



Tronox Mining Australia Ltd

Murray Basin Mines Offset Management Plan

July 2019

Revision History

Rev No.	Document No.	Description	Approval Details	Date
0	603793	Crayfish Offset Management Plan	GHD and Tronox	31/12/2015
DRAFT	603881	Tronox Mining Australia Ltd. Murray Basin Offset Management Plan	GHD and Tronox	31/08/2016
A	603881	Tronox Mining Australia Ltd. Murray Basin Offset Management Plan	GHD and Tronox	07/09/2016
B		Update, Ginkgo Modification 13	GHD and Tronox	23/08/2018
C		Update DPIE comments	GHD and Tronox	02/07/2019

Abbreviations

Abbreviation	Full Title
AEMR	Annual Environmental Management Report
AR	Annual Return (as required by the EPL)
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCD	Biodiversity Conservation Division (DPIE)
BHCC	Broken Hill City Council
Tronox	Tronox Mining Australia Ltd
DA	Development Application
DECC	NSW Department of Environment and Climate Change
DECCW	NSW Department of Environment, Climate Change and Water
DNR	Department of Natural Resources (Now DPIE BCD)
DPIE	NSW Department of Planning, Industry and Environment
DPI	NSW Department of Primary Industries (part of NSW T&I)
DRG	Division of Resources and Geoscience
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Tronox Murray Basin Environmental Management Strat
EPA	NSW Environment Protection Authority
EP & A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	Environmental Protection Licence
FFMP	Murray Basin Mines Flora and Fauna Management Plan
GHD	GHD Pty Ltd
I&I NSW	New South Wales Department of Industry and Investment (now NSW T&I)
IMRP	Ginkgo Integrated Mining Rehabilitation Plan
LMP	Land Management Plan
LPMA	NSW Lands Property Management Authority (abolished April 2011)
MOP	Mining Operations Plan
MLA	Mining Lease Area
MREMP	Mining Rehabilitation and Environmental Management Plan

Abbreviation	Full Title
MSP	Mineral Separation Plant (Broken Hill)
NOW	New South Wales Office of Water
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NSW T&I	NSW Trade and Investment
POEO Act 1997	<i>Protection of the Environment Operations Act 1997</i>
SEE	Statement of Environmental Effects
WESCP	Murray Basin Mines Water, Erosion and Sediment Control Plan
WSC	Wentworth Shire Council

Limitations

This report has been prepared by GHD Pty Ltd (GHD) for Tronox Mining Australia Ltd (Tronox) and may only be used and relied on by Tronox for the purpose agreed between GHD and Tronox as provided in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Tronox arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this offset management plan were limited to those specifically detailed in the report and are subject to the scope limitations provided in the report.

GHD's scope of works was limited to updating Tronox's environmental documentation into standardised templates that are consistent with ISO 14001 and addressing Tronox's most recent approval requirements. GHD has relied on information provided in existing plans, the specific requirements stated within licences, permits and approval conditions provided to GHD and advice provided by Tronox on the status of works and implementation of management measures for the pre-construction and construction phase works. GHD has updated documents based on advice from Tronox relating to their current operations and management practices; GHD has not proposed new mitigation or management measures. Where GHD has identified deficiencies or anomalies in the existing plans, these have been updated based on additional information provided by Tronox. It is not within GHD's scope of works to undertake a detailed risk assessment for environmental aspects or to provide specialist advice on the suitability of mitigation measures or to devise new mitigation measures.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Tronox which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Table of contents

Abbreviations.....	ii
Limitations	iv
1. Introduction.....	1
1.1 Purpose of the Mines Biodiversity Offset Management Plan	1
1.2 Scope of the offset management plan	2
1.3 Document succession.....	2
2. Biodiversity offset description	13
2.1 Location and habitats of biodiversity offset areas.....	13
2.2 Offset Area 1 - Southern Mallee Offset Area and Offset Area 2 – Snapper Biodiversity Offset Area	18
2.3 Ginkgo & Crayfish Offset Areas	24
2.4 Consultation	34
2.5 Objectives for the offset	34
3. Performance and Completion Criteria.....	43
4. Monitoring.....	45
4.1 General requirements	45
4.2 Monitoring the performance of the offset.....	45
4.3 Offset monitoring approach	46
4.4 Threatened fauna monitoring for Offset Area 5 – Crayfish Deposit	47
4.5 Threatened fauna monitoring for Bolam's Mouse in Offset Area 6	47
4.6 Vegetation Condition Assessments	47
4.7 Analysis of key vegetation condition indicators	51
4.8 Fauna Surveys and Threatened Species Monitoring	52
5. Long-term Protection of Offset Areas	56
6. Offset Bond	57
7. Environmental Management	58
7.1 Relevant legislation and other requirements	58
7.2 Roles and responsibilities	58
7.3 Training and inductions.....	58
7.4 Complaint, non-conformance and incident management.....	58
8. Independent Environmental Audit.....	59
8.1 Audits of the Offset Management Plan	59
9. Plan Review, Monitoring and Implementation.....	60
9.1 Review and update of the Offset Management Plan	60
10. Reporting.....	61
10.1 Environmental reporting and correspondence.....	61
10.2 Reconciliation of the Proposed Offset Strategy against BCD Offset Principles	63
10.3 Ecological Gains of the Proposed Offset.....	64

11. References	65
----------------------	----

Table index

Table 1	Summary of Biodiversity Offset areas	1
Table 2	Project Approval Conditions Relevant to this Offset Management Plan for Crayfish, Snapper and Ginkgo Mines.	5
Table 3	Approximate Vegetation communities of Offset Area 1 (Southern Mallee Offset Area) and Offset Area 2 (Snapper Biodiversity Offset Area)	18
Table 4	Vegetation Communities of Ginkgo Offset Area 3	24
Table 5	Vegetation Communities of Ginkgo Offset Area 4	25
Table 6	Approximate areas of vegetation communities within Offset Area 5	27
Table 7	Vegetation communities of Offset Area 5	30
Table 8	Approximate areas of vegetation communities within Offset Areas 7 and 8	32
Table 9	Indicative Schedule of Short, Medium and Long-term Measures for management actions of Offset Areas	38
Table 10	Performance Criteria for Tronox Offset Areas	43
Table 11	Parameters recorded during vegetation condition assessments.....	49
Table 12	Confidence ratings applied to Anabat bat calls	55
Table 13	Summary table to be included in Snapper and Ginkgo AEMR process, for reporting on offset management plan actions throughout the reporting period.....	62
TronoxTronox		

Figure index

Figure 1	Locality map showing Murray Basin Mines (Ginkgo, Snapper, Crayfish MLA) and offset areas.	4
Figure 2	Vegetation communities of Offset Area 1 - Southern Mallee Offset Area Error! Bookmark not defined.	
Figure 3	Vegetation communities of Offset Area 2 – Snapper Biodiversity Offset Area..... Error! Bookmark not defined.	
Figure 4	Vegetation communities of Offset Areas 3, 4 and 5 Error! Bookmark not defined.	
Figure 5	Vegetation communities of Offset Areas 7 and 8 Error! Bookmark not defined.	
Figure 6	Vegetation condition monitoring transect area layout.....	48
Figure 7	Pitfall line with a funnel trap at one end	53

1. Introduction

1.1 Purpose of the Mines Biodiversity Offset Management Plan

Tronox Mining Australia Ltd (Tronox) operates mineral sand mines in the Murray Basin and a mineral separation plant (MSP) at Broken Hill in NSW. This Offset Management Plan (OMP) has been created for the management of ecological values within offset reserves at the Ginkgo mineral sands mine (Ginkgo), Snapper Mineral Sands Mine (Snapper) and the Crayfish Mineral Sands Mine (Crayfish) in the Murray Basin in south-west NSW. Tronox's mine sites in the Murray Darling basin have been collectively referred to as the 'Murray Basin mines' for the purpose of this document. The Murray Basin mines are located approximately 85 km north of Mildura and 40 km west of the township of Pooncarie in western New South Wales.

The Project Approvals for the Murray Basin mines requires the provision of a number of biodiversity offsets. According to the principles stated by the NSW Biodiversity Conservation Division DPIE (BCD) for the use of biodiversity offsets in NSW, biodiversity offsets counterbalance specific impacts of development on biodiversity. A biodiversity offset can be considered an action that is taken at a location away from an impacted site that aims to replace the biodiversity values lost at the impacted site. Offsets result in the legal protection of land and the implementation of management actions to remove threats.

The basic principle to any offset strategy is to improve or maintain environmental outcomes. Part of such outcome is the biodiversity values of an area. Biodiversity values include the composition, structure and function of the ecosystems including threatened species, populations and ecological communities, and their habitats. Biodiversity values can be improved by undertaking actions that increase the quantity, quality or likely persistence of these values. Management actions can improve biodiversity values by increasing the area, connectivity and/or condition of ecological communities or threatened species habitat; and/or by removing threats to these areas through improved security.

A total of 10,504 Ha of land are managed as offset areas for the Murray Basin mines (Table 1), in areas of land located around the existing mines ().

Table 1 Summary of Biodiversity Offset areas

Mine	Area	Development Consent Reference	Minimum Size (Ha)
Snapper	Offset Area 2 - Snapper Biodiversity Offset Area	Snapper Offset	5,471
Ginkgo	Offset Area 1 - Southern Mallee Offset Area	Southern Mallee Offset	521
Ginkgo	Offset Area 3	MOD 12 Offset	1,255 ¹
Ginkgo	Offset Area 4	MOD 12 Offset	158 ¹
Ginkgo	Offset Area 6	MOD 12 Offset	258 ¹
Ginkgo	Offset Areas 7 and 8	MOD 13 Offset	759 ²

¹ Forms total of 1,671 hectares of Offset Area as per MOD 12 of DA 251-09-01

² MOD 13 of DA 251-09-01

Ginkgo	Offset Area 5 - Crayfish Deposit	Crayfish Deposit Offset	2,082
TOTAL	Ginkgo = 5,033 Snapper = 5,471		10,504

The ecological values of the offset areas used to prepare this OMP are based on the assessments and reports on these sites written over a number of years by a number of different organisation, as referenced and attributed throughout this report.

The ecological attributes of the offset areas are summarised in Section 2 and reports from the detailed assessment of these areas, their management is described in Section 2.5, a reconciliation of the proposed offset strategy against the BCD Offset Principles is provided in Section 10.2, and the ecological gains of the proposed Offset areas are provided in Section 10.3.

This OMP has been prepared for all offset areas related to the Murray Basin mines, to address all relevant Mine Project Approval conditions. Table 2 presents the Murray Basin mines Project Approval conditions relevant to this Offset Management Plan, and outlines which section of this report addresses each condition.

1.2 Scope of the offset management plan

The OMP provides an overview of the environmental management and performance requirements related to offset management at the Murray Basin mines. This OMP includes:

- the requirements for environmental management of flora and fauna values for operations at the Murray Basin mines as stipulated by regulatory approvals for the project;
- the responsibilities for implementing this OMP;
- a description of the environmental controls and associated limits to meet objectives, targets and regulatory approval requirements; and
- an overview of the environmental monitoring programs and contingency plans associated with environmental controls and management actions.

Further details on the Environmental Management Framework for Tronox's operations at this site are provided in Section 7.

1.3 Document succession

This OMP supersedes the following OMPs, which are now obsolete:

- Snapper Mineral Sands Mine and Ginkgo Mineral Sands Mine Offset Management Plan (Bemax 2011), dated May 2011, Document No. OMP-O1G
- Crayfish Offset Management Plan (GHD 2015), dated December 2015, Document No. 603793
- Crayfish Offset Management Plan (GHD 2016), dated, September 2016, Document No. 603881

The original management plans were developed at the time in consultation with the NSW Biodiversity Conservation Division DPIE (BCD) and qualified ecologists that were involved in the preparation of documents for the environmental assessment required to obtain regulatory development/project approval.

The new OMP (this document) has been prepared on the basis of information contained within the original management plans and advice received from Tronox and BCD regarding current activities and management measures.

This revision of the OMP captures relevant details of the following Notice of Modification(s) for Tronox's operations in the Murray Darling Basin, issued by the delegate for the Minister of Planning in December 2017:

- 'Notice of modification under Section 75W of the Environment Planning and Assessment Act 1979 – Ginkgo Mineral Sands Mine Extension Modification (DA 251-09-01), Modification 13

Tronox is required to submit management plans to the NSW Department of Planning, Industry and Environment (DPIE) for approval. The NSW Biodiversity Conservation Division DPIE (BCD) was consulted extensively at the time of the approval process for MOD 13 for the Ginkgo mine (see section 2.4 below) and the management plan was updated following the issue of MOD 13 DA 251-09-01. Given the detailed consultation undertaken with BCD during the preparation of reports to support MOD 13, and, only minor changes made to this document since this time, Tronox considered consultation with BCD/DPIE on changes to this document are not required at this time.

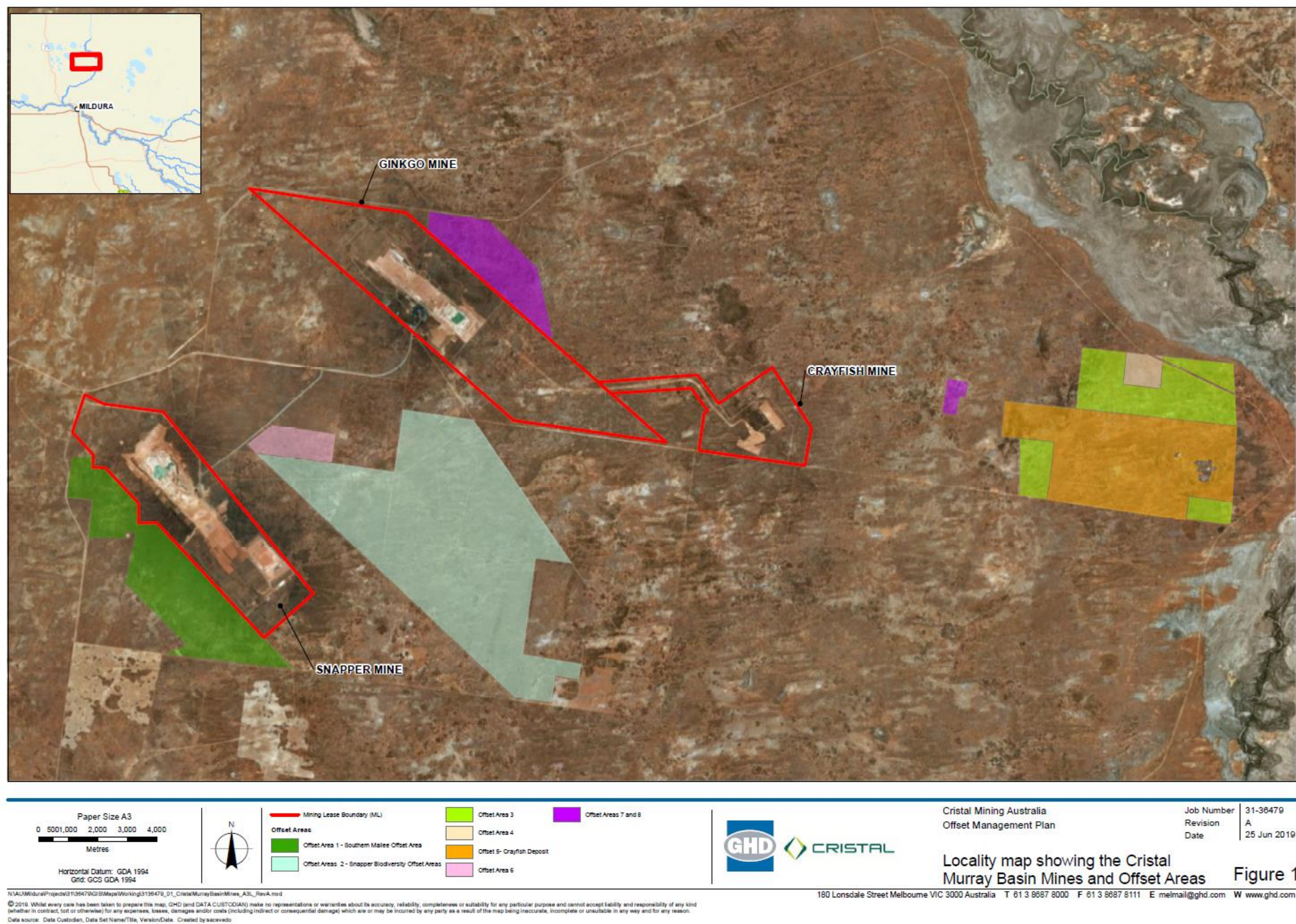


Table 2 Project Approval Conditions Relevant to this Offset Management Plan for Crayfish, Snapper and Ginkgo Mines.

Condition number	Condition details	Section in OMP
Snapper (DA 06-168) Modification 5		
Schedule 3 – Specific Environmental Conditions, Condition 16 – Flora and Faun – Flora and Fauna Management		
	The Proponent shall prepare and implement a Flora and Fauna Management Plan for the project to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with the BCD by a suitably qualified expert(s) whose appointment(s) has been approved by the Secretary; (b) be submitted to the Secretary for approval prior to carrying out any development on the site: and (c) include a: • vegetation clearance protocol; • threatened species management protocol; • description of the detailed measures that would be implemented to: - control weeds, feral pests, and access; - salvage and reuse material from the site for habitat enhancement; - collect and propagate seed; - manage grazing, fauna entrapment in the dredge pond, bushfires, and remnant vegetation on site; and • program to monitor the effectiveness of the protocols and management measures in the plan.	See - Flora and Fauna Management Plan - Ginkgo and Snapper Bushfire Management Plan - Ginkgo and Snapper Land Management Plan
Schedule 3 – Specific Environmental Conditions, Condition 17 – Flora and Fauna – Offset Management Plan		

Condition number	Condition details	Section in OMP
	The Proponent must prepare and implement an Offset Management Plan to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with the BCD by a suitably qualified expert whose appointment has been endorsed by the Secretary; (b) be submitted to the Secretary for approval prior to carrying out any development on the site; and (c) describe the measures to implement the flora and fauna offset (see statement of commitment 4 in Appendix 4 and the detailed description of this offset in the EA), including: - the objectives for the offset - a description of the short, medium and long term measures that would be implemented, including appropriate fencing to exclude grazing, incrementally de-stocking the offset area over three years, removal of unnecessary existing fences, erosion control, signage of the offset, revegetation of unnecessary access tracks, animal pest control, weed management, fire management and threatened species management. - detailed performance and completion criteria for the implementation of the offset; - a detailed description of how the performance of the offset would be monitored, using techniques such as photographic monitoring and permanent flora quadrats; - a description of how the offset would be protected in the long-term; and - details of who would be responsible for monitoring, reviewing and implementing the plan.	See Section 2.5, 3, 4, 5, 9
Schedule 3 – Specific Environmental Conditions, Condition 18 – Flora and Fauna - Offset Bond		
	After the first Independent Environmental Audit (See Schedule 4 of the conditions) after year 10 of the mining operations, the Proponent shall lodge a suitable offset bond with the Secretary. This bond must be determined by the audit team in consultation with the Proponent and contain sufficient funds to ensure the remaining works in the Offset Management Plan are fully	Section 6

Condition number	Condition details	Section in OMP								
	implemented. The Proponent shall revise this bond to the satisfaction of the Secretary after each subsequent audit. <i>Notes:</i> <i>(d) Remaining works are those works required for areas for which completion criteria (as set out in the Offset Management Plan) have not been met, as determined by the Independent Environmental Audit.</i> <i>(e) Areas for which completion criteria have been met, as verified by the Audit, will not require a bond.</i> <i>(f) Where offset completion criteria are met for a particular area, as verified by the Audit, the Secretary will release the bond for that area.</i>									
Ginkgo and Crayfish (DA 251-09-01) Modification 13										
Schedule 3 – Specific Environmental Conditions; Condition 18 – Biodiversity – Biodiversity Offset Strategy										
	The Applicant shall implement a Biodiversity Offset Strategy (as summarised in Table 4 and shown in Appendix 6 of the conditions) to the satisfaction of the Secretary. <u>Biodiversity Offset Strategy:</u> <i>Table 4: Biodiverstiy Offset Strategy</i> <table><tr><th><u>Area</u></th><th><u>Minimum Size/Amount</u></th></tr><tr><td>Southern Mallee Offset</td><td>521 hectares of Southern Mallee vegetation communities, including at least 4 hectares of Chenopod Mallee vegetation communities.</td></tr><tr><td>Crayfish Deposit Offset</td><td>2,082 hectares</td></tr><tr><td>MOD 12 Offset Areas</td><td>1, 671 hectares</td></tr></table>	<u>Area</u>	<u>Minimum Size/Amount</u>	Southern Mallee Offset	521 hectares of Southern Mallee vegetation communities, including at least 4 hectares of Chenopod Mallee vegetation communities.	Crayfish Deposit Offset	2,082 hectares	MOD 12 Offset Areas	1, 671 hectares	See Section 2: See also: - Crayfish Mining Operations Plan - Ginkgo and Snapper Mining Operations Plan
<u>Area</u>	<u>Minimum Size/Amount</u>									
Southern Mallee Offset	521 hectares of Southern Mallee vegetation communities, including at least 4 hectares of Chenopod Mallee vegetation communities.									
Crayfish Deposit Offset	2,082 hectares									
MOD 12 Offset Areas	1, 671 hectares									

Condition number	Condition details		Section in OMP
	MOD 13 Offset Areas	759 hecatres	
	Notes: <i>The Applicant may release 230 hectares of the Southern Mallee Offset if it can demonstrate the long-term success of woodland rehabilitation on the northern initial overburden emplacement, and those areas of the mine path subject to capping of less than five metres of non-slurried overburden, to the satisfaction of the Secretary.</i> <i>The success of native vegetation rehabilitation shall be based on agreed rehabilitation criteria to be included within the MOP and Flora and Fauna Management Plan. Criteria shall include vegetation condition and salinity.</i> <i>At the time of determination of MOD 13, the Applicant retains 4,597 surplus ecosystem credits and 4,462 surplus species credits.</i>		
Schedule 3 – Specific Environmental Conditions; Condition 19 and 19A – Biodiversity – Long Term Security of Offset			
	19. By 30 June 2016, unless otherwise agreed with Secretary, the Applicant shall make suitable arrangements to provide appropriate long term security for the biodiversity offset area identified in Table 4 and Appendix 6 of the conditions, to the satisfaction of the Secretary.		Section 6
	19 A. By 30 June 2018, unless otherwise agreed with the Secretary, the Applicant shall make suitable arrangements to provide appropriate long term security for the biodiversity offset area identified as Biodiversity Offset Areas 7 and 8 in Appendix 6 of the conditions, to the satisfaction of the Secretary.		
Schedule 3 – Specific Environmental Conditions; Condition 20 – Biodiversity – Offset Management Plan			
	The Applicant must prepare and implement an Offset Management Plan to the satisfaction of the Secretary. This plan must:		See Section 2, 2.5, 3, 4, 5, 9

Condition number	Condition details	Section in OMP
	(a) be prepared in consultation with the BCD by a suitably qualified expert whose appointment has been endorsed by the Secretary; (b) be submitted to the Secretary for approval within 6 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary; (c) establish baseline data for the existing habitat in the biodiversity offset areas; (a) describe the short, medium, and long term measures that would be implemented to: - manage the vegetation and habitat in the biodiversity offset areas; and - implement the biodiversity offset strategy, including detailed performance and completion criteria; (b) include a program to monitor and report on the effectiveness of these measures, and progress against detailed performance and completion criteria; (c) include fire management prescriptions for ecological outcomes in conjunction with other local and regional fire management planning; (d) include a description of how artificial watering points would be closed; (e) include a description of how the offset would be protected in the long-term; (f) identify the potential risks to the successful implementation of the Biodiversity Offset Strategy, and the contingency measures that would be implemented to mitigate these risks; and (j) include details of who would be responsible for monitoring, reviewing, and implementing the plan.	
Schedule 3 – Specific Environmental Conditions; Condition 21 and 21A – Biodiversity – Conservation Bond		
	21. Within 12 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary, the Applicant shall lodge a conservation bond with the Department to ensure that the Biodiversity Offset Strategy is implemented in accordance with the performance and completion criteria described in the Offset Management Plan. The sum of the bond shall be determined by:	Section 6

Condition number	Condition details	Section in OMP
	(a) calculating the full cost of implementing the offset strategy (other than land acquisition costs); and (b) employing a suitably qualified quantity surveyor to verify the calculated costs. If the offset strategy is completed generally in accordance with the completion criteria in the Offset Management Plan to the satisfaction of the Secretary, the Secretary will release the bond. If the offset strategy is not completed generally in accordance with the completion criteria in the Offset Management Plan, the Secretary will call in all or part of the conservation bond, and arrange for the satisfactory completion of the relevant works. Notes: • Alternative funding arrangements for long-term management of the biodiversity offset strategy, such as provision of capital and management funding as agreed by BCD as part of a Biobanking Agreement or transfer to conservation reserve estate can be used to reduce the liability of the conservation and biodiversity bond. • The sum of the bond may be reviewed in conjunction with any revision to the biodiversity offset strategy. • With the agreement of the Secretary and BCD, the bond may be released progressively in accordance with the progress of the Biodiversity Offset Strategy. 21 A. Within 6 months of the date of consent for MOD 13, unless otherwise agreed with the Secretary, the Applicant shall: (a) revise the sum of the conservation bond required by condition 21 above to account for the additional offset areas; and (b) lodge the additional bond amount with the Department.	
Schedule 3 – Specific Environmental Conditions; Condition 22 – Biodiversity – Flora and Fauna Management		

Condition number	Condition details	Section in OMP
	The Applicant shall prepare and implement a Flora and Fauna Management Plan for the development to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with BCD by a suitably qualified expert whose appointment has been endorsed by the Secretary; (b) be submitted to the Secretary for approval prior to any vegetation clearing at the Crayfish Deposit, unless otherwise agreed with the Secretary; and (c) describe: vegetation clearance protocols, including quantification of the amount of <i>Swainsona flavicarinata</i> and <i>Swainsona adenophylla</i>; methods for re-establishment of native vegetation and habitat; threatened species management measures with particular reference to <i>Swainsona flavicarinata</i>, <i>Swainsona adenophylla</i>, Western Blue-tongue (<i>Tiliqua occipitalis</i>) lizard, Bolam's Mouse (<i>Pseudomys bolami</i>) and Marble-faced Delma (<i>Delma australis</i>), including any proposed translocation protocols and additional surveys; the specific management measures for the Marble-faced Delma; the specific management measures for the Bolam's Mouse, including additional surveys on site and in the biodiversity offset areas; the detailed measures that would be implemented to: control weeds, feral pests, and access; salvage and reuse material from the site for habitat enhancement; collect and propagate seed; manage grazing and remnant vegetation on site; and prevent fauna entrapment in the dredge pond;	See Flora and Fauna Management Plan See also: - Ginkgo and Snapper Environmental Monitoring Plan - Ginkgo and Snapper Erosion and Sediment Control Plan - Ginkgo and Snapper Land Management Plan - Mining Operations Plans (MOP) for Ginkgo and Snapper

Condition number	Condition details	Section in OMP
	a program to monitor the effectiveness of the protocols and management measures in the plan.	

2. Biodiversity offset description

2.1 Location and habitats of biodiversity offset areas

A total of eight biodiversity offset areas have been established for the Murray Basin mines, as shown in , and summarised below in Table 2. The Snapper and Ginkgo Mine Lease Area not cleared for the mine comprise mostly remnant native vegetation, predominantly Belah and mallee woodlands, chenopod shrublands, and open grasslands, albeit significantly altered by over 150 years of European settlement and pastoral activities. Where vegetation communities have been mapped, these are shown in **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** and Figure 6.

Land use in the Study Area is predominantly livestock grazing of native pastures by sheep, cattle and goats on Perpetual Western Land Leases. Western Land Leases are administered by the DPI under the NSW *Western Lands Act, 1901*. The NSW *Western Lands Act, 1901* is used to establish the conditions under which land is managed for pastoral purposes. Over one hundred years of pastoralism has significantly altered the structure and composition of native plant communities (Cunningham *et al.*, 1981) in the Western Division. The use of water bores has spread stock watering points across the landscape allowing stock access to most of the vegetation. In general, the rate of stocking is conservative due to the low vegetative productivity of the arid environment. The abundance of plant species favoured by sheep has declined, while less palatable species have increased in relative abundance. There has been a decline in palatable perennial shrubs, particularly some saltbushes and bluebushes, and an increased dependence by pastoralists on annual species that require rain for germination, such as grasses (Cunningham *et al.*, 1981).

The vegetation within the region of the Study area has also been affected by the deliberate and accidental introduction of exotic plant species. Some, such as the medics (*Medicago* spp.) and some grasses (e.g. *Hordeum* spp.), have been beneficial to graziers, but others have become major weeds, such as African Boxthorn (*Lycium ferocissimum*) and Bathurst Burr (*Xanthium spinosum*). The spread of feral animals, particularly rabbits and goats, has also had a significant effect on the vegetation.

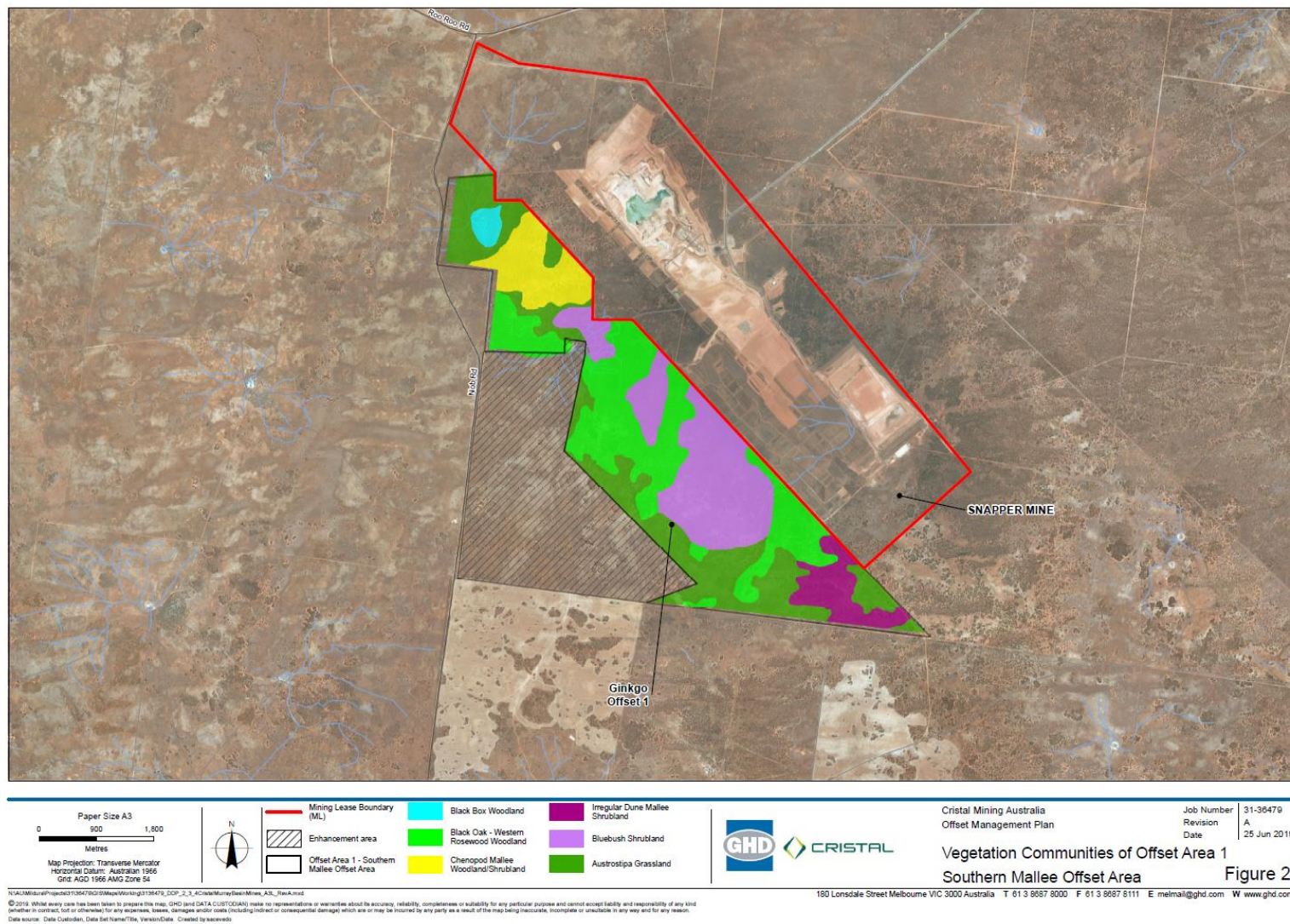


Figure 2 Vegetation communities of Offset Area 1 - Southern Mallee Offset Area

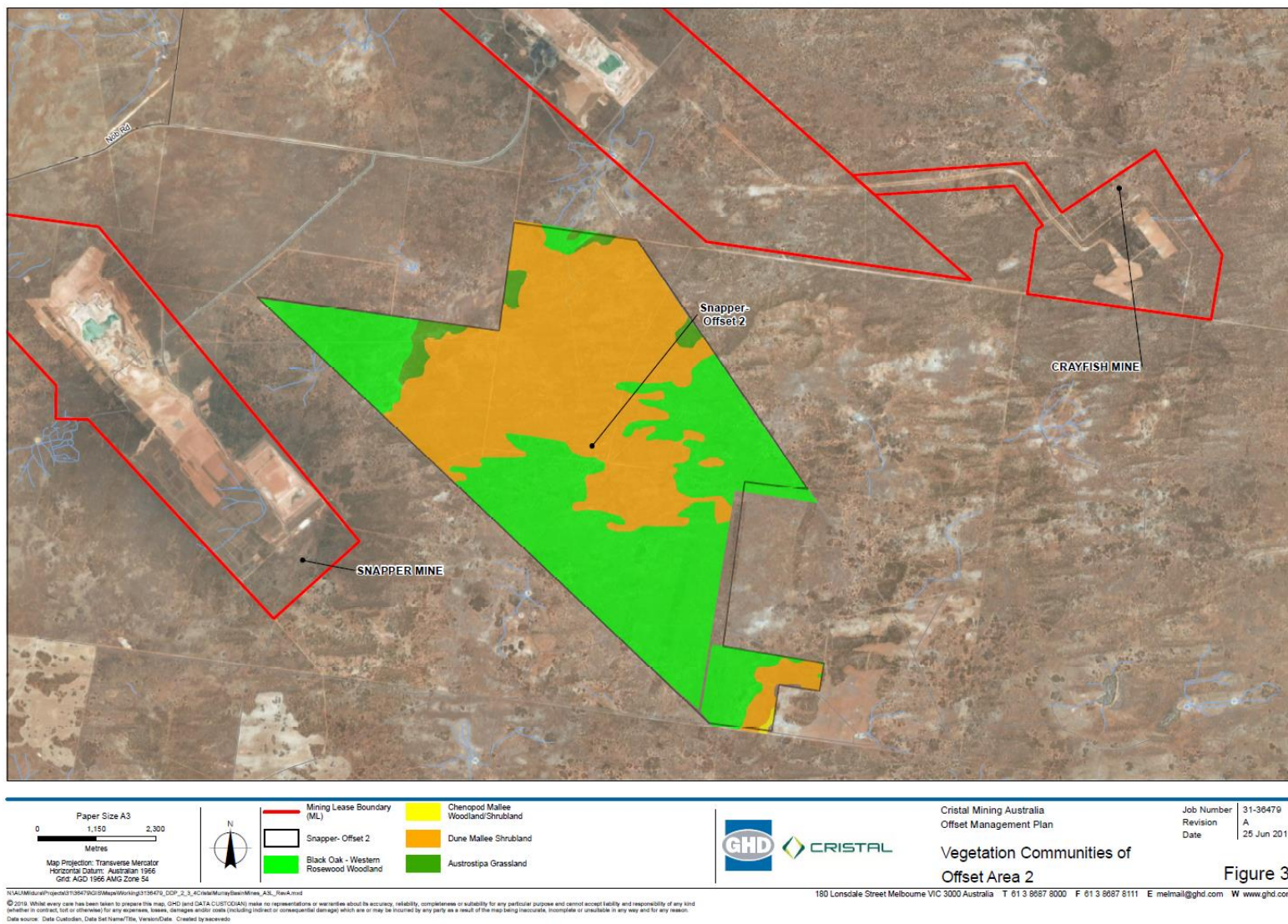


Figure 3 Vegetation communities of Offset Area 2 – Snapper Biodiversity Offset Area

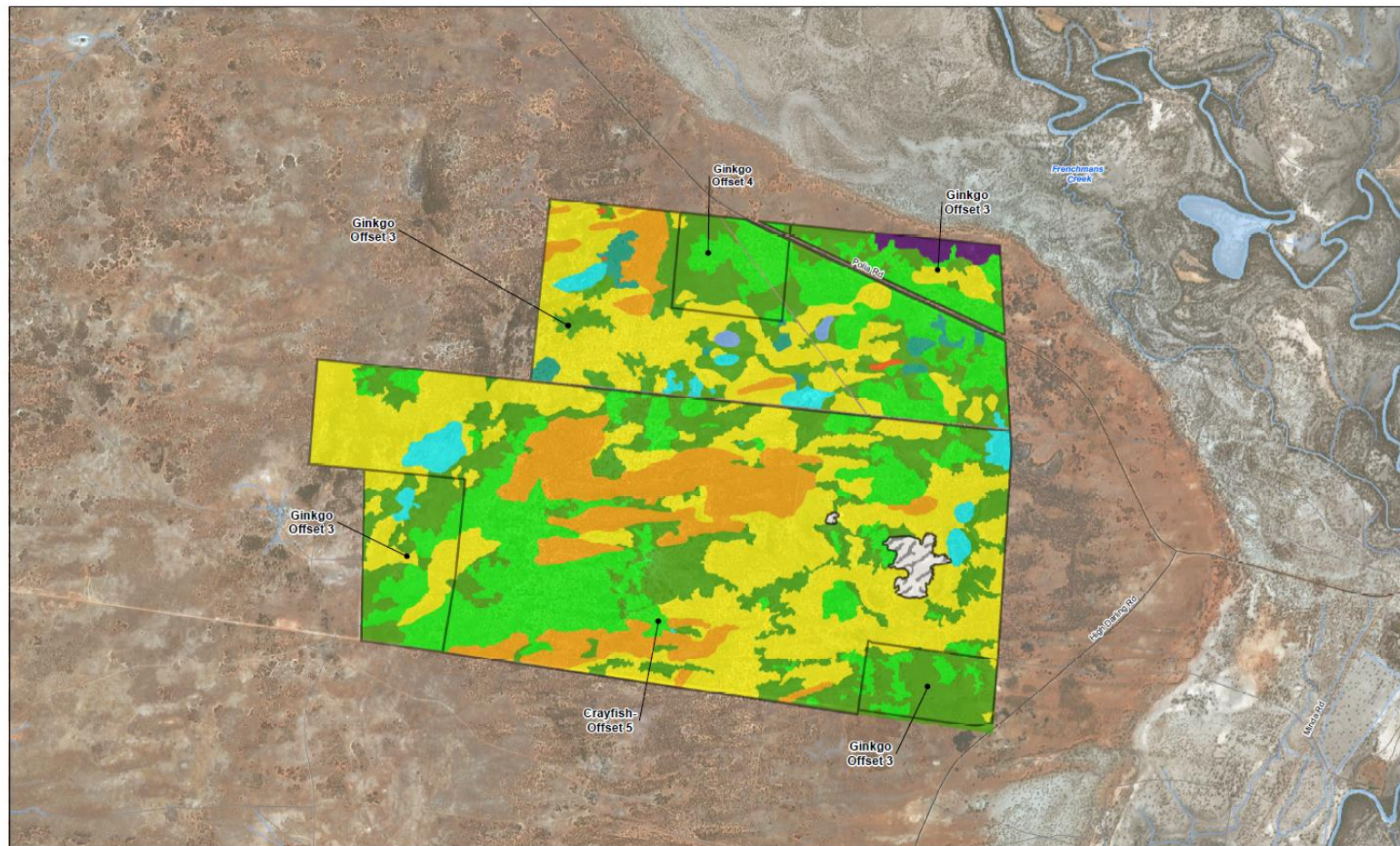


Figure 4 Vegetation communities of Offset Areas 3, 4 and 5

2.2 Offset Area 1 - Southern Mallee Offset Area and Offset Area 2 – Snapper Biodiversity Offset Area

Two offset areas, referred to as Offset Area 1 and 2, are located adjacent to the Snapper Mine and approximately 10 km south-west of the Ginkgo Mine. Offset Area 1 comprises of all of the Southern Mallee Offset Area designated to the Ginkgo Mine and some of the Snapper Biodiversity Offset Area and is to the west of the larger Offset Area 2. Offset Area 2 relates solely to offsets relating to the Snapper mining operations. Both offset areas are located on the Trelega Property within the following Western Lands Leases, leased to Bemax:

- WLL 4087
- WLL 913

These leases are perpetual leases currently conditioned for grazing purposes. An approximate 80 metre (m) wide fenced stock movement corridor has been provided along the southern boundary of the Offset Area 2 to allow for stock movement. A pipeline corridor also currently exists through Offset Area 2. An access track will be maintained along this pipeline corridor with access gates at the offset boundaries. This access track will also be utilised as a fire break. The approximate areas of each vegetation community are summarised in Table 3. Note that these values are approximate only as the exact values were not provided in the original OMP (Bemax 2011).

Table 3 Approximate Vegetation communities of Offset Area 1 (Southern Mallee Offset Area) and Offset Area 2 (Snapper Biodiversity Offset Area)

Vegetation Community	Area (Hectares)
Belah-Rosewood Woodland	2,397
Modified Belah-Rosewood Woodland	1,698
Bluebush Shrubland	539
Modified Bluebush Shrubland - Open Grassland Mosaic	424
Open Grassland – Copperbur Low Shrubland	419
Chenopod Mallee	419
Spinifex Mallee	30
Black Box Woodland	54
Hooked Needlewood Woodland	12
Total	5,992

2.2.1 Offset Area 1 – Southern Mallee Offset Area

Habitat Complexity

Flora and fauna surveys were conducted by FloraSearch and Western Research Institute, respectively, in April/May 2007. The objectives of the surveys were to obtain baseline ecological

data with regard to the flora and fauna of the offset to enable the design and management of the reserve.

Ogyris Ecological Research (Ogyris) was engaged in December 2008 to establish the ecological monitoring protocol for the offset and also undertake a preliminary site assessment (see Sluiter 2009). Ogyris were engaged again in December 2009 to undertake the annual ecological monitoring of Offset Area 1 (see Sluiter 2010).

Sluiter (2009) undertook a review of the vegetation map prepared by FloraSearch (2007) and found that the plant communities utilized by FloraSearch (2007) were not those outlined in the newly devised plant community types outlined for southwest New South Wales by Benson et al. (2006).

As shown in **Error! Reference source not found.**, the Offset Area 1 contains the following 11 vegetation communities (Sluiter 2009):

- Belah-Rosewood Woodland;
- Modified Belah-Rosewood Woodland;
- Bluebush Shrubland;
- Modified Bluebush Shrubland - Open Grassland Mosaic;
- Open Grassland – Copperbur Low Shrubland;
- Chenopod Mallee;
- Spinifex Mallee;
- Black Box Woodland;
- Hooked Needlewood Woodland;
- Australian Boxthorn Shrubland; and
- Turpentine Shrubland

Of the vegetation communities listed above, there are two vegetation types listed that have been highly modified as a result of past attempts at clearing. These include 'Modified Belah-Rosewood Woodland' and 'Modified Bluebush Shrubland – Open Grassland Mosaic'

Initial Habitat Condition

Ogyris in December 2008 undertook a preliminary site assessment of Offset Area 1 and assessed the habitat complexity and vegetation condition of the offset area. A second site assessment was undertaken by Ogyris in December 2009.

Ogyris has undertaken a preliminary site assessment and completed the monitoring program for Offset Area 2 during 2011. Results of this Offset Area 2 monitoring will be provided in the Snapper 2011 AEMR document.

Belah (Black Oak)-Rosewood Woodland (40% of Trelega Offset Area 1)

There are two Belah-Rosewood community types as defined by Benson *et al.* (2006) which occur within the Trelega Station Offset Area 1. They include:

- 'Black Oak (Belah)-Western Rosewood open woodland on deep sandy loams of Murray-Darling Depression and Riverine Bioregions'; and
- 'Black Oak-Pearl Bluebush open woodland of the sandplains of the semi-arid and arid climate zones'

The Belah-Rosewood Woodlands comprise approximately 40% of the Trelega Offset Area 1 and were in moderate condition in 2008 and 2009. Understorey Bluebush shrubs were heavily

overgrazed and the ground flora almost absent. Large areas of the Belah-Rosewood Woodlands have been modified by clearing in the past.

In the Ogyris December 2009 Assessment there had been a slight increase in ground flora plant cover and as well as indigenous plant species diversity.

Bluebush Shrubland (0.9% of Trelega Offset Area 1)

The Bluebush Shrubland comprises approx 1% of the Trelega Offset Area 1 and in December 2008, was in poor to moderate condition only. Areas that have been previously cleared were in worse condition.

In the Ogyris December 2009 Assessment ground flora plant cover and species diversity had increased.

Open Grassland-Copperburr Low Shrubland (7% of Trelega Offset Area 1)

Open grass land areas dominated by speargrass and copperburr comprise 7% of the Trelega Offset Area 1. This community was in very poor condition in both the December 2008 and 2009 surveys, with much of the area in this plant community having been modified.

Chenopod Mallee (7% of the Trelega Offset Area 1)

This is mallee vegetation which has primarily chenopod shrubs as an understorey and comprises 7% of the Trelega Offset Area 1. The Chenopod Mallee on the Trelega Offset Area 1 was in good condition in December 2008 and 2009.

In the Ogyris December 2009 assessment plant cover had increased marginally but indigenous plant species diversity had decreased marginally.

Spinifex Mallee (0.5% of the Trelega Offset Area 1)

Mallee vegetation with a primary understorey made up of porcupine grass which makes up only 0.5% of the Trelega Offset Area 1. The Spinifex Mallee on the Trelega Offset Area 1 is in good condition.

In the Ogyris December 2009 assessment shrub cover comprising mostly Upright Bluebush (*Maireana pentatropis*) had increased from 25% to 35%.

Black Box Woodland (0.9% of the Trelega Offset Area 1)

This Black Box woodland comprises only 0.9% of the Trelega Offset Area 1. This vegetation community was mostly in poor condition in December 2008.

In the Ogyris December 2009 assessment plant native diversity had decreased but plant cover had increased from 10% to 40%

Hooked Needlewood Woodland (0.2% of the Trelega Offset Area 1)

This vegetation community comprises on 0.2% of the Trelega Offset Area. This community was in poor condition in December 2008, with clear evidence of numerous tree suckers having been browsed off at ground level.

In the Ogyris December 2009 assessment this community had increase both native species diversity and vegetation cover, which was up from 5% to 20%.

Turpentine Shrubland (0.1% of the Trelega Offset Area 1)

This community comprises approximately 0.1% of the Trelega Offset Area1 and was in moderate to poor condition in both December 2008 and 2009.

The quality of the existing habitat within the offset area can be currently described as degraded. Heavy grazing pressure and the existing fragmentation of habitats are perhaps the greatest

threat to the sustainability of flora and fauna within the offset area as evidenced by the disturbance to the lower strata of vegetation.

The quality of the existing habitat is also attributed to key threatening processes (listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) such as clearing of native vegetation (including regrowth), removal of dead wood and dead trees (by burning) and proliferation of feral animals such as the European Rabbit and European Red Fox.

The conclusion from the Ogyris December 2009 Assessment (Sluiter 2010) was that the conditions of ground flora had improved in all non mallee vegetation communities. In the mallee vegetation communities plant cover increased but native species diversity remained stable and in some cases declined.

Threatened Flora Species

FloraSearch (2007) tentatively identified a juvenile plant of a Swainson-pea (*Swainsona species*) as Yellow-keeled Swainsona, (*Swainsona flavicarinata*), which is listed as Endangered under the BC Act.

The letter dated 8 June 2007 (Appendix 2 from Ogyris report 2009) from the Identification Botanist at the Royal Botanic Gardens states clearly that a positive identification cannot be made on the specimen in the absence of fertile material.

A further assessment was undertaken by Victorian Government Botanist Mr Neville Walsh (see Appendix 2 from Sluiter 2009) at the Royal Botanic Gardens Melbourne. Mr. Walsh's findings were that the plant is most likely to be an immature Senna plant, not Yellow-keeled Swainson-pea.

A targeted survey was undertaken by Sluiter (2009) to identify *Swainsona* species within the offset area but no members of this genus could be located. Accordingly, Sluiter (2009) has recommended that the requirements for any future searches for Yellow-keeled Swainson-Pea be waived.

This recommendation is based on the findings by Mr. Walsh at the Royal Botanic Gardens Melbourne, due to the lack of suitable habitat in the Trelega Offset Area 1; and also because the area is well outside the known distribution for the Yellow-keeled Swainson-Pea in New South Wales.

Threatened Fauna Species

During the fauna survey of the offset area, Western Research Institute (2007) identified five threatened fauna species, namely, the Swift Parrot (*Lathamus discolor*), Grey-crowned Babbler (Eastern subspecies) (*Pomatostomus temporalis temporalis*), Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) and Little Pied Bat (*Chalinolobus picatus*). A sixth species, the Inland Forest Bat (*Vespadelus baverstocki*), was also potentially identified.

From numerous pre-clearance surveys conducted at both the Ginkgo (Ogyris 2007a; 2007b; 2008a; 2009; 2010a) and Snapper Mines (Ogyris 2008b; 2010b), it is considered extremely unlikely that Grey-crowned Babbler and Yellow-bellied Sheath-tail Bat occur within the Bemax mine areas or surrounding properties. The large bat tentatively identified by the Western Research Institute is almost certainly the White-striped Mastiff-bat (*Tadarida australis*) which has been caught numerous times in the mine pre-clearance surveys (Bemax 2011). The nearest occurrence of Grey-crowned Babbler to the Bemax mine areas near Pooncarie are at Nyah, some 200 km to the southeast in northwest Victoria and at Balranald approximately 100 km to the east (Peter Ewin personal communication). The habitats where it occurs at Nyah are open woodland with a grassy understorey, very different from the habitats present within the broader Pooncarie area.

Preclearance surveys at the Ginkgo and Snapper MLA's have established the presence of both Little Pied Bat and Inland Forest Bat.

In areas containing Mallee with a hummock grass understorey dominated by Porcupine Grass (*Triodia scariosa*), it is also likely that the TSC-listed (Vulnerable) Jewelled Gecko (*Strophurus elderi*) would also occur.

Introduced Weeds

During a survey of the offset area (FloraSearch, 2007), nineteen species of introduced plants were recorded in the study area although none were listed as 'noxious' in the Wentworth Shire. A more recent assessment (Sluiter 2010), found three species of noxious weeds – Horehound (*Marrubium vulgare*), Onion Weed (*Asphodelus fistulosus*) and African Boxthorn (*Lycium ferrocissimum*). Horehound occurs generally around tank sites and in some run-on depression areas. African Boxthorn occurs rarely across the site, whilst Onion Weed was not seen as a significant problem in December 2009 (Sluiter 2010). Monitoring of the status of all three weeds and control of Horehound and African Boxthorn has been recommended by Sluiter (2010).

Pest Animals

The following exotic fauna species were recorded during the fauna survey conducted by Western Research Institute (2007): Feral Goat (*Capra hircus*), Red Fox (*Vulpes vulpes*), pig (*Sus scrofa*) and European Rabbit (*Orctylagus cuniculus*). In the monitoring report for the Trelega Offset Area 1, Sluiter (2010) has outlined control methods for the above feral species.

2.2.2 Offset Area 2 – Snapper Biodiversity Offset Area

Habitat Complexity

Flora and fauna surveys were conducted by FloraSearch and Cenwest Environmental Services, respectively, in October and November 2008. The objectives of the surveys were to obtain relevant ecological information to enable the design and management of the offset area.

Flora Search in 2008 identified five vegetation communities (**Error! Reference source not found.**):

- Black Oak (Belah)-Rosewood-Wilga Woodland (equivalent to Belah-Rosewood Woodland or modified versions thereof in Offset 1);
- Irregular Dune Mallee Shrubland;
- Turpentine Shrubland (equivalent to Turpentine Shrubland in Offset Area 1);
- *Austrostipa* Grassland (equivalent to Open Grassland – Copperbur Low Shrubland or modified versions thereof in Offset 1);
- Linear Dune Mallee Shrubland

A more recent survey by Sluiter (Ogyris P/L report in preparation) in May 2011 indicates that the broad community groupings found by FloraSearch are relevant, but planned mapping of the Offset Area 2 site will result in a few additional plant communities. One important community missing is 'Run-on Depression Herbfields' which are present at a number of locations in Offset Area 2.

Threatened Flora Species

No threatened flora species were identified during the 2008 FloraSearch survey. No threatened species were found by Sluiter (in prep. 2011) either, but the presence of Silver Bindweed (*Convolvulus crispifolius*) is seen as significant as this species has very few records in New South Wales. This species was moderately common on the Snapper powerline track and also

occasionally on linear dunes characterized by Dumosa Mallee (*Eucalyptus dumosa*), White Mallee (*E. gracilis*), Pointed Mallee (*E. socialis*) and Porcupine Grass (*Triodia scariosa*).

Threatened Fauna Species

Cenwest Environmental Services (2008) identified six BC Act threatened species during the Offset Area 2 survey. All species are listed as Vulnerable under the BC Act.

The six species identified were:

- Jewelled Gecko (*Strophurus eldери*);
- Crowned Gecko (*Lucasium stenodactylum*);
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*);
- Grey Crowned Babbler (eastern species) (*Pomatostomus temporalis temporalis*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picummus picummus*); and
- Little Pied Bat (*Chalinolobus pictatus*).

One further species was possibly identified which was unable to be distinguished correctly, Inland Forest Bat (*Vespadulus baverstockii*) which was unable to be differentiated from *Vespadulus vulturnus*. This species is now known to exist within the Murray Basin Mines area.

It has been considered unlikely that the Grey Crowned Babbler (*Pomatostomus temporalis*) exists in the Trelega area, given the nearest populations are over 200km away in grassy woodland habitat at Nyah, Victoria and Balranald, NSW (Ogyris 2009 and Peter Ewin email correspondence 2011). It is considered extremely unlikely that this BC-listed species would occur within the Trelega Offset 2 area.

Pre-clearance surveys at the Ginkgo and Snapper MLA's have established the presence of both Little Pied Bat and Inland Forest Bat.

The Crowned Gecko has in the past been confused with the Beaded Gecko (Peter Ewin email correspondence 2011) which is known to be present at the site. The identification of the Crowned Gecko may need confirming in future fauna monitoring surveys. Identification is based on the presence of small granular subdigital lamellae in *L. stenodactylum* as opposed to spinose in *L. damaeum* (i.e. subtle differences in toe morphology between species).

Introduced Weeds

Seven species of introduced plants were recorded comprising 10.6% of the total species observed. No species listed as noxious with the Wentworth Shire Council were recorded.

The seven introduced species were:

- Saffron Thistle (*Carthamus lanatus*);
- Smooth Mustard (*Sisymbrium erysimoides*);
- Burr Medic (*Medicago polymorpha*);
- Horehound (*Marrubium vulgare*);
- Vervain (*Salvia verbenaca*);
- Blackberry Nightshade (*Solanum nigrum*); and
- Arabian Grass (*Schismus barbatus*)

Bathurst Burr (*Xanthium spinosum*) has also been found adjacent to some tracks with control implemented in April/May 2011.

Pest Animals

Cenwest Environmental Services in 2008 identified eight introduced pest fauna species. The Feral Goat (*Capra hircus*) and the Rabbit (*Orctylagus cuniculus*) were found to be abundant, the Red Fox (*Vulpes vulpes*), Pig (*Sus scrofa*), Cat (*Felix catus*), and the Sheep (*Ovis aries*) were assessed as uncommon and the House Mouse (*Mus musculus*) was observed only once.

2.3 Ginkgo & Crayfish Offset Areas

The offset areas for the Ginkgo and Crayfish mineral sands operations includes six individual offset areas. Offset Area 3, Offset Area 4 and Offset Areas 7 and 8 have been identified to offset the development of the Ginkgo deposit and Offset Area 5 has been identified in relation to the development of the Crayfish deposit.

2.3.1 Offset Area 3

Offset Area 3 adjoins Offset Area 5 for the Crayfish Deposit (refer section 2.3.4 and **Error! Reference source not found.**). Adding parcels of land to the offset area that are adjacent to the Offset Area 5 would increase its size and long term sustainability, and is preferable to establishing an entirely new, small offset area elsewhere.

The vegetation communities previously in the Subject area (i.e. Offset Area 5) have been mapped using Air Photo Interpretation and previous data collected in ML 1504 (Flora Search 2015), and are noted in Table 4. The three dominant communities in the Subject area were Chenopod Mallee Woodland/Shrubland (406.5 ha), *Austrostipa* – *Sida* Grassland/Low Shrubland (383 ha), and Black Oak (Belah) – Western Rosewood Woodland (288 ha), Dune Mallee Shrubland was also prominent (61.5 ha). Smaller areas of Turpentine Tall Open Shrubland (43 ha), Black Box Woodland (37.5 ha), Hopbush Shrubland (24.5 ha), *Acacia victoriae* Shrubland (7.5 ha) and *Eragrostis* Depression Grassland (3.5 ha) were also present.

Offset Area 3 share similar sandplain vegetation with Offset Area 5. However, there are some differences due mainly to the lower altitudes of the proposed offset areas and their close proximity to the Darling River floodplain (FloraSearch 2015).

Table 4 Vegetation Communities of Ginkgo Offset Area 3

Vegetation Community	Area (Hectares)
Black Box Woodland	37.5
Black Oak (Belah) – Western Rosewood Woodland	288
Chenopod Mallee Woodland / Shrubland	406.5
Dune Mallee Shrubland	61.5
<i>Austrostipa</i> – <i>Sida</i> Grassland / Low Shrubland	383
Turpentine Tall Open Shrubland	43
<i>Eragrostis</i> Depression Grassland	3.5
<i>Acacia victoriae</i> Shrubland	7.5
Hopbush Shrubland	24.5
Total	1,255

Threatened Species and Communities

No threatened flora species listed under the BC Act was found in any of the surveys that have been conducted on ML 1504. None of the vegetation communities in the Subject area is listed as threatened under the BC Act.

Hopbush Shrubland, could have been part of the Sandhill Pine Woodland Endangered Ecological Community (EEC) (FloraSearch, 2014). Approximately 24.5 ha of this community occur in the north-eastern corner of the largest proposed offset area's parcel. The presence of this community considerably enhances the biodiversity values of the proposed offset areas.

In addition, the proposed offset areas have part of a very large population of the Winged Peppercress (*Lepidium monoplacoides*) in the south-eastern corner of the larger proposed offset area's parcel (FloraSearch, 2014). Winged Peppercress is listed as Endangered under both the BC Act and the EPBC Act.

No threatened flora species or ecological communities listed under the EPBC Act have been previously recorded in the Subject area or immediate surrounds. It is, therefore, considered unlikely that the clearance of the native vegetation in the Subject area had a significant impact on any threatened flora species or ecological communities. As described above, the Winged Peppercress occurs in the offset area and is listed under the EPBC Act.

2.3.2 Offset Area 4

An assessment of the fauna values within the study area was undertaken by Biodiversity Monitoring Services (2015). This included an assessment of the habitat within the Study area, as well as targeted searches for threatened fauna species. Threatened fauna species recorded during the surveys included a Little Eagle and Hooded Robin (south-eastern form).

Vegetation surveys of the study area were completed by FloraSearch (2014). These recorded three distinct vegetation assemblages were identified in the Offset Area 4 Study area and are mapped in **Error! Reference source not found.** and summarised in Table 5. Three of the vegetation communities are considered to represent some of the original native climax vegetation communities of the South Olary Plain. The *Austrostipa* - *Sida* Grassland/Low Shrubland vegetation community is considered to be a derived vegetation type resulting from removal of most of the original tree and/or shrub cover by previous landowners to promote grass and herb growth for stock grazing.

The vegetation communities listed are consistent with previous surveys undertaken by FloraSearch at the Ginkgo Mine.

Table 5 Vegetation Communities of Ginkgo Offset Area 4

Vegetation Community	Area (Hectares)
Black Oak (Belah) – Western Rosewood Woodland	61
Chenopod Mallee Woodland / Shrubland	18
<i>Austrostipa</i> – <i>Sida</i> Grassland / Low Shrubland	77
Total	156

It is considered that the vegetation of the proposed offset area, although not exactly 'like for like' in terms of vegetation communities, nevertheless represents similar good quality vegetation of high conservation value because:

- Black Oak (Belah) – Pearl Bluebush Woodland is in the same vegetation class as Black Oak – Western Rosewood Woodland, of which there is 61 ha in the offset areas (i.e. both are Semi-arid Sand Plain Woodlands).
- All of the climax communities in the offset areas are inadequately protected in the conservation reserve system (as of 2006). Once combined, the overall offset area would make a significant contribution to the conservation of these communities.
- According to BCD (2015b) data, the Chenopod Mallee Woodland/Shrubland (LM116) has been subject to more clearing in the Lower Murray Darling CMA (70% remains) compared to the other Biometric Vegetation Types in Table 24 (all greater than 80% remaining).
- The proposed offset area contains an additional vegetation community which is not present in the Modification area.

Threatened flora species

No threatened flora species listed under the BC Act were found in any of the surveys that have been conducted on ML 1504.

Condition of the vegetation

The condition of the vegetation on the Study area is influenced by a number of factors including land clearing, grazing by cattle, sheep, feral goats and rabbits, the occasional use of fire by land holders and the weather. Condition is further discussed below.

Pest Animals

Reports by FloraSearch (2014) and Biodiversity Monitoring Services (2015) reported that no domestic stock was present in the study area at the time of the survey, and that similarly, feral and native animals were in relatively low numbers. The unusually low grazing pressure resulted in the retention of much of the native vegetation biomass, including for many ephemeral species that are often quickly removed by heavy grazing.

Introduced and noxious weeds

Twenty species of introduced plants were recorded on the Study area comprising 22.5 percent of the total species observed. The percentages of introduced species varied from 6.2 to 29.2 percent among the climax vegetation communities, with the lowest proportions in the Black Box Woodland which had only 6.2 percent introduced species. The highest proportion of introduced species (38.9%) was recorded in the *Eragrostis* Depression Grassland. A few introduced species were widespread in the Study area and some were relatively common, e.g. Flax-leaf Alyssum (*Alyssum linifolium*), Ward's Weed (*Carrichtera annua*), Maltese Cockspur (*Centaurea melitensis*), Smooth Mustard (*Sisymbrium erysimoides*), Cut-leaved Medic (*Medicago laciniata*), Woolly Burr Medic (*Medicago minima*) and the grasses, Roughtail (*Rostraria pumila*) and Arabian Grass (*Schismus barbatus*). However, none dominated any vegetation communities.

No species listed as Noxious for Wentworth Shire (DPI, 2015) were recorded.

2.3.3 Offset Area 6

This additional offset area is located on the northern boundary of the Snapper Mine Biodiversity Offset Area 2 (), and incorporates 258 hectares of high quality Black Oak (Belah) - Western Rosewood Woodland and Black Oak – Pearl Bluebush Woodland, which has been declared with the primary objective of protecting habitat for threatened species, and in particular the BC Act listed Bolam's Mouse (*Pseudomys bolami*), which is 'Endangered' under NSW state legislation.

Fauna species recorded

Ten fauna survey sites were established within Offset Area 6 by GHD in 2017. Surveys conducted to date have targeted areas of high quality, intact Belah and Chenopod Mallee habitats with consideration given to previous threatened fauna species records, extent and quality of habitats present and the likelihood of occurrence for targeted threatened species. A range of survey techniques have been employed.

In 2019, 38 native fauna species have been recorded in Offset Area 6 including 22 native bird species, eight native bat species and eight native reptile species.

Threatened fauna

Four fauna species of conservation significance under NSW state legislation were recorded in Offset Area 6 in the 2019 survey, including the Inland Forest Bat (*Vespadelus baverstocki*), Little Pied Bat (*Chalinobolus picatus*), Hooded Robin (*Melanodryas cucullata*) and Major Mitchell's cockatoo (*Lophochroa leadbeateri*), all listed as Vulnerable under the BC Act.

2.3.4 Offset Area 5 - Crayfish Deposit

The 2,082 ha Offset Area 5 is approximately rectangular in shape with slightly diverging north and south sides, each eight kilometres long (). Offset Area 5 was allocated as the offset area for the development of the Crayfish Deposit. The area is a gently undulating sand plain with superimposed sand masses comprising both narrow east-west oriented dunes and large irregular dunes. The underlying sand plain predominates in the eastern and western extremities of the offset area, while the sand masses occupy much of the central two thirds. The irregular sand dunes mainly occur to the west of the north-south centreline, while the east-west dunes are mainly to the east of the centre and merge with the irregular dunes to the west.

The areas of each mapped vegetation community within Offset Area 5 are presented in Table 6 and **Error! Reference source not found.**

Table 6 Approximate areas of vegetation communities within Offset Area 5

Vegetation Community	Area (Hectares)
Black Box Woodland	57.6
Black Oak (Belah) - Western Rosewood Woodland	495.9
Chenopod Mallee Woodland / Shrubland	931.3
Dune Mallee Shrubland	368.9
Derived <i>Austrostipa</i> Grassland (includes quarries)	512.2
Derived Turpentine Tall Open Shrubland	(<10)*
Depression Grassland	(<20)*
<i>Sida</i> Low Shrubland	228.2
White Cypress Pine Open Woodland	(<5)*
Australian Boxthorn Open Shrubland	(<20)*

Prickly Wattle Tall Open Shrubland	(<5)*
Total	2,594.1

*Some communities occupy only small areas in widely dispersed locations within the offset. It was not feasible to map these occurrences separately hence the areas given are estimates only. The area occupied by these communities is included in the surrounding communities.

Vegetation Communities

Seven main vegetation assemblages were identified on the study area (Table 7) and are mapped in **Error! Reference source not found.** Community 7 is not mapped due to the small size of its occurrence. The vegetation types are numbered to match the corresponding communities present on the Crayfish Project area. Four of the vegetation communities (1 to 4) are considered to represent the dominant original native climax vegetation communities of the South Olary Plain. Semi-cleared areas of two of these communities are designated with a lower case 'a' after the community number (Table 7). Vegetation communities 5, 7 and 8 are considered to be derived vegetation types resulting from removal of most of the original tree and / or shrub cover by landowners to promote grass and herb growth for stock grazing. The seven main vegetation communities on the offset area are described below (Table 7).

The offset area is dominated by three natural vegetation types which are, in descending order of area; Chenopod Mallee Woodland / Shrubland (Community 3), Black Oak (Belah) – Western Rosewood Woodland (Community 2) and Dune Mallee Shrubland (Community 4). Smaller areas of Black Box Woodland (Community 1) are confined to playa depressions. Numerous large and small cleared areas support three main derived communities; *Austrostipa* Grassland (Community 5), Depression Grassland (Community 6) and *Sida* Low Shrubland (Community 7).

In addition, there are four communities recognised in other studies that occupy only small areas within the proposed offset. One is a natural climax community, White Cypress Pine Open Woodland (Community 9) and three are derived or disclimax shrubland communities; Australian Boxthorn Open Shrubland (Community 10), Prickly Wattle Tall Open Shrubland (Community 11) and Turpentine Tall Open Shrubland (Community 6). These communities are either too diffuse or too small in area to map in.

Flora species recorded

Flora species recorded within the proposed offset area are documented in FloraSearch 2012. A total of 143 vascular plant species was identified within the offset area, of which 116 (81.1%) are native and 27 (18.9%) are introduced. The most prominent families of native plants in descending order were the Chenopodiaceae (Saltbushes) – 24 species, Poaceae (Grasses) – 12 species, Asteraceae (Daisies) – 11 species, Zygophyllaceae (Twinleaves) – 7 species, Malvaceae (*Sida* and relatives) – 6 species, and Myoporaceae (Emubushes) – 5 species. The dominant families of introduced species were the Asteraceae (Daisies) – 7 species, and Brassicaceae (Brassicas) – 4 species. The highest abundance of plant species in the study area were recorded in Black Box Woodland (Community 1) (82 species) and Dune Mallee Shrubland (66 species). The derived communities (Communities 5, 7 and 8) had generally low species counts (44, 32 and 40 species, respectively) owing to the absence of tree and shrub layers.

The total number of plant species found during the survey was relatively low, despite the survey being conducted after good rain in the previous months with subsequent high germination levels and growth of herbs and grasses. The relatively low plant diversity could be attributed to a number of factors including:

- Prolonged grazing of the entire study area by sheep over the last 100+ years, which will have severely reduced most of the shrub and herb species that are palatable to stock;

- Burning of Dune Mallee Shrubland to reduce porcupine grass in the understorey and encourage herb and grass growth palatable to sheep. Such burning would incidentally reduce fire sensitive species;
- The survey was conducted in autumn; many ephemeral flora species flower in spring and were not present during the survey, and
- High feral goat numbers present at the time of the survey.

Table 7 Vegetation communities of Offset Area 5

Vegetation Formation (Keith 2004)	Vegetation Class (Keith 2004)	Community Number		Common Name	Scientific Names	Landscape Position
		This Study	Benson <i>et al.</i> (2006)			
Dominant natural communities						
Semi-arid woodlands (grassy subformation)	Inland floodplain woodlands	1	16	Black Box Woodland	<i>Eucalyptus largiflorens</i>	Playa or 'run-on' depressions.
Semi-arid woodlands (shrubby subformation)	Semi-arid sand plain woodlands	2	58/221	Black Oak – Western Rosewood Woodland	<i>Casuarina pauper</i> ± <i>Alectryon oleifolius</i> subsp. <i>canescens</i> ± <i>Myoporum platycarpum</i> subsp. <i>platycarpum</i>	Flat to undulating sand plains with solonised brown soils and some irregular dunes sandy clay soils.
		2a		Disturbed Black Oak – Western Rosewood Woodland		
	Sand plain mallee woodlands	3	170	Chenopod Mallee Woodland / Shrubland	<i>E. dumosa</i> / <i>E. gracilis</i> ± <i>E. socialis</i> / <i>Maireana</i> spp.	Flat to undulating terrain with clayey sand soils.
		3a		Disturbed Chenopod Mallee Woodland / Shrubland		
	Dune mallee shrublands	4	171	Dune Mallee Shrubland	<i>E. dumosa</i> / <i>E. socialis</i> / <i>Triodia scariosa</i> subsp. <i>scariosa</i>	Deep loose sands of irregular and east-west dune systems.
Dominant derived communities						
-	-	5	165	Austrostipa Grassland	<i>Austrostipa nitida</i>	Secondary vegetation community in areas that have lost both tree and shrub layers to clearing.
-	-	7	-	Depression Grassland	<i>Eragrostis setifolia</i> / <i>Eragrostis dielsii</i>	Periodically wet parts of dune swales and cleared playa depressions
-	-	8	-	Sida Low Shrubland	<i>Sida intricata</i> / <i>Sida fibulifera</i>	Solonised brown soils of cleared sand plains.
Minor communities						
Semi-arid woodlands	Riverine sandhill woodlands	9	28	White Cypress Pine Open Woodland	<i>Callitris glaucophylla</i>	Sandhills close to Darling River
-	-	10	196	Australian Boxthorn Open Shrubland	<i>Lycium australe</i>	Cleared areas in sand plain mallee and Black Oak – Rosewood woodland
-	-	11	139	Prickly Wattle Tall Open Shrubland	<i>Acacia victoriae</i>	Sand plains and sand hills close to the Darling River
-	-	6	143	Turpentine Tall Open Shrubland	<i>Eremophila sturtii</i>	Cleared sand plains and dune swales

Introduced flora species

Twenty-seven species of introduced plants were recorded on the study area comprising 18.9 percent of the total species observed. The percentages of introduced species varied from 10.6 to 28.1 percent among vegetation communities, with the lowest proportions in Mallee areas (Communities 3 and 4) (see FloraSearch 2012 for details). The three derived communities and Community 1 had the highest proportions of introduced species. A few introduced species were widespread in the project area and some were relatively common, e.g. Stemless Thistle (*Onopordum acaulon*), Common Sowthistle (*Sonchus oleraceus*), Mediterranean Turnip (*Brassica tournefortii*), Smooth Mustard (*Sisymbrium erysimoides*), Burr Medic (*Medicago polymorpha*), Barrel Medic (*Medicago truncatula*) and Wild Sage (*Salvia verbenaca*). However, none dominated any of the vegetation communities.

Three introduced species, African Boxthorn (*Lycium ferocissimum*), Bathurst Burr (*Xanthium spinosum*) and Horehound (*Marrubium vulgare*) are listed as Noxious within the Wentworth Shire (DPI, 2012). All were uncommon and in low abundance indicating previous effective control. African Boxthorn was associated with Black Box Woodlands and Bathurst Burr with watering points, while Horehound was a little more widespread throughout communities. All are listed as Category 4 weeds for which 'the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority'.

Threatened flora species

No species listed as threatened under the BC Act or the EPBC Act were found during the FloraSearch 2012 surveys. Nor were any species listed as Rare or Poorly Known in the Rare or Threatened Plants (ROTAP) (Briggs and Leigh, 1995) listing identified.

Threatened ecological communities

No threatened ecological community listed under the BC Act or the EPBC Act was found during the FloraSearch 2012 surveys.

Condition of native vegetation

The condition of the vegetation on the study area is influenced by a number of factors including grazing by sheep, feral goats and rabbits, and the occasional use of fire by land holders.

Fauna species recorded

Four fauna survey sites were established within Offset Area 5 by Biodiversity Monitoring Services 2012. The entire area was surveyed visually with detailed survey techniques used at the four sites. Stratification of the sites was based on habitat classes and all classes were sampled.

Threatened fauna

A number of threatened fauna were recorded during the 2012 fauna survey including the NSW Biodiversity Conservation Act 2016 listed Marble-faced Delma (*Delma australis*), listed as 'Endangered', Hooded Robin (*Melandryas cucullata*), Varied Sitella (*Daphoenositta chrysoptera*) and Little Pied Bat (*Chalinolobus picatus*) all listed as 'Vulnerable' under the BC Act.

2.3.5 Offset Areas 7 and 8

Flora species recorded

Flora species recorded within the proposed offset area are documented in FloraSearch 2017. The baseline survey investigated three potential offset areas, known as the northern, southern and eastern study areas however only a portion of the northern and eastern offset study areas became the actual Offset Areas Areas 7 and 8.

A total of 101 vascular plant species was identified within the offset area, of which 86 (85.1%) are native and 15 (14.9%) are introduced. The most prominent families of native plants in descending order were:

- Chenopodiaceae (Saltbushes) – 21 species,
- Asteraceae (Daisies) – 15 species,
- Zygophyllaceae (Twinleafs) – 6 species and
- Poaceae (Grasses) – 4 species.

The dominant families of introduced species were the Brassicaceae (Brassicas) – 4 species, Asteraceae (Daisies) – 3 species, Poaceae (Grasses) – 2 species and Fabaceae (Pea Flowers) – 2 species.

The highest numbers of plant species in the study areas were recorded in Black Oak – Pearl Bluebush Woodland (53 species) followed closely by Dune Mallee Woodland (49 species) (Table 8 and **Error! Reference source not found.**). The eastern study area was heavily grazed by sheep during the time of the survey which would reflect why the low flora diversity in Black Box Woodland.

Table 8 Approximate areas of vegetation communities within Offset Areas 7 and 8

Vegetation Community	Area (ha)
Black Box Woodland	16.7
Black Oak (Belah) - Western Rosewood Woodland	337.5
Black Oak (Belah)- Pearl Bluebush Woodland	227
Chenopod Sandplain Mallee Woodland	83
Dune Mallee Mallee Woodland	0
Austrostipa Grassland	0
Eragrostis Depression Grassland	17.3
Total Area	759

*Some communities occupy only small areas in widely dispersed locations within the offset. It was not feasible to map these occurrences separately hence the areas given are estimates only. The area occupied by these communities is included in the surrounding communities.

Introduced flora species

Fifteen species of introduced plants were recorded in the study areas comprising of approximately 15% of the total species observed. The percentages of introduced species varied from 11.8% to 35.0% among the climax vegetation communities, with the highest number and

proportion in Chenopod Sandplain Mallee Woodland. The derived community Eragrostis Depression Grassland had the highest proportion of introduced species (35.0%). A few introduced species that were relatively common such as:

- Maltese Cockspur (*Centaurea melitensis*),
- Flax-leaf Alyssum (*Alyssum linifolium*),
- Ward's Weed (*Carrichtera annua*),
- Smooth Mustard (*Sisymbrium erysimoides*),
- Woolly Burr Medic (*Medicago minima*),
- Wild Sage (*Salvia verbenaca*) and
- Arabian Grass (*Schismus barbatus*).

None dominated any vegetation communities, although Woolly Burr Medic and Wards Weed were very common in some derive grassland patches.

Threatened flora species

No species listed as threatened under the BC Act or the EPBC Act were found during the FloraSearch 2017 surveys.

Threatened ecological communities

No threatened ecological community listed under the BC Act or the EPBC Act were found during the FloraSearch 2017 surveys.

Condition of native vegetation

The condition of the vegetation on the study area is influenced by a number of factors including grazing by sheep, feral goats and rabbits, and the occasional use of fire by land holders and weather conditions.

Fauna species recorded

Six detailed survey sites within three offset areas, with 25 additional active search sites were established within the proposed offset areas by Biodiversity Monitoring Services 2017. Stratification of the sites was based on habitat classes and all classes were sampled. Of the three offset study areas surveyed portions of northern and eastern areas were the selected as the Offset Areas 7 and 8 (see).

Threatened fauna

A number of threatened fauna under the NSW *Biodiversity Conservation (BC) Act, 2016* were recorded during the 2017 fauna survey including:

- Jewelled Gecko (*Strophurus elderi*)
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)
- Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)
- Bolam's Mouse (*Pseudomys bolami*)
- Little Pied Bat (*Chalinolobus picatus*)
- Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*)
- Inland Forest Bat (*Vespadelus baverstocki*)

Each of these species are listed as Vulnerable under the BC Act except Bolam's Mouse which is classified as Endangered.

2.4 Consultation

Consultation with the Biodiversity Conservation Division DPIE (BCD) on 15 June 2017 regarding Modification 13, the BCD confirmed that it accepts that the revised biodiversity offset strategy and mitigation measures would appropriately offset the additional biodiversity impacts associated with the proposed modification. BCD also provided broader comments in relation to the longterm security of the biodiversity offsets, which have been considered further in Section 5.1 of the MOD 13 report.

Consultation with the NSW Biodiversity Conservation Division DPIE (BCD) has been conducted throughout the process of offset site selection, including a site visit on 10 August 2015 followed by a meeting on 26 August 2015. Discussions were held regarding the conditions of the 'Modification 9' approval and in particular the management and mitigation of impacts to the BC Act Endangered Marble-faced Delma (*Delma australis*). This species has been recorded both within the Crayfish mineral lease and within the offset area with protection and monitoring of this population a priority for the offset.

Consultation with the then Department of Environment and Climate Change (DECC) was undertaken in regard to the Snapper Mine offset during the Snapper Mine approval process. DECC's email correspondence to Bemax dated 27th April 2007 and 11th July 2007 were considered during preparation of the Offset Management Plan.

Consultation with the then DECCW was undertaken as part of the DA Modification application for both Ginkgo (Modification 8) and Snapper (Modification 3) which was approved on the 18th October 2010. Consultation with the NSW BCD was undertaken in April/May 2011 in regards to the original Snapper and Ginkgo Offset Management Plan. Comments from DECCW were accepted and incorporated into the plan.

2.5 Objectives for the offset

The Offset Management Plan and subsequent management of the offset will aim to address the long-term impacts of the clearing of the Murray Basin Mines mineral leases. Further monitoring of threatened species, particularly Western Blue-tongue Lizard (*Tiliqua occipitalis*) (Plate 1), Marble-faced Delma (*Delma australis*) (Plate 2) and Bolam's Mouse (*Pseudomys bolami*) (Plate 3) (as listed in the conditions), will be conducted within the offset areas, and the offset plan would be reviewed to identify the current population size, the management options to be in place, and the monitoring program to ensure goals are met. Protection of both the offset and adjoining habitats (which is where most animals will move to during clearing) will be of critical importance.

Other general objectives for the offset include:

- Secure the tenure of the offset areas for long-term conservation purposes;
- Enhance flora and fauna habitats within the offset areas;
- Implement the offset under the conditions of the Western Lands Lease and requirements of the Local Land Services Act 2013.

Performance criteria and completion criteria are provided in Section 3 to meet these objectives.

Following discussions between Tronox and BCD, it was determined that the primary objective of the Crayfish offset (and actions highlighted in the plan) is to protect and monitor populations of threatened species and in particular the Marble-faced Delma (*Delma australis*). This species has previously been recorded both within the Crayfish mineral lease and offset area.

Furthermore, an additional area described and mapped as the Ginkgo Offset Area 6 () has been declared with the primary objective of protecting habitat for threatened species and in particular the Bolam's Mouse (*Pseudomys bolami*).



Plate 1 Western Blue-tongue Lizard (*Tiliqua occipitalis*)



Plate 2 Marble-faced Delma (*Delma australis*)



Plate 3 Bolam's Mouse (*Pseudomys bolami*)

2.5.1 Risks impacting on success

The following risks have been identified as having the potential to reduce the success of the Biodiversity Offset Strategy:

- Prolonged drought conditions
- Pest plants and animals
- Grazing pressures
- Bushfire
- Erosion

The contingency measures to mitigate these risks are encompassed within:

- the implementation of the short, medium and long term management measures outlined in section 2.5.2
- the monitoring program for all offset areas outlined in section 4

Progress towards each offset area achieving the performance and completion criteria will be measured in accordance with the requirements of section 3.

2.5.2 Short, Medium and Long-Term Measures

This section provides a description of the short, medium and long-term measures that will/ have been implemented within the offset area, including:

- Fencing to exclude grazing;
- Incremental destocking;
- Removal of unnecessary fencing;
- Erosion control;
- Signage of the offset area;
- Revegetation of unnecessary access tracks;
- Animal pest control;
- Weed management;
- Fire management;
- Threatened species management;
- Security of artificial water sources;
- Revegetation by natural regeneration;
- Vehicle access management; and
- An environmental induction for employees and contractors.

For the purpose of this Offset Management Plan, short, medium and long-term periods have been defined as:

- **Short-term** – the first six months from Project and vegetation clearance beginning.
- **Medium-term** – the period between six months and two years from the beginning of Project and vegetation clearance, and before completion criteria are met.

- **Long-term** – the period two years after beginning of the Project and vegetation clearance, through to the completion of Project and rehabilitation, and to be undertaken in accordance with the Western Lands Lease conditions.

An indicative Schedule of Management for the offset areas is provided in Table 9. A description of the short, medium and long-term measures that will be implemented is provided in the following sub-sections.

Table 9 Indicative Schedule of Short, Medium and Long-term Measures for management actions of Offset Areas

Measures and indicative timing	Short Term (0-6 months)	Medium Term (6-24 months)	Long Term (24 months +)
Fencing to Exclude Grazing			
Fence Maintenance to Exclude Grazing			
Incremental Destocking			
Removal of Unnecessary Fencing			
Erosion Control			
Provision of Signage for the Offset Area			
Revegetation of Unnecessary Access Tracks			
Animal Pest Control a			
Weed Management a			
Fire Management a			
Threatened Species Management			
Security of Artificial Water Sources c			
Provision of Habitat Resources b			
Vehicle Access Management			
Environmental Induction			

a) Erosion control, animal pest and weed management and fire management where considered necessary as a result of the initial site inspection and ongoing monitoring.

b) Provision of habitat resources as where considered necessary as a result of the initial site inspection and ongoing monitoring.

Fencing to Exclude Grazing

Appropriate total grazing pressure fencing of the offset areas will be undertaken to prevent the uncontrolled entry of livestock (e.g. sheep, farmed goats) whilst also limiting the ingress of feral goats so that natural regeneration of native vegetation in accordance with destocking can be facilitated. Fencing must be completed as soon as possible.

Destocking

The Offset Area must be completely destocked before the project, and any vegetation clearing is completed.

Removal of Unnecessary Fencing

Existing fencing within the offset areas will be removed if the fencing is unnecessary to prevent the uncontrolled entry of livestock. The material from these removed fences will be reused where appropriate.

Erosion Control

Erosion control is required in areas where gully erosion is observed from visual monitoring.

The following measures are to be used to control erosion within the offset areas:

- Selective plantings; and/or
- Surface water management structures (e.g. silt fences and temporary sediment traps [such as hay bales]).

The following measures will reduce erosion potential:

- Fencing to exclude grazing;
- Removal of stock
- Restriction of vehicle access to authorised personnel; and
- Control of animal pests (such as European Rabbit).

Signage of the Offset Areas

Signs denoting private conservation reserve will be placed on access gates on perimeter fencing, to minimise the potential for accidental disturbance of the Offset Areas.

Revegetation of Unnecessary Access Tracks

Unnecessary access tracks are those which are not used for stock movement between Agricultural Areas, access or used for fire management. Unnecessary access tracks will be progressively decommissioned and if necessary revegetated.

Animal Pest Control

Many animal pests pose a threat to native fauna through competition for habitat resources and direct predation. Schedule 3 of the BC Act lists the following key threatening processes which are relevant to animal pest management within the offset area:

- Predation by the European Red Fox;
- Predation by feral cats;
- Competition and habitat degradation by feral goats;
- Competition and grazing by the feral European Rabbit; and

- Feral pigs.

Complete removal of any existing dams and artificial water sources, such that they can no longer hold water, will minimise the occurrence of declared and other animal pests.

Pest control strategies will include, but not necessarily be limited to, the destruction of rabbit burrows, removal of rabbit harbor, rabbit poisoning where deemed to be necessary, a twice annual fox baiting program, and monthly mustering for removal of feral goats.

Pest animal control and baiting programs will commence once fencing of the offset areas has been completed, and will be conducted with appropriate permits from the Department of Primary Industries (DPI) – Agriculture. All control measures adopted will be carried out with due regard to the welfare of the animals involved. Methods used will be designed to ensure the lowest level of suffering consistent with effective control and advice would be sought from the Western Local Land Services in regard to appropriate control measures.

If ecological monitoring indicates that regeneration is not occurring to an adequate degree and there remains significant grazing pressure from feral goats in particular, then additional feral goat control will be considered. As a minimum, this would include increased mustering, and potentially improved fencing, with the aim of the total removal of goats.

All procedures used will be consistent with procedures recommended by the Rural Lands Protection Board and will comply with the Standing Committee on Agriculture Model Code of Practice for the Destruction, Capture, Handling and Marketing of Feral Livestock Animals (CSIRO, 1992).

Weed Management

Weed species are effective competitors for resources and have the potential to exclude native species from the landscape, resulting in changes in the composition and structure of plant communities.

The control of noxious weeds on a Western Lands Lease is required under the Westerns Lands Act, 1901 and the Noxious Weeds Act, 1993. In the event that any noxious weed is identified within offset area, it will be controlled in accordance with its DPI – Agriculture control category. The Wentworth Shire Council will be notified in the event a noxious weed with a W1 control category is identified within offset area.

In recognising that weeds can be brought into the offset area on vehicles or personnel, the following measures will be taken to reduce the potential for weeds within the offset areas:

- Identification of weeds via regular site inspections and communication with surrounding landholders;
- Mechanical removal of identified weeds and/or the application of approved herbicides;
- Unnecessary access tracks will be revegetated as access tracks can provide a vector for weeds;
- Vehicle access to the offset area shall be restricted to authorised personnel; and
- Education of employees and contractors on procedures to reduce weed spread.

Regular site inspections will be undertaken to assess the requirement for weed control measures and to determine the effectiveness of eradication programs.

Fire Control

Bushfire prevention is required under the Rural Fires Act, 1997. The absence or lack of fire or grazing can lead to a build up of fire fuel and risk of a high intensity bushfire. Bushfire preventative measures will include:

- Educating employees and contractors on general fire awareness and first response procedures;
- Fire track maintenance for fire control;
- Prevention of extensive wildfire in the offset areas;
- Suppression of lightning strikes as rapidly as possible to prevent extensive wildfire in the offset site, and if required, undertake a hazard reduction process that prevents wildfire (such as strip burns) in a manner that does not impact on the ecological values of the majority of the offset area (particularly loss of spinifex understorey and hollows);
- Annual inspections to identify areas requiring bushfire control measures including assessment of fuel loads; and
- Fuel management (e.g. hazard reduction burns) in consultation with the NSW Rural Fire Service if deemed to be required.

Threatened Species Management

Threatened fauna species known or suspected to occur within habitat provided within the Offset Areas are likely to be considerably enhanced by the elimination of stock grazing and reduction in overall grazing pressure associated with feral goat and rabbit control measures. This will be measured through a monitoring program, as described in section 4. Monitoring of the Offset areas, and area surrounding the mine extensions, will in particular target threatened fauna species such as Marble-faced Delma (*Delma australis*), Western Blue-tongue Lizard (*Tiliqua occipitalis*), and Bolam's Mouse (*Pseudomys bolami*) as required by BCD and the mine approval conditions, along with other threatened species such as Little Pied Bat (*Chalinolobus picatus*), Corben's Long-eared Bat (*Nyctophilus corbeni*), and a range of NSW listed threatened bird species.

Surveys for Yellow-keeled Swainsona and Yellow Swainson-pea were previously recommended to be conducted as part of the regular ecological monitoring schedule, but later disregarded as highly unlikely to occur in the area. Further consultation in regards to appropriate management actions will be undertaken with BCD, if either of these species is incidentally identified during other ecological monitoring.

Security of Artificial Water Sources

As suggested during consultation with the BCD (pers. comm., 10 August 2015), farm dams inside the offset areas, will be fenced to reduce the access of feral goats and kangaroos to water.

Fences will be located at least 2 m from the full storage line to allow for colonization of vegetation around the dam which offer habitat for frogs and small birds. Vegetation also helps to minimise soil erosion.

Fences will be approximately 2 m high with a 4 centimetre (cm) mesh between posts (after DPI, 2007). The mesh will be skirted away from the dam to prevent animal pests burrowing under the fences.

A gate will be installed within each fence to maintain access for firefighting equipment. A track will be maintained to each dam to allow access for firefighting purposes.

Vehicle Access Management

Vehicular movement through the offset areas can result in soil compaction, spread of weeds and vegetation disturbance. To minimise the degree of disturbance, vehicle access within the offset areas shall be restricted to authorised personnel.

Environmental Induction

Employees and contractors entering the offset areas will have an induction which will cover:

- Procedures to reduce spreading weeds and pests;
- General fire awareness and response procedures; and
- Vehicle access management.

3. Performance and Completion Criteria

The performance of the eight offset areas will be monitored against the performance criteria provided in Table 10 for each monitoring period. The performance criteria have been developed to meet the objectives for the offsets.

Table 10 Performance Criteria for Tronox Offset Areas

Monitoring Period	Performance Criteria
Spring Year 1	In Spring Year 1, the offsets will be measured against the following performance criteria: • Appropriate fencing has been provided to exclude grazing stock from offsets. • Unnecessary fences have been removed from the offsets. • Signage has been provided for offsets. • Preliminary site inspection has been conducted to determine the need for management measures within offsets. • Areas which require selective revegetation in offsets have been identified.
Spring Year 2	In Spring Year 2, the offsets will be measured against the following performance criteria: • Perimeter fencing of offsets has been maintained and stock excluded. • Artificial water sources have been fenced in offsets. • Erosion control measures are effective. • Animal pests control measures are effective. • Weed control measures are effective. • Targeted surveys for Marble-faced Delma, Western Blue-tongue Lizard and Bolam's Mouse have been conducted within the relevant offsets.
Spring Year 3	In Spring Year 3, the offsets will be measured against the following performance criteria: • Perimeter fencing of offsets is being maintained and appropriate fencing has been provided to exclude grazing stock from offsets. • Artificial water sources have been fenced in offsets. • Signage has been provided for offsets. • Erosion control measures are effective. • Animal pests control measures are effective. • Weed control measures are effective. • Monitoring for Marble-faced Delma, Western Blue-tongue Lizard and Bolam's Mouse have been conducted within the relevant offsets.

Monitoring Period	Performance Criteria
Spring Year 4 (and following years until completion criteria are met)	In Spring Year 4 (and following years until completion criteria are met), the offsets will be measured against the following performance criteria: • Perimeter fencing has been maintained and stock excluded. • Revegetation activities within possible revegetation areas are underway. • Selective planting has been commenced within offset if required. • Planted vegetation is establishing. • Erosion control measures are effective. • Animal pests control measures are effective. • Weed control measures are effective. • Monitoring for Marble-faced Delma, Western Blue-tongue Lizard and Bolam's Mouse have been conducted within the relevant offsets.

An Independent Environmental Audit will determine which areas within each of the offset areas have met the completion criteria.

4. Monitoring

4.1 General requirements

This section describes the monitoring which will be conducted within the offset areas. Monitoring of the offset areas will comprise:

- Establishment monitoring in Year 1 when baseline monitoring is completed and permanent monitoring sites are located (as required in the mine approval condition 20 (c));
- Annual performance and ecological monitoring for the first three years to assess the performance of the offsets;
- Triennial (once every three years) ecological monitoring of the offsets performance until completion criteria has been satisfactorily met;
- Results of monitoring of the offsets will be incorporated into the ongoing management of the offset areas, with management activities adapted to reflect the results of monitoring activities. Where monitoring fails to show the expected improvements in vegetation condition, habitat values, and threatened species numbers, management actions will be reviewed, with consultation with BCD, and the management actions adapted and/or extended to achieve the desired outcomes.

4.2 Monitoring the performance of the offset

The objectives of performance monitoring are as follows:

- Evaluate the effectiveness of the implemented measures and determine the need for additional measures;
- To monitor the condition of the habitats within the offset areas over time;
- To assess progress towards the completion criteria; and
- Monitor populations of Threatened Species, specifically Western Blue-tongue Lizard, Marble-faced Delma and Bolam's Mouse (as required by the mine approval conditions).

The performance of the offsets will be monitored against the performance criteria provided in Table 10 for monitoring periods in years one, two and three (and the following years until completion criteria are met). The performance monitoring will be undertaken by a suitably qualified person approved by the Director-General.

The performance monitoring will include:

- Photographic monitoring at permanently established photopoints (likely to be co-located at flora and fauna monitoring 'sub-sites' – see section 4.6 below); and
- Flora, fauna, habitat and landscape/ecosystem function monitoring as per the methods described below in section 4.3.

4.2.1 Photographic Monitoring

Permanent photopoints are established within the offset areas to provide a visual representation of the change in the flora and fauna habitat in the offset area over time. The methodology for photographic monitoring described below reflects the National Parks and Wildlife Service (NPWS) (now DECC) (2003) Conservation Management Note 9 – Photographic Monitoring.

A stake with flagging tape is used to mark the location of the photopoint. The coordinates of the photopoint are recorded with a Global Positioning System (GPS). Photos are taken at the photopoints annually at a similar time of day (for consistence of light conditions).

Subsequent photographic monitoring events are used with photographs from the previous monitoring period so that photos can be framed in the same way as photographs from previous monitoring periods.

A record of the photographs will be maintained which includes:

- Co-ordinates of the photopoint;
- Date and time of each photograph;
- The direction in which the photo was taken; and
- The height above the ground at which the photo was taken.

After each photographic monitoring event, the photographs are compared to the photographs from the previous monitoring periods. The following elements will be noted:

- Natural regeneration and condition of native understorey and overstorey species;
- The habitat complexity (e.g. presence of logs, litter);
- Plant establishment; and
- The status of weeds.

Permanent flora quadrats located around the photopoint sites are used to gather quantitative data on the above elements. Data collected includes plant floristic and structural data.

A review of aerial photography can be used to show enhancement of vegetation connectivity.

4.2.2 Reporting

A summary of the results of the monitoring program is provided in the Ginkgo Mine Annual Environmental Management Report (AEMR).

A copy of the annual monitoring reports is forwarded annually to the NSW BCD if not included in the AEMR process.

4.3 Offset monitoring approach

It is recommended that monitoring for the offset areas follows the same approach employed for monitoring sites that were established in 2007, 2009 and 2011 by the then NSW Department of Natural Resources (now Biodiversity Conservation Division DPIE BCD) and Lower Murray Darling Catchment Management Authority in conjunction with GHD as part of the *'Establishing a site-based monitoring programme for threatened fauna in mallee dunefields in the Lower Murray Darling Catchment Management Authority area, south-west NSW'* (DECC, 2008a) and also that of DEC 2004 *'Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft'*. Site selection is outlined in detail in these report, but follows the principles of:

- Sampling sites located away from disturbance factors such as roads and fences;
- Sites located a minimum of approximately 1.5 km from artificial watering points;
- Treatment and control sites located at a similar distance from the nearest watering point;
- The treatment and control sites located in the same vegetation community and similar vegetation structure; and
- The treatment and control sites located in the same landform type and soil type.

These principles when applied correctly, result in the establishment of effective control sites experiencing as similar as possible climatic and ecological conditions as the treatment sites.

4.4 Threatened fauna monitoring for Offset Area 5 – Crayfish Deposit

For the monitoring and management of the Marble-faced Delma and Western Blue-tongue Lizard, discussions with BCD have indicated that monitoring both within the offset area and within suitable habitat within the general proximity of both the Crayfish mining lease and offset will be required. Employing the approach as discussed above in section 4.3 and discussed in greater detail would address a number of objectives for the offset plan as it would both:

- Allow for the monitoring of the condition of the offset reserve via the establishment of both 'treatment' (sites within the offset) and 'control' sites within similar habitats in the general area;
- Monitor the population of Marble-faced Delma/Western Blue-tongue Lizard both within and outside of the offset area as per conditions of approval.

Following this recommended approach, five 'treatment' sites have been permanently established within the offset and an additional five 'control' sites established within suitable habitat within the vicinity of the Crayfish mineral lease/Offset Area 5 (within high quality *Triodia* spp. habitats).

4.5 Threatened fauna monitoring for Bolam's Mouse in Offset Area 6

For the monitoring and management of the Bolam's Mouse, discussions with BCD have indicated that monitoring both within Offset Area 6 and within suitable habitat within the general proximity of both the Existing Snapper mining lease, the Crayfish mining lease and offset will be required. Employing the approach as discussed above in section 4.3 and discussed in greater detail would address a number of objectives for the offset plan as it would both:

- Allow for the monitoring of the condition of the offset reserve via the establishment of both 'treatment' (sites within the offset) and 'control' sites within similar habitats in the general area;
- Monitor the population of Bolam's Mouse both within and outside of the relevant offset areas as per conditions of approval.

Following this recommended approach, five 'treatment' sites would be permanently established within the offset and an additional five 'control' sites established within suitable habitat within the vicinity of the Snapper mine offset and the Crayfish mineral lease/offset area (in high quality Belah-Rosewood habitats observed in the vicinity of both areas).

4.6 Vegetation Condition Assessments

Vegetation condition is recommended to be assessed at each site following the State-wide Vegetation Condition, Evaluation and Reporting Program Operational Manual (DECC 2008b) as used in previous monitoring by LLS Western Region and its predecessor organisations. The collection of field data is undertaken in three distinct modules each following the DECC State-wide vegetation condition standard:

- **Module 1**, field data covers the broad categories of; site details, land use and land cover details, plot disturbance, physiography, site history, vegetation community description, vegetation structure, as well as a description of nine condition attributes that conform to BioMetric assessments;

- **Module 2**, involves a full floristic description of a 20 m x 20 m plot; and
- **Module 3**, involves the establishment of a permanent 50 m transect to monitor ground cover.

Each vegetation condition monitoring site consists of a 50 m x 20 m transect, permanently marked with a star-picket or stainless steel post at each end of the centre-line (see Figure 6 below). These posts also mark one end of the pitfall lines for the fauna survey method where these are included in the habitat. Tape-measures and flags were used to mark the transect area boundaries while the survey was conducted. A summary of the parameters recorded and areas used is summarised in Table 11 below.

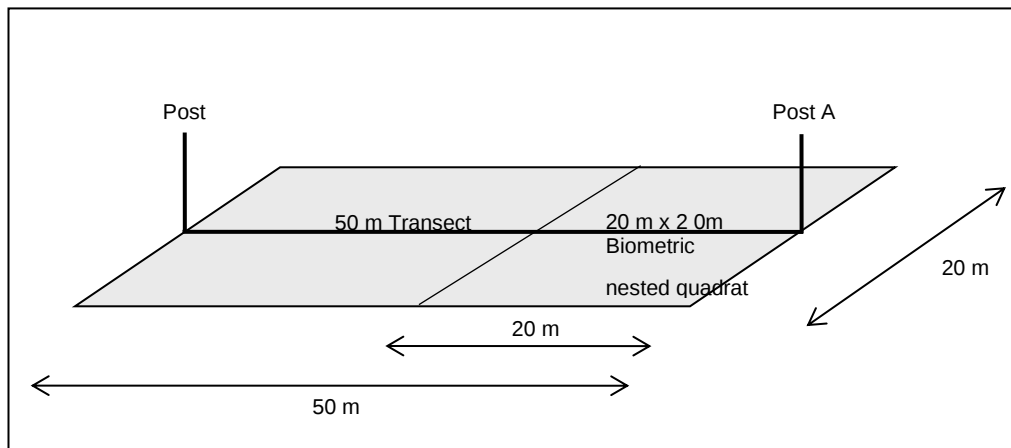


Figure 6 Vegetation condition monitoring transect area layout

Habitat condition key indicators are assessed by collecting parameters including native plant species richness, ground cover, shrub cover, over-storey cover and the abundance of hollow-bearing trees and coarse woody debris (logs). Methods used to assess parameters for the habitat condition key indicator were based on the methods used in BioMetric, A Terrestrial Biodiversity Assessment Tool for the NSW Native Vegetation Assessment Tool (Gibbons *et. al*, 2008). This data is then entered into the computer-based Biometric tool, which compares actual results against benchmarks, which are measures of the range of variability in condition in a particular vegetation type, which has experienced relatively little evidence of alteration, disturbance or modification by humans since European settlement.

Native species richness (total number of native species) is also used as an indicator of vegetation dynamics.

Table 11 Parameters recorded during vegetation condition assessments

Key Indicators	Parameters	Method	Plot Size
Biometric - Habitat Condition and Vegetation Dynamics	Vascular flora – composition and frequency	Number of native plant species – with full species list.	20 m x 20 m nested quadrat
Biometric - Habitat Condition	Native over-story cover	% foliage cover estimate of tallest woody stratum.	50 m x 20 m quadrat
Biometric - Habitat Condition	Native mid-story cover	% foliage cover estimate of vegetation below over-story but over 1 m.	20 m x 20 m nested quadrat
Biometric - Habitat Condition	Native ground cover – grasses	% foliage cover estimate of native grasses.	20 m x 20 m nested quadrat
Biometric - Habitat Condition	Native ground cover – shrubs	% foliage cover estimate of native woody vegetation.	20 m x 20 m nested quadrat
Biometric - Habitat Condition	Native ground cover – other	% foliage cover estimate of native non-woody vegetation.	20 m x 20 m nested plot
Biometric - Habitat Condition	Exotic plant cover	% foliage cover estimate of all exotic vegetation.	20 m x 20 m nested quadrat
Biometric - Habitat Condition	Hollows	Number of living and dead trees with at least one 5 cm diameter hollow over 1 m above ground.	50 m x 20 m quadrat
Biometric - Habitat Condition	Over-story regeneration	Proportion of over-story species regenerating/recruiting in the surrounding area.	Surrounding area
Biometric - Habitat Condition	Fallen logs	Total length of fallen logs, greater than 10 cm diameter.	50 m x 20 m quadrat
Vegetation	NVIS Level 5	Record of dominant species in each stratum.	20 m x 20 m nested quadrat
Disturbance	Site History and Plot Disturbance	Observation of signs of management actions, erosion, and other disturbance within plot.	50 m x 20 m quadrat
Grazing Pressure	Dung count	Count of presence of dung (stock, exotic pests or native species) within 25 cm radius, each 50 cm along transect (100 points).	50 m transect
Site Condition	Site photo	Taken from Post A towards Post B.	50 m x 20 m quadrat

4.6.1 Vascular flora species composition and cover

Native and exotic vascular plant species are assessed within the 20 m x 20 m nested quadrat (see Figure 6). Plants are identified to species level where possible but in some cases sufficient diagnostic material may not be available (e.g. seeds, flowers) to achieve species level identification, in which case plants can be assigned the best identification level possible, generally genus or family. All vascular plant species are included in the assessment, including perennials, annuals and ephemerals.

Native species richness is a component of the BioMetric Habitat Condition Index (Gibbons *et al.* 2008) and is also used to assess the vegetation dynamics key indicator. In subsequent analysis, native species richness is calculated from the 20 x 20 m nested quadrat.

4.6.2 Canopy and mid-storey cover

The cover of canopy trees was assessed by visually estimating the projected foliage cover of all native over-storey trees over the full 50 m x 20 m quadrat (see Figure 6).

The mid-storey includes all native shrubs greater than 1 m in height, and includes all species native to New South Wales (i.e. this assessment is not confined to species indigenous to the area), and is estimated as the percentage of foliage cover in the 20 m x 20 m nested quadrat.

4.6.3 Ground Cover

The ground cover assessment includes all stratum of native vegetation below 1 m in height and includes all species native to New South Wales (i.e. the assessment is not confined to species indigenous to the area). Ground cover is split into three classes, the ground stratum (grasses) refers to native grasses (i.e. plants belonging to the family Poaceae, and also spinifex). The ground stratum (shrubs) refers to native woody vegetation < 1 m. The ground stratum (other) refers to non-woody native vegetation (vascular plants only) < 1 m that is not grass (e.g. herbs, ferns). Ground cover was estimated as the percentage of foliage cover in the 20 m x 20 m nested quadrat as described for native mid-storey cover above.

4.6.4 Exotic plant cover

Exotic plants include all vascular plants not native to Australia. Exotic plant cover is measured as total percentage foliage cover of all exotics in all strata. If the exotics are in the over-storey they are measured using the same method as native over-storey cover, if exotics exist in the mid-storey they are measured using the same method as native mid-storey cover and if exotics are recorded in the ground stratum they are measured using the same method as described for native ground cover.

4.6.5 Number of trees with hollows

The number of trees with hollows is comprised of a count of the number of living and dead trees within the 50 m x 20 m quadrat with at least one hollow (note that the hollows do not have to be within the plot). A hollow is only recorded if, (a) the entrance can be seen, (b) the minimum entrance width is at least 5 cm in diameter; (c) the hollow appears to have depth (i.e. you are unable to see solid wood beyond the entrance), (d) the hollow is at least 1 m above the ground (this omits hollows in cut stumps or at the base of trees) and (e) the centre of the tree is within the plot. Trees are to be examined from all angles.

4.6.6 Overstorey regeneration

Over-storey regeneration is measured as the proportion of over-storey species present at the site (includes the general area, i.e. within sight of the plot) that are regenerating. For example if

there are three tree species present at the site, but only one of these species is regenerating, then the value is 1 of 3 or 0.33. The maximum value for this measure is 1.

4.6.7 Coarse woody debris

The length of coarse woody debris (logs greater than 10 cm in diameter, and at least 0.5 m long) is estimated with a diameter tape and measuring tape within the 50 m x 20 m quadrat.

4.7 Analysis of key vegetation condition indicators

Parameter values are calculated for each transect and the two transects averaged to obtain a mean site parameter score for each assessment period. Mean values are then calculated for each parameter, for each vegetation type and land use category.

Habitat condition

A Habitat Condition Index is calculated for each transect, based on the 'site value' score of the BioMetric terrestrial biodiversity assessment tool (Gibbons *et al.* 2008). This scoring system involves comparing ten variables collected in the field with a set of benchmark values. Benchmark values have been established for each vegetation type and former CMA region. The Benson (2006) classification of sites is used to associate benchmark values with assessment sites. Vegetation condition benchmarks are provided by LLS Western Region and its predecessor organisations.

The ten variables considered in Biometric are:

- Native plant species richness;
- Native over-storey cover;
- Native mid-storey cover;
- Native ground cover – grasses;
- Native ground cover – shrubs;
- Native ground cover – other;
- Exotic plant cover;
- Number of trees with hollows;
- Proportion of over-storey species occurring as regeneration;
- Total length of fallen logs.

Variables are given a score of 0, 1, 2 or 3, based on comparison with benchmark values and then weighted to give an overall score out of 100. Refer to Gibbons *et al.* (2008) for more detail.

Vegetation Dynamics

An indicator of vegetation dynamics was calculated for each transect, using total native species richness. This is defined as the total number of native species (including perennial, ephemeral and annual species) recorded within the 20 m x 50 m assessment area.

4.8 Fauna Surveys and Threatened Species Monitoring

4.8.1 Pit-fall trapping for ground dwelling vertebrate fauna – including targeted survey for threatened species

The methods used to survey for ground dwelling fauna (predominantly reptiles, amphibians and small mammals) follow the well-established and used methods established by DECC (2008a) and DEC 2004. This involves the use of one pitfall line transect comprising of six plastic buckets (each 40 cm deep by 30 cm wide), spaced 5 m apart in an approximately straight line, and buried such that the top of each open bucket is flush with the ground. Each pitfall line transect is permanently marked with a fence dropper post. All pitfall lines are located approximately 50 m to 200 m from a four-wheel drive vehicle access track. Up to 10 pitfall lines are established and monitored, or the maximum number of pitfall lines that can be monitoring twice per day by a team of two ecologists.

During the survey a 30 cm high, 30-35 m long canvacon fence ('drift fence') is erected along each transect to assist in directing animals into the pitfall traps, and a 'funnel trap' is placed at the end of each fence, as shown in Figure 7. Approximately 3 cm of soil, pieces of bark and leaf litter are placed in each bucket to provide shelter for captured animals from predators and climatic conditions such as hot and cold weather during the survey period. The pitfall traps remain open for four successive nights of trapping during which all pitfall line transects are open.

Targeted surveys would use pitfall trapping to monitor key threatened species within high quality areas of a) spinifex (*Triodia*); and b) Belah-Rosewood habitat within the Offset Areas, and in areas surrounding the mine site. Species to be targeted are Marble-faced Delma (*Delma australis*) and Western Blue-tongue Lizard (*Tiliqua occipitalis*) (in spinifex (*Triodia*) as per Crayfish approval conditions), Bolam's Mouse (*Pseudomys bolami*) (in Belah Rosewood as per Ginkgo approval conditions), and possibly other potential threatened species such as Southern Ningau (*Ningau yvonneae*), Mallee Slender Blue-tongue Lizard (*Cyclodomorphus melanops elongatus*), Jewelled Gecko (*Strophurus elderi*). In addition to pit-fall trapping, Elliot traps, funnel traps and nocturnal spotlighting surveys would be conducted.

These approaches would in particular target areas of the highest quality spinifex and Belah Rosewood habitat, allowing the trapping effort to be maximised. Surveys are completed between October and March inclusive, when climatic conditions maximise the number of warm to hot sunny days and mild to warm nights experienced during surveys. This is considered critical to the successful survey of small ground-dwelling fauna, and in particular reptiles, which are significantly more active and therefore more likely to be trapped, during periods with maximum temperatures exceeding 25–30°C and minimum overnight temperatures of 15°C (Spence-Bailey et. al. 2010).



Figure 7 Pitfall line with a funnel trap at one end

Each pitfall trap is checked twice per day, once early in the morning and once in the mid to late afternoon, to prevent animals from being exposed to adverse weather conditions and predation for long durations. All captured animals are marked with a small dab of liquid paper (in an appropriate location e.g. the base of the tail for small mammals and on the back leg for small reptiles) to allow for the detection of recaptures, and released immediately at the point of capture unless it is necessary to hold the animal for longer to clarify identification. All invertebrates are removed from the pitfall traps to prevent their desiccation, thereby reducing the risk of attracting foraging ants into the pitfall traps. Where necessary, insect repellent (surface spray) is used to deter ants from entering the traps as they are known to attack and kill trapped specimens.

At the conclusion of each of the surveys, buckets are left in place with the lids firmly fixed so as to prevent the inadvertent entry of animals and water, and each bucket covered with a 400 mm x 400 mm tin sheet and 10-20 cm of soil to protect the buckets from being opened when trodden on by stock or wildlife, and to protect the plastic lids from being exposed to damaging sunlight if the soil is eroded away. The buckets are left *in-situ* for re-sampling at a later date.

4.8.2 Bird Survey

Bird surveys are conducted on two separate mornings at each survey site within three hours of sunrise, with an additional survey between 3 and 5 hours after sunrise. Surveys are conducted following the standard method developed by Birdlife Australia, which involves a 20 minute two-hectare area based search, centred as much as possible on the transect and within the immediately adjacent vegetation community.

At the commencement of each survey the following details are recorded:

- The site location and name;
- Time of commencement and completion of survey;
- Weather conditions at time of survey, including:
 - General weather (i.e. fine conditions, showers);
 - Wind (nil, slight, moderate, strong, very strong);
 - Cloud cover, (estimated percentage);
 - Rain (i.e. spitting, drizzle, showers, heavy rain); and
 - Temperature (°C).
- The species identified, method of detection, number of individuals recorded and any notes on breeding behaviour; and
- Whether the animal is on-site (within the two-hectare area) or off-site (outside the two-hectare area) when observed.

Spring is considered the optimal season for bird survey, and in particular, territorial species are more easily detected early in the breeding season because vocalisations are more intense and frequent when birds are in the process of establishing or re-defining territories (Bibby *et al.* 1992).

4.8.3 Bat surveys

Bat calls are recorded during field surveys, with Anabat detectors used to record micro-bat calls at each survey site (Titley Scientific Brisbane). Data from each detector is downloaded from the compact flash (CF) card using CFCread (version 4.3s Corben 2011). Calls are identified using zero-crossing analysis and AnalookW software (version 3.8v, Chris Corben 2012) by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from published guidelines.

The Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats (Pennay *et al.* 2004) is used to assist call analysis. Call identification is also assisted by consulting distribution information for possible species (Pennay *et al.* 2011; Churchill 2008; Van Dyck *et al.* 2013) and records from the Atlas of NSW Wildlife (BCD 2015). Reference calls collected from other surveys conducted in the Lower Murray Darling Catchment can also be used to assist call analysis including *Chalinolobus gouldii*, *Mormopterus* species 3/4, *Scotorepens balstoni* and *S. greyii*.

A call (pass) is defined as a sequence of four or more consecutive pulses of similar frequency. Calls with less than four defined pulses are excluded from the analysis. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call is generally assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in Table 12. Due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach is taken when analysing calls.

Species nomenclature follows Pennay *et. al* (2011), then van Dyck and Strahan (2013).

The use of Harp traps has also been previously employed for this monitoring approach, with two Harps generally deployed each night to achieve a minimum of one night of trapping per sub-site. The use of harp traps is necessary to identify the EPBC-listed Corben's Long-eared Bat (*Nyctophilus corbeni*) as the Long-eared Bats are impossible to distinguish using Anabat software.

Table 12 Confidence ratings applied to Anabat bat calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species e.g. <i>Chalinolobus gouldii</i> / <i>M. Mormopterus</i> sp. <i>Mormopterus</i> species 3 and species 4 <i>Nyctophilus</i> sp. The calls of <i>Nyctophilus geoffroyi</i> / <i>corbeni</i> cannot be distinguished during the analysis process and are therefore lumped together. <i>C. gouldii</i> / <i>Scotorepens balstoni</i> <i>Scotorepens</i> sp. (<i>S. blastoni</i> or <i>S. greyii</i>) <i>S. greyii</i> / <i>Chalinolobus picatus</i>

4.8.4 Incidental records

Any noteworthy species observed during field work are recorded as incidental records. These records are included as "opportunistic on-site" or "opportunistic off-site" observations and added to the general list of species observed during a survey. Although important (e.g. these could be records of State or Nationally listed Threatened Species, or species of regional significance), these records are generally not included in any formal analysis of data but are complimentary information to the project, building the knowledge base on threatened species use of the study area.

4.8.5 Other fauna monitoring methods

Other fauna monitoring techniques that could be employed at sites include the use of remote fauna cameras. These remotely operated cameras when set up correctly can be used to detect species that are cryptic and difficult to traps (e.g. Western Blue-tongue Lizard) and also to establish the presence and abundance of exotic species such as foxes/cats. Fauna cameras could be deployed in association with subsites and/or targeted at potential suitable habitat for priority species such as the Western Blue-tongue Lizard. Cameras can either be baited or left *in situ* for weeks to months (deploying cameras for at least 4-6 weeks is a far more effective approach to detect cryptic species).

5. Long-term Protection of Offset Areas

Tronox aims to provide long-term protection of the offset areas by applying to the Department of Lands to change the purpose of the relevant portions of all relevant Western Lands Leases from grazing to conservation purposes under Section 18J of the Westerns Lands Act, 1901.

TronoxThe long-term security of the tenure of the offset area will be undertaken in two stages.

- 1 Security of the lease by Tronox acquiring the WLL title over the offset areas
- 2 Tronox securing a change of lease purpose of the offset areas.

The long term security of the offsets has been guaranteed as Tronox are the current lease holders of the leases which include the Offset Areas. Tronox will submit an application to Department of Industry – Crown Lands to alter the purpose of the required Western Lands Leases as required to satisfy the conditions of the development approvals for the Murray Basin operations.

Condition 19A of DA 251-09-01 (Modification 13) required Tronox to provide appropriate long term security for Biodiveristy Offset Areas 7 and 8 by 30 June 2018. An extension of this time frame to 31 December 2018 was granted by DPIE on 7 September 2018. The long term security of the Offset Areas 7 and 8 was confirmed on 2 November 2018 following the notification from Department of Industry – Crown Lands that Tronox's application to increase the biodiversity offsets area on Western Lands Lease 17 had been granted. This condition provides protection for Ginkgo Offset Areas 1, 2, 3, 4, 7 and 8.

6. Offset Bond

The Snapper Mine Project Approval (DA 06_0168, Modification 5) Condition 18 states:

After the first Independent Environmental Audit (see Schedule 4 [of the conditions]) after year 10 of the mining operations, the Proponent shall lodge a suitable offset bond with the Secretary. This bond must be determined by the audit team in consultation with the Proponent, and contain sufficient funds to ensure the remaining works in the Offset Management Plan are fully implemented. The Proponent shall revise this bond to the satisfaction of the Secretary after each subsequent audit. The first audit is scheduled to occur in November 2020.

The Ginko Crayfish Mine Project Approval (DA 251-09-01, Modification 13) Condition 19 and 19A states:

By 30 June 2016, unless otherwise agreed with Secretary, the Applicant shall make suitable arrangements to provide appropriate long term security for the biodiversity offset area identified in Table 4 and Appendix 6 [of the conditions], to the satisfaction of the Secretary.

By 30 June 2018, unless otherwise agreed with the Secretary, the Applicant shall make suitable arrangements to provide appropriate long term security for the biodiversity offset area identified as Biodiversity Offset Areas 7 and 8 in Appendix 6 [of the conditions], to the satisfaction of the Secretary.

In addition, Conditions 21 and 21A require that:

Within 12 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary, the Applicant shall lodge a conservation bond with the Department to ensure that the Biodiversity Offset Strategy is implemented in accordance with the performance and completion criteria described in the Offset Management Plan. The sum of the bond shall be determined by:

(a) calculating the full cost of implementing the offset strategy (other than land acquisition costs); and

(b) employing a suitably qualified quantity surveyor to verify the calculated costs.

If the offset strategy is completed generally in accordance with the completion criteria in the Offset Management Plan to the satisfaction of the Secretary, the Secretary will release the bond.

If the offset strategy is not completed generally in accordance with the completion criteria in the Offset Management Plan, the Secretary will call in all or part of the conservation bond, and arrange for the satisfactory completion of the relevant works.

And:

Within 6 months of the date of consent for MOD 13, unless otherwise agreed with the Secretary, the Applicant shall:

(a) revise the sum of the conservation bond required by condition 21 above to account for the additional offset areas; and

(b) lodge the additional bond amount with the Department.

Tronox submitted the conservation bond calculation to DPIE on 10 May 2018, satisfying condition 21A.

The Independent Environmental Audit will determine which areas within the overall Snapper/Ginkgo/Crayfish offset areas have / have not met the completion criteria and hence will not / will require a bond.

7. Environmental Management

7.1 Relevant legislation and other requirements

This project is subject to the requirements of the New South Wales *Protection of the Environment Operations Act 1997* and its subordinate legislation. A full legislative register is provided in the EMS (2012); acts, regulations and policies specific to this offset plan are listed below.

Federal (Commonwealth)

Acts

- *Environment Protection and Biodiversity Conservation Act 1999*

State (NSW)

Acts

- *Protection of the Environment Operations Act 1997*
- *Mining Act 1992*
- *Biodiversity Conservation Act 2016*
- *Local Land Services Act 2013*
- *Biosecurity Act 2015*

Regulations

- *Biodiversity Conservation Regulation 2017*

Relevant standards, codes of practice and guidelines

Noxious and environmental weed control handbook – a guide to weed control in non-crop, aquatic and bushland situations (NSW DPI, 2011).

7.2 Roles and responsibilities

Overall roles and responsibilities for environmental management at the Murray Basin mines are outlined in Tronox's EMS.

The Environmental department (Environmental Lead) is responsible for maintaining the currency of the offset plan and for implementing the environmental mitigation measures and monitoring outlined in Sections 3 and 4.

7.3 Training and inductions

Overall training and induction requirements for Tronox's operations at the Murray Basin mines are outlined in the EMS (2012).

An environmental education program will be included in employee and contractor inductions and will include training relevant to the management of native flora and fauna.

7.4 Complaint, non-conformance and incident management

Complaint, non-conformance and incident management for Tronox's operations at the Murray Basin mines is described in Tronox's EMS.

8. Independent Environmental Audit

8.1 Audits of the Offset Management Plan

Conditions of Approval (see Table 2) for the Murray Basin mines require that both Snapper and Ginkgo are subject to an Independent Environmental Audit once every three years or as otherwise directed by the Secretary of the DPIE. Matters to be covered by the Independent Environmental Audit are described in Tronox's Environmental Management Strategy (EMS) for the operational sites in the Murray Basin in NSW. Further detail of the how audits of EMPs will be conducted (including internal audits) is provided in the EMS.

Audits must assess environmental performance related to each site and compliance with Conditions of Approvals, Environmental Protection Licences (EPLs) and Mining Leases. In addition, each audit must review the adequacy of strategies, plans and programs associated with the Conditions of Approval and EPL and provide recommendations to improve environmental performance, as required.

Within six weeks of completing this audit, or as otherwise agreed by the Secretary, Tronox is required to submit a copy of the audit report to the Director-General, with its response to any recommendations contained in the audit report.

9. Plan Review, Monitoring and Implementation

9.1 Review and update of the Offset Management Plan

Conditions of Approval (see Table 2) for the Murray Basin mines outline requirements for revision and update of Offset Management Plans (OMP).

OMPs would be reviewed, and if necessary revised to the satisfaction of the Secretary, within three months of:

- (a) the submission of an Annual Environmental Management Report;
- (b) the submission of an incident report;
- (c) the submission of an Independent Environmental Audit Report;
- (d) any modification of the regulatory consent conditions; and

Further details on the requirements for review and update of EMPs are provided in the EMS.

Tronox's Environmental Lead or delegate will be responsible for the monitoring and implementation of this OMP.

This OMP will be reviewed as a result of relevant recommendations made by the independent environmental audit.

Tronox's Environmental Lead or delegate will be responsible for the implementation of any revisions in consultation with the DPIE and BCD.

10. Reporting

10.1 Environmental reporting and correspondence

Conditions of Approval (see Table 2) for the Murray Basin mines require that Tronox submit an Annual Environmental Management Report (AEMR) to the Secretary of the DPIE. Details of information to be included in the AEMR are provided in the EMS (2014). The AEMR will provide a summary of the flora and fauna management initiatives implemented for Murray Basin mines, present the results of the flora and fauna monitoring program and forecast the flora and fauna management and monitoring programs for the ensuing 12 months. Accordingly, the flora and fauna management and monitoring programs will be subject to annual review from various regulatory and advisory agencies.

The AEMR will, where applicable, report on the following flora/fauna components:

- Status and results of Offset area monitoring surveys;
- Identification and/or occurrence of threatened flora and fauna species;
- Revegetation of disturbance areas;
- Threatened flora and fauna monitoring;
- General flora and fauna management initiatives;
- Incidents related to flora and fauna; and
- Management and monitoring programs for the following year.

Progression toward achievement of rehabilitation objectives in revegetated areas will be reported in the AEMR as part of the Department of Primary Industries' (DPI) Mining Rehabilitation and Environmental Management Process (MREMP) during the life of the mine and until the Mining Lease is relinquished. The results of flora and fauna surveys undertaken by Tronox's contracted ecologist are detailed in reports that will also be appended to the AEMR.

The EPLs for the Murray Basin mines stipulate that a monitoring and complaints summary be completed for each site as part of Tronox's AR that is completed for each site for each site and supplied to the EPA not later than 60 days after the end of each reporting period (see the EMS for further details). There are no specific monitoring requirements for flora and fauna required to be reported to the EPA as part of the AR but if there are complaints or incidents related to flora and fauna these must be reported.

An AEMR will be prepared for each of Ginkgo, Snapper and Crayfish.

Tronox's contracted ecologist will prepare reports that detail the results of all flora and fauna surveys undertaken including pre-clearance surveys, surveys of revegetated areas, threatened species surveys and relocation (if required) and offset area surveys.

The AEMR will report on the following (where applicable):

- Management measures conducted within the offset area;
- Results of the monitoring and whether the performance criteria have been met; and
- Management measures for the following year.

A summary of the implementation and actions taken for the short, medium and long term measures will also be included in the AEMR process, as summarised in Table 13.

Table 13 Summary table to be included in Snapper and Ginkgo AEMR process, for reporting on offset management plan actions throughout the reporting period

Measure / Management control	Completed	Actions taken during the reporting year	Actions planned for the following year
Fencing to exclude grazing			
Destocking			
Threatened species management			
Security of artificial waters			
Removal of unnecessary fencing			
Erosion control			
Signage of offset areas			
Revegetation of unnecessary tracks			
Animal pest control			
Weed management			
Fire management			
Other actions taken			

10.2 Reconciliation of the Proposed Offset Strategy against BCD Offset Principles

The BCD Offset Principles (BCD, 2014) provides a series of guidelines against which a proposed offset can be assessed. Below is a summary of the key aspects of these guidelines which will be addressed.

Impacts must be avoided first by using prevention and mitigation measures. Measures to avoid and mitigate Project impacts on flora and fauna are described in the relevant Flora and Fauna Assessments completed for each stage of Tronox's Murray Basin Mines.

The offset strategy is proposed to address residual impacts. All regulatory requirements must be met. Tronox Resources Ltd. is required to meet all statutory requirements. The offset strategy is not proposed to substitute for other licence/approval requirements. Offsets must never reward ongoing poor performance.

The offset strategy is proposed to address residual impacts associated with the Project only. Offsets will complement other government programs.

An arrangement would be made to ensure long-term protection and management of the Offset area within 12 months of Project approval (e.g. a voluntary conservation agreement pursuant to Section 69B of the National Parks and Wildlife Act 1974).

Offsets must be underpinned by sound ecological principles. The biodiversity offset is underpinned by sound ecological principles such as:

- Consideration of structure, function and compositional elements of biodiversity through flora surveys.
- Offset area shape minimises perimeter to area ratio.
- The offset would be managed to minimise the operation of Key Threatening Processes.

The aim of establishing biodiversity offsets is to result in a net improvement in biodiversity over time. A net improvement in flora and fauna abundance and diversity is likely because:

- Each vegetation type to be impacted is represented in the offset areas.
- Additional vegetation types would be conserved to those that would be impacted.
- The offset areas (totalling 10,504 ha), as listed in Table 1 will be conserved in perpetuity.
- Withdrawal of grazing by livestock and domestic goats will allow regeneration of native shrubs and palatable herb and grass species that have been reduced to low levels under existing land management in the Western Division.
- Relevant Key Threatening Processes would be controlled.
- Measures to monitor and independently audit the biodiversity offset are provided.

Ecological gains of the proposed Offset Areas are discussed in 10.3. Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.

As mentioned in Section 5, the land tenure of the proposed Offset area would be secured in perpetuity for biodiversity conservation. Offsets will be agreed prior to the impact occurring. The offset strategy is proposed as part of the Modification. The implementation of the biodiversity offset is likely to be a condition of modification approval. Offsets must be quantifiable. The impacts and benefits must be reliably estimated.

The flora in the Offset Areas have been extensively surveyed over a number of years. This report provides an assessment of both including:

- Area of the offset and area of impact.

- Communities/species present and their conservation status.
- Condition of habitat.
- Management actions and security for the offset site.

Offsets must be targeted. As discussed in Section 2, the biodiversity offset has been targeted to offset impacts on the basis of a like-for-like or better conservation outcome.

The proposed offset area is located within the same CMA region as the Modification area (i.e. the Western LLS region) and therefore has the capacity to benefit biodiversity values in the same region as the Project. The proposed Offset area is suitably located because it is local to the area proposed to be disturbed and has an optimal chance of maintaining and improving the biodiversity that would be impacted.

The implementation of the offset strategy is beyond existing requirements in previous approvals, in that the biodiversity Offset area is not subject to an existing conservation agreement. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract. Measures to monitor and independently audit the biodiversity offset are provided. The implementation of the biodiversity offset is likely to be a condition of modification approval.

10.3 Ecological Gains of the Proposed Offset

It is considered the Project meets the standard in the requirements of the Director-General of the NSW Department of Planning and Infrastructure that flora biodiversity values in the region would be maintained and improved in the long-term. The Offset area contains a very similar array of natural vegetation types (and vegetation communities) to those on the Modification area, which are also in similar condition.

The Offset area has a number of features that ensure it meets the 'maintain or improve' test. These include:

- Each vegetation type proposed to be cleared by the Project is represented in the Offset area.
- The offset supports samples of all native vegetation communities within the Modification disturbance area and has a greater diversity of vegetation communities than occur on the Modification area.
- The offset is bordered on all sides by similar vegetation and consequently is not isolated in the landscape. That is, it has high connectivity allowing a free flow of biodiversity between it and surrounding large areas of native habitat. This high connectivity helps to ensure the long-term viability of the Offset. Conversely, the addition of the offset as a new protected area enhances nature conservation over the whole region.

11. References

Australian Network for Plant Conservation (ANPC) (2004) Guidelines for the Translocation of Threatened Plants in Australia. Australian Network for Plant Conservation Translocation Working Group, Canberra.

Bemax (2001) Ginkgo Mineral Sands Project, Environmental Impact Assessment, prepared by Resource Strategies on behalf of Bemax Resources Pty Ltd, September 2001.

Bemax (2007) Snapper Mineral Sands Project Environmental Assessment, prepared by Resource Strategies on Behalf of Bemax Resources Pty Ltd, 2006.

Bemax (2007) Southern Mallee Offset Strategy.

Bemax (2011) Snapper Mineral Sands Mine and Ginkgo Mineral Sands Mine, Offset Management Plan, May 2011, Document No. OMP-O1G.

Biodiversity Monitoring Services (2014) Mallara Fauna Survey. Document No. 00597789. Report prepared for Tronox Mining.

Biodiversity Monitoring Services (2015a) Ginkgo Mineral Sands Mine – Southern Extension Modification – Southern Extension Areas Fauna Assessment. Prepared for Bemax Resources Limited.

Biodiversity Monitoring Services (2015b) Ginkgo Mineral Sands Mine – Southern Extension Modification – Offset Increase Fauna Assessment. Prepared for Bemax Resources Ltd.

Biodiversity Monitoring Services (2017) Ginkgo Mineral Sands Mine Extension Modification - Biodiversity Assessment Report and Biodiversity Offset Strategy. Report prepared for Tronox Mining. Cenwest Environmental Services (2009) Trelega North Fauna Survey and Assessment – Prepared for Bemax Resources Limited.

Tronox Resources (2016) Ginkgo Mineral Sands Mine Southern Extension Modification Environmental Assessment.

DEC (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft. November 2004, Department of Environment and Conservation (NSW).

DECC. (2008). Establishing a site-based monitoring programme for threatened fauna in mallee dunefields in the Lower Murray Darling Catchment Management Authority area, south west NSW. Department of Environment and Climate Change.

FloraSearch (2007) Snapper Mineral Sands Project Flora Assessment, prepared by FloraSearch and Resource Strategies on behalf of Bemax Resources, Feb 2007.

FloraSearch (2007) Trelega Property Flora Survey and Assessment. Prepared for Bemax Resources Limited.

FloraSearch (2009) Trelega North Flora Survey and Assessment – Prepared for Bemax resources Limited.

FloraSearch (2014) MALLARA FLORA SURVEY. Report prepared for Tronox Mining.

FloraSearch (2015a) Ginkgo Mineral Sands Mine - Southern Extension Modification - Southern Extension Areas Flora Assessment. Document No. 00717581. Report prepared for Tronox Mining.

FloraSearch (2015b) Ginkgo Mineral Sands Mine - Ginkgo Mineral Sands Mine - Southern Extension Modification - Offset Increase Flora Report. Document No. 00717700. Report prepared for Tronox Mining.

FloraSearch (2017) Ginkgo Mineral Sands Mine- Offset Investigation Baseline Flora Report. Report prepared for Tronox Mining.

GHD (2015a) Crayfish Mine Offset Management Plan. Report prepared for Tronox Mining.

GHD (2015b) Murray Basin Mines Flora and Fauna - Environmental Management Plan. Report prepared for Tronox Mining.

IUCN (1987) IUCN Position Statement on Translocation of Living Organisms: Introductions, Re-introductions and Re-stocking.

iucn (1988) Guidelines for the Re-Introductions.

Mazzer, T., Ellis, M., Smith, J., Ayers, D., Cooper, M., Wallace, G. and Langdon, A. (1998) The Fauna of Western NSW: The Southern Mallee Region NSW. NPWS, Hurstville

Mount King Ecological Surveys (2001) Ginkgo Mineral Sands Project Fauna Assessment. Attachment H of the Ginkgo Mineral Sands Project Environmental Impact Statement. Report prepared by Resource Strategies Pty Ltd.

NPWS (2001a) Guidelines for Fauna Surveying Pre- and Post-clearing Works.

NPWS (2001b) Policy for the Translocation of Threatened Fauna in NSW. Policy and Procedure Statement No. 9. NSW National Parks and Wildlife Service.

BCD (2014) NSW Biodiversity Offsets Policy for Major Projects. Biodiversity Conservation Division DPIE for the NSW Government.

Ogyris Ecological Research (2000) Preliminary Report on the Flora of the Ginkgo Sand Mine Prospect near Pooncarie, Southwest New South Wales. Prepared for Bemax Resources NL.

Ogyris Ecological Research (2009) Establishment of an Ecological Monitoring Program and Preliminary Site Assessment at the Bemax Resources Ltd Ginkgo Mineral Sands Mine Conservation Offset Site at Trelega Station, Southwest New South Wales.

Orchid Research and Marianne Porteners Environmental Consulting (2001) Ginkgo Mineral Sands Project Flora Assessment. Appendix G of the Ginkgo Mineral Sands Project Environmental Impact Statement (Bemax, 2001).

Sluiter, I.R.K. (2009). Establishment of an Ecological Monitoring Program and Preliminary Site Assessment at the Bemax Resources Ltd Ginkgo Mineral Sands Mine Conservation Offset Site at Trelega Station, Southwest New South Wales – January 2009. Ogyris Ecological Report 2009/01 (Unpublished).

Sluiter, I.R.K. (2010). Vegetation Monitoring at the Bemax Resources Ltd Ginkgo and Snapper Mine Stage 1 Conservation Offset Site at Trelega Station, Southwest New South Wales – January 2009. Ogyris Ecological Report 2010/02 (Unpublished).

Southern Mallee Regional Planning Committee (2000) Southern Mallee Regional Guidelines for the Development of Land Use Agreements.

Spence-Bailey, LM., Nimmo, DG, Kelly, L.T., Bennett, AF. and Clarke, MF. (2010) Maximising trapping efficiency in reptile surveys: the role of seasonality, weather conditions and moon phase on capture success. Wildlife Research 37, 104-115.

Stace, C.T., Hubble, G.D., Brewer, R., Northcote, K.H., Sleeman, J.R., Mulcahy, M.J. and Hallsworth, E.G. (1968) A Handbook of Australian Soils. Rellim Technical Publications.

Walker, P.J. (1991) Land Systems of Western New South Wales. Soil Conservation Service of NSW, Sydney

Western Research Institute (2007) Trelega Property Fauna Survey and Assessment. - Prepared for Bemax Resources Limited.

Williams, K. I., Parer, I.B., Coman, B.J., Burley, J. and Braysher, M. (1995) Managing Vertebrate Pests: Rabbits. Australian Government Publishing Service, Canberra, In Environment Australia (2001) Threat Abatement Plan for Predation by the European Red Fox, Commonwealth of Australia, Canberra.

GHD

57 Orange Avenue
Mildura, Victoria 3500

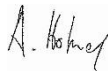
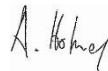
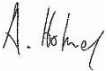
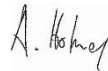
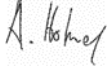
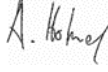
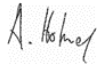
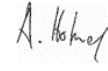
T: (03) 5018 5200 F: (03) 5018 5201 E: milduramail@ghd.com.au

© GHD 2016

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

G:\31\3433602\WP\603881.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	D. Eyles	A. Holmes		A. Holmes		31/08/2016
A	D. Eyles	A. Holmes		A. Holmes		07/09/2016
B	S. Thompson	A. Holmes		A. Holmes		23/08/2018
C	S. Thompson	A. Holmes		A. Holmes		02/07/2019

www.ghd.com

