monitoring program
- Immediate survey and assessment of the new record, and an assessment of the impact of the proposed activity on it.

If further threatened species or significant new records of existing threatened species are collected, the significance of such records will be reviewed, as will the likely impact of existing or proposed management activities, and any options for minimising impacts on these species considered.

## 9 Reporting

The annual BOA report will consist of two parts:

- Summary of the implementation of management actions within the RBOSMP including inspection results and review findings
- The results of the flora and fauna monitoring program

### 9.1 RBOSMP implementation

The annual RBOSMP implementation report will provide a summary of all the actions implemented during the previous year, documented from Property Managers Quarterly Inspections (**Appendix E**). Any significant events that occurred during the year (e.g. wild fire, outbreak of any weeds or incidence of any new threats) and any recommended changes to the management actions, their duration, intensity or relative priority identified through the annual review (**Section 10**) will be included.

### 9.2 Flora and fauna monitoring reporting

#### 9.2.1 Flora

Annual vegetation monitoring reporting is to include a written summary of the methodology and the current year's findings for each vegetation plot, including the average results of each variable recorded. Photo monitoring records of each vegetation transect and field data sheets will be included in an appendix. A flora species list with corresponding plot numbers where species were recorded is to be included in an appendix.

A discussion section is to be included that compares the results from the current monitoring year with previous years either through actual annual records or a mean value where several previous years are being compared. The annual report is to include statistical graphs illustrating changes in diversity and cover/abundance of each attribute recorded within each condition zone.

An assessment of the current trajectory towards benchmarks will also be made.

#### 9.2.2 Fauna

The report is to include methods and results of fauna monitoring and significant findings, including any new records of threatened species. A fauna species list with corresponding transect numbers/survey site numbers where species were recorded will be included as an appendix.

A discussion section will be included that compares the species diversity results, as absolute numbers and grouped into various guilds representing the diversity of habitat types present from the current monitoring year with previous years. The annual report will include graphs and tables illustrating changes in the nocturnal birds, bats, diurnal birds and reptiles' abundance and diversity over time. As discussed in **Section 8.3**, the key species groups targeted to be monitored includes:

*Bats*

Bat diversity will be measured in three different groups:

- Megachiropteran (i.e. Flying-foxes);
- Microchiropteran (microbats) that forage in the sub canopy; and
- Microchiropteran that are canopy or above canopy foragers.

Graphs or tables that illustrate changes in bat diversity in each of these three groups are to be developed for each monitoring plot.

### *Birds*

Bird diversity is to be measured in three different groups:

- Raptors or birds of prey including nocturnal and diurnal;
- Ground and shrub guild, including woodland birds such as finches, wrens and warblers; and
- Generalists such as parrots and honeyeaters.

Graphs or tables that illustrate changes in avian diversity in each of these three groups are to be developed for each zone.

As it is uncertain whether abundance scores will be achievable for avifauna, bird species abundance will be captured where possible and compared over time if it is determined that sufficient data exists for comparison. Population counts will be prioritised to capture data on threatened avifauna, particularly the Grey-crowned Babbler.

## 9.3 Report recommendations and conclusion

A concluding section within the Annual Report that highlights and describes significant findings, either positive or negative, is to be prepared. Changes to any management recommendations for the following year will also be suggested.

A more comprehensive review of the RBOSMP will be conducted every six years starting in year 7. This will reflect on the effectiveness of previous management actions and recommend changes and adjustments for the next period, such as the potential cessation of monitoring in areas that have achieved completion criteria or are determined to be at a stable state (e.g. fauna diversity/abundance neither increasing nor decreasing).

## 10 Review and auditing

CoA 49(d) requires GCC to annually review performance against the RBOSMP and, if necessary, revise the BOS/RBOSMP to the satisfaction of the Director-General. To facilitate the annual review, a review protocol has been developed in **Appendix F** to be completed by the Property Manager. Annual reviews are conducted to assess the effectiveness of management strategies against the objectives of this RBOSMP. A review protocol for the RBOSMP will be completed annually. The findings of the annual review of the RBOSMP will be reported to management and in the annual report, and, if required, the RBOSMP will be updated for DPIE approval.

In general, the RBOSMP will be revised due to:

- Deficiencies being identified
- Outcomes from the Annual Review
- Recommendations from the Annual Report
- Changing environmental condition (e.g. wet/dry years etc)
- Improvements in knowledge or new technology becomes available.

The review and auditing process will be used to identify risks to successful rehabilitation and contingency measures required mitigate these risks.

## 11 Completion criteria

GCC have defined the rehabilitation and biodiversity offset area completion criteria to comply with the CoA detailed in **Table 2.1** to monitor woodland restoration performance against the criteria outlined in **Table 11.1**. The completion criteria have been aligned and made consistent across both the QRA and BOA.

The GCC completion criteria aim to achieve the following:

- The ongoing refinement of completion criteria and monitoring programs that will facilitate lease relinquishment following quarry closure
- Alignment with Rehabilitation and Biodiversity Offset Area objectives
- Facilitate continuous improvement in restoration management practices of the rehabilitation and biodiversity offset areas.

The completion criteria have been aligned to objectives for the rehabilitation and biodiversity offset areas. Each year the annual report will assess if the standard is met for each sub-criteria within the categories of Integrated Landscapes, Sustainable Growth and Development and Land Use. The completion criteria is considered to have been successfully achieved for each quarry rehabilitation area and biodiversity offset area if each sub-criteria standard is reached for each monitoring plot, and therefore, a sustainable final woodland community land use achieved. If the standard is not met for each sub-criteria, the remedial action will be implemented as soon as practical by the Property Manager within budgetary limitations. **Table 11.1** has been adapted specifically for Woodland Ecological Communities to be restored across GCC QRAs and BOA.

**Table 11.1: GCC Completion Criteria for Woodland Ecological Communities**

CRITERIA AND INTENT	MEASURE	STANDARD	REMEDIAL ACTION
<b>1.0 INTEGRATED LANDSCAPES</b>			
1.2 Does the area represent an erosion hazard?	Quarterly visual inspection by GCC staff	Erosion should not exceed 0.3 m (gully) deep (natural drainage lines exempt)	Undertake maintenance rehabilitation by additional shaping of surface to repair gully erosion
<b>2.0 SUSTAINABLE GROWTH AND DEVELOPMENT – WOODLAND ECOLOGICAL COMMUNITIES</b>			
2.1 Is there appropriate native plant species richness for the restored Ecological Community (EC)?	Vegetation monitoring by ecologist or appropriately qualified person will determine native plant species richness	Native plant species numbers (per 400 m <sup>2</sup> ) reach benchmark based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation by re-sowing / replanting missing plant species to achieve desired species richness
2.2 Is there an appropriate density/structure of native overstorey species?	Vegetation monitoring by ecologist will determine native plant species cover	Overstorey cover range measured at 10 points along a 50 m transect reaches lower benchmark based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation by re-sowing / replanting missing plant species to achieve desired species richness

CRITERIA AND INTENT	MEASURE	STANDARD	REMEDIAL ACTION
2.3 Is there an appropriate density/structure of native midstorey species?	Vegetation monitoring by ecologist will determine native plant species cover	Midstorey cover range measured at 10 points along a 50 m transect reaches lower benchmark based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation by re-sowing / replanting missing plant species to achieve desired species richness
2.4 Is there appropriate native groundcover?	Vegetation monitoring by ecologist will determine native plant species cover	Groundcover range measured at 50 points along a 50 m transect reaches lower combined benchmark for each groundcover types (grasses, shrubs, other) based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation either apply mulch and/or by re-sowing / replanting missing plant species to achieve desired coverage
3.0 LAND USE			
3.1 Is the area and sustainability (quality) consistent with intended land use?	RBOSMP monitored annually to measure trajectory to benchmarks outlined above	BOA established to land use consistent with RBOSMP	Undertake required areas of rehabilitation/restoration to achieve final land use
3.2 Are there any potential hazards not consistent with intended land use?	Quarterly visual inspection by Environmental Officer	The site is free of safety or environmental hazards within the area including: <ul style="list-style-type: none"> <li>• Holes, tunnels or unstable areas;</li> <li>• Quarrying and landfill infrastructure or debris; or</li> <li>• Hazardous materials</li> </ul>	All safety or environmental hazards are to be removed as required
3.3 Is exotic/weed vegetation competing or impacting on intended land use?	Quarterly visual inspection by Environmental Officer	Noxious weeds are not present within rehabilitation or biodiversity offset areas	Undertake weed management strategies in LMP/RBOSMP
3.4 Are feral pests impacting on intended land use?	Quarterly visual inspection by Environmental Officer	Impacts of feral pests considered negligible or at maintenance level	Undertake pest management strategies in QRA and BOA

## 12 Long term management strategy

As per CoA 50, the Long Term Management Strategy must:

- a) Define the objectives and criteria for quarry closure post extraction management
- b) Be prepared in consultation with DECCW, NOW and DII
- c) Investigate and/or describe options for the future use of the site
- d) Describe the measures that would be implemented to minimise or manage the environmental effects of the project and
- e) Describe how the performance of these measures would be monitored over time

The objectives and completion criteria for quarry closure post extraction management and infilling are outlined in **Section 11**. The BOS was developed by ELA in consultation with OEH (formerly DECCW), and a draft of the LBMP has been provided to OEH for comment on 17 October 2012 and 14 February 2013. All comments received from 17 October 2012 were incorporated into the report submitted on 14 February 2013 and no further comments were provided.

The Long Term Management Strategy will be developed as part of the RBOSMP review process once the project progresses toward quarry closure. The existing quarry and landfill (QRA2) is still operational, and the proposed quarry and future landfill (QRA1) has not commenced. The Long Term Management Strategy will be developed no later than at the commencement of rehabilitation works at QRA1.

Future landuse of the BOA and QRA will be for conservation as outlined in **Sections 1-4**, and management and monitoring measures are outlined in **Section 5-11** of this document.

## 13 References

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## Appendix A Flora and fauna

**Table 13.1: Exotic flora previously recorded in GCC lands**

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Acetosa</i> sp.	Dock	Vine	Perennial	Polygonaceae				X
<i>Ageratina adenophora</i>	Crofton Weed	Herb	Perennial	Asteraceae		X		
<i>Aira elegantissima</i>	Delicate Hair Grass	Grass	Annual	Poaceae			X	
<i>Aira</i> sp.		Grass	Annual	Poaceae				X
<i>Alternanthera pungens</i>	Khaki Weed	Herb	Perennial	Amaranthaceae		X		
<i>Amaranthus</i> sp.		Herb	A & P	Amaranthaceae		X		
<i>Ambrosia artemisiifolia</i>	Annual Ragweed	Herb	Annual	Asteraceae		X		
<i>Anagallis arvensis</i>	Scarlet Pimpernel,	Herb	A & P	Myrsinaceae				X

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
	Blue Pimpernel							
<i>Anthoxanthum odoratum</i>	Sweet Vernal Grass	Grass	Perennial	Poaceae		X		
<i>Arctotheca calendula</i>	Cape Weed, African Marigold, Cape Dandelion	Herb	Annual	Asteraceae	X		X	BOA
<i>Avena fatua</i>	Wild Oats	Grass	Annual	Poaceae		X		
<i>Axonopus fissifolius</i>	Carpet Grass	Grass	Perennial	Poaceae		X		
<i>Bidens pilosa</i>	Cobbler's Pegs	Herb	Perennial	Asteraceae		X		
<i>Brassica juncea</i>	Mustard	Herb	Annual	Brassicaceae		X		
<i>Briza maxima</i>	Quaking Grass	Grass	Annual	Poaceae		X		
<i>Bromus catharticus</i>	Prarie Grass	Grass	A & P	Poaceae		X		
<i>Bromus rubens</i>	Red Brome	Grass	Annual	Poaceae		X	X	X
<i>Carduus nutans</i>	Nodding Thistle	Herb	Biennial	Asteraceae		X		

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Carthamus lanatus</i>	Saffron Thistle	Herb	Annual	Asteraceae		X		X
<i>Centaureum tenuiflorum</i>	Branched Centaury	Herb	Annual	Gentianaceae		X		
<i>Chloris gayana</i>	Rhodes Grass	Grass	Perennial	Poaceae	X			
<i>Chloris virgata</i>	Feathertop Rhodes Grass	Grass	A & P	Poaceae		X		
<i>Chondrilla juncea</i>	Skeleton Weed	Herb	Perennial	Asteraceae		X		
<i>Cichorium intybus</i>	Chicory	Herb	Perennial	Asteraceae		X		
<i>Cirsium vulgare</i>	Spear Thistle	Herb	Annual	Asteraceae		X		X
<i>Citrullus lanatus</i>	Watermelon	Vine	Annual	Cucurbitaceae				X
<i>Citrullus</i> sp.		Vine	A & P	Cucurbitaceae		X		
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	Herb	Annual	Asteraceae		X		X
<i>Conyza</i> sp.	Fleabane	Herb	Annual	Asteraceae				BOA
<i>Conyza sumatrensis</i>	Tall Fleabane	Herb	Annual	Asteraceae		X		
<i>Cortaderia selloana</i>	Pampas Grass	Grass	Perennial	Poaceae		X		

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Crepis capillaris</i>	Smooth Hawksbeard	Herb	A & P	Asteraceae		X		
<i>Cucumis myriocarpus</i>	Paddymelon	Herb	Annual	Cucurbitaceae		X		X
<i>Cynara cardunculus</i>	Cardoon	Herb	Perennial	Asteraceae		X		
<i>Cynodon dactylon</i>	Couch Grass	Grass	Perennial	Poaceae		X		
<i>Cyperus eragrostis</i>		Sedge	Perennial	Cyperaceae		X		
<i>Echinochloa crus-galli</i>	Barnyard Grass	Grass	Annual	Poaceae		X		
<i>Echium plantagineum</i>	Paterson's Curse	Herb	Annual	Boraginaceae	X	X	X	BOA
<i>Echium vulgare</i>	Viper's Bugloss	Herb	Biennial	Boraginaceae		X		
<i>Eragrostis ciliaris</i>	Stinkgrass	Grass	Annual	Poaceae		X		
<i>Erodium botrys</i>	Long Storksbill	Herb	Annual	Geraniaceae		X		
<i>Erodium cicutarium</i>	Common Storksbill	Herb	Annual	Geraniaceae				X
<i>Erodium</i> sp.	Storks Bill	Herb	Annual	Geraniaceae				BOA

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Euphorbia peplus</i>	Petty Spurge	Herb	Annual	Euphorbiaceae		X		
<i>Foeniculum vulgare</i>	Fennel	Herb	A & Biennial	Apiaceae		X		
<i>Gomphrena celosiodes</i>	Gomphrena Weed	Herb	A & P	Amaranthaceae		X		
<i>Heliotropium europaeum</i>	Common Heliotrope	Herb	Annual	Boraginaceae		X		
<i>Hordeum leporinum</i>	Barley-grass	Grass	Annual	Poaceae	X	X	X	X
<i>Hydrocotyle</i> sp.	Pennywort	Herb	Perennial	Apiaceae		X		
<i>Hypericum perforatum</i>	St. John's Wort	Herb	Perennial	Clusiaceae		X		X
<i>Hypochaeris glabra</i>		Herb	Annual	Asteraceae		X		X
<i>Hypochaeris radicata</i>	Catsear, Flatweed	Herb	Perennial	Asteraceae		X		X
<i>Hypochaeris</i> sp.		Herb	Perennial	Asteraceae				BOA
<i>Juncus acutus</i>	Spiny Rush	Sedge	Perennial	Juncaceae		X		
<i>Lactuca saligna</i>	Willow Leaf Lettuce	Herb	A & Biennial	Asteraceae		X		
<i>Lactuca serriola</i>	Prickly Lettuce	Herb	Biennial	Asteraceae		X		

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Lamarckia aurea</i>	Goldentop	Herb	Annual	Poaceae	X			
<i>Lepidium africanum</i>		Herb	A & P	Brassicaceae	X	X		
<i>Lepidium</i> sp.	Peppercress	Herb	A & P	Brassicaceae			X	BOA
<i>Lolium perenne</i>	Perennial Ryegrass	Grass	Perennial	Poaceae		X		X
<i>Lolium rigidum</i>	Ryegrass	Grass	Annual	Poaceae				BOA
<i>Lolium</i> sp.		Grass	A & P	Poaceae	X			
<i>Lycium ferocissimum</i>	African Boxthorn	Shrub	Perennial	Solanaceae		X	X	
<i>Malva parviflora</i>	Small-flowered Mallow	Herb	Annual	Malvaceae	X	X		X
<i>Marrubium vulgare</i>	Horehound	Shrub	Perennial	Lamiaceae		X	X	
<i>Medicago laciniata</i>	Cut-leaved Medic	Herb	Annual	Fabaceae				BOA
<i>Medicago minima</i>	Little Medic	Herb	Annual	Fabaceae			X	BOA
<i>Medicago polymorpha</i>	Burr Medic	Herb	Annual	Fabaceae	X			
<i>Medicago</i> sp.	Medic	Herb	A & P	Fabaceae		X		BOA

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Medicago truncatula</i>	Barrel Medic	Herb	Annual	Fabaceae				X
<i>Mentha pulegium</i>	Pennyroyal	Herb	Perennial	Lamiaceae		X		
<i>Opuntia aurantiaca</i>	Tiger Pear	Succulent	Perennial	Cactaceae		X		
<i>Oxalis pes-caprae</i>		Herb	Perennial	Oxalidaceae		X		
<i>Papaver somniferum</i>	Opium Poppy	Herb	Annual	Papaveraceae			X	
<i>Paspalum dilatatum</i>	Paspalum	Grass	Perennial	Poaceae		X		X
<i>Pennisetum clandestinum</i>	Kikuyu	Grass	Perennial	Poaceae		X		
<i>Phalaris aquatica</i>	Phalaris	Grass	Perennial	Poaceae		X		
<i>Plantago lanceolata</i>	Plantain	Herb	A & Biennial	Plantaginaceae		X		
<i>Poa annua</i>	Winter Grass	Grass	Annual	Poaceae		X		
<i>Portulaca oleracea</i>	Pigweed	Herb	A & P	Portulacaceae		X		
<i>Ricinus communis</i>	Castor Oil Plant	Shrub	Perennial	Euphorbiaceae		X		
<i>Rosa rubiginosa</i>	Sweet Briar	Shrub	Perennial	Rosaceae		X		

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Rubus fruticosus</i> spp. agg.	Blackberry	Shrub	Perennial	Rosaceae		X		
<i>Salvia verbenaca</i>	Wild Sage, Vervain	Herb	Perennial	Lamiaceae				X
<i>Senecio</i> sp.		Herb	A & P	Asteraceae		X		
<i>Setaria pumila</i>	Pale Pigeon Grass	Grass	Annual	Poaceae		X		
<i>Silybum marianum</i>	Variegated Thistle	Herb	Biennial	Asteraceae		X		X
<i>Sisymbrium erysimoides</i>	Smooth Mustard	Herb	Annual	Brassicaceae	X		X	
<i>Sisymbrium orientale</i>	Hedge Mustard	Herb	A & Biennial	Brassicaceae			X	
<i>Sisymbrium</i> sp.		Herb	Annual	Brassicaceae				X
<i>Solanum nigrum</i>	Blackberry Nightshade	Herb	Perennial	Solanaceae		X		BOA
<i>Sonchus oleraceus</i>	Common Sowthistle	Herb	Annual	Asteraceae		X	X	BOA
<i>Taraxacum officinale</i>	Dandelion	Herb	Perennial	Asteraceae		X		
<i>Trifolium arvense</i>	Hare's-foot Clover	Herb	Annual	Fabaceae	X			X
<i>Trifolium repens</i>		Herb	Perennial	Fabaceae		X		

Scientific Name	Common Name	Growth Form	Annual/ Perennial	Family	Eldridge 2002	ERC 2003	Ecosurveys 2006	ELA 2011
<i>Vulpia bromoides</i>	Squirrel Tail Fescue, Silver Grass	Grass	Annual	Poaceae				X
<i>Vulpia myuros</i>	Rat-tail Fescue	Grass	Annual	Poaceae			X	
<i>Vulpia</i> sp.	Silvergrass	Grass	Annual	Poaceae				BOA
<i>Xanthium spinosum</i>	Bathurst Burr	Shrub	Perennial	Asteraceae		X		X

**Table 13.2: Threatened fauna**

Scientific Name	Common Name	Recorded on site*	Recorded in proximity to site+	Predicted by biobanking credit calculator	Suitable habitat present^
<b>Amphibia</b>					
<i>Litoria raniformis</i>	Growling Grass Frog	No	Yes (PM Search)	-	-
<b>Aves</b>					
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill#	Yes (ERC 2000, 2003; Ecosurveys 2006, 2009)	-	-	Yes
<i>Anseranas semipalmata</i>	Magpie Goose	No	Yes (Atlas records)	-	-
<i>Aphelocephala leucopsis</i>	Southern White Face#	Yes (Ecosurveys 2006)	-	-	Yes
<i>Ardeotis australis</i>	Australian Bustard	No	Yes (PM Search)	-	-
<i>Artamus cyanopterus</i>	Dusky Woodswallow	Yes (ERC 2003, Ecosurveys 2009)	-	-	Yes
<i>Botaurus poiciloptilus</i>	Australasian Bittern	No	Yes (Atlas Record)	-	-
<i>Burhinus grallarius</i>	Bush Stone-curlew	No	Yes (Atlas records)	Yes	-
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	Yes (Ecosurveys 2006)	Yes (Atlas records)	Yes	Yes
<i>Calyptorhynchus lathami</i>	Glossy Black-cockatoo	Adjacent (ERC 2003)	Yes (Atlas records)	-	Yes
<i>Certhionyx variegatus</i>	Pied Honeyeater	No	Yes (Atlas records)	Yes	Yes
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush	No	Yes (ERC 2003)	-	Yes
<i>Circus assimilis</i>	Spotted Harrier	No	Yes (Atlas records)	-	-
<i>Climacteris affinis</i>	White-browed Treecreeper	No	Yes (ERC 2003)	Yes	Yes

Scientific Name	Common Name	Recorded on site*	Recorded in proximity to site+	Predicted by biobanking credit calculator	Suitable habitat present^
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	Yes (ERC 2003)	Yes (Atlas records)	-	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	No	Yes (Atlas records)	-	-
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	No	Yes (Atlas records)	-	-
<i>Epthianura albifrons</i>	White-fronted Chat	No	Yes (Atlas records)	-	-
<i>Falco hypoleucos</i>	Grey Falcon	Adjacent (ERC 2003)	Yes (Atlas records)	-	Yes
<i>Grantiella picta</i>	Painted Honeyeater	Adjacent (ERC 2003)	Yes (Atlas records)	Yes	Yes
<i>Grus rubicundus</i>	Brolga	No	Yes (ERC 2003)	-	-
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	No	Yes (PM Search)	-	-
<i>Hieraaetus morphnoides</i>	Little Eagle	Yes (ERC 2000)	Yes (Atlas records)	-	-
<i>Hirundapus caudacutus</i>	White-throated Needletail	Yes (ERC 2003)	Yes (PM Search)	-	-
<i>Hylacola cautus</i>	Shy Heathwren	No	-	Yes	No
<i>Lathamus discolor</i>	Swift Parrot	No	Yes (ERC 2003)	-	Yes
<i>Leipoa ocellata</i>	Malleefowl	No	Yes (PM Search)	Yes	No
<i>Limosa limosa</i>	Black-tailed Godwit	No	Yes (Atlas records)	-	-
<i>Lophoictinia isura</i>	Square-tailed Kite	No	Yes (ERC 2003)	-	Yes
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	No	Yes (Atlas records)	-	Yes
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	No	Yes (ERC 2003)	-	Yes

Scientific Name	Common Name	Recorded on site*	Recorded in proximity to site+	Predicted by biobanking credit calculator	Suitable habitat present^
<i>Merops ornatus</i>	Rainbow Bee-eater	Yes (ERC 2003)	Yes (PM Search)	-	-
<i>Neophema pulchella</i>	Turquoise Parrot	No	Yes (ERC 2003)	Yes	Yes
<i>Ninox connivens</i>	Barking Owl	Adjacent (ERC 2003)	Yes (ERC 2003)	Yes	Yes
<i>Oxyura australis</i>	Blue-billed Duck	No	Yes (Atlas records)	-	-
<i>Pachycephala inornata</i>	Gilbert's Whistler	No	Yes (ERC 2003)	Yes	Yes
<i>Pachycephala rufiventris</i>	Rufous Whistler#	Yes (Ecosurveys 2006)	-	-	Yes
<i>Pedionomus torquatus</i>	Plains Wanderer	No	Yes (PM Search)	-	-
<i>Petroica goodenovii</i>	Red-capped Robin#	Yes (ERC 2000; 2003; Ecosurveys 2006, 2009, ELA 2011)	-	-	Yes
<i>Petroica phoenicea</i>	Flame Robin	No	Yes (Atlas records)	Yes	-
<i>Polytelis swainsonii</i>	Superb Parrot	Adjacent (ERC 2003)	Yes (PM Search and Atlas Records)	Yes	Yes
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	Yes (ERC 2000, 2003; Ecosurveys 2006, 2009; ELA 2011)	Yes (On site)	Yes	Yes
<i>Pyrholaemus sagittatus</i>	Speckled Warbler	No	Yes (Atlas records)	Yes	Yes
<i>Rostratula benghalensis</i>	Painted Snipe	No	Yes (PM Search and Atlas Records)	-	-
<i>Stagonopleura guttata</i>	Diamond Firetail	No	Yes (Atlas records)	Yes	Yes
<i>Stictonetta naevosa</i>	Freckled Duck	No	Yes (Atlas records)	-	-

Scientific Name	Common Name	Recorded on site*	Recorded in proximity to site+	Predicted by biobanking credit calculator	Suitable habitat present^
<i>Tyto novaehollandiae</i>	Masked Owl	No	Yes (ERC 2003)	-	Yes
<b>Mammalia (Chiroptera)</b>					
<i>Chalinolobus picatus</i>	Little Pied Bat	Yes (ERC 2003)	Yes (Atlas records)	-	Yes
<i>Myotis macropus</i>	Southern Myotis	Yes (ERC 2003)	Yes (Atlas records)	-	-
<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat (south eastern form)	No	Yes (PM and Atlas records)	Yes	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	No	Yes (ERC 2003)		Yes
<i>Vespadelus baverstocki</i>	Inland Forest Bat	Yes (ERC 2003)	Yes (Atlas records)		Yes
<b>Reptilia</b>					
<i>Tiliqua occipitalis</i>	Western Blue-tongues Lizard	No	Yes (ERC 2003)	-	Yes

\* Species was recorded within the GCC lands during surveys including ERC 2000, 2003; Ecosurveys 2006, 2009, ELA 2011. 'Adjacent' indicates the species was found within 5km of the site.

^Where suitable habitat was found the impact area it has been included in this column given the similarity between sites. However, where suitable habitat was not found in the impact area or the habitat potential of the BOA for that species has not been assessed a dash (-) indicates that no answer is given.

+ Including NSW Wildlife Atlas records (Atlas Records) within and EPBC Protected Matters Search (PM Search). Note that Fish, Marine, Migratory Marine and Migratory Wetland species have been excluded given the lack of any appropriate habitat onsite. A dash (-) indicates that the species is present on site but no records about proximity exist.

# Species not listed as threatened or endangered under State or Commonwealth legislation, but identified as declining woodland bird species in south-western NSW (Reid 1999).

**Table 13.3: Threatened flora**

Scientific Name	Common Name	Recorded on site*	Recorded in proximity to site+	Predicted by biobanking credit calculator	Suitable habitat present^
<i>Acacia curranii</i>	Curly-bark Wattle	No	Yes (ERC 2003)	-	Yes
<i>Austrostipa metatoris</i>		No	Yes (ERC 2003, PM Record)	-	Yes
<i>Austrostipa wakoolica</i>		No	Yes (ERC 2003)	-	-
<i>Brachyscome papillosa</i>	Mossgiel Daisy	No	Yes (ERC 2003, PM Record)	-	-
<i>Caladenia arenaria</i>	Sand-hill Spider Orchid	No	Yes (ERC 2003)	-	Yes
<i>Diuris tricolor</i> (syn <i>D. sheaffiana</i> )	Painted Diuris	No	Yes (ERC 2003)	-	Yes
<i>Grevillea ilicifolia</i> subsp. <i>ilicifolia</i>	Holly-leaf Grevillea	No	Yes (Atlas Record)	-	-
<i>Lepidium aschersonii</i>	Spiny Peppercross	No	Yes (ERC 2003)	-	Yes
<i>Lomandra patens</i> #	Irongrass	Adjacent (ERC 2003)	Yes (ERC 2003)	-	Yes
<i>Swainsona murrayana</i>	Slender Darling-pea	No	Yes (ERC 2003, PM Record)	-	-
<i>Swainsona sericea</i>	Silky Swainsona-pea	No	Yes (ERC 2003)	-	Yes

# Species not listed as threatened or endangered under State or Commonwealth legislation, but is a Rare Or Threatened Australian Plant (ROTAP) species

## Appendix B Weed Control Techniques

Details of specific weed control techniques to be used such as cut and paint, scrape and paint, herbicide spraying and hand weeding are provided in Muyt (2001) and are summarised below. The principles of bush regeneration and techniques to promote natural regeneration will follow the Bradley Method and use other techniques described in Buchanan (2000). Techniques of primary weed control particularly for woody weeds will use techniques that will not encourage flushes of secondary weed growth following primary work. Given the low densities of weeds, hand pulling and spot spraying will enable minimal disturbance. Spot spraying techniques will be as per the Noxious and Environmental Weed Control Handbook (NSW DPI 2011). Hand pulling will be undertaken by:

- Selecting the most appropriate tool for the weed being removed (if required);
- Minimise soil disturbance by controlling weeds when the soil is moist;
- Control plants before fruits or other propagules develop;
- Remove excess soil from the root system when there is no risk of spreading vegetative material;
- Cover disturbed soil or gaps with leaf litter and twigs;
- Ensure bulbs, corms, tubers, rhizomes or stolons are carefully dug out; and
- Bag all propagules before removing them off-site (Muyt 2001).

The preferred treatment for significant weeds is outlined in further detail in the WCP. However, alternatives are provided below, and the most appropriate method to be used will be determined by the bush regeneration contractor.

### WOODY WEEDS

All woody weeds will be controlled by the cut and paint or drill and fill method using a non-specific herbicide, unless otherwise noted below or in **Section 5.6**. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-specific herbicide.

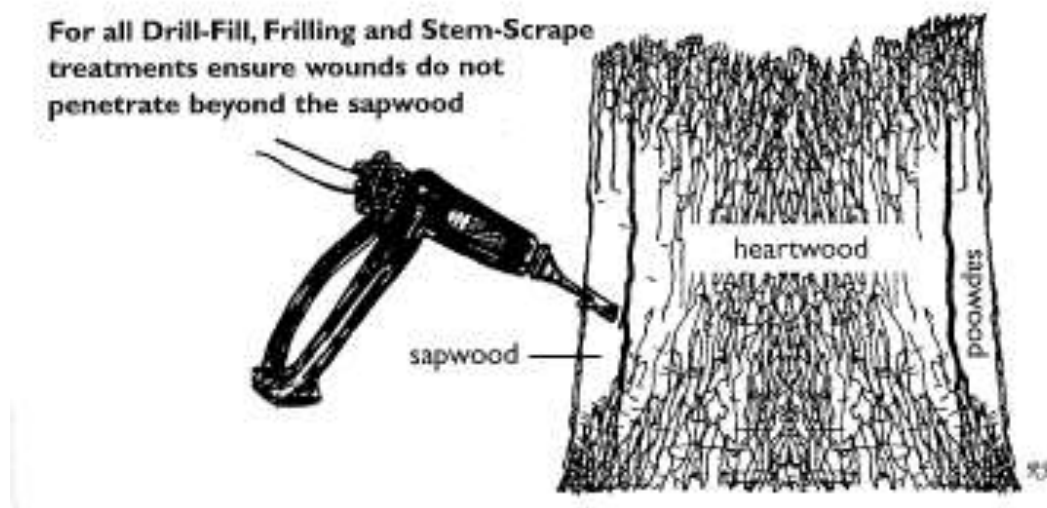
*Lycium ferocissimum* (African Boxthorn), a noxious weed, has been observed within GCC lands. Seedlings of this species will be controlled by hand pulling, with any mature plants being controlled by the cut and paint or drill and fill methods.

For the cut and paint method, the plant needs to be actively growing with green foliage present. African Boxthorn usually begins actively growing in September and fruiting occurs in autumn and winter. Control will be undertaken during summer months prior to fruiting occurring. The plant needs to be cut horizontally as close to the base as possible and below any branches. A chainsaw, handsaw or secateurs can be used to make the cut, depending on the size of the plant. Remove any dirt from the stump and immediately apply the appropriately mixed herbicide directly to the stump using a dabber bottle or brush. Plants may re-sprout and follow up work maybe required.

The 'drill and fill' method is more suitable for the control of large African Boxthorn. The drill and fill method involves drilling a hole into the base of a tree below any branches with a hand held drill and a 9 or 10 mm drill bit at an angle of 40-60 degrees. The hole should only penetrate through the sap wood and not through to the heart wood (**Error! Reference source not**



found.). The hole should then be filled immediately with the appropriately mixed herbicide. An eye dropper or a squeeze bottle with a narrow nozzle can be used to fill the hole. If the plant re-sprouts follow up work will be required.



**Figure 13.1: The drill and fill technique (Muyt 2001)**

The cut and paint and drill and fill method can be used for any woody weeds, and the cut and paint method can even be used for climbers and large herbaceous weed if required.

## **CREEPERS/CLIMBERS**

The control of creepers depends on the species being controlled. For the most part, seedlings will be hand pulled, while mature plants can be controlled by the stem-scrape method or spot spraying using a non-specific herbicide. The method to be used will be determined by the bush regeneration contractor.

*Rubus fruticosus* sp. agg. (Blackberry), a noxious weed, will be controlled by spot spraying using a dicot specific herbicide (i.e. Grazon®) when it is actively growing, prior to fruits being developed (December). If the plant is in among native species then it should be scraped along the stem and with non-specific herbicide. Alternately, the roots can be hand removed and elevated to dry the plant out. If this technique is used all seeds need to be removed, bagged, and properly disposed of. Seedlings will either be dug out or controlled by spot spraying.

## **ANNUAL GRASSES**

Concentrations of annual grasses such as *Avena fatua* (Wild Oats), *Briza maxima* (Quaking Grass), *Eragrostis ciliensis* (Stinkgrass), *Hordeum leporinum* (Barley-grass) and *Lolium rigidum* (Ryegrass), may be brush cut in late spring to early summer, after flowering, but prior to seed set. Slashing prior to this will promote vigorous growth. However, brush cutting may not be practical in some areas due to dangers such as uneven terrain, hidden holes and debris such as timber and rocks. In these areas, best results may be obtained from spraying with a monocot specific herbicide (e.g. Fusilade®) at the onset of spring when the plant is actively growing and just about to flower. Monitoring of these species will occur and if new growth

occurs, the same treatment will be applied to the new growth to prevent seed production. Individual plants should be hand removed, bagged and disposed of appropriately offsite.

Some annual grasses can grow and produce seed at any time of the year dependent on climatic conditions such as high rainfall and warm temperatures. Therefore, monitoring of these species is crucial and plants need to be treated if flowering is observed.

## PERENNIAL GRASSES

Perennial grasses, including *Cortaderia selloana* (Pampas Grass), *Phalaris aquatic* (Phalaris), *Chloris gayana* (Rhodes Grass) and *Pennisetum clandestinum* (Kikuyu), will be slashed prior to seed production in spring or summer (depending on the growth cycle of the species) and the regrowth will be spot sprayed 2-3 weeks later when it is actively growing and approximately 10 cm in length.

Pampas Grass, a significant environmental weed, will be dealt with swiftly, as each flower head can produce up to 100,000 seeds and disperse up to 25 km (Sutherland Shire Council 2008). If flowers are present, each flower head will be deseeded and disposed off-site. Plants can be brush-cut or sawed, and undiluted non-specific herbicide applied to the stump.

A grass specific herbicide (e.g. Fusilade®: active ingredient Fluazifop-P) will be used to control all perennial grass weeds across the BOA. Care will be required when spot spraying is being undertaken to prevent native grasses from being killed by the spot spraying process. If weedy grasses are found in the vicinity of native grasses they will be hand pulled to prevent off target damage to native species from occurring.

It is recommended that *Cynodon dactylon* (Couch) should only be managed if it begins to smother native vegetation or dominates large areas. If necessary to control it should be sprayed with a monocot specific herbicide (e.g. Fusilade®) between September and March.

## HERBACEOUS WEEDS

*Opuntia aurantiaca* (Tiger Pear), a noxious weed, should be controlled by hand removal. As this plant reproduces vegetatively, all material should be bagged and taken off site. In addition, the use of *Cochineal* and *Cactoblastis* biological control agents suited to the variety of pear is a very effective management practice (NSW DPI 2011).

*Xanthium spinosum* (Bathurst Burr) should be controlled by slashing the adult plants prior to flowering and hand pulling or spot spraying regrowth with a specific or non-specific herbicide.

*Marrubium vulgare* (Horehound) should be controlled by spraying with a specific or non-specific herbicide. Small infestations can be hand removed, but great care needs to be taken to ensure that seeds do not stick to clothing or equipment and are transferred to other areas. If particularly dense, infestations can also be cut, stacked and burned.

Where individual plants of other herbaceous weeds, such as *Bidens pilosa* (Cobblers Peg), *Plantago lanceolata* (Plantain), *Senecio* sp. (Fireweed,) and *Conyza* sp. (Fleabane), are found, they will be hand pulled prior to flowering. Where large swaths of these species occur they will be sprayed using a non-specific herbicide. If high densities of mature stands occur, weeds



may be slashed first using a brush cutter and any subsequent regrowth sprayed. Regular monitoring of these species will be required to prevent seed production. *Cirsium vulgare* (Spear Thistle) and *Carthamus lanatus* (Saffron Thistle) will not be hand-pulled due to its thorns and instead will be spot sprayed using a non-specific herbicide. All vegetative material that is pulled out and has the potential to regrow if deposited on ground will be bagged and removed from site.

## SEDGES

Sedges found on site (e.g. *Cyperus eragrostis*) should be hand removed or spot sprayed with a non-specific herbicide. *Juncus acutus* (Spiny Rush) should be carefully hand removed when small. When large, this species can be sprayed with a non-specific herbicide with a penetrant added (e.g. Pulse®) (Dixon 2005). Spraying should not be undertaken over free water, and conducted in the summer months to ensure maximum dryness.

## MANAGEMENT OF WEED WASTE

It is appropriate to leave all woody weed waste in situ, provided that any fruits are bagged, taken off site and disposed of appropriately. When leaving debris in situ it should be 'rafted'; dead wood should be laid on the ground first then stacked with the cut, living material on top. This keeps the live tips off the ground, preventing them from re-sprouting. All other weed waste will be bagged, taken off site and disposed of at a site licensed to receive green waste.

## Appendix C Example of Biodiversity Offset Area property signage



## Appendix D Feral animal control techniques

### PESTICIDE BAITING

Pesticide Control Orders (PCOs) exist for the use of each of 1080 under Part 4 of the NSW *Pesticides Act 1999* and associated regulations. These PCOs stipulate that only Authorised Control Officers are authorised to implement the use of concentrated 1080 baits, although ready-made baits can be used by landowners/managers. Furthermore, as of 1 September 2005, training in the use of pesticides has been compulsory if pesticides are used in a job or business (including farming).

The following is a broad outline of the process for using each chemical, notwithstanding the requirement for the operator to be trained in the use of these chemicals. Advice should be sought from OEH as to the most effective methods to minimise off-target kills and animal ethics in relation to the disposal of un-used bait and carcasses.

It is highly recommended that any baiting that takes place within the BOA is supported by a strategic off-site baiting program with cooperation from adjacent landowners.

All stock should be removed from the site prior to baiting program (note that no domestic stock are allowed in the BOA before Period 3 (year 7)).

#### 1080 baits (Rabbits)

- Under take baiting in summer or when there is limited green feed on the BOA;
- Select appropriate sites – it is recommended to locate sites near known Rabbit harbour;
- Acquire 1080 baits (mixing of 1080 concentrate must be carried out by an Authorised Control Officer);
- ‘Free feed’ Rabbits on non-toxic bait prior to baiting commencing;
- Scatter bait in selected locations and repeat dose three to four days apart for the entirety of the baiting treatment period; and
- If possible destroy warrens once a kill of the Rabbit population has been assured. This prevents recolonisation of warrens.

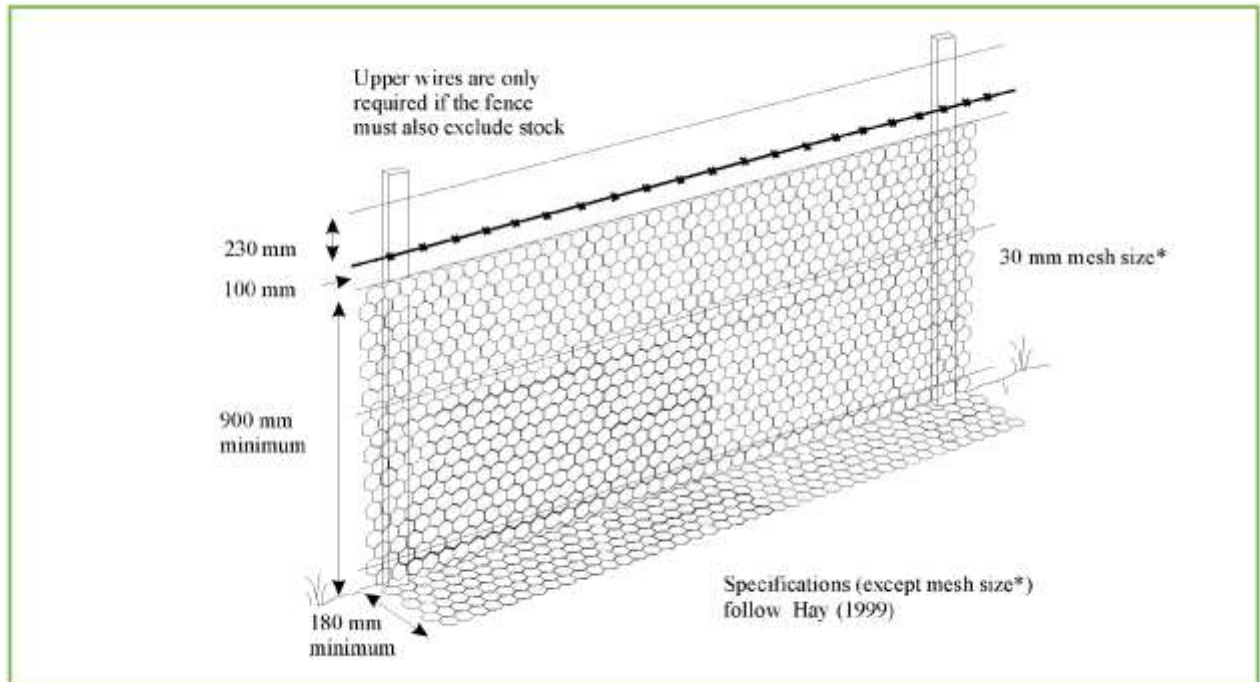
#### 1080 baits (Foxes)

- Seek approval from relevant agencies (e.g. RLPB, Dept Agriculture) for baiting program;
- Notify neighbours;
- Erect signage;
- Acquire 1080 Fox baits;
- Foxes using guidelines developed by DECCW (2008):
  - Bury baits 8-10 cm below the surface.
  - Place baits at least 500 metres apart or 1 per 10 ha (e.g. ~10 baits for the BOA).
  - Conduct baiting in autumn (juveniles dispersing) and spring (breeding season) during Periods 1-2
  - Conduct baiting in spring (breeding season) during Periods 3-4

- Check baits regularly and replace taken baits during treatment.
- Collect and dispose of unused baits after treatment.

## RABBIT FENCE SPECIFICATIONS

Source: Cost effective feral animal exclusion fencing for areas of high conservation value in Australia (Department of the Environment and Heritage 2004)



## Appendix E BOA quarterly visual inspection pro forma

Note: This proforma is a working document and modifications to this template should be made as considered appropriate by the land manager to include additional observation or remove tasks.

Who:

Date of Inspection:

INSPECTION ITEM	PHOTO NO.	GPS CO-ORDINATES	COMMENT	ACTION COMPLETED
<b>BIODIVERSITY OFFSET AREA: MZ1</b>				
Evidence of erosion (e.g. sheet, rilling, gullying etc.)				
Stability and function of erosion and sediment control structures				
Presence of undesirable vegetation cover (e.g. weeds)				
Evidence of plant mortality or dieback				
Presence of overstorey species (Y/N)				
Presence of mid-storey species (Y/N)				
Presence of understorey species (Y/N)				
Evidence of reproductive potential include presence of buds, flowers, fruits, juveniles and second generations				
Evidence of biological nutrient cycling include the presence of puffballs, toadstools and bracket fungi				
Evidence of feral animals and pests				
<b>Biodiversity Offset Area: MZ2</b>				
Visual assessment of surface materials (e.g. rocky substrate, topsoil cover, presence of chitter etc.)				
Evidence of erosion (e.g. sheet, rilling, gullying etc.)				
Stability and function of erosion and sediment control structures				
Presence of undesirable vegetation cover (e.g. weeds)				

INSPECTION ITEM	PHOTO NO.	GPS CO-ORDINATES	COMMENT	ACTION COMPLETED
Growth rates				
Evidence of plant mortality or dieback				
Species diversity (e.g. evidence of target species present)				
Presence of mid-storey species (Y/N)				
Presence of understorey species (Y/N)				
Evidence of reproductive potential include presence of buds, flowers, fruits, juveniles and second generations				
Evidence of biological nutrient cycling include the presence of puffballs, toadstalls and bracket fungi				
Evidence of feral animals and pests				
<b>Biodiversity Offset Area: MZ3</b>				
Evidence of soil profile development (e.g. leaf litter, decomposition, pedality etc.)				
Visual assessment of surface materials (e.g. rocky substrate, topsoil cover, presence of chitter etc.)				
Evidence of erosion (e.g. sheet, rilling, gullying etc.)				
Stability and function of erosion and sediment control structures				
Presence of undesirable vegetation cover (e.g. weeds)				
Growth rates				
Evidence of plant mortality or dieback				
Species diversity (e.g. evidence of target species present)				
Presence of mid-storey species (Y/N)				
Presence of understorey species (Y/N)				
Evidence of reproductive potential include presence of buds, flowers, fruits, juveniles and second generations				
Evidence of biological nutrient cycling include the presence of puffballs, toadstalls and bracket fungi				
Evidence of feral animals and pests				

Signed:

Date:

## Appendix F Annual review protocol

RBOSMP SECTION	CLAUSE	COMPLIANT	EVIDENCE/COMMENT	RECOMMENDATION
5.2	Manage human disturbance Rubbish dumping			
5.3	Fencing and signage Fence maintenance			
5.4	Vegetation clearing protocol			
5.5	Management of grazing for conservation			
5.6	Weed control MZ1 MZ2 MZ3 MZ4 MZ 5			
5.7	Bushfire management Prescribed burning regime			

<b>RBOSMP SECTION</b>	<b>CLAUSE</b>	<b>COMPLIANT</b>	<b>EVIDENCE/COMMENT</b>	<b>RECOMMENDATION</b>
5.8	Retention of regrowth and remnant vegetation			
5.9	Thinning of native vegetation (if required)			
5.10	In fill plantings MZ1  MZ2			
5.11	Retention of dead timber			
5.12	Nest boxes			
5.13	Erosion and Sedimentation Control (if required)			
5.14	Retention of rocks			
5.15	Control of feral and overabundant native herbivores  Rabbits  Goats  Kangaroos (under Licence)			

RBOSMP SECTION	CLAUSE	COMPLIANT	EVIDENCE/COMMENT	RECOMMENDATION
5.16	Vertebrate pest management  Foxes  Cats  Rodents			

