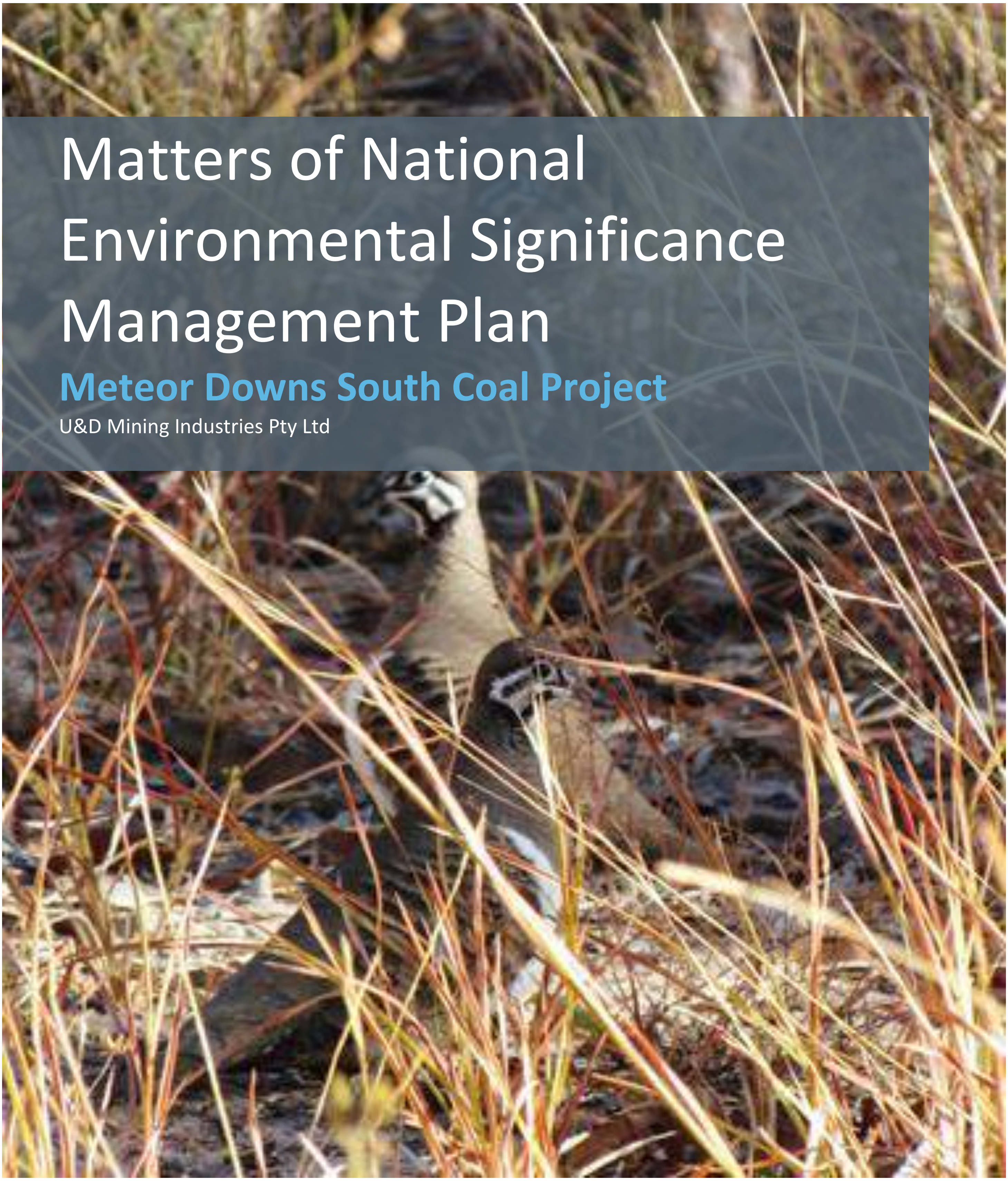
Matters of National Environmental Significance Management Plan

Meteor Downs South Coal Project

U&D Mining Industries Pty Ltd



APPROVALS

Rev	Date	Description
A	17 November 2017	Draft for review by client
B	18 November 2017	Revised draft for review by client
0	20 November 2017	Final report following feedback from client
1	19 December 2017	Final report following feedback from Australian Government
2	9 January 2018	Final report following feedback from Australian Government
3	17 January 2018	Final report following feedback from Australian Government
4	22 March 2019	Update based on Annual Report 2018
5	9 May 2019	Update to incorporate additional impacts
6	20 June 2019	Incorporation of feedback from Australian Government

	Name	Position	Date
ORIGINATORS	Kate McBean Meghan Farr	Senior Consultant Consultant	9 May 2019
APPROVER	Rebecca Enright	Senior Manager – Environmental Services	9 May 2019

Commercial in Confidence

This document is provided expressly in accordance purchase order PMDS000217 dated 22 March 2018 (‘Engagement Agreement’). This advice is for the sole benefit of the Client.

Disclaimer

The information in this document has not been independently verified as to its accuracy or completeness. This document is based on the information available at the time of preparation as well as certain assumptions. No representation or warranty, express or implied, is given by CO2 or any of its directors, officers, affiliates, employees, advisers or agents (and any warranty expressed or implied by statute is hereby excluded (to the extent permitted by law)) as to the accuracy or completeness of the contents of this document or any other information supplied, or which may be supplied at any time or any opinions or projections expressed herein or therein, nor is any such party under any obligation to update this document or correct any inaccuracies or omissions in it which may exist or become apparent.

To the extent permitted by law, CO2 limits its liability in accordance with the terms of the Engagement Agreement. Subject to the terms of the Engagement Agreement, no responsibility or liability is accepted for any loss or damage howsoever arising that you may suffer as a result of this document or reliance on the contents of this document and any and all responsibility and liability is expressly disclaimed (to the extent permitted by law) by CO2 and any of its respective directors, partners, officers, affiliates, employees, advisers or agents.

Marketing

If, in any document or other communication to be made public or disclosed to a government agency, the Client wishes to make reference to the use of CO2's services, CO2's consent must first be obtained, and this will not unreasonably be withheld.

Maps

The maps in this document are based on or contain data that has been provided by the State which gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

ABBREVIATIONS, ACRONYMS AND DEFINITIONS

BBN	Brigalow Belt North
BBS	Brigalow Belt South
CMSHA	– *Coal Mining Safety and Health Act 1999* (Qld)
CMSHR	– Coal Mining Safety and Health Regulation 2017 (Qld)
DAF	Queensland Department of Agriculture and Fisheries
dBA	A-weighted decibels
DEHP	Queensland Department of Environment and Heritage Protection
DES	Queensland Department of Environment and Science
DoEE	Commonwealth Department of Environment and Energy
EA	The Environmental Authority (EPML00559513) for the Meteor Downs South Coal Mine
EMS	Environmental Management System
Environmental Representative	The person employed on the Meteor Downs South Coal Mine who is responsible for environmental matters
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (Cth)
Glencore	Glencore Coal Queensland Pty Ltd
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia bioregions
Km	Kilometres
MDS	Meteor Downs South
ML	Megalitres
mm	Millimetre
mg	Milligrams
ML	Mining Lease
MNES	Matters of National Environmental Significance
MNESMP	Matters of National Environmental Significance Management Plan
mtpa	Million tonnes per annum
NC Act	Nature Conservation Act 1992 (Qld)
Project footprint	The area to be directed disturbed to facilitate mine infrastructure
RE	Regional Ecosystem
Rolleston	Rolleston Coal Mine
ROM	Run of Mine
SHMS	Safety and Health Management System
The Project	The Meteor Downs South Coal Mine
The Project area	The Project site and nearby local environs
The Project site	The area set out in the Mining Lease (ML70452) for the Meteor Downs South Coal Mine.
VM Act	Vegetation Management Act 1999 (Qld)

TEC	Threatened Ecological Community
U & D	U & D Mining Industry Australia Pty

1 INTRODUCTION

1.1 BACKGROUND

The Project is an open cut coal mining operation located approximately 100 km south of Emerald, between Rolleston and Springsure in the Central Highlands Regional Council local government area, Queensland. The Project is authorised pursuant to mining lease 70452 and the Environmental Authority (EA) EPML00559513.

The Project was referred to the Commonwealth Department of the Environment and Energy (DoEE) and on 26 April 2013 was determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2013/6799). U&D Mining Industry (Australia) Pty (U&D) has approval under the EPBC Act to develop and operate the Meteor Downs South Coal Project (the Project) and is in a joint venture with Sojitz Coal Mining Pty Ltd (Sojitz) is to develop and operate the Project.

This document has been prepared to satisfy conditions 2, 3 and 4 of the EPBC Act approval, which relate to the provision of a Matters of National Environmental Significance Management Plan (MNESMP). A delegate of the Minister approved the MNESMP on 19 January 2018.

1.2 REQUIREMENTS OF THE MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE MANAGEMENT PLAN

In accordance with the EPBC approval 2013/6799 (conditions 2, 3 and 4), a management plan is required to address direct and indirect impacts of the action on the following MNES:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community (Brigalow TEC).
- Natural Grasslands of the Queensland Central Highlands and Fitzroy Basin threatened ecological community (Natural Grasslands TEC)
- king blue-grass (*Dichanthium queenslandicum*)
- bluegrass (*Dichanthium setosum*)
- squatter pigeon (southern) (*Geophaps scripta scripta*)
- Australian painted snipe (*Rostratula australis*)

2 PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The Project is located along the Dawson Highway, approximately 25 km west of Rolleston and 45 km south east of Springsure in Central Queensland as shown in Figure 1. The nearest regional town is Emerald, approximately 110 km to the north. The Project falls within the Central Highlands Regional Council local government area.

Immediately to the south of the Project is the Rolleston Coal Mine (Rolleston), which produced 13 mtpa in 2016 and is currently expanding up to 18 mtpa with the Rolleston Expansion Project. The Rolleston Coal Mine is owned by Glencore Coal Queensland Pty Ltd (Glencore).

Figure 1
Regional context

2.1.1 Water Management

All water management for the Project will be undertaken in accordance with all relevant conditions of the Project's EA. A mine water management system has been designed to minimise the potential impacts on the water quality downstream of the Project. The mine water management system will manage water in three types of catchments based on water quality:

- 'Clean' – surface runoff from areas of the Project Site where water quality is unaffected by mining operations. Clean water includes runoff from undisturbed areas;
- 'Dirty' – surface runoff water and seepage from the Project Site areas that are disturbed by mining operations such as out of pit dump areas, workshop areas and roads. This runoff may contain silt and sediment however does not contain contaminated material or high salt concentrations. As specified in the EA and associated Erosion and Sediment Control Plan, this runoff must be managed to ensure that downstream water quality is within the adopted water quality compliance criteria; and
- 'Mine Affected' – surface water from areas affected by mining operations and potentially containing chemicals of various types used in the mining operations. There are restrictions on the use and release of this water. Contaminated water areas include sumps, stockpile areas, service bays and fuel storage areas. Rainfall and resulting runoff from these areas are also potentially contaminated and therefore must be managed to avoid discharge of potentially contaminated water into the natural water courses.

2.1.2 Changes to mine plan and water management system

As a result of continual refinement of design, as well as a determination by the Queensland Land Court, there have been some changes to both the mine plan and the water management system from that described in the preliminary documentation (lodged with the department in May 2014) and since the approval of this MNESMP (January 2018). Changes relate to:

- alteration to the haul road ingress/egress point on the Dawson Highway, based on safety advice from the Queensland Department of Main Roads
- additional areas to channel the surface water flows around the mining operations, to avoid impeding flows to Naroo Dam
- changes to locations of pipeline and access tracks to bores.

The preliminary documentation described how, during mining operations, the open cut pit and out of pit overburden dumps (and associated dams) would capture and retain runoff from areas that would have previously flowed to Spring Creek and Naroo Dam. As described in Appendix E of the preliminary documentation, over the life of the Project, the catchment area draining to Naroo Dam was to be reduced by between 82-90% with the largest loss of catchment occurring in Year 5. Once final landform was complete, the catchment area draining to Naroo Dam was to be reduced by 73.8% in comparison to existing conditions, with inflows to Naroo Dam therefore expected to be significantly reduced. However, as explained in the preliminary documentation, this was based upon the worst-case scenario based on the mine plan at the time of writing, and U&D made a commitment to continuing to refine the design to reduce the impact on Naroo Dam, both in terms of area and water quality, which has since been upheld.

The new mine plan now comprises a single open cut pit which will be developed using a "centre pit basal seam ramp" configuration. As described in the Project EA (see Appendix A), mine affected water cannot be released into Naroo Dam.

In terms of loss of catchment for Naroo Dam, revision of the mine plan has been such that the reduction in the size of the catchment will now be between 6% and 11% over the life of the mine with the largest loss of catchment occurring in Year 10. However, once rehabilitation and final landform is complete, the catchment area draining to Naroo Dam will not be reduced at all, and in fact will be 0.5% larger, due to the increase in the surface area of the catchment as a result of the spoil mounds. As such, inflows to Naroo Dam will not be reduced post mining.

The preliminary documentation described how mining would occur within the portion of Naroo Dam that lies within the Project site, as the resource extends under the dam itself. Since then, the mine plan has been revised such that no mining is proposed in Naroo Dam and a 50 m exclusion zone has been applied to the maximum dam capacity edge.

As part of the revised design, all available catchment will now flow into Naroo Dam without interference. Flows to Naroo Dam will be maintained through the construction of a diversion drain directing flow around the northern Project area into Naroo Dam. Figure 2 shows a typical cross section of the drain, and Figure 3 shows the location of the north diversion drain and discharge point at Naroo Dam. The diversion drain will be designed to maximise benefits to the Australian painted snipe, including the provision of micro-habitat features and the ability for ponding, noting species habitat requirements described in Section 9.2.2.

In addition, U&D have entered into a make good water agreement with Glencore, who use Naroo Dam as a source of water for their Rolleston Coal Mine (which contains the majority of Naroo Dam), immediately adjacent to the Project site. As a result of a determination in the Queensland Land Court, U&D are required to provide make good water to Glencore to make up for any reduction in water flow to Naroo Dam as a result of mining operations on the Project site. Make good water will be calculated as the area of catchment unavailable multiplied by rainfall multiplied by the runoff coefficient.

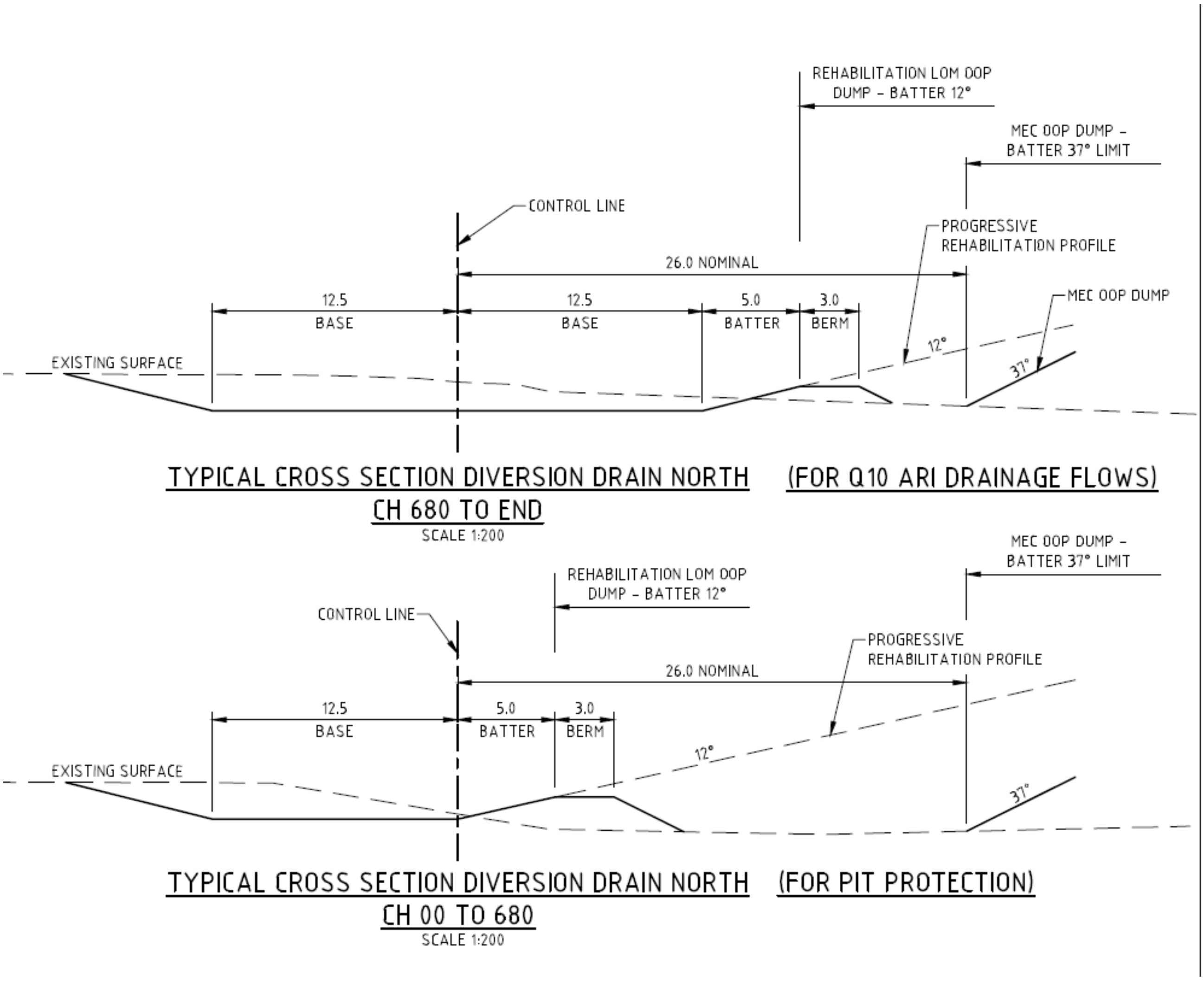
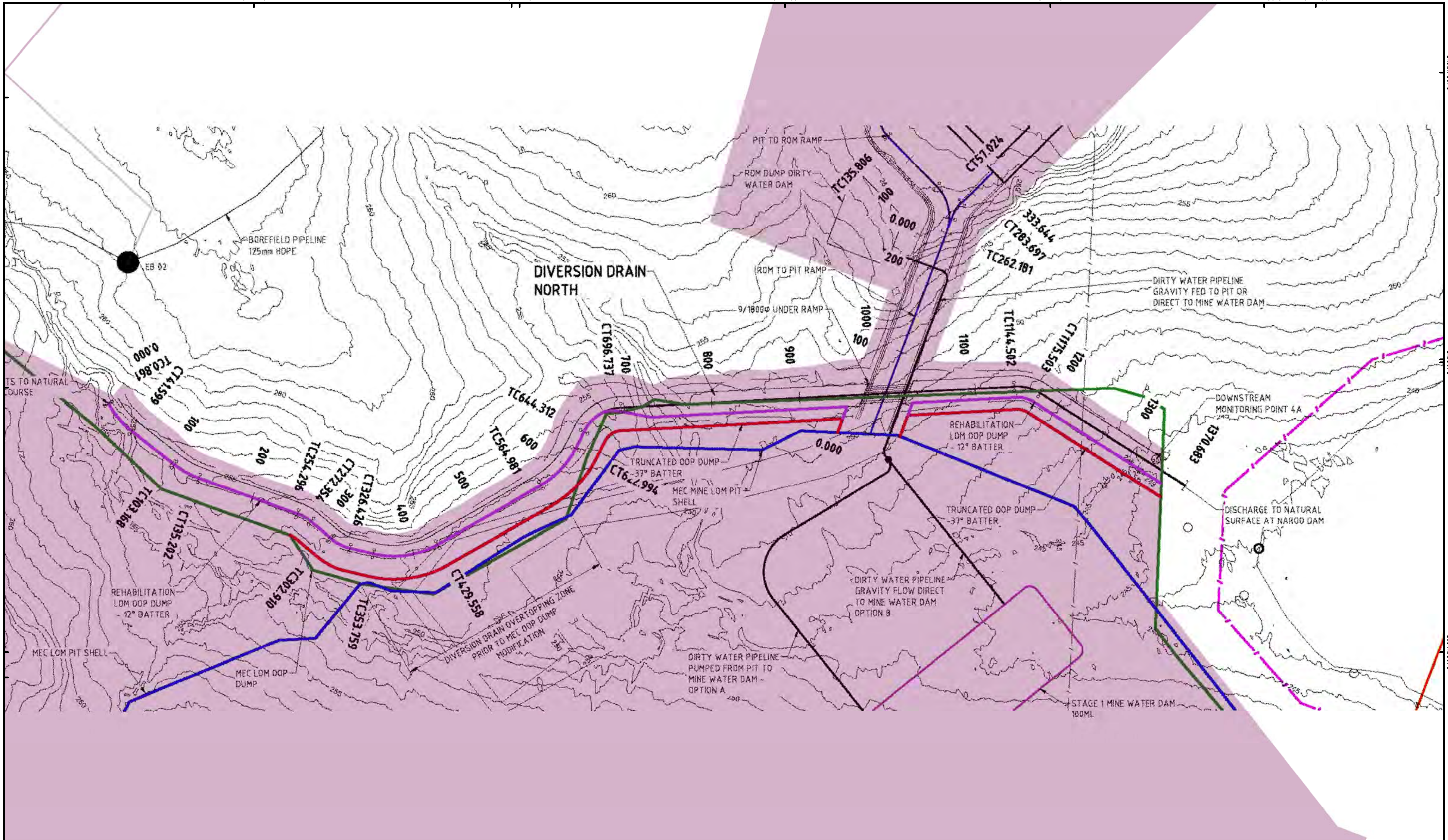


Figure 2: Typical cross section of the diversion drain north



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 3
Diversion drains

Disturbance areas

DATA SOURCE:
The following datasets provided by Sojitz
- Disturbance areas
- Diversion drains

0 50 100 150 200
Metres

Date: 8/04/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:4,000@A3

Path: P:\GIS\Data\Projects\Sojitz\911_20190322_Updated MINESMP_figures\Figure 3 - Diversion drains.mxd

3 LEGISLATIVE AND REGULATORY FRAMEWORK

3.1.1 Commonwealth Approval Process

The Project was referred to the Commonwealth Government on the 22 March 2013. The Project was declared a controlled action on the 26 April 2013 due to potential impacts on listed threatened species and communities and listed migratory species. The Project was granted approval under the EPBC Act by the Commonwealth Government on 25 November 2014 (EPBC 2013/6799). The approval contained 21 conditions with condition 1 relevant to, and conditions 2, 3 and 4 specific to, the provision of a MNESMP.

3.2 EPBC ACT APPROVAL CONDITIONS RELEVANT TO MNESMP

Conditions 1 to 3 of the EPBC Act approval are relevant to the development of the MNESMP and are detailed in Section 3.2.1 and 3.2.2.

3.2.1 Condition 1

Condition 1 of the EPBC Act approval for the Project relates to the maximum area of habitat for listed threatened species and ecological communities that U&D is permitted to impact on over the life of the mine. These maximum approved disturbance limits for listed threatened species and ecological communities permitted in Condition 1 of the EPBC Act approval are presented in Table 1.

Since the approval was issued and the MNESMP approved, several refinements to the mine design, have been made resulting in a change to the impacts on the threatened species and ecological communities to which Condition 1 applies. As such, the impacts on the threatened species and ecological communities have been recalculated and are presented as the planned disturbance limits in Table 1, remaining well below the maximum disturbance limits permitted in the EPBC Act approval.

Table 1: Approved Disturbance Limits for MNES

Threatened Species	Maximum approved disturbance limits (ha) (EPBC 2013/ 6799)	Planned disturbance (ha)
Squatter pigeon (southern) (*Geophaps scripta scripta*)	240.54	138.4
King blue-grass (Dichanthium queenslandicum)	426.53	109.7
Bluegrass (Dichanthium setosum)	426.53	109.7
Australian painted snipe (*Rostratula australis*)	6.60	0.00
Threatened Ecological Communities	**Maximum disturbance limits (ha) (EPBC 2013/ 6799)**	**Planned disturbance (ha)**
Natural Grasslands of the Queensland Central Highlands and Fitzroy Basin Threatened Ecological Community	186.00	109.7
Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community	2.21	0.00

3.2.2 Condition 2 and 3

Condition 2 and 3 of the EPBC Act approval relate to the requirement to develop a MNESMP for the threatened species and ecological communities listed in Condition 1. These conditions and where they have been addressed in this MNESMP are presented in Table 2.

Table 2: MDS Project EPBC Act Approval (EPBC 2013/6799) Conditions

EPBC Act Condition	Description		Section of MNESMP
2	At least three (3) months prior to commencement of the action, the approval holder must submit to the Minister for approval a Matters of National Environmental Significance Management Plan (MNESMP) for the management of direct and indirect impacts of the action on Matters of National Environmental Significance (MNES), being for the purposes of this approval, the EPBC Act listed species and EBPBC Act listed communities listed in Table 1. The MNESMP must be prepared by, in consultation with, or be reviewed by a suitably qualified ecologist.		This document - complete.
3	The MNESMP must be consistent with relevant recovery plans, threat abatement plans and conservation advices and must include:		
	a)	a description of environmental values for each of the MNES addressed in the plan;	Sections 6, 7.2, 8.2, 9.2, 10.2 and 11.2
	b)	details of potential impacts from the action, including area of impact, on each of the MNES;	Sections 7.4, 8.4, 9.4, 10.4 and 11.4
	c)	measures that will be undertaken to mitigate and manage the impacts on relevant MNES resulting from the action. These measures must include but may not be limited to:	
	i.	measures to avoid, minimise and mitigate impacts on MNES and their habitat located in the Project Area	Section 12
	ii.	measures to control and reduce the overall occurrence and abundance of animal, pest and weed species which could impact the MNES retained in the Project Area	
	iii.	measures to minimise and mitigate any impacts of the action on MNES and their habitat as a result of changes in hydrology of surface water resources including at Naroo Dam	Sections 4.1, 9.4 and 12
	iv.	measures to ensure no net loss of habitat for the Australian Painted Snipe as a result of impacts to Naroo Dam catchment or water quality; and	Section 12
	v.	measures to rehabilitate areas of habitat impacted by the action.	Section 12
	d)	goals for habitat management for each MNES	Section 12
	e)	a program, including monitoring locations, parameters and timing for monitoring the outcomes of mitigation and management measures to minimise direct impacts to MNES and their habitat; a schedule of regular reporting to the Department the details and outcomes of the monitoring program, including the actual impacts of the project on MNES and their habitat;	Section 12 Section 13 Section 14
	f)	corrective and contingency measures in the event monitoring reveals impacts on MNES are not in accordance with predictions in the MNESMP or modelling;	Section 12
	g)	details of the timeframe for a regular (at least every three years) review and subsequent updates, of the MNESMP; and	Section 14
	h)	Details of the qualifications and experience of persons responsible for undertaking monitoring, review and implementation of the MNESMP, including those of a suitably qualified ecologist.	Section 14

3.3 RELEVANT PLANS AND GUIDELINES

Table 3 lists the conservation advice and plans relevant to each of the threatened species and ecological communities covered by this MNESMP. These documents have been reviewed in preparing this MNESMP in order to capture measures specific to each of the threatened species and ecological communities.

Table 3: Relevant Conservation Advice, Recovery Plans and Threat Abatement Plans

MNES	Relevant Conservation Advice and Plans
Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community	▶ Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community (DoE 2013) ▶ Recovery Plan for the "Brigalow (*Acacia harpophylla* dominant and co-dominant)" endangered ecological community (Butler 2008a – included as Appendix C) ▶ Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (CoA 2011)
Natural Grasslands of the Queensland Central Highlands and Fitzroy Basin Threatened Ecological Community	▶ Approved Conservation Advice for Natural Grassland of the Central Highlands and North Fitzroy Basin (DEWHA 2008c) ▶ Draft National Recovery Plan for the "bluegrass (*Dichanthium* spp.) dominant grasslands in the Brigalow Belt Bioregions (north and south)" endangered ecological community (Butler 2008b) ▶ Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (CoA 2011) ▶ Threat abatement advice for predation, habitat degradation, competition and disease by feral pigs (CoA 2014)
Squatter pigeon (southern) (*Geophaps scripta scripta*)	▶ Approved Conservation Advice for *Geophaps scripta scripta* (squatter pigeon (southern)) (TSSC 2015) ▶ Threat abatement plan for predation by feral cats (Commonwealth of Australia 2015) ▶ Threat abatement plan for competition and land degradation by rabbits (Commonwealth of Australia 2016) ▶ Threat abatement plan for predation by the European red fox (DEWHA 2008a)
Australian painted snipe (*Rostratula australis*)	▶ Commonwealth Listing Advice for *Rostratula australis* (Australian painted snipe) (TSSC 2013b) ▶ Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (DSEWPaC 2013b)
King blue-grass (*Dichanthium queenslandicum*)	▶ Approved Conservation Advice for *Dichanthium queenslandicum* (king blue-grass) (DSEWPaC 2013c) ▶ Commonwealth Listing Advice on *Dichanthium queenslandicum* (king blue-grass) (TSSC 2013c) ▶ Draft National Recovery Plan for the "bluegrass (*Dichanthium* spp.) dominant grasslands in the Brigalow Belt Bioregions (north and south)" endangered ecological community (Butler 2008b)
Bluegrass (*Dichanthium setosum*)	▶ Approved Conservation Advice for *Dichanthium setosum* (DEWHA 2008b) ▶ Commonwealth Listing Advice on *Dichanthium setosum* (bluegrass) (TSSC 2012) ▶ Draft National Recovery Plan for the "bluegrass (*Dichanthium* spp.) dominant grasslands in the Brigalow Belt Bioregions (north and south)" endangered ecological community (Butler 2008b) ▶ Threat abatement plan for competition and land degradation by rabbits (Commonwealth of Australia 2016)

4 MANAGEMENT APPROACH

4.1 AVOIDING AND MINIMISING ENVIRONMENTAL IMPACTS

U&D's overarching approach to environmental management is to avoid, minimise and mitigate potential impacts associated with construction and operation of the Project on MNES and MNES habitat. In accordance with this approach U&D commits to the following:

- Maintaining water flows into Naroo Dam by diverting overland flows around the mine into the dam.
- Restricting vegetation clearing to that which is essential for the development of the Project.
- Authorising vegetation clearing/excavation only in accordance with the Project's clearing/disturbance permitting system (i.e. permit to disturb). This is to ensure that the Environmental Representative has reviewed all proposed clearing/excavation activities throughout operation of the mine.
- Ensuring vegetation connectivity around the mining operation is retained wherever possible.
- Facilitating natural regeneration in non-remnant areas surrounding the Project site, particularly where it improves connectivity of corridors.
- Implementing a monitoring program that provides for 'early control' (that management actions are effective) and 'early warning' (corrective actions are required) functions, to inform timely decisions on corrective actions to ensure performance targets are achieved.
- Adopting an adaptive management approach which involves ongoing assessment of the effectiveness of the management plan in achieving its objectives, and iterative amendments to management actions based on the results and outcomes of the ongoing assessment, including the results of the monitoring program.
- Following disturbance, areas will be rehabilitated and revegetated to be consistent with densities, composition and distribution of native vegetation based on the pre-clearing regional ecosystems.

4.2 ADAPTIVE MANAGEMENT

The MNESMP is based on an adaptive management approach which involves 'flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood' (National Research Council 2004).

Adaptive management includes two key phases. The first phase involves the establishment of the key components of a management framework including engaging stakeholders, developing clear and measurable objectives and performance criteria, identification and selection of potential management actions and the development of monitoring protocols which enable the evaluation of progress towards achieving objectives and which will effectively contribute to the adaptive decision-making process. The second phase is an iterative learning phase which involves utilisation of the management framework to learn about the natural resource system and iteratively adapt management strategies and approaches based on what is learned (Williams 2011).

4.2.1 Management Process for this MNESMP

Figure 4 below illustrates the overarching management process for this MNESMP which is based on an adaptive management approach. The management process is an ongoing cycle of implementation, learning and review and involves:

- completion of a risk assessment to determine the risk of failure to achieve the objectives of the MNESMP for each MNES (complete – see Appendix D)

- implementation of mitigation and management measures to minimise the impact of the Project on MNES and their habitat
- monitoring to:
  - evaluate performance of the MNESMP against performance criteria
  - identify triggers for further action
  - develop contingency plans and corrective actions if required
  - capture learnings from plan implementation and assess the effectiveness of the management framework
  - inform subsequent reviews and amendments to the MNESMP
- implementation of contingency plans and corrective actions
- review of the MNESMP and management framework
- amending the MNESMP to ensure continuous improvement of the management framework based on learnings obtained.

Notwithstanding amendments made through the adaptive management process, the MNESMP will also be reviewed annually and, if required, amended as described in Section 14. Any new data and information collected will be incorporated into the plan. This data may be obtained as a result of implementing the plan, or from new information derived from external sources.

It is anticipated that through adherence to the adaptive management process, the habitat management goals for each MNES will be maintained for the life of the Project.

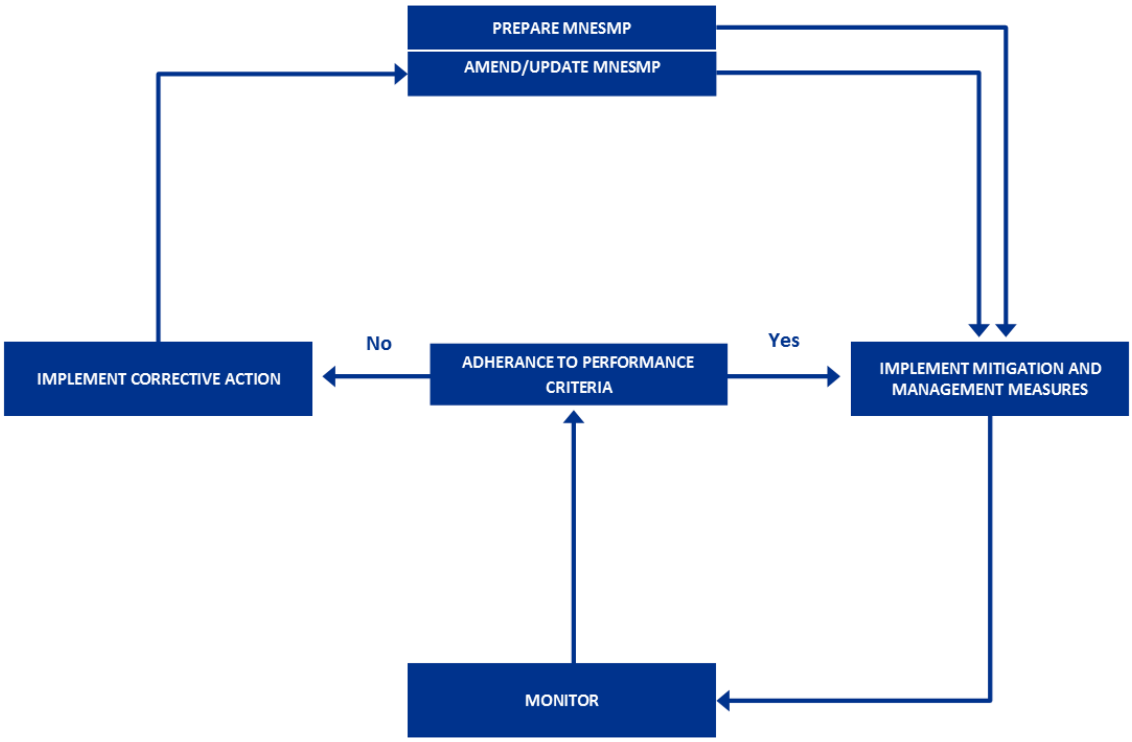


Figure 4: Management process

5 EXISTING ENVIRONMENT

The following provides a brief overview of the existing environmental conditions and values within the vicinity of the Project.

5.1 CLIMATE AND METEOROLOGY

The Project site is in the Central Queensland region which has a sub-tropical climate with hot, moist summers and warm, dry winters, with occasional frost in the south. Rainfall in the Central Queensland region is highly seasonal, with most rain occurring during October to March.

5.2 LAND USE

The Project site and surrounding lands have been extensively grazed from 1850 to the present. Much of the area was cleared in the 1960's and in recent decades has been largely used for grazing on native vegetation, with some dryland cropping and minor forestry. Current land uses are pastoral, open cut coal mining and there are also several conservation tenures within 30 km of the Project site (Albinia National Park, Conservation Park and Resources Reserve; Mount Hope, Mount Pleasant and Cairdbeign State Forests; Carnavon National Park – see Figure 1).

5.3 GEOLOGY AND TOPOGRAPHY

The Project site is situated on the edge of the Bowen Basin in a tectonic region known as the Denison Trough, in which thick sequences of Permian and Triassic sediments were deposited.

On the Project site itself, the geology comprises Quaternary alluvium and Tertiary basalt overlying Permian sedimentary rocks. Alluvium primarily occurs along major drainage features.

Topography over the Project site is relatively flat to gently undulating, with approximately 50 m of relief across the area. Steeper topography occurs to the west of the Project site.

5.4 TERRESTRIAL ECOLOGY

5.4.1 Vegetation communities

The Project site lies within Province 6 (Northern Bowen Basin) in the Brigalow Belt Bioregion. Soils of the Project site are described as being associated with Land Zones 3 and 8. These land zones are described as follows:

- Land Zone 3 - Quaternary alluvial systems, including floodplains, alluvial plains, alluvial fans, terraces, levees, swamps, channels, closed depressions and fine textured paleo-estuarine deposits; and
- Land Zone 8 - Cainozoic igneous rocks, predominantly flood basalts forming extensive plains and occasional low scarps. Also includes hills, cones and plugs on trachytes and rhyolites, and associated interbedded sediments, and talus.

Six remnant vegetation communities were identified during ground truthing of the Project site. About one third of the Project site has been previously cleared for grazing, with grazing occurring until 2013. The site also shows evidence of historic logging and more recent ringbarking in the vegetation communities associated with alluvial soils near Naroo Dam. As such, around 510 ha of non-remnant areas are present on the site, including cleared areas and areas of exotic grasses with or without emergent *Eucalyptus* spp. saplings (CQU 2012). The six remnant vegetation communities are described below in Table 4.

Table 4: Regional ecosystems within the Project site

Vegetation Community Description	Regional Ecosystem	Status under the Qld VMA	Area (ha) in Project site
Riverine wetland or fringing riverine wetland. *Melaleuca bracteata* woodland. On alluvial plains.	11.3.3a	Of Concern	3
Eucalyptus orgadophila grassy open-woodland. With sub-dominant species of *Corymbia erythrophloia* and *E. melanophloia*. Sparse shrubs with a moderately dense to dense ground layer dominated by *Themeda triandra*, *Dichanthium sericeum* and *Heteropogon contortus.*	11.8.5	Least Concern	598
Grassland dominated by Dichanthium sericeum, Heteropogon contortus and Aristida spp. With occasional emergent Eucalyptus orgadophila.	11.8.11	Of Concern	424
Melaleuca bracteata woodland associated with drainage depressions, over grasslands dominated by Chloris divaricata and containing Dichanthium sericeum, Iseilema vaginiflorum and Heteropogon contortus.	11.8.11a (subset of 11.8.11)	Of Concern	50
Eucalyptus populnea with occasional small Acacia harpophylla (over a grassy ground cover of Paspalidium caespitosum and Chloris divaricate.	11.8.15	Endangered	513
Acacia harpophylla and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains.	11.4.3	Endangered	2.21

5.4.2 Fauna

One hundred and sixty-one terrestrial vertebrate species were identified during the initial two seasonal surveys of the Project site, undertaken from 1 to 6 November 2011, and 2 to 8 August 2012 (CQU 2012). They were comprised of:

- 110 bird species
- eight amphibians
- 13 reptiles
- 14 non-avian mammals
- 16 bats

The Australian painted snipe was the only EPBC Act listed species recorded during these surveys.

During baseline monitoring surveys undertaken between 7 and 12 December 2017 (see Appendix C), targeted fauna surveys failed to detect the squatter pigeon or Australian painted snipe, however a single Latham's snipe (*Gallinago hardwickii*) - an EPBC-listed migratory species - was observed.

5.4.3 MNES Baseline Habitat Condition

Based on the results of the baseline site condition assessments undertaken in December 2017 (refer to Appendix C), habitat quality scores for the six MNES ranged between 4.74 (Australian painted snipe) and 8.04 (Natural grasslands TEC) out of 10 (Table 5). The comparatively low score for Australian painted snipe habitat is in part attributable to the low site condition for RE 11.3.3a habitat (5.25), but also the low fauna species habitat index (2.40), reflecting an absence of appropriate foraging and shelter habitat for the species. In contrast, Natural Grasslands TEC habitat had the highest habitat quality score (8.04), attributable in large part to greater than benchmark condition species richness for grasses and forbs at each of the contributing RE 11.8.11 sites.

Table 5: Monitoring sites showing their habitat quality scores contributing to MNES

Site	RE	Brigalow TEC	Natural Grasslands TEC	King blue-grass	Bluegrass	Squatter pigeon	Australian painted snipe
01	11.8.5					7.02	
02	11.8.11		8.21	6.57	6.57		
03	11.8.5					8.14	
04	11.8.11		7.68	6.14	6.14		
05	11.8.5					6.19	
06	11.8.11		7.86	6.29	6.29		
07	11.4.3	7.36					
08	11.8.11		8.39	8.05	6.71		
09	11.3.3a						4.74
10	11.8.5					7.85	
Average score		7.36	8.04	6.76	6.43	7.30	4.74

5.4.4 Pests and Weeds

The ecological assessments undertaken during the 2011 and 2012 surveys revealed that there was a low abundance of weed cover over most of the Project site. Weed species of environmental and/or biodiversity significance identified at the Project site are presented in Table 6. Four exotic pest species were recorded at the Project site which included the cane toad (*Bufo rhinella*), house mouse (*Mus musculus*), European rabbit (*Oryctolagus cuniculus*) and feral pig (*Sus scrofa*). Domestic species such as cattle and horses were also present.

Baseline surveys undertaken in December 2017 identified 16 weed species at the 20 weed monitoring plots, with weed cover averaging 7.1%, and ranging between 0% (Site 08) and 54% (Site 20). Section 3.3 and Figure 7 of Appendix C (MNES baseline monitoring report) describe and depict the baseline data on weeds within each of the weed monitoring plots. During these baseline surveys, the presence of three species of pest animal were identified:

- European hare (*Lepus europaeus*)
- wild dog (*Canis familiaris/lupus*)
- cat (*Felis catus*).

The assessment of overall rabbit/hare impact was noted as ‘acceptable’ for all sites except site R02 which was denoted as ‘monitor closely’. Across all eight pig monitoring plots there was no confirmed evidence of feral pigs.

Table 6: Weed species identified at the Project site

Species	Common name
Acacia farnesiana *(Vachellia farnesiana)*	Mimosa bush
Argemone ochroleuca	Mexican poppy
Asclepias curassavica	Red-head cottonbush
Aster subulatus	Bushy starwort

Species	Common name
Bidens bipinnata	Bipinnate beggar's ticks
Bidens pilosa	Cobbler’s peg
Bothriochloa pertusa	Indian bluegrass
Brassica juncea	Indian mustard
Cenchrus ciliaris	Buffel grass
Centaurium tenuiflorum	
Cirsium vulgare	Spear thistle
Clitoria ternatea	Butterfly pea
Crotalaria juncea	Sunn hemp
Cyclospermum leptophyllum	Slender celery
Cyperus rotundus	Nutgrass
Dichanthium annulatum	Sheda grass
Dichanthium aristatum	Angleton grass
Emilia sonchifolia	Purple Emily
Gomphocarpus physocarpus	Balloon cotton bush
Gomphrena celosioides	Gomphrena weed
Macroptilium lathyroides	Phasey bean
Malvastrum americanum	Spiked malvastrum
Malvastrum coromandelianum	Prickly malvastrum
Melinis repens	Red natal grass
Opuntia stricta	Common prickly pear
Opuntia tomentosa	Velvety tree pear
Parthenium hysterophorus*	Parthenium
Paspalum dilatatum	Paspalum
Pennisetum ciliare	Buffel grass
Scoparia dulcis	Scoparia
Senecio madagascariensis*	Fireweed
Sida cordifolia	Flannel weed
Sida spinosa	Spiny sida
Solanum americanum	Glossy nightshade
Sonchus oleraceus	Common sowthistle
Sorghum halepense	Johnson grass
Stylosanthes scabra	Shruby stylo
Verbena litoralis var. litoralis	
Verbena officinalis	Common verbena
Xanthium pungens	Noogoora burr

*Biosecurity Act 2014 Category 3 matter – must not be distributed or released into the environment

5.5 AQUATIC ECOLOGY AND HYDROLOGY

The Project is located within the Fitzroy Basin. The watercourses in the vicinity of the Project area form part of the Comet River catchment, a major tributary of the Fitzroy River. Several small drainage paths located on the Project site flow to Spring Creek in the south and Aldebaran Creek in the north, both of which drain into Meteor Creek (Spring Creek via Bootes Creek) which flows to the Comet River approximately 35km downstream of the Project site.

The other major aquatic feature in the vicinity of the Project area is Naroo Dam, situated on the eastern side of the Project area.

Each of the aquatic features on or near the Project site are described below.

5.5.1 Spring Creek

Spring Creek is located to the south and east of the Project site. The southern portion of the Project site is situated within the catchment of Spring Creek, comprising 8.5 km^2 of the 61.1 km^2 Spring Creek catchment. A further 23.8 km^2 of the Spring Creek catchment is located within the Rolleston Coal Mine lease.

Spring Creek is an ephemeral creek which flows only after rainfall events. However, some shallow waterholes may persist after the flow ceases. The portion of the Spring Creek channel located adjacent to the Project area is generally clear of vegetation with some small stands of trees located along the banks and within the channel. Significant erosion is present due to stock accessing the creek for water impacting the soils. The dominant land use within this section of the Spring Creek catchment is low intensity grazing (Plate 1). The ecological assessments undertaken for the Project (CQU 2012 and Ecosure 2013) did not identify Spring Creek as potential habitat for any MNES.

Plate 1: Spring Creek Channel in Vicinity of the Project Site

5.5.2 Aldebaran Creek

The northern portion of the Project site, including the access road is situated within the catchment of Aldebaran Creek. Aldebaran Creek is located to the north and east of the Project site and flows in a north-easterly direction, crossing the Dawson Highway, then changing to a south-easterly direction and draining into Meteor Creek approximately 17 km downstream of the highway. Aldebaran Creek is an ephemeral creek which flows only after rainfall events. However, some shallow waterholes may persist after the flow ceases. The Aldebaran Creek channel is well vegetated with a sandy bed. The dominant land use within the Aldebaran Creek catchment is low intensity grazing, with the creek considered a watering point on stockroute PO42, which runs alongside the Dawson Highway (Plate 2). The ecological assessments undertaken for the Project (CQU 2012 and Ecosure 2013) did not identify Aldebaran Creek as potential habitat for any MNES.

Plate 2: Aldebaran Creek channel at the Dawson Highway

5.5.3 Meteor Creek

Spring Creek and Aldebaran Creek flow into Meteor Creek. Meteor Creek bisects the neighbouring Rolleston Coal Mine lease, flowing in a north-easterly direction draining into the Comet River approximately 14 km from the Dawson Highway. The Meteor Creek catchment area constitutes approximately 9% of the Comet River catchment upstream of the Mackenzie River. Meteor Creek is an ephemeral creek which flows only after rainfall events. However, some shallow waterholes may persist after the flow ceases. The dominant land use within the Meteor Creek catchment is low intensity grazing and conservation (National Park). Meteor Creek has a gravelly bed with well vegetated banks (Plate 3).

Plate 3: Meteor Creek channel at Dawson Highway

Plate 4: Southern Catchment Drainage Path Channel associated with Naroo Dam

5.5.4 Aquatic Flora

Five aquatic plant species were recorded at the Project survey sites. Most of the plants had moderate abundance however there was a high abundance of bulrush (*Typha orientalis*) at the Creek 3 site and water nymph (*Najas tenuifolia*) at Naroo Dam. No aquatic flora of conservation significance was identified within the Project site. No exotic aquatic species were identified.

5.5.5 Aquatic Fauna

Three native fish species, one turtle and twenty-two waterbird species were observed during the aquatic survey undertaken from 1 to 6 November 2011 (CQU 2012). No mega-invertebrates (prawns, shrimp or yabbies) were found in the Project site. Naroo Dam had the greatest abundance and species richness of the freshwater sites that were surveyed. No freshwater species were recorded at two of the creek sites.

Of the 110 species of birds recorded, 22 were waterbirds, including the Australian Painted Snipe, which is addressed in Section 9 of this document.

6 BRIGALOW THREATENED ECOLOGICAL COMMUNITY

6.1 STATUS AND DISTRIBUTION

Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community (Brigalow TEC) is listed as endangered under the EPBC Act.

Brigalow TEC occurs in semi-arid areas of Queensland and New South Wales (DoE 2013). It extends from south of Townsville in Queensland to Narrabri in New South Wales, and east of Blackall, Charleville, Cunnamulla and Bourke.

In Queensland it occurs within the Brigalow Belt North, Brigalow Belt South, Darling Riverine Plains and South-east Queensland Interim Biogeographic Regionalisation for Australia (IBRA) bioregions (DoE 2013).

6.2 COMMUNITY ECOLOGY

6.2.1 Community Description

Brigalow TEC is an open forest to open woodland characterised by the presence of Brigalow (*Acacia harpophylla*) as one of the three most abundant tree species (DoE 2013). It incorporates a range of vegetation structures and composition including species that prefer acidic and salty clay soils (Butler 2008a).

Acacia harpophylla is either dominant or co-dominant in the tree layer occurring with other species such as belah (*Casuarina cristata*), *Acacia* sp. and *Eucalyptus* sp. Common Eucalypt species that are associated with Brigalow TEC include Dawson gum, mountain yapunyah, coolibah, Pilliga box, grey box, gum-topped box, Reid River box and Chinchilla whitegum. Common Acacia species that are associated with Brigalow TEC include gidgee (*Acacia cambagei*), blackwood (*Acacia melanoxylon*), myall and yarran (Butler 2008a).

The height of the dominant tree layer varies from approximately 9 m in low rainfall areas averaging 500 mm per annum, up to 25 m in higher rainfall areas averaging 750 mm per annum.

Brigalow TEC generally includes one or more shrub layers below the tree canopy. Common shrub species that are present include wilga (*Geijera parviflora*), false sandalwood (*Eremophila mitchellii*), yellowwood (*Terminalia oblongata*), peach bush, scrub boonaree, western rosewood, small-fruited mock-olive, Ellangowan poison bush, lime bush, wild orange, narrow-leaved bumble and broom bush (Butler 2008a).

Currant bush is often present as a patchy lower shrub layer, as well as a range of climbing plants including small-leaf grape, nipan, native jasmines and northern silk-pod (*Parsonsia lanceolata*).

There is generally a sparse ground layer, with small chenopod sub-shrubs present, and limited presence of grasses and small forbs (Butler 2008a).

Most Brigalow soils are saline, relatively fertile and have a clay field texture throughout the profile (Butler 2008a). In Queensland, the soils are predominantly cracking clays where Brigalow is dominant, but texture contrast soils are common where Eucalyptus species are co-dominant.

6.2.2 Regional Ecosystems Associations

In Queensland, Brigalow TEC is defined by 16 regional ecosystems (REs). Regional Ecosystem 11.4.3, which has been identified within the Project site, forms part of the Brigalow TEC. A description of RE 11.4.3 is provided in Table 7.

Table 7: Regional ecosystems located within the Project site associated with Brigalow TEC

RE	VM Status	RE description
11.4.3	Endangered	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains.

6.2.3 Condition Thresholds

Brigalow TEC can comprise both remnant and regrowth (i.e. non-remnant) vegetation, particularly regrowth vegetation greater than 15 years old (Butler 2008a). As stated in DoE 2013, remnant REs in poor condition, which would otherwise be considered Brigalow TEC, should be excluded from the listed Brigalow TEC. These include patches where vegetation has been comprehensively cleared in the last 15 years, and/or exotic perennial plants have a cover of more than 50%, and/or individual patches are less than 0.5 ha in size. Therefore, Brigalow TEC is limited to patches that meet the following condition thresholds (DoE 2013):

- the patch must be greater than 0.5 ha in size
- exotic perennial plants must comprise less than 50% of total vegetation cover of the patch (as assessed over a minimum sample area of 0.5 ha that is representative of the patch).

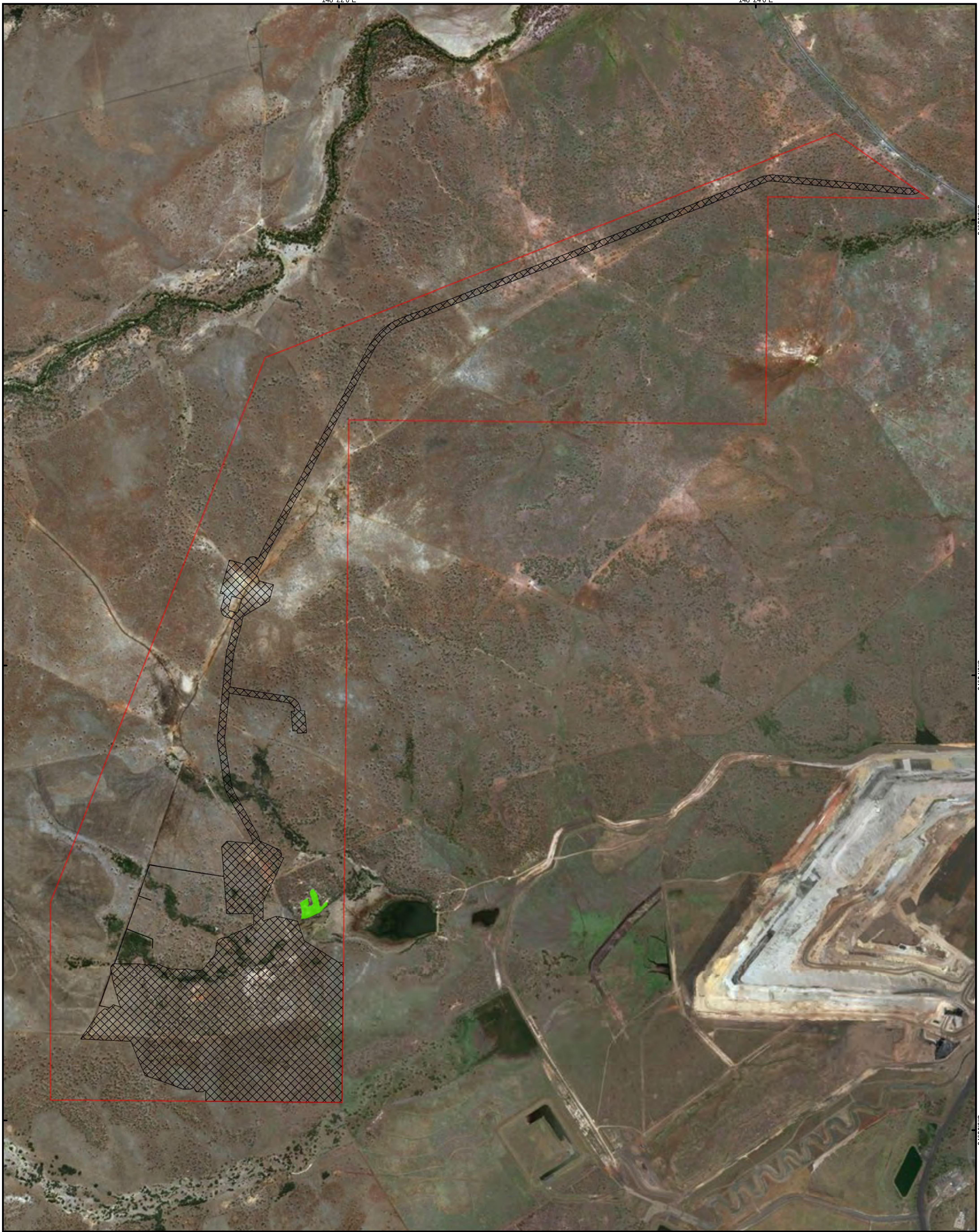
6.2.4 Known Locations within the Project site

As illustrated in Figure 5, a small area of regrowth Brigalow TEC has been mapped within the Project site close to Naroo Dam (Ecosure 2013). The patch is approximately 2.21 ha in size and corresponds to high value regrowth of RE 11.4.3. None of the Brigalow TEC within the Project site will be cleared.

6.2.5 Condition within Project site

A BioCondition assessment was undertaken in accordance with Eyre et al (2011) within RE 11.4.3 (Ecosure 2013). The results of the assessment indicate a BioCondition score of 65/100 which corresponds with a BioCondition class of 2. Communities with a BioCondition class of 2 are classified as moderately functional.

Baseline habitat condition assessments undertaken in accordance with the Guide to determining terrestrial habitat quality (DEHP 2017) during December 2017, determined that the patch of Brigalow TEC had a habitat quality score of 7.36 out of 10.



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 5
Location of Brigalow TEC within Project site

Mining Lease
Disturbance areas
Brigalow TEC

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by Sojitz
- Disturbance areas
- Ground-truthed regional ecosystem mapping (Cumberland Ecology)

Date: 8/04/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

0 0.5 1 1.5 2
Kilometres

N

Path: P:\GIS\Data\Projects\Sojitz\911_20190322_Updated MNESMP_figures\Figure 4 - Brigalow TEC.mxd

6.3 THREATS

Brigalow TEC once covered an area of more than 7,000,000 ha in semi-arid eastern Australia, however, by 2003 the remnant extent of Brigalow TEC had been reduced to about 560,000 ha (Butler 2008a). The key threats to Brigalow TEC, in order of significance, are described in Table 8. Whilst climate change is an emerging threat (DoE 2013), capacity to address this threat is beyond the scope of this plan

Table 8: Threats to Brigalow TEC

Threat	Description
Clearing	The clearing of Brigalow, predominantly post 1960, is the primary reason for its listing as Endangered. The introduction of vegetation clearing laws in Queensland afford some protection, however, clearing is still permitted for certain activities (e.g. routine property maintenance, mining, and energy and transport infrastructure projects) and illegal clearing is also a serious threat (Butler 2008a). Mapping under the Qld *Vegetation Management Act 1999* (VM Act) is used to protect vegetation, however, due to limitations of scale and accuracy, potentially significant patches of Brigalow TEC (i.e. non-remnant or those below the mapping scale) are not afforded protection under the VM Act (Butler 2008a).
Fire	Historically, fire has been rare in Brigalow TEC and whilst Brigalow can recover from fire by suckering from the roots, recovery is a slow process and the structure of Brigalow forests can be significantly altered (Butler 2008a). Butler (2008a) states that 'with the exception of clearing, the most important threat to remnant and regrowth Brigalow is fire fuelled by exotic grasses'. Fire exclusion is therefore the recommended fire regime for Brigalow TEC.
Invasive species (plants and animals)	Invasive plant and animal species threaten the biodiversity of Brigalow TEC by affecting the ecosystem's suitability as habitat for native species, and they can significantly alter the structure or function of the community (Butler 2008a). Exotic pasture grasses, such as buffel grass, currently pose the greatest threat to Brigalow TEC due to their propensity to increase fire risk, intensity and frequency. However, other weed species also occur in and affect Brigalow TEC, including succulents (e.g. tree pear, prickly pear and Harrisia cactus), mother of millions, climbing weeds (e.g. rubber vine, asparagus and Brazilian nightshade), shrubs and trees (e.g. African box thorn and parkinsonia) and herbaceous weeds (e.g. noogoora burr, inkweed and coal berry). Maintaining an intact and healthy tree canopy cover increases resistance to weeds and reduces the threat from weeds to Brigalow TEC (Butler 2008a). A variety of invasive animal species are present within Brigalow TEC, with feral pigs likely to be the most widespread and problematic (Butler 2008a). Feral pigs can cause significant degradation by impacting young plants and disturbing soil (DoE 2013). Other serious pest animal species affecting Brigalow TEC include cane toads, cats, foxes and goats. All these species are responsible for key threatening processes listed under the EPBC Act (DoE 2013). Although a native species, noisy minors (*Manorina melanocephala*) impact on Brigalow TEC by excluding all small native bird species from the areas they occupy (DoE 2013).
Inappropriate grazing	Trampling and grazing by large herbivores can have a detrimental impact on Brigalow TEC. Trampling results in soil compaction and reduces the availability of leaf litter and coarse woody debris, which is likely to degrade fauna habitat values. Trampling can also alter the composition and density of herbs and shrubs in the understorey (DoE 2013). Grazing impacts plant recruitment and growth but is also an important tool for the management of fuel loads, particularly the management of exotic pasture grasses (Butler 2008a).
Climate change	While *Acacia harpophylla* and its associated species are considered to be tolerant of a broad range of environments, their ability to cope with the expected unprecedented future climatic conditions is unknown, and the rates of change are expected to be higher than previously experienced (Butler 2008a).

Threat	Description
	In addition, the landscape within which Brigalow TEC faces climate change is significantly different from those of the past, and this may limit its capacity to adapt to changing conditions. For example, threats posed by exotic pasture grasses and fire may be worsened by increased variability in rainfall (Butler 2008a).

6.4 PROJECT IMPACTS

Table 9 outlines potential impacts to Brigalow TEC that may occur as a result of construction or operation of the Project.

Table 9: Potential impacts to Brigalow TEC as a result of the Project

Threat	Potential Project impacts
Recognised threats as per conservation documents	
Clearing	There will be no clearing of Brigalow within the Project site.
Fire	Construction and operation of the Project has the potential to increase fire hazards and fire risk (e.g. storage of fuel, waste laydown areas and scrap tyre storage areas). There is also the potential for increase of fuel loads (e.g. exotic pasture grasses) as a result of the introduction of exotic pasture grasses within Brigalow TEC areas.
Invasive species (plants and animals)	Spread of existing, and/or introduction of, invasive plant species through the movement of vehicles and machinery. Increase in pest animal numbers and/or introduction of new invasive animal species through Project construction and operation (e.g. poor mine site waste management practices) has the potential to impact on Brigalow TEC through increased grazing of native plants and soil disturbance.
Other threats	
Dust	Dust emissions from the construction and/or operation of the Project may smother Brigalow TEC and constituent species adjacent to the Project site.

7 NATURAL GRASSLANDS THREATENED ECOLOGICAL COMMUNITY

7.1 STATUS AND DISTRIBUTION

Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin Threatened Ecological Community (natural grasslands TEC) is listed as endangered under the EPBC Act.

Natural grasslands TEC is endemic to Queensland. It occurs within the Brigalow Belt North (BBN) and Brigalow Belt South (BBS) IBRA bioregions (DEWHA 2008c), extending from Collinsville in the north to Carnarvon National Park in the south. Natural grasslands TEC occurs within eight IBRA subregions: BBN 6 Northern Bowen Basin, BBN 9 Anakie Inlier, BBN 10 Basalt Downs, BBN 11 Isaac-Comet Downs, BBN 12 Nebo-Connors Range, BBN 13 South Drummond Basin, BBS 1 Claude River Downs and BBS 9 Buckland Basalts.

It mostly occurs within the Fitzroy River Basin; however, it does extend part way into adjacent catchments including where five of the subregions extend into the Burdekin River Basin and where one subregion extends into the Warrego River Basin (DSEWPaC 2013a).

7.2 COMMUNITY ECOLOGY

7.2.1 Community Description

Natural grasslands TEC are native grasslands characteristically comprising perennial native grasses. They occur on flat or gently undulating rises, on fine textured soils (often cracking clays) derived from either basalt or fine-grained sedimentary rocks. Soils have either formed *in situ* or have been transported to form extensive alluvial plains along watercourses (DSEWPaC 2013a). Natural grasslands TEC occurs in areas with relatively high summer rainfall.

Natural grasslands TEC are dominated by *Dicanthium* spp. (bluegrass), with tropical *Aristida* spp. and *Panicum* spp. (panic grasses) (TSSC 2009b). They lack temperate grasses (e.g. *Austrostipa* spp. and *Austrodanthonia* spp.) which are a more dominant feature of grasslands in the south. Native grasses are the primary indicator of the TEC, however, a range of forbs are also typically present (e.g. *Commelina ensifolia* (scurvy grass), *Corchorus trilocularis* (native jute), *Ipomoea lonchophylla* (cow vine), *Vigna lanceolata* (pencil yam), *Vigna radiata* (mung bean), *Desmodium campylocaulon* (creeping tick trefoil), *Neptunia gracilis* (native sensitive plant), *Psoralea tenax* (emu foot), *Rhynchosia minima* (rhyncho), *Crotalaria dissitiflora* (grey rattlepod), *Glycine latifolia* and *Hibiscus trionum* var. *vesicarius* (bladder ketmia).

A shrub layer is generally a minor component of natural grasslands TEC, however, in some areas there can be a more extensive shrub cover including species such as *Acacia salicina* (Sally wattle) and *Acacia farnesiana* (mimosa) (TSSC 2009b).

A tree canopy is usually absent, but when present, projective crown cover is no more than 10% (TSSC 2009b). Species present may include *Corymbia erythrophloia* (gum-topped bloodwood), *Eucalyptus coolabah* (coolibah), *E. crebra* (narrow-leaved ironbark), *E. melanophloia* (silver-leaved ironbark), *E. orgadophila* (mountain coolibah), *E. populnea* (poplar box), and *Melaleuca bracteata* (black tea-tree).

There can be seasonal variation in the appearance of natural grasslands TEC as many native wildflowers are more visible during spring (DSEWPaC 2013a). In addition, some wildflowers do not appear every year and some species that are sensitive to disturbance may decline or disappear from disturbed sites (e.g. grazing sensitive species may disappear from sites that are intensively grazed) (DSEWPaC 2013a).

7.2.2 Condition Thresholds

Condition thresholds have been established to determine when a patch is considered to be part of the ecological community. Condition thresholds aim to focus on the protection of vegetation remnants in relatively good to excellent condition (DSEWPaC 2013a).

Natural grassland TEC is considered to be present and to be of the **best quality** if:

- the patch occurs within any of the subregions of the Brigalow Belt North and Brigalow Belt South bioregions outlined above in Section 7.1.
- trees are absent or sparse such that the projective foliage cover of trees in the patch is 10% or less.
- there are at least 200 native grass tussocks in the patch.
- the patch size is at least 1 hectare.
- there are at least four perennial native grass indicator species present.
- the total projective foliage cover of shrubs is less than 30%.
- perennial non-woody introduced species make up less than 5% of the total perennial projective foliage cover.

Natural grassland TEC is considered to be present and to be of **good quality** if:

- the patch occurs within any of the subregions of the Brigalow Belt North and Brigalow Belt South bioregions outlined above in Section 7.1.
- trees are absent or sparse such that the projective foliage cover of trees in the patch is 10% or less.
- there are at least 200 native grass tussocks in the patch.
- the patch size is at least 5 hectares.
- there are at least three perennial native grass indicator species present.
- the total projective foliage cover of shrubs is less than 50%.
- perennial non-woody introduced species make up less than 30% of the total perennial projective foliage cover.

7.2.3 Regional Ecosystems Associations

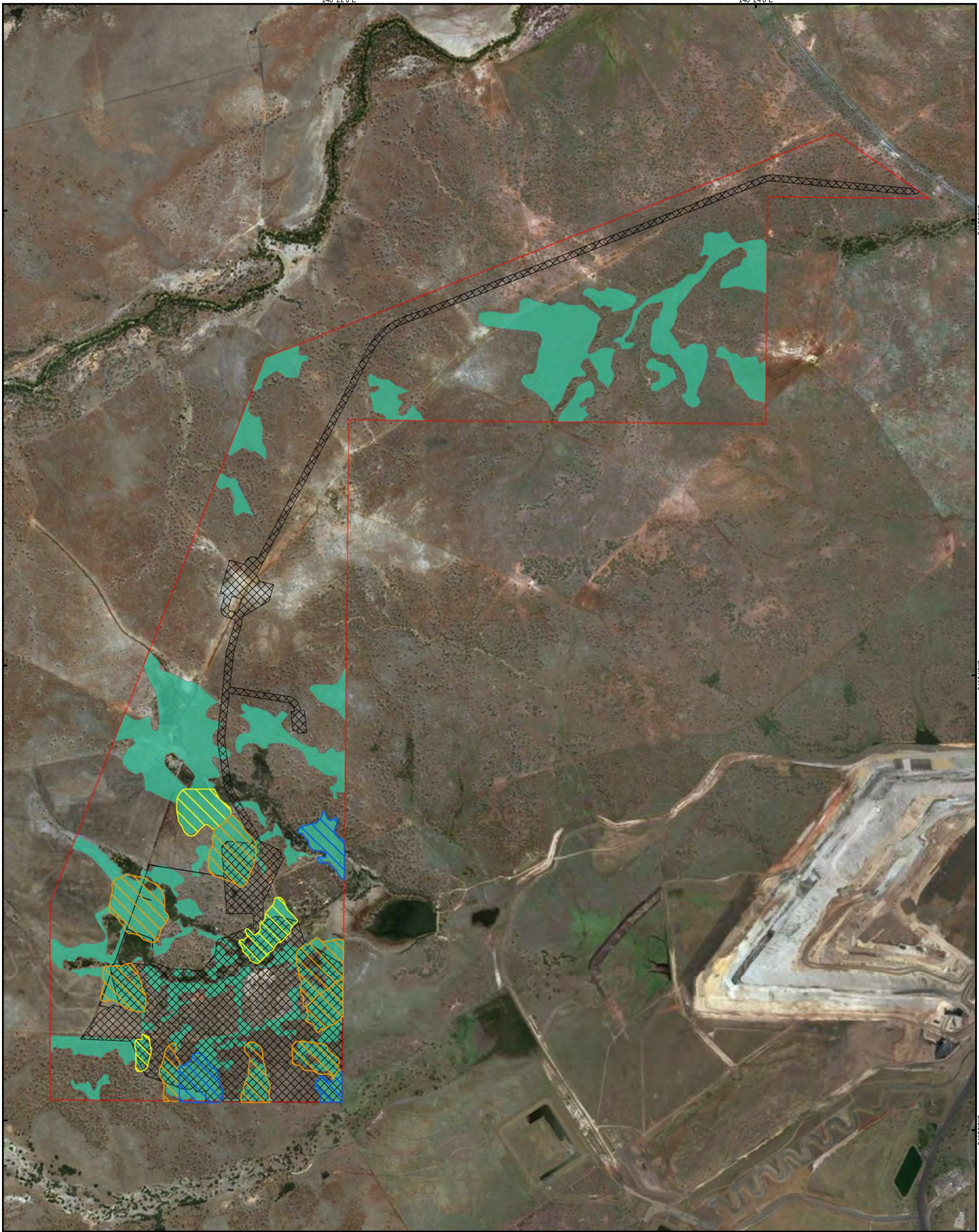
Natural grassland TEC corresponds closest to 7 regional ecosystems in Queensland. Regional Ecosystem 11.8.11, which has been identified within the Project site, is one of the REs that corresponds with natural grasslands TEC. A description of RE 11.8.11 is provided in Table 10.

Table 10: Regional ecosystems located within the Project site associated with natural grasslands TEC

RE	VM Status	RE Description
11.8.11	Of concern	*Dichanthium sericeum* grassland on Cainozoic igneous rocks.

7.2.4 Known Locations within the Project site

A total of 424 ha of natural grasslands TEC has been identified within the Project site (Gaia 2015). As illustrated in Figure 6, various patches of natural grasslands TEC are located throughout the Project site, particularly in the north-east and south of the Project site.



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Figure 6
Location of Natural Grasslands TEC within Project site

Mining Lease
Disturbance areas
Natural Grassland TEC

Natural grassland condition
Best quality
Good quality
Does not meet criteria

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by Sojitz
- Disturbance areas
- Ground-truthed regional ecosystem mapping (Cumberland Ecology)

0 0.5 1 1.5 2
Kilometres
N

CO2 Australia

Date: 8/04/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

Location diagram

Path: P:\GISData\Projects\Sojitz\911_20190322_Updated MNESMP_figures\Figure 5 - Natural Grasslands TEC.mxd

7.2.5 Condition within the Project site

The natural grasslands TEC within the Project site are generally in good to best condition (Ecosure 2013). Condition assessments concluded that eight natural grassland TEC patches met the good condition class, and three met the best condition class (Figure 6). However, it is important to note that not all patches were assessed to determine their condition class during the surveys.

Within the Project site, four BioCondition assessments were undertaken in RE 11.8.11. The average BioCondition score for RE 11.8.11, based on these results, is 67/100 which corresponds with a BioCondition class of 2 (Gaia 2015). Communities with a BioCondition class of 2 are classified as moderately functional. In some patches, there are signs of heavy grazing and over-sowing with exotic pasture grasses including buffel (*Cenchrus ciliaris*), bambatsi (*Panicum coloratum* var. *makarikariensis*) and Indian blue-grass (*Bothriochloa pertusa*). Whilst buffel was found to be dense in some locations it never comprised more than 50% of the sward (Ecosure 2013).

Of the 424 ha of natural grasslands TEC present, 109.7 ha will be cleared as a result of the Project.

Baseline surveys conducted in December 2017 determined that the habitat quality scores for areas of Natural Grasslands TEC ranged between 7.68 and 8.39 out of 10 (average of 8.04 out of 10). These relatively high scores are attributable in large part to greater than benchmark condition species richness for grasses and forbs at each of the RE 11.8.11 plot sites.

7.3 THREATS

Natural grasslands TEC, and other native grasslands and grassy woodlands, were once present in large areas throughout Australia, however, they are now one of the most threatened ecosystems in the country (TSSC 2009b). This is largely due to the conversion of native pastures to improved pastures and cropping and overgrazing by stock. The key known threats to natural grasslands TEC, as listed in the conservation and listing advice, are described below in Table 11.

Table 11: Threats to Natural Grasslands TEC

Threat	Description
Grazing, cropping and pasture improvement	Remaining patches of natural grasslands TEC are predominantly subject to grazing (TSSC 2009b). With persistent heavy grazing of these patches, dominant perennial plants are eliminated in favour of annual species, particularly weeds (TSSC 2009b). Grazing also results in soil compaction and loss of ground cover which impacts habitat for grassland fauna species. The expansion of exotic pastures and tree crops impacts natural grassland TEC by replacing the native grassland with introduced species (e.g. buffel grass), or altering the structure of the community through the introduction of a woody over-storey (e.g. leucaena) (TSSC 2009b). Some techniques used to develop and improve pastures exacerbate impacts to the TEC more than other techniques. For example, more intensive preparation of the seedbed and greater soil disturbance increases the impacts on natural grasslands TEC and its constituent species (TSSC 2009b).
Invasive species (plants and animals)	Impacts of pest animals on natural grasslands TEC including predation and competition with native animals, grazing of native plants and soil disturbance through burrowing and digging (TSSC 2009b). Pest animals that occur in this community include rabbits, feral cats, European fox, and the house mouse, which is the most abundant pest animal in natural grasslands TEC. House mouse competes with native mammals, reptiles and birds and may also impact upon seed production and recruitment of some plants.

Threat	Description
	However, this species is also considered an important food resource for common grassland predators such snakes (TSSC 2009b). Invasion of intact grasslands by weeds is typically caused by natural or human induced disturbance. Weeds can affect the integrity of the natural grasslands TEC by altering the vegetation structure through development of a woody shrub layer, affecting the appearance of the community and impacting threatened species (TSSC 2009b). Weeds impacting this community include parthenium (*Parthenium hysterophorus*), parkinsonia (*Parkinsonia aculeata*), prickly acacia (*Acacia nilotica* subsp. *indica*), buffel grass, Columbus grass (*Sorghum* x *almum*), Rhodes Grass, and green Panic *(Megathyrsus maximus*).
Mining activities	Mining and associated activities, including development of roads, conveyors and spoil heaps, can result in the physical destruction of natural grasslands TEC. Mining activities can result in the permanent destruction of natural grasslands TEC, as it is often difficult to re-establish the community after mining (TSSC 2009b).
Construction and maintenance of roads and other infrastructure	Natural grasslands TEC occurring along road and rail corridors is often of high conservation value due to the low levels of grazing in these areas and the importance of the habitat for flora and fauna. The construction of roads and other infrastructure can directly destroy grasslands, increase weed invasion and increase erosion of sites which further exacerbating weed dispersal (TSSC 2009b).
Climate change	Climate change is a potential long-term threat to this community as it has the potential to change the ecology of these environments (TSSC 2009b). It threatens species that cannot adapt and exacerbates existing threats such as invasive species. It may affect species composition, and the extent and distribution of the community (TSSC 2009b).

7.4 PROJECT IMPACTS

Table 12 outlines potential impacts to natural grasslands TEC that may occur as a result of construction or operation of the Project.

Table 12: Potential impacts to Natural Grasslands TEC as a result of the Project

Impacts	Potential impacts associated with the Project
Recognised threats as per conservation documents	
Invasive species (weeds and pest animals)	Spread of existing, and/or introduction of, invasive plant species through the movement of vehicles and machinery. Disturbance associated with Project activities may result in invasion of intact natural grasslands TEC by weeds. Increase in pest animal numbers and/or introduction of new invasive animal species through Project construction and operation (e.g. poor mine site waste management practices, increased transmission via roads) has the potential to impact on natural grasslands TEC through increased grazing of native plants and soil disturbance.
Mining activities	Mining activities within the Project site will result in the removal of 109.7 ha of natural grasslands TEC. 314.2 ha of natural grasslands TEC will be retained within the Project site.
Construction and maintenance of roads and other infrastructure	Access tracks and roads associated with the Project have been designed to avoid natural grasslands TEC as much as practicable. Only a small area of the TEC will be impacted by the road alignment, this impact area is included in the total disturbance of 109.7 ha.

Impacts	Potential impacts associated with the Project
Other threats	
Dust	Dust emissions from the construction and/or operation of the Project may smother natural grasslands TEC and constituent species adjacent to the Project site.
Fire	Construction and operation of the Project has the potential to increase fire hazards and fire risk (e.g. storage of fuel, waste laydown areas and scrap tyre storage areas). Natural grasslands TEC may be degraded, and individual plants destroyed through increased fire frequency, as a result of the Project.

8 SQUATTER PIGEON (GEOPHAPS SCRIPTA SCRIPTA)

8.1 STATUS AND DISTRIBUTION

The squatter pigeon (southern) (*Geophaps scripta scripta*) is listed as vulnerable under both the EPBC Act and the Queensland *Nature Conservation Act 1992* (NC Act). The squatter pigeon (southern) occurs on the inland slopes of the Great Dividing Range. Its known distribution extends north of the Burdekin River, east to Townsville and Proserpine and south to the Queensland-New South Wales Border and as far west as Longreach and Charleville.

The distribution of the southern subspecies overlaps with the distribution of the northern subspecies (*Geophaps scripta peninsulae*) and interbreeding is known to occur where their distributions overlap (DoEE 2017a).

8.2 SPECIES ECOLOGY

8.2.1 Species Description

The squatter pigeon (southern) is a medium-sized, ground-dwelling pigeon that measures approximately 30 cm long. Adults of both sexes are predominantly grey-brown with conspicuous black and white stripes on the face and throat. The upper wings of the squatter pigeon (southern) are dark-brown, sometimes with patches of iridescent green or violet. The upper breast is light grey-brown grading to blue-grey on the lower breast and centre of the belly while the rest of the belly and flanks are white. The squatter pigeon (southern) has a black bill, dark-brown irises, and dull-purple legs and feet.

The southern and northern subspecies of the squatter pigeon are distinguished by the colour of the skin around the eyes which is predominantly blue-grey in the southern subspecies and yellowy-orange to orange-red in the northern subspecies (TSSC 2015).

8.2.2 Species Habitat

Foraging habitat for the squatter pigeon (southern) consists of remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species, on sandy or gravelly soils, within 3 km of a suitable, permanent or seasonal waterbody (Squatter Pigeon Workshop 2011).

Breeding habitat occurs on stony rises occurring on sandy or gravelly soils, within 1 km of a suitable, permanent waterbody (Squatter Pigeon Workshop 2011).

Ground cover in areas of foraging and breeding habitat for the squatter pigeon (south) consists of native, perennial tussock grasses or a mix of perennial tussock grasses and low shrubs or forbs. Ground cover is often patchy and rarely exceeds 33% of the ground area in areas of suitable habitat (DoEE 2017a).

The squatter pigeon (southern) requires access to suitable waterbodies to drink daily. Permanent or seasonal rivers, creeks, lakes, ponds and waterholes, and artificial dams all provide suitable watering points. The squatter pigeon (southern) prefers to drink where there is gently sloping, bare ground on which to approach and stand at the water's edge. While patchy to moderate ground covering vegetation may occur along the banks of suitable water bodies, a small patch (less than a square metre) of bare ground at the water's edge is all that the bird requires (Squatter Pigeon Workshop 2011).

The squatter pigeon (southern) uses areas of forest and woodland to move between patches of foraging or breeding habitat and suitable waterbodies. They are unlikely to move far from woodland trees which provide protection from predatory birds, however where scattered trees still occur, they may be found foraging in or moving across modified or degraded environments such as pastures, sides of roads and stockyards (Squatter Pigeon Workshop 2011).

8.2.3 Movement Patterns

The squatter pigeon (southern) is considered sedentary or locally nomadic (Squatter Pigeon Workshop 2011, Frith 1982). Food resources are likely to be influenced by rainfall patterns from year to year and as such the squatter pigeon (southern) is likely to be sedentary where food and water resources are reliable. Where these resources are unavailable, the subspecies may disperse along vegetated corridors to access permanent water sources elsewhere in the region (Squatter Pigeon Workshop 2011).

8.2.4 Breeding Biology

The squatter pigeon (southern) typically breeds from April to October, although this is variable and is dependent on the availability of food resources (Frith 1982, Squatter Pigeon Workshop 2011).

Breeding habitat is found on stony rises occurring on sandy or gravelly soils, within 1 km of a suitable, permanent waterbody (Squatter Pigeon Workshop 2011). The squatter pigeon (southern) nests on the ground in depressions scraped beneath tussocks of grass, bush, fallen trees or logs. They usually lay two eggs, which are incubated for approximately 17 days. Chicks remain in the nest for two to three weeks and are dependent on their parents for around four weeks (DoEE 2017a).

8.2.5 Feeding Ecology

The squatter pigeon (southern) mainly forages on bare ground between sparse grasses under an open canopy of trees. They feed on seeds from grasses, herbs and shrubs which have fallen to the ground (Chrome 1976, Chrome and Shields 1992).

8.2.6 Known Populations within the Project site

The squatter pigeon (southern) has not been recorded from the Project site or surrounds. The closest record of the squatter pigeon (southern) is from 4 km to the south-east of the Project site (Gaia Environmental Consulting 2015).

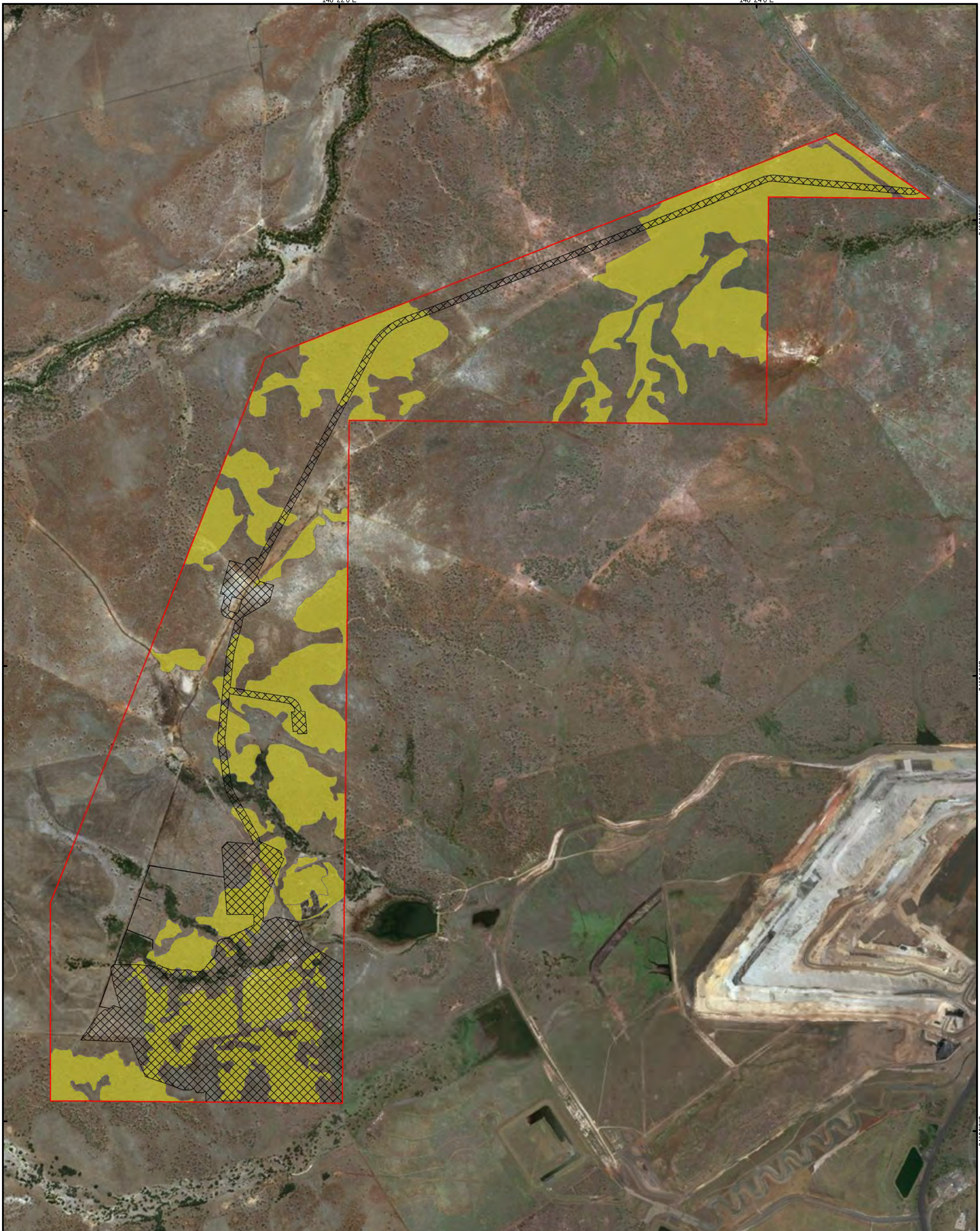
Targeted surveys undertaken in December 2017 failed to detect the squatter pigeon (see Appendix C).

8.2.7 Condition of Habitat within the Project site

Habitat for the squatter pigeon is present across the Project site and consists of areas of grassy woodland (RE 11.8.5 - *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks and RE 11.8.15 - *Eucalyptus brownii* or *Eucalyptus populnea* woodland on Cainozoic igneous rocks) (Figure 7). BioCondition assessments undertaken in accordance with the methodology prescribed in Eyre et.al (2011) within RE 11.8.5 and RE 11.8.15 indicate a score of 79/100 in which indicates that the REs are in a moderately functional condition.

Additionally, Naroo Dam and several ephemeral pools along creek lines within the Project site provide potential watering points for the squatter pigeon (south).

Baseline surveys (December 2017) used the Guide to Determining Terrestrial Habitat Quality (DEHP 2017) to determine the quality of squatter pigeon foraging and breeding habitat in RE 11.8.5. Habitat quality scores ranged from 6.19 to 8.14 out of 10, with an average score of 7.3 out of 10.



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 7
Location of potential Squatter Pigeon habitat within Project site

Mining Lease
Disturbance areas
Potential squatter pigeon habitat

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by Sojitz
- Disturbance areas
- Ground-truthed regional ecosystem mapping (Cumberland Ecology)

Date: 8/04/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

0 0.5 1 1.5 2
Kilometres

N

CO2 Australia

Path: P:\GIS\Data\Projects\Sojitz\611_20190322_Updated MINESMP_figures\Figure 6 - Squatter pigeon.mxd

8.3 THREATS

The squatter pigeon (southern) population declined rapidly during the late 19th and early 20th centuries, and it has continued to decline in NSW and southern Queensland where it is now very rare. The species remains relatively common in central Queensland; however, it is under threat from vegetation clearing, overgrazing, invasion of weeds and pasture grasses and predation from feral animals (TSSC 2015).

The key threats to the squatter pigeon (southern) are summarised in Table 13.

Table 13: Threats to the squatter pigeon (southern)

Threat	Description
Vegetation clearing and fragmentation	Clearing of vegetation for agriculture and development continues to result in the loss and fragmentation of habitat for the squatter pigeon (southern).
Overgrazing and trampling of nests by livestock.	Habitat for the squatter pigeon (southern) has been degraded by overgrazing by domesticated livestock, especially sheep and cattle. Overgrazing often facilitates the proliferation of weeds (e.g. *Cenchrus ciliaris, Parthenium hysterophorus*) and pasture grasses at the expense of native perennial grasses. Livestock may also trample nests.
Invasive species (plants and animals)	The squatter pigeon (southern) is subject to predation from feral animals including feral cat (*Felis catus*) and European fox (*Vulpes vulpes*). Overgrazing by feral herbivores such as the rabbit (*Oryctolagus cuniculus*) is also a recognised threat to the squatter pigeon (southern). The invasion of weeds and pasture grasses has resulted in the modification of breeding and foraging habitat for the squatter pigeon.
Illegal shooting	The squatter pigeon (southern) has been historically hunted as its tame nature makes it an easy and susceptible target. Despite being protected by both state and Commonwealth legislation, some illegal shooting has continued to occur (Chrome 1976).

8.4 PROJECT IMPACTS

Table 14 outlines potential impacts to the squatter pigeon and its habitat that may occur as a result of construction or operation of the Project.

Table 14: Potential impacts to the squatter pigeon (southern) as a result of the Project

Impacts	Potential impacts associated with the Project
Recognised threats as per conservation documents	
Vegetation clearing and fragmentation	The Project will result in the direct loss 138.4 ha of potential habitat for the squatter pigeon (southern). A total of 468.6ha of squatter pigeon habitat will be retained in the Project site. Indirect impacts may result from the fragmentation and loss of connectivity between areas of remaining habitat in the Project site.
Invasive species (plants and animals)	Increased movements of vehicles, machinery and people could result in the introduction and/or spread of weeds throughout the Project site. If weeds are not appropriately controlled and managed this could result in the degradation of habitat quality and reduction in food resources for the squatter pigeon (southern).
	If not appropriately controlled, feral herbivores, namely rabbits, may result in overgrazing and the degradation of habitat quality and a reduction in food resources for the squatter pigeon (southern). An increase in predators may result in increased levels of predation on the squatter pigeon (southern).
Other threats	

Impacts	Potential impacts associated with the Project
Noise and vibration	Should squatter pigeon occur on site, utilisation of habitat adjacent to the Project may be reduced as a result of noise and vibration impacts from the construction and operation of the Project. Noise modelling undertaken for the Project indicates noise levels close to the Project footprint are likely to be 50dBA or greater (McCollum 2013). A review of available literature by SLR Consulting Australia (2015) indicates noise levels between 50 to 65 dBA result in occasional minor impacts on habitat use for most species while noise levels between 65 and 85 dBA may trigger and alert and alarm response. Studies indicate that noise levels over 85 dBA may result in the avoidance or abandonment of habitat by a species altogether. However, noise and vibration are unlikely to have significant impact on squatter pigeons, given: ▶ Squatter pigeons have not been recorded on the Project site to date. ▶ Squatter pigeons are known to inhabit noisy disturbed areas, including road and railway corridors, and homesteads. ▶ Noise levels are likely to be below levels that result in avoidance or abandonment of habitat.
Dust emissions	Dust emissions from the construction and/or operation of the Project may smother vegetation adjacent to the Project site and potentially reduce habitat quality for the squatter pigeon (southern).
Changes in hydrological regimes and water quality	Changes in hydrological regimes as a result of the Project could potentially change the distance between water sources and feeding and breeding habitat which may affect the movement of squatter pigeons through the landscape (Reis 2012).
Vehicle strike	Squatter pigeons are often recorded along road and vehicle tracks. As such they are at risk of injury or mortality as a result of vehicle strike from Project traffic.

9 AUSTRALIAN PAINTED SNIPE (*ROSTRATULA AUSTRALIS*)

9.1 STATUS AND DISTRIBUTION

The Australian painted snipe is listed as Endangered under the EPBC Act and Vulnerable under the Queensland NC Act. It is also listed as a marine species (as *Rostratula benghalensis*) and a migratory species (under the China-Australia migratory bird agreement as *Rostratula benghalensis*) under the EPBC act.

The species is widespread and is not considered to have a limited geographic distribution (TSSC 2013b), having been recorded at wetlands in all states of Australia (DoEE 2017b). However, it is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia. It has been less frequently recorded from a smaller number of more scattered locations farther west in South Australia, the Northern Territory and Western Australia (DoEE 2017b). It has only been recorded on single occasions in Tasmania and at Lord Howe Island (DoEE 2017b).

9.2 SPECIES ECOLOGY

9.2.1 Species Description

The Australian painted snipe is a stocky wading bird of between 220–250 mm in length, with a long pinkish bill.

The adult female is brighter in appearance than the adult male and has a chestnut-coloured head, with white around the eye and a white crown stripe, as well as metallic green back and wings, barred with black and chestnut. There is a pale stripe extending from the shoulder into a V down its upper back. The adult male is similar to the female, but is smaller, duller and greyer than the female, with buff spots on the wings and without any chestnut colouring on the head, nape or throat.

9.2.2 Species Habitat

The Australian painted snipe generally inhabits a diverse range of shallow, vegetated, terrestrial freshwater or brackish wetlands; including temporary, infrequently filled or permanent lakes, swamps and claypans (DoEE 2017b, Birdlife Australia 2017).

They are especially known from temporary wetlands with muddy edges and small low-lying islands (Birdlife Australia 2017). However, they also use inundated or waterlogged grassland or saltmarsh, grazing pastures, dams, rice crops, sewage farms, bore drains and irrigation schemes, and occasionally areas that are lined with trees, or that have some scattered fallen or washed-up timber (DoEE 2017b).

Locations where they are typically found include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*).

Whilst the Australian painted snipe uses highly modified habitats, such as those mentioned above, they do not necessarily breed in such habitats (DoEE 2017b). The requirements for breeding habitat may be quite specific, being shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Nest records are all, or nearly all, from or near small islands in freshwater wetlands (DoEE 2017b), provided that these islands are a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover (DoEE 2017b).

9.2.3 Movement Patterns

The species is nomadic and dispersive movements have been attributed to responses to local conditions: they will move when an area begins to dry up, becomes flooded or gets too cold (TSSc 2013b, DoEE 2017b). There is increasing evidence that they disperse from the east to central and northern Australia for at least part of the year to exploit favourable seasonal conditions (TSSC 2013b). It is considered likely that a reasonable proportion of the eastern Australian population migrates to tropical coastal Queensland in February to August and also to inundated wetlands in western Queensland when these become available (TSSC 2013b).

9.2.4 Breeding Biology

The female is polyandrous. Three to six eggs are laid (usually four), which are incubated by the male in a shallow scrape nest (TSSC 2013b, Garnett & Crowley 2000). The young hatch after 19-20 days. Nesting typically occurs in ephemeral wetlands that are drying out after a recent influx. As mentioned above, the habitat requirements for breeding are thought to be very specific, with continuous reed beds, stands of reed-like vegetation, rice fields and areas with no surrounding low cover avoided, and nesting instead occurring among tall rank tussocks, frequently on small, muddy islands or mounds surrounded by shallow fresh water, sometimes on shores of swamps or on banks of channels (TSSC 2013b).

Breeding occurs from December to May in the north and October to December in the south (TSSC 2013b).

It is thought to primarily breed in the Murray-Darling Basin (TSSC 2013b).

9.2.5 Feeding Ecology

The species is mainly nocturnal and crepuscular and sits quietly under reeds or grass during the day.

Feeding occurs at the water's edge and on mudflats. Food consists of seeds and various aquatic and terrestrial invertebrates, including insects, crustaceans, molluscs and worms (TSSC 2013b, Garnett & Crowley 2000). Australian painted snipe generally remains in dense cover whilst feeding, but may also forage over nearby mudflats, ploughed land or grassland (TSSC 2013b). The bill is adapted to probe in soft mud (TSSC 2013b).

9.2.6 Known Populations within the Project site

The Australian painted snipe is considered to occur in a single, contiguous breeding population (Garnett & Crowley 2000). The most recent estimates of the current population size of the Australian painted snipe was 2,500 mature individuals (DSEWPaC 2013b).

Two Australian painted snipe were observed on the Project side of Naroo Dam in November 2012 (CQU 2013), however no Australian painted snipe were recorded during 2017 targeted surveys (refer to Appendix C).

9.2.7 Condition of Habitat within the Project site

There are several ephemeral drainage lines present in the Project site. Some of these could provide potential habitat for Australian painted snipe after inundation events (Figure 8). The drainage features within the Project site are generally well defined and although modified by access for stock watering, generally have some vegetation along the banks (see Plate 5 to Plate 10). In the upper portions of the drainage feature catchments, the channels are steep, often with exposed rock in the bed (refer to Plate 5). In the lower parts of the catchment, the drainage feature channels are sandy, with signs of significant erosion (refer to Plate 6). The drainage feature channels at the Project site are typically between 5 m and 10 m wide, and up to 1 m deep. There are numerous minor overland flowpaths evident at the Project site, typically characterised by small gullies and rills draining into the major drainage features.

The mine is within the catchment draining to Naroo Dam. Naroo Dam is located on the eastern side of the Project area (Figure 8, Plate 11 and Plate 12). It is a human-made water storage with a capacity of approximately 750 ML. As discussed in Section 3.1.1 no part of the dam is included in the MDS ML, and all the dam, including the embankment and spillway now lie to the east of the Project boundary. The Naroo Dam spillway has a crest level of 243.78 m AHD. The area of inundation due to the dam extends into the Project mining lease when water levels in the dam exceed approximately 242.0 m AHD. Based on available survey information, the crest of the Naroo Dam embankment appears to be approximately 246.0 m AHD. Naroo Dam is approximately 5.78 m deep at the deepest point, however the depth of the inundation area located within the Project site is less than 2m. Naroo Dam is currently used as a mine water supply source by Rolleston Coal Mine.

Plate 5: Creek 1 Upstream (November 2012, after significant rainfall event)

Plate 6: Creek 1 Downstream (November 2012, after significant rainfall event)

Plate 7: Creek 2 Upstream (November 2012, after significant rainfall event)

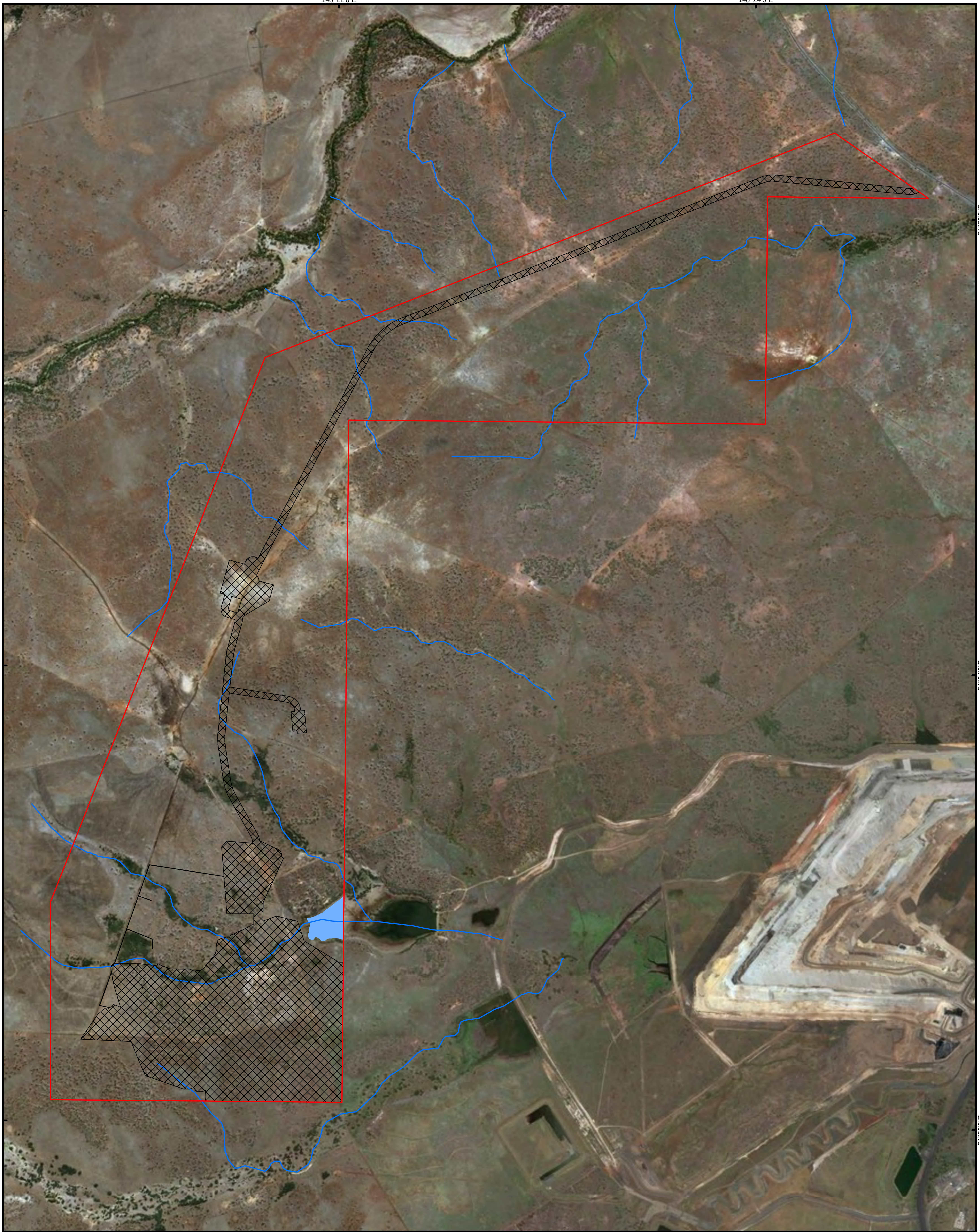
Plate 8: Creek 2 Downstream (November 2012, after significant rainfall event)

Plate 9: Creek 3 Upstream (November 2012, after significant rainfall event)

Plate 10: Creek 3 Downstream (November 2012, after significant rainfall event)

Plate 11: Naroo Dam edge (November 2012, after significant rainfall event)

Plate 12: Naroo Dam (November 2012, after significant rainfall event)



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 8
Location of potential Australian Painted Snipe habitat within Project site

- Mining Lease
- Disturbance areas
- Watercourses
- Potential Australian painted snipe habitat

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
- Watercourses

The following datasets provided by Sojitz
- Disturbance areas
- Ground-truthed regional ecosystem mapping (Cumberland Ecology)

0 0.5 1 1.5 2
Kilometres

N

CO2 Australia

Date: 8/04/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

Path: P:\GISData\Projects\Sojitz\911_20190322_Updated MNESMP_figures\Figure 7 - Australian painted snipe.mxd

Hydrological regime is an important determinant of habitat for Australian painted snipe. Alteration of hydrological regime in the form of a reduction in the frequency of flooding and/or stabilisation of water levels are key threatening processes for this species. Surveys for Australian painted snipe were undertaken in November 2012 (CQU), and December 2013 (Ecosure). As such, Figure 9 (reproduced from WRM, 2014) provides information regarding dam volumes and rainfall around the time of the November 2012 ecological survey when two Australian painted snipe were seen in the portion of Naroo Dam that lay within the Project site at the time. As discussed in Section 2.1.2 no portion of the Naroo Dam now lies within the MDS ML.

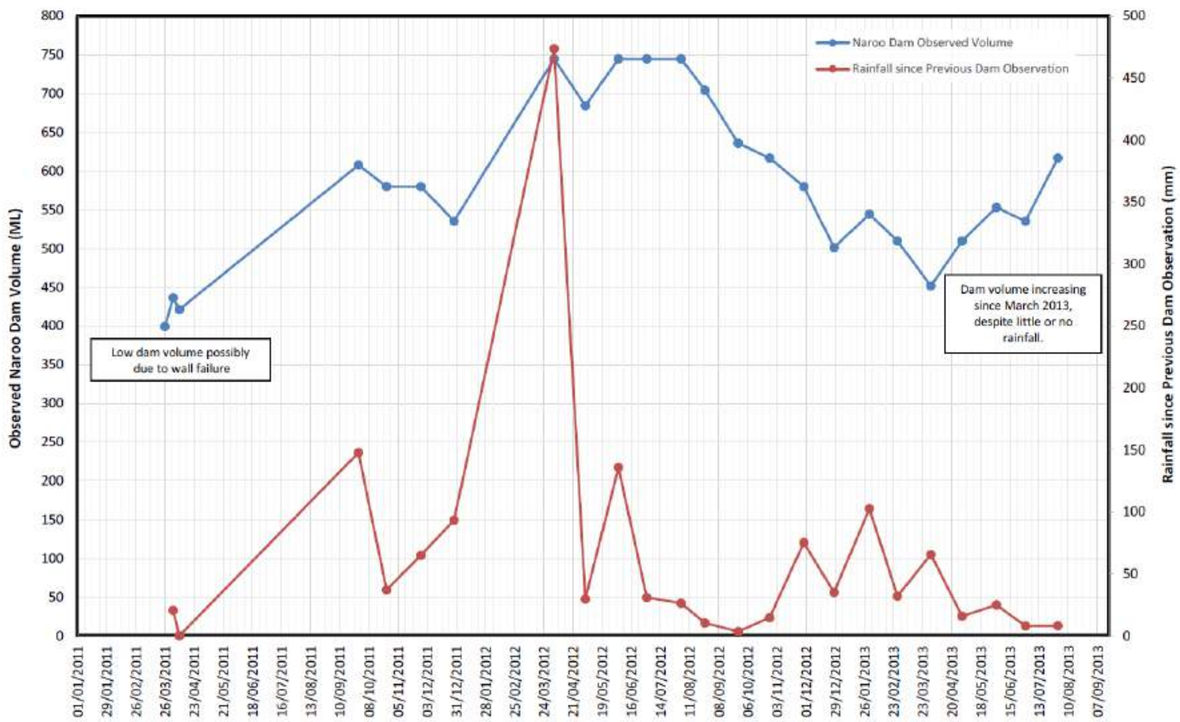


Figure 9: Observed Naroo Dam Volumes and Rainfall, 26 March 2011 to 31 July 2013

As can be seen from Figure 9, a significant rainfall event occurred in March/April 2012, resulting in Naroo Dam filling to full capacity. The dam remained full until August, after which water levels began to recede. At the time of the sighting of the two Australian painted snipe within Naroo Dam, in November 2012, the dam was still relatively full (around 610 ML).

The following is also of note with regards to Figure 9:

- Glencore advised that the Naroo Dam embankment failed during January 2011, resulting in the loss of much of the dam contents. The Naroo Dam embankment and spillway were repaired during 2011. It is not known what the spillway and embankment level of Naroo Dam were prior to the wall failure in January 2011.
- The volume of water stored in Naroo Dam typically increases following periods of significant rainfall and catchment runoff and decreases during periods of low rainfall due to evaporation and extraction of water for Rolleston demands – as such the current hydrological regime is varied, and subject to anthropogenic interference.
- The amount of water extracted from Naroo Dam over the data period is unknown.
- Figure 9 shows that the volume of water stored in the dam begins to increase from 31 March 2013, despite no significant rainfall having occurred. The volume of water stored in the dam increased from 451.7 ML on 31 March to 553.0 ML on 2 June, and from 535.5ML on 30 June to 616.9 ML on 31 June.

Glencore advised EOC that during this time the pumped excess water from one of their raw water dams into Naroo and that this practice occurs from time to time.

The important point to note is that the water levels in the dam are not just dependent upon rainfall, runoff and evaporation, but are subject to variation as a result of Rolleston's water demands, operations and management of the Dam. It is also important to note that Glencore are authorised to take water from the dam as they wish, even emptying the dam if other water sources or infrastructure fails.

At the time of the Ecosure surveys in December 2013, the level of Naroo Dam had dropped, the shoreline had retreated across exposed mudflats and any original fringing vegetation was dying back (Ecosure 2013). The habitat opportunities for the Australian painted snipe were mainly confined to areas of the dam outside the Project site at that time, although suitable day-time shelter was still considered to be present in a few places within the Project lease at that time (Ecosure, 2013). This suggests that habitat for Australian painted snipe in Naroo Dam changes in response to changes in dam water level.

Baseline surveys undertaken in December 2017 used the Guide to determining terrestrial habitat quality (DEHP 2017) to assess quality of Australian painted snipe habitat within the Project Area. The monitoring site in RE 11.3.3a resulted in a habitat quality score of 4.74 out of 10.

The comparatively low score for Australian painted snipe habitat is in part attributable to the low site condition for RE 11.3.3a habitat (score of 5.25), but also the low fauna species habitat index (score of 2.40), reflecting an absence of appropriate foraging and shelter habitat for the species (refer to Appendix C).

9.3 THREATS

The main threat identified for Australian painted snipe is the loss and degradation of wetlands, through drainage and diversion of water for agriculture and reservoirs (DSEWPaC 2013b, TSSC 2013b). Key and listed potential threats to the Australian painted snipe are described in Table 15 (DSEWPaC 2013b, TSSC, 2013b and references therein).

Table 15: Threats to Australian painted snipe

Threat	Description
Loss and degradation of wetlands	The main threat identified for Australian painted snipe is the loss and degradation of wetlands, through drainage and diversion of water for agriculture and reservoirs (DSEWPaC 2013b, TSSC 2013b). In particular the loss of breeding habitat in the Murray-Darling Basin has been brought about by a reduction in the frequency of flooding of previously suitable habitat, stabilisation of water levels so that wetlands become too deep or continuous reed beds develop, and changes to vegetation through cropping and possibly altered fire regimes (DSEWPaC 2013b, TSSC 2013b and references therein). These hydrological changes have been exacerbated by occurring in concert with extended drought periods (TSSC, 2013b).
Overgrazing	Overgrazing and trampling by cattle have been linked with declines in some regions, particularly in the north where grazing may be concentrated around wetlands in the dry season (DSEWPaC 2013b, TSSC 2013b and references therein).
Climate change	Climate changes and the associated reduction in rainfall and runoff in the Murray-Darling Basin may pose a threat to Australian painted snipe in the future.
Predation by feral animals	Predation by feral animals (e.g. nest predation by foxes (*Vulpes vulpes*) or cats (*Felis catus*) may be a threat to the Australian painted snipe, however there is no evidence for this.
Coastal port and infrastructure development	Coastal port and infrastructure development near the species autumn-winter sites on the central Queensland coast are a potential threat to the species.

Threat	Description
Shale oil mining	Shale oil mining near the species autumn-winter sites on the central Queensland coast is a potential threat to the species.
Invasive weeds	Replacement of wetland vegetation by invasive weeds (for example *Parkinsonia aculeata*) is a potential threat to Australian painted snipe habitat.

9.4 PROJECT IMPACTS

Table 16 outlines potential impacts to Australian painted snipe that may occur as a result of construction or operation of the Project.

Table 16: Potential impacts to the Australian painted snipe as a result of the Project

Impacts	Potential impacts associated with the Project
Recognised threats as per conservation documents	
Loss of wetlands	The Project will result in a small direct loss of potential habitat for Australian painted snipe. The mine no longer intersects Naroo Dam or the location of the previous sighting of Australian painted snipe. There are several unnamed ephemeral drainage lines on the site. This type of modified habitat is widespread throughout the local area, both on the Project site, and on surrounding properties. These ephemeral drainage lines may possibly provide habitat suitable for Australian painted snipe after periods of inundation. Two of the larger ephemeral drainage lines intersect the mine footprint, and another is crossed by the road within the Project site (see Figure 8). However, these are of marginal habitat quality and it is considered more likely that Naroo Dam would be preferred over these ephemeral drainage lines. A diversion drain will be constructed around the edge of the open cut mine pit to drain the overland flow that would have traversed through the area occupied by the open cut mine. As stated in Section 9.2.2 above, Australian painted snipe are known to utilise a wide range of habitats, including drains. As such, it is considered that the loss of the marginal ephemeral drainage line habitat, is offset by the provision of the diversion drain.
Degradation of wetlands	The Project is not expected to lead to the degradation of the wetlands. No mine affected water will be allowed to enter Naroo Dam or any of the drainage lines that run into it.
Alteration of hydrological regimes (Reduction in the frequency of flooding, stabilisation of water levels)	▶ During the ten-year life of the mine there will be a reduction in the size of the catchment for Naroo Dam. This reduction will be, at most, 11% of the catchment (in Year 10 of mining). This may, in turn result in a reduction in the amount of water in Naroo Dam. The water will be provided back in the form of make good water. This may alter the hydrological regime of Naroo Dam dependant on water demands and management practices being implemented for Naroo Dam by Rolleston operations at the time. ▶ However, the evidence from the site, as well as the literature on Australian painted snipe, suggests that the habitat for Australian painted snipe within Naroo Dam (and possibly some of the ephemeral drainage lines that flow into Naroo Dam) will become available in response to a significant rainfall event. ▶ Given this, it is not considered that a reduction of 6-11 % of the catchment would be likely to affect conditions in the dam to the point where inundation of previously dry areas would not occur in a significant rainfall event. ▶ It is also important to note that this will only occur for ten years, and at the end of the mine life there will be no reduction in the size of the catchment. As evidenced by Figure 9, Naroo Dam has been subject to varying hydrological regimes as a result of its use as mine water by Glencore mining and associated water management practices. Given that Glencore is licenced to extract an amount up to all of the water from the Naroo Dam at any time it is certainly the case that operations by Glencore's water demands, operations and management of the dam, will have a far greater influence on water

Impacts	Potential impacts associated with the Project
	levels within the Dam than the reduction in the size of the catchment due to the Project. ▶ So, while there may be alteration of hydrological regimes as a result of the Project, they are not considered to be of a nature or a magnitude that would cause a net loss of habitat for Australian painted snipe. ▶ It is also worth noting that given the usage of water in the dam for industrial purposes by Glencore, it would be incredibly difficult if not impossible to determine which of the impacts to habitat, if there were any, are from MDS activities, Glencore activities or natural conditions.
Reduction in rainfall and runoff in the Murray-Darling Basin as a result of climate change	▶ It is beyond the scope of this project and its EPBC approval to directly mitigate the impacts of climate change, however management proposals in this plan will help establish a more resilient ecosystem and habitats for EPBC species and communities.
Predation by feral animals	▶ The Project may lead to an increase in pests due to inappropriate waste management practices and edge effects. Weed and pest management plans will be implemented to mitigate any potential impacts.
Replacement of wetland vegetation by invasive weeds (for example *Parkinsonia aculeata*).	▶ The Project may lead to an increase in weeds through spread by vehicles and machinery. Additionally, altered surface water flows may carry weeds to the wetlands. A weed management plan will be implemented to mitigate any potential impacts.
Other threats	
Changes in the water quality of potential habitat areas	The Project has the potential to result in changes to the water quality of potential habitat areas such as Naroo Dam and ephemeral drainage lines. However, a mine water management system has been designed to minimise the potential impacts on the water quality downstream of the Project. The mine water management system will be undertaken in accordance with the specifications of the make good agreement with Glencore. As such, impacts on habitat due to changes in water quality are considered to be low.
Noise and vibration	▶ Should Australian painted snipe occur on site, utilisation of habitat adjacent to the Project may be reduced as a result of noise and vibration impacts from the construction and operation of the Project. Noise modelling undertaken for the Project indicates noise levels close to the Project footprint are likely to be 50dBA or greater (McCollum 2013). A review of available literature by SLR Consulting Australia (2015) indicates noise levels between 50 to 65 dBA result in occasional minor impacts on habitat use for most species while noise levels between 65 and 85 dBA may trigger and alert and alarm response. Studies indicate that noise levels over 85 dBA may result in the avoidance or abandonment of habitat by a species altogether. ▶ However, noise and vibration is unlikely to have a significant impact on Australian painted snipe as they are only likely to utilize the site when suitable conditions exist, for instance: – when hydrological regimes result in the creation of suitable habitat at Naroo Dam – after periods of inundation which may result in the creation of potentially suitable habitat in ephemeral drainage lines. ▶ Additionally, should Australian painted snipe be present, noise levels at preferred habitat areas (Naroo Dam) and marginal habitat areas (i.e. ephemeral drainage lines) are likely to be below levels that result in avoidance or abandonment of habitat.
Dust emissions	Dust emissions from the construction and/or operation of the Project may smother suitable habitat adjacent to the Project site and potentially reduce habitat quality for the Australian painted snipe.
Vehicle strike	There is a low risk of injury or mortality by vehicle strike given the preferred habitat on the Project site (Naroo Dam) does not intersect any road corridors. There is the potential risk

Impacts	Potential impacts associated with the Project
	of injury or mortality by vehicle strike where ephemeral drainage lines are located in proximity to road corridors, although it is important to note that these areas are considered only potential habitat for the Australian painted snipe and would only be utilised after significant rainfall events result in suitable habitat conditions.

10 KING BLUE-GRASS (DICANTHIUM QUEENSLANDICUM)

10.1 STATUS AND DISTRIBUTION

King blue-grass (*Dicanthium queenslandicum*) is listed as endangered under the EPBC Act and vulnerable under the Queensland NC Act. It is endemic to central and southern Queensland and has a restricted distribution where it occurs in three disjunct populations (DSEWPaC 2013c):

- Hughenden (one record)
- Nebo to Monto and west to Clermont and Rolleston
- Dalby district, Darling Downs

King blue-grass occurs within the following IBRA bioregions: South Eastern Queensland, Brigalow Belt South, Brigalow Belt North, Central Mackay Coast, Desert Uplands, Mitchell Grass Downs and Einasleigh Uplands.

10.2 SPECIES ECOLOGY

10.2.1 Species Description

King blue-grass is a perennial grass of the Poaceae family growing to 80 cm tall (Plate 13). It has erect, solitary or rarely branched culms. Culms are smooth with a single groove, 4–5-noded with nodes prominently hairy. Leaf sheaths are hairy with the hairs arising from wart-like projections. Leaf blades are 9 to 18 cm long, and 3 to 5 cm wide with the leaf-blade surface indumented (AusGrass2 2017a). Inflorescences are single racemes of paired spikelets to 10 cm long. Spikelets are sessile, bisexual, dorsally compressed, and straw-coloured to pale mauve (DSEWPaC 2013c). Companion spikelets are pedicelled with one in the cluster, male, 6 mm long and straw-coloured to pale mauve. King blue-grass flowers from November to January after sufficient rain.

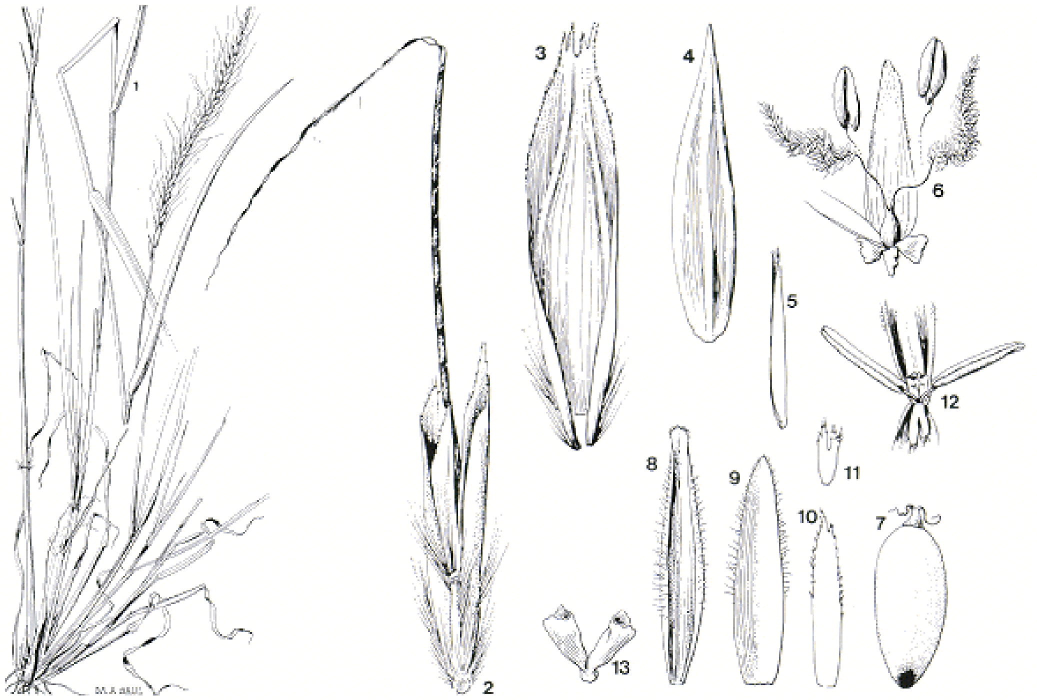


Plate 13: *Dicanthium queenslandicum* (Source: AusGrass2 2017a)

King blue-grass occurs on black cracking clay in tussock grasslands (TSSC 2013c). The species is mainly associated with other *Dichanthium* spp. and *Bothriochloa* spp., but also with other grasses restricted to this soil type.

King blue-grass is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, open downs) on undulating plains, although it can also be found in *Acacia salicina* thickets in grassland, as well as eucalypt woodlands comprising *Corymbia dallachiana*, *C. erythrophloia* and *Eucalyptus orgadophila*.

10.2.2 Known Locations within the Project site

Targeted surveys for king blue-grass were undertaken within the Project site in December 2013, focusing on the southern part of the mining lease where the greatest impacts are likely to occur (Ecosure 2013). One population of approximately 40 plants was located within a 25 m^2 area, south of Naroo Dam, in association with RE 11.8.11. Plants were in the early stages of flowering and, based on the results of the survey, additional surveys were undertaken within the Project site in February 2014 at the peak flowering time to establish more accurate distributions and population sizes (Ecosure 2013).

The 2014 survey did not identify any additional locations, outside of the existing known location, where the species occurs. However, the area of the known population was revised from 25 m^2 to 2,022.6 m^2. This area included a main population of approximately 520 plants within an area of 1,303.6 m^2, and a smaller population of approximately 30 individuals located 27 m to the west of the main population (Ecosure 2014). Species detection was also difficult in this survey due to the disarticulation of the seed heads and the presence of other grass species.

It is likely that additional specimens of king blue-grass, which were undetected during targeted surveys, are present within the Project site (Gaia 2015). On this basis, it has been assumed that king blue-grass is associated with 424 ha of natural grasslands TEC within the Project site (mapped as RE 11.8.11), of which 109.7 ha will be cleared.

The location of the known population of king blue-grass (as identified during 2013 surveys), and the extent of RE 11.8.11, is illustrated on Figure 10.

During baseline surveys undertaken in December 2017, incidental surveying was undertaken for king blue-grass (*Dichanthium queenslandicum*) as part of all habitat condition assessments and while traversing the site. From that surveying, approximately four king blue-grass tussocks were positively identified as part of habitat condition assessments at one of the sites (Site 08 – Figure 5 in Appendix C). In addition to these four tussocks, three tussocks were confirmed just outside of the Site 08 habitat condition plot.

10.2.3 Condition of Habitat within the Project site

King blue-grass individuals located within the Project site are associated with RE 11.8.11. This RE satisfies the criteria for natural grasslands TEC.

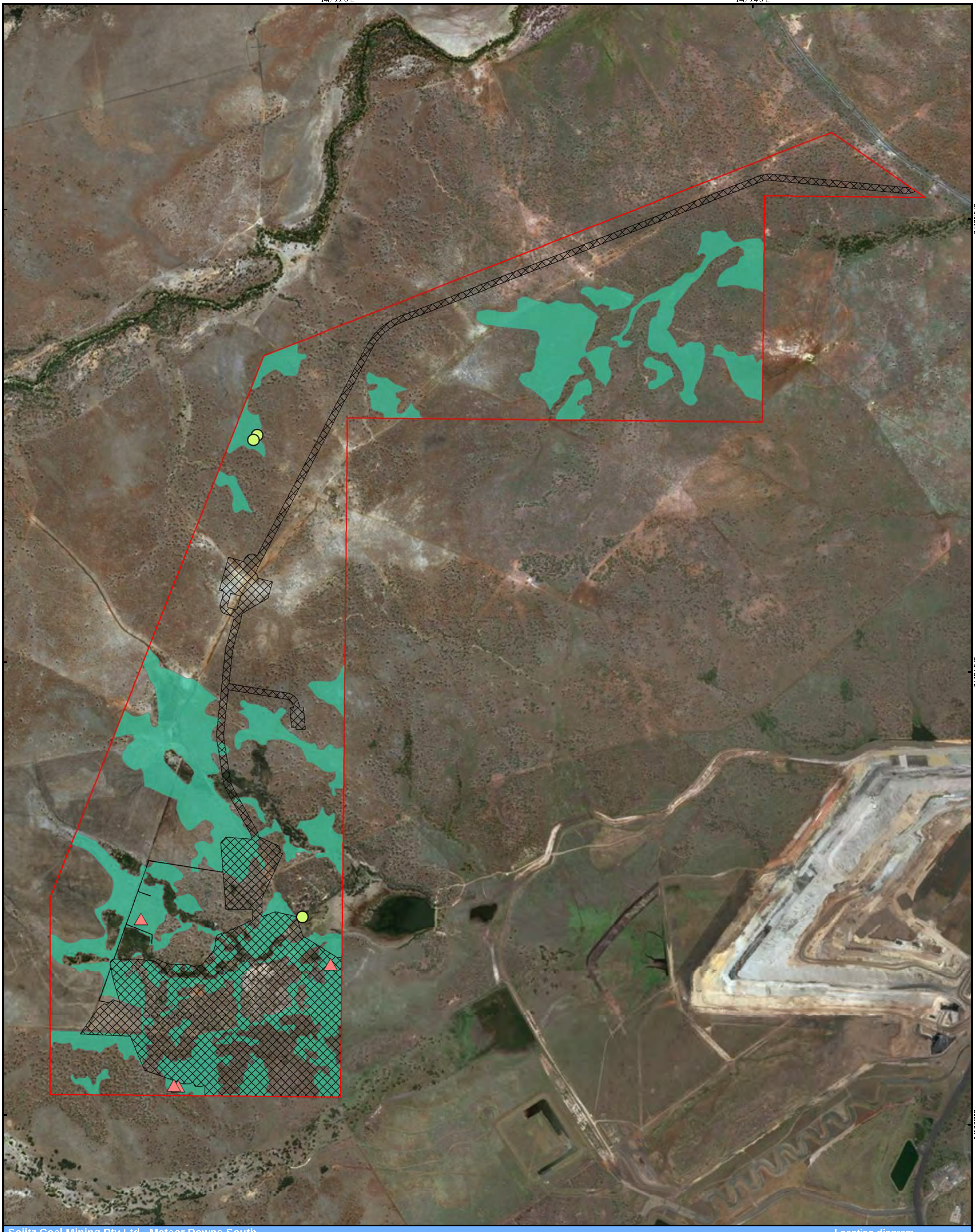
The natural grasslands TEC within the Project site are generally in good to best condition (Ecosure 2013). Condition assessments concluded that eight natural grassland TEC patches met the good condition class, and three met the best condition class.

Within the Project site, four BioCondition assessments were undertaken in RE 11.8.11. The average BioCondition score for RE 11.8.11, based on these results, is 67/100 which corresponds with a BioCondition class of 2 (Gaia 2015). Communities with a BioCondition class of 2 are classified as moderately functional.

In some patches of 11.8.11, there are signs of heavy grazing and over-sowing with exotic pasture grasses including buffel (*Cenchrus ciliaris*), bambatsi (*Panicum coloratum* var. *makarikariensis*) and Indian blue-grass

(*Bothriochloa pertusa*). Whilst buffel was found to be dense in some locations it never comprised more than 50% of the sward (Ecosure 2013).

The 2017 baseline surveys (see Appendix C), determined that king blue-grass habitat in the Project area had condition scores ranging between 6.14 and 8.05 out of 10 (average of 6.76 out of 10).



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 10
Location of known records and potential king blue-grass and bluegrass habitat within Project site

Mining Lease
Disturbance areas
Potential king blue-grass and bluegrass habitat

Confirmed records

King blue-grass (Dicanthium queenslandicum)
Bluegrass (Dicanthium setosum)

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by Sojitz
- Disturbance areas
- Ground-truthed regional ecosystem mapping (Cumberland Ecology)

0 0.5 1 1.5 2
Kilometres

N

Date: 8/04/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

Path: P:\GISData\Projects\Sojitz\911_20190322_Updated MNESMP_figures\Figure 9 - KBG and BG.mxd

10.3 THREATS

The distribution of endangered blue-grass grassland has been significantly reduced from previous known distributions, with a 64.8 % reduction in extent (TSSC 2013c). Only small remnants of blue-grass grasslands remain. The key threats to king blue-grass, as listed in the listing (TSSC 2013c) and conservation advice (DSEWPaC 2013c) and the draft national recovery plan for the bluegrass endangered ecological community (Butler 2008b), are described below in Table 17.

Table 17: Threats to king blue-grass

Threat	Description
Loss of habitat through agricultural and mining activities, road construction and other infrastructure development	Agricultural and mining activities, road construction and other infrastructure development result in the direct loss of individuals and habitat for king blue-grass (DSEWPaC 2013c).
Cultivation and crop production	Cultivation and crop production is an ongoing threat to the extent of both blue-grass grasslands and its constituent species, including king blue-grass, as it results in the conversion of native grasslands to cropping land (Butler 2008b).
Grazing and heavy stocking regimes	Although highly palatable, king blue-grass is sensitive to grazing and does not tolerate continual heavy stocking regimes (TSSC 2013c). With persistent heavy grazing of bluegrass grasslands, dominant perennial plants, such as king blue-grass, are eliminated in favour of annual species, particularly weeds (TSSC 2009b).
Invasive species (weeds)	Invasion from weeds such as a parthenium (*Parthenium hysterophorus*) and parkinsonia (*Parkinsonia aculeata*) is a known threat to king blue-grass (DSEWPaC 2013c). Weed species such as these threaten the species habitat (i.e. bluegrass grassland). Some weeds, including exotic grasses, are disturbance dependent for establishment but aggressively dominate sites following invasion (TSSC 2013c).

10.4 PROJECT IMPACTS

Table 18 outlines potential impacts to king blue-grass that may occur as a result of construction or operation of the Project.

Table 18: Potential impacts to king blue-grass as a result of the Project

Impacts	Potential impacts associated with the Project
Recognised threats as per conservation documents	
Loss of habitat through mining activities and road construction	The Project will result in the removal of 109.7 ha of potential habitat for the king blue-grass. A total of 314.2 ha of potential habitat for king blue-grass will be retained in the Project site. Approximately 550 individuals have been recorded in the Project site. These individuals are located within the Project footprint and will be directly impacted during the construction of the Project.
Invasive species (weeds)	Increased movements of vehicles, machinery and people could result in the introduction and/or spread of weeds throughout the Project site. If weeds are not appropriately controlled and managed this could result in the degradation of habitat for king blue-grass. Additionally, disturbance associated with Project activities may result in the invasion of weeds in areas of intact natural grasslands which provide habitat for the king blue-grass.
Other threats	

Impacts	Potential impacts associated with the Project
Dust	Dust emissions from the construction and/or operation of the Project may smother king blue-grass and its habitat adjacent to the Project site.
Pest animals	Increase in pest animal numbers and/or introduction of new invasive animal species through Project construction and operation (e.g. poor mine site waste management practices) has the potential to impact on king blue-grass through increased grazing of native plants and soil disturbance.

11 BLUEGRASS (DICANTHIUM SETOSUM)

11.1 STATUS AND DISTRIBUTION

Bluegrass (*Dicanthium setosum*) is listed as vulnerable under the EPBC Act and least concern under the Queensland NC Act. Bluegrass is known to occur in Queensland and New South Wales. In Queensland it has been reported from the Leichhardt, Morton, North Kennedy and Port Curtis regions, and occurs in the Mistake Range, in Main Range National Park, and possibly on Glen Rock Regional Park, adjacent to the national park (TSSC 2012). It occurs within the following Queensland bioregions: Brigalow Belt, Cape York Peninsula, Desert Uplands, Einasleigh Uplands, North West Highlands and South East Queensland bioregions. In New South Wales it is found on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes, extending west to Narrabri.

11.2 SPECIES ECOLOGY

11.2.1 Species Description

Bluegrass is a perennial grass, of the Poaceae family, that grows up to 1 m in height (Plate 14). Culms are erect, 2 to 4 noded and mid-culm nodes are usually bearded. The leaf sheaths are glabrous, except near the junction with the blade. The ligules are less than 1 mm long. Leaf blades are 7 to 15 cm long, and 2 to 3.5 mm wide with the leaf-blade surface scaberulous or scabrous, glabrous or indumented (AusGrass2 2017b). Racemes (1 to 2) are 3.5 to 8 cm long. Spikelets are sessile, 5 to 6 mm long. Companion spikelets are pedicelled with one in the cluster, male and 5 to 5.5 mm long.

The species commences growing in spring and becomes dormant in late autumn. Flowers are densely hairy and clustered together along a stalk in a cylinder shape, and they typically appear during the summer months (TSSC 2012). Bluegrass can form pure swards or occur as scattered clumps.

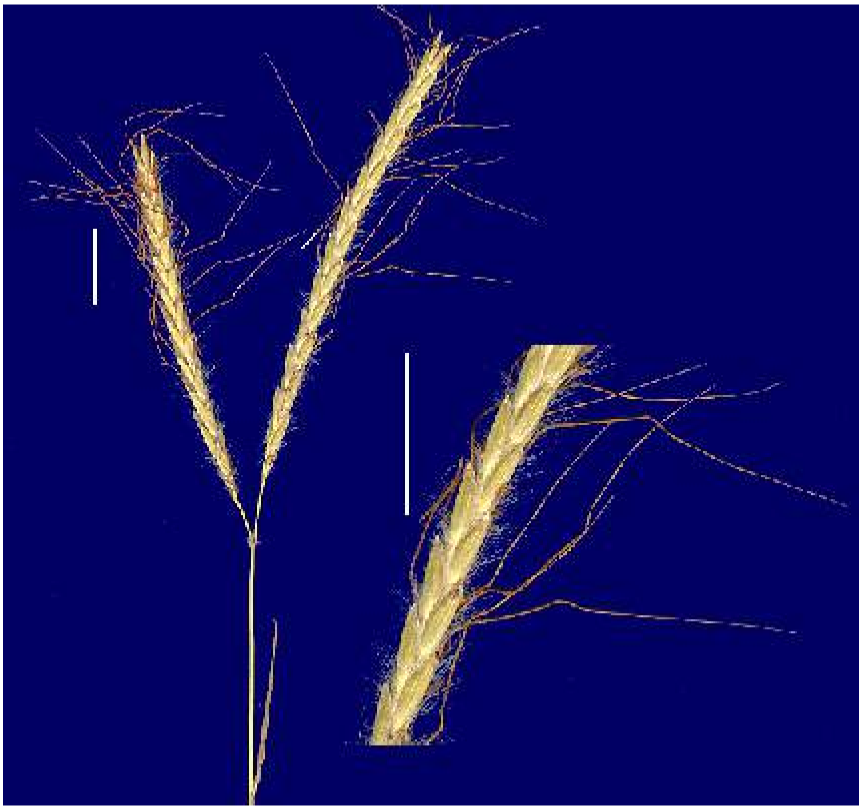


Plate 14: *Dicanthium setosum* (Source: AusGrass2 2017b)

Bluegrass occurs in heavy soils (predominantly cracking clays or alluvium, often in gilgai) in woodland or open woodland usually dominated by *Acacia* and/or *Eucalyptus* species, but also with species such as *Eremophila debilis, Aristida ramosa*, *Themeda triandra*, *Bothriochloa* spp., *Brachyscome* spp., *Vittadinia* spp. and *Wahlenbergia* spp. The species is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture.

11.2.2 Known Locations within the Project site

Targeted surveys for bluegrass were undertaken within the Project site in December 2013, focusing on the southern part of the mining lease where the greatest impacts are likely to occur (Ecosure 2013). Approximately five individuals, suspected to be bluegrass, were identified, adjacent to Naroo Dam.

As the survey was undertaken early in season, additional surveys were undertaken within the Project site in February 2014. These additional surveys did not reveal any additional locations where the species may occur within the Project site, and no additional individuals were recorded (Gaia 2015).

The individuals recorded in the 2013 survey are associated with RE 11.8.11 which is directly adjacent to an area of RE 11.3.3a (Gaia 2015). The location of the suspected population of bluegrass, and the extent of RE 11.8.11, is illustrated on Figure 10.

It is likely that additional bluegrass individuals, which were undetected during targeted surveys, are present within the Project site (Gaia 2015). On this basis, it has been assumed that bluegrass is associated with 424 ha of natural grasslands TEC within the Project site (mapped as RE 11.8.11), of which 109.7 ha will be cleared.

During baseline surveys undertaken in December 2017, incidental surveying was undertaken for and bluegrass as part of the habitat condition assessments and while traversing the site. No bluegrass individuals were recorded during these incidental surveys.

11.2.3 Condition of Habitat within the Project site

Bluegrass individuals located within the Project site are primarily associated with RE 11.8.11. This RE satisfies the criteria for natural grasslands TEC.

The natural grasslands TEC within the Project site are generally in good to best condition (Ecosure 2013). Condition assessments concluded that eight natural grassland TEC patches met the good condition class, and three met the best condition class.

Within the Project site, four BioCondition assessments were undertaken in RE 11.8.11. The average BioCondition score for RE 11.8.11, based on these results, is 67/100 which corresponds with a BioCondition class of 2 (Gaia 2015). Communities with a BioCondition class of 2 are classified as moderately functional.

In some patches of 11.8.11, there are signs of heavy grazing and over-sowing with exotic pasture grasses including buffel (*Cenchrus ciliaris*), bambatsi (*Panicum coloratum* var. *makarikariensis*) and Indian blue-grass (*Bothriochloa pertusa*). Whilst buffel was found to be dense in some locations it never comprised more than 50% of the sward (Ecosure 2013).

The 2017 baseline surveys (see Appendix C), determined that bluegrass habitat in the Project area had condition scores ranging between 6.14 and 6.71 out of 10 (average of 6.43 out of 10).

11.3 THREATS

The key threats to bluegrass, as listed in the conservation advice (DEWHA 2008b), are described below in Table 19. It is not known whether these are known, past, current or future threats, and it is also unknown the extent to which the species tolerates disturbance.

Table 19: Threats to bluegrass

Threat	Description
Grazing	Bluegrass is at threat from heavy grazing associated with trampling, browsing and grazing by domestic stock (DEWHA 2008b), particularly when grazing is conducted during the growing season (i.e. when plants are fertile).
Loss of habitat through clearing for pasture improvement and cropping	Cultivation and crop production is an ongoing threat to the extent of both bluegrass grasslands as it results in the conversion of native grasslands to cropping land (Butler 2008b).
Fire	Bluegrass is at threat from frequent fires, especially regular burning for agricultural purposes. A fire frequency of greater than five years is considered appropriate for the species (DEWHA 2008b).
Invasive species (weeds)	Bluegrass is at threat from invasion by introduced grasses such as such as Coolatai grass (*Hyparrhenia hirta*), lippia (*Phyla canescens*) and African lovegrass (*Eragrostis curvula*) (DEWHA 2008b).
Road widening	Widening of roads and maintenance activities (or other infrastructure or development activities as appropriate) results in the direct loss of habitat for bluegrass.

11.4 PROJECT IMPACTS

Table 20 outlines potential impacts to bluegrass that may occur as a result of construction or operation of the Project.

Table 20: Potential impacts to bluegrass as a result of the Project

Impacts	Potential impacts associated with the Project
Recognised threats as per conservation documents	
Fire	Construction and operation of the Project has the potential to increase fire hazards and fire risk (e.g. storage of fuel, waste laydown areas and scrap tyre storage areas). Bluegrass habitat may be degraded, and individual plants destroyed through increased fire frequency, as a result of the Project.
Invasive plants	Increased movements of vehicles, machinery and people could result in the introduction and/or spread of weeds throughout the Project site. If weeds are not appropriately controlled and managed this could result in the degradation of habitat for bluegrass. Additionally, disturbance associated with Project activities may result in the invasion of weeds in areas of intact natural grasslands which provide habitat for the bluegrass.
Road widening	Access tracks and roads associated with the Project have been designed to avoid habitat for bluegrass as much as practicable. Only a small area of potential habitat will be impacted by the road alignment, this impact area is included in the total disturbance of 109.7 ha.
Other threats	
Loss of habitat	The Project will result in the removal of 109.7 ha of potential habitat for bluegrass. A total of 314.2 ha of potential habitat for bluegrass will be retained in the Project site. Construction of the Project will not have a direct impact on the five potential specimens of bluegrass that were identified adjacent to Naroo Dam.
Dust	Dust emissions from the construction and/or operation of the Project may smother bluegrass and its habitat adjacent to the Project site.
Pest animals	Increase in pest animal numbers and/or introduction of new invasive animal species through Project construction and operation (e.g. poor mine site waste management practices) has the potential to impact on bluegrass through increased grazing of native plants and soil disturbance.

12 MITIGATION, MANAGEMENT AND MONITORING

The overarching objectives to be achieved through the implementation of this management plan, and the associated performance criteria related to each objective are presented in

Table 21. Based on the potential Project impacts on each MNES as discussed in the sections above, Table 22 outlines the measures that will be undertaken to mitigate, manage and monitor the impacts of the Project on MNES, and achieve the objectives for habitat management.

Habitat management objectives, performance criteria, management and monitoring activities have been developed based on field surveys and in accordance with the key threats and recommended priority actions for each species and community as listed in recovery plans, threat abatement plans and conservation advices.

Table 21: Objectives for habitat management and performance criteria

1. Limit or avoid loss of MNES/ habitat for MNES.	▶ Clearing of MNES/ habitat for MNES does not occur outside of the Project footprint and does not exceed the disturbance limits detailed in Table 1 of this management plan. ▶ No clearing of Brigalow TEC**.** ▶ No net loss of habitat for the Australian painted snipe. ▶ No loss of permanent water sources for the squatter pigeon, in particular Naroo Dam. ▶ Known king blue-grass and bluegrass specimens located outside of the Project footprint will not be cleared as a result of the Project. ▶ Rehabilitation of disturbed areas, namely the mine pit and overburden areas, to native ecosystems.
2. Prevent the decline of habitat quality for retained habitat within the Project site.	▶ Maintain or improve habitat quality score in areas of retained MNES/ habitat for MNES, in relation to baseline scores.
3. Minimise risk of weed introduction and/or spread in areas of MNES/ habitat for MNES.	▶ No new weed species are established in areas of MNES/ habitat for MNES based on baseline data. ▶ No spread of existing weed infestations as determined during baseline surveys.
4. Reduce degradation of MNES/ habitat for MNES by pest animals and reduce potential predation of squatter pigeon and Australian painted snipe by pest animals.	▶ Reduction in pest animal numbers in areas of MNES/ habitat for MNES below baseline levels. ▶ No new pest animal species are established in areas of MNES in comparison to baseline data.
5. Minimise impact of dust deposition on MNES/ habitat for MNES as a result of the construction and/or operation of the Project.	▶ Dust deposition must not exceed 120 mg per square metre per day, averaged over one month when measured at any sensitive receptor.
6. Minimise degradation of MNES/ habitat for MNES as a result of increased risk of fire due to Project activities and management actions.	▶ No uncontrolled fire within the Project site. ▶ If required, controlled burns in RE 11.8.11 (natural grasslands TEC, potential blue grass and king blue-grass habitat) occur at an interval greater than 5 years. ▶ If required, controlled burns in RE 11.8.5 and 11.8.15 (squatter pigeon habitat) occur every 6 – 10 years. ▶ No controlled burns within Brigalow TEC.
7. Minimise degradation of habitat for the Australian painted snipe and squatter pigeon as a result of changes to water quality in Naroo Dam.	▶ Water quality does not exceed trigger levels set out in Table F8 of the Project's EA, at any of the monitoring sites listed in Table F7 of the Project's EA.
8. Minimise noise and vibration impacts in areas of squatter pigeon and Australian painted snipe habitat.	▶ When measured, noise and vibration levels do not exceed criteria set out in Tables D1 and D2 of the Project EA.
9. Minimise potential for mortality or injury to squatter pigeons and Australian painted snipe as a result of the construction and operation of the Project (e.g. from clearing activities, vehicle strikes etc.).	▶ No mortalities or injuries of squatter pigeons or Australian painted snipes as a result of the construction and operation of the Project (e.g. from clearing activities, vehicle strikes etc).

Table 22: Mitigation, management and monitoring requirements for MNES

	Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
1.	Limit or avoid loss of MNES/ habitat for MNES.	Clearing of MNES/ habitat for MNES does not occur outside of the Project footprint and does not exceed the disturbance limits detailed in Table 1 of this management plan.	▶ Mapping of MNES within the Project site is provided in Figure 5 to Figure 10 (excluding Figure 9) and in Appendix C of this MNESMP. This mapping (and associated GIS shapefiles), will be provided to clearing personnel and/or contractors prior to the commencement of clearing operations. ▶ A permit to disturb must be initiated and signed off by the site Environmental Representative prior to any vegetation clearing. ▶ Any conditions listed in the permit to disturb must be implemented. For example, clearing extents will be clearly marked and any vegetation or areas to be protected adjacent to the Project footprint will barricaded (for example using safety bunting, pegs or mesh safety fences). ▶ Areas to be cleared will be restricted to the minimum area necessary for the construction and operation of the Project. ▶ Temporary stockpile sites for soil and equipment, access routes, laydown yards and other associated infrastructure will be in cleared areas and will not be situated in areas of MNES. ▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures. ▶ All vegetation clearing operations are to be monitored for compliance by a suitably qualified person.	▶ The Environmental Representative will monitor and record the total area of MNES habitat cleared by the Project every quarter and assess compliance with the actual disturbance limits detailed in Table 1 of this management plan. ▶ Auditing of the permit to disturb system will be undertaken quarterly to ensure all disturbance has been undertaken in accordance with the requirements of this MNESMP and the site Environmental Management System (EMS), and to ensure no unauthorised disturbance has occurred.	Clearing of MNES/ habitat for MNES occurs outside of the Project footprint and/or exceeds disturbance limits detailed in Table 1 of this management plan.	Step 1: Contingency Planning ▶ Should clearing of MNES/ habitat for MNES occur outside of the Project footprint and/or exceed actual disturbance limits detailed in Table 1 of this management plan, clearing works are to cease immediately and DoEE will be notified of the incident within five business days. The incident will be recorded in the Project's environmental and incident reporting system. ▶ Following clearing, the area will be assessed by a suitably qualified ecologist/expert within 15 business days, and appropriate corrective actions will be outlined in a contingency plan and provided to the DoEE. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan and approved by DoEE will be implemented. ▶ Potential corrective actions may include: - rehabilitation of habitat for MNES - provision of an offset.
		No clearing of Brigalow TEC.	▶ Mapping of Brigalow TEC within the Project site is provided in Figure 5 and in Appendix C of this MNESMP. This mapping (and associated GIS shapefiles), will be provided to clearing contractors and/or personnel prior to the commencement of clearing operations. ▶ Clearing of Brigalow TEC will not be permitted. ▶ All other site clearing can only be undertaken in accordance with the authorised permit to disturb. ▶ Prior to vegetation clearing, the extent of Brigalow TEC will be clearly marked or barricaded to prevent/minimise vehicle/machinery access (for example using safety bunting, pegs or mesh safety fences). ▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures.	During construction and operation of the Project the Environmental Representative will undertake quarterly visual inspections of the Brigalow TEC within the Project site.	Clearing of Brigalow TEC.	Step 1: Contingency Planning ▶ If clearing of Brigalow TEC occurs, clearing is to cease immediately and DoEE notified of the incident within five business days. Incident is recorded in the Project's environmental and incident reporting system. ▶ Following clearing, the area is to be assessed by a suitably qualified ecologist/expert within 15 business days, and appropriate corrective actions will be detailed in a contingency plan and provided to the DoEE. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions

Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
		▶ All vegetation clearing operations are to be monitored for compliance by a suitably qualified person.			▶ The appropriate corrective actions identified in the contingency plan and approved by DoEE will be implemented. ▶ Potential corrective actions may include: - rehabilitation of the TEC - provision of an offset.
	– No net loss of habitat for the Australian painted snipe.	▶ The mine does not intersect with Naroo Dam, which is the preferred habitat area for Australian painted snipe on the Project site. ▶ A 50 m exclusion zone has been applied to the maximum dam capacity edge. ▶ Water flows into Naroo Dam will be maintained by diverting overland flows around the mine into the dam, through the construction of a diversion drain. ▶ The mine does not exceed 11% of the catchment for Naroo Dam. Whilst this may result in a reduction in the amount of water in Naroo Dam, U & D have entered into a Make Good Agreement with Glencore which ensures that make good water is delivered directly into Naroo Dam and ensures that water does not fall below critical storage level. ▶ The loss of marginal ephemeral drainage line habitat (i.e. two of the larger ephemeral drainage lines intersect the mine footprint, and another is crossed by the road within the Project site), is offset by the provision of the north diversion drain. ▶ The diversion drain will be designed to maximise benefits to the Australian painted snipe including the provision of micro-habitat features and the ability for ponding, noting species habitat requirements described in Section 9.2.2. ▶ The size of the Naroo Dam catchment will be restored at the end of the mine life.	The availability of habitat for the Australian painted snipe will be monitored in accordance with the methodology set out in Section 13.5.	Reduction of habitat from baseline or subsequent monitoring event.	Step 1: Contingency Planning ▶ Should there be a reduction in Australian painted snipe habitat from baseline surveys or a subsequent monitoring event, the source of the reduction will be investigated immediately after a trigger has been exceeded. ▶ If the reduction is related to Project activities, a contingency plan will be developed by a suitably qualified ecologist/expert within 15 business days. The contingency plan will include appropriate corrective actions. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. These may include: - Review of the Make Good Agreement, and the process for the provision of water to Naroo Dam. - Alteration of diversion drain design. - Additional measures to increase the availability of habitat for Australian painted snipe at the Project site.
	– No loss of permanent water sources for the squatter pigeon, in particular Naroo Dam.	▶ The mine footprint does not directly impact permanent water sources on the Project site. ▶ The mine footprint does not exceed more than 11% of the catchment for Naroo Dam. ▶ Water flows into Naroo Dam will be maintained by diverting overland flows around the mine into the dam, through the construction of a diversion drain. ▶ U & D have entered into a Make Good Agreement with Glencore which ensures that make good water is delivered directly into Naroo Dam and ensures that water does not fall below critical storage level. ▶ No other permanent water sources will be indirectly impacted by the Project.	Water level monitoring of Naroo Dam will be in accordance with the methods outlined in Section 13.12.	Loss of permanent water sources.	Step 1: Contingency Planning ▶ Should there be a loss of permanent water sources, the cause will be investigated immediately after the trigger has been exceeded. ▶ If the loss is related to Project activities, a contingency plan will be developed by a suitably qualified ecologist/expert within 15 business days, and appropriate corrective actions will be outlined in a contingency plan and provided to the DoEE. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed.

Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
					Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. ▶ These may include: - Review of the Make Good Agreement, and the process for the provision of water to Naroo Dam. - Alteration of diversion drain design. - Provision of additional permanent watering points suitable for use by the squatter pigeon.
	– Known king blue-grass and bluegrass specimens located outside of the Project footprint will not be cleared as a result of the Project.	▶ Prior to disturbance targeted surveys will be undertaken for king blue-grass and bluegrass in areas of retained Natural Grassland TEC within 500 m of the Project footprint. These searches will be undertaken by suitably qualified ecologists in accordance with the methodology outlined in Section 13.5. ▶ Prior to disturbance, the location of any known king blue-grass and bluegrass specimens outside of the Project footprint will be clearly marked or barricaded (using for example, safety bunting, pegs or mesh safety fences). ▶ Should additional king blue-grass and bluegrass specimens be identified outside of the Project footprint, at any time during construction and/or operation of the Project, these areas will be clearly identified on site maps and clearly marked if close to the Project footprint. ▶ Clearing outside of the Project footprint will not be permitted. ▶ All other site clearing can only be undertaken in accordance with the authorised permit to disturb. ▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures.	During construction and operation of the Project the Environmental Representative will undertake biannual visual inspections of the location of known king blue-grass and bluegrass specimens outside of the Project footprint.	Known king blue-grass and bluegrass specimens (identified during baseline and targeted surveys) which occur outside of the Project footprint are cleared.	Step 1: Contingency Planning ▶ If known king blue-grass and bluegrass specimens located outside of the Project footprint are cleared, clearing is to cease immediately and DoEE will be notified of the incident. It will be recorded as an incident in the proponent's environmental and incident reporting system. ▶ Following clearing, the area will be assessed by a suitably qualified ecologist/expert and appropriate corrective actions will be detailed in a contingency plan and provided to the DoEE. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. ▶ Clearing will not re-commence unless agreed to by DoEE. Step 2: Implementation of Corrective Actions ▶ Corrective actions will be dependent upon the extent and nature of the incident. Potential corrective actions may include: - Rehabilitation of the impacted area. ▶ The appropriate corrective actions identified in the contingency plan and approved by DoEE will be implemented.
	– Rehabilitation of disturbed areas to native ecosystems, namely the mine pit and overburden areas.	▶ The Project's EA (Appendix A) sets out the conditions for progressive rehabilitation of the Project site. ▶ Rehabilitation will establish specified self-sustaining natural vegetation and habitats. ▶ Section 15 of this management plan outlines the progressive rehabilitation process proposed, which includes: - Topsoil recovery - Regrading - Drainage construction	As outlined in Section 15, U&D will develop and implement a Rehabilitation Monitoring Program which will focus on completion criteria appropriate to the specific post mining land use.	Rehabilitation fails to meet the rehabilitation indicators and completion criteria set out in Section 15	Step 1: Contingency Planning ▶ Should rehabilitation fail to meet objectives, indicators and completion criteria, the reasons for failure will be investigated. ▶ Within 20 business days of a trigger being exceeded, a contingency plan will be developed by a suitably qualified ecologist to address the reason for failure and identify appropriate corrective actions. ▶ The contingency plan will include an implementation schedule for the identified

	Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
			- Topsoil spreading - Seed bed preparation - Seeding, fertilizing and other amelioration - Selection of native seed mixes endemic to the Project site and surrounds, and representative of pre-clearing vegetation communities.			corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. These may include: - Repair of erosion areas. - Supplementary planting of tube-stock. - Additional seeding of key native flora species if required. - Repair of drainage structures.
2.	Prevent the decline of habitat quality for retained habitat within the Project site.	– Maintain or improve habitat quality score in areas of retained MNES/ habitat for MNES, in relation to baseline scores.	▶ Areas of MNES/ habitat for MNES adjacent to the Project footprint will be clearly marked or barricaded during clearing operations (for example using safety bunting, pegs or mesh safety fences). ▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures. ▶ No clearing to be undertaken within areas of retained MNES. ▶ No unauthorised access into areas of for MNES. ▶ Vehicles and other machinery to be driven on designated access tracks only. ▶ Pest animals and weeds will be managed in accordance with the Weeds will be managed in accordance with the Project's weed management plan and pest management plan. ▶ Implementation of dust suppression techniques in accordance with the CMSHA and the CMSHR. ▶ Maintenance of existing fences.	▶ Annual habitat quality assessments will be undertaken in areas of MNES in accordance with the methodology outlined in Section 13.1 and Appendix C.	The habitat quality score in areas of retained MNES falls below the baseline habitat quality score.	Step 1: Contingency Planning ▶ Should there be a decline in the habitat quality scores, the cause of the decline (i.e. failed management action, breach of protocols, external factor from surrounding landscape) will be investigated. ▶ Should the decline in the habitat quality score be found to be attributable to Project related activities or activities undertaken by the proponent, a contingency plan will be developed by a suitably qualified ecologist within 20 business days. The contingency plan will include appropriate corrective actions. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ Corrective actions identified in the contingency plan will be implemented. Depending on the cause of the decline in habitat quality score, potential corrective actions may include: - Rehabilitation of MNES or provision of an offset. - Provision of further environmental awareness training to workers regarding access restrictions in areas of MNES. - Increasing the frequency and intensity of pest animal and weed control measures or revising the type of measures to be implemented. - Increasing the frequency of dust suppression techniques, particularly during dry and windy conditions. - Repair of damaged fences, or installation of new fencing.

	Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
3.	Minimise risk of weed introduction and/or spread in areas of MNES/ habitat for MNES.	▶ No new weed species are established in areas of MNES/ habitat for MNES based on baseline data. ▶ No spread of existing weed infestations as determined during baseline surveys.	▶ Weeds will be managed in accordance with the Project's weed management plan. The weed control plan will be developed by suitably qualified ecologists, with implementation commencing within six months from commencement of construction. The plan will include the following: ▶ Detailed control measures as recommended by the Queensland Department of Agriculture and Fisheries to eradicate where possible, or otherwise reduce the extent of weeds. ▶ A site induction program that provides information to staff, contractors and visitors on weed control issues. ▶ Systems for requiring all earthmoving equipment brought onto site to be thoroughly washed down prior to arriving at site and inspected on arrival to ensure all spoil and plant matter has been removed. ▶ Targeted weed control/eradication measures that will benefit MNES within the Project Area. As a minimum, control actions will target the following weed species (if present) which pose a threat to MNES: - Brigalow TEC: exotic pasture grasses including buffel grass, Rhodes grass, green panic grass. - Natural grassland TEC: parthenium (*Parthenium hysterophorus*), parkinsonia (*Parkinsonia aculeata*), prickly acacia (*Acacia nilotica* subsp. *indica*), buffel grass, Columbus grass (*Sorghum* x *almum*), Rhodes grass, and green panic (*Megathyrsus maximus*). - King blue-grass: parthenium (*Parthenium hysterophorus*) and parkinsonia (*Parkinsonia aculeata*). - Bluegrass: Coolatai grass (*Hyparrhenia hirta*), lippia (*Phyla canescens*) and African lovegrass (*Eragrostis curvula*). ▶ An integrated weed control program including where possible and effective the combination of fire management, biological, chemical and mechanical removal with consideration of suitability for each MNES.	▶ Weed surveys will be undertaken within the Project site every two years using the methodology detailed in Section 13.8 and Appendix C.	▶ Outbreak of a weed species that has not been previously recorded in the Project site, respective to baseline surveys. ▶ An increase in the mean cover score of weed species from baseline and/or previous monitoring event.	Step 1: Contingency Planning ▶ The cause of an increase in weed cover or presence of new weed species will be investigated. This will involve reviewing adherence to weed management plan and an analysis of distribution of weeds within the Project site to identify likely and/or recurrent incursion sources. ▶ Based on this review a contingency plan will be developed by a suitably qualified ecologist within 20 business days. The contingency plan will include appropriate corrective actions. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. ▶ Potential corrective actions may include: - Amending weed hygiene restrictions. - Increasing the frequency of weed control efforts. - Investigating and implementing alternative weed management control actions. - Updating the weed management plan.
4.	Reduce degradation of MNES/ habitat for MNES by pest animals and reduce potential predation of squatter pigeon and Australian painted snipe by pest animals.	Reduction in pest animal numbers in areas of MNES/ habitat for MNES below baseline levels. No new pest animal species are established in areas of MNES in comparison to baseline data.	▶ Pest animals will be managed in accordance with the Project's pest management plan which will be developed by suitably qualified ecologists. Implementation of the plan will commence within six months from commencement of construction. ▶ Pest management actions detailed in the pest management plan will focus on rabbits, feral pigs, foxes and cats as these pests have been	Monitoring of pest animal activity in areas of MNES/ habitat for MNES will be undertaken using the methodology detailed in Section 13.7 and Appendix C Potential predation of squatter pigeon and Australian painted snipe	▶ An observed increase in the abundance of (or signs of) pest animals in areas of MNES above baseline levels. ▶ Observation of (or signs of) a pest animal species not identified during the baseline surveys.	Step 1: Contingency Planning ▶ Investigate potential sources or reasons that may have attributed to an increase in pest animal abundance or species (e.g. mine site waste management practices increasing predator prey and predators), or reasons for predation of squatter pigeon or Australian painted snipe.

	Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
			identified on site and pose a potential threat to MNES and their habitat. However, should any additional pests be identified, these will also be included in the pest management plan as required. ▶ Pest management will include a combination of shooting, trapping, fencing and baiting in line with best practice guidelines. ▶ The pest management plan will include requirements for: - Appropriate waste management. - Reporting framework to ensure sightings of pest animals are recorded. - Site induction program to include information on pest animal control issues and reporting on pest animals seen during construction and operation activities.	will also be assessed during habitat condition assessments as outlined in Section 13.3.	▶ Evidence of predation of squatter pigeon or Australian painted snipe by pest animals.	▶ Review adherence to pest management plan. ▶ Within 20 business days, a contingency plan which includes appropriate corrective actions to manage increase in pest animals will be developed by a suitably qualified ecologist. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. ▶ Potential corrective actions may include: - Increasing the frequency and intensity of pest animal control. - Revising the type of invasive pest animal control in accordance with Queensland Department of Agriculture and Fisheries (DAF) guidelines and coordinate with neighbouring land owners to ensure a consistent approach. - Incorporation into the weed and pest animal management plan and implementation of control strategies for any new pest animals recorded on site.
5.	Minimise impact of dust deposition on MNES/ habitat for MNES as a result of the construction and/or operation of the Project.	– Dust deposition must not exceed 120 mg per square metre per day, averaged over one month when measured at any sensitive receptor.	▶ Dust suppression for coal mining operations in Queensland is governed by the CMSHA and the CMSHR. ▶ Dust and dust suppression of mine roads is prescribed in Section 129 of the CMSHR which states that a surface mine must have a standard procedure for maintaining and watering mine roads. ▶ Speed limits on mine roads for vehicles, mobile plant and equipment is regulated under the CMSHA and CMSHR. ▶ In addition to the rigorous requirements under the CMSHA and CMSHR, the following dust suppression measures will be implemented: - Minimise disturbed areas by limiting clearing to what is necessary. - Progressively rehabilitating disturbed areas. - Removal and dumping of overburden as soon as practicable after blasting (i.e. minimising drying time by retaining as much inherent moisture as possible). - Restrict vehicle access, other than mining machinery on overburden dumps.	▶ Monitoring of dust deposition levels will be undertaken in accordance with the Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited Matter – Gravimetric method, as outlined in Section 13.10. ▶ Monitoring of dust deposition will also include regular visual inspection of vegetation adjacent to the Project footprint, as described in Section 13.1.	▶ When measured at any sensitive receptor, dust deposition levels exceed the guideline of 120 mg per square metre per day, averaged over one month. ▶ Visual inspections of vegetation adjacent to the Project footprint indicate visible signs of dust deposition.	Step 1: Contingency Planning ▶ Dust will be managed in accordance with Conditions B3 and B4 of the EA., if dust deposition levels exceed the trigger value of 120 mg per square metre averaged over one month, the proponent is required to investigate whether the exceedance is a result of the Project and notify the administering authority of the exceedance within seven days. ▶ Should an exceedance of dust deposition levels be found to be attributable to Project related activities, a contingency plan will be developed by a suitably qualified expert within 20 business days. The contingency plan will involve a review of adherence to, and an assessment of the effectiveness of dust suppression techniques. Appropriate corrective actions will be included in the contingency plan. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed.

	Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
						Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. ▶ Depending on the cause of the exceedance, potential corrective actions may include: - Increasing the frequency of dust suppression techniques, particularly during dry and windy conditions. - Shut down and cover up policy in extreme dry or windy conditions. - Installation of speed limit signage along internal roads. - Lowering speed limits on internal roads.
6.	Minimise degradation of MNES/ habitat for MNES as a result of increased risk of fire due to Project activities and management actions.	No uncontrolled fire within the Project site. If required, controlled burns in RE 11.8.11 (natural grasslands TEC, potential blue grass and king blue-grass habitat) occur at an interval greater than 5 years. If required, controlled burns in RE 11.8.5 and 11.8.15 (squatter pigeon habitat) occur every 6 – 10 years. No controlled burns within Brigalow TEC.	▶ Fire management for coal mining operations in Queensland is governed by the CMSHA and the CMSHR. ▶ One of the major hazards identified to coal mine workers present during coal mining operations is fire and the CMHSR prescribes both prevention, preparedness and management of fire hazards for surface and underground mines. ▶ These prescriptions are detailed in Section 37 of the CMSHR, which details amongst other things that a Safety and Health Management System (SHMS) must provide for the following at the mine (where mine is defined as the Mining Lease tenure as a whole): - Fire prevention and control - An effective firefighting capability - The safety of persons fighting fires - A risk assessment to identify all potential fire hazards at the mine. ▶ The system must also provide for the following: - The availability at the mine, at all times, of equipment that is appropriate and sufficient to extinguish any potential fire identified in the risk assessment - The location of portable fire extinguishers on or near equipment and installations identified as potential fire hazards by the risk assessment - The compatibility, throughout the mine, of all fire-fighting equipment. ▶ The coal mine must have a standard operating procedure for action to be taken when a fire is discovered at the mine.	▶ Compliance with the SHMS will be monitored in accordance with the requirements of the CMSHA. ▶ Biomass monitoring for fire management will be undertaken in accordance with the methodology outlined in Section 13.9.	▶ An uncontrolled fire occurs. ▶ Biomass monitoring indicates risk of fire due to increased fuel loads. ▶ A controlled burn in RE 11.8.11 occurs in a five-year period. ▶ A controlled burn in RE 11.8.5 and 11.8.15 occurs at a frequency greater than once every 6-10 years. ▶ A controlled burn occurs within Brigalow TEC. ▶	▶ If an uncontrolled fire occurs within the Project site: - The Emergency Response Plan will be enacted, and contingency actions undertaken will be recorded. - Any required changes to fire management as a result of the incident will be in accordance with the requirements of the CMSHA and CMSHR and will be incorporated into the SHMS. ▶ If biomass monitoring indicates that there is a risk of an uncontrolled fire occurring: - The fuel control measures will be assessed within 20 business days by a suitably qualified ecologist. - If suggested by a suitably qualified ecologist, a controlled burn or strategic grazing regime may be implemented to reduce fuel loads. - Weed management measures may be modified if deemed suitable by a qualified ecologist. ▶ If a controlled burn occurs outside of the specified frequencies: - The cause of the exceedance in frequency will be investigated. - Any required changes to fire management as a result of the incident will be in accordance with the requirements of the CMSHA and CMSHR and will be incorporated into the SHMS.

	Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
			▶ Fire management of the site will consider appropriate fire management regimes for the vegetation type including: - no fires in areas of Brigalow TEC - controlled burns in RE 11.8.11 (natural grasslands TEC, potential blue grass and king blue-grass habitat) occur at an interval greater than 5 years - controlled burns in RE 11.8.5 and 11.8.15 (squatter pigeon habitat) occur every 6 – 10 years. ▶ Fuel loads will be minimised through weed control as specified in the weed management plan. ▶ Weed management actions will target high biomass exotic grasses (e.g. buffel grass).			
7.	Minimise degradation of habitat for the Australian painted snipe and squatter pigeon as a result of changes to water quality in Naroo Dam.	– For each quarterly monitoring event, water quality does not exceed the water quality specifications detailed in the make good agreement.	No dirty or contaminated water will be permitted to enter Naroo Dam.	Water quality monitoring of Naroo Dam will be in accordance with the methods outlined in Section 13.12.	Water quality exceeds water quality specifications detailed in the make good agreement	Step 1: Contingency Planning ▶ Should water quality exceed specifications detailed in the make good agreement, the source of the change in water quality will be investigated. ▶ If the change is related to Project activities, a contingency plan will be developed by a suitably qualified expert within 20 business days. The contingency plan will include appropriate corrective actions. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented in accordance with the make good agreement
8.	Minimise noise and vibration impacts in areas of squatter pigeon and Australian painted snipe habitat.	– When measured, noise and vibration levels do not exceed criteria set out in Tables D1 and D2 of the Project EA.	▶ All plant and equipment will be regularly serviced and maintained to minimise machinery noise. ▶ All engine covers will be kept closed while equipment is operating. ▶ Blasting will only occur between 7am and 6pm.	Noise and vibration monitoring will be undertaken in accordance with the methods outlined in Section 13.11.	When measured, noise and vibration levels exceed criteria set out in Tables D1 and D2 of the Project EA.	Step 1: Contingency Planning ▶ Should noise and vibration levels exceed the criteria set out in the Project EA: - The source of the exceedance will be investigated. - If the source of the noise or vibration exceedance is attributable to Project activities, a contingency plan will be developed by a suitably qualified expert within 20 business days. The contingency plan will include appropriate corrective actions. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for

	Objectives for habitat management	Performance Criteria	Management and Mitigation Measures	Monitoring	Trigger for Further Action	Contingency Response and Corrective Actions
						delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. ▶ These may include: - Plant and equipment found to produce excessive noise will be removed from site or stood down until repairs can be made.
9.	Minimise potential for mortality or injury to squatter pigeons and Australian painted snipe as a result of the construction and operation of the Project (e.g. from clearing activities, vehicle strikes etc).	– No mortalities or injuries of squatter pigeons or Australian painted snipes as a result of the construction and operation of the Project (e.g. from clearing activities, vehicle strikes etc).	▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures, and identification of squatter pigeons and Australian painted snipe. ▶ At least one qualified fauna spotter catcher will be present during clearing activities. ▶ A wildlife carer will be called to collect any injured fauna. ▶ Speed limits (60 km/hour) will be set and enforced on all internal roads. ▶ Vehicle movements will be restricted in areas of squatter pigeon and Australian painted snipe habitat.	All personnel will be required to be report any interactions between vehicles/machinery and wildlife, in particular squatter pigeon and the Australian painted snipe, in the Project site.	Injury or mortality of a squatter pigeon or Australian painted snipe.	Step 1: Contingency Planning ▶ Should there be a recorded injury or mortality of a squatter pigeon or Australian painted snipe as a result of Project activities, the cause of the injury or mortality will be investigated, and a contingency plan will be developed within 20 business days by a suitably qualified ecologist. ▶ The contingency plan will include an implementation schedule for the identified corrective actions, as the timeframes for delivery will be dependent on the corrective actions proposed. Step 2: Implementation of Corrective Actions ▶ The appropriate corrective actions identified in the contingency plan will be implemented. ▶ These may include: - Lowering speed limits. - Restricting access to areas of known habitat.

13 MONITORING METHODS

13.1 MONITORING OBJECTIVES

U&D commits to implementing a monitoring program that provides for ‘early control’ and ‘early warning’ functions to enable U&D to demonstrate that management actions are effective and make timely decisions on corrective actions to ensure performance criteria are achieved. In broad terms this will be achieved through the implementation of monitoring methods that are:

- Specific to the performance criteria being assessed. The results of the monitoring program will determine whether the performance criteria have been met, or whether corrective actions need to be implemented. For example, dust monitoring involves the measurement of dust deposition levels. If the results of this monitoring indicate that levels are below 120 mg per square metre per day, averaged over one month then the performance criteria have been achieved and no further action is required.
- Quantitative and repeatable. The data collected will be able to be compared between monitoring events which will allow any changes to be detected. Monitoring will be undertaken prior to the commencement of the Project to establish a baseline against which the results of future monitoring can be compared against.

The overarching objectives of the monitoring program are to:

- evaluate performance of the MNESMP against performance criteria
- identify triggers for further action
- develop contingency plans and corrective actions if required
- capture learnings from plan implementation and assess the effectiveness of the management framework
- inform subsequent reviews and amendments to the MNESMP.

13.2 GENERAL SITE INSPECTIONS

General site inspections of retained MNES vegetation and habitat will be undertaken at least biannually to assess:

- condition of fencing
- incidence of erosion of access tracks
- condition of firebreaks
- signs of land degradation
- signs of dust deposition on vegetation located adjacent to the Project footprint
- locations of known king blue-grass and bluegrass specimens outside of the Project footprint
- any additional risks to MNES (i.e. evidence of vehicle strike).

13.3 HABITAT CONDITION ASSESSMENTS

Baseline habitat condition assessments were undertaken in December 2017. Subsequent assessments will be undertaken annually, and during the same season, for the life of the Project.

Ten permanent habitat monitoring points were established as part of the baseline assessments (Appendix C). These sites are described in Table 23 below and presented on Figure 11 (northern site) and Figure 12 (southern site). The number and location of monitoring points for habitat condition assessments is based on the requirements of the Guide to Determining Terrestrial Habitat Quality (GTDTHQ) (DEHP 2017), which itself is based on the methodology set out in the BioCondition Assessment Manual and BioCondition benchmarks (Eyre *et. al.* 2015), as developed by the Queensland Herbarium.

Through the application of the GTDTHQ, a habitat quality score is calculated for each MNES based on three key indicators:

- site condition: a general condition assessment of vegetation compared to a benchmark
- site context: an analysis of the site in relation to the surrounding environment
- species habitat index: the ability of the site to support a species

includes targeted fauna surveys for Australian painted snipe and squatter pigeon (undertaken in accordance with the Survey Guidelines for Australia's Threatened Birds (DEWHA 2010)) and Incidental surveys for king blue-grass and bluegrass (habitat quality scores for these threatened flora species will be calculated according to the method outlines in the baseline monitoring report, Appendix C).

Data from habitat condition assessments will be recorded in survey sheets and these will be attached to annual monitoring reports.

Table 23: Monitoring site locations and purpose

Site	Habitat monitoring						Photo monitoring	Weed monitoring	Pest animal monitoring			
	Brigalow TEC	Natural Grasslands TEC	King blue-grass	Bluegrass	Squatter pigeon	Australian painted snipe			Rabbit plot	Feral pig plot		Camera trap – cats, foxes, dogs etc.
01					✓		✓	✓	✓			
02		✓	✓	✓			✓	✓	✓			
03					✓		✓	✓	✓			
04		✓	✓	✓			✓	✓	✓			
05					✓		✓	✓	✓			
06		✓	✓	✓			✓	✓	✓			
07	✓						✓	✓	✓			
08		✓	✓	✓			✓	✓	✓			
09						✓	✓	✓	✓			
10					✓		✓	✓	✓			
11 – 20							✓	✓				
P01 – P08										✓		
T01 – T20												✓

13.4 PHOTO MONITORING

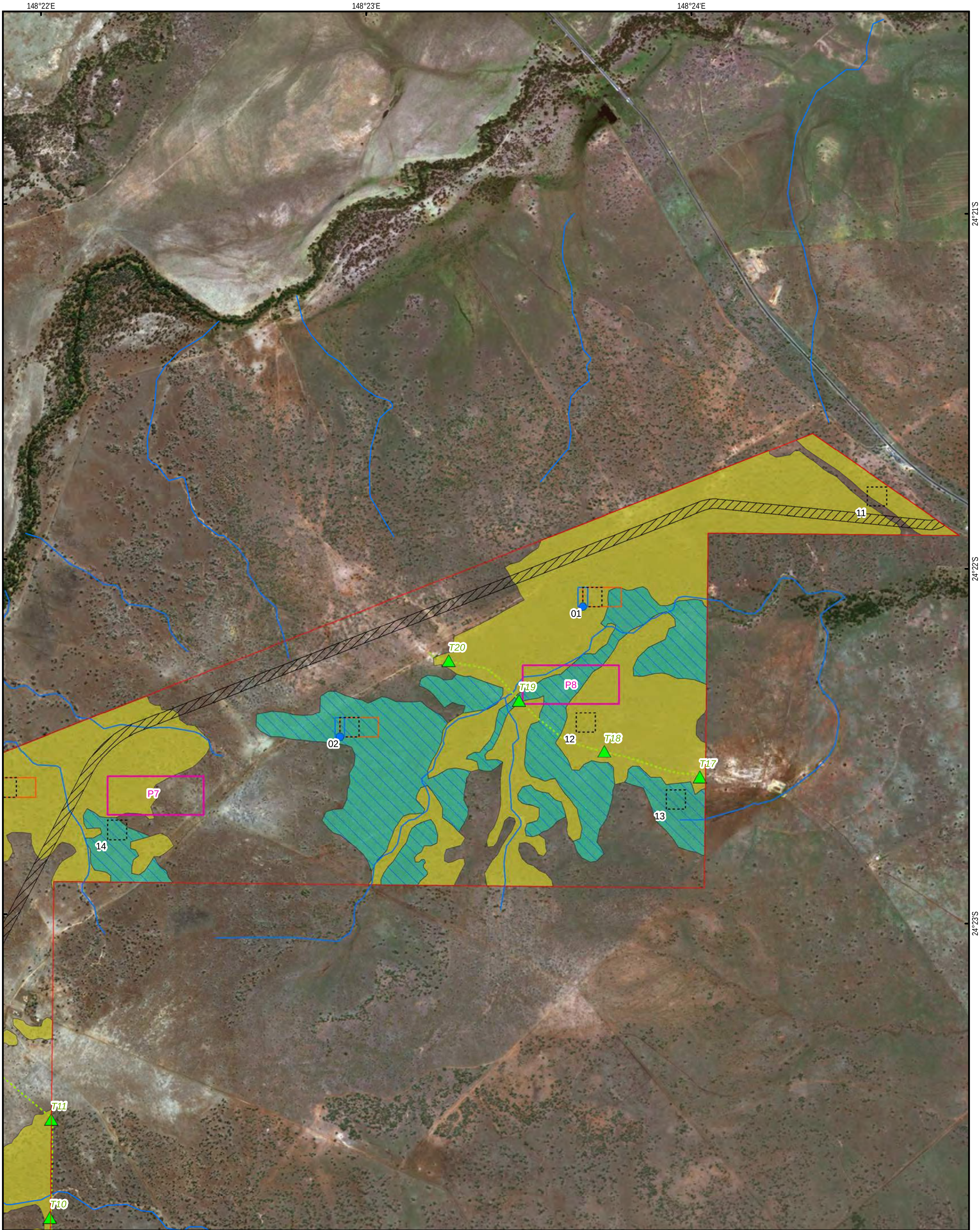
Photo monitoring will be undertaken at each monitoring location identified in Table 23 to enable visual assessment of habitat changes over time.

Photo monitoring will be undertaken at the same time as habitat condition assessments (see Section 13.1), that is, prior to construction and then annually for the life of the Project. Appendix C includes photo monitoring pictures taken during the 2017 baseline surveys.

Photos at each photo monitoring point will be taken in a north, east, south and westerly direction. Consideration should be made with respect to which aspect would best capture the change in vegetation. If the area is sloped, the photo monitoring point should be positioned either at the top or the bottom of the slope. Wherever possible, a permanent feature should be included within the photo frame such as a large tree, tree stump or fence line. This will ensure that the exact frame of the photo can be captured each time a photo is taken and will also assist with making comparisons between photos over time.

A record of the photographs will be maintained, including GPS co-ordinates, date and time of each photograph, the direction in which the photograph was taken, and the height above the ground at which the photograph was taken.

Data from photo monitoring will be recorded in survey sheets and these will be attached to annual monitoring reports.



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Figure 11
Habitat, weed and pest animal monitoring - north

- Mining Lease
- Disturbance areas
- Watercourse
- Habitat for King blue-grass and bluegrass
- Habitat for squatter pigeon
- Brigalow TEC
- Natural Grassland TEC
- Habitat for Australian painted snipe
- Habitat monitoring site
- Habitat monitoring transect
- Weed monitoring plots
- Rabbit monitoring plots
- Pig monitoring plots
- Pest animal camera trap tracks
- Pest animal camera trap (TBD)

0 0.25 0.5 0.75 1
Kilometres

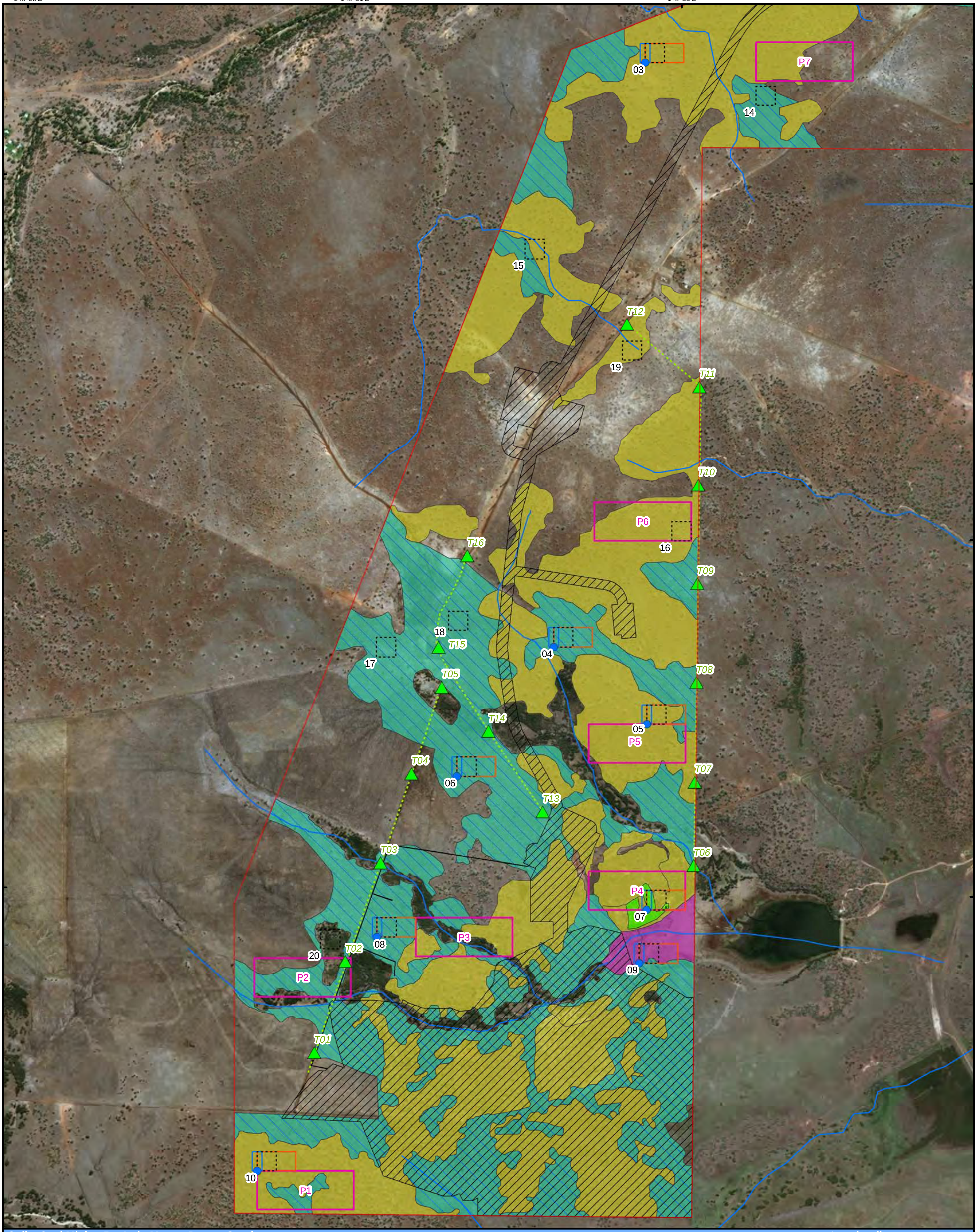
N

Location diagram

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by Sojitz
- Disturbance areas
- Ground-truthed regional ecosystem mapping (Cumberland Ecology)

Date: 22/03/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:17,500@A3

Path: P:\GISData\Projects\Sojitz\911_20190322_Updated MNESMP_figures\Figure 13 - Monitoring points north.mxd



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 12
Habitat, weed and pest animal monitoring - south

- Mining Lease
- Disturbance areas
- Watercourse
- Habitat for King blue-grass and bluegrass
- Habitat for squatter pigeon
- Brigalow TEC
- Natural Grassland TEC
- Habitat for Australian painted snipe
- Habitat monitoring site
- Habitat monitoring transect
- Weed monitoring plots
- Rabbit monitoring plots
- Pig monitoring plots
- Pest animal camera trap tracks
- Pest animal camera trap (TBD)

0 0.25 0.5 0.75 1
Kilometres

N

CO2 Australia

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by Sojitz
- Disturbance areas
- Ground-truthed regional ecosystem mapping (Cumberland Ecology)

Date: 22/03/2019 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:17,500@A3

Path: P:\GISData\Projects\Sojitz\911_20190322_Updated MNESMP_figures\Figure 14 - Monitoring points south.mxd

13.5 TARGETED SURVEYS FOR KING BLUE-GRASS AND BLUEGRASS

Targeted surveys will be undertaken by suitably qualified ecologists for king blue-grass and bluegrass in areas of retained Natural Grassland TEC within 500 m of the Project footprint. These surveys will be undertaken with reference to the methods detailed in the Queensland Department of Environment and Heritage Protection Flora Survey Guidelines – Protected Plants (DEHP 2016). Baseline surveys will be undertaken prior to the commencement of construction with subsequent surveys to be undertaken annually.

13.6 HABITAT AVAILABILITY FOR AUSTRALIAN PAINTED SNIPE

Monitoring of habitat availability for Australian painted snipe will be undertaken every two years, preferably during the wet season, or following a large rainfall event and will include:

- systematic surveying by traversing Australian painted snipe habitat areas (where possible) with the aim of detecting by sight or by flushing
- quantification of the area of Australian painted snipe habitat.

Quantification of the area (in hectares) of Australian painted snipe habitat will involve the calculation of the following:

- Shallow water foraging habitat – calculated as the area of open water habitat (on the lease and adjacent lease).
- Muddy substrate foraging habitat – calculated as 10 m buffer adjacent open water habitat (on the lease and adjacent lease).
- Area of appropriate shelter habitat – calculated as areas of rank emergent tussocks of grass, sedges, rushes or reeds, samphire, clumps of lignum, *Muehlenbeckia*, canegrass or *Melaleuca* within 50 m of the boundary of open water habitat.

13.7 PEST ANIMAL MONITORING

Pest animal monitoring will be undertaken to monitor and manage pest animal activity in the Project site. Monitoring will be undertaken in accordance with the methods outlined below.

The surveys undertaken in December 2017 (see Appendix C) provided a baseline against which the results of ongoing monitoring will be compared against.

Ongoing surveys will be undertaken every two years, consisting of a survey during the dry season and a survey post wet season. If trigger levels for any pest animal species are met or exceeded, then biannual monitoring will occur in conjunction with appropriate management measures until pest animal presence reduces to baseline levels or below.

Pest animals will also be opportunistically surveyed throughout the year outside of monitoring times, including observations for potential new pest animal species that have not been previously recorded within the Project site, and which are known to impact and degrade the MNES that are addressed in this management plan. Pest animal monitoring will also include observations to identify any evidence of predation of squatter pigeon and Australian painted snipe by pest animals.

Pest animal monitoring sites are identified on Figure 11, Figure 12, and also in Appendix C.

RABBITS (*ORYCTOLAGUS CUNICULUS*) AND EUROPEAN HARES (*LEPUS EUROPAEUS*)

Assessments of rabbit/hare impacts will be undertaken in accordance with Cooke et al (2008). Ten randomly stratified, permanent monitoring points have been established as part of baseline assessments (see Appendix C) and a 2-ha area will be traversed for 15 to 20 minutes assessing:

- Rabbit abundance – a measure of the presence and number of rabbit warrens and the abundance of any faecal pellets (including 'buck-heaps' or latrines) – measured on a scale of 0 – 5
- Seedling abundance – a measure of the presence and abundance of native vegetation seedlings encountered during the 15-20-minute traverse – measured on a scale of 0 – 5
- Rabbit damage – a measure of seedlings (< 0.5 m height) with evidence of rabbit damage, identified as 45˚ 'secateurs-like' cuts through smaller stems, defoliation and gnawing of bark – measured on a scale of 0 – 5.

From this assessment, a 'corrected regeneration score' is calculated from the seedling abundance and rabbit damage score.

As illustrated in Figure 13, overall rabbit impact is assigned as one of three categories – 'acceptable', 'monitor closely' or 'unacceptable', as determined from a combination of the score for rabbit abundance and the corrected regeneration score.

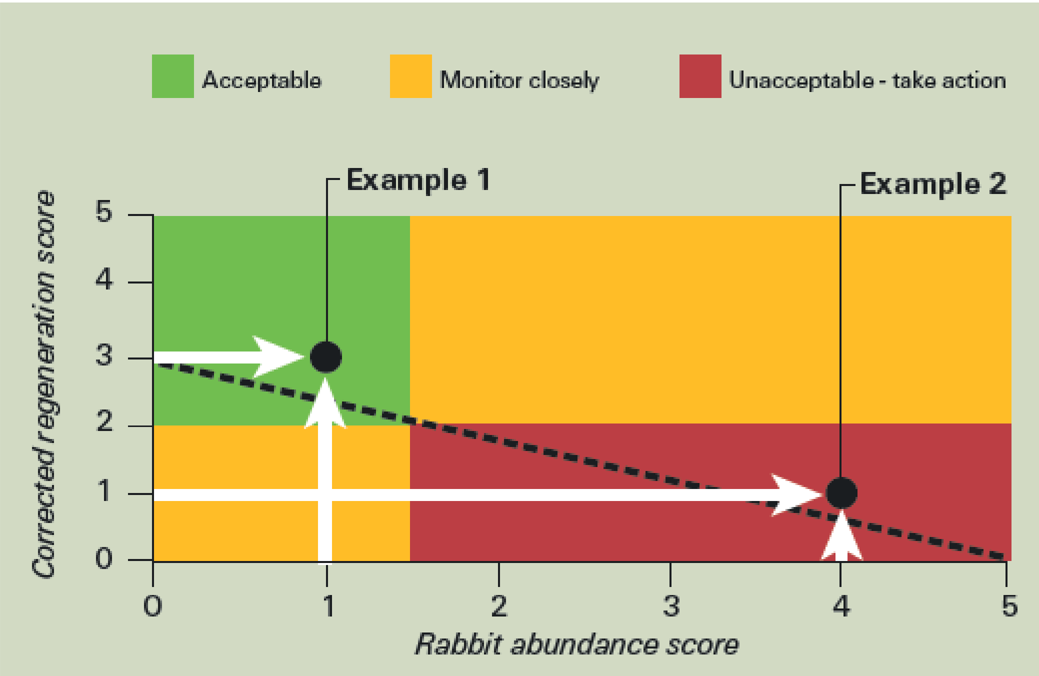


Figure 13: Assessing overall rabbit impact

FOXES (*VULPES VULPES*) AND CATS (*FELIS CATUS*)

Initially, the proposed method of monitoring of pest animal activity was for track counts, based on a modified version of Mitchell and Balogh (2007a) and Fleming et al (1996), whereby track stations are identified and covered with a thin layer of sand in which animal tracks can be identified and counted. However, during the 2018 annual MNESMP monitoring campaign, sand tracks were found to be time consuming to establish and maintain, as well as unreliable following rain or windy conditions when any tracks captured were obscured/erased. Further, tracks were often ambiguous and difficult to attribute to a species. Therefore, in place of sand tracks, camera traps will be established at each of the 20 pest animal monitoring sites. These are quicker to establish, more reliable during adverse weather and enable greater certainty in identification.

An assessment of pest animal presence/activity based on a modified version of Mitchell and Balogh (2007a) and Fleming et al. (1996), will be undertaken as follows:

- select sites to be monitored, along access tracks. At least 15 camera trap stations are required, to be operable across the offset site for at least three nights
- record the location of camera trap stations on GPS so that future surveys can be undertaken at the same locations
- convert to indices via the percentage of station nights with confirmed photographic encounters (Catling index).

FERAL PIGS (*SUS SCROFA*)

An assessment of the presence or absence of feral pig signs as a measure of feral pig activity in accordance with Mitchell and Balogh (2007b) and Hone (1988), will be undertaken as follows:

- at the eight randomly stratified, permanent 0.5 km x 0.3 km sites across the Project area as decided during baseline surveys and depicted in Appendix C
- at each site, randomly select the start location of 0.5 km transects, and record locations via GPS
- traverse in an east-west direction, surveying for the presence of any feral pig signs 1 m either side of the transect in every 50 m section
- calculate an abundance score for each transect as the percentage of 'present' feral pig signs from the 10 sections along the 0.5 km transect
- calculate the mean abundance score (and variance) across all transects in the Project site. If the variance exceeds 20% of the mean, more sites/transects are required.

Repeat surveys will be undertaken from permanently established transects. The average frequency of occurrence across the Project site can be used as an index of abundance and change over time. Furthermore, changes to scores for individual sites/transects can point to areas to target control activities.

Feral pig signs can include rooting, wallows, dung, footprints, travel pads, plant damage and tree rubs, as well as the physical presence of feral pigs.

13.8 WEED MONITORING

The distribution and density of weed infestations will be monitored across the Project site. Baseline data on the abundance and distribution of weed species within the Project Area was determined during the December 2017 surveys (see report at Appendix C). Ongoing weed surveys will be undertaken every two years, with a survey during the dry season and a survey post wet season. If trigger levels for weed cover are met or exceeded, monitoring will occur biannually in conjunction with appropriate management actions in order to reduce weed cover to baseline levels or below.

Twenty permanent 1 ha weed monitoring sites were established as part of baseline surveys (see Appendix C). The sites were located according to the following considerations:

- randomly stratified, permanent monitoring sites and incorporating natural variability such as aspect (e.g. a mix of north-, east-, south- and west-facing monitoring sites) and community type.
- permanent weed monitoring sites at strategic trafficable areas (e.g. entry gates, creek crossings, stock watering points) to monitor potential introduction and/or irruptions of prohibited and restricted weed species.

At each of the permanent weed monitoring sites, monitoring of weeds will be undertaken utilising two approaches:

- Plot-based weed transects – an assessment of weed species richness and relative abundance based on plot-based cover estimates along transects within 1 ha weed monitoring sites
- Photo monitoring – time series analysis of changes in vegetation composition, structure and integrity over time. In areas where active management is being undertaken, photo monitoring offers a simple and effective visual means by which to capture the response of the vegetation to management actions

In addition to permanent weed monitoring sites, incidental observations will be collated as part of general Project site monitoring, noting weed infestations away from permanent weed monitoring sites.

Details of the weed monitoring methodology are presented in Table 24.

Table 24: Weed monitoring methodology

Weed monitoring method	Methodology
Plot-based weed transects	An assessment of weed species richness and relative abundance, will be undertaken in accordance with the following method: ▶ at a number of randomly stratified, permanent 1 ha sites (100 m x 100 m) across the Project site in environments that are more regularly impacted by weeds (e.g. drainage lines, around swamps/lagoons etc) and high traffic areas ▶ at each site, mark out three 100 m transects (traversing in an east-west direction), keeping them parallel to one another, 50 m apart ▶ at every 10 m interval along each of the transects, centre a 2 m x 2 m plot frame and record the presence, species and cover of weeds. Weed cover at each 2 m x 2 m survey site will be reported as one of five cover classes: 1 = 0%, 2 = 0-5%, 3 = 6-25%, 4 = 26-50% and 5 = 51-100% (Auld 2009) ▶ an average cover score for each weed species for each 1 ha site will be calculated. The average cover score is calculated as the average percentage from the 30 plots surveyed from the three 100 m transects ▶ calculate the mean cover score across all weed monitoring sites in the Project site
Photo monitoring	A time-series photographic analysis to visually assess changes in vegetation composition (namely, weeds), will be undertaken as follows: ▶ at each end of the 20 plot-based weed transects, establish photo-monitoring points ▶ at each of the photo monitoring points, take five photos from 1.5 m height above ground level, namely photos facing north, east, south, west and one facing the ground. The ground shot should be chosen to give a representative indication of cover and species composition for the general area.
Incidental observations	As part of general Project site monitoring, outside of plot-based weed transects, record details (including location, species and extent) of weeds, species not previously encountered in the Project site, new weed outbreaks and areas of significantly weed cover.

13.9 BIOMASS MONITORING FOR FIRE MANAGEMENT

Biomass monitoring for fire management is required to be undertaken to determine the risk of fire within the Project site.

Biomass will be assessed at the end of each wet season. Biomass monitoring will be undertaken in accordance with the following, or a similar, methodology:

- Department of Natural Resources, Queensland GRASS Check – Grazier Rangeland Assessment for Self-Sustainability DNRQ97002, Second edition-revised methodology

Representative monitoring locations will also be re-assessed at the end of the dry season to determine if any additional fire management is required to further reduce pasture biomass to reduce the likelihood of widespread wildfire outbreaks.

13.10 DUST DEPOSITION MONITORING

Dust deposition will be monitored in accordance with the relevant conditions of the Project's EA (see conditions B1 to B4).

13.11 NOISE MONITORING

Noise and vibration generated by mining activities will be monitored in accordance with conditions D1, D2 and D3 of the Project's EA. Monitoring undertaken for the EA will ensure that noise limits are not exceeded at sensitive places. The results of noise monitoring events undertaken during a management period will be recorded in the annual report.

13.12 WATER QUALITY AND WATER LEVEL MONITIORING OF NAROO DAM

13.12.1 Environmental Authority

Water quality and water level monitoring of the Naroo Dam will be done in accordance with the EA.

13.13 MANAGING UNCERTAINTY

The management of natural systems involves uncertainty which can affect the success of the management measures in achieving the performance criteria. To manage this uncertainty an adaptive management approach has been adopted and is described in further detail Section 4.2. It is important, however, to recognise and account for potential sources of uncertainty. Williams (2011 and 2016) identifies four kinds of uncertainty:

- Environmental Variation
  - the most prevalent source of uncertainty, often the dominant influence on natural systems
  - caused by external factors that act upon natural systems, but which are not influenced by the resource conditions and dynamics (e.g. variation in rainfall or temperature may affect habitat quality scores or the availability of Australian painted snipe habitat in the Project site)
  - largely outside of the control of the manager (Williams 2011), however, its influence is considered in the analysis of the effectiveness of the management framework, and in the analysis of the ability to achieve performance criteria.
  - considered when determining the need for corrective actions or amendments to management strategies. For example, it is important to understand if the cause of the trigger for further action is attributable to Project activities or to environmental variation, prior to a decision regarding the appropriate action to be taken.
- Partial Observability
  - Partial observability includes potential uncertainty that arises from variation in the collection of data during monitoring events, and from being unable to completely observe the natural system in its entirety (Williams 2016).
  - managed in this MNESMP through the development of a monitoring program based on scientifically tested and repeatable methods. Furthermore, the persons implementing specific management and monitoring activities are required to have appropriate skills and qualifications in order to minimise the potential for variation.

- Partial Controllability
  - relates to difference between the effect of the management measures intended to be implemented as part of this MNESMP and the effect of their actual implementation on the ground (Williams 2016)
  - addressed through adherence to an adaptive management approach as outlined in Section 4.2.
- Structural or Process Uncertainty
  - concerns a lack of knowledge or understanding regarding biological and ecological processes and relationships, and differing views regarding how natural systems respond to management (Williams 2016)
  - In contrast to environmental variation, structural or process uncertainty can be reduced largely through an adaptive management approach which incorporates an iterative learning process (Williams 2016), as has been adopted in the development of this MNESMP (further aided by the use of published scientific literature, conservation advices and field data).

13.14 DATA MANAGEMENT AND RECORD KEEPING

The requirement for sound data management and record keeping is encapsulated in the conditions of the EPBC Act approval. Condition 15 of the EPBC Act approval for the Project requires U&D to maintain accurate records of all activities associated with or relevant to the conditions of approval, including this MNESMP. This includes records of the management measures undertaken as well as the results of monitoring activities. All records and data associated with the MNESMP will be made available to the Department of the Environment and Energy upon request and are subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act.

it will be the responsibility of the Project's Environmental Representative to oversee and manage all the management and monitoring activities, including compiling, storing and managing all the information and data produced in the company's central database. The Environmental Representative will be responsible for:

- adherence to the internal data and information handling systems, including data storage, protection and extraction
- data quality control
- data analysis and interpretation
- reporting and presentation of data and analysis.

13.15 MONITORING SUMMARY

A summary of monitoring activities is provided in Table 25 including the goal/s for habitat management to which the monitoring activity applies to, the parameters to be measured, applicable guidelines/methods, location, timing and an assessment of the reliability of the proposed monitoring activities.

Table 25: Summary of monitoring activities

Monitoring activity	Relevant goal for habitat management	Parameters measured	Relevant survey guidelines/methods	Location	Timing	Reliability
General site inspections	– 2. Prevent the decline of habitat quality for retained habitat within the Project site. – 5. Minimise impact of dust deposition on areas of potential habitat for MNES as a result of the construction and/or operation of the Project. – 9. Minimise potential for mortality or injury to squatter pigeons and Australian painted snipe as a result of the construction and operation of the Project (e.g. from clearing activities, vehicle strikes etc).	▶ condition of fencing ▶ incidence of erosion of access tracks ▶ condition of firebreaks ▶ signs of land degradation ▶ signs of dust deposition on vegetation located adjacent to the Project footprint ▶ any additional risks to MNES (i.e. evidence of vehicle strike).	-	All areas of retained habitat for MNES	At least biannually	Visual assessment to identify the need for any maintenance or additional management.

Monitoring activity	Relevant goal for habitat management	Parameters measured	Relevant survey guidelines/methods	Location	Timing	Reliability
Habitat condition assessments	– 2. Prevent the decline of habitat quality for retained habitat within the Project site.	Habitat condition	Guide to Determining Terrestrial Habitat Quality (DEHP 2017)	At 10 permanent habitat monitoring points (refer to Table 23, Figure 11 and Figure 12 and Appendix C)	– Annually during December	– Scientific method developed by the Queensland Herbarium. It is a quantitative and repeatable assessment procedure.
Photo monitoring	– 2. Prevent the decline of habitat quality for retained habitat within the Project site.	Habitat condition	-	At 10 permanent habitat monitoring points (refer to Table 23, Figure 11 and Figure 12 and Appendix C)	At the same time as the habitat condition assessments	Method based on best practice photo monitoring techniques.
Targeted surveys for king blue-grass and bluegrass	– 1. Limit or avoid loss of habitat for MNES.	▶ Presence of king blue-grass and bluegrass	Flora Survey Guidelines – Protected Plants (DEHP 2016)	In areas of retained Natural Grassland TEC within 500 m of the Project footprint	Annually	Scientific method developed by the Queensland DEHP
Habitat availability for the Australian painted snipe	– 1. Limit or avoid loss of habitat for MNES.	▶ Presence of the Australian painted snipe ▶ Quantification of the area of Australian painted snipe habitat	Presence to be assessed in accordance with the Survey Guidelines for Australia's Threatened Birds (DEWHA 2010).	At Naroo Dam and ephemeral drainage lines	Every two years, preferably during the wet season or following inundation event	Evidence based approach, developed based on the known ecology of the species, and method developed by the Australian government

Monitoring activity	Relevant goal for habitat management	Parameters measured	Relevant survey guidelines/methods	Location	Timing	Reliability
Pest animal monitoring	– 4. Reduce degradation of habitat for MNES by pest animals.	– Rabbit, fox and feral pig activity and other species opportunistically observed and seen in camera trap data	– Rabbits: Cooke et al (2008) – Foxes: Mitchell and Balogh (2007a) and Fleming et al (1996) – Feral pigs: Mitchell and Balogh (2007b) and Hone (1988)	At pest animal monitoring sites shown on Figure 11 and Figure 12 and in Appendix C	Every two years (surveys during the dry and post wet season)	Based on published scientific methods
Weed monitoring	– 3. Minimise risk of weed introduction and/or spread in areas of habitat for MNES.	– Weed distribution and density	– -	At weed monitoring sites shown on Figure 11 and Figure 12 and in Appendix C	Every two years (surveys during the dry and post wet season)	Based on published scientific methods.
Biomass monitoring for fire management	– 6. Minimise degradation of habitat for MNES as a result of inappropriate fire regimes.	– Fuel loads	– Queensland GRASS Check – Grazier Rangeland Assessment for Self-Sustainability DNRQ97002, Second edition-revised methodology	In all areas of retained habitat for MNES	At the end of each wet and dry season	Method developed by the Queensland Department of Primary Industries.

Monitoring activity	Relevant goal for habitat management	Parameters measured	Relevant survey guidelines/methods	Location	Timing	Reliability
Dust deposition monitoring	– 5. Minimise impact of dust deposition on areas of potential habitat for MNES as a result of the construction and/or operation of the Project.	– Dust deposition levels	– Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited Matter – Gravimetric method	At sensitive receptors	When requested by the administering authority or as a result of a complaint	Method based on a recognised Australian Standard.
Noise monitoring	– 8. Minimise noise and vibration impacts in areas of squatter pigeon and Australian painted snipe habitat.	– Noise and vibration	– -	At sensitive receptors	When measured as per requirements of the Project EA	Methods based on requirements of the Project's EA issued by the Queensland Department of Environment and Heritage Protection.
Water quality and water level monitoring of Naroo Dam	– 1. Limit or avoid loss of habitat for MNES. – 7. Minimise degradation of habitat for the Australian painted snipe and squatter pigeon as a result of changes to water quality in Naroo Dam.	– Water quality and quantity	– As per the specifications of the make good water agreement between Glencore and U&D	At Naroo Dam	Water levels: monthly Water quality: daily during the release of water from the Project and quarterly monitoring	Method based on the requirements of the make good water agreement between Glencore and U&D

14 REPORTING, COMPLIANCE AND IMPLEMENTATION

14.1 UPDATING THE MNESMP

Notwithstanding amendments made during the adaptive management process, the MNESMP will be reviewed at least every 3 years in accordance with condition 3(g) of the EPBC Act approval.

14.2 ANNUAL REPORTS

U&D will prepare an annual report on the implementation of, and adherence to, this MNESMP. The report will be provided to the DoEE by 30 June every year and will contain, (but may not be limited to) the following information:

- EPBC approval number
- Queensland Government EA number
- name and contact details of the proponent
- details of contractors or consultants who have undertaken management and monitoring activities, including skills and expertise of the responsible entity/ies
- a general description of climatic conditions for the management period
- a summary of Project construction and operation activities that occurred during the management period
- the actual impacts of the Project on MNES and their habitat
- a summary of the mitigation, management and monitoring activities, associated with this MNESMP, which were undertaken during the management period
- summary of data collected from previous monitoring events to allow an analysis of trends over time
- data and results of any monitoring events which were undertaken within the management period
- assessment of adherence to performance criteria including any instances where corrective actions were triggered and the details of any corrective actions that have been implemented
- an indication of any potential threats or risks to MNES that have become apparent since the development of the MNESMP, and mitigation and/or management measures to be undertaken to manage these threats and risks
- recommendations for revising the MNESMP including any:
  - proposed changes to mitigation and management actions
  - additional activities (including monitoring activities) to be undertaken to support the attainment of goals for habitat management
  - changes to corrective action triggers or corrective actions
  - additional risks or revisions to the risk register.

14.3 ROLES, RESPONSIBILITES AND QUALIFICATIONS

Sojitz, on behalf of U&D, will implement all elements of this plan.

Persons implementing specific management and monitoring activities described in this management plan will have appropriate skills and qualifications, as summarised in Table 26.

Where the identification of a suspected threatened species is not clear, the Queensland Museum will be the first contact for identification confirmation (via photographs and/or detailed description), followed by persons with demonstrable identifications skills for the suspected threatened species.

If injured fauna are encountered, they will be taken to the nearest qualified veterinary practitioner or wildlife carer. Animals with a poor prognosis for survival and that are suffering must be euthanised on site in accordance with the *Code of Practice: Care of Sick, Injured or Orphaned Protected Animals in Queensland*.

Table 26: Qualification requirements for persons undertaking monitoring activities

Monitoring focus	Qualifications required	Demonstrated experience required
Habitat condition assessment	More than 2 years' experience applying the GTDTHQ in the Brigalow Belt Bioregion Appropriate identification skills for each MNES	
Brigalow TEC	Ecologist/botanist	Woodland surveys
Natural grasslands TEC	Ecologist/botanist	Grass surveys
King blue-grass	Ecologist/botanist	Grass surveys
Bluegrass	Ecologist/botanist	Grass surveys
Squatter pigeon	Ecologist/ornithologist	Fauna spotter catcher Bird surveys
Australian painted snipe	Ecologist/ornithologist	Bird surveys
Feral dog	Ecologist	Pest surveys
Feral cat	Ecologist	Pest surveys
Feral pig	Ecologist	Pest surveys
Fox	Ecologist	Pest surveys
Rabbit	Ecologist	Pest surveys
Invasive weeds	Ecologist	Weed surveys

15 REHABILITATION MEASURES

The Project's EA (Appendix A) and EM Plan set out the conditions and process for rehabilitation of the Project site. The rehabilitation program will aim to restore the landform to a post-mine land use that is stable, self-sustaining and maintenance free. As outlined in the EM Plan:

- Disturbed land will be progressively rehabilitated as it becomes available.
- U&D is committed to the four general rehabilitation goals, i.e. that the rehabilitated landform be:
  - safe to humans, wildlife and stock
  - non-polluting
  - stable
  - able to sustain an agreed post-mining land use.
- The Project's rehabilitation operating philosophy is based on the following concepts:
  - design earthworks and rehabilitate to a predetermined post-mine land use
  - minimise unnecessary land disturbance
  - minimise erosion and its potential off-lease effects
  - protect downstream water quality from contaminated runoff
  - recognise and protect downstream beneficial uses (surface and groundwater)
  - on relinquishment of title, ensure the agreed post-mine land use has been reached.
- All areas significantly disturbed by mining activities will be rehabilitated to a stable landform with a self-sustaining vegetation cover.
- U&D will be responsible for ongoing maintenance of the post-mining landform in accordance with the mining lease conditions.
- Where reasonable and practicable, areas of the site where grazing is nominated as the post mine land use must include grass species endemic to the area.
- U&D will continue to research the most appropriate species mix of native trees, shrubs and grasses for revegetation and determine rehabilitation success criteria using on-site research program and relevant data from other mines. The program will include investigations into vegetation productivity, diversity, and soil fertility.
- The selection and establishment of revegetation will be complementary to nearby remnant vegetation.
- U&D will establish a Rehabilitation Monitoring Program to review progress against rehabilitation indicators and objectives and assist in formulating completion criteria.

15.1 PROGRESSIVE REHABILITATION PROCESS

U&D is committed to progressively rehabilitating areas of disturbance at the Project site wherever possible. This will include:

- topsoil recovery ahead of disturbance, with topsoil either stockpiled or, wherever possible, directly used in rehabilitation

- regrading to shape the surface of disturbed areas to conform to the final landform and proposed post mining land use
- construction of drainage features following regrading to reduce erosion and ensure stability of the landform
- topsoil to be spread over the surface of the final landform following regrading and drainage construction
- seedbed preparation involving contour ripping
- seeding, fertilising and adding other soil ameliorants as required as soon as practicable following the preparation of the seedbed
- maintenance where required, including reestablishing erosion prone areas, reseeding, supplementary planting with tube-stock, additional fertiliser or other ameliorant application and repair to drainage structures
- monitoring of rehabilitated areas to be incorporated into the site monitoring program, focusing on key indicators relevant to the proposed post-mine land uses, for example, soil properties and characteristics, soil biota, vegetation and fauna.

15.1.1 Topsoil recovery

Where topsoil has been determined as suitable for reuse in the rehabilitation program, it will be recovered ahead of disturbance and either stockpiled or, wherever possible, directly used in rehabilitation. Immediate reuse of recovered topsoil is preferable to stockpiling, as it reduces handling losses and has less impact on the integrity of the topsoil than stockpiling. However, the opportunity to directly reuse topsoil is dependent on mine sequencing and availability of rehabilitation areas within the vicinity of the topsoil recovery operation.

15.1.2 Topsoil stockpiling

In cases where topsoil stockpiling is unavoidable, stockpiles will be located as near as possible to the intended reuse destination. To protect the physical, chemical and biological integrity of stockpiled topsoil, stockpiles will be constructed in accordance with the following criteria wherever achievable:

- located clear of potential future disturbance
- located in well drained areas and placed to minimise soil loss off site and sedimentation of watercourses
- constructed to heights below 2m
- maintain irregular surface/s to encourage water infiltration
- seeded with a sterile annual cover crop where future reuse is likely to be in excess of 6 months
- clearly identifiable in the field as a topsoil resource and identified on a site register recording location, volume, soil type, date established and soil source location.

Stockpiles will be regularly inspected as part of the site internal environmental auditing process. Records will be retained on weed status, erosion status, cover crop condition, post construction disturbance and any other information relevant to the integrity of the stockpile.

Where stockpile age exceeds 12 months, additional sampling and analysis prior to spreading on rehabilitation will be undertaken. Results will be assessed against those obtained from the initial recovery operation and where necessary, subsequent changes will be made to stability and amelioration activities.

15.1.3 Regrading

Where disturbance results in elevated and or uneven sections of land, regrading will be required. Regrading involves shaping the surface of the disturbed area so that it conforms to the final landform and proposed post-mining land use.

15.1.4 Drainage construction

Once regrading is completed, constructed drainage may be required to ensure protection from erosion. For minor regrading areas, drainage would typically be incorporated as part of the regrading process. For regraded overburden dumps, significant drainage structures will be required to ensure stability of the landform.

15.1.5 Topsoil spreading

Following regrading and the construction of graded banks and rock lined waterways, topsoil will be spread over the surface of the final landform. The depth at which topsoil will be spread on rehabilitation will average in the order of 120mm, however may be up to 500mm if subsoils are also stripped and re-spread. The average spreading depth has been calculated based on available topsoil (both A and B horizons) for recovery ahead of disturbance and the surface area of the final landform requiring topsoil application.

15.1.6 Seed bed preparation

Following the spreading of topsoil on the surface of rehabilitation areas, seedbed preparation will be undertaken. Seedbed preparation will typically involve ripping along the contour using a dozer with three tynes mounted behind the machine. Ripping along the contour reduces the potential for erosion by creating a key between the topsoil and underlying material, promoting infiltration and providing a barrier to down slope runoff. During the ripping process tynes will be lifted at various distances depending on soil type to reduce the potential for channel erosion to develop within rip lines.

Seed bed preparation will be undertaken as soon as practicable following the spreading of topsoil on the rehabilitation area to minimise the potential for topsoil loss through erosion. It is noted that timing of seedbed preparation will be dependent on machinery availability, ground conditions and weather conditions.

15.1.7 Seeding, fertilizing and other amelioration

Seeding, fertilising and addition of any other soil ameliorants will be undertaken as soon as practicable following the preparation of the seedbed. Timing will be dependent upon on the selected methodology, machinery availability, ground conditions and weather conditions. There are several methods available for spreading of seed, fertiliser and other ameliorants, which include:

- direct application at the same time as seedbed preparation using appropriately modified machinery
- casting over an area of prepared seedbed using ground-based spreaders, mounted either on conventional agricultural equipment or mining machinery
- aerial application over the prepared seedbed using light aircraft.

15.1.8 Seed mix

The seed mix selected for rehabilitation will be primarily dependent on the pre-clearance native vegetation intended to be revegetated. Other factors influencing the seed mixes will be the availability of preferred species and the quality of available species. Composition of seed mixes and application rates will be progressively developed based on trials and rehabilitation success. Early seed mixes and application rates will be determined in consultation with a specialist rehabilitation consultant. Native seed mixes will reflect locally endemic species associated with the pre-clearing vegetation community.

15.1.9 Maintenance

During the establishment of vegetation on areas of rehabilitation, erosion or other factors may result in the requirement for maintenance activities. Maintenance activities may include the following:

- repair of erosion areas
- reseeding
- supplementary planting of tube-stock
- additional fertiliser or other ameliorant application on areas of poor establishment
- repair of drainage structures.

The requirement for rehabilitation maintenance will be determined through regular field inspections undertaken as part of the site internal environmental auditing process and rehabilitation monitoring results.

15.1.10 Monitoring

U&D will develop and implement a Rehabilitation Monitoring Program which will focus on completion criteria appropriate to the specific post mining land use. Undisturbed (by mining) reference sites will be included in the monitoring program to provide local data and enable progression towards rehabilitation area success to be quantified. Draft rehabilitation completion criteria for areas to be rehabilitated to native ecosystems are presented in Table 27. The program will include the following elements:

- vegetation cover
- plant density
- plant species diversity
- soil profile development
- soil erosion
- faunal colonisation.

15.2 REHABILITATION OBJECTIVES, INDICATORS AND COMPLETION CRITERIA

The *EHP Guideline EM1122 Version 1 Rehabilitation requirements for mining projects* has been taken into consideration in the development of rehabilitation criteria for the Project. Table 27 outlines the rehabilitation objectives, indicators and completion criteria for areas to be rehabilitated to native ecosystems in accordance with Appendix A of Guideline EM1122. It is noted that Table 27 is a live table and will be updated throughout the construction and operational phases of the Project, as further information relating to rehabilitation becomes available.

Table 27: Rehabilitation goals, indicators and completion criteria

Rehabilitation Goal	Rehabilitation Objectives	Indicators	Nature of Completion Criteria
Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	▶ Presence and or absence of physical risk factors which could result in injury or death. ▶ Risk assessment documentation.	▶ A Geotechnical study has been completed within 3 years prior to mine closure to confirm: – that elevated landform slopes are stable and safe – the criteria of 12 degrees (approx. 20%) for landform slopes are achievable and sustainable over the long term. – A safety assessment of elevated sections of the landform has been conducted. – Evidence that landform final landform construction has met the specified design requirements – Risk assessment relative to safety of humans, stock and wildlife completed and risk mitigation measures have been implemented in accordance with relevant guidelines and Australian Standards such as ISO 31000 Risk Management.
Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	▶ Exposure to and availability of heavy metals and other toxic material or other introduced contaminants	▶ Potential hazardous materials have been identified during mine life and removed or selected capping material has been applied with cover thickness appropriate to the contaminant. ▶ Leaching tests have been conducted to complement the analyses undertaken and reported under the Overburden Assessment section of the MDS Soils, Land, Overburden and Process Waste Study; as well as ongoing overburden and reject characterisation programs. ▶ Surface water monitoring has been conducted consistent with guidelines derived from ANZECC 2000 for the final 5 years of mine operation and for 3 years post mine operation. ▶ Local program of fire control and proscribed weeds and woody weeds control have been conducted.
Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	▶ Adequacy and long-term performance of safety barriers.	▶ Fencing and appropriate signage is in place to restrict access has been conducted. ▶ Cattle are excluded.

Rehabilitation Goal	Rehabilitation Objectives	Indicators	Nature of Completion Criteria
			▶ Where risk mitigation measures include fencing and appropriate signage around a perimeter to restrict access, these have been erected in accordance with relevant guidelines and Australian Standards.
Non-polluting	– Hazardous overburden materials adequately handled.	▶ A program of identification of hazardous and benign overburden materials.	▶ Selective burial of hazardous materials and covering of landforms with benign materials including topsoil has been conducted. ▶ If required, a selection of an appropriate "barrier layer" beneath the top capping suitable to the level of sulphides or other contaminants not removed, has been applied. ▶ Compliance with the site's Topsoil Management Plan ▶ Average broad range topsoil pH range of 6 to 9 and an Electrical Conductivity of less than 1dS/cm.
Non-polluting	– Elimination of all permanent water storages on the site outside the final void.	▶ Polluted water contained on site. ▶ Leachate and drainage control.	▶ Mine water has been transferred to the final mining void at cessation of operations. ▶ Surface and groundwater water monitoring has been conducted according to guidelines derived from ANZECC 2000 for 5 years during mine operation and for 3 years post mine operation. ▶ Minor drainage works to reinforce and consolidate natural drainage to the north of site as part of final landform have been completed. ▶ Evidence in the Rehabilitation Report, as prepared by an appropriately qualified person, that the rock lined drains have remained stable. ▶ Average broad range topsoil pH range has been achieved of 6 to 9 and an Electrical Conductivity of less than 1dS/cm with reference to the MDS Soils, Land, Overburden and Process Waste Study.
Stable	– Very low probability of subsidence or slope slippage.	▶ Design criteria. ▶ Safety assessment. ▶ Erosion rate. ▶ Slope stability.	▶ A Geotechnical study and assessment that the elevated landforms are stable and safe has been conducted by qualified entity. ▶ All elevated landforms regraded to 12 Degrees overall where possible.

Rehabilitation Goal	Rehabilitation Objectives	Indicators	Nature of Completion Criteria
			▶ Evidence provided in the Rehabilitation Report that the reshaping of elevated sections of the landform ▶ have complied with the site's final landform design criteria. ▶ Erosion rates from disturbed areas and rehabilitated areas are comparable with reference (undisturbed) areas. ▶ Evidence that the reshaping of the upper surface of the elevated landforms has been to a stable gradient to direct runoff to the rock-lined waterway and prevent gully erosion. ▶ Slopes on elevated sections of the landform are geotechnically stable enough to maintain covers constructed for containment of hazardous material and for ecosystem support.
Stable	– Landform design achieves appropriate erosion rates.	▶ Slope angle and length.	▶ All elevated sections of the landform have been graded to 12 Degrees (approximately 20%). ▶ Greater than 12 Degree slopes have been subject to a geotechnical assessment and drainage plan. ▶ Vertical intervals between slope breaks are 10m so that the length of slope will be approximately 50m. ▶ Slope breaks include a waterway and a graded bank constructed at a slope of less than 2%.
Stable	Landform design achieves appropriate erosion rates.	▶ Rate of soil loss.	▶ A benchmark erosion study has been conducted based on rainfall and sediment run- off rates in undisturbed region (to be conducted by qualified entity). ▶ Drainage points have been established approximately every 50 meters on exposed slopes. ▶ Spray-on barriers (mulch) have been applied if required. ▶ Erosion rates similar to the surrounding undisturbed region have been achieved within 3 years of cessation of mining. ▶ Results have shown that significant active erosion features are not present and that any initial erosion has been stabilised by vegetation cover;

Rehabilitation Goal	Rehabilitation Objectives	Indicators	Nature of Completion Criteria
			▶ Evidence has been included in Rehabilitation Report.
Stable	▶ Vegetation cover to minimise erosion. ▶ Resilience to Disturbance. ▶ A perennial, self-sustaining ground cover is maintained that is resilient to environmental stresses such as fire, drought and pest species is extensive enough to control erosion; and contributes to the integrity of constructed covers.	▶ Vegetation type and density.	▶ Scarification with direct seeding and fertilizer (primary grasses and legumes) has been completed. ▶ Contour ripping has been completed. ▶ Revegetation works have been implemented and standard establishment techniques have included contour deep ripping: and - Shrub species have been established; and - Tree species have been established. ▶ Desirable grass species comprise at least 60% of total grass cover. Tree density and height of >25 stems per 5ha each being >2m in height have been established. ▶ The relevant management programs and completion criteria to be implemented as part of the final rehabilitation plan as outlined in Chapter 5 of the Flora, Fauna and Freshwater Ecology Assessment Report have been conducted. ▶ Evidence of utilised revegetation techniques has been included in the Rehabilitation Report.
Sustainable land use	Soil properties to support the final land use proposed to be a self-sustaining native ecosystem comprising of local native vegetation assemblages.	▶ Physical and Chemical properties of surface materials.	▶ Testing to confirm achievement of pH in range 6.0 to 9.0. ▶ Testing to confirm achievement of Electrical Conductivity of less than 1dS/cm.
Sustainable land use	Establish specified self-sustaining natural vegetation and habitats.	▶ Presence of key species. ▶ Species type and diversity. ▶ Weeds.	▶ Environmental Audit has been conducted by qualified entity to grade success of: - Erosion mitigation program; - Vegetation program; - Water monitoring program; and - Weed management. ▶ The following species forming the vegetation communities referenced in Table 5 of "Flora, fauna and freshwater ecology assessment of the Meteor Downs South Project, near Rolleston, Central Queensland 2012"

Rehabilitation Goal	Rehabilitation Objectives	Indicators	Nature of Completion Criteria
			have been introduced into the revegetation seed mix and establishment has been attempted: - *Melaleuca bracteata;* - *Eucalyptus orgadophila;* - *Corymbia erythrophloia;* *E. melanophloia;* - *Themeda triandra;* - *Heteropogon contortus;* - *Aristida* spp; - *Chloris divaricata;* - *Iseilema vaginiflorum* - *Eucalyptus populnea; and* - *Paspalidium caespitosum.*
Sustainable land use	Establish land use with comparable management requirements to similarly used non-mined land.	▶ Initial establishment of native species to form the basis of a longer term self-sustaining native ecosystem.	▶ Baseline Land Suitability Class has been determined in accordance with Technical Guidelines for Environmental Management of Exploration and Mining Queensland (QDME 1995). ▶ Environmental audit conducted by appropriately qualified persons to: - Establish progress towards a native ecosystem; - Identify the Land Suitability Class; and - Establish adequacy and predicted long term performance of safety barriers.

16 REFERENCES

Auld, B. (2009), Guidelines for monitoring weed control and recovery of native vegetation. NSW Department of Primary Industries, Orange NSW.

AusGrass2 (2017a), *Dichanthium queenslandicum*. Available at: http://ausgrass2.myspecies.info/content/dichanthium-queenslandicum. Accessed 14 November 2017.

AusGrass2 (2017b), *Dichanthium setosum*. Available at: http://ausgrass2.myspecies.info/content/dichanthium-setosum. Accessed 14 November 2017.

Birdlife Australia, 2017, *Australian Painted Snipe.* Rostratula australis –*Rostratulidae.* Available online: http://www.birdlife.org.au/bird-profile/australian-painted-snipe. Accessed 06 November 2017.

Butler, D.W (2008a), *Recovery plan for the "Brigalow (*Acacia harpophylla) *dominant and co-dominant" endangered ecological community*. Report to the Department of the Environment and Water Resources, Canberra. Queensland National Parks and Wildlife Service, Brisbane.

Butler, D.W (2008b), Draft national recovery plan for the "bluegrass (Dichanthium spp.) dominant grasslands in the Brigalow Belt Bioregions (north and south)" endangered ecological community. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Environmental Protection Agency, Brisbane.

Central Queensland University (CQU) (2012), *Flora, fauna and freshwater ecology assessment of the Meteor Downs South Project, near Rolleston, Central Queensland*. Centre for Environmental Management.

Crome, F. and J. Shields (1992), *Parrots and Pigeons of Australia*. Angus & Robertson, Sydney.

Crome, F.H.J. (1976), Breeding, moult and food of the Squatter Pigeon in north-eastern Queensland. Australian Wildlife Research. 3:45-59.

Commonwealth of Australia (CoA) (2011), *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads*. Canberra: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-biological-effects-including-lethal-toxic-ingestion-caused-cane-toads

Commonwealth of Australia (CoA) (2014), *Threat abatement advice for predation, habitat degradation, competition and disease transmission by feral pigs (2013)*. Available from:

http://www.environment.gov.au/biodiversity/threatened/key-threatening-processes/feral-pigs

Commonwealth of Australia (CoA) (2015), *Threat abatement plan for predation by feral cats.* Canberra, ACT: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats.

Commonwealth of Australia (CoA) (2016), *Threat abatement plan for competition and land degradation by rabbits.* Canberra, ACT: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016.

Cooke, B., McPhee, S., and Hart, Q. (2008), *Rabbits: A threat to conservation and natural resources management. How to rapidly assess a rabbit problem and take action.* Bureau of Rural Sciences, Canberra.

Department of the Environment (DoE) (2013a), *Commonwealth Conservation Advice for Brigalow Ecological Community*. Department of the Environment, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/028-conservation-advice.pdf. Accessed 2 November 2017.

Department of Environment and Energy (2017a), *Species Profile and Threats Database for* Geophaps scripta scripta – *squatter pigeon (southern).* Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64440

Department of Environment and Energy (2017b), Species Profile and Threats Database. Rostratula australis — *Australian Painted Snipe.* Available online: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=77037. Accessed 02 November 2017

Department of Environment and Heritage Protection (DEHP) (2016) Flora Survey Guidelines – Protected Plants. Department of Environment and Heritage Protection (State of Queensland), Brisbane.

Department of Environment and Heritage Protection (DEHP) (2017), *Guide to determining terrestrial habitat quality.* Department of Environment and Heritage Protection (State of Queensland), Brisbane.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008a), *Threat abatement plan for predation by the European red fox*. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/foxes08.html.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008b), *Approved Conservation Advice for* Dichanthium setosum. Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/14159-conservation-advice.pdf. Accessed 14 November 2017.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008c), *Commonwealth Conservation Advice on Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin*. Department of the Environment, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/99-conservation-advice.pdf. Accessed 13 November 2017.

Department of Environment, Water, Heritage and the Arts (2010), Survey Guidelines for Australia's Threatened Birds. Canberra.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2013a), Nationally Threatened Ecological Communities: Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland, and Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin [Information Sheet]. Available from: http://www.environment.gov.au/system/files/resources/347c5d4e-cef8-411c-b53c-bed3ed1d3e1c/files/bio237-0512-natural-grasslands-guide.pdf. Accessed 10 November 2017.

Department of Sustainability, Environment, Water, Population and Communities (2013b), *Approved Conservation Advice for* Rostratula australis *(Australian painted snipe)*. Canberra: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/77037-conservation-advice.pdf.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2013c), *Approved Conservation Advice for* Dichanthium queenslandicum *(king blue-grass*). Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/5481-conservation-advice.pdf. Accessed 13 November 2017.

Ecosure (2013), Meteor Downs South – supplementary ecological surveys. A report prepared for U&D Mining.

Ecosure (2014), *Natural grasslands survey - Survey summary report*. A report prepared for U&D Mining.

Eyre T. J., Ferguson D. J., Hourigan C. L., Smith G. C., Mathieson M. T., Kelly, A. L., Venz M. F., Hogan, L. D. and Rowland, J. (2014), *Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland*. Department of Science, Information Technology, Innovation and the Arts, Queensland Government, Brisbane.

Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. (2011), *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.1*. Department of Environment and Resource Management (DERM), Biodiversity and Ecosystem Sciences, Brisbane.

Eyre, T. J., Kelly, A. L, Neldner, V. J., Wilson, B. A., Ferguson, D. J., Laidlaw, M. J. and Franks, A. J. (2015), *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2*. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts (State of Queensland), Brisbane.

Fleming, P. J. S., Thompson, J. A., Nicol, H. I. (1996*). Indices for measuring the efficacy of aerial baiting for wild dog control in north-eastern New South Wales*. Wildlife Research 23: 665-674.

Frith, H.J. (1982*), Pigeons and Doves of Australia.* Melbourne: Rigby.

Gaia Environmental Consulting (Gaia) (2015), *Meteor Downs South Coal Mining Project EPBC Act Offsets Strategy (March 2015)*. A report prepared for U & D Mining Pty Ltd.

Hone, J. (1988). Feral pig rooting in a mountain forest and woodland. Distribution, abundance and relationships with environmental variables. Australian Journal of Ecology 13: 393-400.

McCollum Environmental Management Services (McCollum) (2013). *Meteor Downs South Environmental Management Plan*. A report prepared for Endcoal Limited.

Mitchell, B. and Balogh, S. (2007a). *Monitoring techniques for vertebrate pests – wild dogs*. NSW Department of Primary Industries, Orange NSW.

Mitchell, B. and Balogh, S. (2007b). *Monitoring techniques for vertebrate pests – feral pigs.* NSW Department of Primary Industries, Orange NSW.

National Research Council (2004). *Adaptive Management for Water Resources Planning*. The National Academies Press, Washington DC.

Threatened Species Scientific Committee (TSSC) (2009b), *Commonwealth Listing Advice on Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin*. Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/99-listing-advice.pdf. Accessed 13 November 2017.

Threatened Species Scientific Committee (TSSC) (2012), *Commonwealth Listing Advice on* Dichanthium setosum *(bluegrass)*. Department of Sustainability, Environment, Water, Population and Communities. Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/14159-listing-advice.pdf. Accessed 14 November 2017.

Threatened Species Scientific Committee (2013b), *Commonwealth Listing Advice on* Rostratula australis (Australian Painted Snipe). Canberra: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/77037-listing-advice.pdf. Accessed 2 November 2017.

Threatened Species Scientific Committee (TSSC) (2013c), *Commonwealth Listing Advice on* Dichanthium queenslandicum *(king blue-grass)*. Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/5481-listing-advice.pdf. Accessed 14 November 2017.

Threatened Species Scientific Committee (TSSC) (2015), *Conservation Advice* Geophaps scripta scripta *squatter pigeon (southern).* Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/64440-conservation-advice-31102015.pdf. Accessed on 2 November 2017.

Williams, B. (2011). *Adaptive management of natural resources – framework and issues*. Journal of Environmental Management 92: 1346 – 1353.

WRM (2014), *Meteor Downs South Project Surface Water Impact Assessment.* Report prepared for U&D Mining Industry (Australia) Pty Ltd. January 2014.

APPENDIX A ENVIRONMENTAL AUTHORITY EPML00559513 METEOR DOWNS SOUTH COAL MINE

Department of Environment and Heritage Protection

Permit[1]

Environmental Protection Act 1994

Environmental authority EPML00559513 – Meteor Downs South Coal Mine

This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Permit[1] number: EPML00559513

Environmental authority takes effect: 19 January 2017

Anniversary Day: 27 November

Environmental authority holder

Name	Registered address
Endocoal Ltd	Level 4, Rowes Building, 235 Edward Street Brisbane QLD 4000

Environmentally relevant activity and location details

Environmentally relevant activities	Location
Environmental Protection Regulation 2008, Schedule 2A ERA 13 Mining black coal ***Environmental Protection Regulation 2008, Schedule 2*** ERA 8 Chemical storage – storing more than 500m^3 of chemicals of class C1 or C2 combustible liquids under AS 1940 or dangerous goods class 3 under subsection (1)(c) ERA 16 Extractive and screening industries – extracting, other than by dredging, in a year, the following quantity of material – (b) more than 100,000t but not more than 1,000,000t. ERA 63 Sewage treatment – operating sewage treatment works, other than no-release works, with a total daily peak design capacity of – 21 to 100EP – (i) if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme.	ML70452

[1] Permit includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation

Additional information for applicants

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority is issued is a restatement of the ERA as defined by legislation at the time the approval is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an environmental authority as to the scale, intensity or manner of carrying out an ERA, then the conditions prevail to the extent of the inconsistency.

An environmental authority authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the authority specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

Contaminated land

It is a requirement of the EP Act that if an owner or occupier of land becomes aware a notifiable activity (as defined in Schedule 3 and Schedule 4) is being carried out on the land, or that the land has been, or is being, contaminated by a hazardous contaminant, the owner or occupier must, within 22 business days after becoming so aware, give written notice to the chief executive.

Signature	19 January 2017.

Signature | Date

Ben Byrd
Department of Environment and Heritage Protection
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Business Centre (Coal)
Department of Environment and Heritage Protection
PO Box 3028
EMERALD QLD 4720
Phone: (07) 4987 9320
Email: CRMining@ehp.qld.gov.au

Obligations under the *Environmental Protection Act 1994*

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319);
- duty to notify environmental harm (section 320-320G);
- offence of causing serious or material environmental harm (sections 437-439);
- offence of causing environmental nuisance (section 440);
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG); and
- offence to place contaminant where environmental harm or nuisance may be caused (section 443).

Conditions of environmental authority

Department interest: General	
Condition number	**Condition**
A1	This environmental authority authorises environmental harm referred to in the conditions. Where there is no condition or this environmental authority is silent on a matter, the lack of a condition or silence does not authorise environmental harm.
A2	In carrying out the mining activity authorised by this environmental authority, the holder of this environmental authority must comply with **Schedule 1 - Figure 1: MDS Conceptual Mine Plan**.
A3	The holder of this environmental authority must: a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority; b) maintain such measures, plant and equipment in a proper and efficient condition; c) operate such measures, plant and equipment in a proper and efficient manner; and d) ensure all instruments and devices used for the measurement or monitoring of any parameter under any condition of this environmental authority are properly calibrated.
A4	**Monitoring** Except where specified otherwise in another condition of this authority, all monitoring records or reports required by this environmental authority must be kept for a period of not less than **five (5) years**.
A5	**Financial assurance** Provide to the administering authority financial assurance for the amount and in the form acceptable to the administering authority in accordance with the most recent edition of the administering authority's *Guideline—Financial Assurance under the Environmental Protection Act 1994* (EM1010), before the proposed mining activities can commence.
A6	The amount of financial assurance must be reviewed by the holder of this environmental authority when a plan of operations is amended or replaced or the authority is amended.

A7	**Risk management** The holder of this environmental authority must develop and implement a risk management system for mining activities which mirrors the content requirement of the Standard for Risk Management (ISO 31000:2009), or the latest edition of an Australian standard for risk management, to the extent relevant to environmental management, prior to the commencement of **project stage 2**.
A8	**Notification of emergencies, incidents and exceptions** The holder of this environmental authority must notify the administering authority by written notification within **twenty four (24) hours**, after becoming aware of any emergency or incident which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with the conditions of this environmental authority.
A9	Within **ten (10) business days** following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the latter, further written advice must be provided to the administering authority, including the following: a) results and interpretation of any samples taken and analysed; b) outcomes of actions taken at the time to prevent or minimise unlawful environmental harm; and c) proposed actions to prevent a recurrence of the emergency or incident.
A10	**Complaints** The holder of this environmental authority must record all environmental complaints received about the mining activities including: a) name, address and contact number of the complainant; b) time and date of complaint; c) reasons for the complaint; d) investigations undertaken; e) conclusions formed; f) actions taken to resolve the complaint; g) any abatement measures implemented; and h) person responsible for resolving the complaint.
A11	The holder of this environmental authority must, when requested by the administering authority, undertake relevant specified monitoring within a reasonable timeframe nominated or agreed to by the administering authority to investigate any complaint of environmental harm. The results of the investigation (including an analysis and interpretation of the monitoring results) and abatement measures, where implemented, must be provided to the administering authority within **ten (10) business days** of completion of the investigation, or no later than **ten (10) business days** after the end of the timeframe nominated by the administering authority to undertake the investigation.
A12	**Third-party reporting** The holder of this environmental authority must: a) within **one (1) year** of the commencement of this authority, obtain from a suitably qualified and experienced third party a report on compliance with the conditions of this environmental authority; b) obtain further such reports at regular intervals not exceeding **three (3) years** from the completion of the report referred to above; and c) provide each report to the administering authority within **90 days** of its completion.
A13	Where a condition of this environmental authority requires compliance with a standard, policy or

	guideline published externally to this environmental authority and the standard is amended or changed subsequent to the issue of this environmental authority the holder of this environmental authority must: a) comply with the amended or changed standard, policy or guideline within **two (2) years** of the amendment or change being made, unless a different period is specified in the amended standard or relevant legislation, or where the amendment or change relates specifically to regulated structures referred to in **Condition I36** the time specified in that condition; and b) until compliance with the amended or changed standard, policy or guideline is achieved, continue to remain in compliance with the corresponding provision that was current immediately prior to the relevant amendment or change.

Department interest: Air	
Condition number	**Condition**
B1	**Dust nuisance** Dust and particulate matter must not exceed the following levels when measured at any sensitive or commercial place: a) Dust deposition of 120 milligrams per square metre per day, averaged over **one (1) month**, when monitored in accordance with the most recent version of *Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air—Determination of particulate matter—Deposited matter – Gravimetric method.* b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometres (PM_{10}) suspended in the atmosphere of 50 micrograms per cubic metre over a 24-hour averaging time, when monitored in accordance with the most recent version of either: i) *Australian Standard AS3580.9.6 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM10 high volume sampler with size-selective inlet – Gravimetric method*, or ii) *Australian Standard AS3580.9.9 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM10 low volume sampler—Gravimetric method.* c) A concentration of particulate matter with an aerodynamic diameter of less than 2.5 micrometres ($PM_{2.5}$) suspended in the atmosphere of 25 micrograms per cubic metre over a 24-hour averaging time, when monitored in accordance with the most recent version of *AS/NZS3580.9.10 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM (sub) 2.5(/sub) low volume sampler—Gravimetric method.* d) A concentration of particulate matter suspended in the atmosphere of 90 micrograms per cubic metre over a 1 year averaging time, when monitored in accordance with the most recent version of *AS/NZS3580.9.3:2003 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—Total suspended particulate matter (TSP)—High volume sampler gravimetric method.*

B2	When requested by the administering authority or as a result of a complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer), dust and particulate monitoring (including dust deposition, total suspended particles (TSP), PM_{10} and $PM_{2.5}$) must be undertaken, and the results thereof notified to the administering authority within **fourteen (14) days** following completion of monitoring. This includes providing interim reports if the monitoring lasts for more than one month. Monitoring must be carried out at a place(s) relevant to the potentially affected dust sensitive place. Monitoring must be conducted in accordance with the appropriate standards.
B3	If the monitoring which is carried out in accordance with **Condition B2** indicates an exceedance of the relevant limits in **Condition B1**, then the environmental authority holder must investigate whether the exceedance is due to emissions from the activity. If the mining activity is found to be the cause of the exceedance then the environmental authority holder must: a) address the complaint including the use of appropriate dispute resolution if required; and b) immediately implement dust abatement measures so that emissions of dust from the activity do not result in further environmental nuisance.
B4	The environmental authority holder must notify the administering authority within **seven (7) days** of an exceedance of the relevant limits in **Condition B1**.
B5	**Odour nuisance** The release of noxious or offensive odour(s) or any other noxious offensive airborne contaminant(s) resulting from the mining activity must not cause an environmental nuisance at any nuisance sensitive or commercial place.
B6	When requested by the administering authority, odour monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaints (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within **fourteen (14) days** to the administering authority following completion of monitoring.
B7	If the administering authority determines the odour released to constitute an environmental nuisance, then the environmental authority holder must: a) address the complaint including the use of appropriate dispute resolution if required; and b) immediately implement odour abatement measures so that emissions of odour from the activity do not result in further environmental nuisance

Department interest: Waste management	
Condition number	**Condition**
C1	Unless otherwise permitted by the conditions of this environmental authority or with prior approval from the administering authority and in accordance with a relevant standard operating procedure, waste must not be burnt.
C2	The holder of this environmental authority may burn vegetation cleared in the course of carrying out extraction activities provided the activity does not cause environmental harm at any sensitive place or commercial place.

C3	A waste rock and spoil disposal plan must be developed by a suitably qualified and experienced person and implemented prior to the commencement of mining activities (waste rock management plan).
C4	The waste rock management plan must include, where relevant, at least: a) effective characterisation of the waste rock and spoil to predict under the proposed placement and disposal strategy the quality of runoff and seepage generated concerning potentially environmentally significant effects including salinity, acidity, alkalinity and dissolved metals, metalloids and non-metallic inorganic substances; b) a program of progressive sampling and characterisation to identify dispersive and non-dispersive spoil and the salinity, acid and alkali producing potential and metal concentrations of waste rock; c) a materials balance and disposal plan demonstrating how potentially acid forming and acid forming waste rock will be selectively placed and/or encapsulated to minimise the potential generation of acid mine drainage; d) where relevant, a sampling program to verify encapsulation and/or placement of potentially acid-forming and acid-forming waste rock; e) how often the performance of the plan will be assessed; and f) the indicators or other criteria on which the performance of the plan will be assessed.

Department interest: Noise	
Condition number	**Condition**
D1	The holder of this environmental authority must ensure that noise generated by the mining activities does not cause the criteria in **Table D1: Noise limits** to be exceeded at a sensitive place or commercial place.

Table D1: Noise limits

Sensitive Place						
Noise level dB(A) measured as:	**Monday to Saturday**			**Sunday and Public Holidays**		
	7am – 6pm	**6pm – 10pm**	**10pm – 7am**	**9am – 6pm**	**6pm – 10pm**	**10pm – 9am**
$L_{Aeq, adj, 15 mins}$	CV = 50 AV = 5	CV = 45 AV = 5	CV = 40 AV = 0	CV = 45 AV = 5	CV = 40 AV = 5	CV = 35 AV = 5
$L_{A1, adj, 15 mins}$	CV = 55 AV = 10	CV = 50 AV = 10	CV = 45 AV = 5	CV = 50 AV = 10	CV = 45 AV = 10	CV = 40 AV = 5
Commercial Place						
Noise level dB(A) measured as:	**Monday to Saturday**			**Sunday and Public Holidays**		
	7am – 6pm	**6pm – 10pm**	**10pm – 7am**	**9am – 6pm**	**6pm – 10pm**	**10pm – 7am**
$L_{Aeq, adj, 15 mins}$	CV = 55 AV = 10	CV = 50 AV = 10	CV = 45 AV = 5	CV = 50 AV = 10	CV = 45 AV = 10	CV = 40 AV = 5

Note: *Table D1: Noise limits:*

1. *CV = Critical Value*
2. *AV = Adjustment Value*
3. *To calculate noise limits in Table D1:*

   If bg ≤ (CV – AV):

   Noise limit = bg + AV

   If (CV – AV) < bg ≤ CV:

   Noise limit = CV

   If bg > CV:

   Noise limit = bg + 0
4. *In the event that measured bg **(LA90, adj, 15 mins)** is less than 30 dB(A), then 30 dB(A) can be substituted for the measured background level*
5. *bg = background noise level **(LA90, adj, 15 mins)** measured over 3-5 days at the nearest sensitive receptor*
6. *If the project is unable to meet the noise limits as calculated above alternative limits may be calculated using the processes outlined in the "Planning for Noise Control" guideline.*

D2	The holder of this environmental authority must ensure that blasting does not cause the limits for peak particle velocity and air blast overpressure in **Table D2: Blasting noise limits** to be exceeded at a sensitive place or commercial place.

Table D2: Blasting noise limits

Blasting noise limits	Sensitive or commercial place blasting noise limits	
	7am to 6pm	6pm to 7am
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time	No blasting
Ground vibration peak particle velocity	5mm/second peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/second peak particle velocity at any time	No blasting

D3	Noise monitoring and recording must include the following descriptor characteristics and matters: a) LAN,T (where N equals the statistical levels of 1, 10 and 90 and T = 15 mins); b) background noise LA90; c) the level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to statistical levels; d) atmospheric conditions including temperature, relative humidity and wind speed and directions; e) effects due to any extraneous factors such as traffic noise; f) location, date and time of monitoring; and g) if the complaint concerns low frequency noise, Max LpLIN,T and one third octave band measurements in dB(LIN) for centre frequencies in the 10 – 200 Hz range.

Department interest: Groundwater

Condition number	Condition
E1	The holder of this environmental authority must not release contaminants to groundwater.
E2	The holder of this environmental authority must develop and implement a groundwater monitoring program prior to the commencement of **project stage 2**. The program must be able to detect a change in groundwater quality values (consistent with the current suitability of the groundwater for domestic, agricultural and industrial use) due to activities that are part of this mining activity. The monitoring program must also be able to detect changes to groundwater values as a result of mining activities where groundwater is hydraulically linked to Naroo Dam. All determinations of groundwater monitoring must be performed by an appropriately qualified person.
E3	Groundwater quality and levels must be monitored at the locations and frequencies defined in **Table E1 – Groundwater monitoring locations and frequency** for quality characteristics identified in **Table E2 – Groundwater quality parameters.** Results and analysis of groundwater monitoring must be submitted to the administering authority via WaTERS with each annual return.

Table E1: Groundwater monitoring locations and frequency

Monitoring Point[1]	Aquifer type	Location		Elevation RL (m)[2]		Screen Interval (mbgl)	Monitoring Frequency
		Easting (GDA94, z55)	Northing (GDA94, z55)	Top of casing	Ground surface		
Compliance bores							
MW1S	Basalt	636797	7297783	274.60	273.52	16 - 21.5	Quarterly (groundwater quality and groundwater levels)
MW2S	Basalt	638593	7297358	243.21	242.14	38.5 - 44.5	Quarterly (groundwater quality and groundwater levels)
MW3S	Basalt	638584	7299994	266.06	265.36	12 - 21.5	Quarterly (groundwater quality and groundwater levels)
MW4	Basalt	638669	7299616	257.22	256.68	21 - 27	Quarterly (groundwater quality and groundwater levels)
MW7S	Colluvium & weathered Permian coal measures	638439	7298686	244.21	243.73	9 - 12	Quarterly (groundwater quality and groundwater levels)
MW14S	Colluvium & weathered Permian coal measures	638917	7299145	245.34	244.83	14 - 20	Quarterly (groundwater quality and groundwater levels)
MW15S	Colluvium & weathered Permian coal measures	638897	7298485	244.83	244.35	11 - 14	Quarterly (groundwater quality and groundwater levels)
MW16S	Basalt	638843	7298370	247.14	246.63	10 - 13	Quarterly (groundwater quality and groundwater levels)
MW17S	Basalt	TBC	TBC	TBC	TBC	TBC	Quarterly (groundwater quality and groundwater levels)
MW18S	Basalt	TBC	TBC	TBC	TBC	TBC	Quarterly (groundwater quality and groundwater levels)

Notes: *1. Monitoring is not required where a bore has been removed as a direct result of the mining activity.*

2. RL must be measured to the nearest 5 cm from the top of bore casing.

TBC = To be confirmed. These bores must be installed as required in condition E4.

Table E2: Groundwater contaminant triggers and limits

Parameter	Unit	Trigger levels	Limit type
Compliance bores			
Groundwater level	RL	Table E3	Maximum
pH	pH unit	Table E5	Table E4
Total Dissolved Solids	mg/L	Table E5	Table E4
Sulphate	mg/L	Table E5	Table E4
Total dissolved solids	mg/L	Table E5	Table E4
Aluminium	mg/L	Table E5	Table E4
Arsenic	mg/L	Table E5	Table E4
Boron	mg/L	Table E5	Table E4
Cadmium	mg/L	Table E5	Table E4
Chromium	mg/L	Table E5	Table E4
Cobalt	mg/L	Table E5	Table E4
Copper	mg/L	Table E5	Table E4
Fluoride	mg/L	Table E5	Table E4
Lead	mg/L	Table E5	Table E4
Mercury	mg/L	Table E5	Table E4
Molybdenum	mg/L	Table E5	Table E4
Nickel	mg/L	Table E5	Table E4
Selenium	mg/L	Table E5	Table E4
Zinc	mg/L	Table E5	Table E4

E4	Compliance bores MW17S and MW18S as referred to in **Table E1: Groundwater monitoring locations and frequency**, must be installed within 12 months from the commencement of **project stage 2**.

E5	**Exceedance investigation** If groundwater quality characteristics or levels from compliance bores identified in **Table E1: Groundwater monitoring locations and frequency** exceed any of the trigger levels, or the contaminant limit, stated in **Table E2: Groundwater triggers and limits** the holder of this environmental authority must: a) notify the administering authority via WaTERS within **fourteen (14) days** of receiving the analysis results. b) compare the compliance monitoring bore results to baseline data and other relevant data, c) complete an investigation into the potential for environmental harm.
E6	The exceedance investigation under condition **E5 c)** must be completed and submitted to the administering authority via WaTERS within **three (3) months** of notifying the administering authority under condition **E5 a).**

Table E3: Groundwater level monitoring

Monitoring location	Level trigger threshold[1]
MW1S	25m total
MW2S	50m total
MW3S	9m total
MW4	10m total
MW7S	2.5m per year
MW14S	2.5m per year
MW15S	2.5m per year
MW16S	45m total
MW17S	18m total
MW18S	2m per year

Note: 1. The level trigger threshold is equal to the groundwater level drawdown observed within each compliance bore measured from the commencement of mining.

Table E4: Event based thresholds

Type	Event based threshold
Groundwater quality trigger value	For all parameters including upper pH trigger value: An investigation is triggered by: • 1 value greater than the upper trigger value (UTV)[1,2] listed in **Table E5 – Groundwater quality triggers and limits** • 2 consecutive values greater than the middle trigger value (MTV)[1,2] listed in **Table E5 – Groundwater quality triggers and limits** • 5 consecutive values greater than the lower trigger value (LTV)[1,2] listed in **Table E5 – Groundwater quality triggers and limits** For lower pH trigger value: An investigation is triggered by: • 1 value less than the upper trigger value (UTV)[1,2] listed in **Table E5 – Groundwater quality triggers and limits** • 2 consecutive values less than the middle trigger value (MTV)[1,2] listed in **Table E5 – Groundwater quality triggers and limits** • 5 consecutive values less than the lower trigger value (LTV)[1,2] listed in **Table E5 – Groundwater quality triggers and limits**
Contaminant limit	For all parameters including upper pH contaminant limit: An investigation is triggered by: • 1 value greater than the contaminant limit (CL) listed in **Table E5 – Groundwater quality triggers and limits** For lower pH contaminant limit: An investigation is triggered by: • 1 value less than the contaminant limit (CL) listed in **Table E5 – Groundwater quality triggers and limits**

Notes: 1. Calculated from the baseline dataset for the bore

E7	The baseline datasets, as referred to in **Schedule E** of this environmental authority, are to consist of at least **eight (8)** values collected over a minimum of at least one year from: a) Prior to the commencement of **project stage 2**; or b) Routine monitoring data determined by an appropriately qualified person to not be impacted by the operation. Routine monitoring data for a compliance bore collected after the start of **project stage 2** may be transferred to is baseline dataset after **eight (8)** monitoring events have demonstrated no trigger level exceedance and no trending in the dataset has been identified.
E8	The contaminant limit for each compliance bore, as defined in **Table E5: Groundwater quality trigger values and contaminant limits,** must not be exceeded.

Table E5: Groundwater quality trigger values and contaminant limits

Compliance Bore	Trigger values, & contaminant limits	pH (field)	TDS (mg/L)	Ca (mg/L)	SO_4 (mg/L)	Total concentration*													
						Al (mg/L)	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	F (mg/L)	Pb (mg/L)	Hg (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	Zn (mg/L)
MW1S	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	6.68 & 7.35	1120	111	35	1.1	TBC	TBC	TBC	TBC	TBC	TBC	0.4	TBC	TBC	TBC	TBC	TBC	TBC
	MTV	6.79 & 7.24	1025	109	31	0.9	TBC	TBC	TBC	TBC	TBC	TBC	0.34	TBC	TBC	TBC	TBC	TBC	TBC
	LTV	6.90 & 7.13	930	93	27	0.5	TBC	TBC	TBC	TBC	TBC	TBC	0.20	TBC	TBC	TBC	TBC	TBC	TBC
MW2S	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	7.68 & 8.42	586	12	21	TBC	TBC	0.12	TBC	TBC	TBC	TBC	0.4	TBC	TBC	0.006	TBC	TBC	TBC
	MTV	7.80 & 8.30	571	11	20	TBC	TBC	0.1	TBC	TBC	TBC	TBC	0.37	TBC	TBC	0.005	TBC	TBC	TBC
	LTV	7.93 & 8.16	556	10	18	TBC	TBC	0.09	TBC	TBC	TBC	TBC	0.2	TBC	TBC	0.004	TBC	TBC	TBC
MW3S	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	6.98 & 7.76	717	60	48	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.40	TBC	TBC	TBC*	TBC*	TBC	0.044
	MTV	7.11 & 7.63	699	57	45	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.37	TBC	TBC	TBC*	TBC*	TBC	0.042
	LTV	7.24 & 7.50	680	55	38	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.28	TBC	TBC	0.002	0.002	TBC	0.013
MW4	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	7.24 & 7.82	571	36	25	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.28	TBC	TBC	TBC*	TBC	TBC	TBC
	MTV	7.33 & 7.72	567	34	22	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.23	TBC	TBC	TBC*	TBC	TBC	TBC
	LTV	7.43 & 7.62	552	33	20	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.18	TBC	TBC	0.002	TBC	TBC	TBC
MW7S	CL	6.0 & 8.5	4000	1000	1000	13.5*	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	7.26 & 7.76	1131	56	25	13.5	TBC	0.14	TBC	0.14	TBC	0.02	0.59	TBC	TBC	TBC	0.074	TBC	0.042
	MTV	7.35 & 7.68	1093	53	22	12.5	TBC	0.13	TBC	0.11	TBC	0.016	0.53	TBC	TBC	TBC	0.058	TBC	0.040
	LTV	7.43 & 7.59	1055	49	20	6.5	TBC	0.11	TBC	0.08	TBC	0.011	0.47	TBC	TBC	TBC	0.042	TBC	0.028
MW14S	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	6.92 & 7.64	861	44	95	TBC	TBC*	0.32	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
	MTV	7.04 & 7.52	847	42	84	TBC	TBC*	0.29	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
	LTV	7.16 & 7.40	834	40	45	TBC	0.002	0.29	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
MW15S	CL	6.0 & 8.5	4078#	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	6.79 & 7.17	4078	506	210	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.4	TBC	TBC	TBC	TBC	TBC	0.054
	MTV	6.80 & 7.13	3879	472	202	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.35	TBC	TBC	TBC	TBC	TBC	0.045
	LTV	6.85 & 6.96	3679	439	152	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.2	TBC	TBC	TBC	TBC	TBC	0.012

Compliance Bore	Trigger values, & contaminant limits	pH (field)	TDS (mg/L)	Ca (mg/L)	SO_4 (mg/L)	Total concentration*													
						Al (mg/L)	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	F (mg/L)	Pb (mg/L)	Hg (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	Zn (mg/L)
MW16S	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	7.06 & 7.48	628	88	10	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.36	TBC	TBC	TBC	TBC	TBC	TBC
	MTV	7.13 & 7.41	627	83	10	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.30	TBC	TBC	TBC	TBC	TBC	TBC
	LTV	7.20 & 7.34	621	77	9	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.23	TBC	TBC	TBC	TBC	TBC	TBC
MW17S+	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
	MTV	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
	LTV	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
MW18S+	CL	6.0 & 8.5	4000	1000	1000	5	0.5	5	0.01	1	1	1	2	0.1	0.002	0.15	1	0.02	20
	UTV	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
	MTV	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
	LTV	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC

Notes: *CL = contaminant limit. The contaminant limit is equal to the livestock (beef cattle) watering guidelines provided by ANZECC (2000), except where noted.*
UTV = upper trigger value.
MTV = middle trigger value.
LTV = lower trigger value.
TBC = trigger value to be confirmed. Insufficient data is available above the laboratory limit of reporting (LOR) to statistically derive the trigger value with confidence. The trigger value can be confirmed once more data that is above the LOR is available.
** = the trigger values and contaminant limits for all metals and metalloids are given as total concentrations to compare directly with the livestock (beef cattle) watering guidelines provided by ANZECC (2000).*
+ = trigger values will be derived following the installation of MW17S and MW18S. These bores will be installed within the first 12 months of operations at the MDS Project.
 # = contaminant limit is equal the UTV because the baseline groundwater data set exceeds the guidelines provided by ANZECC (2000).
≠ = all samples (or the very large majority) within the baseline data set have the same measurement value. The statistical distribution of this data is very small to nil. In this case, the MTV and UTV are TBC until more data provides a sufficient statistical distribution.

E9	Where it is identified that there is potential for environmental harm, an action plan to mitigate potential harm must be developed by an appropriately qualified person and implemented within three (3) months of the completion of the investigation under condition **E6**.
E10	**Bore construction and maintenance and decommissioning** The construction, maintenance and management of groundwater bores (including groundwater monitoring bores) must be undertaken in a manner that prevents or minimises impacts to the environment and ensures the integrity of the bores to obtain accurate monitoring.

Department interest: Water	
Condition number	**Condition**
F1	**Contaminant release** Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly to any waters as a result of the authorised mining activities, except as permitted under the conditions of this environmental authority.
F2	Unless otherwise permitted under the conditions of this environmental authority, the release of mine affected water to waters must only occur from the release points specified in **Table F1: Mine affected water release points, sources and receiving waters**.

Table F1: Mine affected water release points, sources and receiving waters

Release Point	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Mine affected water source and location	Monitoring point	Receiving waters description
RP1	TBA*	TBA*	Mine Water Dam Spillway Overflow	Pipe Outlet	Meteor Creek via Spring Creek

Note: ** Coordinates of all release points must be provided to the administering authority prior to the commencement of **project stage 2**.*

F3	The release of mine affected water to internal water management infrastructure installed and operated in accordance with a water management plan that complies with **Conditions F32** to **F37** inclusive is permitted.
F4	The release of mine affected water to waters in accordance with **Condition F2** must not exceed the release limits stated in **Table F2: Mine affected water release limits** when measured at the monitoring points specified in **Table F1: Mine affected water release points, sources and receiving waters** for each quality characteristic.

Table F2: Mine affected water release limits

Quality Characteristic	Release Limits	Monitoring
Electrical Conductivity (µS/cm)	Release limits specified in **Table F4: Mine affected water release during flow events** during flow events for variable flow criteria.	Daily during release (the first sample must be taken within two hours of commencement of release)
pH (pH Unit)	6.5 (minimum) 9.0 (maximum)	Daily during release (the first sample must be taken within two hours of commencement of release)
Turbidity (NTU)	Current limit or limit derived from suspended solids limit and demonstrated correlation between turbidity to suspended solids historical monitoring data for dam water*	Daily during release* (first sample within two hours of commencement of release)
Suspended solids (mg/L)	Limit to be determined based on receiving water reference data and achievable best practice sedimentation control and treatment*	Daily during release* (first sample within two hours of commencement of release)
Sulphate (SO_4^{2-}) (mg/L)	Release limits specified in **Table F4: Mine affected water release during flow events** during flow events for variable flow criteria.	Daily during release* (first sample within two hours of commencement of release)

Note: **Limit for suspended solids can be omitted if turbidity limit is included. Limit for turbidity not required if suspended solids limit included. Both indicators should be measured in all cases.*

F5	The release of mine affected water to waters from the release points must be monitored at the locations specified in **Table F1: Mine affected water release points, sources and receiving waters** for each quality characteristics and at the frequency specified in **Table F2: Mine affected water release limits** and **Table F3: Release contaminant trigger investigation levels**. ***Note:*** *The administering authority will take into consideration any extenuating circumstances prior to determining an appropriate enforcement response, in the event* ***Condition F5*** *is contravened due to a temporary lack of safe or practical access. The administering authority expects the environmental authority holder to take all reasonable and practicable measures to maintain safe and practical access to designated monitoring locations.*

Table F3 - Release contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Comment on trigger level	Monitoring frequency
Aluminium	55	For aquatic ecosystem protection, based on SMD guideline	Commencement of release and thereafter weekly during release
Arsenic	13	For aquatic ecosystem protection, based on SMD guideline	
Cadmium	0.2	For aquatic ecosystem protection, based on SMD guideline	
Chromium	1	For aquatic ecosystem protection, based on SMD guideline	
Copper	2	For aquatic ecosystem protection, based on LOR for ICPMS	
Iron	300	For aquatic ecosystem protection, based on low reliability guideline	
Lead	4	For aquatic ecosystem protection, based on SMD guideline	
Mercury	0.2	For aquatic ecosystem protection, based on LOR for CV FIMS	
Nickel	11	For aquatic ecosystem protection, based on SMD guideline	
Zinc	8	For aquatic ecosystem protection, based on SMD guideline	
Boron	370	For aquatic ecosystem protection, based on SMD guideline	
Cobalt	90	For aquatic ecosystem protection, based on low reliability guideline	
Manganese	1900	For aquatic ecosystem protection, based on SMD guideline	
Molybdenum	34	For aquatic ecosystem protection, based on low reliability guideline	
Selenium	10	For aquatic ecosystem protection, based on LOR for ICPMS	
Silver	1	For aquatic ecosystem protection, based on LOR for ICPMS	
Uranium	1	For aquatic ecosystem protection, based on LOR for ICPMS	
Vanadium	10	For aquatic ecosystem protection, based on LOR for ICPMS	
Ammonia	900	For aquatic ecosystem protection, based on SMD guideline	
Nitrate	1100	For aquatic ecosystem protection, based on ambient Qld WQ Guidelines (2006) for TN	
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	2000	Protection of livestock and short term irrigation guideline	

Notes:

1. All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered). Trigger levels for metal/metalloids apply if dissolved results exceed trigger.
2. The quality characteristics required to be monitored as per **Table F3** can be reviewed once the results of two years monitoring data is available, or if sufficient data is available to adequately demonstrate negligible environmental risk. It may be determined that a reduced monitoring frequency is appropriate or certain quality characteristics can be removed from **Table F3** by amendment.
3. SMD—slightly moderately disturbed level of protection, guideline refers ANZECC & ARMCANZ (2000).
4. LOR—typical reporting for method stated. ICPMS/CV FIMS—analytical method required to achieve LOR.

F6	If quality characteristics of the release exceed any of the trigger levels specified in **Table F3: Release contaminant trigger investigation levels**, the environmental authority holder must compare the downstream results in the receiving waters to the trigger values specified in **Table F3: Release contaminant trigger investigation levels** and: 1) where the trigger values are not exceeded then no action is to be taken; or 2) where the downstream results exceed the trigger values specified **Table F3: Release contaminant trigger investigation levels** for any quality characteristic, compare the results of the downstream site to the data from background monitoring sites and; a) if the result is less than the background monitoring site data, then no action is to be taken; or b) if the result is greater than the background monitoring site data, complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining: i) details of the investigations carried out; and ii) actions taken to prevent environmental harm. ***Note:** Where an exceedance of a trigger level has occurred and is being investigated, in accordance with **Condition F6 (2)(b)** of this condition, no further reporting is required for subsequent trigger events for that quality characteristic.*
F7	If an exceedance in accordance with **Condition F6 2) b)** is identified, the holder of the authority must notify the administering authority within **fourteen (14) days** of receiving the result.
F8	**Mine affected water release events** The holder must ensure a stream flow gauging station(s) is installed, operated and maintained to determine and record stream flows at the locations and flow recording frequency specified in **Table F4: Mine affected water release during flow events**.

Table F4: Mine affected water release during flow events

Receiving Waters / stream	Release Points (RP)	Gauging Station	Gauging station latitude (decimal degree, GDA94)	Gauging station longitude (decimal degree, GDA94)	Receiving water flow recording frequency	Receiving water flow criteria for discharge (m3/s)	Maximum release rate (for all combined RP flows)	Electrical conductivity and sulphate release limits
Meteor Creek via Spring Creek	RP1 (Mine Water Dam)	Meteor Creek at Dawson Highway (flow gauge to be installed)	24.4258 S*	148.4839 E*	Continuous (minimum daily)	<u>**Low Flow**</u> $<1m^3/s$ For a period of 28 days after natural flow events that exceed $1m^3/s$	$1.00\ m^3/s$	Electrical conductivity (µS/cm): <700µS/cm Sulphate (SO_4^{2-}): 250 mg/L
						<u>**Medium Flow**</u> $>1m^3/s$	$0.17m^3/s$	Electrical conductivity (µS/cm): <1500µS/cm Sulphate (SO_4^{2-}): 250mg/L
						<u>**High Flow**</u> $>5m^3/s$	$0.60m^3/s$	Electrical conductivity (µS/cm): <2500µS/cm Sulphate (SO_4^{2-}): 250mg/L
						<u>**Flood Flow**</u> $>20m^3/s$	$1.08\ m^3/s$	Electrical conductivity (µS/cm): <5000µS/cm Sulphate (SO_4^{2-}): 250mg/L

Note: Coordinates must be confirmed prior to the commencement of **project stage 2**.*

F9	Notwithstanding any other condition of this environmental authority, the release of mine affected water to waters in accordance with **Condition F2** must only take place during periods of natural flow events in accordance with the receiving water flow criteria for discharge specified in **Table F4: Mine affected water release during flow events** for the release point(s) specified in **Table F1: Mine affected water release points, sources and receiving waters**.
F10	The release of mine affected water to waters in accordance with **Condition F2** must not exceed the electrical conductivity and sulphate release limits or the maximum release rate (for all combined release point flows) for each receiving water flow criteria for discharge specified in **Table F4: Mine affected water release during flow events** when measured at the monitoring points specified in **Table F1: Mine affected water release points, sources and receiving waters**.
F11	The daily quantity of mine affected water released from each release point must be measured and recorded at the monitoring points in **Table F1: Mine affected water release points, sources and receiving waters**.
F12	Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build-up of sediment in such waters.
F13	**Notification of release event** The environmental authority holder must notify the administering authority as soon as practicable and no later than **twenty four (24) hours** after commencing to release mine affected water to the receiving environment. Notification must include the submission of written advice to the administering authority of the following information: a) release commencement date/time; b) expected release cessation date/time; c) release point(s); d) release volume (estimated); e) receiving water(s) including the natural flow rate; and f) any details (including available data) regarding likely impacts on the receiving water(s). ***Note:*** *Notification to the administering authority must be addressed to the Manager and Project Manager of the local administering authority via email.*
F14	The environmental authority holder must notify the administering authority as soon as practicable (nominally within **twenty four (24) hours** after cessation of a release event) of the cessation of a release notified under **Condition F13** and within **twenty eight (28) days** provide the following information in writing: a) release cessation date/time; b) natural flow volume in receiving water; c) volume of water released; d) details regarding the compliance of the release with the conditions of agency interest—water of this environmental authority (i.e. contamination limits, natural flow, discharge volume); e) all in-situ water quality monitoring results; and f) any other matters pertinent to the water release event. ***Note:*** *Successive or intermittent releases occurring within **24 hours** of the cessation of any individual release can be considered part of a single release event and do not require individual notification for the purpose of compliance with **Conditions F13** and **F14**, provided the relevant details of the release are included within the notification provided in accordance with **Conditions F13** and **F14**.*

F15	**Notification of release event exceedance** If the release limits defined in **Table F2: Mine affected water release limits** when measured at the monitoring points' are exceeded, the holder of the environmental authority must notify the administering authority within **twenty four (24) hours** of receiving the results.
F16	The authority holder must, within **twenty eight (28) days** of a release that exceeds the conditions of this authority, provide a report to the administering authority detailing: a) the reason for the release; b) the location of the release; c) all water quality monitoring results; d) any general observations; e) all calculations; and f) any other matters pertinent to the water release event.
F17	**Monitoring of water storage quality** Water storages stated in **Table F5: Water storage monitoring** which are associated with the release points must be monitored for the water quality characteristics specified in **Table F6: Onsite water storage contaminant limits** at the monitoring locations and at the monitoring frequency specified in **Table F5: Water storage monitoring**.

Table F5: Water storage monitoring

Water Storage Description	Northing (GDA94, Zone 55)	Easting (GDA94, Zone 55)	Monitoring Location	Frequency of monitoring
Mine Water Dam (RP1)	7,297,450	636,740	To be negotiated- will depend on the individual storage structure volume. This will deal with stratification – depth profiles and be appropriate to in situ quality characteristics.	Quarterly

F18	In the event that waters storages defined in **Table F5: Water storage monitoring** exceed the contaminant limits defined in **Table F6: Onsite water storage contaminant limits**, the holder of the environmental authority must implement measures, where practicable, to prevent access to waters by all livestock.

Table F6: Onsite water storage contaminant limits

Quality Characteristic	Test Value	Contaminant Level
pH (pH unit)	Range	Greater than 4, less than 9[#]
EC (µS/cm)	Maximum	5970*
Sulphate (mg/L)	Maximum	1000*
Fluoride (mg/L)	Maximum	2*
Aluminium (mg/L)	Maximum	5*
Arsenic (mg/L)	Maximum	0.5*
Cadmium (mg/L)	Maximum	0.01*
Cobalt (mg/L)	Maximum	1*
Copper (mg/L)	Maximum	1*
Lead (mg/L)	Maximum	0.1*
Nickel (mg/L)	Maximum	1*
Zinc (mg/L)	Maximum	20 [1]

Note:

[#] Contaminant limit based on ANZECC & ARMCANZ (2000) stock water quality guidelines.

* Page 4.2–15 of ANZECC & ARMCANZ (2000) 'Soil and animal health will not generally be affected by water with pH in the range of 4–9'.

Note: Total measurements (unfiltered) must be taken and analysed

F19	**Receiving environment monitoring and contaminant trigger levels** The quality of the receiving waters must be monitored at the locations specified in **Table F7: Receiving water upstream background sites and downstream monitoring points** for each quality characteristic and at the monitoring frequency stated in **Table F8: Receiving waters contaminant trigger levels**.

Table F7: Receiving water upstream background sites and downstream monitoring points

Monitoring points	Receiving waters location description	Northing (GDA94, Zone 55)	Easting (GDA94, Zone 55)
Upstream background monitoring points			
Monitoring point 1	Upstream Naroo Dam	7,299,200	636,890
Monitoring point 2	Spring Creek 900 metres upstream of RP1	7,296,630	636,210
Downstream monitoring points			
Monitoring point 3	Upstream Naroo Dam	7,299,220	638,613
Monitoring point 4	Upstream Naroo Dam (minor)	7,298,740	638,360
Monitoring point 5	Naroo Dam	7,298,810	639,400
Monitoring point 6	Spring Creek 900 metres upstream of RP1	7,297,175	638,650
Monitoring point 7	Meteor Creek at Dawson Highway, 14,700 metres downstream of RP1	7,297,760	650,398

Table F8: Receiving waters contaminant trigger level

Quality characteristic	Trigger level	Monitoring frequency
pH	6.5–8.5	Daily during the release
Electrical conductivity (µS/cm)	1000	
Suspended solids (mg/L)	TBD*	
Sulphate (SO_4^{2-}) (mg/L)	250	

Note:*Trigger level must be provided to the administering authority prior to the commencement of* ***project stage 2.***

F20	If quality characteristics of the receiving water at the downstream monitoring points exceed any of the trigger levels specified in **Table F8: Receiving waters contaminant trigger levels** during a release event the environmental authority holder must compare the downstream results to the upstream results in the receiving waters and: a) where the downstream result is the same or a lower value than the upstream value for the quality characteristic then no action is to be taken; or b) where the downstream results exceed the upstream results, complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining: i) details of the investigations carried out; and ii) actions taken to prevent environmental harm. ***Note:*** *Where an exceedance of a trigger level has occurred and is being investigated, in accordance with* ***Condition F20 b)*** *of this condition, no further reporting is required for subsequent trigger events for that quality characteristic.*
F21	All determinations of water quality and biological monitoring must be performed by an appropriately qualified person.
F22	**Receiving environment monitoring program (REMP)** The environmental authority holder must develop and implement a REMP to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. This must include monitoring the effects of the mine on the receiving environment periodically (under natural flow conditions) and while mine affected water is being discharged from the site. For the purposes of the REMP, the receiving environment is the waters of the Spring Creek and connected or surrounding waterways within 5km downstream of the release. The REMP should encompass any sensitive receiving waters or environmental values downstream of the authorised mining activity that will potentially be directly affected by an authorised release of mine affected water.

F23	The REMP must: a) assess the condition or state of receiving waters, including upstream conditions, spatially within the REMP area, considering background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality); b) be designed to facilitate assessment against water quality objectives for the relevant environmental values that need to be protected; c) include monitoring from background reference sites (e.g. upstream or background) and downstream sites from the release (as a minimum, the locations specified in **Table F7**); d) specify the frequency and timing of sampling required in order to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the *Queensland Water Quality* Guidelines *2009*. This should include monitoring during periods of natural flow irrespective of mine or other discharges; e) include monitoring and assessment of dissolved oxygen saturation, temperature and all water quality parameters listed in **Table F6: Onsite water storage contaminant limits** and **Table F3: Release contaminant trigger investigation levels**); f) include, where appropriate, monitoring of metals/metalloids in sediments (in accordance with ANZECC & ARMCANZ 2000, BATLEY and/or the most recent version of AS5667.1 *Guidance on Sampling of Bottom Sediments*); g) include, where appropriate, monitoring of macroinvertebrates in accordance with the AusRivas methodology; h) apply procedures and/or guidelines from ANZECC and ARMCANZ 2000 and other relevant guideline documents; i) describe sampling and analysis methods and quality assurance and control; and j) incorporate stream flow and hydrological information in the interpretations of water quality and biological data.
F24	A REMP Design Document that addresses each criterion presented in **Conditions F22** and **F23** must be prepared and submitted to the administering authority prior to the first of the following; i) commencement of project stage 2 activities, or ii) 31 December 2016. Due consideration must be given to any comments made by the administering authority on the REMP Design Document and subsequent implementation of the program.
F25	A report outlining the findings of the REMP, including all monitoring results and interpretations in accordance with **Conditions F22** and **F23** must be prepared annually and made available on request to the administrating authority. This must include an assessment of background reference water quality, the condition of downstream water quality compared against water quality objectives, and the suitability of current discharge limits to protect downstream environmental values.
F26	**Water reuse** Mine affected water may be piped or trucked or transferred by some other means that does not contravene the conditions of this environmental authority and deposited into artificial water storage structures, such as farm dams or tanks, or used directly at properties owned by the environmental authority holder or a third party (with the consent of the third party).

F27	If the responsibility for mine affected water is given or transferred to another person in accordance with **Condition F26**: a) the responsibility for the mine affected water must only be given or transferred in accordance with a written agreement (the third party agreement); and b) the third party agreement must include a commitment from the person utilising the mine affected water to use it in such a way as to prevent environmental harm or public health incidents and specifically make the persons aware of the General Environmental Duty (GED) under section 319 of the *Environmental Protection Act 1994*, environmental sustainability of the water disposal and protection of environmental values of waters; and c) the third party agreement must be signed by both parties to the agreement.
F28	All determinations of water quality and biological monitoring must be: a) performed by a person or body possessing appropriate experience and qualifications to perform the required measurements; and b) made in accordance with methods prescribed in the latest edition of the Department of Environment and Heritage Protection's *Monitoring and Sampling Manual.* ***Note: Condition F28** requires the* Monitoring and Sampling Manual *to be followed and where it is not followed because of exceptional circumstances this should be explained and reported with the results.* *a) collected from the monitoring locations identified within this environmental authority, within 2 hours of each other where possible;* *b) carried out on representative samples; and* *c) analysed at a laboratory accredited (e.g. NATA) for the method of analysis being used.*
F29	The release of any contaminants as permitted by this environmental authority, directly or indirectly to waters, other than internal water management infrastructure that is installed and operated in accordance with a water management plan that complies with **Conditions F32** to **F34** inclusive: a) must not produce any visible discolouration of receiving waters; and b) must not produce any slick or other visible or odorous evidence of oil, grease or petrochemicals nor contain visible floating oil, grease, scum, litter or other objectionable matter.
F30	**Annual Water Monitoring Reporting** The following information must be recorded in relation to all water monitoring required under the conditions of this environmental authority and submitted to the administering authority in the specified format with each annual return: a) the date on which the sample was taken; b) the time at which the sample was taken; c) the monitoring point at which the sample was taken; d) the measured or estimated daily quantity of mine affected water released from all release points; e) the release flow rate at the time of sampling for each release point; f) the results of all monitoring and details of any exceedances of the conditions of this environmental authority; and g) water quality monitoring data must be provided to the administering authority in the specified electronic format upon request.

F31	**Temporary interference with waterways** Temporarily destroying native vegetation, excavating, or placing fill in a watercourse, lake or spring necessary for and associated with mining operations must be undertaken in accordance with Department of Natural Resources and Mine's *Guideline - Activities in a Watercourse, Lake or Spring Associated with Mining Activities.*
F32	**Water Management Plan** A Water Management Plan must be developed by an appropriately qualified person and implemented prior to the commencement of **project stage 2**.
F33	The Water Management Plan must: a) provide for effective management of actual and potential environmental impacts resulting from water management associated with the mining activity carried out under this environmental authority; and b) be developed in accordance with the administering authority's guideline *Preparation of Water Management Plans for Mining Activities* (EM324) and include: i) a study of the source of contaminants; ii) a water balance model for the site; iii) a water management system for the site; iv) measures to manage and prevent saline drainage; v) measures to manage and prevent acid rock drainage; vi) contingency procedures for emergencies; and vii) a program for monitoring and review of the effectiveness of the water management plan.
F34	The water management plan must be reviewed each calendar year and a report prepared by an appropriately qualified person. The report must: a) assess the plan against the requirements under **Condition F33**; b) include recommended actions to ensure actual and potential, environmental impacts are effectively managed for the coming year; and c) identify any amendments made to the water management plan following the review.
F35	The holder of this environmental authority must attach to the review report required by **Condition F34**, a written response to the report and recommended actions, detailing the actions taken or to be taken by the environmental authority holder on stated dates: a) to ensure compliance with this environmental authority; and b) to prevent a recurrence of any non-compliance issues identified.
F36	The review report required by **Condition F34** and the written response to the review report required by **Condition F35** must be submitted to the administering authority with the subsequent annual return under the signature of the appointed signatory for the annual return.
F37	**Stormwater and water sediment controls** An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.

F38	Stormwater, other than mine affected water, is permitted to be released to waters from: a) erosion and sediment control structures that are installed and operated in accordance with the Erosion and Sediment Control Plan required by **Condition F37**; and b) water management infrastructure that is installed and operated, in accordance with a Water Management Plan that complies with **Conditions F32** to **F36** inclusive, for the purpose of ensuring water does not become mine affected water.
F39	The maintenance and cleaning of any vehicles, plant or equipment must not be carried out in areas from which contaminants can be released into any receiving waters.

Department Interest: Sewage treatment	
Condition number	**Condition**
G1	The only contaminant permitted to be released to land is treated sewage effluent in compliance with the release limits stated in **Table G1: Contaminant release limits to land**.

Table G1: Contaminant release limits to land

Contaminant	Unit	Release limit	Limit type	Frequency
5 day Biochemical oxygen demand (BOD)1	mg/L	20	Maximum	Monthly
Total suspended solids	mg/L	30	Maximum	Monthly
Nitrogen	mg/L	30	Maximum	Monthly
Phosphorus	mg/L	15	Maximum	Monthly
E-coli	Organisms/100ml	1000	Maximum	Monthly
pH	pH units	6.0 – 9.0	Range	Monthly

G2	The application of treated effluent to land must be carried out in a manner such that: a) vegetation is not damaged; b) there is no surface ponding of effluent; and c) there is no run-off of effluent.
G3	If areas irrigated with effluent are accessible to employees or the general public, prominent signage must be provided advising that effluent is present and care should be taken to avoid consuming or otherwise coming into unprotected contact with the effluent.
G4	All sewage effluent released to land must be monitored at the frequency and for the parameters specified in **Table G1: Contaminant release limits to land**.
G5	The daily volume of effluent release to land must be measured and records kept of the volumes of effluent released.

G6	When circumstances prevent the irrigation or beneficial reuse of treated sewage effluent such as during or following rain events, waters must be directed to a wet weather storage or alternative measures must be taken to store/lawfully dispose of effluent.
G7	Treated sewage effluent must only be supplied to another person or organisation that has a written plan detailing how the user of the treated sewage effluent will comply with their general environmental duty under section 319 of the *Environmental Protection Act 1994* whilst using the treated sewage effluent.

Department interest: Land and rehabilitation	
Condition number	**Condition**
H1	Land disturbed by mining must be rehabilitated in accordance with **Schedule 2 - Table H1: Rehabilitation Goals, Indicators and Completion Criteria**, attached to this environmental authority.
H2	Rehabilitation must commence progressively in accordance with the Plan of Operations.
H3	**Contaminated land** Before applying for surrender of a mining lease, the holder must (if applicable) provide to the administering authority a site investigation report under the *Environmental Protection Act 1994*, in relation to any part of the mining lease which has been used for notifiable activities or which the holder is aware is likely to be contaminated land, and also carry out any further work that is required as a result of that report to ensure that the land is suitable for its final land use.
H4	Before applying for progressive rehabilitation certification for an area, the holder must (if applicable) provide to the administering authority a site investigation report under the Act, in relation to any part of the area the subject of the application which has been used for notifiable activities or which the holder is aware is likely to be contaminated land, and also carry out any further work that is required as a result of that report to ensure that the land is suitable for its final land use under **Condition H1**.
H5	**Impacts to Prescribed Environmental Matters** Significant residual impacts to prescribed environmental matters are not authorised under this environmental authority or the *Environmental Offsets Act 2014* unless the impact(s) is specified in **Table H2 - Significant residual impacts to prescribed environmental matters**.

Table H2 - Significant residual impacts to prescribed environmental matters

Prescribed environmental matter	Maximum extent of impact	Environmental offset required
Endangered regional ecosystem – 11.8.15	3ha	Yes
Of concern regional ecosystem – 11.8.11*	101ha	No
Of concern regional ecosystem – 11.8.11a	17ha	Yes
Regional ecosystem within a defined distance from the defining banks of a relevant watercourse 11.8.11	5ha	Yes
Regional ecosystem within a defined distance from the defining banks of a relevant watercourse 11.8.11a	7ha	Yes
Regional ecosystem within a defined distance from the defining banks of a relevant watercourse 11.8.5	3ha	Yes
Habitat for an animal that is vulnerable – Squatter pigeon*	118ha	No
Habitat for a plant that is vulnerable – *Dichanthium queenslandicum**	101ha	No

*these matters will be offset under EPBC Act approval conditions (EPBC 2013/6799)

H6	Records demonstrating that each impact to a prescribed environmental matter not listed in **Table H2 - Significant residual impacts to prescribed environmental matters** did not, or is not likely to, result in a significant residual impact to that matter must be: a) completed by an appropriately qualified person; and b) kept for the life of the environmental authority.
H7	An environmental offset made in accordance with the *Environmental Offsets Act 2014* and Queensland Environmental Offsets Policy, as amended from time to time, must be undertaken for the maximum extent of impact to each prescribed environmental matter authorised in **Table H2 - Significant residual impacts to prescribed environmental matters**, unless a lesser extent of the impact has been approved in accordance with condition **H8**.
H8	The notice of election for the environmental offset required by condition **H7**, if applicable, must be provided to the administering authority no less than three months before the proposed commencement of the significant residual impacts for which the environmental offset is required.

Department interest: Regulated Structures	
Condition number	**Condition**
I1	**Assessment of Hazard Category** The hazard category of any structure must be assessed by a suitably qualified and experienced person: a) in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM365)*; and b) in any of the following situations: i) prior to the design and construction of the structure; or ii) prior to any change in its purpose or the nature of its stored contents; and

	iii) in accordance with the *Manual for assessing Hazard Categories and Hydraulic Performance of Dams.*
I2	A hazard assessment report and certification must be prepared for any structure assessed and the report may include a hazard assessment for more than one structure.
I3	The holder must, on receipt of a hazard assessment report and certification, provide to the administering authority one paper copy and one electronic copy of the hazard assessment report and certification.
I4	Certification must be provided by the suitably qualified and experienced person who undertook the assessment, in the form set out in the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635).*
I5	The holder must take reasonable and practical measures so that each dam associated with the mining activity is designed, constructed, operated and maintained in accordance with accepted engineering standards and is fit for the purpose for which it is intended.
I6	**Design and construction of a regulated structure** All regulated structures must be designed by, and constructed under the supervision of, a suitably qualified and experienced person in accordance with the requirements of the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635).*
I7	Construction of a regulated structure is prohibited unless the holder has: a) submitted a hazard category assessment report and certification to the administering authority; b) commissioned a suitably qualified and experienced person to prepare a design plan for the structure; and c) received the certification from a suitably qualified and experienced person for the design and design plan and the associated operating procedures in compliance with the relevant condition of this authority.
I8	Certification must be provided by the suitably qualified and experienced person who oversees the preparation of the design plan, in the form set out in the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635).*
I9	Regulated structures must: a) be designed and constructed in accordance with and conform to the requirements of the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635);* and b) be designed and constructed with due consideration given to ensuring that the design integrity would not be compromised on account of: i) floodwaters from entering the regulated dam from any watercourse or drainage line; and ii) wall failure due to erosion by floodwaters arising from any watercourse or drainage line.
I10	The design plan for a regulated structure must include, but is not limited to: 1) certification that the design plan: a) is in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635)*, including subsidiary certifications if necessary; and b) addresses the requirements in **Conditions I10 2)** to **I10 8)** inclusive. 2) a design report which provides:

	a) a description of all the documents which constitute the design plan; b) a statement of: i) the applicable standards including engineering criteria, industry guidelines, relevant legislation and regulatory documents, relied upon in preparing the design plan; ii) all relevant facts and data used in preparing the design plan, including any efforts made to obtain necessary facts and data, and any limitations or assumptions to facts and data used in preparing the design plan; iii) the hazard category of the regulated structure; and iv) setting out the reasoning of the suitably qualified and experienced person who has certified the design plan, as to how the design plan provides the necessary required performance; c) documentation of hydrological analyses and estimates required to determine all elements of the design including volumes and flow capacities; d) detailed criteria for the design, operation, maintenance and decommissioning of the regulated structure, including any assumptions; and e) design, specification and operational rules for any related structures and systems used to prevent failure scenarios; 3) drawings showing the lines and dimensions, and locations of built structures and land forms associated with the regulated structure; 4) consideration of the interaction of the pit design with the levee or regulated dam design; 5) an operational plan that includes: a) normal operating procedures and rules (including clear documentation and definition of process inputs in the DSA allowance); b) contingency and emergency action plans including operating procedures designed to avoid and/or minimise environmental impacts including threats to human life resulting from any overtopping or loss of structural integrity of the regulated structure; 6) a plan for the decommissioning and rehabilitation of the regulated structure at the end of its operational life; 7) details of reports on investigations and studies done in support of the design plan; and 8) any other matter required by the suitably qualified and experienced person.
I11	Certification by the suitably qualified and experienced person who supervises the construction must be submitted to the administering authority on the completion of construction of the regulated structure, and state that: a) the 'as constructed' drawings and specifications meet the original intent of the design plan for that regulated structure; and b) construction of the regulated structure is in accordance with the design plan.
I12	Where a regulated dam is to be managed as part of an integrated containment system and the DSA volume is to be shared across the integrated containment system, the design and operating rules for the system as a whole must be documented in a system design plan that is certified by a suitably qualified and experienced person.
I13	The system design plan must contain: a) the design plans; b) the 'as constructed' plans;

	c) the operational rules for each individual regulated dam that forms part of the integrated system; d) the standards of serviceability and accessibility of water transfer equipment or structures; and e) the operational rules for the system as a whole.
I14	**Operation of a regulated structure** Operation of a regulated structure is prohibited unless: a) the holder has submitted to the administering authority: i) one paper copy and one electronic copy of the design plan and certification of the 'design plan' in accordance with **Condition I10**, and ii) a set of 'as constructed' drawings and specifications, and iii) certification of those 'as constructed drawings and specifications' in accordance with **Condition I10**, and iv) where the regulated structure is to be managed as part of an integrated containment system for the purpose of sharing the DSA volume across the system, a copy of the certified system design plan. b) the requirements of this authority relating to the construction of the regulated structure have been met; and c) relevant details for the dam have been included in **Table I1: Location of regulated structures** and **Table I2: Basic details of regulated dams** of this authority.

Table I1: Location of regulated structures

Name of Regulated Structure	Control Points		Levees only
	Northing (GDA 94, Zone 55)	Easting (GDA 94, Zone 55)	Unique Location ID
PMF Levee	7,297,330	638,620	1
Mine Water Dam (RP1)	7,297,440	636,608	-

Table I2: Basic Details of Regulated Dams

Name of Regulated Dam	Hazard Category	Maximum Surface area of dam (ha)	Maximum volume of dam (ML)	Maximum depth of dam (m)	Spillway Level (mAHD)	Use of dam
Mine Water Dam	Significant (dam break only)	8ha	400ML	6m	265mAHD	Storage of dewatered mine water.

I15	Each regulated structure must be maintained and operated in a manner that is consistent with the current design plan, the current operational plan, and the associated certified *'as constructed'* drawings for the duration of its operational life until decommissioned and rehabilitated.

I16	The holder must take reasonable and practicable control measures to prevent the causing of harm to persons, livestock or wildlife through the construction and operation of a regulated structure. Reasonable and practicable control measures may include, but are not limited to: a) the secure use of fencing, bunding or screening; and b) escape arrangements for trapped livestock and fauna.
I17	**Mandatory reporting level** The Mandatory Reporting Level (the MRL) must be marked on a regulated dam in such a way that during routine inspections of that dam, it is clearly observable.
I18	The holder must, as soon as practical and **within forty-eight (48) hours** of becoming aware, notify the administering authority when the level of the contents of a regulated dam reaches the MRL.
I19	The holder must, immediately on becoming aware that the MRL has been reached, act to prevent the occurrence of any unauthorised discharge from the regulated dam.
I20	**Annual inspection report** Each regulated structure must be inspected each calendar year by a suitably qualified and experienced person.
I21	At each annual inspection, the condition and adequacy of all components of the regulated structure must be assessed: a) against the most recent hazard assessment report and design plan (or system design plan); b) against recommendations contained in previous annual inspections reports; c) against recognised dam safety deficiency indicators; d) for changes in circumstances potentially leading to a change in hazard category; e) for conformance with the conditions of this authority; f) for conformance with the 'as constructed' drawings; g) for the adequacy of the available storage in each regulated dam, based on an actual observation or observations taken after **31 May** each year but prior to **1 November** of that year, of accumulated sediment, state of the containment barrier and the level of liquids in the dam (or network of linked containment systems); and h) for evidence of conformance with the current operational plan.
I22	A suitably qualified and experienced person must prepare an annual inspection report containing details of the assessment and including recommended actions to ensure the integrity of the regulated structure.
I23	The suitably qualified and experienced person who prepared the annual inspection report must certify the report in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635).*

I24	The holder must: a) upon receipt of the annual inspection report, consider the report and its recommendations and take action to ensure that the regulated structure will safely perform its intended function; and b) within **twenty (20) business days** of receipt of the annual inspection report, notify the administering authority in writing, of the recommendations of the inspection report and the actions being taken to ensure the integrity of each regulated structure.
I25	A copy of the annual inspection report must be provided to the administering authority upon request and within **ten (10) business days**.
I26	**Design storage allowance** On **1 November** of each year, storage capacity must be available in each regulated dam (or network of linked containment systems with a shared DSA volume), to meet the Design Storage Allowance (DSA) volume for the dam (or network of linked containment systems).
I27	The holder must, as soon as possible and within **forty-eight (48) hours** of becoming aware that the regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on **1 November** of any year, notify the administering authority.
I28	The holder must, immediately on becoming aware that a regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on **1 November** of any year, act to prevent the occurrence of any unauthorised discharge from the regulated dam or linked containment systems.
I29	**Performance review** The holder must assess the performance of each regulated dam or linked containment system over the preceding November to May period based on actual observations of the available storage in each regulated dam or linked containment system taken prior to **1 July** of each year.
I30	The holder must take action to modify its water management or linked containment system so as to ensure that the regulated dam or linked containment system will perform in accordance with the requirements of this authority, for the subsequent November to May period. ***Note:*** *Action may include seeking the necessary approvals for physical modification of a regulated dam.*
I31	**Transfer arrangements** The holder must provide a copy of any reports, documentation and certifications prepared under this authority, including but not limited to any Register of Regulated Structures, hazard assessment, design plan and other supporting documentation, to a new holder and the administering authority on transfer of this authority.

I32	**Decommissioning and rehabilitation** Prior to the cessation of the environmentally relevant activity, each regulated structure must be decommissioned such that: a) ongoing environmental harm is minimised by the regulated structure: i) becoming a safe site for humans and animals at the completion of rehabilitation; or ii) becoming a stable landform, that no longer contains flowable substances and minimises erosion impacts; or iii) not allowing for acid mine drainage; or iv) being approved or authorised under relevant legislation for a beneficial use; or v) being a void authorised by the administering authority to remain after decommissioning; and b) the regulated structure is compliant with all other relevant rehabilitation requirements of this authority.
I33	**Regulated structure location and performance** Each regulated structure named in **Table I1: Location of regulated structures** must be wholly located within the control points for that structure.
I34	Each regulated dam named in **Table I2: Basic details of regulated dams** must be consistent with the details noted in **Table I2: Basic details of regulated dams** for that dam.
I35	Each regulated dam named in **Table I1: Location of regulated structures**, must meet the hydraulic performance criteria noted in **Table I3: Hydraulic performance of regulated dams** for that dam.

Table I3: Hydraulic performance of regulated dams

Name of Regulated Structure	Spillway Capacity AEP	Design Storage Allowance AEP	Mandatory Reporting Level AEP
Mine Water Dam	1:1000 AEP	N/A (low hazard for failure to contain and contaminant concentration)	N/A (low hazard for failure to contain and contaminant concentration)

I36	Each regulated levee named in **Table I4: Basic details of regulated levees**, must be consistent with the details noted in **Table I4: Basic details of regulated levees** for that levee.

Table I4: Basic details of regulated levees

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Name of Regulated Levee	**Design AEP**	**Design Flood Level1 (mAHD)**	**Minimum Levee Level1 (mAHD)**	**Table I1 Location ID[1]**	**Use of levee**
PMF Levee	Probable Maximum Flood (PMF)	243.0mAHD	243.5mAHD	1	Protection of active mining pit and final void from flooding up to and including the PMF event.

Note: *[1] Design flood levels, and hence regulated levee levels, are expected to vary along the length of that levee. The location IDs listed (Column 5) must correspond with location IDs listed in* ***Table I1****, define the minimum design level envelope for the longitudinal crest of the structure.*

I37	**Register of Regulated Dams** A Register of Regulated Dams must be established and maintained by the holder and include, as a minimum, the following information for each regulated dam: a) date of entry in the register; b) name of the dam, its purpose and intended/actual contents; c) location of the dam defined by coordinates (latitude and longitude in GDA94) within five metres at any point from the outside of the dam including its storage area; d) the hazard category of the dam as assessed using *the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (EM635); e) dates, names, and reference numbers of all document(s) lodged as part of a design plan for the dam; f) name and qualifications of the suitably qualified and experienced person who certified the design plan and 'as constructed' drawings; g) for the regulated dam, other than in relation to any levees: i) the dimensions (metres) and surface area (hectares) of the dam measured at the footprint of the dam; ii) dam crest volume (megalitres); iii) spillway crest level (metres AHD). iv) maximum operating level (metres AHD); v) storage rating table of stored volume versus level (metres AHD); vi) design storage allowance (megalitres) and associated level of the dam (metres AHD); and vii) mandatory reporting level (metres AHD); h) the design plan title and reference relevant to the dam; i) the date construction was certified as compliant with the design plan; j) the name and details of the suitably qualified and experienced person who certified that the constructed dam was compliant with the design plan; k) details of the composition and construction of any liner; l) the system for the detection of any leakage through the floor and sides of the dam; m) dates when the regulated dam underwent an annual inspection for structural and operational adequacy, and to ascertain the available storage volume for **1 November** of any year; n) dates when recommendations and actions arising from the annual inspection were provided to the administering authority; and o) dam water quality as obtained from monitoring required under this authority as at **1 November** of each year.
I38	The holder must provisionally enter the required information in the Register of Regulated Dams when a design plan for a regulated dam is submitted to the administering authority.
I39	The holder must make a final entry of the required information in the Register of Regulated Dams once compliance with **Condition I14** has been achieved.
I40	The holder must ensure that the information contained in the Register of Regulated Dams is current and complete on any given day.

I41	All entries in the Register of Regulated Dams must be approved by the chief executive officer for the holder of this authority, or their delegate, as being accurate and correct.
I42	The holder must, at the same time as providing the annual return, supply to the administering authority a copy of the records contained in the Register of Regulated Dams, in the electronic format required by the administering authority.

Definitions

Words and phrases used throughout this environmental authority are defined below. Where a definition for a term used in this environmental authority is not provided within this environmental authority, but is provided in the EP Act 1994 or subordinate legislation, the definition in the EP Act or subordinate legislation must be used.

'acid rock drainage' means any contaminated discharge emanating from a mining activity formed through a series of chemical and biological reactions, when geological strata is disturbed and exposed to oxygen and moisture.

'administering authority' means the Department of Environment and Heritage Protection or its successor.

'airblast overpressure' means energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure is the peak airblast overpressure measured in decibels linear (dBL).

'Annual exceedance probability' or 'AEP' means the probability that at least one event in excess of a particular magnitude will occur in any given year.

'appropriately qualified person' means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relating to the subject matter using the relevant protocols, standards, methods or literature.

'assessed' and 'assessment' by a suitably qualified and experienced person in relation to a hazard assessment of a dam, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit of the assessment:

a) exactly what has been assessed and the precise nature of that determination;

b) the relevant legislative, regulatory and technical criteria on which the assessment has been based;

c) the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts; and

d) the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.

'associated works' means in relation to a dam,

a) operations of any kind and all things constructed, erected or installed for that dam; and

b) any land used for those operations.

'authority' means an environmental authority.

'background', with reference to the water schedule means the average of samples taken prior to the commencement of mining from the same waterway that the current sample has been taken.

'blasting' means the use of explosive materials to fracture:

a) rock, coal and other minerals for later recovery; or

b) structural components or other items to facilitate removal from a site or for reuse.

'certification' means assessment and approval must be undertaken by a suitably qualified and experienced person in relation to any assessment or documentation required by this manual, including design plans, 'as constructed' drawings and specifications, construction, operation or an annual report regarding regulated structures, undertaken in accordance with the Board of Professional Engineers of Queensland Policy Certification by RPEQs (ID: 1.4 (2A)).

'certifying', 'certify' or 'certified' have a corresponding meaning as 'certification'.

'chemical' means:

a) an agricultural chemical product or veterinary chemical product within the meaning of the Agricultural and *Veterinary Chemicals Code Act 1994* (Commonwealth); or

b) a dangerous good under the Australian Code for the Transport of Dangerous Goods by Road and Rail approved by the Australian Transport Council; or

c) a lead hazardous substance within the meaning of the Workplace Health and Safety Regulation 1997;

d) a drug or poison in the Standard for the Uniform Scheduling of Drugs and Poisons prepared by the Australian Health Ministers' Advisory Council and published by the Commonwealth; or

e) any substance used as, or intended for use as:

  i) a pesticide, insecticide, fungicide, herbicide, rodenticide, nematocide, miticide, fumigant or related product; or

  ii) a surface active agent, including, for example, soap or related detergent; or

  iii) a paint solvent, pigment, dye, printing ink, industrial polish, adhesive, sealant, food additive, bleach, sanitiser, disinfectant, or biocide; or

  iv) a fertiliser for agricultural, horticultural or garden use; or

  v) a substance used for, or intended for use for mineral processing or treatment of metal, pulp and paper, textile, timber, water or wastewater; or

  vi) manufacture of plastic or synthetic rubber.

'commercial place' means a workplace used as an office or for business or commercial purposes, which is not part of the mining activity and does not include employees' accommodation or public roads.

'construction' or **'constructed'** in relation to a regulated structure includes building a new regulated structure and lifting or otherwise modifying an existing regulated structure, but does not include investigations and testing necessary for the purpose of preparing a design plan.

'dam' means a land-based structure or a void that contains, diverts or controls flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and **associated works**. A dam does not mean a fabricated or manufactured tank or container, designed and constructed to an Australian Standard that deals with strength and structural integrity of that tank or container.

'dam crest volume' means the volume of material (liquids and/or solids) that could be within the walls of a dam at any time when the upper level of that material is at the crest level of that dam. That is, the instantaneous maximum volume within the walls, without regard to flows entering or leaving (eg via spillway).

'design storage allowance' or 'DSA' means an available volume, estimated in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635)* published by the administering authority, must be provided in a dam as at 1 November each year in order to prevent a discharge from that dam to an annual exceedance probability (AEP) specified in that manual.

'designer' for the purposes of a regulated dam, means the certifier of the design plan for the regulated dam.

'disturbance' of land includes:

a) compacting, removing, covering, exposing or stockpiling of earth;

b) removal or destruction of vegetation or topsoil or both to an extent where the land has been made susceptible to erosion;

c) carrying out mining within a watercourse, waterway, wetland or lake;

d) the submersion of areas by tailings or hazardous contaminant storage and dam/structure walls;

e) temporary infrastructure, including any infrastructure (roads, tracks, bridges, culverts, dam/structures, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be removed after the mining activity has ceased; or

f) releasing of contaminants into the soil, or underlying geological strata.

However, the following areas are not included when calculating areas of 'disturbance':

a) areas off lease (e.g. roads or tracks which provide access to the mining lease);

b) areas previously disturbed which have achieved the rehabilitation outcomes;

c) by agreement with the administering authority, areas previously disturbed which have not achieved the rehabilitation objective(s) due to circumstances beyond the control of the mine operator (such as climatic conditions);

d) areas under permanent infrastructure. Permanent infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dam/structures, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be left by agreement with the landowner.

e) disturbance that pre-existed the grant of the tenure.

'EC' means electrical conductivity.

'effluent' means treated waste water released from sewage treatment plants.

'emergency action plan' means documentation forming part of the operational plan held by the holder or a nominated responsible officer, that identifies emergency conditions that sets out procedures and actions that will be followed and taken by the dam owner and operating personnel in the event of an emergency. The actions are to minimise the risk and consequences of failure, and ensure timely warning to downstream communities and the implementation of protection measures. The plan must require dam owners to annually update contact details that are part of the plan, and to comprehensively review the plan at least every five years.

'environmental authority' means environmental authority granted in relation to an environmentally relevant activity under the *Environmental Protection Act 1994*.

'environmental authority holder' means the holder of this environmental authority.

'flowable substance' means matter or a mixture of materials which can flow under any conditions potentially affecting that substance. Constituents of a flowable substance can include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension.

'hazard' means in relation to a dam as defined, means the potential for environmental harm resulting from the collapse or failure of the dam to perform its primary purpose of containing, diverting or controlling flowable substances.

'hazard category' means a category, either low significant or high, into which a dam is assessed as a result of the application of tables and other criteria in 'Manual for Assessing Hazard Categories and Hydraulic Performance of Dams'.

'holder' means any person who is the holder of, or is acting under, that environmental authority.

'hydraulic performance' means the capacity of a regulated dam to contain or safely pass flowable substances based on a probability (AEP) of performance failure specified for the relevant hazard category in the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635)*.

'infrastructure' means water storage dams, levees,, roads and tracks, buildings and other structures built for the purpose of the mining activity.

'land' in the 'land schedule' of this document means land excluding waters and the atmosphere, that is, the term has a different meaning from the term as defined in the *Environmental Protection Act 1994*. For the purposes of the *Acts Interpretation Act 1954*, it is expressly noted that the term 'land' in this environmental authority relates to physical land and not to interests in land.

'land use' –means the selected post mining use of the land, which is planned to occur after the cessation of mining operations.

'leachate' means a liquid that has passed through or emerged from, or is likely to have passed through or emerged from, a material stored, processed or disposed of at the operational land which contains soluble, suspended or miscible contaminants likely to have been derived from the said material.

'levee' means an embankment that only provides for the containment and diversion of stormwater or flood flows from a contributing catchment, or containment and diversion of flowable materials resulting from releases from other works, during the progress of those stormwater or flood flows or those releases; and does not store any significant volume of **water** or **flowable substances** at any other times.

'low hazard dam' means any dam that is not a high or significant hazard category as assessed using the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (EM635).

'm' means metres.

'mandatory reporting level' or 'MRL' means a warning and reporting level determined in accordance with the criteria in the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635)* published by the administering authority.

'mine affected water':

1) means the following types of water:
   a) pit water, tailings dam water, processing plant water;
   b) water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the Environmental Protection Regulation 2008 if it had not formed part of the mining activity;
   c) rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an Erosion and Sediment Control Plan to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water;
   d) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated;
   e) groundwater from the mine's dewatering activities;
   f) a mix of mine affected water (under any of paragraphs i)-v) and other water.
2) does not include surface water runoff which, to the extent that it has been in contact with areas disturbed by mining activities that have not yet been completely rehabilitated, has only been in contact with:
   a) land that has been rehabilitated to a stable landform and either capped or revegetated in accordance with the acceptance criteria set out in the environmental authority but only still awaiting maintenance and monitoring of the rehabilitation over a specified period of time to demonstrate rehabilitation success; or
   b) land that has partially been rehabilitated and monitoring demonstrates the relevant part of the landform with which the water has been in contact does not cause environmental harm to waters or groundwater, for example:
      i) areas that are been capped and have monitoring data demonstrating hazardous material adequately contained with the site;
      ii) evidence provided through monitoring that the relevant surface water would have met the water quality parameters for mine affected water release limits in this environmental authority, if those parameters had been applicable to the surface water runoff; or
   c) both.

'measures' includes any measures to prevent or minimise environmental impacts of the mining activity such as bunds, silt fences, diversion drains, capping, and containment systems.

'modification or modifying' (see definition of 'construction')

'NATA' means National Association of Testing Authorities, Australia.

'natural flow' means the flow of water through waters caused by nature.

'non polluting' means having no adverse impacts upon the receiving environment.

'operational plan' for a dam means a document that amongst other things sets out procedures and criteria to be used for operating a dam during a particular time period. The operational plan as defined herein may form part of a plan of operations or plan otherwise required in legislation.

'peak particle velocity (ppv)' means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mm/s).

'Probable Maximum Flood (PMF)' means the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.

'project stage 1' means project activities carried out prior to commencement of significant ground disturbance, including:

a) pre-construction surveying and technical assessment including geotechnical, establishment of site security arrangements (including signs, fences, safety barriers, and temporary security personnel facilities) and maintenance of existing roads and tracks;

b) installation of facilities for the purpose of environmental monitoring compliance; and

c) other works limited to the existing site facilities and access roads.

d) groundwater monitoring bore installation;

e) activities ordinarily authorised under an Exploration Permit to determine the existence, quality and quantity of coal.

'project stage 2' means project activities, other than activities carried out under *project stage 1*, leading to the production of coal, including:

a) removal of existing structures, site clearance

b) construction of access roads, potable water treatment and sewage treatment plants, new power plants, mine administrative buildings, water storage infrastructure and hardstanding

c) removal and stockpiling of overburden and/or excavation of a drift for underground mining.

d) commencement of dewatering operations.

'protected area' means – a protected area under the *Nature Conservation Act 1992*; or

a) a marine park under the *Marine Parks Act 1992*; or

b) a World Heritage Area.

'receiving environment' in relation to an activity that causes or may cause environmental harm, means the part of the environment to which the harm is, or may be, caused. The receiving environment includes (but is not limited to):

a) a watercourse;

b) groundwater; and

c) an area of land that is not specified in Schedule 1 – Figure 1 of this environmental authority.

'receiving waters' means the waters into which this environmental authority authorises releases of mine affected water.

'regulated dam' means any dam in the significant or high hazard category as assessed using the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635)* published by the administering authority.

'rehabilitation' the process of reshaping and revegetating land to restore it to a stable landform

'release event' means a surface water discharge from mine affected water storages or contaminated areas on the licensed place.

'RL' means reduced level, relative to mean sea level as distinct from depths to water.

'representative' means a sample set which covers the variance in monitoring or other data either due to natural changes or operational phases of the mining activities.

'saline drainage' The movement of waters, contaminated with salts, as a result of the mining activity.

'sensitive place' means:

a) a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or

b) a motel, hotel or hostel; or

c) an educational institution; or

d) a medical centre or hospital; or

e) a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 1992* or a World Heritage Area; or

f) a public park or gardens.

***Note:** The definition of 'sensitive place' and 'commercial place' is based on Schedule 1 of EPP Noise. That is, a sensitive place is inside or outside on a dwelling, library & educational institution, childcare or kindergarten, school or playground, hospital, surgery or other medical institution, commercial & retail activity, protected area or an area identified under a conservation plan under Nature Conservation Act 1992 as a critical habitat or an area of major interest, marine park under Marine Parks Act 2004, park or garden that is outside of the mining lease and open to the public for the use other than for sport or organised entertainment. A commercial place is inside or outside a commercial or retail activity.*

A mining camp (i.e., accommodation and ancillary facilities for mine employees or contractors or both, associated with the mine the subject of the environmental authority) is not a sensitive place for that mine or mining project, whether or not the mining camp is located within a mining tenement that is part of the mining project the subject of the environmental authority. For example, the mining camp might be located on neighbouring land owned or leased by the same company as one of the holders of the environmental authority for the mining project, or a related company. Accommodation for mine employees or contractors is a sensitive place if the land is held by a mining company or related company, and if occupation is restricted to the employees, contractors and their families for the particular mine or mines which are held by the same company or a related company.

For example, a township (occupied by the mine employees, contractors and their families for multiple mines that are held by different companies) would be a sensitive place, even if part or all of the township is constructed on land owned by one or more of the companies.

'spillway' means a weir, channel, conduit, tunnel, gate or other structure designed to permit discharges form the dam, normally under flood conditions or in anticipation of flood conditions.

'suitably qualified and experienced person' in relation to regulated structures means a person who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the *Professional Engineers Act 2002*, and has demonstrated competency and relevant experience:

a) for regulated dams, an RPEQ who is a civil engineer with the required qualifications in dam safety and dam design.

b) for regulated levees, an RPEQ who is a civil engineer with the required qualifications in the design of flood protection embankments.

***Note:** It is permissible that a suitably qualified and experienced person obtain subsidiary certification from an RPEQ who has demonstrated competence and relevant experience in geomechanics, hydraulic design or engineering hydrology.*

'structure' in relation to regulated structures means dam or levee.

'system design plan' means a plan that manages an integrated containment system that shares the required DSA volume across the integrated containment system.

'the Act' means the *Environmental Protection Act 1994*.

'µS/cm' means micro siemens per centimetre.

'Void' means any constructed, open excavation in the ground.

'watercourse' has the same meaning given in the *Water Act 2000*.

'water quality' means the chemical, physical and biological condition of water.

'waters' includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined natural or artificial watercourse, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), storm water channel, storm water drain, and groundwater and any part thereof.

'water year' means the 12-month period from 1 July to 30 June.

'wet season' means the time of year, covering one or more months, when most of the average annual rainfall in a region occurs. For the purposes of DSA determination this time of year is deemed to extend from 1 November in one year to 31 May in the following year inclusive.

END OF DEFINITIONS

Schedule 1—Approved plans

Figure 1: MDS Conceptual Mine Plan

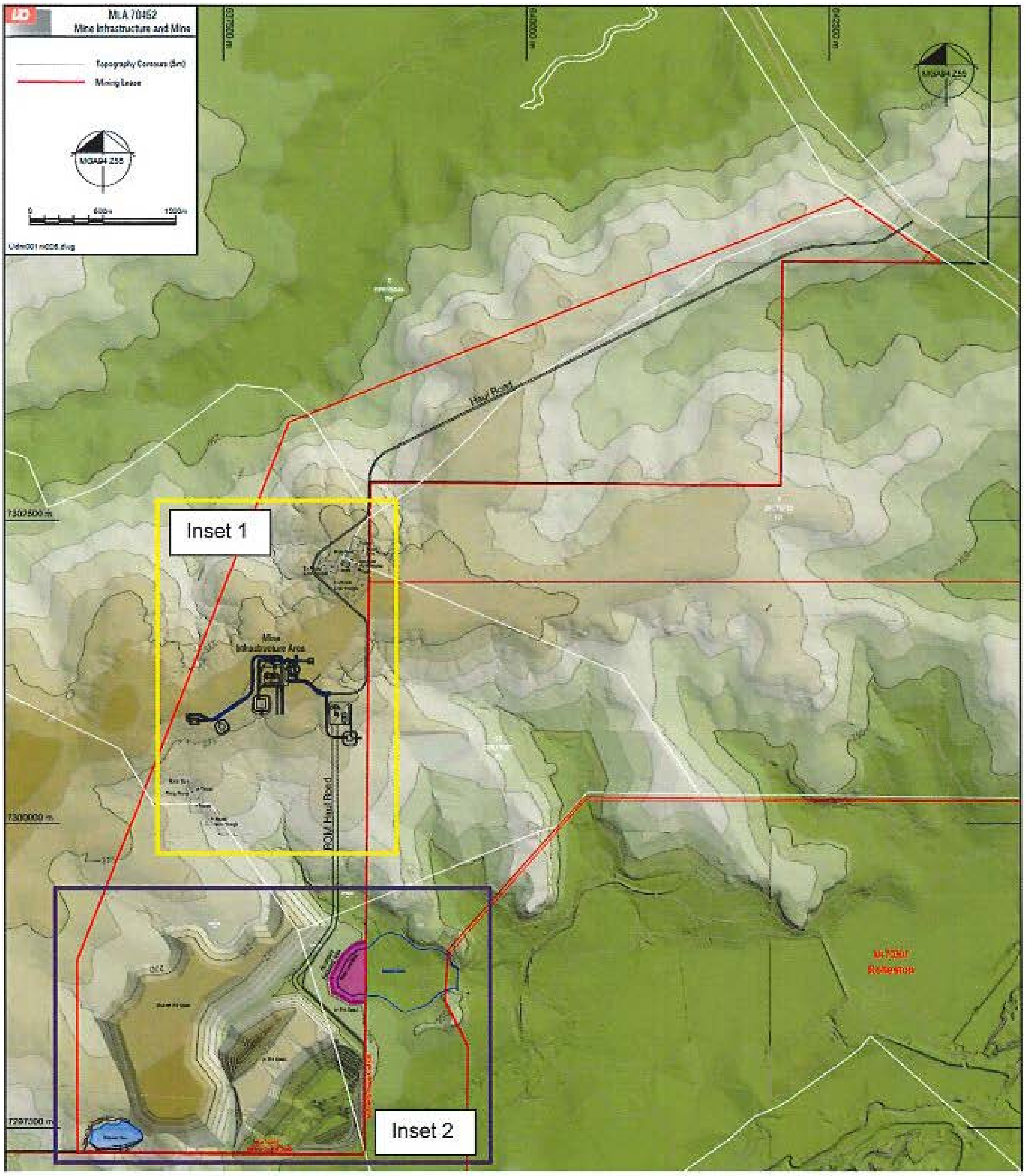


Figure 1: MDS Conceptual Mine Plan (Insets 1 and 2)

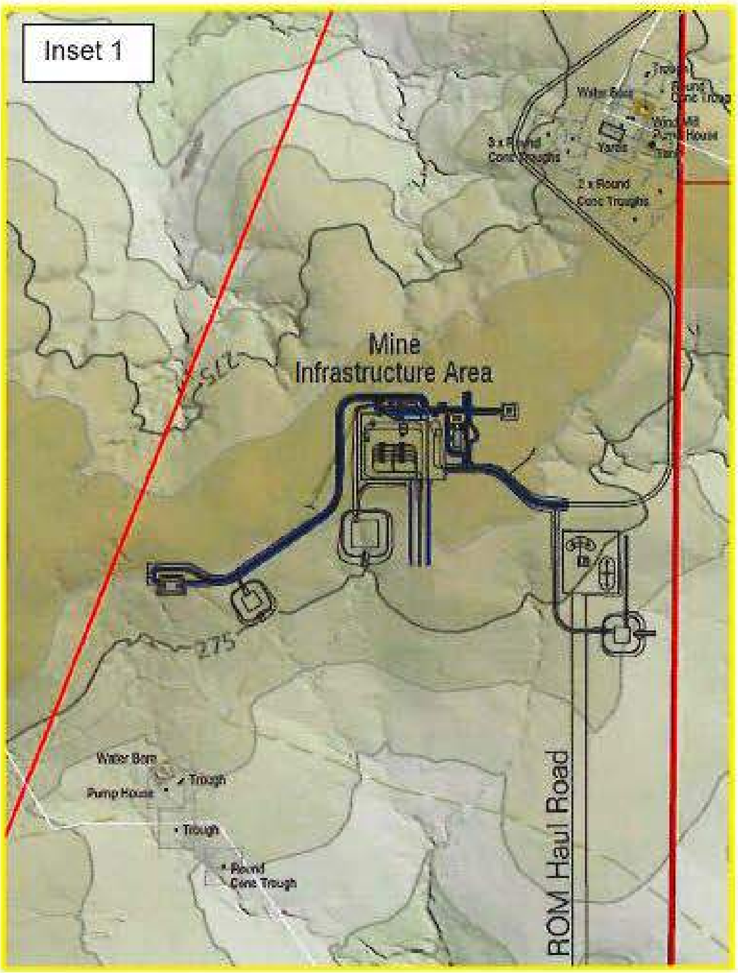
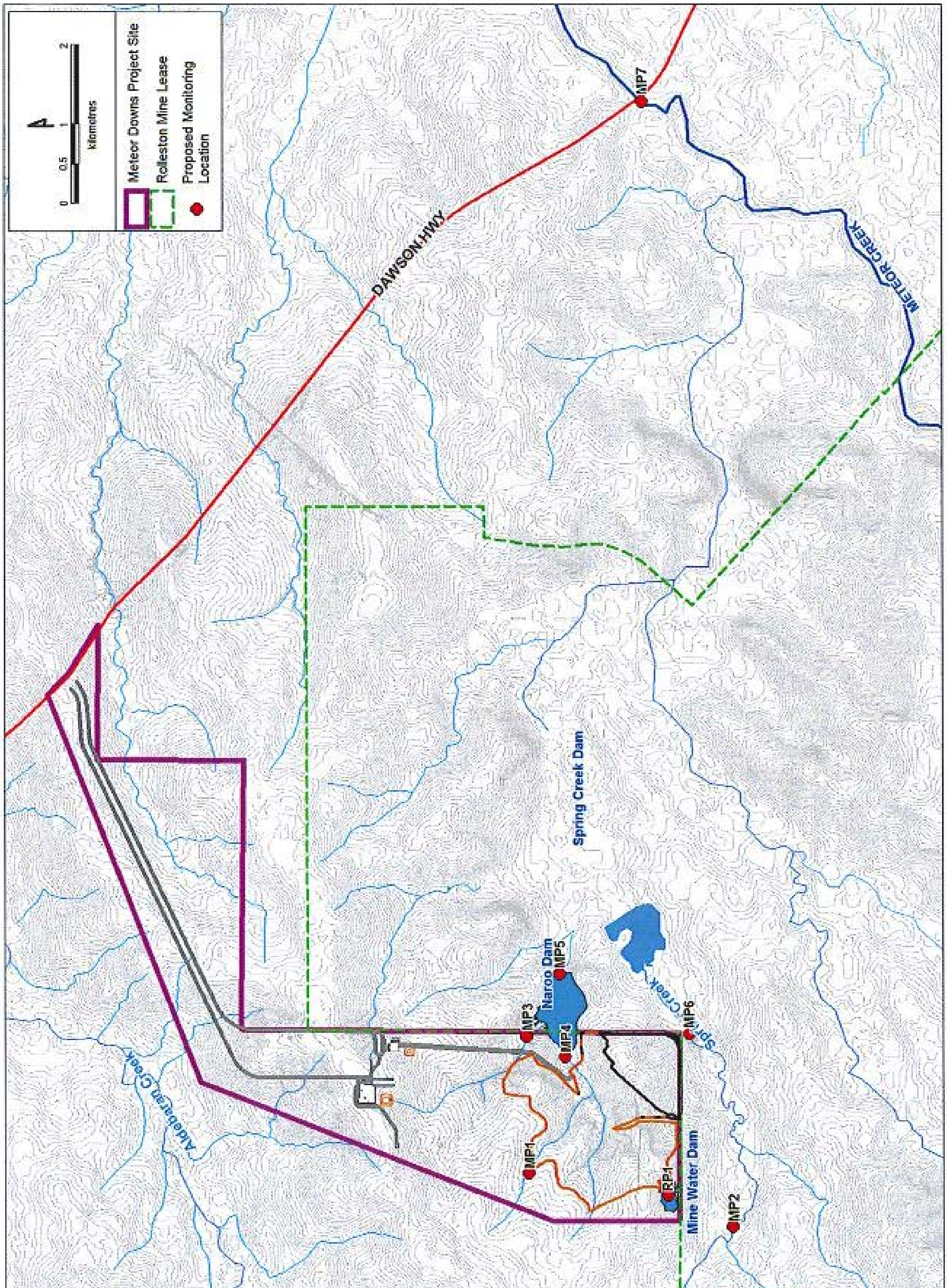


Figure 2: Monitoring Points - Water



Schedule 2 — Rehabilitation

Table H1: Rehabilitation Goals, Indicators and Completion Criteria

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
FINAL VOID				
Final Void	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Presence and/or absence of physical risk factors which could result in injury or death. • Geotechnical Study report • Risk Assessment documentation.	• A Geotechnical study has been completed within 3 years prior to mine closure to confirm: a) that Highwall slopes are stable and safe; and b) the criteria of 12 degrees for Lowwall and an average of 40 degrees for Highwall slopes are achievable and sustainable over the long term. • A safety assessment of Highwall slopes that are >30 Degrees and >5m in height has been conducted. • Risk assessment relative to safety of humans, stock and wildlife completed and risk mitigation measures have been implemented in accordance with relevant guidelines and Australian Standards such as ISO31000 Risk Management. • Completion of a Rehabilitation Report by an appropriate and qualified person at the end of the mine life to ensure successful rehabilitation of the final void and other landforms. This Rehabilitation Report has been completed in accordance with the relevant guidelines and Australian standards.
Final Void	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Presence and availability of heavy metals and other toxic material or other introduced contaminants.	• The identification of potential hazardous materials during mine life through water quality monitoring and material characterisation has been conducted. • During the 5 years prior to mine closure surface water monitoring and leaching tests have been undertaken in compliance with guidelines derived from ANZECC 2000. • Hydrological modelling has been conducted of the groundwater environment in the vicinity of the final void to

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
				establish relationship between water in the final void and the groundwater. • Evidence has been included in decommissioning records of elimination of any exposed carboniferous material that may present a spontaneous combustion risk. • Evidence in decommissioning records that carboniferous material has been encapsulated within an inert cover.
Final Void	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Adequacy and long term performance of safety barriers, etc.	• Final void design has included: a) Bund walls; b) Remediated waterways; c) Fencing; and d) Signage. • Cattle have been excluded from accessing bunding. • A Landholder program has been conducted. • Where risk mitigation measures include fencing and appropriate signage around a perimeter to restrict access; these have been erected in accordance with relevant guidelines and Australian Standards.
Final Void	Non -polluting	Polluted water contained on site.	• Water quality. • Leachate and drainage control	• Surface water monitoring has been conducted with water quality criteria derived from ANZECC 2000 for 3 years post mining operation. • Evidence that effective leachate prevention has been conducted through testing of mining waste and management in accordance with a documented Mine Waste Management Plan. • Evidence from surface water monitoring that successful prevention measures have been implemented for poor quality leachate or discharge mobilisation from the void to watercourses.

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
				▪ A groundwater study has been conducted on the long-term groundwater levels and on the post-mining aquifer recovery (once the details of the final void for mine closure has been finalised). • Evidence that no significant difference in water quality has occurred relative to historic (background) groundwater quality. ▪ Successful establishment of adequate drainage control between the Final Void edge and location of bunds has been made to redirect any runoff away from the edge of the void. ▪ Evidence in the Rehabilitation Report that the void water levels have remained similar to modelled scenarios and the risk of void overflow have been maintained as minimal where appropriate.
Final Void	Non -polluting	Hazardous and toxic materials are not buried within the mine area.	• A life of mine hazardous materials register indicating the volumes used and disposal methods is available.	▪ Evidence has been included in Rehabilitation Report that required waste management measures have been implemented. • An audit of the hazardous materials register has been conducted to identify the location, use and disposal of potentially hazardous materials during the life of the mine.
Final Void	Stable	Very low probability of subsidence, slope slippage or degradation of the Highwall.	• Laboratory and field studies conducted to determine probabilities of landform failure.	▪ A Geotechnical study has been completed and assessment that Highwall slopes are stable and safe by appropriately qualified persons has been conducted. • Safety assessment has been made of Highwall slopes that are >30 Degrees and>5m in height. • Completion of an assessment report by a Registered Professional Engineer of Queensland (RPEQ) on the geotechnical issues and erosivity of the proposed final landforms, including final voids, to demonstrate long-term landform stability. Reference has been made to the

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
				Queensland Mining Guidelines (or subsequent reprints) during the completion of this assessment.
Final Void	Stable	• Landform design achieves appropriate erosion rates. • Rates of soil loss will reduce over a three year period post-closure to acceptable levels.	• Rate of soil loss will be similar to sites in the general area surrounding the mine.	• Benchmark erosion study has been conducted based on rainfall and sediment run-off rates in undisturbed region (to be conducted by appropriately qualified persons). • Spray-on barriers (mulch) if required has been applied. • The erosion rates on disturbed land are similar to rates on the analogue sites surrounding undisturbed region within 3 years of cessation of mining.
Final Void	Stable	• Vegetation cover established on the lowwall. • Establish specified self-sustaining natural vegetation and habitats.	• Self-sustaining vegetation assemblage growing on the Lowwall over a period of 3 years post-mine closure. • Presence of key local species and diversity.	• Groundcover species have been sown into the Lowwall and species which may include Buffel, Panic and Rhodes Grasses and associated legumes. • Compatible with the rehabilitation program outlined below, standard establishment techniques have included Contour deep ripping; and a) Small shrub species have been established; b) Medium shrub species have been established; c) Small tree species have been established; and d) Tree species have been established. • Environmental Audit has been conducted by appropriately qualified persons to grade success of: a) Erosion mitigation program; b) Vegetation program; c) Water monitoring program; and d) Weed management.
Final Void	Sustainable land use	Post mine land use for the residual voids is water storage.	• Physical and Chemical properties of contained	• Final void water quality: pH in range 6.0 to 9.0. Electrical Conductivity less than 5000uS/cm.

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
			water.	
Final Void	Sustainable land use	Post mine land use for areas between Final Void crest and safety bund walls is be vegetation establishment, which excludes cattle.	• Groundcover and erosion.	• Evidence has shown ground cover between the void crests and bunds as being >70% where ground cover is defined as any cover that assists in controlling erosion and may include live cover. • Results have shown that significant active erosion features are not present and that any initial erosion has been stabilised by vegetation cover.
ELEVATED LANDFORMS (INCLUDING OVERBURDEN DUMPS, QUARRY AND SECTIONS OF ROM/CRUSHING AND SCREENING AREAS)				
Elevated Landform	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Presence and or absence of physical risk factors which could result in injury or death. • Risk assessment documentation	• A Geotechnical study has been completed within 3 years prior to mine closure to confirm: • that elevated landform slopes are stable and safe; and • the criteria of 12 degrees (approx 20%) for landform slopes are achievable and sustainable over the long term. • A safety assessment of elevated sections of the landform has been conducted. • Evidence that landform final landform construction has met the design requirements of Rehabilitation Management Plan. • Risk assessment relative to safety of humans, stock and wildlife completed and risk mitigation measures have been implemented in accordance with relevant guidelines and Australian Standards such as ISO 31000 Risk Management.
Elevated Landforms	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Exposure to and availability of heavy metals and other toxic material or other introduced contaminants.	• Potential hazardous materials have been identified during mine life and removed, or selected capping material has been applied with cover thickness appropriate to the contaminant. • Leaching tests have been conducted to complement the

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
				analyses undertaken and reported under the Overburden Assessment section of the MDS Soils, Land, Overburden and Process Waste Study; as well as ongoing overburden and reject characterisation programs. • Surface water monitoring has been conducted consistent with guidelines derived from ANZECC 2000 for the final 5 years of mine operation and for 3 years post mine operation • Local program of fire control and proscribed weeds and woody weeds control have been conducted.
Elevated Landforms	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Adequacy and long term performance of safety barriers.	• Fencing and appropriate signage is in place to restrict access has been conducted. • Cattle are excluded • Where risk mitigation measures include fencing and appropriate signage around a perimeter to restrict access, these have been erected in accordance with relevant guidelines and Australian Standards.
Elevated Landforms	Non -polluting	Hazardous overburden materials adequately handled.	• A program of identification of hazardous and benign overburden materials.	• Selective burial of hazardous materials and covering of landforms with benign materials including topsoil has been conducted. • If required, a selection of an appropriate "barrier layer" beneath the top capping suitable to the level of sulphides or other contaminants not removed, has been applied. • Compliance with the site's Topsoil Management Plan; • Average broad range topsoil pH range of 6 to 9 and an Electrical Conductivity of less than 1dS/cm.
Elevated Landforms	Non -polluting	Tailings and rejects: Hazardous overburden materials adequately handled.	*Note: The site has no on-site tailings storage facilities.*	*No decommissioning or capping of tailings storage facilities is required.*

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
Elevated Landforms	Non -polluting	Elimination of all permanent water storages on the site outside the final void.	• Polluted water contained on site. • Leachate and drainage control	• Mine water has been transferred to the final mining void at cessation of operations. • Surface and groundwater water monitoring has been conducted according to guidelines derived from ANZECC 2000 for 5 years during mine operation and for 3 years post mine operation. • Minor drainage works to reinforce and consolidate natural drainage to the north of site as part of final landform have been completed. • Evidence in the Rehabilitation Report, as prepared by an appropriately qualified person, that the rock lined drains have remained stable. • Average broad range topsoil pH range has been achieved of 6 to 9 and an Electrical Conductivity of less than 1dS/cm with reference to the MDS Soils, Land, Overburden and Process Waste Study.
Elevated Landforms	Stable	Very low probability of subsidence or slope slippage.	• Design criteria. • Safety assessment. • Erosion rate. • Slope stability.	• A Geotechnical study and assessment that the elevated landforms are stable and safe has been conducted by qualified entity. • All elevated landforms regraded to 12 Degrees overall where possible. • Evidence provided in the Rehabilitation Report that the reshaping of elevated sections of the landform have complied with the site's final landform design criteria. • Erosion rates from disturbed areas and rehabilitated areas are comparable with reference (undisturbed) areas. • Evidence that the reshaping of the upper surface of the elevated landforms has been to a stable gradient to direct runoff to the rock-lined waterway and prevent gully erosion.

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
				• Slopes on elevated sections of the landform are geotechnically stable enough to maintain covers constructed for containment of hazardous material and for ecosystem support.
Elevated Landforms	Stable	Landform design achieves appropriate erosion rates.	• Slope angle and length.	• All elevated sections of the landform have been graded to 12 Degrees (approximately 20%). • Greater than 12 Degree slopes have been subject to a geotechnical assessment and drainage plan. • Vertical intervals between slope breaks are 10m so that the length of slope will be approximately 50m. • Slope breaks include a waterway and a graded bank. constructed at a slope of less than 2%.
Elevated Landforms	Stable	Landform design achieves appropriate erosion rates.	• Rate of soil loss.	• A benchmark erosion study has been conducted based on rainfall and sediment run- off rates in undisturbed region (to be conducted by qualified entity). • Drainage points have been established approximately every 50 meters on exposed slopes. • Spray-on barriers (mulch) have been applied if required. • Erosion rates similar to the surrounding undisturbed region have been achieved within 3 years of cessation of mining • Results have shown that significant active erosion features are not present and that any initial erosion has been stabilised by vegetation cover; • Evidence has been included in Rehabilitation Report.
Elevated Landforms	Stable	• Vegetation cover to minimise erosion. • Resilience to Disturbance.	• Vegetation type and density.	• Scarification with direct seeding and fertiliser (primary grasses and legumes) has been completed. • Contour ripping has been completed. • Revegetation works have been implemented in

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
		• A perennial, self-sustaining ground cover is maintained that is resilient to environmental stresses such as fire, drought and pest species is extensive enough to control erosion; and contributes to the integrity of constructed covers.		accordance with the Rehabilitation Management Plan and standard establishment techniques have included contour deep ripping: and a) Shrub species have been established; and b) Tree species have been established. • Desirable grass species comprise at least 60% of total grass cover. Tree density and height of >25 stems per 5ha each being >2m in height have been established. • The relevant management programs and completion criteria to be implemented as part of the final rehabilitation plan as outlined in Chapter 5 of the Flora, Fauna and Freshwater Ecology Assessment Report have been conducted. • Evidence of utilised revegetation techniques has been included in the Rehabilitation Report.
Elevated Landforms	Sustainable land use	Soil properties to support the final land use proposed to be a self-sustaining native ecosystem comprising of local native vegetation assemblages.	• Physical and Chemical properties of surface materials.	• Testing to confirm achievement of pH in range 6.0 to 9.0. • Testing to confirm achievement of Electrical Conductivity of less than 1dS/cm.
Elevated Landforms	Sustainable land use	Establish specified self-sustaining natural vegetation and habitats.	• Presence of key species. • Species type and diversity. • Weeds.	• Environmental Audit has been conducted by qualified entity to grade success of: a) Erosion mitigation program; b) Vegetation program; c) Water monitoring program; and d) Weed management. • The following species forming the vegetation communities referenced in Table 5 of " Flora, fauna and freshwater ecology assessment of the Meteor Downs

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
				South Project, near Rolleston, Central Queensland 2012" have been introduced into the revegetation seed mix and establishment has been attempted: a) *Melaleuca bracteata;* b) *Eucalyptus orgadophila;* c) *Corymbia erythrophloia;* d) *E. melanophloia;* e) *Themeda triandra;* f) *Heteropogon contortus;* g) *Aristida spp;* h) *Chloris divaricata;* i) *Iseilema vaginiflorum;* j) *Eucalyptus populnea;* and k) *Paspalidium caespitosum.*
Elevated Landforms	Sustainable land use	Establish land use with comparable management requirements to similarly used non-mined land.	• Initial establishment of native species to form the basis of a longer term self-sustaining native ecosystem.	• Baseline Land Suitability Class has been determined in accordance with *Technical Guidelines for Environmental Management of Exploration and Mining Queensland* (QDME 1995). • Environmental audit conducted by appropriately qualified persons to a) Establish progress towards a native ecosystem; b) Identify the Land Suitability Class; and c) Establish adequacy and predicted long-term performance of safety barriers.
MIA (INCLUDING INFRASTRUCTURE, CRUSHING EQUIPMENT, SCREENING EQUIPMENT, ROM AREAS, & ROADS) AT THE APPROXIMATE ORIGINAL CONTOUR				
MIA and Infrastructure	Long-term safety	Site is safe for humans and animals now and in the	• Unless the subsequent landholder agrees in writing	• Excavations have been backfilled.

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
areas		foreseeable future.	to assume responsibility for infrastructure components such as roads, the final rehabilitation plan will include the following indicators and activities. • Removal of all constructed structures including dams, concrete to a depth of 1m, disused industrial equipment and materials.	• Risk assessment relative to safety of humans, stock and wildlife completed and risk mitigation measures have been implemented in accordance with relevant guidelines and Australian Standards such as ISO 31000 Risk Management. • Any remaining infrastructure has written agreement with post-mining landholder.
MIA and Infrastructure areas	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Exposure to and availability of heavy metals and other toxic material or other introduced contaminants.	• The identification of potential hazardous materials during mine life and their removal, or selected capping material applied with cover thickness appropriate to the contaminant. • Topsoil has been spread over disturbed areas in accordance with the site Topsoil Management Plan. • Surface water monitoring has been conducted and complies with guidelines derived from ANZECC 2000 FOR 5 years during mine operation and for 3 years post mine operation. • Local program of fire control and proscribed weeds and woody weeds control has been implemented.
MIA and Infrastructure areas	Long-term safety	Site is safe for humans and animals now and in the foreseeable future.	• Adequacy and long term performance of safety barriers.	• Fencing and appropriate signage around a perimeter is in place to restrict access; these have been erected in accordance with relevant guidelines and Australian Standards.
MIA and Infrastructure areas	Non -polluting	Hazardous material adequately handled.	• Technical design of capping. • Compliance with risk	• Capping requirement has been established over mine life. • If required, an appropriate "barrier layer" has been

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
			assessment documentation.	selected and implemented beneath the top capping suitable to the level of sulphides or other contaminants not removed. • Average broad range topsoil pH range of 6 to 9 and an Electrical Conductivity of less than 1dS/cm has been achieved. • Appropriate storage of all chemicals and fuels has been undertaken in accordance with AS10940 – *The Storage and Handling of Flammable and Combustible Liquids*. • Evidence has shown removal of all infrastructure including concrete, steel and timber. • Compliance with the Rehabilitation Management Plan. • Completion of a post-mine contamination assessment report. • Evidence of decommissioning has been included in the Rehabilitation Report.
MIA and Infrastructure areas	Non -polluting	Polluted water contained on site.	• Surface, groundwater and downstream monitoring.	• Mine water transferred to the final mining void at cessation of operations. • Surface water monitoring in accordance with guidelines derived from ANZECC 2000 has been conducted for 5 years during mine operation and for 3 years post mine operation. • Minor drainage works to reinforce and consolidate natural drainage has been implemented.
MIA and Infrastructure areas	Stable	Very low probability of subsidence or slope failure.	• Design criteria of slopes regraded to a maximum of 12 Degrees (average) overall where required.	• Completion of a Geotechnical study and assessment that rehabilitated MIA areas are stable and safe by qualified entity.
MIA and Infrastructure	Stable	Landform design achieves appropriate erosion rates.	• Slope angle and length.	• All slopes have been regraded to 12 Degrees (average).

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
areas				• Greater than 12 Degree slopes have been subjected to a geotechnical assessment and drainage plan.
MIA and Infrastructure areas	Stable	Landform design achieves appropriate erosion rates.	• Rate of soil loss.	• A benchmark erosion study has been conducted based on rainfall and sediment run- off rates in undisturbed region (to be conducted by qualified entity). • Drainage points approximately every 50 meters on exposed slopes have been established. • Spray-on barriers (mulch) have been applied if required. • Evidence in Rehabilitation Report that erosion rates are compatible with surrounding undisturbed region within 5 years of cessation of mining. • Compliance with the site's Topsoil Management Plan.
MIA and Infrastructure areas	Stable	Vegetation cover to minimise erosion and to re-establish the pre-mine agricultural capability.	• Vegetation type and density to support cattle grazing at the same standard as the pre-mining grazing activity.	• Scarification with direct seeding and fertilizer (primarily grasses and legumes) has been conducted. • Contour deep ripping, establish grasses and legumes to support cattle grazing has been implemented. • The success of the final land use is measured by live weight gain in grazing cattle on mining infrastructure lands. • Evidence in the Rehabilitation Report that measured erosion rates have shown to be comparable to unmined land in the same locality. • Results have shown that significant active erosion features are not present and that any initial erosion has been stabilised by vegetation cover; • Evidence has been included in Rehabilitation Report.
MIA and Infrastructure areas	Sustainable land use	All infrastructure to be removed or retained where applicable	• Beneficial land use – low intensity grazing - is established and proven to	• Predicted economics and /or benefits have been defined and agreed by the stakeholders. • Buildings, water management structures, roads (except

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
			be sustainable.	those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. • Where practicable, area accomplishes and remains as sustainable grazing. *To the extent that some Naroo Dam water impinges on the MDS mining lease, water quality in that water body will have been monitored for contaminants; and the grazing water quality criteria in the relevant Water Quality Guidelines will have been used as criteria for water management.*
MIA and Infrastructure areas	Sustainable land use	Soil properties to support eventual use as grazing land.	• Physical and Chemical properties of surface materials.	• Testing to confirm achievement of pH in range 6.0 to 9.0 for semi-arid grazing practices has been conducted. • Testing to confirm achievement of an Electrical Conductivity in soils of less than 1dS/cm for semi-arid grazing practices has been achieved. • Water testing has been conducted of surface water (ANZECC 2000) to ensure livestock standards achieved.
MIA and Infrastructure areas	Sustainable land use	Soil properties to support eventual use as grazing land.	• Physical properties.	• Regrading to an appropriate gradient has been undertaken for dry-land grazing practices.
MIA and Infrastructure areas	Sustainable land use	Establish specified self-sustaining natural vegetation and habitats.	• Presence of key species. • Species type and diversity. • Weeds.	• Environmental Audit has been conducted by qualified entity to grade success of: a) Erosion mitigation program; b) Vegetation program; c) Water monitoring program; and d) Weed management. • Documented usage of re-vegetation methods as per the Rehabilitation Management Plan

Mine Feature Name	Rehabilitation Goal	Rehabilitation Objectives	Indicators	Completion Criteria
				• Evidence of revegetation work with species forming the vegetation communities referenced in Table 5 of "Flora, fauna and freshwater ecology assessment of the Meteor Downs South Project, near Rolleston, Central Queensland 2012" to be included in Rehabilitation Report.
MIA and Infrastructure areas	Sustainable land use	Establish land use with comparable management requirements to similarly used non-mined land.	• Dryland grazing similar to grazing activities on surrounding unmined lands.	• Baseline Land Suitability Class has been determined in accordance with *Technical Guidelines for Environmental Management of Exploration and Mining Queensland* (QDME 1995). • Environmental audit has been conducted by appropriately qualified persons to: a) establish suitability of all areas for dryland grazing practices within 3 years of cessation of mining b) ensure post-mining land is of a Suitability Class; (QDME 1995) similar to the pre-mining Class as determined by the baseline study – MDS Soils, Land, Overburden and Process Waste Study; and c) there is long-term performance of safety barriers.

END OF PERMIT

APPENDIX B DRAFT NATIONAL RECOVERY PLAN FOR THE "BLUEGRASS (*DICANTHIUM* SPP.) DOMINANT GRASSLANDS IN THE BRIGALOW BELT BIOREGIONS (NORTH AND SOUTH)"

Draft national recovery plan for the “bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (north and south)” endangered ecological community

Queensland Government
Environmental Protection Agency

Australian Government

Draft national recovery plan for the "bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (north and south)" endangered ecological community.

Prepared by: Don W. Butler of the Queensland Environmental Protection Agency

Copies may be obtained from the:
Executive Director
Sustainable Communities
Environmental Protection Agency
PO Box 15155
City East, Qld, 4002

Disclaimer:
The Australian Government, in partnership with the Environmental Protection Agency facilitates the publication of recovery plans to detail the actions needed for the conservation of threatened native wildlife.

The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved, and may also be constrained by the need to address other conservation priorities. Approved recovery actions may be subject to modification due to changes in knowledge and changes in conservation status.

Publication reference:
Butler, D.W. 2008. Draft national recovery plan for the "bluegrass (*Dichanthium* spp.) dominant grasslands in the Brigalow Belt Bioregions (north and south)" endangered ecological community. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Environmental Protection Agency, Brisbane.

Contents

Executive Summary

Community and conservation status

This recovery plan is for four types of bluegrass grassland in the Brigalow Belt bioregion. These grasslands are collectively recognised as a threatened ecological community, referred to as "bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (north and south)". This grassland community is listed as an 'Endangered' ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Habitat and distribution summary

Bluegrass dominant grasslands occur on heavy black clay soils throughout the Brigalow Belt Bioregions. Their distribution had two main centres in Queensland – the Darling Downs and the Central Highlands – and also extended into New South Wales on the eastern Barwon River plains near Moree. The Darling Downs consisted of 390,000 hectares of grassland, of which 99 percent have been transformed, mainly into grain cropping. About 70 percent of the grasslands in the Central Highlands have also been replaced. Persistent grazing has changed the composition of much remaining grassland, so that plants of relatively low palatability are often dominant, and the grazing-sensitivity of some plants has largely restricted them to roadsides and other non-agricultural locations.

Threat summary

Expansion of exotic pastures and tree crops	Expansion of mining activities
Expansion of cultivation for cropping	Persistent heavy grazing
Invasive species	Construction of roads and other infrastructure
Lack of knowledge	

Recovery objectives

The overall objective of this plan is to maintain and conserve the environmental and pastoral values of the bluegrass grassland ecological community over the long term, by minimising the loss of such grasslands and encouraging improvement in their condition and management.

Summary of actions

The following actions are recommended:

A 1.1 Encourage landholders to enter into conservation agreements over bluegrass grasslands.

A 1.2 Increase the area of bluegrass grassland in the conservation estate.

A 2.1.1 Promote landholder awareness of sustainable management practices and their importance to the preservation of bluegrass grasslands' environmental and pastoral values.

A 2.1.2 Undertake consultation with indigenous groups to identify indigenous knowledge of and association with bluegrass EC.

A 2.1.3 Research and develop use of bluegrass grassland species for pasture renovation and land rehabilitation, and encourage mines, the Department of Main Roads and others to use native species in plantings by establishing a seed bank from which seed may be purchased at competitive prices.

A 2.1.4 Assist graziers to fence bluegrass grasslands out from other land types and to subdivide bluegrass grasslands to facilitate sound grazing management, including rest from grazing during critical periods in the summer growing season.

A 2.2 Officers to monitor and improve the condition of priority grasslands in stock routes and other roads in the Central Highlands and Darling Downs through management of grazing by travelling and agisted stock and by landholders' stock adjoining the stock route network.

A 3.1 Monitor selected populations of Belyando cobblers-peg, Dalton weed, downs Cymbonotus, finger panic grass, five-clawed worm skink, grassland earless dragon, king bluegrass, poppy-leaf nightshade, plains Picris and winged nightshade across the ecological community, and continue efforts to locate Allan's lerista.

A 3.2 Research into the basic ecology of key threatened species.

A 4.1 Research into the basic ecology of main ecosystem components and their response to common management practices, including a cost-benefit analysis to compare recovery actions.

1. General information

Conservation Status

"Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (north and south)" is listed as an 'Endangered' ecological community (EC) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Four of seven types of bluegrass grassland described for the Brigalow Belt bioregion (Sattler and Williams 1999) are included in the bluegrass grassland EC listing (Table 1).

Table 1 Summary of the Regional Ecosystems (mapped and described by QLD EPA) included within EPBC Act listed bluegrass grassland endangered ecological community.

Regional Ecosystem	Short description	Distribution
11.3.21	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils	Occurs throughout Brigalow Belt, often as relatively small black soil flats. Most of the Darling Downs grasslands belonged to this RE. About 40,000ha of 465,000ha remain.
11.4.4	*Dichanthium* spp., *Astrebla* spp. grassland on Cainozoic clay plains	Mainly in northern and eastern Brigalow Belt, particularly the Belyando Downs subregion. About 27,000ha remain of 69,000ha.
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	Most Central Highlands grasslands are of this type, also occurs elsewhere, notably in the Northern Bowen Basin subregion. Mapping suggests 177,000ha remain of 548,000ha.
11.9.12	*Dichanthium sericeum* grassland with clumps of *Acacia harpophylla* on fine-grained sedimentary rocks	Minor grassland type, mainly occurs in Dawson River Downs subregion, 4000ha of 24,000ha remain.

The four Regional Ecosystems that make up the bluegrass grassland EC are also listed under Queensland's *Vegetation Management Act 1999* (VMA) as 'Endangered' (11.3.21 and 11.9.12), or 'Of-concern' (11.8.11) and 'Not of concern' (11.4.4). However, the VMA focuses on woody plants, and 'vegetation' under the VMA excludes grass. As a result the VMA does not protect most remnant bluegrass grasslands in Queensland, other than natural woody components (RE 11.9.12 and 11.8.11) that occur in some bluegrass grassland. Two of the four regional ecosystems included in the bluegrass grassland EC are exempt from requirements to apply for a permit to clear native vegetation under the VMA (11.3.21 and 11.4.4). Cultivation is not controlled under the VMA unless it involves clearing woody plants.

The listing advice for the bluegrass grassland EC suggests that it does not occur in New South Wales. However, bluegrass dominant grasslands certainly occur in the NSW section of the Brigalow Belt South bioregion and have undergone extensive agricultural development (Hunter and Earl 2002). These grasslands are analogous to Regional Ecosystems 11.3.21 and 11.4.4 and are therefore arguably part of the bluegrass grassland EC. This plan applies to the listed entity, which is restricted to Queensland. It can, however, be used to guide management of bluegrass dominant grasslands in NSW.

International Obligations

Actions in this plan are consistent with Australia's international obligations.

Affected interests

The following organisations may have management responsibilities for the bluegrass grassland EC and threats to it identified in this plan.

<u>Natural Resource Management Regional Bodies</u>
Burdekin Dry Tropics Board
Condamine Alliance
Desert Channels Queensland Inc.

Fitzroy Basin Association
Queensland Murray Darling Committee Inc.
South West NRM Inc.

<u>Organisations representing landholder and public interests</u>
AgForce
Australian Conservation Foundation
National Farmers Federation
Queensland Farmers Federation
Queensland Resources Council
Queensland Conservation Council
The Wilderness Society
Wildlife Preservation Society of Queensland
WWF Australia

<u>Local Governments</u>

Banana Shire Council	Issac Regional Council
Barcaldine Regional Council	Murweh Shire Council
Blackall-Tambo Regional Council	Roma Regional Council
Central Highlands Regional Council	Southern Downs Regional Council
Dalby Regional Council	Toowoomba Regional Council

<u>Queensland Government</u>
Department of Natural Resources and Water
Department of Primary Industries and Fisheries
Environmental Protection Agency
Department of Main Roads
Queensland Transport
Department of Mines and Energy

Consultation with Indigenous people
Implementation of recovery plan actions includes consideration of the role and interests of Indigenous people whose country incorporates bluegrass EC. Documenting Indigenous knowledge and traditional management practices for bluegrass EC should be encouraged as part of this recovery program. Traditional owners will be encouraged throughout the life of this plan to be involved in further consultation and implementation of recovery actions.

Benefits of this plan to other species and communities
The actions recommended in this plan will benefit threatened species for which the bluegrass grassland EC is habitat (Table 2). The list includes several reptiles, one of which may be the only known Australian reptile to have become extinct since 1788 (Allan's lerista, *Lerista allanae*). This species has not been seen since 2003 but grassland reptiles such as this burrowing skink can be very difficult to find. Benefits to reptiles in bluegrass grasslands align with the goals of the Draft Recovery Plan for Reptiles in the Brigalow Belt Bioregion (by WWF-Australia).

In addition to the species listed in Table 2 there are several uncommon plants that occur predominantly in the bluegrass grassland EC but are not currently listed as threatened. Such species on the Darling Downs include downs Cymbonotus *Cymbonotus maidenii*, plains Picris *Picris barbarorum* and Dalton weed *Senecio daltonii*. Several animal species in Darling Downs grasslands are of regional conservation concern. Such species include spotted black snake *Pseudechis guttatus*, salmon-striped frog *Limnodynastes salmoni*, common dunnart *Sminthopsis murina*, narrow-nosed planigale *Planigale tenuirostris* and Australian bustard *Ardeotis australis* (Hobson 2002).

Table 2. Plants and animals that frequently or primarily occur in the bluegrass grassland EC and are listed as threatened under Queensland or Commonwealth legislation.

Scientific name	Common name	Commonwealth status[1]	Qld status[2]	Range
Plants				
Bothriochloa biloba	lobed bluegrass	vulnerable	no longer listed[3]	Darling Downs & NSW NW slopes & plains
Cyperus clarus	grassland sedge	not listed	vulnerable	From near Emerald to northern NSW
Dichanthium queenslandicum	king bluegrass	vulnerable	vulnerable	Grazing intolerant, most frequent in BBN, very rare on Darling Downs
Digitaria porrecta	finger panic grass	endangered	rare	Emerald-Springsure, Darling Downs & NSW NW slopes & plains
Discaria pubescens	hairy anchor plant	not listed	rare	Eastern Qld & northern NSW.
Picris evae	hawkweed	vulnerable	vulnerable	Grazing intolerant, Darling Downs & NSW NW slopes & plains
Solanum papaverifolium	poppy-leaf nightshade	not listed	endangered	Darling Downs & northern NSW
Solanum stenopterum	winged nightshade	not listed	vulnerable	From Moonie to Gayndah in southern QLD.
Rhaponticum australe	Austral cornflower	vulnerable	vulnerable	Grazing intolerant, eastern Darling Downs, Callide Valley, Carnarvon Station
Thesium australe	Austral toadflax	vulnerable	vulnerable	Grazing intolerant, southeast Qld, Carnarvon Ranges, northern NSW
Trioncinia retroflexa	Belyando cobblers-peg	not listed	endangered	Grazing intolerant, Clermont to northern Darling Downs
Animals				
Anomalopus mackayi	five-clawed worm skink	vulnerable	endangered	Darling Downs & NSW NW slopes & plains
Hemiaspis damelii	grey snake	not listed	endangered	From near Rockhampton to NW NSW.
Lerista allanae	Allan's lerista	endangered	endangered	Known from Retro, Logan Downs & Clermont in the BBN, last seen 2003
Tympanocryptis pinguicolla	grassland earless dragon	endangered	endangered	Darling Downs & Canberra-Monaro area

[1]*Environment Protection and Biodiversity Conservation Act 1999*
[2]*Nature Conservation Act 1992*
[3]*B. biloba* was formerly listed as Vulnerable by both Qld and NSW but has been de-listed

Social and economic impacts

The key to retention of the 'Endangered' bluegrass grasslands in the Brigalow Belt is to halt and reverse decline in their area and condition. The approach recommended is to encourage managers of significant areas of the bluegrass grassland EC to undertake activities that will not adversely impact on the bluegrass grassland EC, and facilitate improvements in grassland condition through education and support. In some situations this may impact upon plans to intensify use and may have an economic impact. The principle activities likely to be impacted are expansion of mining, and expansion of exotic pastures or crops.

Successful implementation of recovery actions that encourage improvement in the condition and sustainable utilisation of grasslands, including financial assistance and incentives, are anticipated to produce social and economic benefits as well as environmental benefits. Bluegrass grasslands are productive native pastures and their diversity and productivity are important to the long-term resilience and sustainability of pastoralism in the Brigalow Belt (Bisset 1960, Barrett and Bishop 2000). Sustainable grazing management and resulting improvements in pasture structure should reduce the cost of weed management. Some benefits are likely to be difficult to quantify but cost-benefit analysis of recovery actions should be undertaken during subsequent reviews of the plans implementation.

2. Biological information

Community description
Bluegrass grasslands can be floristically diverse communities containing many annual and perennial grass species, as well as various sedges and other herbs such as daisies and twining legumes. The relative dominance of bluegrass can vary considerably with soil type, seasonal conditions and management. The key terms in the title "bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt bioregions (north and south)" can be explained as follows:

- **bluegrass** is a common name for grasses of the genus *Dichanthium* and *Bothriochloa*, which are typically perennial tussocks with predominantly summer growing seasons. The most prominent bluegrass in the listed community is Queensland bluegrass *Dichanthium sericeum*. king bluegrass *Dichanthium queenslandicum* can also be a common grass in northern parts of the bluegrass grassland EC and is listed as 'Vulnerable' under Queensland's *Nature Conservation Act 1992* and the EPBC Act. King bluegrass is extremely rare on the Darling Downs however it can be common in well-managed grasslands in the Central Highlands.
- the **Brigalow Belt bioregions** (north and south) cover approximately six million hectares of predominantly sub-coastal country from Dubbo in central New South Wales to Townsville in north Queensland (Thackway and Creswell 1995).
- **grassland** is vegetation in which the predominant stratum (the vegetation layer that contains more biomass than any other layer) is typically and primarily composed of grasses. Fensham (2003) defined grasslands as "vegetation where trees and shrubs are sparse and where grasses, mostly perennial, are dominant". Natural grasslands are widespread in Australia, particularly in arid and semi-arid areas.

Queensland bluegrass (*Dichanthium sericeum*) is a very widespread and variable summer-growing grass prominent in Australian sub-humid tussock grasslands. In eastern Australia, early botanists and pastoralists called these grasslands 'bluegrass downs' to distinguish them from the semi-arid 'Mitchell grass downs'. These grassland types share a broad diffuse boundary (known as an ecotone), running from west of Clermont in central Queensland to Moree in northern NSW. Along this ecotone, a run of wet year's increases dominance of bluegrass, while drier years increase the prominence of Mitchell grasses. These shifts highlight the dynamic nature of grassland species composition (Blake 1938).

Bluegrass grasslands are generally dominated by several perennial tussock grasses including Queensland bluegrass *Dichanthium sericeum*, white speargrass *Aristida leptopoda,* Yabilla grass *Panicum queenslandicum*, native millet *Panicum decompositum*, satintop *Bothriochloa erianthoides*, coolibah grass *Thellungia advena*, hoop Mitchell grass *Astrebla elymoides* and curly Mitchell grass *Astrebla lappacea*. Annuals grasses such as Flinders grass *Iseilema* spp. can be very prominent when grasslands are recovering from prolonged heavy grazing or other disturbances such as drought. Growing among and between the grasses are legumes (e.g. creeping tick trefoil *Desmodium campylocaulon,* native sensitive plant *Neptunia gracilis* and *Vigna* spp.) as well as prostrate herbs (e.g. scurvy grass *Commelina ensifolia*), robust forbs (e.g. *Amaranthus* spp, bladder ketmia *Hibiscus trionum, Sida* spp. and *Verbena* spp.), saltbushes (e.g. *Atriplex* spp.) and daisies (e.g. woolly fuzzweed *Camptacra barbata,* bears-ears *Cymbonotus* spp., hawkweeds *Picris* spp., and fuzzweeds *Vittadinia* spp.). The diversity of life forms and species can be quite impressive. It is common to find more than 30 native plant species in 500m^2. Species composition varies with latitude; grasslands in the southern Brigalow Belt typically have more 'temperate' plants including wallaby grasses (*Austrodanthonia* spp.) and spear grasses (*Stipa* spp.) as well as more winter growing forbs (Fensham 1999).

The distribution of bluegrass grasslands within the Brigalow Belt is strongly constrained by soil type. Bluegrass grasslands occur on heavy clay soils that can range from grey to black in colour but are generally referred to as 'black soils' (Blake 1938). Black soils can develop in situ on fine-grained parent rocks with low silica content, such as mudstone, shale or basalt. Alluvial deposits commonly support heavy clay soils, and black soils are especially common on alluvium in catchments composed of fine-grained, low silica rocks (McKenzie *et al.* 2004). The bluegrass grasslands of the Darling Downs occurred on basalt-derived alluvium associated with the Condamine River.

The specific factors that restrict tree growth sufficiently to produce grasslands are not well understood. Association of grasslands with heavy soils in the Brigalow Belt might be due to the way black soils swell and shrink as they wet and dry, perhaps killing young trees by breaking their root systems. Other factors such as fire, frost, extreme drying during drought and soil chemistry (particularly low sodicity) may also be important for tree exclusion (Fensham 2003).

Deep cracking on black soils is thought to be a key habitat characteristic for some of the more grassland dependent fauna, particularly reptiles such as five-clawed worm-skink *Anomalopus mackayi*, grassland earless dragon *Tympanocryptis pinguicolla* and numerous other lizards and snakes (Hobson 2002). Deep soil cracks in bluegrass grasslands are also believed to be habitat for small mammals such as narrow-nosed planigale, long tailed planigale *Planigale ingrami*, pale field rat *Rattus tunneyi* and common planigale *Planigale maculata* (Goodland 2003, Hobson 2002, Keith and Betts 2003).

Other fauna, including several grassland birds, are thought to be more dependent upon structural complexity in grassland vegetation than soil structure for habitat quality. Well-developed grass tussocks and inter-tussock spaces of varying size and character, as well as forbs, twining herbs, and decaying vegetation provide structural complexity in grasslands. Vegetation cover provides nesting material and protection from avian predators for granivorous birds like brown quail *Coturnix ypsilophora*, stubble quail *Coturnix pectoralis*, little button-quail *Turnix velox* and red-chested button-quail *Turnix pyrrhothorax* as well as insectivores like rufous songlarks *Cincloramphus mathewsi*, brown songlarks *Cincloramphus cruralis* and golden-headed cisticola *Cisticola exilis* (Goodland 2003, Hobson 2002, Keith and Betts 2003).

Bluegrass grasslands also support an array of raptors (at least 12 species) including widespread species such as brown falcons *Falco berigora* as well as more grassland dependant species such as spotted harrier *Circus assimilis* (Augusteyn and Melzer 2002, Hobson 2002).

Ecology

Substantial changes in the condition and composition of bluegrass grasslands can occur over fairly short periods. High grazing pressure can remove vegetation cover from grasslands rapidly, whereas a good season can (but won't always) induce rapid recovery of grassland from a state of low vegetation cover. However the actual composition of a given bluegrass grassland at the end of a growing season can be affected by many factors.

Rainfall (season and quantity), grazing, fire, locusts, army-worms, weed invasion and soil seed banks can significantly affect grassland condition. Of these, grazing by domestic stock is the most widespread and manageable in remnant bluegrass grasslands. Grazing by undomesticated native and feral animals can also exert significant grazing pressure. Sustained heavy grazing pressure is clearly likely to alter grassland composition but lower grazing pressure can also produce changes (Prober and Thiele 1995, Orr and Phelps 2003). Grazing animals tend to preferentially consume the soft and sweet plant parts and species within a pasture. As a result grazing tends to favour the persistence of unpalatable species over palatable species. Grazing intensity often affects species composition and relative dominance more than it affects total species richness in grasslands (McIntyre and Lavorel 1994, Fensham 1998, Fensham *et al*. 1999, Lewis 2006).

Research into grazing dynamics highlights the complexity of the interactions involved and suggests that accurately predicting the response of many species to a given grazing regime, or changes therein, is often beyond current scientific capacity. This is probably because factors such as rainfall, temperature, other disturbances, and the presence or absence of other species can all be important in determining the response of a given species to grazing. For example, 41 percent of 324 species that showed significant positive or negative responses to grazing in two or more of 55 Australian grazing studies reviewed by Vesk and Westoby (2001), showed the opposite response in at least one other study.

Grazing is not incompatible with environmental values in remnant grasslands provided grazing is managed to maintain palatable perennial grasses and legumes, and to prevent erosion. Grazing can be compatible with the survival of some grazing sensitive plants such as Belyando cobblers-peg, particularly if it occurs outside their growing season (which means winter grazing for Belyando cobblers-peg, Fensham *et al.* 2002). Moderate levels of grazing can produce the highest levels of plant species richness (Fensham 1998, Orr and Phelps 2003). Total exclusion of grazing can also have detrimental outcomes including changes in grassland structure (Orr and Phelps 2003). Low intensity or intermittent grazing can increase the availability of suitable sites for seed germination (by reducing plant cover), while high frequency grazing reduces the persistence of perennials in some grasslands (Dorrough *et al.* 2004). However, Lewis (2006) found there was little evidence that grazing is necessary to maintain species richness in bluegrass/Mitchell grass grasslands in northern New South Wales. As a general rule extreme grazing frequency and intensity decreases the dominance of perennial plants and increases the prominence of annual grasses and herbs (Tremont 1994, Fensham *et al.*1999, Dorrough *et al.* 2004).

Pasture degradation associated with grazing in the bluegrass grasslands of Queensland's Central Highlands attracted attention soon after settlement (Bisset 1960). Substantial compositional changes had reportedly occurred prior to 1915 as a result of both extreme climatic events and grazing. The degradation was mainly increasing dominance of comparatively unpalatable native perennial tussock grasses, most frequently white spear grass *Aristida leptopoda* and Yabila grass *Panicum queenslandicum* (Everist 1939). Signs of more severe degradation in bluegrass/Mitchell grass grasslands include dominance by annual grasses or forbs, or dominance by herbaceous or woody weeds (McArthur *et al*. 1994).

Tothill and Gillies (1992) estimated that in 1991, 60 percent of bluegrass pastures in the Central Highlands were in 'Poor' condition and 'required rehabilitation and stabilisation needing major works or landuse change'. The condition of grasslands in the southern bluegrass grasslands was apparently better than in more northern areas in 1991, with an estimated 50 percent in 'Good' condition in the south compared to 10 percent in the northern bluegrass pastures (Tothill and Gillies 1992). Parthenium *Parthenium hysterophorus* invasion was listed as a major factor in the poor condition of northern bluegrass pastures.

Parthenium is an annual herb from the Americas, and is a declared pest plant (class 2) in Queensland. Persistent heavy grazing and other forms of disturbance such as inappropriate fires (resulting in slow recovery) and mechanical disturbance can facilitate parthenium invasion by increasing the space available to the invasive species. Reduction in pasture cover associated with parthenium invasion can also make cultivation a more attractive proposition to landholders, increasing the weed's threat to the bluegrass EC (Fensham 1999). However, sustainable grazing management can provide effective parthenium management in many cases (Chamberlain and Gittens 2004).

Maintaining a good component of perennial grasses is the most reliable method of managing the risk of parthenium invasion and should also maximise resistance to other weed species. Strategic rest (spelling) of grassland from grazing is an essential part of best practice management of parthenium infested pastures (Chamberlain and Gittens 2004). Spelling pastures for at least six to eight weeks early in the growing season, following rain or fire, is strongly recommended to allow grassland plants to set seed, establish seedlings and replenish plant reserves.

The apparent grazing sensitivity of threatened grassland flora means that infrequently grazed grasslands such as occur in stock routes and other roads, travelling stock reserves and railway corridors are now essential habitat for several threatened plants including King bluegrass *Dichanthium queenslandicum,* hawkweed *Picris evae,* Austral cornflower *Rhaponticum australe,* Austral toadflax *Thesium australe* and Belyando cobblers-peg *Trioncinia retroflexa* (Fensham 1998). Corresponding evidence for strong sensitivity to grazing has not been provided for grassland fauna, however studies are limited to date (Augusteyn and Melzer 2003). Grassland fauna are potentially threatened by grazing if it causes soil compaction or removes ground cover (Hobson 2002). Some grassland specialist fauna such as the pale field rat *Rattus tunneyi* and several bird species (stubble quail, brown quail, little button quail, red-chested button quail and singing bushlark *Mirafra javanica*) prefer habitats with high levels of vegetation cover and complexity, and are therefore likely to be threatened by management that reduces grass height and density such as persistent heavy grazing or persistent slashing.

The effect of grazing on bluegrass grasslands varies with conditions. For example, many plants are likely to be most palatable and most grazing sensitive as seedlings, which means that spelling grassland from grazing when seedlings are prevalent after rain can potentially increase recruitment of new plants. Consistent failure to spell grasslands following rain can result in deteriorating in pasture condition, including dominance by relatively unpalatable species. Summer is the most important period for successful germination and establishment of warm season perennial grasses, including bluegrass species (Lodge 1981), which suggests that spelling grasslands is particularly important following summer rainfall.

Spelling bluegrass grasslands during the summer growing season also increases the chances for plants to successfully set seed. Seed fall for many perennial grasses often begins about a month after flowering commences. Many bluegrass grassland species possess some form of seed dormancy mechanism. Such mechanisms rarely completely preclude germination immediately after seed fall but act to spread germination over a longer period (Lodge 1981, Lodge and Whalley 1981). Once pasture is dominated by relatively unpalatable species, re-establishing desirable perennial grasses can be a slow process (Bishop *et al.* 1999) and even relatively low grazing pressure appears to significantly retard recovery.

Further information on grazing management and monitoring is available from many sources including the Department of Primary Industries in New South Wales and DPI&F in Queensland.

***Recovery following severe disturbance*.**

Severe disturbances such as cultivation presumably increase the importance of the soil seed bank to grassland recovery. The seeds of Queensland bluegrass and many other native species increase in viability for the first year after seed set and remain viable in good, dry storage for up to eight to 10 years (Silcock *et al.* 1990). However persistence in dry storage is very different to field conditions. A recent assessment of seed banks in bluegrass grassland soils stored for 10 years indicated very little germinable seed remained after this period (Butler unpublished data[1]). Seed banks in bluegrass grasslands can contain relatively low seed densities (Bahnisch *et al.* 1999). These observations suggest that soil seed banks will be valuable for recovery of severely disturbed grasslands for limited periods, estimated maximum of four to five years, beyond which seed will have to disperse into the system to effect recolonisation. Drought or grazing can reduce seed production and therefore retard recovery (Lambert *et al.* 1999).

Queensland bluegrass appears to produce seeds with high viability (100% reported by Read and Bellairs 1999, 84% reported by Silcock *et al.* 1990, and 86-92% viability reported by Lodge and

[1] soil samples collected from bluegrass grasslands on the Darling Downs and Central Highlands in 1994 and 1995 were spread over trays of potting mix then regularly watered and monitored for 90 days. Half of the trays were also treated with smoke to test for possible germination enhancing effects. Germination of native grassland species was negligible.

Whalley 1981). Smoke has been shown to increase germination of Queensland bluegrass and greatly increases germination of native millet *Panicum decompositum* (Read and Bellairs 1999).

Anecdotal evidence suggests that Queensland bluegrass is a very effective coloniser of previously cultivated areas, and that the bluegrass component of bluegrass grasslands can re-establish within a few years of the cessation of cultivation (A. Goodland, J. Chamberlain, M. Olsen pers comm.). This was confirmed by observations of well-developed sward of bluegrass (including king bluegrass) in areas that had been cultivated up until five years earlier, in Albinia Downs National Park. This situation is exceptional because of the absence of domestic stock grazing during the recovery of the previously cultivated area.

More detailed survey work has demonstrated that the species richness of previously cultivated grasslands approaches that of adjacent remnant bluegrass grassland rapidly over the first 10 years, after which the rate of increase in species richness slows (Figure 1). This survey sampled 52 pairs of sites in fallow and adjacent remnant bluegrass grasslands across the Central Highlands, most of which included some grazing pressure from domestic stock. Areas that were cultivated tend to have 80 percent of the native species richness of adjacent remnant bluegrass grasslands after about 15 years of recovery. Although this study is a one-off assessment it sits well with anecdotal evidence and similar quantitative assessments from bluegrass/Mitchell grass grasslands in northern New South Wales (Lewis 2006).

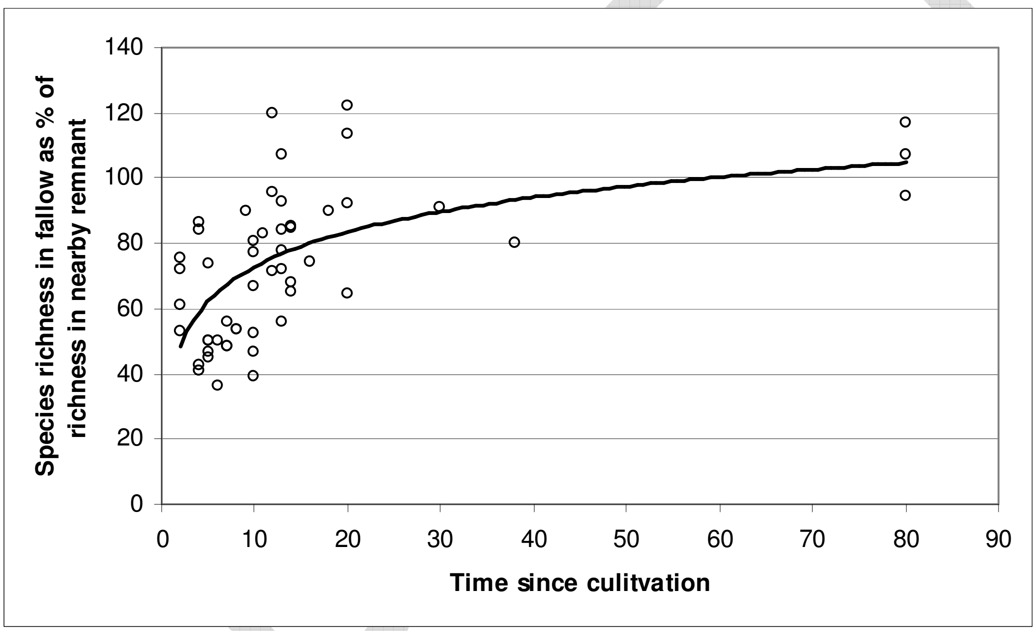


Figure 1. Association between time since last cultivation and the number of native species in previously cultivated areas as a percentage of the number of native species in adjacent remnant areas, for bluegrass grasslands in Queensland's Central Highlands.

While the overall richness of fallow paddocks increases over time, their floristic composition also changes considerably. During the first year or two they tend to support many prostrate herbs such as caltrop *Tribulus* spp. and cow vine *Ipomoea lonchophylla* and stoloniferous grasses such as *Moorochloa eruciformis*. Perennial tussock grasses establish more slowly and their establishment appears to be particularly sensitive to competition from other plants (including weeds like Parthenium) and grazing pressure. Complete 'recovery' from cultivation may take considerably longer than 10 or 15 years (particularly for some long lived species such as Mitchell grasses). Grazing management and the weather can have obvious effects. For example, constant or heavy grazing appears to impede perennial grass establishment and to bias the perennial grass tussocks toward species with relatively low palatability such as white speargrass *Aristida leptopoda* .

Distribution
Mapping of the current and historical distribution of the bluegrass grassland EC in Queensland is presented in Figure 2. The Queensland distribution features two major areas of occurrence for the bluegrass grassland EC: the Darling Downs in the south and the Central Highlands in the north. Grasslands in these two areas differ in species composition, the Darling Downs grasslands supporting more species typical of temperate grassy ecosystems (Fensham 1999). A third centre occurred in northern NSW, on the eastern Barwon River plains near Moree.

The total area of the four listed regional ecosystems comprising the EC within the Queensland portions of the IBRA Brigalow Belt bioregions[2] was 1,106,942 hectares prior to the commencement of cultivation. Twenty-three percent of this area (250,424 hectares) was mapped as remnant in 2003 (Queensland Herbarium Regional Ecosystem mapping, Version 5.0, released December 2005). Grasslands are classified as remnant in this mapping unless they have been cultivated within the last 15 years or are so degraded that they are unlikely to recover to a natural state in 15 years (Neldner *et al.* 2005). In practice, bluegrass grasslands that have not been cultivated in the preceding 15 years should be considered remnant as long as exotic perennial grasses contribute less than 50 percent of the total cover of perennial grasses. This rule of thumb was chosen because exotic perennial grasses are believed to be a key factor in recoverability to a ‘natural state’, and because it is also consistent with the 50 percent ‘undisturbed’ canopy cover cut-off used to distinguish remnant and non-remnant vegetation for tree and shrub dominated Regional Ecosystems. The mapped extent of remnant bluegrass grasslands is probably an over-estimate of the area of grassland fitting the remnant criteria outlined above. Although cultivation for cropping is quite apparent on satellite imagery, exotic grass establishment can be difficult to recognise. Further work on the condition of remnant grasslands will be valuable. As the apparent condition of bluegrass grasslands is highly variable, it might be more useful to assess whether grasslands that satisfy the remnant criteria generally retain the potential to attain good ecological condition over a reasonable time frame (less than 5 years) under appropriate management and median rainfall.

Twenty-five of the Brigalow Belt’s 34 Queensland subregions supported the bluegrass EC prior to clearing, and two of these subregions no longer contained mapped remnant areas of the bluegrass EC in 2003 (Appendix 1, Callide Creek Downs and Taroom Downs subregions). Clearing has been most comprehensive on the Darling Downs (the Eastern Darling Downs subregion in Appendix 1). The Darling Downs originally supported more than one third of the extent of the bluegrass EC but only 1 percent of this remained in 2003. Areas of remnant grassland on the Darling Downs are of the greatest significance to the overall distribution of the bluegrass grassland EC.

The Basalt Downs subregion (the core of the Central Highlands), which includes basalt country around Clermont and Springsure (Appendix 2), now contains more of the bluegrass grassland EC than any other subregion. Three other subregions supported more than 15,000ha of mapped remnant bluegrass grassland EC in 2003, the Claudie River Downs (southwest of Springsure), Belyando Downs (north-west of Clermont) and Northern Bowen Basin (north-east of Clermont) subregions. These three subregions together with the Basalt Downs subregion make up the Central Highlands. Recent ‘clearing’ of remnant grasslands (cultivation, mining, pasture development) has also been concentrated in the Central Highlands, particularly in the Basalt Downs subregion (7187ha between 1997 and 2003) and the Claudie River Downs subregion (1220ha).

The distribution of mapped remnants of the bluegrass grassland EC includes 25 local government areas (Appendix 3) and is covered by six of Queensland’s Natural Resource Management Regional Bodies (Appendix 4, Appendix 5). The Fitzroy Basin Association’s region supports 70 percent of mapped remnants, but the Burdekin Dry Tropics NRM’s region also supports 60 000 hectares. Sixty-two percent of mapped remnant areas of the EC occur on freehold land and 35 percent on leasehold land. Bauhinia, Belyando, Peak Downs and Emerald shires all contain substantial areas of the bluegrass grassland EC. Keith (2002) surveyed bluegrass grassland

[2]This excludes outlying occurrences of the listed Regional Ecosystems in adjacent bioregions, and also excludes the northern sections of the IBRA Darling Riverine Plain bioregion which project into southern Queensland but are generally treated as part of the Brigalow Belt by biodiversity planners in Queensland.

remnants on public lands in these shires and found that each support several hundred hectares of grassland with conservation value on public land, mainly on road reserves.

Overall the bluegrass grassland EC is extremely poorly represented within the conservation estate. Two percent of the remnant area of the bluegrass grassland EC occurs within conservation reserves or state forests, and of this 80 percent is in the recently acquired Albinia Downs National Park (Appendix 6, mainly RE 11.8.11). Some significant bluegrass grasslands are conserved on private nature reserves, including the Australian Bush Heritage Fund's Carnarvon Station and Goonderoo Station. Regional Ecosystems 11.4.4 and 11.9.12 are completely unrepresented in state forests or conservation reserves. It is strongly recommended that the representation of bluegrass grassland within the conservation estate be increased.

The modern distribution of the bluegrass grassland EC is substantially more fragmented than its historical distribution, indicated by greatly reduced numbers of large grasslands in the landscape (Appendix 7) and reduced proportions of grassland area in large patches (Appendix 8). This change has been more pronounced in the Brigalow Belt South than in the Brigalow Belt North. In the historical distribution, about 70 percent of the extent of the bluegrass grassland EC mapped in pure grassland patches occurred in the 5 percent of such patches larger than 1000ha. There are few patches of this size left in the Brigalow Belt South bioregion and they only occur in the Claudie River Downs subregion, which lies in the far north of the Brigalow Belt South bioregion and is appropriately considered part of the Central Highlands grassland complex. The largest remnant patch mapped on the Darling Downs covers less than 500ha whereas the largest patch in pre-clearing is estimated to have covered more than 230,000ha (EPA map data).

Reduction in grassland extent threatens species persistence in the landscape. As for most ecosystems, very few of bluegrass grasslands' component species are reliably present in most locations. The majority of species are quite infrequent in the bluegrass grasslands. For example, 161 native vascular plants were recorded in a recent one-off survey[3] of forty-nine 10m x 50m plots in remnant bluegrass grassland in the Central Highlands. Eighteen species (11%) were recorded in more than half of the plots, no species was recorded in all plots; closest were Queensland bluegrass and rhynchosia *Rhynchosia minima*, recorded in 48 of the 49 plots. Even if the 75 species (47 percent) that were recorded in one or two sites are excluded (as blow-ins or mis-identifications), half the remaining species were recorded in less than a quarter of plots. This suggests that rarity is a common condition for native plants (not always due to management), and also suggests that removal of large areas of habitat can impact substantially on the abundance of some species.

[3] conducted in February and March 2005

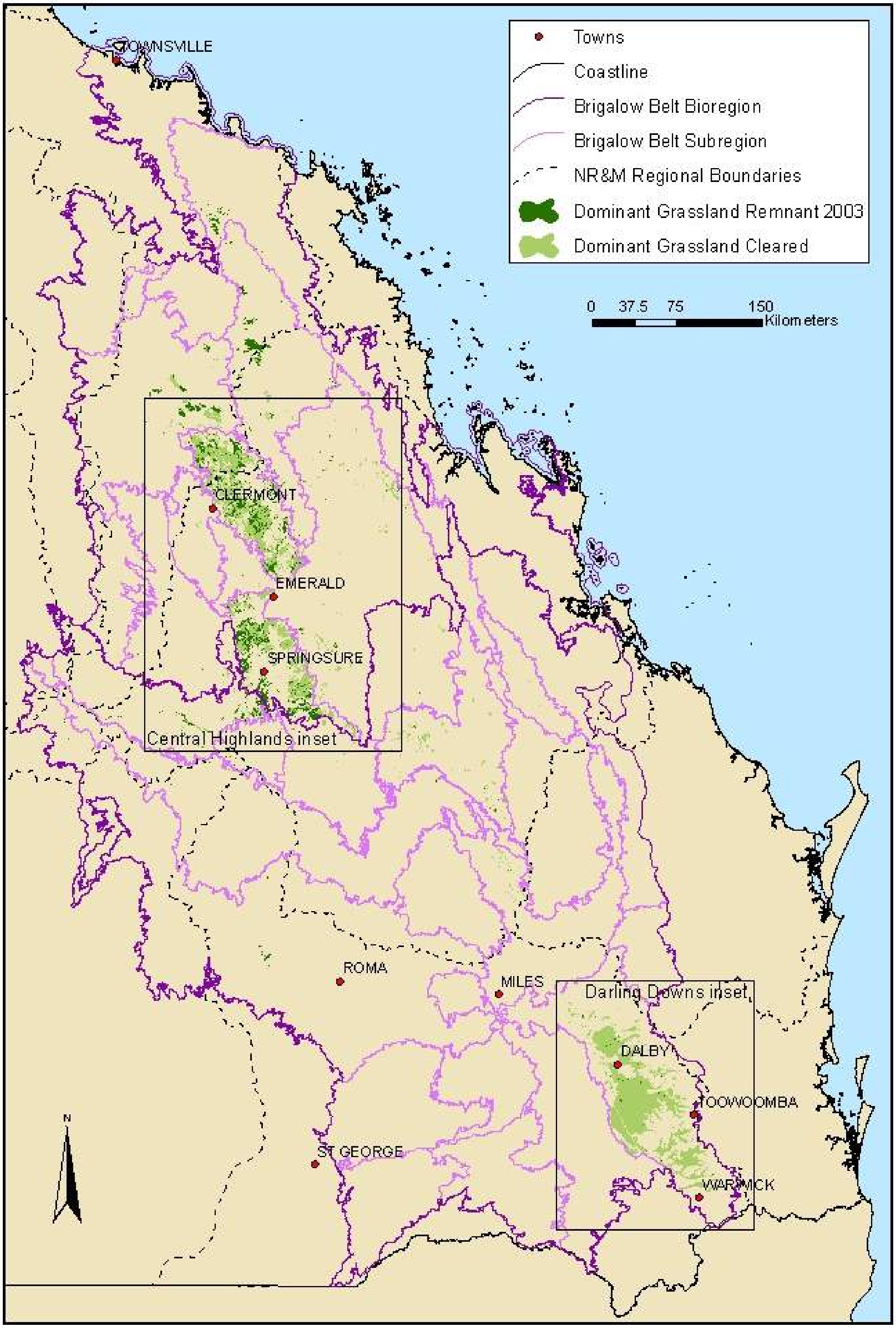
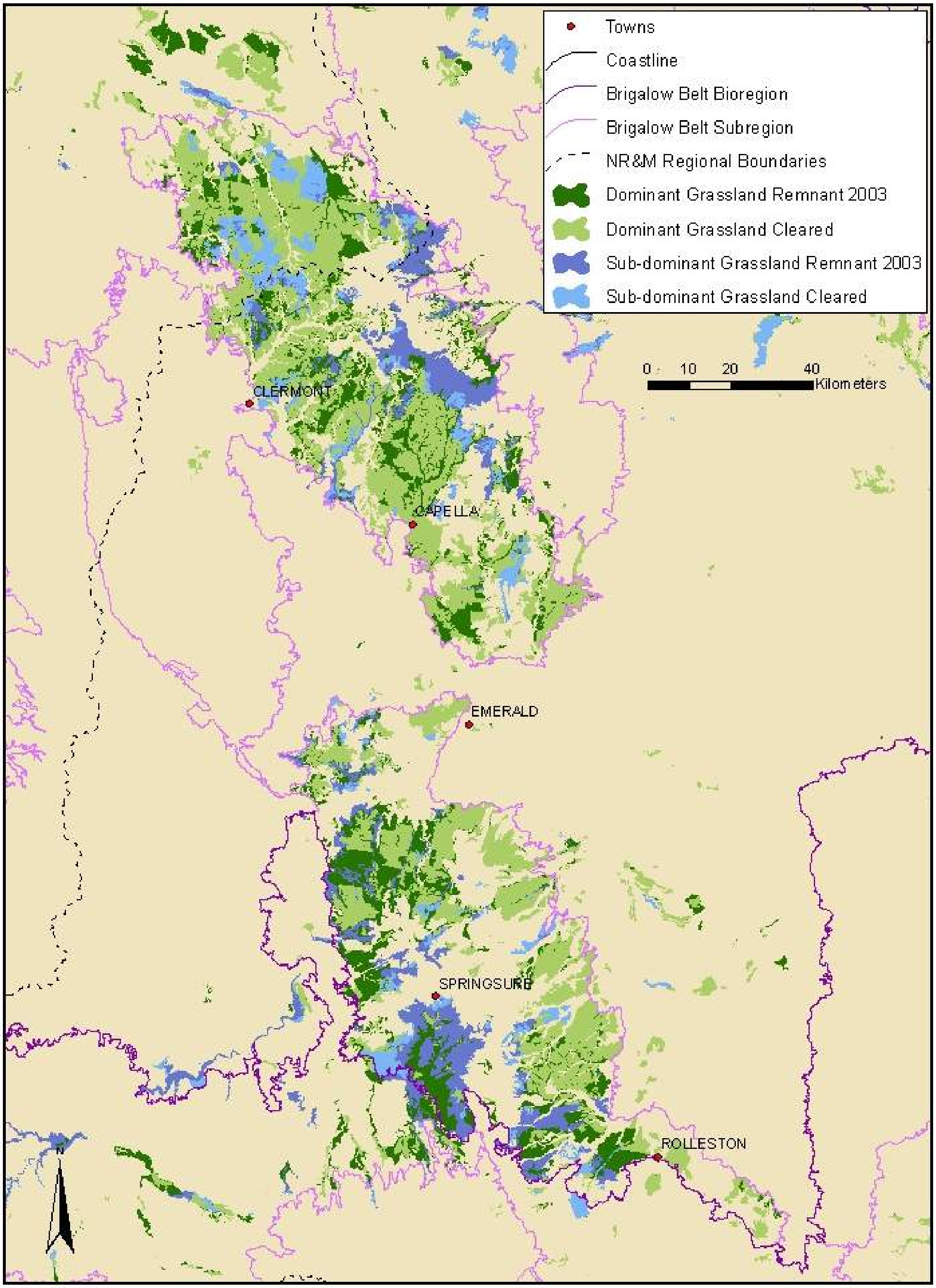
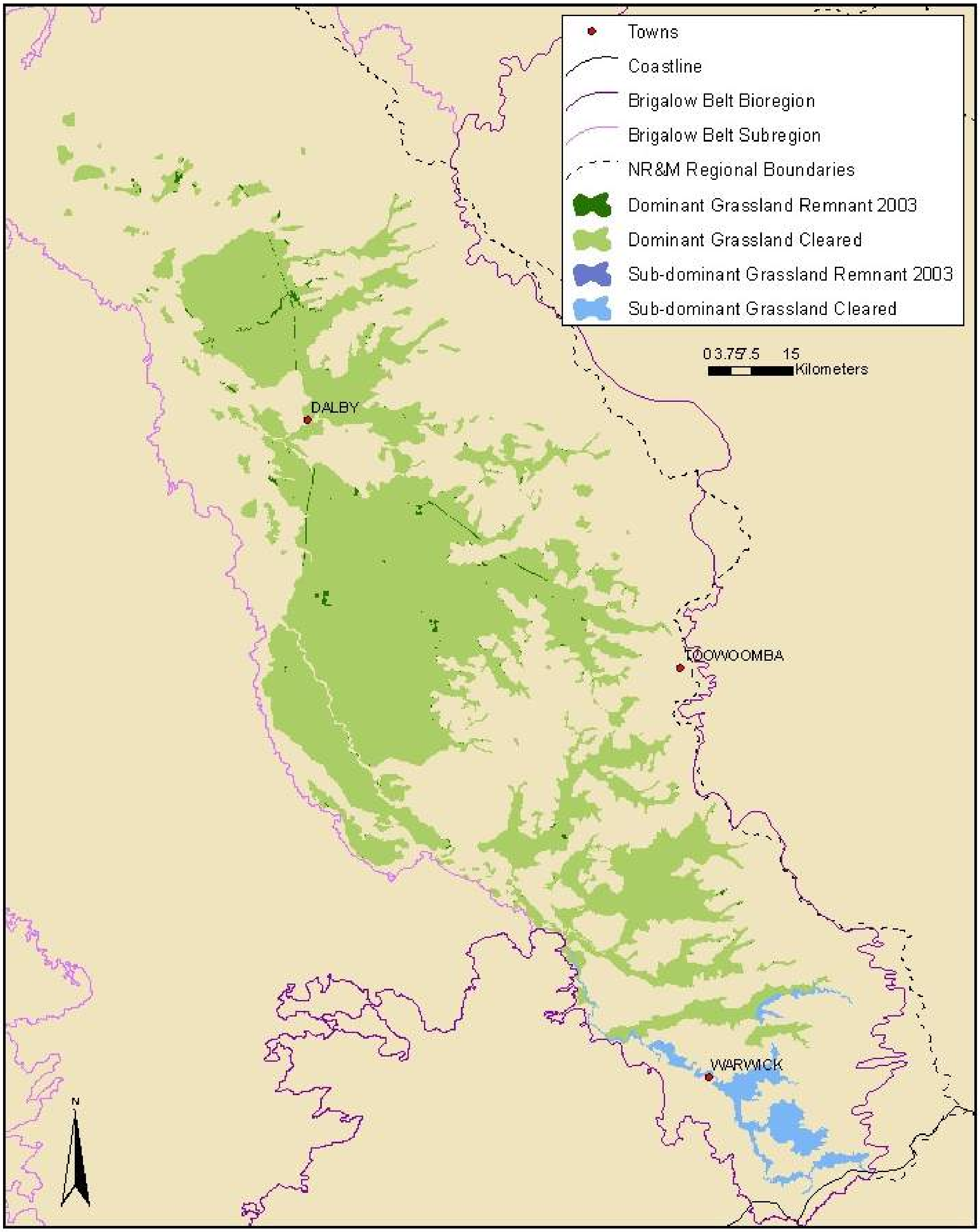


Figure 2 Distribution of bluegrass grasslands included in EPBC listing. Data from Queensland Herbarium 2005, only polygons in which EEC is dominant vegetation are shown.



Central Highlands Inset. Distribution of bluegrass grasslands included in EPBC listing.
Data from Queensland Herbarium 2005.



Darling Downs Inset Distribution of bluegrass grasslands included in EPBC listing.
Data from Queensland Herbarium 2005.

Habitat critical to the survival of the community

Habitat critical to the bluegrass grassland EC includes all remnant areas of Regional Ecosystems 11.3.21, 11.4.4, 11.8.11 and 11.9.12 within the Brigalow Belt bioregions. That is, areas which have not been cultivated within the last fifteen years and in which no more than half of the total perennial grass cover present is from exotic species. Beyond this statement, which identifies all vegetation included in the ecological community as currently mapped, higher priority areas are any that meet one or more of the following four criteria:

1. extensively developed subregion - severe reduction in grassland area on the Darling Downs means that all remaining grassland areas on the Darling Downs are habitat critical to the survival of the ecosystem and the geographic variation therein. Remaining patches in other extensively developed subregions such as the Dawson River Downs are essential habitat for the same reason. A cut-off for 30 percent of pre-clearing area remaining can be used to identify extensively developed subregions (Appendix 1), within which any remnant grassland is considered habitat critical to survival of the bluegrass grassland EC.
2. infrequent grazing - grasslands which receive infrequent grazing such as stock routes, travelling stock reserves, road and rail reserves and some paddocks (eg. weaner paddocks which are not grazed in summer) are of the highest conservation value because of the known sensitivity of many threatened grassland species to grazing.
3. threatened species – grasslands that are known habitat for any of the threatened grassland flora and fauna (listed in Table 2) are of the highest priority.
4. large area – large grassland areas are particularly valuable because large areas generally support more species and small grasslands are often over-grazed (in mixed-country paddocks). A suggested cut-off for ‘large’ grasslands is 50ha (about 30 percent of BBN grassland patches in mapping, accounting for about 90 percent of BBN grassland area). Note that smaller grasslands can also be of high value for one of the three reasons listed above.

These criteria suggest that all remnant areas of the bluegrass grassland EC in subregions with less than 30 percent of their pre-clearing grassland area remaining should be considered habitat critical to survival. Similarly, infrequently grazed areas on designated stock routes, travelling stock reserves, or on road or rail reserves are also habitat critical to the bluegrass EC, as are areas that support threatened species. Frequently grazed grasslands without threatened species that are in a subregion with more than 30 percent of the pre-clearing extent remaining, are habitat critical to the survival of the bluegrass grassland EC where they form part of a grassland covering 50ha or more (ignoring small breaks such as roads and fence lines). The same criteria should be considered when prioritising degraded grasslands for restoration work under offset arrangements.

The approach outlined here avoids problematic condition thresholds for inclusion within the bluegrass grassland EC, other than the basic criteria to establish remnant status i.e. at least 15 years since cultivation and less than 50 percent of the cover of perennial grasses provided by introduced species. Most of the criteria are based upon readily available spatial data (e.g. Regional Ecosystem Mapping, Stock Route maps), which is actively maintained and will be corrected where errors are identified. The exception is the criteria dealing with the presence of threatened species, which precludes comprehensive spatial description of critical habitat, however pre-existing data such as museum and herbarium databases can also be used as a first cut for this criterion.

3. Threats

Identification of threats

The main threats to the bluegrass EC are:

1. Expansion of exotic pastures and tree crops
2. Expansion of mining activities
3. Expansion of cultivation for cropping
4. Persistent heavy grazing

5. Invasive species
6. Construction of roads and other infrastructure
7. Lack of knowledge

The order in which the threats are listed above is based on judgement about the area potentially affected and the severity of impact of each of the threats, it is intended to be indicative only. Each of the listed threats interact so that exposure to one will often increase the chances of others occurring. For example, degradation of remnant bluegrass grasslands by persistent heavy grazing, and associated increases in unpalatable species and invasion of weeds such as parthenium, increases the economic attractiveness of cultivation to overcome weed problems, perhaps accompanied by exotic pasture development.

1. Expansion of exotic pastures and tree crops replaces the native flora of bluegrass grasslands with cultivated species or alters the grassland structure by introducing a woody over-storey. This threat is most concentrated in the east and south of the bluegrass grassland ECs distribution but occurs throughout its range. Common cultivated pasture plants utilised in recent times have included purple pigeon grass *Setaria incrassata*, butterfly pea *Clitoria ternatea*, bambatsi panic *Panicum coloratum*), Rhodes grass *Chloris gayana* (mostly variety 'Callide'), buffel grass *Pennisetum ciliare* (mainly variety 'Biloela'), creeping bluegrass *Bothriochloa insculpta,* (mostly variety 'Bissets'), Indian bluegrass *Bothriochloa pertusa*, and the only common tree crop is the fodder tree Leucaena *Leucaena leucocephala*. Some seed companies have begun offering 'black soil mixes' which include selections of the grasses listed above as well as other legumes. For preservation of the natural values of bluegrass grasslands the use of native grasses and legumes for restoration of bluegrass grasslands would be preferable to exotic pastures. It is likely that some landholders would use native seeds (particularly of bluegrasses and Mitchell grasses) if they were more readily available, preferably at competitive prices.

Pasture development can involve various techniques from simply broadcasting seed (eg. some legumes), delivering seeds into fairly intact grassland soil using machinery such as 'crocodile' or band seeders, through to intensive seed bed preparation by cultivation and planting. The more intensive the seedbed preparation the more native biota will be impacted. In terms of the remnant definition for grasslands, only intensive seedbed preparation involving 'ploughing' should be considered to be cultivation. Less intense forms of pasture development render grasslands non-remnant only if they make the grasslands native condition 'unrecoverable' within the medium term, this would probably be the case if exotic perennial grasses become dominant. Some of the pasture species mentioned above can also threaten 'intact' grasslands by invasion, the most notable example in recent years is the successful recent establishment of buffel grass, often in places that landholders have been broadcasting the seed for years with limited success. Whether this reflects a change in the grass or environmental change, such as recent run of dry years, remains to be seen. Such mechanically subtle forms of pasture development are difficult to detect using satellite imagery or aerial photography, which means that the mapped remnant area of the bluegrass grassland EC is an over-estimate of the actual area remaining.

Areas subject to pasture development can maintain some habitat value for bluegrass grassland flora and fauna, more so than areas subject to regular cultivation for cropping. For example, although development of butterfly pea pastures generally involves intense seedbed preparation, the fairly open pastures produced by butterfly pea often also feature native annual grasses such as Flinders grass (*Iseilema* spp.), as well as colonising vines such as caltrop (*Tribulus* spp.) and cow vine (*Ipomea lonchophylla*). Conversion of grasslands into leucaena (*Leucaena leucocephala*) plantations can sometimes briefly improve the condition uncultivated areas of bluegrass grassland in the same paddock, because grazing must be tightly controlled while the leucaena is establishing. However over the longer term, unless leucaena is planted in very wide rows (eg. 20m spacing), establishment of leucaena will substantially alter the grassland between the rows, and areas planted to dense leucaena will not be recognised as remnant grassland.

2. Expansion of mining activities threatens the bluegrass grassland EC because it can result in the physical destruction of grasslands. The Brigalow Belt in Queensland is a centre for coal and natural gas production, and mining activity, including exploration, is expanding on the Darling Downs and the Central Highlands. The coal industry is presently working with the Fitzroy Basin Association and government regulators, and has developed an industry-focused biodiversity strategy for the Bowen Basin. Exploration can have very little effect on grasslands. However, long-wall mining has the potential to affect substantial areas of the bluegrass grassland EC. Construction of other infrastructure associated with mining activities such as roads, conveyors, pipelines and spoil heaps can also be important factors in the overall impact of expanding mining activities. For some such infrastructure, Environmental Management and Cultural Heritage Management Plans are developed in association with the grant of Pipeline Licences under the *Petroleum and Gas Act 2004.* These generally require that rehabilitation of the very narrow construction corridor is undertaken. However, 'rehabilitation' may not equate to 'restoration' of the natural grassland composition and structure, and proponents should be required to undertake the highest level of rehabilitation in bluegrass grassland EC areas, utilising native species and re-establishing natural community structure.

The high value of the resource developed by mining means that mines are well placed to mitigate against impacts their activities have on remnant grasslands by rehabilitating greater areas of degraded but otherwise comparable habitat. Such 'offset' arrangements are likely to be an important part of balancing the need to conserve bluegrass grasslands against the economic benefits brought by mining. Wherever practicable such arrangements should aim to deliver the promised offset prior to the destruction of the pre-existing high-value habitat. Experience rehabilitating degraded grassland will also provide experience to guide restoration of grassland following mining.

Mine sites also often include grasslands that are out of the mine's direct path, and mining companies have shown that they can manage such grasslands for environmental benefit and should be encouraged to continue doing so. Nature refuge agreements or similar arrangements may be useful in such instances.

3. Expansion of cultivation for cropping remains an ongoing and immediate threat to the extent of bluegrass grasslands. Conversion of grassland to cropping removes many of the environmental values of the grassland, although cultivation paddocks may have residual value for some fauna and ruderal plants. A range of very valuable grain, pulse and forage crops are grown on the black vertosols derived from bluegrass grasslands, including grain sorghum, sunflowers, mungbeans and wheat as well as forage sorghum and oats. It is difficult to judge the aerial extent of the threat of cropping expansion to the bluegrass EC as it is possible that much of the land realistically suited to cultivation for cropping has already been converted to this purpose. This threat is most imminent to grasslands in the east and south but is a general threat across the range of the bluegrass grassland EC.

4. Persistent heavy grazing is a pressing threat to the bluegrass grassland EC because grazing is the predominant use to which remnant grassland is subject and:

- persistent heavy grazing can degrade grasslands and greatly increases the risk of weed invasion; and
- some threatened bluegrass grassland plants and animals are not favoured by grazing.

Grazing management should focus on maintaining the most palatable perennial species, such as Queensland bluegrass or king bluegrass, and carrying vegetation cover through the driest years. This generally means reducing cattle stocking rates from a typical year round average of around one cattle equivalent to 11 acres (4.5ha, Barrett and Bishop 2000) to something closer to 20 acres (8ha) per head, as well as spelling grasslands during the summer growing season as often as possible (wet season spelling). Given their importance as a grazing refuge, it is essential that grazing of endangered bluegrass grasslands in stock routes and travelling stock reserves is well managed and closely monitored. Although relatively few areas of stock routes and travelling stock reserves are likely to be subject to persistent heavy grazing, their general management should also follow the practice of minimising grazing pressure on bluegrass grasslands during the summer growing season.

Degraded paddocks appear to be particularly sensitive to grazing pressure, and even very low grazing pressure is sufficient to perpetuate degradation in grassland. Complete de-stocking in the short to medium term (one season to several years) is recommended in degraded areas, especially following summer rain, at least until key palatable perennial grasses are re-established. Weed management may become an issue in such situations. Advice on appropriate weed management is available through the Department of Primary Industries and Fisheries in Queensland and the Department of Natural Resources in New South Wales. Marsupial grazing pressure, and identifying appropriate management options for this pressure, can be a serious issue for some landholders attempting to spell paddocks and more closely manage grazing pressure (eg. case studies in Chamberlain and Gittens 2004).

When bluegrass grasslands are a small part of a paddock containing a mixture of land types they are at risk of degradation by preferential grazing. Fencing according to land type is strongly recommended to improve the management and condition of grasslands in such situations. For this reason, incentive schemes to help landholders with the cost of fencing bluegrass grasslands out of mixed country paddocks would be useful.

Persistent heavy grazing threatens the bluegrass grassland EC across it range but is least likely in areas such as road and rail corridors and in conservation reserves.

5. Invasive species threaten the value of bluegrass grasslands as habitat for native organisms and also often diminishes their pastoral value. This threat is present across the bluegrass grassland ECs range but the most invasive species vary. Invasive animals that use bluegrass grasslands include rabbits, pigs, cats, foxes, and dogs, as well as birds such as common starlings and Indian mynas. The most abundant animal pest found in grasslands is the house mouse *Mus musculus*. The house mouse potentially competes with native small mammals, reptiles and birds such as quail, and may impact upon seed production and recruitment by some plants. The house mouse is also an important food resource for grassland specialist predators such as the black-shouldered kite *Elanus axillaris*, Australian kestrel *Falco cenchroides*, barn owl *Tyto alba* and spotted black snake *Pseudechus guttatus*, as well as predators with more generalist habitat preferences such as eastern brown snake *Pseudonaja textilis* (Hobson 2002). There is very little information available on the impact of pest animals on bluegrass grassland's environmental or pastoral values.

Most invasive plants require some form of disturbance to invade healthy bluegrass grasslands. However, disturbances also include drought, fire, carefully managed grazing and the activities of native animals, and over the longer term weed invasion may occur without being facilitated by management. Many weed species will mostly occur as scattered plants and rarely reach plague proportions without severe disturbance (e.g. Mexican poppy *Argemone ochroleuca*). Some weeds, such as the exotic grasses listed in relation to road works, are primarily disturbance dependent for establishment in bluegrass grasslands, but hold onto sites very tenaciously following invasion.

Recent experience in the Central Highlands suggests that buffel grass is establishing populations on heavy black clay soils to which it had previously appeared unsuited. Buffel grass has also come to dominate the ground stratum in many areas of mountain coolibah *Eucalyptus orgadophila*)\ woodland, which often form a landscape mosaic with bluegrass grasslands. The invasion of these woodlands, which grow on slightly lighter and redder clay soils higher in the landscape, has implications for the biota of the bluegrass grasslands because the mountain coolibah woodlands used to provide additional habitat for many plants of bluegrass grasslands. In other words, invasion of woodlands by weedy grasses increases the overall pressure on many threatened grassland species.

The Weeds of National Significance include three species that threaten the bluegrass EC: parthenium *P. hysterophorus*, parkinsonia *Parkinsonia aculeata* and prickly acacia *Acacia nilotica* subsp. *indica*. Parkinsonia and prickly acacia are prickly leguminous shrubs. Parkinsonia is primarily a floodplain weed that threatens mainly the alluvial component of the bluegrass EC (RE 11.3.21) in the north, particularly adjacent dams. Prickly acacia currently occurs in the Central Highlands, around Clermont, and is climatically suited to clay soils over large areas of the Brigalow Belt bioregion (Spies and March 2004).

Some native woody weeds can also threaten the integrity of bluegrass grasslands. Such plants are often a natural part of bluegrass grasslands and intervention is only warranted where they present a clear threat to grassland integrity. Sally wattle *Acacia salicina*, a.k.a black wattle appears to be a particularly problematic species in the Central Highlands but mimosa *Acacia farnesiana* can also form dense thickets. Increasing density of wattles and other woody plants can be a result of fire exclusion. As such, initiation of appropriate fire regimes, particularly following woody weed germination events, is recommended as the preferred method to manage woody plant densities in grasslands. Fire may initially stimulate germination from the seed bank, resulting in more *A. salicina* after the first fire than before it. However, subsequent fires can reasonably be expected to slowly reduce the soil seed bank as well as killing some established plants, and eventually provide some control. Identifying appropriate fire regimes beyond broad guidelines (e.g. time fires to avoid exposing bare ground for extended periods, or to follow woody plant germination events), will require an adaptive approach from managers and would also benefit from specific research. Where dense and extensive stands of mature wattles or other shrubs are threatening the viability of high value grasslands (e.g. in stock routes) chemical or physical control may be required to re-establish grassland structure, after which more frequent burning may be adequate to keep their density low.

Weed invasion is a complex issue involving a large number of invasive plants. The basic principles of minimising disturbance, maintaining high grass cover, and allowing regular opportunities for native seed bank and plant reserve replenishment, offer the best chance for rapid recovery from unavoidable disturbance, and resistance to weed invasion. However, some particularly invasive species such as lippia *Phyla canescens* may still cause problems, which means that regular monitoring and early response to invasive species is important for grassland managers. For example, bluegrass grassland remnants in stock routes on the Darling Downs are of the highest significance to the bluegrass EC and are threatened by several serious weed species. Active and ongoing monitoring is strongly recommended in such situations to allow a rapid response to new incursions by weed species. Early intervention is well established as the most cost effective strategy in weed management.

6. Construction of roads and other infrastructure is a very significant threat to grasslands because:

- the Darling Downs bluegrass grasslands are a significant subtype of the bluegrass grassland EC which have been cleared to about one percent of their original extent, much of which occurs in road reserves; and,
- bluegrass grasslands in road reserves and rail corridors provide essential habitat for grazing intolerant flora and fauna. Grazing by domestic stock is a pervasive influence in remnant grasslands and some species (e.g. *Trioncinia retroflexa*) are so sensitive to grazing that infrequently grazed bluegrass grassland (such as road and rail reserves) is frequently of the highest conservation value.

Road widening and associated construction of culverts, drainage lines, stock-piles, site offices and turning circles destroy grassland cover, and therefore directly damage the ecosystem and also increase the likelihood of weed invasion and soil erosion. Importation of rock and soil and mechanical disturbance associated with road work frequently enables invasion by exotic grasses such as Columbus grass *Sorghum x almum*, Johnson's grass *Sorghum halepense*, African lovegrass *Eragrostis curvula*, Rhodes grass *Chloris gayana*, buffel grass *Pennisetum ciliare*, green panic *Megathyrsus maximus*, paspalum *Paspalum dilatatum* and rat's tail grasses *Sporobolus* *natalensis* and *S. pyramidalis*. Slashing and movement with stock helps to spread these grasses and they are very difficult to eradicate once established.

Unnecessary slashing occurs on some broad areas of stock routes on roadsides. Although slashing has potential to spread weeds it probably has limited impact on the bluegrass grassland EC provided it is restricted to the already disturbed road verge (within a few metres). Persistent slashing of larger areas of remnant bluegrass grasslands, particularly on roadsides on the Darling Downs, certainly alters their value as habitat for cover dependent fauna (Hobson 2002) and is also likely to increase the risk of weed invasion by spreading propagules and providing open space for weed establishment. Frequent slashing may also inhibit flower and seed production by taller plants and could result in compositional changes over the long term (a few years to a decade).

7. Lack of knowledge about complex issues such as climate change, the detailed ecology of threatened species, weed invasion and fire regimes means that we could be overlooking some threats to the bluegrass grasslands in the Brigalow Belt. A strategic approach to development of knowledge about the grasslands should involve detailed studies of the ecology of the relevant common and threatened species, as well as formalised and appropriately funded monitoring programs and management research to assess trends in condition and function.

Threatened species (listed in Table 2) are candidates for ecological research however reliable knowledge of even quite common species is generally poorly known. Even some of the rarest and most charismatic creatures such as the grassland earless dragon *Tympanocryptis pinguicolla* are poorly known. The ecology of the related, lined earless dragon *Tympanocryptis lineata* on grasslands in the Central Highlands probably also needs study. The ecology of Queensland bluegrass and King bluegrass should certainly be more closely examined, particularly since their palatability may make them useful as indicators for sustainable grazing management. Survey and ecological work is also clearly needed on other rare and poorly known species that are not currently listed as threatened, such as downs Cymbonotus *Cymbonotus maidenii*, plains Picris *Picris barbarorum* and Dalton weed *Senecio daltonii*.

Although rare species deserve research attention, documented understanding of key grassland components, including common species such as *Dichanthium sericeum* and other dominant perennial grasses and key legumes, is also inadequate. Detailed work on key grassland species and community level studies will increase and test our knowledge of the ecosystem as a whole.

Populations under threat

Not all populations are equally threatened by all of the threatening processes, for example the threat of road and infrastructure construction is more likely for the high priority grasslands in road and rail reserves, stock routes and travelling stock reserves.

Table 3. Threats summary

Type of threat	Current actions to reduce threats	Future actions to reduce threats
Expansion of exotic pastures and tree crops	Protection under EPBC Act. Protection under nature-refuge agreements and other reserves. Sustainable grazing management.	Encourage sustainable grazing management of native species. Ensure relevant proposed future land management actions are referred under the EPBC Act.
Expansion of mining activities	Protection under EPBC Act. Protection under Mineral Resources Act 1989 and Environment Protection Act 1994. Protection under nature-refuge agreements.	Ensure relevant proposed future land management actions are referred under the EPBC Act. Negotiated conservation agreements and appropriate offset arrangements. Purchase land for addition to protected area estate.

Expansion of cultivation for cropping	Protection under EPBC Act. Protection under nature-refuge agreements and other reserves.	Ensure relevant proposed future land management actions are referred under the EPBC Act. Negotiated conservation agreements. Purchase land for addition to protected area estate.
Persistent heavy grazing	Extension work by DPI&F and others to encourage and empower landholders to adopt sustainable grazing practices. Provisions under Land Protection Act to prevent land degradation of the stock route network by overgrazing.	Financial support or incentives for best practice grazing management and more resources for extension by DPI&F. Strengthening of legislative provisions concerning grazing of the stock route network and other relevant land.
Invasive species	Considerable effort is already made to control weedy plants and pest animals by landholders and numerous government and non-government agencies. DPI&F extension often identifies prevention of weed invasion as a major benefit from sustainable grazing practices.	Avoid propagation or promotion of invasive exotic species. More resources to encourage sustainable grazing practices. Control slashing where appropriate. Research into problematic pest animals and invasive plants (including natives), and their control.
Construction of roads and other infrastructure	Mining companies, Shire Councils, Main Roads and Queensland Transport have environment officers and protocols in place to minimise impact on endangered vegetation.	Reinforce importance of roadside grasslands to relevant agencies. Periodic survey of roadsides to provide up-to-date information on the distribution of high value grasslands to relevant agencies.
Lack of knowledge	Considerable previous research as well as informal monitoring by landholders and biologists.	Further research into detailed ecology of key ecosystem components and threatened species. Including fire ecology, recruitment and mortality. Establish strategic monitoring.

4. Objectives and criteria

The following objectives, criteria and actions are included here as starting points for discussion.

Overall objective
Maintain and conserve the environmental and pastoral values of the bluegrass grasslands in the Brigalow Belt over the long term, by minimising the loss of bluegrass grasslands in the Brigalow Belt and improving their condition and management.

Specific objectives

S.O. 1 Maintain all areas of the bluegrass grassland EC in subregions in which its extent is 30 percent or less of its pre-clearing extent and, in other subregions, maintain areas of the bluegrass EC that are either known habitat for threatened species, are infrequently grazed, or are larger than 50ha.

S.O. 2 Promote landholder awareness of bluegrass grasslands and their sustainable management to improve the condition of bluegrass grasslands across the Brigalow Belt.

S.O. 3 Maintain or enhance populations and knowledge of threatened flora and fauna from bluegrass grasslands, such as grazing sensitive plants.

S.O. 4 Improve knowledge of key ecosystem components, such as perennial grasses and legumes, and identify appropriate management practices that will contribute to S.O. 2.

Performance criteria
Progress toward the objectives of this plan can be measured against the following performance criteria:

C 1 The area of the bluegrass grassland EC in extensively developed subregions (30 percent or less of EC's pre-clearing extent remaining) does not decline, and no remnant areas 50 ha or larger, or known to support threatened species, or in infrequently grazed situations (such as on public land) are cultivated, mined or otherwise rendered non-remnant between 2008 and 2012.

C 2.1.1 Greater frequency of palatable perennial grasses in 2012 than in surveys conducted in February-March 2005.

C 2.1.2 Fencing and water infrastructure in grazed portions of the bluegrass EC is modified to better integrate the ecological needs of the grasslands into grazing management, principally for spelling during the growing season.

C 2.2 Improved condition of grasslands on stock routes, travelling stock reserves, and road and rail corridors in the Central Highlands and on the Darling Downs.

C 3.1 Monitoring established for selected populations of Belyando cobblers-peg, Dalton weed, downs Cymbonotus, finger panic grass, five-clawed worm skink, grassland earless dragon, king bluegrass, poppy-leaf nightshade, plains Picris and winged nightshade across the EC and these populations are extant in 2012.

C 3.2 Increased knowledge of the ecology of threatened species, documented in peer-reviewed publications.

C 4.1 Increased knowledge of the ecology of key ecosystem components and their responses to common management practices documented in peer-reviewed publications and summarised into public information resources.

Evaluation of recovery plan
The plan will be reviewed at intervals no longer than five years. Implementation will be reviewed by relevant experts, including EPA staff, and should include a cost–benefit analysis to identify those actions that deliver value.

5. Recovery actions

The implementation of the following recovery actions needs co-operation with landholders managing bluegrass grasslands. In many cases existing management is adequate, explaining the presence of diverse grasslands or the persistence of healthy populations of threatened species. Where actions are recommended they may require external resources beyond the responsibilities of landholders. The costs associated with these actions are total estimates for five years and the real cost will depend upon how they are implemented and how well they are taken up.

Action 1.1 Encourage landholders to enter into conservation agreements over bluegrass grasslands.

Negotiation of conservation agreements, such as Nature Refuges in Queensland and Conservation Agreements in New South Wales, which attach to the title and cover all or part of a parcel of land, can be mutually beneficial for landholders and biodiversity. In Queensland, landholders who commit to a Nature Refuge agreement may be eligible for the land tax and transfer duty reimbursement under the NatureAssist program. Environmental Protection Agency Nature Refuge Officers undertake property assessments, negotiate Nature Refuges and provide follow-up advice and assistance with management. In addition, lessees may be entitled to benefits under proposed changes for leaseholders under the *Land Act 1994* and may be advantaged in seeking grants for conservation works (e.g. fencing, watering points) through Natural Resource Management Regional Bodies and the Australian Government's Caring for our Country initiative.

Relevant aims for nature refuges over bluegrass grasslands might include low intensity stock grazing with regular rest in the growing season, as well as effort to remove or contain any localised infestations of invasive plants such as buffel grass, and avoid introducing new weeds into the grassland (e.g. on vehicles or in stock guts). Flora and fauna surveys would be conducted initially when preparing to enter a Nature Refuge agreement and should be repeated periodically to gauge the affect of management.

Several initiatives have been taken to encourage the management of both remnant and regenerating native vegetation by private landholders. The Australian Government provides grants for on-ground work to improve environmental management. In Queensland, landholders who have sufficiently viable and important vegetation to establish a nature refuge can also apply for funding under the NatureAssist program (a competitive tender arrangement under Queensland's Environmental Partnerships Scheme, Queensland Environmental Protection Agency). NatureAssist funding can provide assistance for a range of activities which include managing areas to allow for natural regeneration.

An alternative to a perpetual conservation agreement would be to consider a Land for Wildlife agreement or similar agreement coordinated by local councils or NRM Regional Bodies. These arrangements are non-binding and encourage and support landholders to provide habitat for native plants and animals on their property.

Potential contributors: Queensland Environmental Protection Agency (EPA), Australian Government, Natural Resource Management Regional Bodies and Queensland Department of Natural Resources and Water (DNRW).

Action 1.2 Increase the area of bluegrass grassland in the conservation estate.
The bluegrass grassland EC is poorly represented in the national park estate (2% of remnant area). Increasing the area of bluegrass grassland in the protected area estate avoids the conflict between production and conservation values present across most of the landscape. Alluvial grasslands (Regional Ecosystem 11.3.21) have been extensively cultivated and are particularly poorly reserved. Grasslands on Cainozoic clay plains are also very poorly reserved. There may also be opportunities to reserve bluegrass/Mitchell grass grasslands that are not part of the EPBC

Act listed bluegrass EC but are habitat for many of the same species, such as grasslands with patchy brigalow or coolibah on Cainozoic clay plains (RE 11.4.11) and on fine grained sedimentary rock (RE 11.9.3).

Strategic establishment of populations of threatened flora within existing conservation reserves is also recommended.

Potential contributors: EPA, NRM Regional Bodies, and NRW.

Action 2.1.1 Promote landholder awareness of sustainable management practices and their importance to the preservation of bluegrass grasslands' environmental and pastoral values.

Field days aimed at people with an interest in bluegrass grasslands, including landholders and government officers, should be conducted to demonstrate well managed grasslands in good condition and to provide a forum for extension of best practice grassland management. Some landcare groups are already conducting such field days. Field days would ideally include the experience of extension and research officers of the Department of Primary Industries and Fisheries. Field days will also progress some of the other proposed actions including encouragement toward Nature Refuge agreements (A 1.2) and discussion of sustainable grazing management (A 2.1.1 and A 3.2). The Department of Primary Industries & Fisheries (DPI&F) "Stocktake Grazing Land Management" package (Aisthorpe and Paton 2004, Open Downs land type) provide a useful framework within which to promote best practice grazing management of bluegrass grasslands.

Potential contributors: NRM Regional Bodies, AgForce, Queensland Farmers Federation, Queensland Resources Council, DPI&F, EPA, Indigenous representatives and NRW.

Action 2.1.2 Undertake consultation with indigenous groups to identify indigenous knowledge of and association with bluegrass EC.

Use existing networks of Aboriginal Land Management Facilitators within NRM groups to consult with traditional owner groups and document their knowledge about habitat values and management in bluegrass EC..

Potential contributors: Indigenous representatives, NRM Regional Bodies.

Action 2.1.3 Research and develop use of bluegrass grassland species for pasture renovation and land rehabilitation, and encourage mines, Department of Main Roads and others to use native species in plantings by establishing a seed bank from which seed may be purchased at competitive prices.

Though desirable, the uses to which native pasture species are currently put are limited by the availability and cost of seed and technological know-how regarding its use. Significant progress has been made toward establishing native grass industries in southern Australia but relatively little progress has been made in Queensland.

Natural Resource Management Regional Bodies could help this industry to develop by seeking and funding appropriate proposals. For example, a first step might trial the use of material from healthy bluegrass grasslands to renovate or recover degraded pastures, perhaps by cutting and bailing hay from a healthy bluegrass grassland late in summer (when the grasses are carrying seed) and then spreading the hay over a degraded pasture. Similar trials may be appropriate to restore grasslands subject to physical disturbance such as road works. Other techniques such as seed harvesting and sowing perennial grasses such as Queensland bluegrass also need trialling. The use of native species should be encouraged. The ecology of Queensland bluegrass and other grassland plants certainly suggests they have potential as utility species.

Techniques using native grassland species for restoration or reclamation will develop faster if their use is required by policy and government action. At present exotic grasses such as buffel grass and Rhodes grass tend to be species of choice for reclamation of disturbed areas. This is primarily because the seed of such species is readily available whereas native species are not. Investment is required to address this discrepancy. Establishing a seed bank of key species such as Queensland bluegrass would enable parties with an interest in using natives to purchase seed. Whether potential users will buy seed will often depend upon a reasonably competitive price. Mining companies and other potentially large-scale users of seed may find it in their interest to establish seed reserves themselves and should be encouraged to do so. When using seed, local provenance should be sought.

Potential contributors: NRM Regional Bodies, Queensland Resources Council (and its members), DPI&F, Queensland Department of Main Roads (DMR), EPA, CSIRO, local government and Universities.

Action 2.1.4 Assist graziers to fence bluegrass grasslands out from other land types and to subdivide bluegrass grasslands to facilitate sound grazing management, including spelling from grazing during critical periods in the summer growing season.

Sustainable grazing management of bluegrass grasslands has mainly been developed and communicated by pasture scientists and extension officers from the Queensland Department of Primary Industries and Fisheries. Extension officers possess knowledge relevant to a very wide range of problems landholders face, including weed management, pasture decline and soil loss. Additional support for these officers in the form of assistance to run field days, production of extension material and information sheets, and most importantly, extra staff to increase the availability of their services, would all benefit grazing management of the bluegrass grasslands.

Field days, as discussed in Action 2.1.1, should be organised to discuss and demonstrate sustainable grazing management of bluegrass grassland, involving graziers and other managers of bluegrass grasslands, as well as representatives of regional NRM bodies and government.

Bluegrass grasslands in paddocks mainly of other land-types can be preferentially grazed. The threat of overgrazing can be managed by fencing so that grasslands are major components of the paddocks within which they occur. This will not always be practical but should be encouraged where it is.

Persistent heavy grazing is well understood as a major cause of pasture decline and dominance by unpalatable perennial grasses or weeds. Grassland managers should be encouraged and assisted to strategically spell paddocks during phases of very active growth during and following wet warm weather. This might require additional watering points, fences or other infrastructure.

Financial support for this action may already be available under initiatives such as the NatureAssist (administered by Queensland Environmental Protection Agency) or the Australian Government 's Caring for our Country. Natural Resource Management Regional Bodies may also have opportunities to help landholders better manage grasslands. Fencing by land type and summer spelling should also be common components of Nature Refuge agreements or other conservation agreements.

Potential contributors: DPI&F, Australian Government, and NRM Regional Bodies

Action 2.2 Officers to monitor and improve the condition of priority grasslands in stock routes and other roads in the Central Highlands and Darling Downs.

Grasslands in stock routes, other roads and travelling stock reserves are important parts of the bluegrass grassland 'Endangered' ecological community because of their association with infrequent grazing, but they are linear strips with large edge to interior ratios and may be particularly prone to weed invasion and disturbance.

For the Central Highlands, Keith's (2002) survey of grasslands on stock routes and road reserves provided a basis for ongoing monitoring and targeted management. It is recommended that at least the priority grassland areas identified by Keith (Table 5) are revisited and permanent monitoring plots are installed. In the process, weed issues in each area should be identified and then systematically addressed. Where signage has not been installed to identify these areas this should be addressed with signs installed at each end of the grassland area. Neighbouring landholders, local government stock route supervisors and fire wardens should be consulted regarding fire management history and constraints, and where appropriate fire should be applied to portions of the areas and the results monitored. Where low quality areas such as infestations of Columbus grass or Johnson's grass interrupt high quality section of grassland in a stock route they should be targeted for restoration.

On the Darling Downs the grasslands in stock routes and road reserves comprise about a third of the bluegrass grassland ecological community's remaining distribution and are therefore of the highest biodiversity significance. Remnant grassland areas on the Darling Downs were mapped by Fensham (1996) and the condition of the four major stock route grasslands was assessed by Goodland (2000), as summarised in Table 6.

Table 5. Priority stock route grassland areas in the Central Highlands (from Keith 2002)

Shire	Road
Belyando Shire	1. Peak Downs highway from the Charters Towers Road turn-off to Wolfang Peak. 2. Kilcummin-Diamond Downs Road 3. Clermont-Dysart Road
Peak Downs Shire	1. Gregory Highway at Lilyvale between Freshfields and Lucknow 2. Gregory Highway at Retro Creek
Emerald Shire	1. Gregory Highway at Fernlees 2. Cullin-La-Ringo Road
Bauhinia Shire	1. Gregory Highway between the Emerald shire boundary and Minerva Creek 2. Dawson Highway between Staircase Range and Orion 10 Chain Road 3. Orion 10 Chain Road between Dawson Highway and Orion State School 4. Dawson Highway between Bottle Tree Downs Road and Rolleston 5. Wealwandangie Road

Table 6. Priority stock route grasslands on the Darling Downs (from Goodland 2000)

Stock Route	Description
Warrego Highway (from western end of Oakey bypass to Bowenville)	Wide stock route adjacent rail corridor. Mainly in good condition but threatened by weedy grasses including Rhodes grass and African lovegrass, being spread by slashing. Known habitat for *Anomalopus mackayi, Thesium australe*, *Digitaria porrecta* and first record of *Dichanthium queenslandicum* on Darling Downs since 1951.
Dalby to Jandowae Road (from railway intersection in Dalby to Jandowae)	Wide stock route. Mix of grassland and poplar box woodland. Mainly in good condition but some significant degraded parts.
Dalby to Cecil Plains Road (from 1.8km south of Warrego Highway to 13km NE of Cecil Plains)	Some areas heavily invaded by Lippia *Phyla canescens* and others degraded by exotic grasses. Unconfirmed record of *Tympanocryptis pinguicolla* from 1970's. Known habitat for *Cymbonotus maidenii*

Warrego Hwy & Dalby to Kogan Rd. (from 5km west of Dalby to Condamine River on Kogan Rd.)	Wide stock route with patches in excellent condition and others that have been badly degraded. Known habitat for *Hemiaspis damelii*, *Digitaria porrecta* and *Solanum papaverifolium*

For the Darling Downs, it is recommended that the condition assessment for these priority stock routes reported by Goodland be repeated and permanent monitoring plots installed. In the process, weed issues in each area should be identified and then systematically addressed. Where signage has not been installed to identify these areas this should be addressed, with signs installed at least at each end of the grassland area. Where low quality areas such as infestations of Rhodes grass *Chloris gayana* interrupt more natural sections of grassland in a stock route they should be targeted for restoration.

Stock Route Management Plans are currently being prepared for most shires that contain grasslands on stock routes and travelling stock reserves. The monitoring and intervention work proposed in this action will provide opportunities for collaborative work with stock route supervisors, land protection officers, neighbouring landholders and other grassland managers.

Potential contributors: Toowoomba Regional Council, Dalby Regional Council, Central Highlands Regional Council, Isaac Regional Council, NRM Regional Bodies, NRW, DPI&F, DMR and EPA.

Action 3.1 Monitor selected populations of Belyando cobblers-peg , Dalton weed, downs Cymbonotus, finger panic grass, five-clawed worm skink*,* grassland earless dragon, king bluegrass, poppy-leaf nightshade*,* plains Picris and winged nightshade across the EC, and continue efforts to locate Allan's lerista.

Monitoring of selected populations has been established across the EC and these populations are extant in 2012. Sites containing threatened flora and fauna should be identified and subject to ongoing monitoring.

Plant species recommended for monitoring include: Belyando cobblers-peg *Trioncinia retroflexa*, Dalton weed *Senecio daltonii,* finger panic grass *Digitaria porrecta,* downs Cymbonotus *Cymbonotus maidenii*, king bluegrass *Dichanthium queenslandicum,* poppy-leaf nightshade *Solanum papaverifolium*, plains Picris *Picris barbarorum* and winged nightshade *Solanum stenopterum.* Animal species recommended for monitoring include: five-clawed worm skink *Anomalopus mackayi* and grassland earless dragon *Timpanocryptis pinguicolla.*

Monitoring should be attentive to recovery from fire, grazing or other management interventions and should be set up in collaboration with local stock route supervisors, extension officers and landholders.

High priority should also be given to further attempts to locate populations of Allan's lerista *Lerista allanae*. This burrowing skink was last seen in 2003 and is possibly extinct. If extinct, Allan's lerista is the only known Australian reptile to have become extinct since 1788.

Potential contributors: Councils, EPA, DMR, DPI&F, Universities and NRM Regional Bodies.

Action 3.2 Research the basic ecology of threatened species as part of the ecological community*.*

Studies of the ecology of threatened species are a core part of a strategic approach to the development of knowledge about 'Endangered' bluegrass grasslands. The grassland earless dragon is poorly known and 'Endangered' and occurs on the Darling Downs while the related lined earless dragon *Tympanocryptis lineata* occurs on grasslands in the Central Highlands. Studying the basic habitat requirements, diet, breeding and mortality in both areas would enable betterinformed management of its populations and of grasslands more generally. Closer examination of the earless dragons on the grasslands of the Central Highlands is also probably warranted.

The ecology of king bluegrass should also be subject to detailed research. King bluegrass is a highly palatable perennial grass with potential as an indicator species for grazing management, but little is documented about why it is apparently so sensitive to grazing, its breeding biology or its habitat requirements. It would help biodiversity planning to know more about the numerous rare and poorly known species in bluegrass grasslands (examples under A 3.1).

Potential contributors: Universities, EPA, CSIRO.

Action 4.1 Research into the basic ecology of main ecosystem components and their response to common management practices, including a cost-benefit analysis to compare recovery actions.

Our understanding of the ecology of bluegrass grasslands is incomplete. More published information is needed on the response of key ecosystem components (including perennial grasses and legumes but especially fauna), to grazing, fire and invasive species. Research scientists in the Department of Primary Industries and Fisheries have been working for decades on these issues and should be supported to continue to do so, but more research is also needed into the ecology of the bluegrass grasslands' fauna.

Additional work on economic aspects of bluegrass grassland recovery would also be useful. Although concepts such as improvement in grassland condition and environmental values are notoriously difficult to quantify in dollar terms, a cost-benefit analysis of the various actions proposed under this plan should be undertaken when it is reviewed in 2012.

Potential contributors: Universities, DPI&F, EPA, CSIRO.

Table 7. Recovery summary

Specific objective	Performance criteria	Actions	Priority
S.O. 1 Maintain all areas of the bluegrass grassland EC in subregions in which its extent is 30 percent or less of its pre-clearing extent and, in other subregions, maintain areas of the bluegrass EC that are either known habitat for threatened species, are infrequently grazed, or are larger than 50ha.	C 1 The area of the bluegrass grassland EC in extensively developed subregions (30 percent or less of EECs pre-clearing extent remaining) does not decline, and no remnant areas 50 ha or larger, or known to support threatened species, or in infrequently grazed situations (such as on public land) are cultivated, mined or otherwise rendered non-remnant between 2007 and 2011.	A 1.1 Encourage landholders to enter into conservation agreements over bluegrass grasslands.	med
		A 1.2 Increase the area of bluegrass grassland in the conservation estate.	high
S.O. 2 Improve the condition of bluegrass grasslands across the Brigalow Belt.	C 2.1.1 The frequency of palatable perennial grasses is greater in 2011 than it was in surveys conducted in February-March 2005.	A 2.1.1 Promote landholder awareness of the importance of sustainable management practices to the preservation of bluegrass grasslands' environmental and pastoral values.	high
		A 2.1.2 Undertake consultation with indigenous groups to identify indigenous knowledge of and association with bluegrass EC.	high
		A 2.1.3 Research and develop use of bluegrass grassland species for pasture renovation and land rehabilitation, and encourage mines, main roads and others to use native species in plantings by establishing a seed bank from which seed may be purchased at competitive prices.	high
	C 2.1.2 Fencing and water infrastructure in grazed portions of the bluegrass EC is modified to better integrate the ecological needs of the grasslands into grazing management, principally for spelling during the growing season.	A 2.1.4 Assist graziers to fence bluegrass grasslands out from other land types and to subdivide bluegrass grasslands to facilitate sound grazing management, including rest from grazing during critical periods in the summer growing season.	med
	C 2.2 The condition of grasslands on stock routes & roads etc in the Central Highlands and on the Darling Downs is improved.	A 2.2 Officers to monitor and improve the condition of priority grasslands in stock routes in the Central Highlands and Darling Downs through management of grazing by travelling and agisted stock and by landholders' stock adjoining the stock route network..	high

S.O. 3 Maintain or enhance populations and knowledge of threatened flora and fauna from bluegrass grasslands, such as grazing sensitive plants.	C 3.1 Monitoring established for selected populations of Belyando cobblers-peg, Dalton weed, downs Cymbonotus, finger panic grass, five-clawed worm skink, grassland earless dragon, king bluegrass, poppy-leaf nightshade, plains Picris and winged nightshade across the EC and these populations are extant in 2011.	A 3.1 Monitor selected populations of Belyando cobblers-peg, Dalton weed, downs Cymbonotus, finger panic grass, five-clawed worm skink, grassland earless dragon, king bluegrass, poppy-leaf nightshade, plains Picris and winged nightshade across the EC, and continue efforts to locate Allan's lerista.	med
	C 3.2 Knowledge of bluegrass grasslands and threatened species, documented in peer-reviewed publications, is increased.	A 3.2 Research into the basic ecology of key threatened species.	med
S.O. 4 Improve knowledge of key ecosystem components, such as perennial grasses and legumes, and identify appropriate management practices that will contribute to S.O. 2.	C 4.1 Knowledge of the ecology of key ecosystem components and their responses to common management practice, documented in peer-reviewed publications, is increased.	A 4.1 Research into the basic ecology of main ecosystem components and their response to common management practices, including a cost-benefit analysis to compare recovery actions.	med

6. Management practices

Other than managing to avoid gross physical or biological disruption (such as long wall mining, road works or pasture development) the primary management practice relevant to maintaining 'Endangered' bluegrass grasslands in the Brigalow Belt is grazing. For bluegrass grasslands it is recommended that fencing and water infrastructure should be designed to allow responsive stock management and to control grazing pressure on grassland areas in mixed-country paddocks. Grazing management should aim to maintain healthy populations of palatable perennial grasses such as Queensland bluegrass *Dichanthium sericeum*. Aim to keep at least 50 percent of the ground surface covered by grass (droughts permitting), and allow grasslands strategic rest from grazing of two to three months duration, preferably during the summer growing season, especially following rain.

Infrastructure works such as pipeline construction and road works are potential causes of weed dispersal and often provide disturbed ground, which may increase the chance of weed establishment. Avoiding such impacts is recommended, especially in infrequently grazed situations. Where they can't be avoided, care should be taken to minimise weed spread and establishment. For most such infrastructure, Environmental Management and Cultural Heritage Management Plans are developed in association with the grant of Pipeline Licences under the *Petroleum and Gas Act 2004*, these generally require that rehabilitation of the very narrow construction corridor is undertaken. Rehabilitation with native grasses should be encouraged.

The high value of the resources produced by mining in the Brigalow Belt means that mines are well placed to mitigate against impacts their activities have on remnant grasslands by rehabilitating greater areas of degraded but otherwise comparable habitat. Such 'offset' arrangements are likely to be an important part of balancing the need to conserve bluegrass grasslands against the economic benefits brought by mining. Wherever practicable such arrangements should aim to deliver the promised offset prior to the destruction of the pre-existing high-value habitat.

7. Cost of recovery ($)

Table 8. Recovery cost summary

Action		2008	2009	2010	2011	2012	Total
1.1	Encourage conservation agreements	15,000	10,000	10,000	10,000	5000	50,000
1.2	Acquisition for conservation estate	10,000	10,000	10,000	3,000,000	0	3,030,000
2.1.1	Promote landholder awareness	5000	5000	5000	5000	0	20,000
2.1.2	Undertake consultation with indigenous groups						
2.1.3	Research and develop native plant usage and seed bank	100,000	100,000	100,000	100,000	100,000	500,000
2.1.4	Assistance for improved infrastructure and management	150,000	70,000	50,000	20,000	10,000	300,000
2.2	Officers to monitor and improve priority stock route grasslands	150,000	150,000	150,000	150,000	150,000	750,000
3.1	Monitor selected species[A]	5000	5000	5000	5000	5000	25,000
3.2	Research into basic ecology of threatened species[A]	10,000	10,000	2000	2000	1000	25,000
4.1	Research into basic ecology of key	20,000	20,000	20,000	20,000	20,000	100,000

ecosystem components[A]						
Total	465,000	380,000	352,000	3,312,000	291,000	4,800,000

[A]Cost for actions 3.1, 3.2 and 4.1 assume full implementation of action 2.2.

Acknowledgements
Thanks to the many Central Highlands landholders who discussed grassland management with the author and allowed access to their fallow paddocks and bluegrass grasslands. For comments on drafts and advice on relevant literature and issues thanks to: John Chamberlain, Harry Bishop, David Orr, Richard Silcock and Ruth Kerr (DPI&F); John Neldner, Rod Fensham, Russell Fairfax, Juliana McCosker, Lara Connell and Sara Williams (EPA); Peter Sparshott (Queensland Department of Main Roads); Craig Magnussen and George Borne (NRW), Frances Hayter (Queensland Resources Council), Alison Goodland (Queensland Murray Darling Basin Commission); Tom Lewis (University of New England), and; Helena Mills (Australian Government Department of Environment, Water, Heritage and the Arts).

References

Aisthorpe J. and Paton C. 2004 *Stocktake. Balancing supply and demand*. Department of Primary Industries and Fisheries, Brisbane.

Augusteyn J. and Melzer R. 2002 *Central Highlands bluegrass downs fauna study*. Report for WWF Australia, Queensland Parks and Wildlife Service, Rockhampton.

Bahnisch G.A., Orr D.M., Rickert K.G., Quirk M.F. and Hilder T.B. 1999 Germinable soil seed banks of Queensland bluegrass pastures in Central Queensland. In *People and Rangelands: building the future. Proceedings of the VIth International Rangelands Congress.* eds D. Eldridge and D. Freudenberger VI International Rangelands Congress, Inc: Aitkenvale, Qld., pp. 241-242.

Barrett C. and Bishop H. 2000 *Producer management practices for Queensland bluegrass downs country*. Queensland Department of Primary Industries, Mackay.

Bishop H.G, Hilder T.B., Lambert G.A., Dodt R.M. and Bahnisch G. 1999 Reclaiming and sustaining the productivity of Queensland bluegrass pastures. In *People and Rangelands: building the future. Proceedings of the VIth International Rangelands Congress.* eds D. Eldridge and D. Freudenberger VI International Rangelands Congress, Inc: Aitkenvale, Qld., pp. 239-240.

Bisset W.J. 1960 Overcoming white spear and yabila grass problems. *Queensland Agricultural Journal* **86**, 401-406.

Blake S.T. 1938 The plant communities of western Queensland and their relationships, with special reference to the grazing industry. *Proceedings of the Royal Society of Queensland* **49**, 156-204.

Chamberlain J. and Gittens A. 2004 *Parthenium weed management.* Department of Natural Resources and Mines, Brisbane.

Dorrough J., Ash J. and McIntyre S. 2004 Plant responses to livestock grazing frequency in an Australian temperate grassland. *Ecography* **27**, 1-13.

Everist S.L. 1939 Some notes on the Springsure and Clermont districts, July 1938. *Queensland Agricultural Journal* **51**, 30-42.

Fensham R.J. 1998 The grassy vegetation of the Darling Downs, south-eastern Queensland, Australia. Floristic and grazing effects. *Biological Conservation* **84**, 301-310.

Fensham R.J. 1999 Native grasslands of the central highlands, Queensland Australia. Floristics, regional context and conservation. *Rangeland Journal* **21**, 82-103.

Fensham R.J. 2003 Grasslands. In P. Attiwill and B. Wilson (*eds*) *Ecology; an Australian perspective.* Oxford University Press, Melbourne. pp 247-262.

Fensham R.J., Fairfax R.J. and Holman J.E. 2002 Response of a rare herb (*Trioncinia retroflexa*) from semi-arid tropical grassland to occasional fire and grazing. *Austral Ecology* **27**, 284-290.

Fensham R.J., Holman J.E. and Cox M.J. 1999 Plant species responses along a disturbance gradient in Australian grassland. *Journal of Vegetation Science* **10**, 77-86.

Fitzroy Basin Association (2007) *Biodiversity Values of Coal Mining Areas in the Bowen Basin ~ Threatened Species and Communities.* Fitzroy Basin Association, Rockhampton

Goodland A. 2000 *Grassy ecosystem significant sites of the Darling Downs, Queensland. Locations and management recommendations*. WWF Australia, Spring Hill.

Goodland A. 2003 *More than meets the eye: Your guide to managing the native grasslands of Queensland's Darling Downs*. WWF Australia, Spring Hill.

Hobson, R. 2002 *Vertebrate fauna of remnant native grasslands of the eastern Darling Downs.* Report for Environmental Protection Agency and World Wide Fund for Nature (WWF), Toowoomba.

Hunter J.T and Earl J. 2002 *Floristic descriptions of grassland areas on the Moree Plains.* Unpublished report to the Department of Land and Water Conservation and the NSW National Parks and Wildlife Service.

Keith G. 2002 *Bluegrass downs native grasslands remnants on public lands in the central highlands*. WWF Australia, Spring Hill.

Keith G. and Betts S. 2003 *Getting down to grass roots: your guide to the fauna of Queensland's Central Highland's bluegrass downs.* WWF Australia, Brisbane. 22 pp.

Lambert G.A., Hilder T.B., Bishop H.G. and Dodt R.M. 1999 Regeneration of drought-affected Queensland bluegrass pastures. In *People and Rangelands: building the future. Proceedings of the VIth International Rangelands Congress.* eds D. Eldridge and D. Freudenberger VI International Rangelands Congress, Inc: Aitkenvale, Qld., pp. 239-240.

Lewis T. 2006 Management for conservation of plant diversity in native grasslands of the Moree Plains, NSW. PhD Thesis, Ecosystem Management, University of New England, Armidale.

Lodge G.M. 1981 Establishment of warm- and cool-season native perennial grasses on the north-west slopes of New South Wales. II Establishment and seedling survival in the field. *Australian Journal of Botany* **29**, 121-133.

Lodge G.M and Whalley R.D.B. 1981 Establishment of warm- and cool-season native perennial grasses on the north-west slopes of New South Wales. I. Dormancy and germination. *Australian Journal of Botany* **29**, 111-119.

McArthur S.R., Chamberlain H.J and Phelps D.G. 1994 State and transition models for rangelands. 12. A general state and transition model for Mitchell grass, bluegrass-browntop and Queensland bluegrass pasture zones of northern Australia. *Tropical Grasslands* **28**, 274-278.

McIntyre S. and Lavorel S. 1994 How environmental and disturbance factors influence species composition in temperate Australian grasslands. *Journal of Vegetation Science* **5**, 373-384.

McKenzie N.J., Jacquier D., Isbell R. and Brown K. 2004 *Australian soils and landscapes; an illustrated compendium.* CSIRO Publishing, Melbourne. 416pp.

Neldner V.J., Wilson B.A., Thompson E.J. and Dillewaard H.A. 2005 *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland*. Version 3.1. Updated September 2005. Queensland Herbarium, Environmental Protection Agency, Brisbane. 128 pp.

Orr D.M. and Phelps D.G. 2003 Plant species diversity in *Astrebla* spp. grassland following 18 years of sheep grazing. In Allsop N., Palmer A.R., Milton S.J., Kirkman K.P., Kerley G.I.H., Hurt C.R. and Brown C.J. (eds.) *Rangelands in the New Millenium, Proceedings of the VIIth International Rangelands Congress 26th July – 1st August 2003, Durban, South Africa*. International Rangeland Congress. pp 256-258.

Prober S.M. and Thiele K.R. 1995 Conservation of the grassy white box woodlands: Relative contributions of size and disturbance to floristic composition and diversity of remnants. *Australian Journal of Botany* **43**, 349-366.

Read T.R. and Bellairs S.M. 1999 Smoke affects the germination of native grasses of New South Wales. *Australian Journal of Botany* **47**, 563-576.

Sattler, P.S. and Williams, R.D. (*eds*) 1999 *The conservation status of Queensland bioregional ecosystems*. Environmental Protection Agency, Brisbane.

Silcock R.G., Williams L.M. and Smith F.T. 1990 Quality and storage characterstics of the seeds of important native pasture species in south-west Queensland. *Australian Rangeland Journal* **12**, 14-20.

Spies P. and March N. 2004 Prickly acacia national case studies manual; approaches to the management of prickly acacia (*Acacia nilotica* subsp. *indica*) in Australia. Queensland Department of Natural Resources Mines and Energy, Brisbane.

Thackway R. and Cresswell I.D. (*eds*) 1995 *An Interim Biogeographic Regionalisation for Australia: A framework for establishing the national system of reserves.* Australian Nature Conservation Agency, Canberra.

Tothill J.C. and Gillies C. 1992 *The pasture lands of northern Australia: Their condition, productivity and sustainability.* Tropical Grassland Society of Australia Occasional Publication No. 5, Tropical Grassland Society of Australia Inc., Brisbane.

Tremont R.M. 1994 Life history attributes of plants in grazed and ungrazed grasslands on the Northern Tablelands of New South Wales. *Australian Journal of Botany* **42**, 511-530.

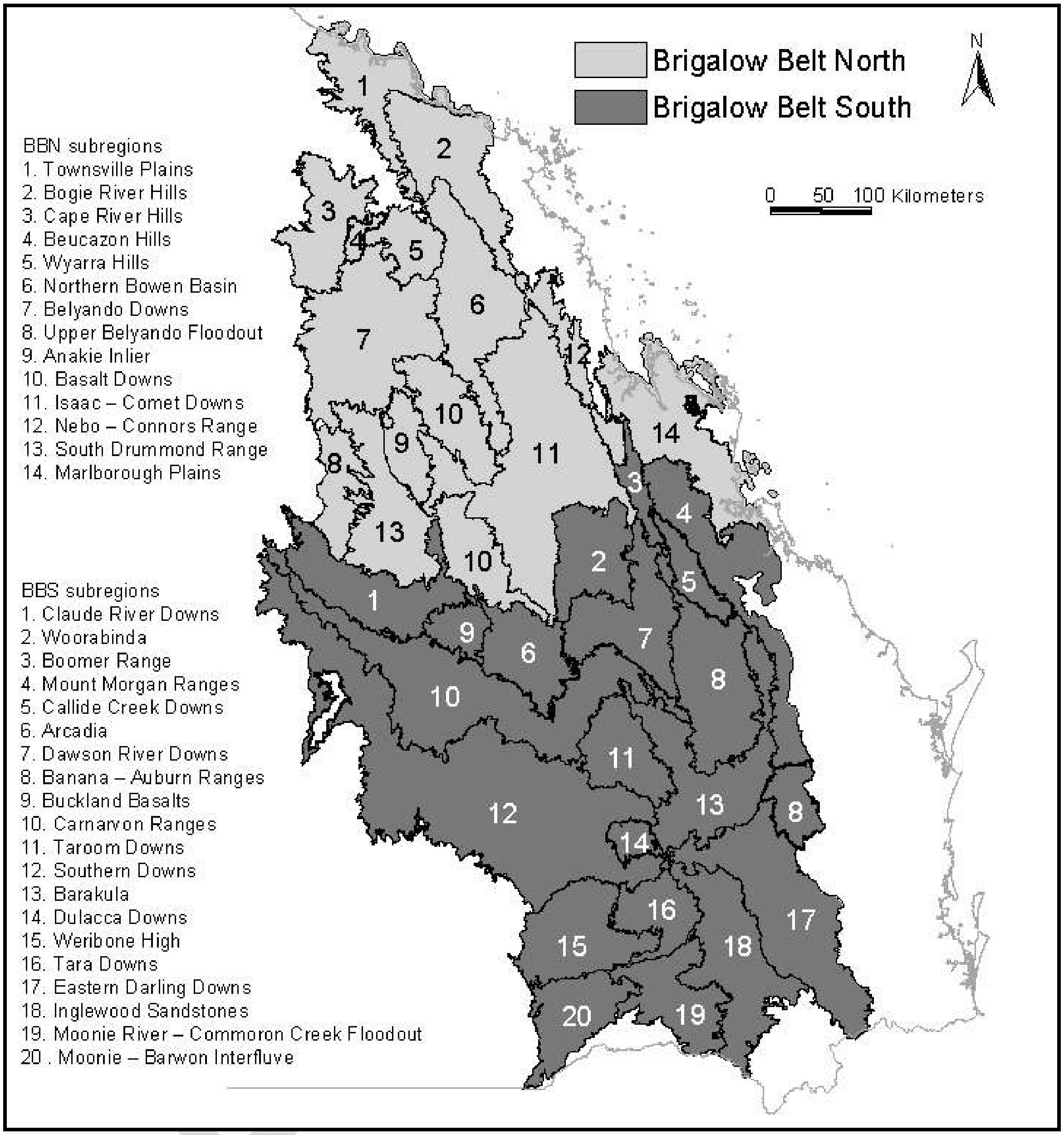
Vesk P.A. and Westoby M. 2001 Predicting plant species' responses to grazing. *Journal of Applied Ecology* **38**, 897-909.

Weston E.J., Harbison J., Leslie J.K., Rosenthal K.M. & Mayer R.J. 1981 Assessment of the agricultural and pastoral potential of Queensland. Qld Dept. Primary Industries: Brisbane

Appendix 1. Pre-clearing and remnant extent of bluegrass grassland EC Regional Ecosystems in the Queensland portions of the Brigalow Belt bioregions.

Values are area in hectares followed by the percentage of pre-clearing area remnant in 2003 in parentheses. Appendix 2 is a map of the subregions.

	11.3.21			**11.4.4**			**11.8.11**			**11.9.12**			% EC
Subregion	Pre-clear	2003	cleared 1997-03	Pre-clear	2003	cleared 1997-03	Pre-clear	2003	cleared 1997-03	Pre-clear	2003	cleared 1997-03	remnant in subregion
Brigalow Belt North													
Bogie River Hills				6014	5474 (91%)	-				2260	2224 (99%)	-	93.4
Cape River Hills	150	17 (11%)	-										11.1
Beucazon Hills	446	205 (46%)	-										45.9
Wyarra Hills				82	66 (81%)	-							80.5
Northern Bowen Basin	7322	2323 (32%)	234	1979	171 (9%)	-	28,999	20,806 (72%)	167	847	688 (81%)	-	61.2
Belyando Downs	6238	2507 (40%)	65	40,129	17,214 (43%)	324	209	4 (2%)	27				42.3
Upper Belyando Floodout	268	33 (12%)	2				1868	1838 (98%)	30				87.6
Anakie Inlier							997	7 (1%)	2				0.7
Basalt Downs	14,572	8868 (61%)	284	4726	1112 (24%)	9	490,239	147,260 (30%)	6889	172	54 (31%)	5	31.3
Isaac - Comet Downs	7848	1252 (16%)	218	10,946	1927 (17%)	57	17,120	2727 (16%)	189	555	0 (0%)	-	16.2
Nebo - Connors Ranges	275	138 (50%)	26										50.1
South Drummond Basin	2663	469 (18%)	19	317	98 (31%)	-	270	191 (71%)	33				23.3
Brigalow Belt South													
Claude River Downs	26,678	15,797 (59%)	1220	781	658 (84%)	-	565	462 (82%)	-	77	66 (85%)	-	60.4
Woorabinda							1450	106 (7%)	-				7.3
Callide Creek Downs	829	0 (0%)					2	0 (0%)					0
Arcadia	2165	28 (1%)	-	272	0 (0%)	-	430	37 (9%)	-	1337	74 (6%)	14	3.3
Dawson River Downs	4936	119 (2%)	18	3823	365 (10%)	25	1266	18 (1%)	-	13,717	720 (5%)	221	5.1
Banana - Auburn Ranges	1203	42 (4%)	-				52	0 (0%)	-	291	1 (0%)	-	2.8
Buckland Basalts	703	378 (54%)	-				1737	1697 (98%)	11	135	12 (9%)	9	81.0
Carnarvon Ranges	1423	832 (58%)	156				1015	224 (22%)	-				43.3
Taroom Downs										639	0 (0%)	-	0
Southern Downs	2599	2435 (94%)	15				1944	1697 (87%)	29				91.0
Barakula	57	0 (0%)	-							4555	532 (12%)	22	11.5
Weribone High	24	24 (100%)	-										100
Eastern Darling Downs	384,587	4107 (1%)	314	139	0 (0%)	-							1.1
Total	464,986	39,574 (9%)	2916	69,208	27,085 (39%)	415	548,163	177,074 (33%)	7380	24,585	4371 (18%)	271	22.6



Appendix 2. Subregions of Queenslands Brigalow Belt Bioregions.
The Brigalow Belt as applied here follows the Interim Biogeogrphic Regionalisation for Australia (IBRA version 5.1, Thackway and Cresswell 1995). The definition used for the Regional Ecosystem framework in Queensland (Sattler and Williams 1999) differs slightly from IBRA by including the northern sections of IBRA's Darling Riverine Plains bioregion, which are excluded here.

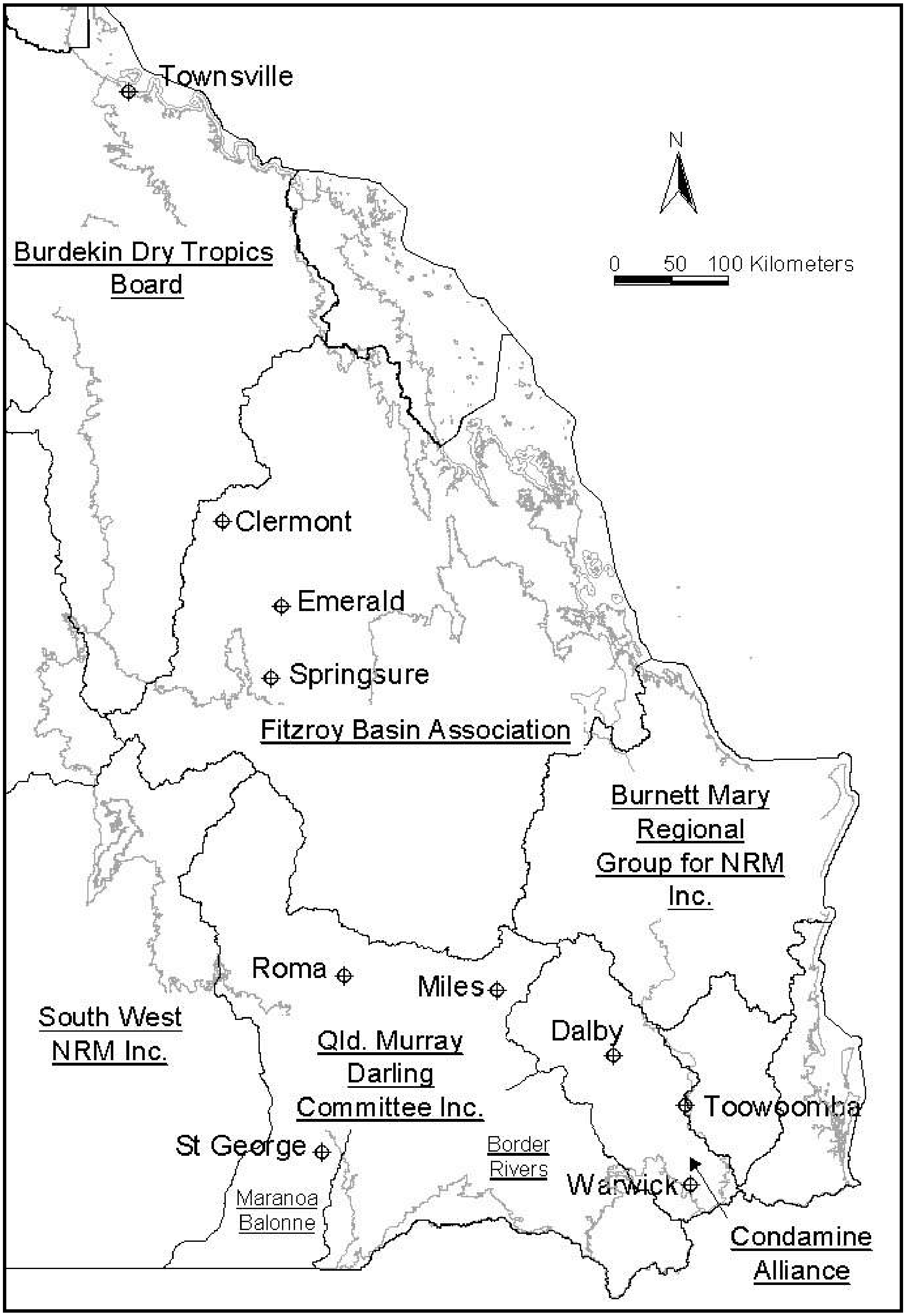
Appendix 3. Local government areas supporting more than 10ha of mapped remnants of the bluegrass grassland EC in 2003.

Values are 2003 remnant extent (hectares), arranged by tenure.

Local Government	Freehold	Leasehold	National Park	State Forest	Other	Total
Balonne Shire Council	8913	1967			9	10894 (4.3%)
Banana Shire Council	475	729		37	0	1241 (0.5%)
Barcaldine Regional Council		2096				2096 (0.8%)
Blackall Tambo Regional Council	29	1581				1612 (0.6%)
Central Highlands Regional Council	87186	40970	76	197	5219	133736 (53%)
Charters Towers Regional Council		250				250 (0.1%)
Dalby Regional Council	1329	351		0	0	1680 (0.7%)
Goondiwindi Regional Council	1514	5				1519 (0.6%)
Issac Regional Council	56631	24716	519	17	239	82156 (32%)
Murweh Shire Council		3142	72			3228 (1.3%)
Roma Regional Council	1933	287	210		1	2431 (1%)
Southern Downs Regional Council	16	3			0	19 (0.01%)
Toowoomba Regional Council	1498	106			7	1611 (0.6%)
Whitsunday Regional Council	2022	8367			32	10442 (4.1%)

Appendix 4. Extent (hectares) of mapped 2003 remnants of the bluegrass grassland EC by Natural Resource Management Body area and tenure.

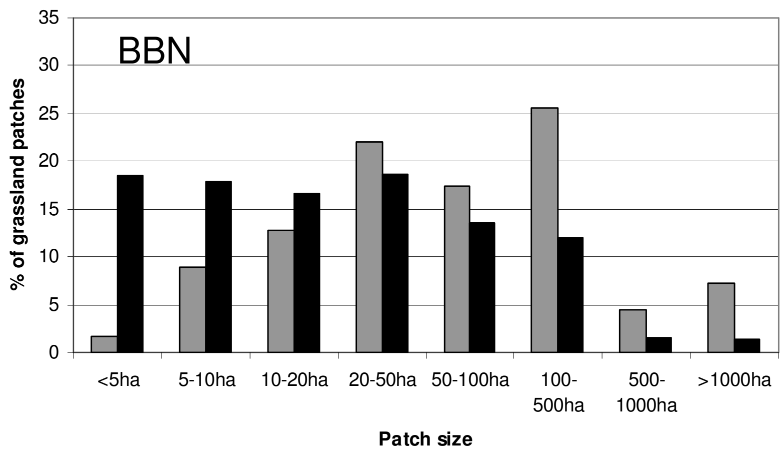
Regional NRM Body	Freehold	Leasehold	National Park	State Forest	Other	Total
Fitzroy Basin Association	118,506	50,342	5509	223	795	175,375
Burdekin Dry Tropics NRM	30,305	30,825	367	17	119	61,633
Queensland Murray Darling Committee Inc (Maranoa Balonne NHT section)	1699	345	208		10	2262
Condamine Alliance	2684	1385			37	4106
South West NRM Inc		3210	67			3277
Desert Channels Queensland Inc		1356				1356
Total	153,194	87,463	6151	240	961	248,009

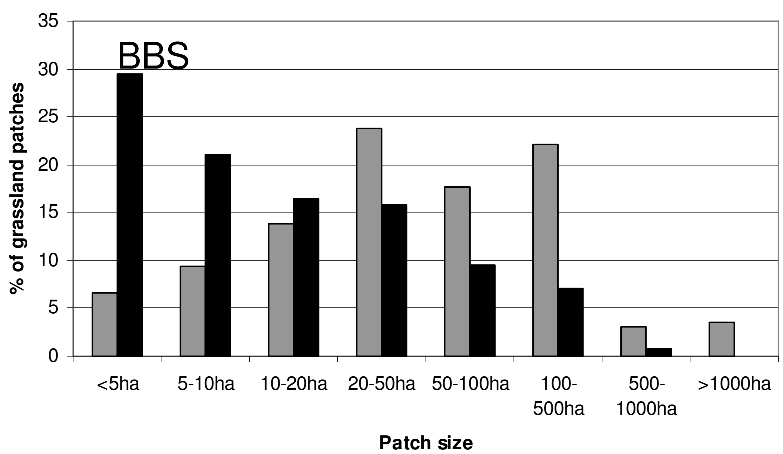


Appendix 5. Queensland's Natural Resource Management Regional NRM Bodies.

Appendix 6. Extent of mapped remnants (as at 2003) for the bluegrass grassland EC in State Forests and Conservation Reserves.

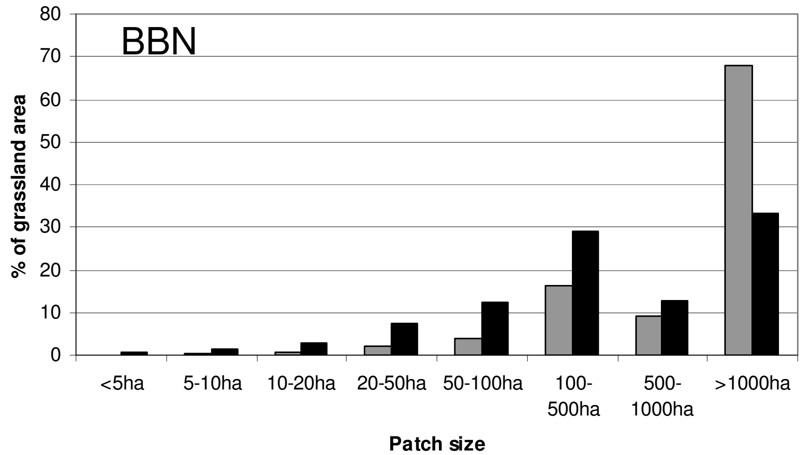
Reserve	Area (ha) and RE
Albinia Downs National Park	5277 (11.8.11)
Peak Range National Park	521 (11.8.11)
Carnarvon National Park	150 (11.3.21) + 191 (11.8.11)
Mount Hope State Forest	124 (11.8.11)
Nandowrie State Forest	37 (11.3.21)
Theodore State Forest	29 (11.8.11)
Fairbairn State Forest	27 (11.8.11)
Blair Athol State Forest	17 (11.8.11)
Minerva Hills National Park	14 (11.8.11)
Dawson Range State Forest	5 (11.8.11)

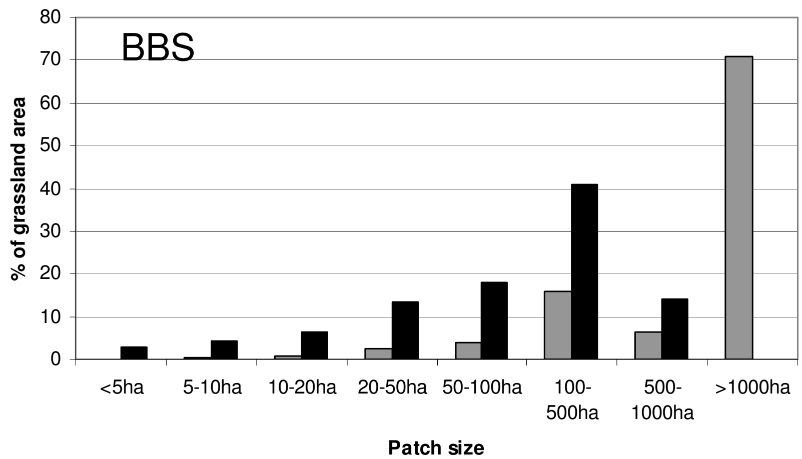




Appendix 7. Frequency distribution for classes of bluegrass grassland EC patch size for the Brigalow Belt North (BBN) and Brigalow Belt South (BBS) bioregions

Figures based on pure grassland polygons from Qld Herbarium mapping. Pre-clearing (grey bars) and 2001 (black bars),





Appendix 8. Percentages of the total area of bluegrass grassland EC occurring in patches of different sizes for the Brigalow Belt North (BBN) and Brigalow Belt South (BBS) bioregions.

Based on pure grassland polygons from Qld Herbarium mapping. Pre-clearing (grey bars) and 2001 (black bars).

Appendix 9. Scientific names and authors for plant common names

Common name	*Scientific name* (* denotes introduced species)
African lovegrass	**Eragrostis curvula* (Schrad.) Nees
Austral cornflower	*Rhaponticum australe* (Gaudich.) Sojak
Austral toadflax	*Thesium australe* R.Br.
bambatsi panic	**Panicum coloratum* L.
Belyando cobblers-peg	*Trioncinia retroflexa* (F.Muell.) Veldcamp
bladder ketmia	*Hibiscus trionum* L.
buffel grass	**Pennisetum ciliare* L.
butterfly pea	**Clitoria ternatea* L.
Columbus grass	**Sorghum x almum* Parodi
coolibah grass	*Thellungia advena* Stapf ex Prost
cow vine	*Ipomoea lonchophylla* J.M.Black
creeping bluegrass	**Bothriochloa insculpta*(Hochst. ex A.Rich.) A.Camus
creeping tick trefoil	*Desmodium campylocaulon* F.Muell. ex Benth.
curly Mitchell grass	*Astrebla lappacea* (Lindl.) Domin
Dalton weed	*Senecio daltonii* F.Muell.
downs Cymbonotus	*Cymbonotus maidenii* (G.Beauverd) A.E.Holland & V.A.Funk
finger panic grass	*Digitaria porrecta* S.T.Blake
grassland sedge	*Cyperus clarus* S.T.Blake
green panic	**Megathyrsus maximus* B.K.Simon & S.W.L.Jacobs
hairy anchor plant	*Discaria pubescens* (Brongn.) Druce
hawkweed	*Picris evae* Lack
hoop Mitchell grass	*Astrebla elymoides* F.Muell ex F.M.Bailey
Indian bluegrass	**Bothriochloa pertusa* (L.) A.Camus
Johnson's grass	**Sorghum halepense* (L.) Pers.
king bluegrass	*Dichanthium queenslandicum* B.K.Simon
leucaena	**Leucaena leucocephala* (Lam.) de Wit
lippia	**Phyla canescens* (Kunth) Greene
lobed bluegrass	*Bothriochloa biloba* S.T.Blake
Mexican poppy	**Argemone ochroleuca* Sweet
mountain coolibah	*Eucalyptus orgadophila* Maiden & Blakely
native millet	*Panicum decompositum* R.Br.
native sensitive plant	*Neptunia gracilis* Benth.
parkinsonia	**Parkinsonia aculeata* L.
parthenium	**Parthenium hysterophorus* L.
paspalum	**Paspalum dilatatum* Poir.
plains Picris	*Picris barbarorum* Lindl.
poppy-leaf nightshade	*Solanum papaverifolium* Symon
prickly acacia	**Acacia nilotica* subsp. *indica* (Benth.) Brenan
purple pigeon grass	**Setaria incrassata* (Hochst.) Hack.
Queensland bluegrass	*Dichanthium sericeum* (R.Br.) A.Camus
rats tail grasses	**Sporobolus natalensis* (Steud.) T.Durand & Schinz and **Sporobolus pyramidalis* P.Beauv.
Rhodes grass	**Chloris gayana* Kunth
satintop	*Bothriochloa erianthoides* (F.Muell.) C.E.Hubb.
sweet summer grass	**Moorochloa eruciformis* (Sm.) Veldkamp.
white speargrass	*Aristida leptopoda* Benth.
winged nightshade	*Solanum stenopterum* A.R.Bean
woolly fuzzweed	*Camptacra barbata* N.T.Burb
Yabilla grass	*Panicum queenslandicum* Domin

Appendix 10. Scientific names and authors for animal common names

Common name	Scientific name (* denotes introduced species)
Australian bustard	*Ardeotis australis* Gray
Australian kestrel	*Falco cenchroides* Vigors & Horsfield
barn owl	*Tyto alba* Scopoli
black-shouldered kite	*Elanus axillaris* Latham
brown falcon	*Falco berigora* Vigors & Horsfield
brown quail	*Coturnix ypsilophora* Bosc
brown songlark	*Cincloramphus cruralis* Vigors & Horsfield
cat	**Felis catus* Linnaeus
common dunnart	*Sminthopsis murina* Waterhouse
common planigale	*Planigale maculata* Gould
dog	**Canis familiaris* Linnaeus
eastern brown snake	*Pseudonaja textiles* Dumeril, Bibron & Dumeril
five-clawed worm skink	*Anomalopus mackayi* Greer & Cogger
fox	**Vulpes vulpes* Linnaeus
golden-headed cisticola	*Cisticola exilis* Vigors & Horsfield
grassland earless dragon	*Tympanocryptis pinguicolla* Mitchell
grey snake	*Hemiaspis damelii* Gunther
house mouse	**Mus musculus* Linnaeus
Indian myna	**Acridotheres tristis* Linnaeus
lined earless dragon	*Tympanocryptis lineata* Peters
little button-quail	*Turnix velox* Gould
long tailed planigale	*Planigale ingrami* Thomas
narrow-nosed planigale	*Planigale tenuirostris* Troughton
pale field rat	*Rattus tunneyi* Thomas
pig	**Sus scrofa* Linnaeus
rabbit	**Oryctolagus cuniculus* Linnaeus
red-chested button-quail	*Turnix pyrrhothorax* Gould
Allan's lerista	*Lerista allanae* Longman
rufous songlark	*Cincloramphus mathewsi* Iredale
salmon-striped frog	*Limnodynastes salmoni* Steindachner
singing bushlark	*Mirafra javanica* Horsfield
spotted black snake	*Pseudechis guttatus* De Vis
spotted harrier	*Circus assimilis* Jardine & Selby
common starling	**Sturnus vulgaris* Linnaeus
stubble quail	*Coturnix pectoralis* Gould

APPENDIX C MNESMP BASELINE MONITORING REPORT

MNESMP Baseline Monitoring Report

Meteor Downs South Coal Mine Project

Sojitz Coal Mining Pty Ltd

Rev	Date	Description
0	20/12/17	Final issued to client

	Name	Position	Date
ORIGINATORS	Dr Jarrad Cousin	Senior Ecologist	20 December 2017
APPROVER	Christopher Ewing	Senior Consultant	20 December 2017

Commercial in Confidence

Disclaimer

Marketing

If, in any document or other communication to be made public or disclosed to a government agency, Sojitz Coal Mining Pty Ltd wishes to make reference to the use of CO2 Australia's services, consent must first be obtained, and this will not unreasonably be withheld.

Maps

The maps in this document are based on or contain data that has been provided by the State which gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.

EXECUTIVE SUMMARY

The Meteor Downs South coal mine (the 'MDS project') is located within mining lease (ML) 70452, approximately 100 km south of Emerald, between Rolleston and Springsure in the Central Highlands Regional Council local government area, Queensland.

Sojitz Coal Mining engaged CO2 Australia to undertake the following, as per the Matters of National Environmental Significance Management Plan for MDS:

- establishment of permanent monitoring sites
- habitat condition assessments and photo monitoring of areas of Brigalow TEC, Natural Grasslands TEC, bluegrass, king blue-grass, squatter pigeon and Australian painted snipe habitat
- pest animal and weed surveys

Accordingly, this report details the results of field surveys undertaken by Senior Ecologist Dr Jarrad Cousin and Principal Botanist Simon Danielsen during 7 – 12 December 2017.

Habitat condition

Results of the habitat condition assessments identified an average site condition score of 7.79 out of 10 across all 10 habitat monitoring sites, with scores ranging between 5.25 (Site 09) and 9.33 (Sites 02 and 08).

Habitat condition scores for the six matters of national environmental significance ranged between 4.74 (Australian painted snipe) and 8.04 (Natural grasslands threatened ecological community (TEC)) out of 10.

The habitat condition score of 4.74 for Australian painted snipe is a result of no appropriate habitat being observed within ML70452.

Areas of Natural Grasslands TEC were all in good condition, with habitat condition scores for the four assessment sites of between 7.69 and 8.39. The four assessment sites all supported a minimum of six TEC indicator grass species identified under the Commonwealth listing advice for the Natural Grasslands TEC; greater than the four considered to represent (amongst a number of other biotic and spatial factors) 'best quality' Natural Grasslands TEC areas.

Flora and fauna of national environmental significance

Approximately four king blue-grass tussocks were positively identified as part of habitat condition assessments at one of the sites (Site 08 – Figure 5). In addition to these four tussocks, three tussocks were confirmed just outside of the Site 08 habitat condition plot. No confirmed records of bluegrass were made.

Targeted fauna surveys failed to detect the squatter pigeon or Australian painted snipe.

Weeds

A total of 16 species of weeds were identified from the 20 weed monitoring plots, with the average number per plot being 2.9 species. Plots ranged between no species (Site 08) and nine species (Site 20), with seven weed species only encountered at single sites. Weed cover across the 20 weed monitoring plots averaged 7.1%; ranging between 0% (Site 08) and 54% (Site 20).

Pest animals

The assessment identified three species of pest animal, namely European hare (*Lepus europaeus*), wild dog (*Canis familiaris/lupus*) and cat (*Felis catus*) present on site. The assessment of overall rabbit impact was denoted as 'acceptable' for all sites except site R02 which was denoted as 'monitor closely'. Across all eight pig monitoring plots there was no confirmed evidence of feral pigs.

CONTENTS

1 INTRODUCTION

U&D Mining Industry (Australia) Pty Ltd (U&D Mining) is developing the Meteor Downs South coal mine (the 'MDS project'), through its wholly-owned subsidiary Endocoal Ltd, in a joint venture with Sojitz Coal Mining Pty Ltd (Sojitz). The open cut coal mining operation is located within mining lease (ML) 70452, approximately 100 km south of Emerald, between Rolleston and Springsure in the Central Highlands Regional Council local government area, Queensland (Figure 1).

A Matters of National Environmental Significance Management Plan (MNESMP) was developed for the MDS Project, in accordance with the requirements of the project's approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth; EPBC Act). The MNESMP provides for the management of direct and indirect impacts on the following MNES:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community (Brigalow TEC)
- Natural Grasslands of the Queensland Central Highlands and Fitzroy Basin threatened ecological community (Natural Grasslands TEC)
- king blue-grass (*Dichanthium queenslandicum*)
- bluegrass (*Dichanthium setosum*)
- squatter pigeon (southern) (*Geophaps scripta scripta*)
- Australian painted snipe (*Rostratula australis*).

The MNESMP requires that the following baseline monitoring activities be completed prior to commencement of construction:

- establishment of permanent monitoring sites
- habitat condition assessments and photo monitoring of areas of Brigalow TEC, Natural Grasslands TEC, bluegrass, king blue-grass, squatter pigeon and Australian painted snipe habitat
- pest animal and weed surveys
- update of the MNESMP following completion of the baseline surveys to include the final location of the permanent monitoring points.

This report presents the results of the baseline monitoring activities completed by CO2 Australia in December 2017.

Sojitz Coal Mining Pty Ltd - Meteor Downs South

Figure 1
Site location

- Disturbance areas
- Mining Lease

Protected areas
- Conservation Park
- National Park
- Resources Reserve
- State Forest

0 5 10 15 20
Kilometres

N

CO2 Australia

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
- Protected areas
The following datasets provided by U&D Mining
- Disturbance areas

Date: 20/12/2017 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:350,000@A3

Path: P:\GIS\Data\Projects\Sojitz\6_Baseline_report_figures\Figure 1 - site location.mxd

2 METHODOLOGY

Field surveys were undertaken by Senior Ecologist Dr Jarrad Cousin and Principal Botanist Simon Danielsen during 7 – 12 December 2017. The field surveys included the activities described below.

2.1 ESTABLISHMENT OF PERMANENT MONITORING SITES

A total of 48 permanent monitoring sites/plots were established across the balance of ML70452 outside of the MDS project (refer to Figure 3 and Figure 4). Permanent monitoring sites comprised a mix of nested and non-nested sites (Table 1), according to the following:

- 10 x habitat monitoring sites (100 m x 50 m)
  - collocated with weed and rabbit monitoring plots (Sites 01 – 10)
- 30 x photo monitoring sites
  - established at 0 m and 50 m points along 100 m habitat monitoring transect (Sites 01 – 10) and at SW corner of weed monitoring plots (Sites 11 – 20)
- 20 x weed monitoring plots (1 ha)
  - partly collocated with weed and rabbit monitoring plots (Sites 01 – 10), with remaining 10 sites (Sites 11 – 20) standalone weed monitoring plots
- 10 x rabbit monitoring plots (2 ha)
  - collocated with habitat monitoring sites and weed monitoring plots (Sites R01 – R10)
- 8 x pig monitoring plots (15 ha) (Sites P01 – P08)
- 20 x pest animal sand track stations
  - spaced 0.5 km apart along four access tracks (Sites T01 – T20)
  - four digital camera trap sites co-located with four of the 10 pest animal sand track stations

Refer to Appendix A for detailed location and other relevant details for each of the sites.

Table 1: Monitoring site locations and purpose

	Habitat monitoring								Pest animal monitoring			
Site	Brigalow TEC	Natural Grasslands TEC	King blue-grass	Bluegrass	Squatter pigeon	Australian painted snipe	Photo monitoring	Weed monitoring	Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs etc.	Camera trap
01					✓		✓	✓	✓			
02		✓	✓	✓			✓	✓	✓			
03					✓		✓	✓	✓			
04		✓	✓	✓			✓	✓	✓			
05					✓		✓	✓	✓			
06		✓	✓	✓			✓	✓	✓			
07	✓						✓	✓	✓			
08		✓	✓	✓			✓	✓	✓			

Site	Habitat monitoring						Photo monitoring	Weed monitoring	Pest animal monitoring			
	Brigalow TEC	Natural Grasslands TEC	King blue-grass	Bluegrass	Squatter pigeon	Australian painted snipe			Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs etc.	Camera trap
09						✓	✓	✓	✓			
10					✓		✓	✓	✓			
11 – 20							✓	✓				
P01 – P08										✓		
T01 – T20											✓	✓

2.2 HABITAT MONITORING

The number and location of habitat monitoring sites was based on the requirements of the *Guide to determining terrestrial habitat quality* (DEHP 2017). A total of 10 habitat monitoring sites (comprising N_S running 100 m x 50 m transect) were established (Sites 01 – 10), with the start and central points marked with a 1.8 m galvanised steel picket with plastic safety cap (refer to Figure 3 and Figure 4).

Baseline habitat condition assessments for Brigalow TEC, Natural Grasslands TEC, bluegrass, king blue-grass, squatter pigeon and Australian painted snipe were undertaken at the habitat monitoring sites generally in accordance with the *Guide to determining terrestrial habitat quality* (DEHP 2017). Through the application of the guide, a habitat quality score was calculated for each MNES based on the following key indicators:

1. site condition: a general condition assessment of vegetation compared to a benchmark
2. site context: an analysis of the site in relation to the surrounding environment
3. fauna species habitat index: the ability of the site to support the given target fauna species.

The species habitat index assessment included targeted fauna surveys for squatter pigeon and Australian painted snipe. Targeted fauna surveys were undertaken generally in accordance with the *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010).

Habitat monitoring for the Australian painted snipe was undertaken within a small patch of RE 11.3.3a along the western boundary of the Australian painted snipe habitat area (refer to Figure 4). This location was chosen to allow for a comparison to a benchmark (given the area of Australian painted snipe habitat was within an undefined vegetation community termed 'water') as well as being located in an area able to be accessed and assessed in the event of a greater degree of inundation of Naroo Dam.

The extent of actual Australian painted snipe habitat on the site was identified and quantified in the field in accordance with the following criteria, consistent with the known ecology of the species:

- Shallow water foraging habitat – calculated as the area of open water habitat (on the lease and adjacent lease)
- Muddy substrate foraging habitat – calculated as 10 m buffer adjacent open water habitat (on the lease and adjacent lease)

- Area of appropriate shelter habitat – calculated as areas of rank emergent tussocks of grass, sedges, rushes or reeds, samphire, clumps of lignum, *Muehlenbeckia*, canegrass or Melaleuca within 50 m of the boundary of open water habitat.

In the absence of the *Guide to determining terrestrial habitat quality* (DEHP 2017) including a species habitat index for flora species, the habitat condition scores for the two MNES flora species (king blue-grass and bluegrass) included a species presence index out of three, whereby: 0 = absent/not confirmed, 2 = up to five tussocks confirmed, 2.5 = up to 20 tussocks confirmed, 3 = more than 20 tussocks confirmed. The habitat condition score for the two MNES flora species was then calculated as a combination of site condition and site context for the RE assessment unit (representing 80% of the score), with species stocking rate converted to a score out of 10 and contributing 20%.

2.3 PHOTO MONITORING

Photo monitoring was undertaken at 30 sites, including two at each of the 10 habitat condition assessment sites (0 m and 50 m points: Site 01 – 10), with single photo monitoring points at the SW corner of the remaining 10 weed monitoring plots (Site 11 – 20) identified in Table 1 and shown in Figure 3 and Figure 4. Photo monitoring sites were established with a 1.8 m galvanised steel picket with plastic safety cap. Permanent photo monitoring sites were established to give a representative indication of cover and species composition (including weeds) for the general area and enable visual assessment of habitat changes over time. Photo monitoring was undertaken at the same time as habitat monitoring assessments.

At each of the photo monitoring points, five photos were taken from 1.5 m height above ground level looking north, east, south and west with a ground photo taken looking down at an angle of 45° to the north-west of the star picket.

A record of the photographs is provided in Appendix A.

2.4 WEED MONITORING

A total of 20 x 1 ha (100 m x 100 m) weed monitoring plots were established across the site (Sites 01 – 20), 10 of which were collocated with habitat monitoring sites and rabbit monitoring plots (Sites 01 – 10)(Figure 3 and Figure 4). Weed monitoring plots were established to incorporate natural variability such as aspect (e.g. a mix of north-, east-, south- and west-facing monitoring sites) and community type, while also targeting trafficable areas (e.g. entry gates, creek crossings, stock watering points) to monitor potential introduction and/or irruptions of prohibited and restricted weed species. At each weed monitoring plot, 3 x 100 m transects (traversing in an east-west direction) were traversed, keeping them parallel to one another, 50 m apart.

At each of the permanent weed monitoring plots, monitoring of weeds was undertaken in accordance with the following method:

- At 10 m intervals along each of the three transects, a 2 m x 2 m plot frame was used to record the presence, species and cover of weeds
- Weed cover at each 2 m x 2 m survey site was recorded as one of five cover classes: 1 = 0%; 2 = 0-5%; 3 = 6-25%; 4 = 26-50%; 5 = 51-100% (Auld 2009)
- An average cover score for each weed species for each 1 ha site was calculated
- The average cover score was then calculated as the average percentage from the 30 plots surveyed from the three 100 m transects
- The mean cover score across all weed monitoring sites was then calculated.

For the purposes of the calculation of average percentage cover of weeds, each of the five weed cover classes (0 – 5) were converted to a quantitative weed cover value based on the average value of the range corresponding to that weed cover class, as outlined below:

- Weed cover class 1 (0%) retained a value of 0%
- Weed cover class 2 (0-5%) was converted to a value of 2.5%
- Weed cover class 3 (6-25%) was converted to a value of 15%
- Weed cover class 4 (26-50%) was converted to a value of 37.5%
- Weed cover class 5 (51-100%) was converted to a value of 75%.

In addition to permanent weed monitoring sites, where relevant, incidental observations were collated as part of general site monitoring, recording details of weeds (including location, species and extent) and areas of significant weed cover.

For the purposes of this assessment, weeds were taken as any species of plant not considered by the Queensland Herbarium as being native to Queensland, as well as species of plant not considered locally endemic to the region.

2.5 PEST ANIMAL MONITORING

Pest animal monitoring was undertaken through a combination of:

- plot based monitoring, searching for direct presence (e.g. visual confirmation) or indirect evidence (e.g. tracks, diggings, scats, rubbings etc)
- sand track stations, searching for evidence of footprints attributable to known pest animals
- camera traps, representing opportunities to visually confirm the presence of pest animals.

For the purposes of this assessment, pest animals are defined as any species of fauna not native to Queensland, nor protected under the *Nature Conservation Act 1992* (Qld).

2.5.1 Rabbits

An assessment of the presence and impact of rabbits was undertaken generally in accordance with Cooke *et al.* (1990). A total of 10 rabbit monitoring plots (R01 – R10) were established at the same location as habitat monitoring sites and weed monitoring plots (Figure 3 and Figure 4). Each rabbit monitoring plot consisted of a 2 ha plot which was traversed for 15 to 20 minutes, assessing the following (refer to Cooke *et al.* 1990):

- Rabbit abundance – a measure of the presence and number of rabbit warrens and the abundance of any faecal pellets (including 'buck-heaps' or latrines) – measured on a scale of 0 – 5.
- Seedling abundance – a measure of the presence and abundance of native vegetation seedlings encountered during the 15-20 minute traverse – measured on a scale of 0 – 5.
- Rabbit damage – a measure of seedlings (< 0.5 m height) with evidence of rabbit damage, identified as 45˚ 'secateurs-like' cuts through smaller stems, defoliation and gnawing of bark – measured on a scale of 0 – 5.

From this assessment, a 'corrected regeneration score' was calculated from the seedling abundance and rabbit damage score in accordance with the following table. This measure corrects for seedling regeneration as a function of observed rabbit damage, and is subsequently used to calculate overall rabbit impact with the rabbit abundance score.

Table 2: Calculation of corrected regeneration score.

	Seedling abundance					
Rabbit damage	**0**	**1**	**2**	**3**	**4**	**5**
0	0.20	1.00	2.00	3.00	4.00	5.00
1	0.20	0.50	1.0	1.50	2.00	2.50
2	0.20	0.34	0.70	1.00	1.30	1.70
3	0.20	0.28	0.50	0.80	1.00	1.30
4	0.20	0.20	0.40	0.60	0.80	1.00
5	0.20	0.20	0.30	0.50	0.70	0.80

As illustrated in Figure 2, overall rabbit impact was assigned as one of three categories – 'acceptable', 'monitor closely' or 'unacceptable', as determined from a combination of the score for rabbit abundance and the corrected regeneration score. Note that it was assumed that any site with a rabbit abundance score of '0' was assumed to be 'acceptable', irrespective of corrected regeneration score. This is to avoid the situation where, with an absence of rabbits, and a corrected regeneration score of ≤2 (attributable to no rabbit damage and less than 20 seedlings), a given site may be identified as one to 'monitor closely' only by virtue of the fact that the few seedlings are attributable to the site being a grassland, rather than it reflecting rabbit grazing.

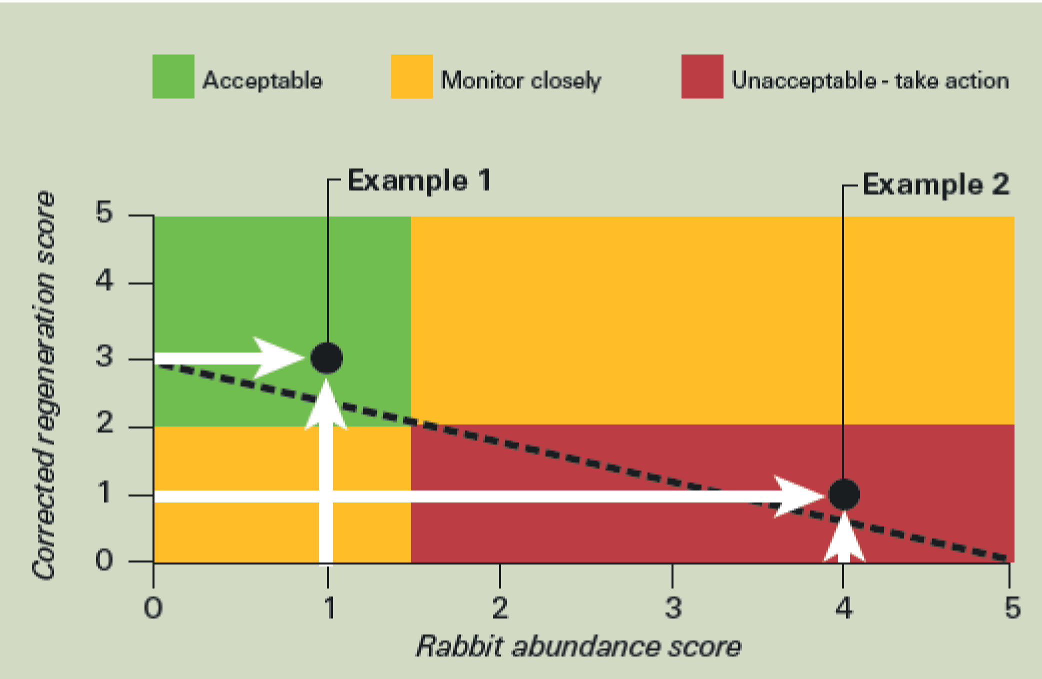


Figure 2: Calculation of overall rabbit impact based on rabbit abundance score and corrected regeneration score.

2.5.2 Sand track stations

An assessment of pest animal tracks was undertaken as a measure of pest animal presence and activity, based on a modified version of (Mitchell and Balogh 2007a) and (Fleming *et al.* 1996). A total of 20 sand track stations were established along four access tracks (Figure 3 and Figure 4). Sand track stations were established by placing a thin layer of screened river sand approximately 1 m wide and 1 to 3 cm deep, covering the track from side to side, and then raked smooth (screed). Once established, sand track stations were assessed within the first couple of hours of the morning, recording positive incidences of pest animal species. Once assessed and photographed, the track station was screed clean of footprints. The assessment was repeated on three consecutive mornings.

In order to reduce the potential for recording false negatives, track stations were not assessed if there was clear evidence of rain during the previous night, or where the 'detectability' value of track stations was equal to 1, as per the method below.

A detectability value is calculated by the observer taking 10 paces across the tracking substrate and scoring the resulting imprints on a scale of 0 to 3 where 0 = no print visible; 1 = print barely visible; 2 = complete outline of print and some detail of the sole visible; 3 = complete outline of print and all detail of the sole visible. Summing the resulting 10 paces will give a detectability score out of 30, allowing allocation of a score (0 – 4) for the given track station. A detectability score of 0–5 (out of 30) = poor detectability (1); 6–15 = fair (2); 16–25 = good (3); and 26–30 = excellent (4). Any track stations that score (1) should not be included in the index. All remaining sand track stations are considered operable stations for the purposes of calculating pest animal presence/activity, with the number of operable station nights calculated as the sum, across nights, of all operable stations.

For each pest animal species, a measure of pest animal presence/activity (Catling Index value) was calculated for the site by summing the number of operable sand track stations with evidence of the targeted pest animal by the sum of all operable station nights (refer to Mitchell and Balogh 2007a).

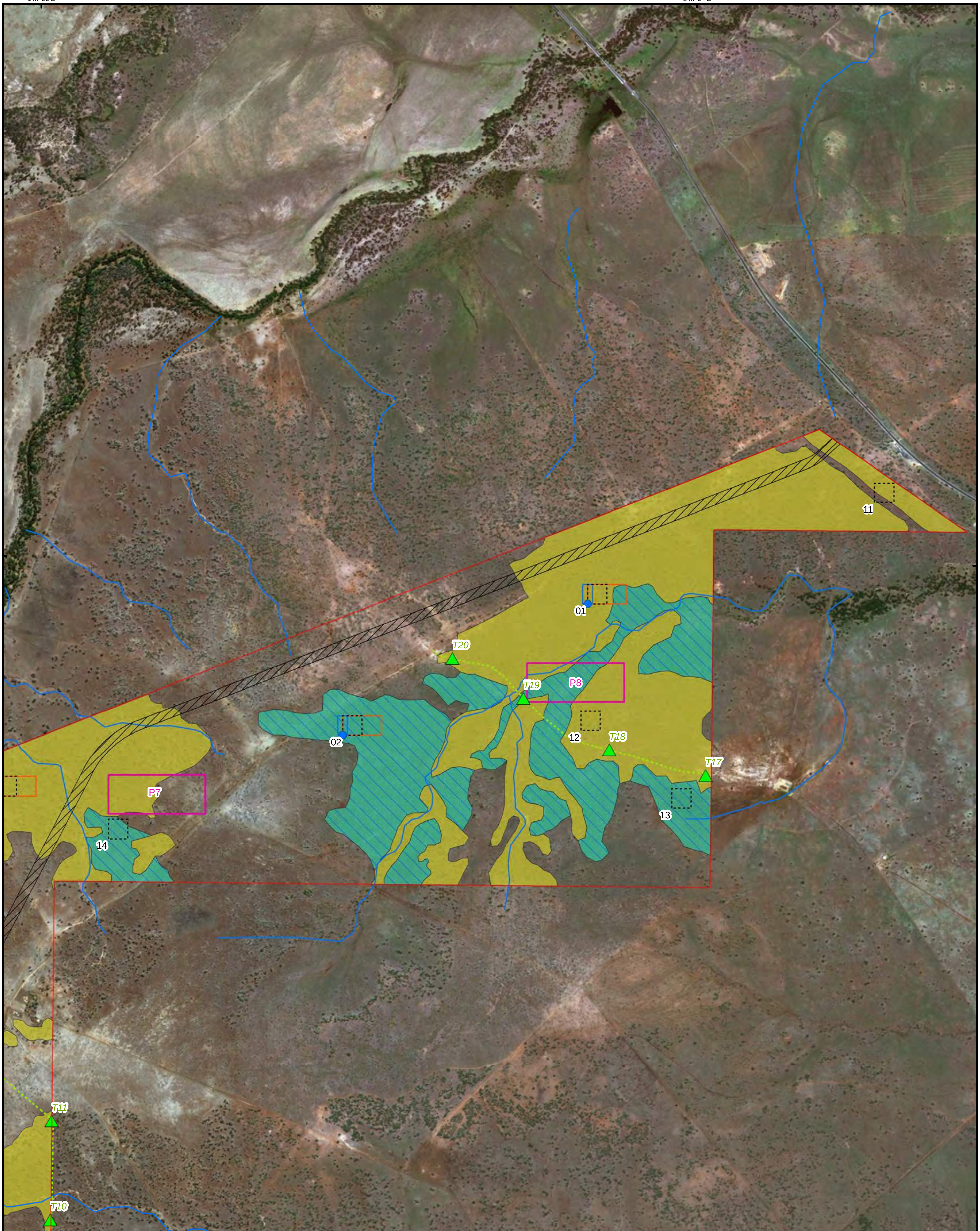
Fauna camera stations

Of the 20 sand track stations, four were supplemented with infra-red fauna cameras. These were placed approximately 1.3 m above the ground within 3 m of the sand track station. Cameras were represented by LTL-6310 12 mega-pixel digital cameras (LTL Acorn), supported by 940nm infra-red night vision.

2.5.3 Feral pigs

An assessment of the presence of feral pigs signs (as a measure of feral pig presence or activity) was undertaken generally in accordance with (Mitchell & Balogh 2007b) and (Hone 1988). A total of 8 randomly stratified, 500 m x 300 m (15 ha) plots were established across the site in environments that are more regularly impacted. This included plots within and traversing ephemeral watercourses, as well as plots within the immediate vicinity of Naroo Dam in the east of the site (Figure 3 and Figure 4). Each 15 ha plot comprised 3 x 500 m transects spaced 100 m apart. At each plot, the following method was used for each of the transects:

- traversing in an east-west direction, surveying for the presence of any feral pig signs (rooting, wallows, dung, footprints, travel pads, plant damage and tree rubs, as well as the physical presence of feral pigs) 1 m either side of the transect in 50 m sections
- calculating an abundance score for each transect as the percentage of 'present' feral pig signs from the 10 sections along the 500 m transect
- calculating the mean abundance score (and variance) across all transects.



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Figure 3
Habitat monitoring sites - north

- Mining Lease
- Disturbance areas
- Watercourse
- Brigalow TEC
- Natural Grassland TEC
- Habitat for King blue-grass and bluegrass
- Habitat for squatter pigeon
- Habitat for Australian painted snipe
- Habitat monitoring site
- Habitat monitoring transect
- Weed monitoring plots
- Rabbit monitoring plots
- Pig monitoring plots
- Animal track station tracks
- Animal track station

0 0.25 0.5 0.75 1
Kilometres

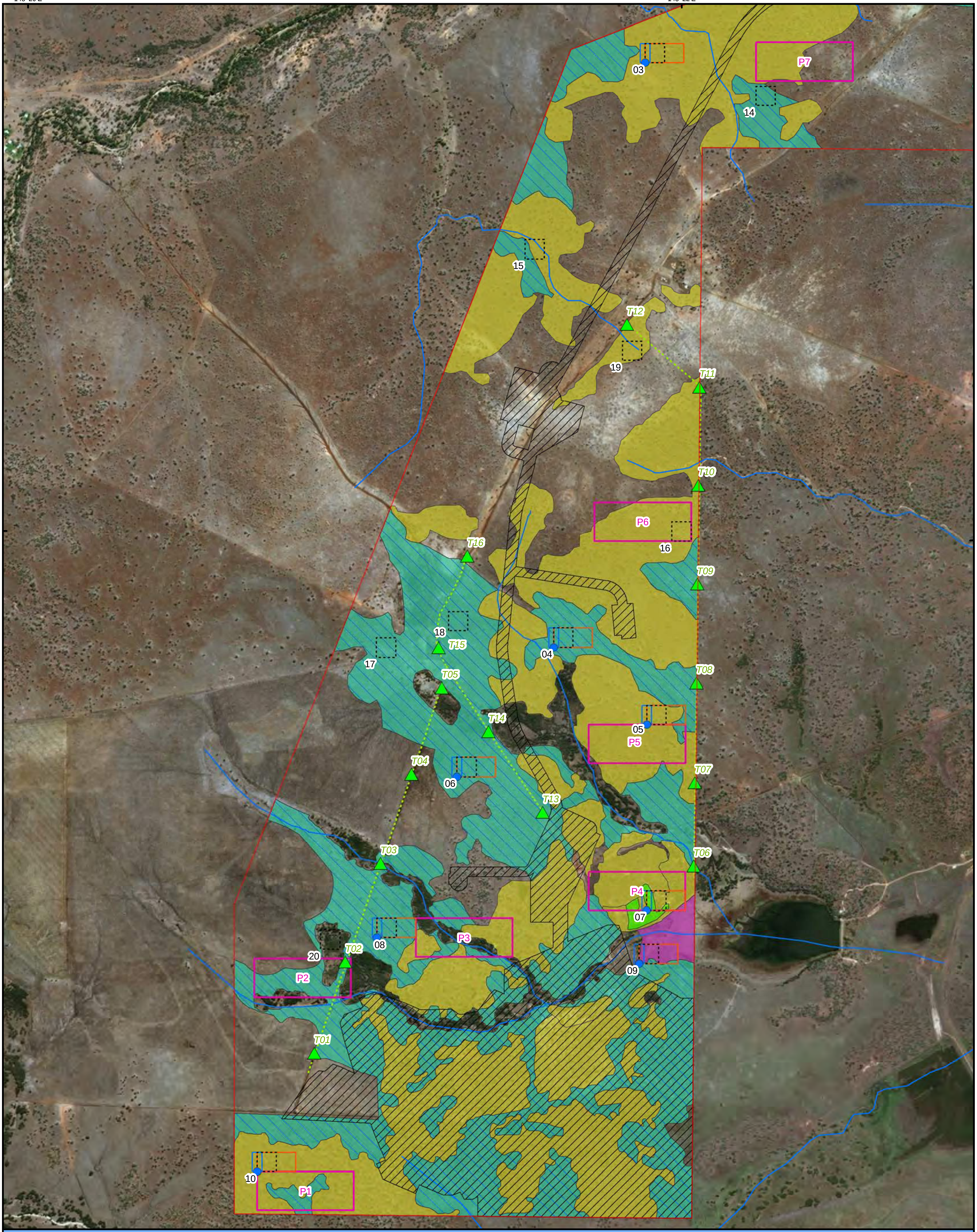
N

Location diagram

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by U&D Mining
- Disturbance areas
- Ground-truthed regional ecosystem mapping

Date: 20/12/2017 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:17,500@A3

Path: P:\GIS\Data\Projects\Sojitz\6_Baseline_report_figures\Figure 3 - Habitat monitoring north.mxd



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 4
Habitat monitoring sites - south

- Mining Lease
- Disturbance areas
- Watercourse
- Habitat for King blue-grass and bluegrass
- Habitat for squatter pigeon
- Brigalow TEC
- Natural Grassland TEC
- Habitat for Australian painted snipe
- Habitat monitoring site
- Habitat monitoring transect
- Weed monitoring plots
- Rabbit monitoring plots
- Pig monitoring plots
- Animal track station tracks
- Animal track station

0 0.25 0.5 0.75 1
Kilometres

N

CO2 Australia

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by U&D Mining
- Disturbance areas
- Ground-truthed regional ecosystem mapping

Date: 20/12/2017 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:17,500@A3

Path: P:\GISData\Projects\Sojitz\6_Baseline_report_figures\Figure 4 - Habitat monitoring south.mxd

3 RESULTS

3.1 HABITAT MONITORING

Results of the habitat condition assessments identified an average site condition score of 7.79 out of 10 across all 10 habitat monitoring sites, with scores ranging between 5.25 (Site 09) and 9.33 (Sites 02 and 08). Table B1 and Table B2 of Appendix B outline details of the site condition assessments, summarised below in Table 3.

Table 3: Habitat monitoring sites showing their site condition and site context scores in accordance with the *Guide to determining terrestrial habitat quality*.

Site	RE	Easting	Northing	Site condition score (/10)	Site context score (/10)
01	11.8.5	641462	7304249	7.44	7.69
02	11.8.11	640199	7303572	9.33	6.92
03	11.8.5	638418	7303259	9.00	7.69
04	11.8.11	637945	7300236	7.67	7.69
05	11.8.5	638426	7299836	5.81	7.69
06	11.8.11	637445	7299566	8.33	7.31
07	11.4.3	638426	7298876	7.25	7.69
08	11.8.11	637032	7298735	9.33	7.31
09	11.3.3a	638387	7298599	5.25	7.69
10	11.8.5	636412	7297523	8.44	7.69
			Average score	**7.79**	**7.54**

MNES habitat condition assessments

Based on the results of the site condition assessments, habitat condition scores for the six MNES ranged between 4.74 (Australian painted snipe) and 8.04 (Natural grasslands TEC) out of 10 (Table 4). The comparatively low score for Australian painted snipe habitat is in part attributable to the low site condition for RE 11.3.3a habitat (5.25), but also the low fauna species habitat index (2.40), reflecting an absence of appropriate foraging and shelter habitat for the species. In contrast, Natural Grasslands TEC habitat had the highest habitat condition score (8.04), attributable in large part to greater than benchmark condition species richness for grasses and forbs at each of the contributing RE 11.8.11 sites (refer to Table B-1 of Appendix B for site condition raw data contributing to site condition score in Table B-2).

Table 4: Monitoring sites showing their habitat condition scores contributing to MNES

Site	RE	Brigalow TEC	Natural Grasslands TEC	King blue-grass	Bluegrass	Squatter pigeon	Australian painted snipe
01	11.8.5					7.02	
02	11.8.11		8.21	6.57	6.57		
03	11.8.5					8.14	

Site	RE	Brigalow TEC	Natural Grasslands TEC	King blue-grass	Bluegrass	Squatter pigeon	Australian painted snipe
04	11.8.11		7.68	6.14	6.14		
05	11.8.5					6.19	
06	11.8.11		7.86	6.29	6.29		
07	11.4.3	7.36					
08	11.8.11		8.39	8.05	6.71		
09	11.3.3a						4.74
10	11.8.5					7.85	
	Average score	**7.36**	**8.04**	**6.76**	**6.43**	**7.30**	**4.74**

Natural Grasslands TEC habitat

As discussed above, areas of Natural Grasslands TEC, represented by RE 11.8.11, were all in good condition, with habitat condition scores for the four assessment sites of between 7.69 and 8.39. The four assessment sites all supported a minimum of six TEC indicator grass species identified under the Commonwealth listing advice for the Natural Grasslands TEC (DEWHA 2008)(Table 5); greater than the four considered to represent (amongst a number of other biotic and spatial factors) 'best quality' Natural Grasslands TEC areas (DEWHA 2008).

Table 5: Natural Grasslands TEC indicator species

Scientific name	Common name	Site			
		02	04	06	08
Aristida latifolia	Feather-top wiregrass	✓	✓		
Aristida leptopoda	White speargrass	✓	✓	✓	✓
Astrebla elymoides	Hoop mitchell grass				
Astrebla lappacea	Curly mitchell grass				
Astrebla squarrosa	Bull mitchell grass				
Bothriochloa erianthoides	Satin-top grass		✓	✓	✓
Dichanthium queenslandicum	King blue-grass				✓
Dichanthium sericeum	Queensland bluegrass	✓	✓	✓	✓
Eriochloa crebra	Cup grass	✓	✓	✓	✓
Panicum decompositum	Native millet	✓	✓	✓	✓
Panicum queenslandicum	Yabila grass				
Paspalidium globoideum	Shot grass	✓	✓	✓	✓
Thellungia advena	Coolibah grass				
	TOTAL	**6**	**7**	**6**	**7**

King blue-grass and bluegrass habitat

Incidental surveying was undertaken for king blue-grass (*Dichanthium queenslandicum*) and bluegrass (*Dichanthium setosum*) as part of all habitat condition assessments and while traversing the site. From that surveying, approximately four king blue-grass tussocks was positively identified as part of habitat condition assessments at one of the sites (Site 08 – Figure 5). In addition to these four tussocks, three tussocks were confirmed just outside of the Site 08 habitat condition plot. No confirmed records of bluegrass were made during the surveying.

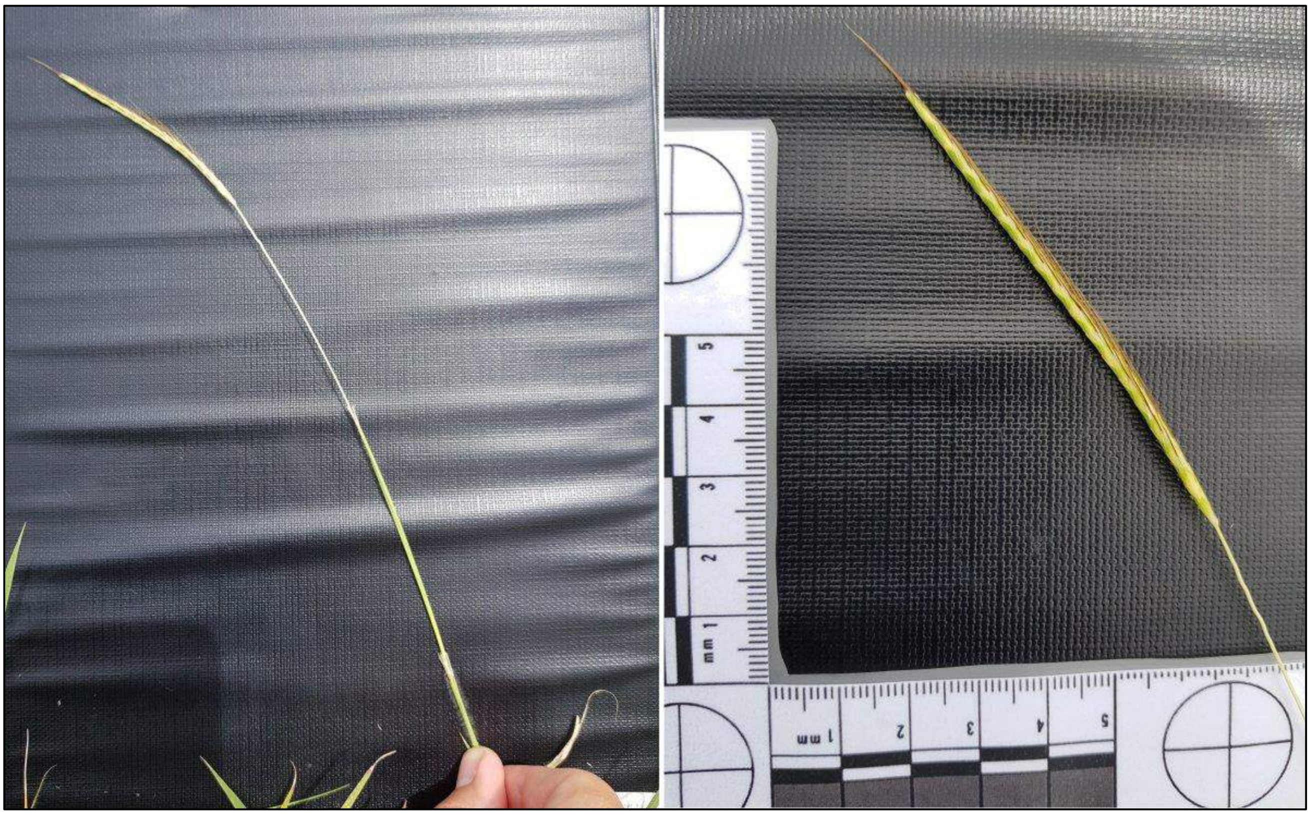


Figure 5: King blue-grass (*Dichanthium queenslandicum*) positively identified from Site 08.

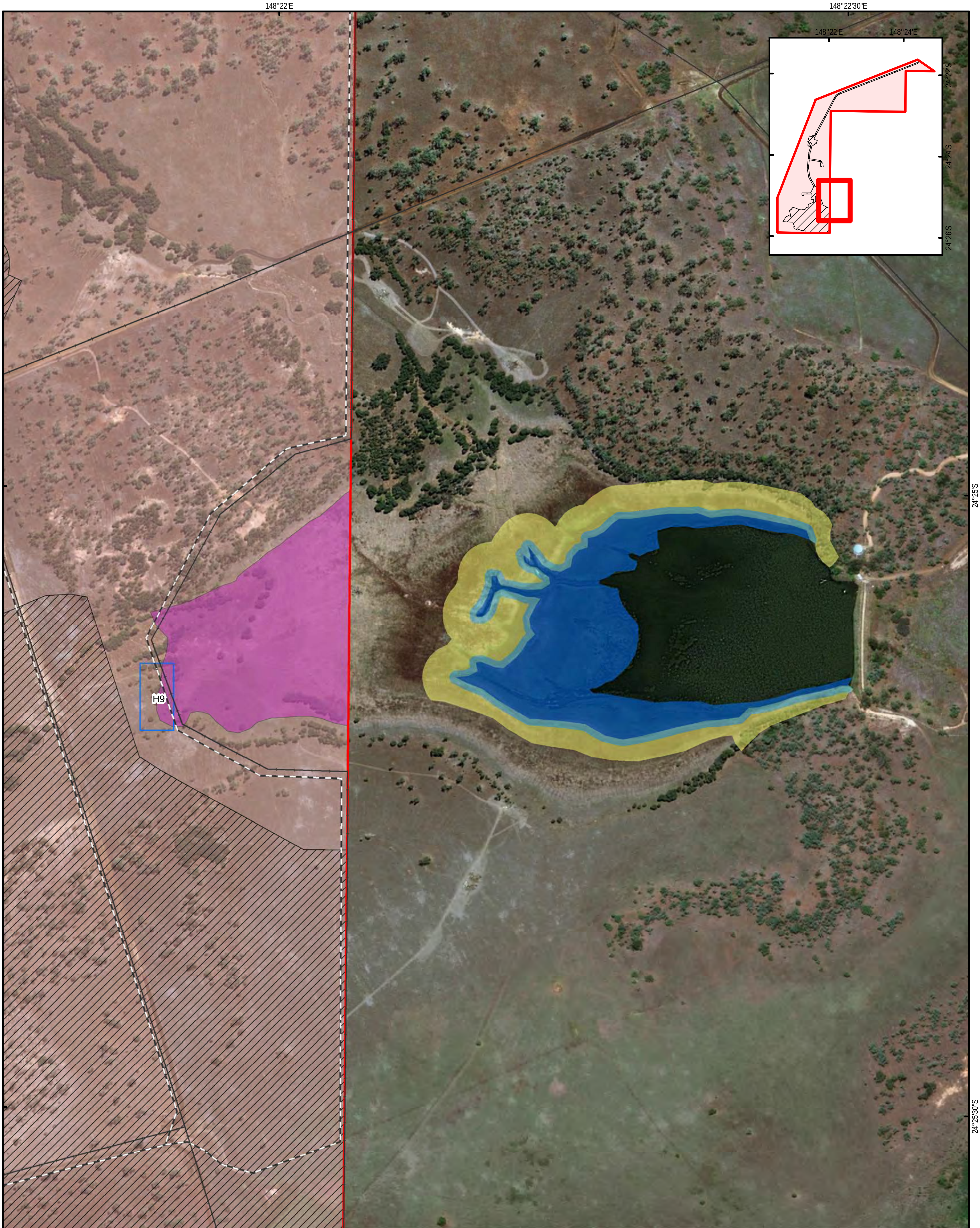
Squatter pigeon and Australian painted snipe

Targeted fauna surveys failed to detect the squatter pigeon, despite more than 259 km of driving and walking throughout the site, as well as searches at likely habitat areas, including habitat surrounding Naroo Dam and other water sources. Targeted fauna searches also failed detect Australian painted snipe. At the time of surveying, no appropriate Australian painted snipe habitat was observed within ML70452, with the only potential foraging and shelter habitat being located in the adjacent Naroo Dam, ~200 m to the east of the site on adjacent Glencore-owned and operated land (Figure 6).

At the time of surveying, Naroo Dam was seen to support a very large number of shallow water and open water waterbird species, including 30+ red-kneed dotterels (*Erythrogonys cinctus*), 10+ black-fronted dotterel (*Elseyornis melanops*), 15+ sharp-tailed sandpiper (*Calidris acuminata*), 10+ glossy ibis (*Plegadis falcinellus*), 50+ black winged stilt (*Himantopus himantopus*), 150+ Eurasian coots (*Fulica atra*).

Areas of rank grassland and other vegetation away from open water areas similarly supported a large number of wetland-dependent and wetland-associated species such as clamorous reed warbler (*Acrocephalus stentoreus*), red-backed fairy-wren (*Malurus melanocephalus*), plum-headed finch (*Neochmia modesta*), red-browed finch (*Neochmia temporalis*) and double-barred finch (*Taeniopygia bichenovii*).

In addition to these species, a single Latham's snipe (*Gallinago hardwickii*) was observed alighting from dense grassland habitat fringing Naroo Dam before settling back into grass habitat along the northern boundary of Naroo Dam. The confirmed presence of Latham's snipe at Naroo Dam affords the requirement for a cautionary note on the difficulty, to the inexperienced ecologist, to distinguish this species from the more uncommon Australian painted snipe, especially given the flighty nature and brief glimpse often afforded to viewing either of these species. Accordingly, it is recommended that ecologists undertaking ongoing surveys familiarise themselves with the differences between the two species to allow an accurate appraisal of the presence (or otherwise) of the species in potential habitat surrounding Naroo Dam.



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 6
Australian painted snipe habitat

Disturbance areas
Mining Lease
Fences
Tracks
Habitat for Australian painted snipe
Habitat monitoring transect

Australian painted snipe habitat
Shallow water foraging habitat
Muddy substrate foraging habitat
Shelter habitat

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by U&D Mining
- Disturbance areas
- Ground-truthed regional ecosystem mapping

0 50 100 150 200
Metres

N

CO2 Australia

Date: 20/12/2017 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:5,000@A3

Path: P:\GISData\Projects\Sojitz\6_Baseline_report_figures\Figure 6 - Australian painted snipe.mxd

3.2 PHOTO MONITORING

The results of the photo monitoring are present in Appendix A, showing five photos were taken ~1.5 m height above ground level looking north, east, south and west with a ground photo taken looking down at an angle of 45° to the north-west of the star picket.

Photo monitoring showed a variety of levels of cover ranging from dense grassy understorey (Site 10: refer to Photo C-100 in Appendix C) through to areas subject to moderate grazing (Site 13: Photo C-115 in Appendix C) resulting in reduced grass cover.

3.3 WEED MONITORING

A total of 16 species of weeds were identified from the 20 weed monitoring plots. No additional species of weeds were observed on the site outside of those identified within the weed monitoring plots. Across the 20 weed monitoring plots the average number of weed species was 2.9 species, ranging between no species (Site 08) and nine species (Site 20), with seven weed species only encountered at single sites. Weed cover across the 20 weed monitoring plots averaged 7.1%; ranging between 0% (Site 08) and 54% (Site 20)(Table 6).

The most commonly encountered weed was *Melinis repens*, recorded from 14 of the 20 sites (Table 6). However, while encountered at a large number of sites, the average cover of *Melinis repens* across those encountered sites averaged 1.9%. *Bidens bipinnata* was the weed species with the highest average cover, averaging 11.2% cover across the three sites it was recorded within (Table 6).

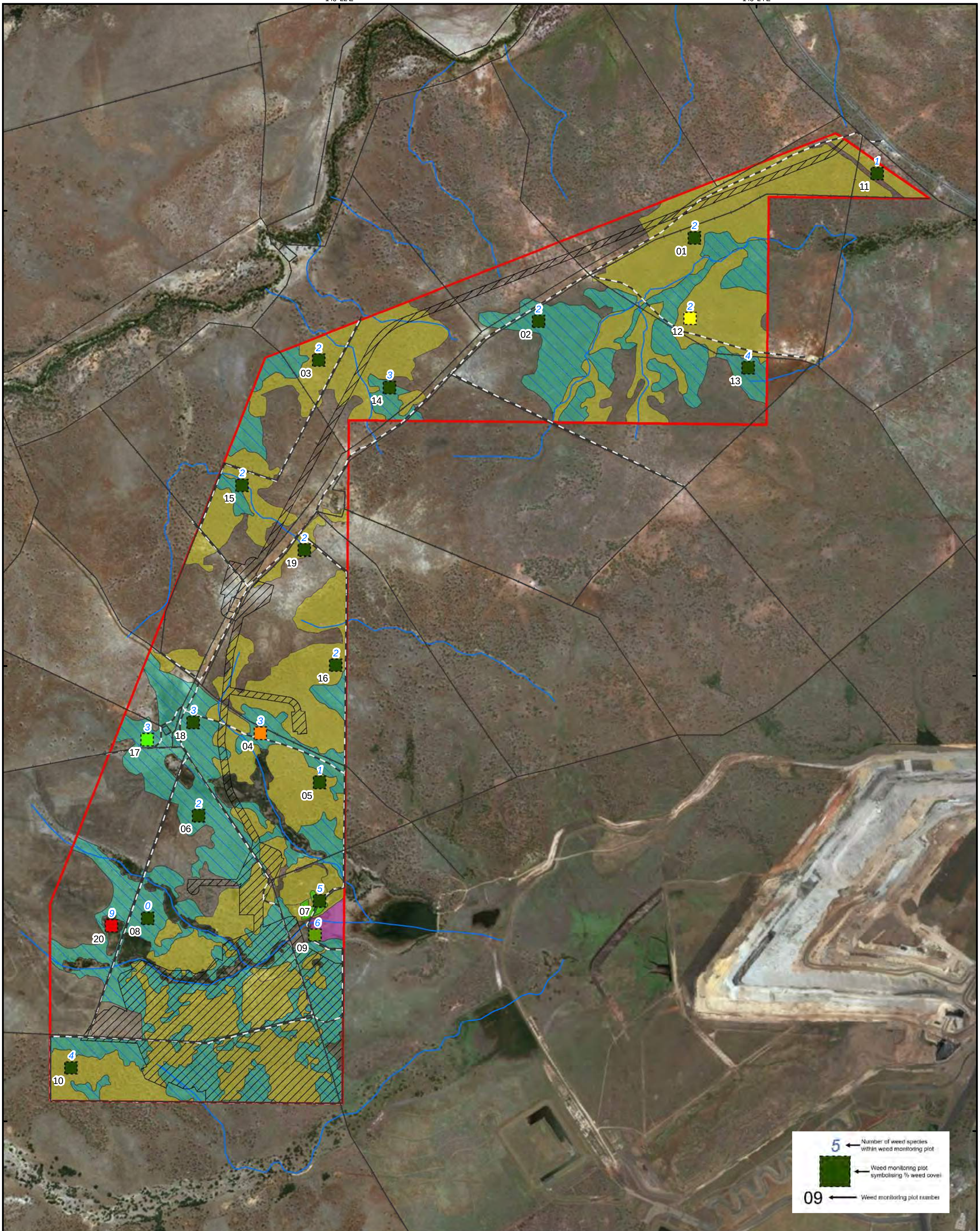
Spatially, the site with the highest diversity and cover of weeds was subject to grazing impacts (e.g. Site 20); however, another site (Site 13), subject to grazing, only supporting four weed species, with relatively a low weed cover of 4.1% (Figure 7).

Table 6: Results of weed monitoring assessments

Scientific name	Common name	Family name	Percentage cover of weed species from given site																				# sites	Avg cover (%)[a]
			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		
Bidens bipinnata	bipinnate beggar's ticks	Asteraceae							0.2		3.0											30.5	**3**	**11.2**
Parthenium hysterophorus	parthenium weed	Asteraceae				0.1			0.7		0.4				4.1				5.0	2.7		20.7	**7**	**4.8**
Sonchus oleraceus	common sowthistle	Asteraceae													0.1								**1**	**0.1**
Xanthium occidentale	noogoora burr	Asteraceae									0.2				0.1								**2**	**0.2**
Opuntia stricta	common prickly pear	Cactaceae									0.1												**1**	**0.1**
Opuntia tomentosa	velvety tree pear	Cactaceae																				0.5	**1**	**0.5**
Clitoria ternatea	butterfly pea	Fabaceae																				0.2	**1**	**0.2**
Sida spinosa	spiny sida	Malvaceae							0.1													0.1	**2**	**0.1**
Vachellia farnesiana	mimosa bush	Mimosaceae				25.1			0.1		1.8					0.1			4.3				**5**	**6.3**
Bothriochloa pertusa	Indian bluegrass	Poaceae										2.5											**1**	**2.5**
Cenchrus ciliaris	buffel grass	Poaceae										0.1										1.3	**2**	**0.7**
Dichanthium aristatum	angleton grass	Poaceae									0.7								1.8	0.1			**3**	**0.9**
Melinis repens	red natal grass	Poaceae	0.1	0.6	1.2		2.5	0.5	0.1			0.2	0.5	19.1		0.2	0.4	0.3			0.5	0.1	**14**	**1.9**
Paspalum dilatatum	paspalum	Poaceae																				0.9	**1**	**0.9**
Sorghum halepense	Johnson grass	Poaceae										0.1											**1**	**0.1**
Verbena officinalis	common verbena	Verbenaceae	1.2	0.6	0.2	0.8		0.3						0.3	0.2	1.2	1.2	0.6		0.7	0.3	0.1	**13**	**0.6**
		Count	**2**	**2**	**2**	**3**	**1**	**2**	**5**	**0**	**6**	**4**	**1**	**2**	**4**	**3**	**2**	**2**	**3**	**3**	**2**	**9**		
		Weed cover (%)[b]	**1.3**	**1.2**	**1.4**	**26**	**2.5**	**0.8**	**1.2**	**0**	**6.2**	**2.9**	**0.5**	**19.4**	**4.5**	**1.5**	**1.6**	**0.9**	**11.1**	**3.5**	**0.8**	**54.4**		

[a] Avg cover (%) represents the average percentage cover of a given weed species across encountered sites.

[b] Weed cover represents the sum of the average weed cover percentages of all weed species.



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Location diagram

Figure 7
Weed monitoring results

- Disturbance areas
- Mining Lease
- Fences
- Tracks
- Watercourse
- Brigalow TEC
- Natural Grassland TEC
- Habitat for King blue-grass and bluegrass
- Habitat for squatter pigeon
- Habitat for Australian painted snipe
- Weed monitoring plots

Weed cover (%)

- < 5
- 6 - 10
- 11 - 15
- 16 - 25
- 26 - 50
- 51 - 100

0 0.25 0.5 0.75 1
Kilometres

N

CO2 Australia

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by U&D Mining
- Disturbance areas
- Ground-truthed regional ecosystem mapping

Date: 20/12/2017 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

Path: P:\GISData\Projects\Sojitz16_Baseline_report_figures\Figure 7 - Weeds.mxd

3.4 PEST ANIMAL MONITORING

3.4.1 Rabbits

Results of rabbit monitoring confirmed the presence of rabbit/hare scats (Figure 8) from one of the 10 rabbit monitoring plots (R02). European hares (*Lepus europaeus*) were also visually confirmed while traversing the site ~1 km to the SW of R02 (see Figure 10), with sand track stations and corresponding camera traps confirming European hares along the eastern boundary of the site.

Figure 8: Observed rabbit/hare scats within the R2 rabbit monitoring plot.

Figure 9: European hare (*Lepus europaeus*) captured on fauna camera C1 (Site T02).

Table 7 shows the results of the assessment of overall rabbit impact. The results indicate that only site R02 showed any evidence of rabbit abundance. Seedling abundance scores varied between 1 (representing between 1 – 5 seedlings in the 2 ha plot) and 4 (representing between 100 – 200 seedlings in the 2 ha plot). The assessment of overall rabbit impact was denoted as 'acceptable' for all sites except site R02 which was denoted as 'monitor closely'.

Table 7: Assessment of overall rabbit impact

Site	Rabbit abundance score (0 – 5)	Seedling abundance score (0 – 5)	Rabbit damage score (0 – 5)	Corrected regeneration score (0 – 5)	Overall rabbit impact
R01	0	3	0	3	Acceptable
R02	1	1	0	1	Monitor closely
R03	0	3	0	3	Acceptable
R04	0	1	0	1	Acceptable
R05	0	2	0	2	Acceptable
R06	0	1	0	1	Acceptable
R07	0	4	0	4	Acceptable
R08	0	2	0	2	Acceptable
R09	0	2	0	2	Acceptable
R10	0	3	0	3	Acceptable

Sojitz Coal Mining Pty Ltd - Meteor Downs South

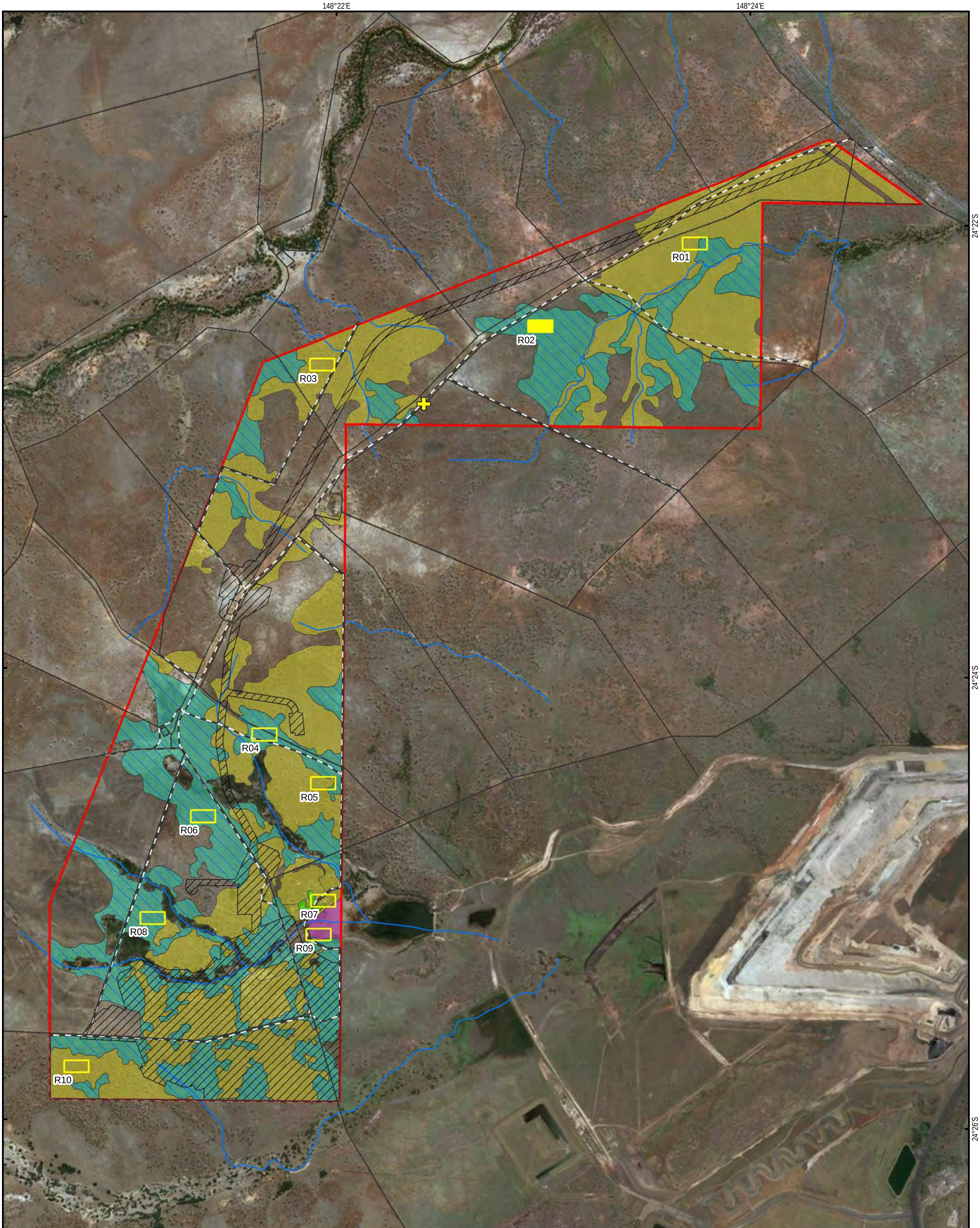


Figure 10
Evidence of rabbits/hares

Disturbance areas
Mining Lease
Fences
Tracks
Watercourse

Brigalow TEC
Natural Grassland TEC
Habitat for King blue-grass and bluegrass
Habitat for squatter pigeon
Habitat for Australian painted snipe

Rabbit monitoring plots (R01 - R10)
No evidence for rabbits/hares
Evidence of rabbits/hares
Observed European hares

0 0.25 0.5 0.75 1
Kilometres
N

CO2 Australia

Location diagram

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by U&D Mining
- Disturbance areas
- Ground-truthed regional ecosystem mapping

Date: 20/12/2017 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

Path: P:\GISData\Projects\Sojitz\6_Baseline_report_figures\Figure 10 - Rabbits.mxd

3.4.2 Sand track stations

Of the 20 sand track stations, all 20 were considered operable stations across each of the three consecutive nights, resulting in a total of 60 operable station nights for the purposes of calculating Catling Index values for pest animal species. While there was evidence of rainfall across at least a number of the sand track stations, this rainfall event occurred during the late afternoon prior to the first evening's monitoring period, with pest animal tracks confirmed on these stations at the following mornings' assessment. Assessment of the detectability of sand track stations (refer to Section 2.5.2) identified that all had a detectability rating of 4 (excellent) across each of the three days of monitoring.

The sand track stations and camera traps confirmed the presence of at least 10 species of fauna, including three species of pest animal, namely European hare (*Lepus europaeus*), wild dog (*Canis familiaris/lupus*) and cat (*Felis catus*). Non-pest animals were also confirmed from the sand track stations and fauna cameras including eastern grey kangaroo (*Macropus giganteus*), rufous bettong (*Aepyprymnus rufescens*), whiptail wallaby (*Macropus parryi*), Australian magpie (*Cracticus tibicen*), crested pigeon (*Ocyphaps lophotes*), pied butcherbird (*Cracticus nigrogularis*) and nobbi dragon (*Diporiphora nobbi*).

Pest animal activity varied little across the three days, with cats and dogs confirmed from track stations across all three days, and rabbits from fewer stations on two of the days. Pest animals were recorded from 13 of the 20 stations, with numerous records in the southern half of the site, within the vicinity of areas mapped as RE 11.8.11a (Figure 11). These areas are represented by *Melaleuca bracteata* woodland along ephemeral drainage lines, and are likely to be favoured by pest animals given they afford more favourable cover than surrounding open woodland and grassland habitat.

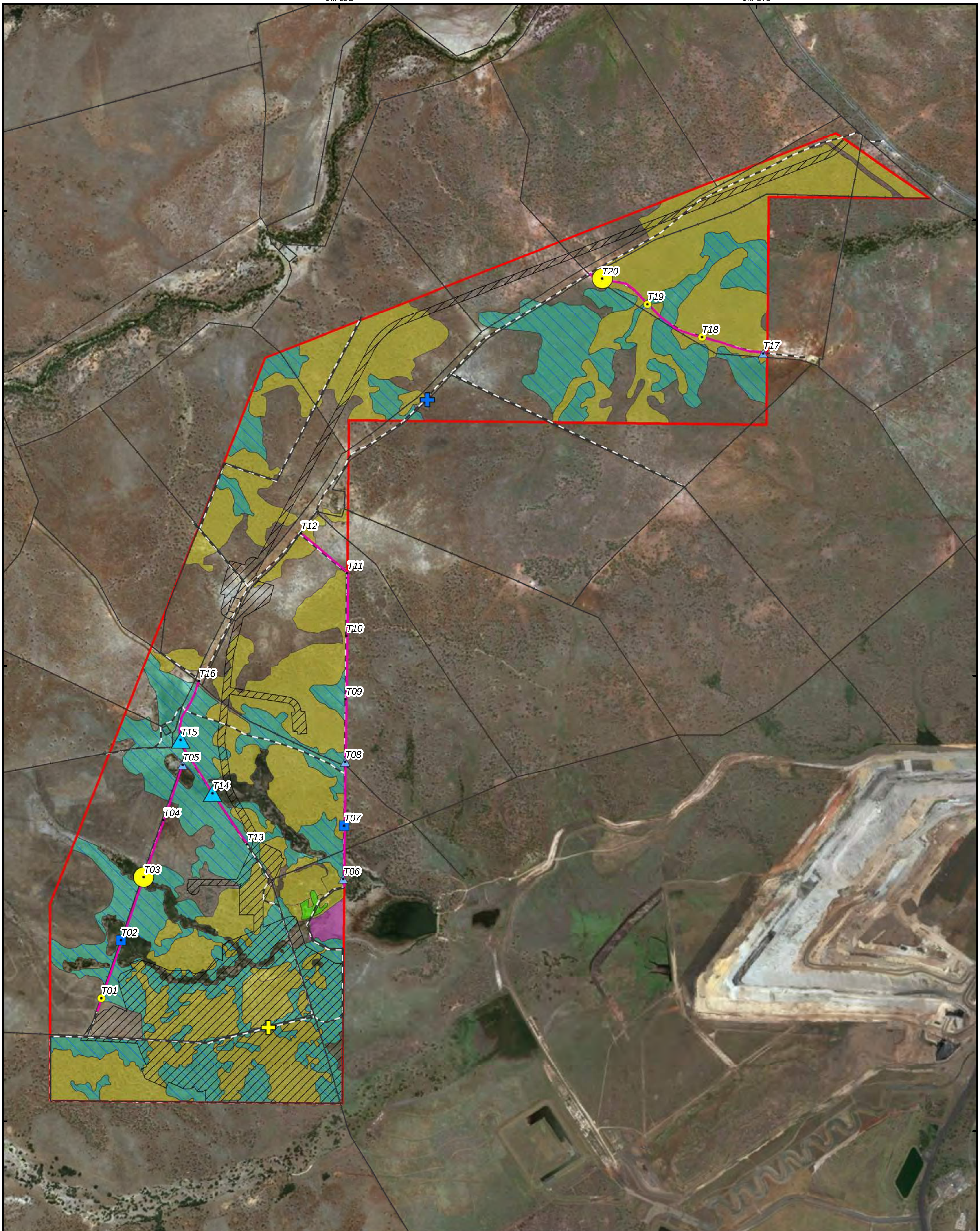
There was an apparent concentration of cats from a number of sites near the centre of the site (T05, T14 and T15), although there was a single record from the very north (Site T17)(Figure 11). Records of wild dogs were spread throughout the site, with a number of repeat records in the north of the site (T18, T19 and T20), and in the south of the site (T03). Rabbits/European hares were only recorded from two isolated sites, with a single European hare observed in the north of the site (Figure 11).

3.4.3 Feral pigs

Across all eight pig monitoring plots, represented by a total of 12 km of transects, there was no confirmed evidence for the presence of rooting, wallows, dung, footprints, travel pads, plant damage and tree rubs attributable to feral pigs. In addition to the pig monitoring plots, there was also no evidence for feral pigs either through direct observation, sand track stations or via the fauna cameras. In addition, opportunistic surveying through ephemeral watercourses, including while surveying within these areas as part of weed monitoring did not find any evidence of feral pigs. This was despite numerous soaked, muddy areas observed within such environments.

Table 8: Sand track station results

Pest animal species		Confirmed incidence of pest animal species from given site																				
		T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Catling Index
Wild dog																						
	Day 1																		✓		✓	= (7 ÷ 60) x 100 **11.7**
	Day 2			✓																✓		
	Day 3	✓		✓																	✓	
Cat																						
	Day 1														✓	✓		✓		✓		= (9 ÷ 60) x 100 **15.0**
	Day 2					✓																
	Day 3						✓		✓						✓	✓						
Rabbit/hare																						
	Day 1																					= (2 ÷ 60) x 100 **3.3**
	Day 2							✓														
	Day 3		✓																			



Sojitz Coal Mining Pty Ltd - Meteor Downs South

Figure 11
Pest animal results

- Disturbance areas
- Mining Lease
- Fences
- Tracks
- Animal track station tracks
- Brigalow TEC
- Natural Grassland TEC
- Habitat for King blue-grass and bluegrass
- Habitat for squatter pigeon
- Habitat for Australian painted snipe

Dogs (# days confirmed)
- 1 day
- 2 days

Cats (# days confirmed)
- 1 day
- 2 days

Rabbits/European hare (# days confirmed)
- 1 day

Additional pest animal sightings
- Wild dog/dingo
- European hare

0 0.25 0.5 0.75 1
Kilometres

N

CO2 Australia

DATA SOURCE:
The folowing datasets are © State of Qld:
- Mining Lease
The following datasets provided by U&D Mining
- Disturbance areas
- Ground-truthed regional ecosystem mapping

Date: 20/12/2017 Coordinate System: GDA 1994 MGA Zone 55 Projection: Transverse Mercator Datum: GDA 1994 Scale: 1:27,500@A3

Location diagram

Path: P:\GIS\Data\Projects\Sojitz\6_Baseline_report_figures\Figure 11 - Pest animals.mxd

Figure 12: Examples of pest animal tracks a) cat track at T14, b) dog track at T20

4 REFERENCES

Auld, B. (2009). Guidelines for monitoring weed control and recovery of native vegetation. Orange NSW: NSW Department of Primary Industries.

Cooke, B., McPhee, S., & Hart, Q. (1990). Rabbits: a threat to conservation & natural resource management, how to rapidly assess a rabbit problem and take action. Canberra: Australia Bureau of Rural Sciences.

Department of Environment and Heritage Protection (DEHP). (2017). *Guide to determining terrestrial habitat*. Brisbane: Department of Environment and Heritage Protection (State of Queensland).

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008), *Commonwealth Listing Advice on Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin*. Department of the Environment, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/99-listing-advice.pdf

Department of Environment, Water, Heritage and the Arts (DEWHA). (2010). *Survey Guidelines for Australia's Threatened Birds*. Canberra: Department of Environment, Water, Heritage and the Arts.

Fleming, P., Thompson, J., & Nicol, H. (1996). Indices for measuring the efficacy of aerial baiting for wild dog control in north-eastern New South Wales. *Wildlife Research*, 23, 665-674.

Hone, J. (1988). Feral pig rooting in a mountain forest and woodland: Distribution, abundance and relationships with environmental variables. *Australian Journal of Ecology*, 13, 393-400.

Mitchell, B., & Balogh, S. (2007a). *Monitoring techniques for vertebrate pests: wild dogs. Orange, NSW: New South Wales*. Department of Primary Industries & Australia. Bureau of Rural Science.

Mitchell, B., & Balogh, S. (2007b). *Monitoring techniques for vertebrate pests – feral pigs*. Orange NSW: NSW Department of Primary Industries.

APPENDIX A MONITORING SITE LOCATIONS

Appendix Table A-1 Monitoring site locations and purpose

Site	Start point name[a]	Easting	Northing	Star picket?	Habitat condition MNES values	Photo monitoring	Weed monitoring	Pest animal monitoring			
								Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs	Camera trap
01	H01_0m	641462	7304249	✓	Squatter pigeon	✓					
	H01_50m	641462	7304301	✓		✓					
	W01_01	641462	7304249	✓			✓				
	W01_02	641462	7304301				✓				
	W01_03	641462	7304348				✓				
	R01	641462	7304249	✓				✓			
02	H02_0m	640199	7303572	✓	Natural Grasslands TEC, King blue-grass, bluegrass	✓		✓			
	H02_50m	640203	7303621	✓		✓		✓			
	W02_01	640199	7303572	✓			✓				
	W02_02	640203	7303621				✓				
	W02_03	640210	7303627				✓				
	R02	640199	7303572	✓				✓			
03	H03_0m	638418	7303259	✓	Squatter pigeon	✓					
	H03_50m	638425	7303308	✓		✓					
	W03_01	638418	7303259	✓			✓				
	W03_02	638425	7303308				✓				
	W03_03	638430	7303358				✓				
	R03	638418	7303259	✓				✓			
04	H04_0m	637945	7300236	✓	Natural Grasslands TEC, King blue-grass, bluegrass	✓					

Site	Start point name[a]	Easting	Northing	Star picket?	Habitat condition MNES values	Photo monitoring	Weed monitoring	Pest animal monitoring			
								Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs	Camera trap
	H04_50m	637951	7300287	✓		✓					
	W04_01	637945	7300236	✓			✓				
	W04_02	637951	7300287				✓				
	W04_03	637950	7300338				✓				
	R04	637945	7300236	✓				✓			
05	H05_0m	638426	7299836	✓	Squatter pigeon	✓					
	H05_50m	638420	7299885	✓		✓					
	W05_01	638426	7299836	✓			✓				
	W05_02	638420	7299885				✓				
	W05_03	638416	7299937				✓				
	R05	638426	7299836	✓				✓			
06	H06_0m	637445	7299566	✓	Natural Grasslands TEC, King blue-grass, bluegrass	✓					
	H06_50m	637447	7299615	✓		✓					
	W06_01	637445	7299566	✓			✓				
	W06_02	637447	7299615				✓				
	W06_03	637443	7299668								
	R06	637445	7299566	✓				✓			
07	H07_0m	638426	7298876	✓	Brigalow TEC	✓					
	H07_50m	638419	7298926	✓		✓					
	W07_01	638426	7298876	✓			✓				

Site	Start point name[a]	Easting	Northing	Star picket?	Habitat condition MNES values	Photo monitoring	Weed monitoring	Pest animal monitoring			
								Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs	Camera trap
	W07_02	638419	7298926				✓				
	W07_03	638423	7298974				✓				
	R07	638426	7298876	✓				✓			
08	H08_0m	637032	7298735	✓	Natural Grasslands TEC, King blue-grass, bluegrass	✓					
	H08_50m	637034	7298785	✓		✓					
	W08_01	637032	7298735	✓			✓				
	W08_02	637034	7298785				✓				
	W08_03	637039	7298835				✓				
	R08	637032	7298735	✓				✓			
09	H09_0m	638387	7298599	✓	Australian painted snipe	✓					
	H09_50m	638380	7298648	✓		✓					
	W09_01	638387	7298599	✓			✓				
	W09_02	638380	7298648				✓				
	W09_03	638372	7298699				✓				
	R09	638387	7298599	✓				✓			
10	H10_0m	636412	7297523	✓	Squatter pigeon	✓					
	H10_50m	636415	7297571	✓		✓					
	W10_01	636412	7297523	✓			✓				
	W10_02	636415	7297571				✓				
	W10_03	636413	7297617				✓				

Site	Start point name[a]	Easting	Northing	Star picket?	Habitat condition MNES values	Photo monitoring	Weed monitoring	Pest animal monitoring			
								Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs	Camera trap
	R10	636412	7297523	✓				✓			
	W11_01	642941	7304772	✓			✓				
11	W11_02	642937	7304825				✓				
	W11_03	642938	7304876				✓				
	W12_01	641428	7303597	✓			✓				
12	W12_02	641426	7303646				✓				
	W12_03	641429	7303696				✓				
	W13_01	641896	7303196	✓			✓				
13	W13_02	641899	7303247				✓				
	W13_03	641900	7303297				✓				
	W14_01	638991	7303038	✓			✓				
14	W14_02	638987	7303090				✓				
	W14_03	638988	7303140				✓				
	W15_01	637797	7302245	✓			✓				
15	W15_02	637796	7302296				✓				
	W15_03	637796	7302347				✓				
	W16_01	638556	7300785	✓			✓				
16	W16_02	638560	7300832				✓				
	W16_03	638566	7300882				✓				
17	W17_01	637029	7300184	✓			✓				

Site	Start point name[a]	Easting	Northing	Star picket?	Habitat condition MNES values	Photo monitoring	Weed monitoring	Pest animal monitoring			
								Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs	Camera trap
	W17_02	637028	7300231				✓				
	W17_03	637024	7300282				✓				
18	W18_01	637401	7300321	✓			✓				
	W18_02	637401	7300368				✓				
	W18_03	637398	7300421				✓				
19	W19_01	638301	7301720	✓			✓				
	W19_02	638295	7301771				✓				
	W19_03	638290	7301821				✓				
20	W20_01	636740	7298674	✓			✓				
	W20_02	636746	7298723				✓				
	W20_03	636752	7298771				✓				
21	P01_01	636412	7297523						✓		
	P01_02	636412	7297423						✓		
	P01_03	636412	7297323						✓		
22	P02_01	636397	7298627						✓		
	P02_02	636397	7298527						✓		
	P02_03	636397	7298427						✓		
23	P03_01	637232	7298835						✓		
	P03_02	637232	7298735						✓		
	P03_03	637232	7298635						✓		

Site	Start point name[a]	Easting	Northing	Star picket?	Habitat condition MNES values	Photo monitoring	Weed monitoring	Pest animal monitoring			
								Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs	Camera trap
24	P04_01	638126	7299076						✓		
	P04_02	638126	7298976						✓		
	P04_03	638126	7298876						✓		
25	P05_01	638126	7299836						✓		
	P05_02	638126	7299736						✓		
	P05_03	638126	7299637						✓		
26	P06_01	638156	7300985						✓		
	P06_02	638156	7300885						✓		
	P06_03	638156	7300785						✓		
27	P07_01	638992	7303366						✓		
	P07_02	638992	7303266						✓		
	P07_03	638992	7303166						✓		
28	P08_01	641150	7303945						✓		
	P08_02	641150	7303845						✓		
	P08_03	641150	7303745						✓		
29	T01	636706	7298137							✓	
30	T02	636867	7298608							✓	
	C01	636867	7298608								✓
31	T03	637050	7299119							✓	
32	T04	637209	7299579							✓	

Site	Start point name[a]	Easting	Northing	Star picket?	Habitat condition MNES values	Photo monitoring	Weed monitoring	Pest animal monitoring			
								Rabbit plot	Feral pig plot	Sand track station – cats, foxes, dogs	Camera trap
33	T05	637366	7300027							✓	
34	T06	638668	7299104							✓	
35	T07	638674	7299536							✓	
	C02	638674	7299536								✓
36	T08	638683	7300051							✓	
37	T09	638687	7300562							✓	
38	T10	638692	7301073							✓	
39	T11	638698	7301582							✓	
	C03	638698	7301582								✓
40	T12	638324	7301905							✓	
41	T13	637888	7299382							✓	
42	T14	637608	7299799							✓	
43	T15	637349	7300233							✓	
44	T16	637498	7300708							✓	
45	T17	642069	7303364							✓	
	C04	642069	7303364								✓
46	T18	641574	7303496							✓	
47	T19	641131	7303763							✓	
48	T20	640764	7303969							✓	

[a] Start points with prefix H = habitat assessment sites (HXX_0m and HXX_50m corresponds to 0 m and 50 m point of north-south habitat assessment transect), W = start point (west) of each site's weed monitoring plot transects (WXX_01, WXX_02 and WXX_03 corresponds to transect 1, 2 and 3), R = start point (south-west) of 2 ha rabbit monitoring plot, P = start point (west) of each site's pig monitoring plot transects (PXX_01, PXX_02 and PXX_03 corresponds to transect 1, 2 and 3), T = animal track sand station, C = camera trap. Start points for habitat assessment, weed monitoring and rabbit monitoring plots are the same for sites 01 – 10, with sites 11 – 20 only corresponding to weed monitoring plots.

APPENDIX B BASELINE HABITAT CONDITION ASSESSMENT

The following tables provide a summary of the data used to calculate the baseline habitat condition score for MNES, calculated in accordance with the *Guide to Determining Terrestrial Habitat Quality version 1.2* (DEHP, 2017). The data required to inform the site condition, fauna species habitat index scores and flora species stocking rates were collected as part of detailed field surveys in December 2017. The site context score was calculated based on a desktop assessment following the method prescribed in the *Guide to Determining Terrestrial Habitat Quality version 1.2* (DEHP, 2017), incorporating ground-truthed regional ecosystem mapping within the extent of ML70452.

Table B-1: Site condition raw data for each RE assessment unit

Ecological condition indicators	Site 01 RE 11.8.5			Site 02 RE 11.8.11			Site 03 RE 11.8.5			Site 04 RE 11.8.11			Site 05 RE 11.8.5			Site 06 RE 11.8.11			Site 07 RE 11.4.3			Site 08 RE 11.8.11			Site 09 RE 11.3.3a			Site 10 RE 11.8.5		
	Raw data	Benchmark (11.8.5)	Score	Raw data	Benchmark (11.8.11)	Score	Raw data	Benchmark (11.8.5)	Score	Raw data	Benchmark (11.8.11)	Score	Raw data	Benchmark (11.8.5)	Score	Raw data	Benchmark (11.8.11)	Score	Raw data	Benchmark (11.4.3)	Score	Raw data	Benchmark (11.8.11)	Score	Raw data	Benchmark (11.3.3)	Score	Raw data	Benchmark (11.8.5)	Score
Recruitment of woody perennial species	100	100	5	-	-	-	100	100	5	-	-	-	100	100	5	-	-	-	60	100	3	-	-	-	100	100	5	100	100	5
Native plant species richness - trees	2	2	5	-	-	-	3	2	5	-	-	-	1	2	3	-	-	-	5	2	5	-	-	-	1	3	3	2	2	5
Native plant species richness - shrubs	2	3	3	-	-	-	3	3	5	-	-	-	1	3	3	-	-	-	10	10	5	-	-	-	4	5	3	2	3	3
Native plant species richness - grasses	12	6	5	10	5	5	10	6	5	9	5	5	10	6	5	8	5	5	10	4	5	11	5	5	9	12	3	8	6	5
Native plant species richness - forbs	13	16	3	11	10	5	16	16	5	10	10	5	14	16	3	11	10	5	18	13	5	10	10	5	13	15	3	14	16	3
Tree canopy height	14	15	2.5	-	-	-	14	15	5	-	-	-	13	15	2.5	-	-	-	12	24	3	-	-	-	7	18	3	14	15	5
Tree sub canopy height	0	5		-	-	-	8	5		-	-	-	0	5		-	-	-				-	-	-	4	10		6	5	
Tree canopy cover	4	13	1	-	-	-	15.6	13	5	-	-	-	0	13	0	-	-	-	29	70	2	-	-	-	3.5	28	1	7.5	13	3.5
Tree sub canopy cover	0	4		-	-		4.2	4		-	-		0	4		-	-					-	-		0	5		1.8	4	
Shrub canopy cover	1	3	3	-	-	-	0	3	0	-	-	-	0	3	0	-	-	-	7	48	3	-	-	-	11.5	4	3	0	3	0
Native perennial grass cover	83.2	60	5	83.6	30	5	61	60	5	71.6	30	5	69.6	60	5	76.6	30	5	20	6	5	72	30	5	54	45	5	43	60	3
Organic litter	14	25	5	7	49	3	31.8	25	5	6	49	3	6.4	25	3	4.8	49	0	56	75	5	15	49	3	10	30	3	39	25	5
Large eucalypt trees	4	6	10	-	-	-	8	6	15	-	-	-	2	6	5	-	-	-	0	0	5	-	-	-	0	10	0	8	6	15
Large non-eucalypt trees	0	0		-	-		0	0		-	-		0	0		-	-		2	80		-	-		0	0		0	0	
Coarse woody debris	114	250	2	-	-	-	558	250	2	-	-	-	43	250	2	-	-	-	590	1752	2	-	-	-	0	285	0	244	250	5
Non-native plant cover	2	0	10	2	0	10	1	0	10	5	0	5	0	0	10	1	0	10	3	0	10	1	0	10	2	0	10	2	0	10
Total			**59.5**			**28**			**72**			**23**			**46.5**			**25**			**58**			**28**			**42**			**67.5**
/10			**7.44**			**9.33**			**9.00**			**7.67**			**5.81**			**8.33**			**7.25**			**9.33**			**5.25**			**8.44**

Table B-2: Summary of the site condition, site context and fauna species habitat index scores used to calculate the habitat condition score for each RE assessment unit

	Site 01	Site 02	Site 03	Site 04	Site 05	Site 06	Site 07	Site 08	Site 09	Site 10
	11.8.5	11.8.11	11.8.5	11.8.11	11.8.5	11.8.11	11.4.3	11.8.11	11.3.3a	11.8.5
MNES values	Squatter pigeon	Natural Grasslands TEC, King blue-grass, Bluegrass	Squatter pigeon	Natural Grasslands TEC, King blue-grass, Bluegrass	Squatter pigeon	Natural Grasslands TEC, King blue-grass, Bluegrass	Brigalow TEC	Natural Grasslands TEC, King blue-grass, Bluegrass	Australian painted snipe	Squatter pigeon
Site condition										
Recruitment of woody perennial species	5	-	5	-	5	-	3	-	5	5
Native plant species richness - trees	5	-	5	-	3	-	5	-	3	5
Native plant species richness - shrubs	3	-	5	-	3	-	5	-	3	3
Native plant species richness - grasses	5	5	5	5	5	5	5	5	3	5
Native plant species richness - forbs	3	5	5	5	3	5	5	5	3	3
Tree canopy height	2.5	-	5	-	2.5	-	3	-	3	5
Tree canopy cover	1	-	5	-	0	-	2	-	1	3.5
Shrub canopy cover	3	-	0	-	0	-	3	-	3	0
Native perennial grass cover	5	5	5	5	5	5	5	5	5	3
Organic litter	5	3	5	3	3	0	5	3	3	5
Large trees	10	-	15	-	5	-	5	-	0	15
Coarse woody debris	2	-	2	-	2	-	2	-	0	5
Non-native plant cover	10	10	10	5	10	10	10	10	10	10
Total of BioCondition attributes	**59.5**	**28**	**72**	**23**	**46.5**	**25**	**58**	**28**	**42**	**67.5**
MAX ecological condition score	**80**	**30**	**80**	**30**	**80**	**30**	**80**	**30**	**80**	**80**
Score /10	**7.44**	**9.33**	**9.00**	**7.67**	**5.81**	**8.33**	**7.25**	**9.33**	**5.25**	**8.44**
Site context										
Size of patch (fragmented bioregions)	10	10	10	10	10	10	10	10	10	10
Connectivity (fragmented bioregions)	5	4	5	5	5	5	5	5	5	5
Context (fragmented bioregions)	5	4	5	5	5	4	5	4	5	5
Distance to permanent watering point (intact bioregions)	-	-	-	-	-	-	-	-	-	-
Ecological corridors	0	0	0	0	0	0	0	0	0	0
Total of site context attributes	**20**	**18**	**20**	**20**	**20**	**19**	**20**	**19**	**20**	**20**
MAX site condition score	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**
Score /10	**7.69**	**6.92**	**7.69**	**7.69**	**7.69**	**7.31**	**7.69**	**7.31**	**7.69**	**7.69**
Fauna species habitat index										
Threats to species	7	-	7	-	7	-	-	-	1	7
Quality and availability of food and foraging habitat	5	-	10	-	5	-	-	-	5	10
Quality and availability of shelter	5	-	5	-	5	-	-	-	1	5
Species mobility capacity	10	-	10	-	10	-	-	-	1	10
Role of site location to species overall population in the state	3	-	3	-	3	-	-	-	4	3
Total of fauna species habitat index	**30**	**-**	**35**	**-**	**30**	**-**	**-**	**-**	**12**	**35**
MAX fauna habitat index score	**50**	**-**	**50**	**-**	**50**	**-**	**-**	**-**	**50**	**50**
Score /10	**6.00**	**-**	**7.00**	**-**	**6.00**	**-**	**-**	**-**	**2.40**	**7.00**

Table B-3: Summary of the species stocking rate index for king blue-grass and bluegrass

Species stocking rate /3[a]	Site 01	Site 02	Site 03	Site 04	Site 05	Site 06	Site 07	Site 08	Site 09	Site 10
	11.8.5	11.8.11	11.8.5	11.8.11	11.8.5	11.8.11	11.4.3	11.8.11	11.3.3a	11.8.5
King blue-grass	-	0	-	0	-	0	-	2	-	-
Bluegrass	-	0	-	0	-	0	-	0	-	-

[a] species stocking rate contributes 20% toward the habitat condition score for the two MNES flora species, with the remaining 80% made up of site condition and site context.

Table B-4: Summary of the MNES habitat condition score for each RE assessment unit

Assessment unit habitat condition score /10	Site 01	Site 02	Site 03	Site 04	Site 05	Site 06	Site 07	Site 08	Site 09	Site 10	FINAL MNES habitat quality score
	11.8.5	11.8.11	11.8.5	11.8.11	11.8.5	11.8.11	11.4.3	11.8.11	11.3.3a	11.8.5	
Brigalow TEC	-	-	-	-	-	-	7.36	-	-	-	**7.36**
Natural Grasslands TEC	-	8.21	-	7.68	-	7.86	-	8.39	-	-	**8.04**
King blue-grass	-	6.57	-	6.14	-	6.29	-	8.05	-	-	**6.76**
Bluegrass	-	6.57	-	6.14	-	6.29	-	6.71	-	-	**6.43**
Squatter pigeon	7.02	-	8.14	-	6.19	-	-	-	-	7.85	**7.30**
Australian painted snipe	-	-	-	-	-	-	-	-	4.74	-	**4.74**

APPENDIX C   PHOTO MONITORING

SITE 01 – H01_0M

Photo C-1 North

Photo C-2 East

Photo C-3 South

Photo C-4 West

Photo C-5 Ground

SITE 01 – H01_50M


Photo C-6 North

Photo C-7 East


Photo C-8 South

Photo C-9 West

Photo C-10 Ground

SITE 02 – H02_0 M

Photo C-11 North

Photo C-12 East

Photo C-13 South

Photo C-14 West

Photo C-15 Ground

SITE 02 – H02_50M


Photo C-16 North


Photo C-17 East


Photo C-18 South


Photo C-19 West


Photo C-20 Ground

SITE 03 – H03_0M


Photo C-21 North

Photo C-22 East


Photo C-23 South

Photo C-24 West

Photo C-25 Ground

SITE 03 – H03_50M

Photo C-26 North

Photo C-27 East

Photo C-28 South

Photo C-29 West

Photo C-30 Ground

SITE 04 – H04_0M

Photo C-31 North

Photo C-32 East

Photo C-33 South

Photo C-34 West

Photo C-35 Ground

SITE 04 – H04_50M


Photo C-36 North

Photo C-37 East


Photo C-38 South

Photo C-39 West

Photo C-40 Ground

SITE 05 – H05_0M

Photo C-41 North

Photo C-42 East

Photo C-43 South

Photo C-44 West

Photo C-45 Ground

SITE 05 – H05_50M

Photo C-46 North

Photo C-47 East

Photo C-48 South

Photo C-49 West

Photo C-50 Ground

SITE 06 – H06_0M

Photo C-51 North

Photo C-52 East

Photo C-53 South

Photo C-54 West

Photo C-55 Ground

SITE 06 – H06_50M

Photo C-56 North

Photo C-57 East

Photo C-58 South

Photo C-59 West

Photo C-60 Ground

SITE 07 – H07_0M

Photo C-61 North

Photo C-62 East

Photo C-63 South

Photo C-64 West

Photo C-65 Ground

SITE 07 – H07_50M

Photo C-66 North

Photo C-67 East

Photo C-68 South

Photo C-69 West

Photo C-70 Ground

SITE 08 – H08_0M

Photo C-71 North

Photo C-72 East

Photo C-73 South

Photo C-74 West

Photo C-75 Ground

SITE 08 – H08_50M

Photo C-76 North

Photo C-77 East

Photo C-78 South

Photo C-79 West

Photo C-80 Ground

SITE 09 – H09_0M

Photo C-81 North

Photo C-82 East

Photo C-83 South

Photo C-84 West

Photo C-85 Ground

SITE 09 – H09_50M

Photo C-86 North

Photo C-87 East

Photo C-88 South

Photo C-89 West

Photo C-90 Ground

SITE 10 – H10_0M

Photo C-91 North

Photo C-92 East

Photo C-93 South

Photo C-94 West

Photo C-95 Ground

SITE 10 – H10_50M

Photo C-96 North

Photo C-97 East

Photo C-98 South

Photo C-99 West

Photo C-100 Ground

SITE 11 – W11

Photo C-101 North

Photo C-102 East

Photo C-103 South

Photo C-104 West

Photo C-105 Ground

SITE 12 – W12

Photo C-106 North

Photo C-107 East

Photo C-108 South

Photo C-109 West

Photo C-110 Ground

SITE 13 – W13


Photo C-111 North

Photo C-112 East


Photo C-113 South

Photo C-114 West

Photo C-115 Ground

SITE 14 – W14

Photo C-116   North

Photo C-117   East

Photo C-118   South

Photo C-119   West

Photo C-120   Ground

SITE 15 – W15

Photo C-121 North

Photo C-122 East

Photo C-123 South

Photo C-124 West

Photo C-125 Ground

SITE 16 – W16

Photo C-126 North

Photo C-127 East

Photo C-128 South

Photo C-129 West

Photo C-130 Ground

SITE 17 – W17

Photo C-131 North

Photo C-132 East

Photo C-133 South

Photo C-134 West

Photo C-135 Ground

SITE 18 – W18

Photo C-136 North

Photo C-137 East

Photo C-138 South

Photo C-139 West

Photo C-140 Ground

SITE 19 – W19

Photo C-141 North

Photo C-142 East

Photo C-143 South

Photo C-144 West

Photo C-145 Ground

SITE 20 – W20

Photo C-146 North

Photo C-147 East

Photo C-148 South

Photo C-149 West

Photo C-150 Ground

APPENDIX D RISK ASSESSMENT

The following risk assessment assesses the risks of failure to achieve the plan's objectives for MNES.

For each risk identified, the potential consequence of the risk (rated from minor to critical; Table D 1) was assessed against the likelihood of that risk occurring (rated from very unlikely to almost certain;

Table D 2) to determine a risk rating. The risk rating was evaluated by using the matrix in

Table D 3.

The consequence and likelihood of each risk was first considered without the proposed management and mitigation measures in place to provide an initial risk rating. The consequence and likelihood of each risk occurring was then reassessed following the implementation of the management and mitigation measures (i.e. control measures) to provide a residual risk rating.

Table D 4 provides the risk register which was used to document the findings of the risk assessment process.

Table D 1: Consequence classification

1. Minor	Minor risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing low cost, well characterised corrective actions.
2. Moderate	Moderate risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing well characterised, high cost/effort corrective actions.
3. High	High risk of failure to achieve the plan's objectives. Results in medium-long term delays to achieving plan objectives, implementing uncertain, high cost/effort corrective actions.
4. Major	The plan's objectives are unlikely to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies.
5. Critical	The plan's objectives are unable to be achieved, with no evidenced mitigation strategies.

Table D 2: Likelihood classification

5. Almost certain	Is expected to occur in most circumstances
4. Likely	Will probably occur during the life of the project
3. Possible	Might occur during the life of the project
2. Unlikely	Could occur but considered unlikely or doubtful
1. Very unlikely	May occur in exceptional circumstances

Table D 3: Risk rating matrix

Likelihood	Consequence				
	1 - Minor	2 - Moderate	3 - High	4 - Major	5 - Critical

5 - Almost Certain	Medium	High	High	Severe	Severe
4 - Likely	Low	Medium	High	High	Severe
3 - Possible	Low	Medium	Medium	High	Severe
2 - Unlikely	Low	Low	Medium	High	High
1 - Very Unlikely	Low	Low	Low	Medium	High

A brief description of each overall possible risk rating is provided below.

Severe

A ranking of extreme represents an unacceptable risk, which is usually critical in nature in terms of consequences and is considered possible to almost certain to occur. Such risks significantly exceed the risk acceptance threshold and require comprehensive control measures, and additional urgent and immediate attention towards the identification and implementation of measures necessary to reduce the level of risk.

High

High risks typically relate to moderate to critical consequences that are rated as possible to almost certain to occur. These are also likely to exceed the risk acceptance threshold, and although proactive control measures are usually planned or implemented, a very close monitoring regime and additional actions towards achieving further risk reduction is required.

Medium

As suggested by the classification, medium level risks span a group of risk combinations varying from relatively minor consequence/likely likelihood to mid-level consequence/likelihood to relatively major consequence/very unlikely likelihood scenarios. These risks are likely to require active monitoring as they are effectively positioned on the risk acceptance threshold.

Low

Low risks are below the risk acceptance threshold and although they may require additional monitoring in certain cases, are not considered to require active management. In general, such risks represent relatively low likelihood, and low to mid-level consequence scenarios.

Table D 4: Risk register

Objectives for MNES management	Risk	Event or circumstance	Initial risk rating: Likelihood	Initial risk rating: Consequence	Initial risk rating: Overall Risk Rating	Control strategies	Residual risk rating: Likelihood	Residual risk rating: Consequence	Residual risk rating: Overall Risk Rating
1. Limit or avoid loss of MNES/ habitat for MNES.	Clearing of MNES/ habitat for MNES occurs outside of the Project footprint and/or exceeds actual disturbance limits.	▶ Clearing personnel/contractors are not made aware of the location of areas of MNES habitat. ▶ ▶	4	3	H	▶ Mapping of MNES within the Project site is provided in Figure 5 to Figure 10 (excluding Figure 9). This mapping, and associated GIS shapefiles, will be provided to clearing personnel and/or contractors prior to the commencement of clearing operations. ▶ A permit to disturb must be initiated and signed off by the site Environmental Representative prior to any vegetation clearing. ▶ Any conditions listed in the permit to disturb must be implemented. For example, clearing extents will be clearly marked and any vegetation or areas to be protected adjacent to the Project footprint will barricaded (using for example safety bunting, pegging or mesh safety fences). ▶ Areas to be cleared will be restricted to the minimum area necessary for the construction and operation of the Project. ▶ Temporary stockpile sites for soil and equipment, access routes, laydown yards and other associated infrastructure will be located in cleared areas, where possible. ▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures. ▶ All vegetation clearing operations are to be monitored for compliance by a suitably qualified person.	1	3	L
	Clearing of Brigalow TEC occurs.	▶ Clearing occurs outside of the Project footprint. ▶ Clearing contractors are not made aware of the location of areas of Brigalow TEC.	2	3	M	▶ Mapping of Brigalow TEC within the Project site is provided in Figure 5. This mapping and associated GIS shapefiles, will be provided to clearing contractors and/or personnel prior to the commencement of clearing operations. GIS shapefiles can be provided on request. ▶ Clearing of Brigalow TEC is not permitted. ▶ Clearing outside of the Project footprint is not permitted. ▶ A permit to disturb must be initiated and signed off by the site Environmental Representative prior to any vegetation clearing. ▶ Any conditions listed in the permit to disturb must be implemented. For example, clearing extents will be clearly marked and any vegetation or areas to be protected adjacent to the Project footprint will barricaded (using for example safety bunting, pegging or mesh safety fences). ▶ Prior to vegetation clearing, the extent of Brigalow TEC will be clearly marked or barricaded to prevent/minimise disturbance.	1	3	L

Objectives for MNES management	Risk	Event or circumstance	Initial risk rating: Likelihood	Initial risk rating: Consequence	Initial risk rating: Overall Risk Rating	Control strategies	Residual risk rating: Likelihood	Residual risk rating: Consequence	Residual risk rating: Overall Risk Rating
	Net loss of habitat for the Australian painted snipe.	▶ Mining occurs at Naroo Dam. ▶ Water is not diverted to Naroo Dam. ▶ More than 11 % of the catchment is affected by the Project footprint. ▶ Diversion drain does not provide suitable habitat for the Australian painted snipe.	2	2	L	▶ The mine has been reconfigured such that it does not intersect with Naroo Dam, which is the preferred habitat area for Australian painted snipe on the Project site. ▶ Water flows into Naroo Dam will be maintained by diverting overland flows around the mine into the dam, through the construction of a diversion drain. ▶ U & D have entered into a Make Good Agreement with Glencore which ensures that make good water is delivered directly into Naroo Dam, and ensures that water does not fall below critical storage level. ▶ With regards to ephemeral drainage lines, which may possibly provide habitat suitable for Australian painted snipe after periods of inundation, this type of modified habitat is widespread throughout the local area, both on the Project site, and on surrounding properties. ▶ The loss of marginal ephemeral drainage line habitat (i.e. two of the larger ephemeral drainage lines intersect the mine footprint, and another is crossed by the road within the Project site), is offset by the provision of the north diversion drain. ▶ The diversion drain will be designed to maximise benefits to the Australian painted snipe including the provision of micro-habitat features and the ability for ponding, noting species habitat requirements described in Section 9.2.2. ▶ The size of the Naroo Dam catchment will be restored at the end of the mine life.	1	2	L
	Loss of permanent water sources for the squatter pigeon, in particular Naroo Dam.	▶ Project footprint removes part of Naroo dam. ▶ All or part of the catchment of Naroo Dam is removed by the Project. ▶ The Project impacts on other permanent water sources within the Project site (i.e. stock dams).	2	2	L	▶ The mine has been reconfigured such that it does not intersect with Naroo Dam. ▶ The mine footprint does not exceed more than 11% of the catchment for Naroo Dam. ▶ Water flows into Naroo Dam will be maintained by diverting overland flows around the mine into the dam, through the construction of a diversion drain. ▶ U & D have entered into a Make Good Agreement with Glencore which ensures that make good water is delivered directly into Naroo Dam, and ensures that water does not fall below critical storage level. ▶ No other permanent water sources will be directly impacted by the Project.	1	2	L
	Known king blue-grass and bluegrass specimens located outside of the Project footprint are cleared.	▶ Clearing occurs outside of the Project footprint. ▶ Clearing contractors are not made aware of the location of areas of king blue-grass and bluegrass specimens.	2	3	M	▶ Prior to clearing the location of any known king blue-grass and bluegrass specimens, outside of the Project footprint, will be clearly marked or barricaded (using for example, safety bunting, pegging or mesh safety fences). ▶ Should additional king blue-grass and bluegrass specimens be identified outside of the Project footprint, at any time during construction and/or operation of the Project, these areas will be clearly identified on site maps and clearly marked if in close proximity to the Project footprint. ▶ A permit to disturb must be initiated and signed off by the site Environmental Representative prior to any vegetation clearing. ▶ Any conditions listed in the permit to disturb must be implemented. For example, clearing extents will be clearly marked and any vegetation or areas to be protected adjacent to the Project footprint will barricaded (using for example safety bunting, pegging or mesh safety fences).	1	3	L

Objectives for MNES management	Risk	Event or circumstance	Initial risk rating			Control strategies	Residual risk rating		
			Likelihood	Consequence	Overall Risk Rating		Likelihood	Consequence	Overall Risk Rating
	Rehabilitation fails to meet the established objectives, indicators and completion criteria.	▶ Disturbed areas are not rehabilitated in appropriate timeframes. ▶ Topsoil is not appropriately stockpiled and/or used on rehabilitation areas. ▶ Species which are not endemic to the area are used in the rehabilitation. ▶ Introduction/spread of weed species in rehabilitated areas. ▶ Erosion is not managed.	3	3	M	▶ The Project's EA (Appendix A) sets out the conditions and process for rehabilitation of the Project site. ▶ U & D is committed to progressively rehabilitating areas of disturbance at the Project site wherever possible. This will include: - topsoil recovery ahead of disturbance, with topsoil either stockpiled or, wherever possible, directly used in rehabilitation - regrading to shape the surface of disturbed areas to conform to the final landform and proposed post mining land use - construction of drainage features following regrading to reduce erosion and ensure stability of the landform - topsoil to be spread over the surface of the final landform following regrading and drainage construction - seedbed preparation involving contour ripping - seeding, fertilising and adding other soil ameliorants as required as soon as practicable following the preparation of the seedbed - maintenance where required, including reestablishing erosion prone areas, reseeding, supplementary planting with tube-stock, additional fertiliser or other ameliorant application and repair to drainage structures - monitoring of rehabilitated areas to be incorporated into the site monitoring program, focusing on key indicators relevant to the proposed post-mine land uses, for example, soil properties and characteristics, soil biota, vegetation and fauna. ▶ Rehabilitation will establish specified self-sustaining natural vegetation and habitats. ▶ Mine pit and overburden dump will be rehabilitated to native ecosystems. ▶ Selection of native seed mixes will include species endemic to the Project site and surrounds, and representative of pre-clearing vegetation communities.	2	3	M
2. Prevent the decline of habitat quality for retained habitat within the Project site.	Habitat quality score in areas of retained MNES/ habitat for MNES falls below the baseline habitat quality score.	▶ Weeds are introduced and/or spread across the Project site as a result of the movement of vehicles and machinery. ▶ Pest animal abundance increases as a result of Project activities. ▶ Increased dust deposition as a result of Project activities. ▶ Uncontrolled fire as a result of Project activities.	4	3	H	▶ Areas of habitat for MNES adjacent to the Project footprint will be clearly marked or barricaded during clearing operations (for example using safety bunting, pegs or mesh safety fences). ▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures. ▶ No clearing to be undertaken within areas of retained habitat for MNES. ▶ No unauthorised access into areas of habitat for MNES. ▶ Vehicles and other machinery to be driven on designated access tracks only. ▶ Pest animals and weeds will be managed in accordance with the Project's pest and weed management plans. ▶ Implementation of dust suppression techniques according to the *Coal Mining Safety and Health Act 1999* (CMSHA) and the Coal Mining Safety and Health Regulation 2017 (CMSHR). ▶ Maintenance of existing fences.	3	3	M

Objectives for MNES management	Risk	Event or circumstance	Initial risk rating: Likelihood	Initial risk rating: Consequence	Initial risk rating: Overall Risk Rating	Control strategies	Residual risk rating: Likelihood	Residual risk rating: Consequence	Residual risk rating: Overall Risk Rating
3. Minimise risk of weed introduction and/or spread in areas of MNES/ habitat for MNES.	▶ Outbreak of a weed species that has not been previously recorded in the Project site. ▶ Spread of existing weed species on site.	▶ A pest and weed management is not developed and/or implemented for the Project. ▶ Vehicles are not washed down prior to arriving on site. ▶ Weed infestations on site are not managed.	4	2	M	▶ Weeds will be managed in accordance with the Project's weed management plan. The weed control plan will be developed by suitably qualified ecologists, with implementation commencing within six months from commencement of construction. The plan will include the following: ▶ Detailed control measures as recommended by the Queensland Department of Agriculture and Fisheries to eradicate where possible, or otherwise reduce the extent of weeds. ▶ A site induction program that provides information to staff, contractors and visitors on weed control issues. ▶ Systems for requiring all earthmoving equipment brought onto site to be thoroughly washed down prior to arriving at site and inspected on arrival to ensure all spoil and plant matter has been removed. ▶ Targeted weed control/eradication measures that will benefit MNES within the Project Area. As a minimum, control actions will target the following weed species (if present) which pose a particular threat to MNES: - Brigalow TEC: exotic pasture grasses including buffel grass, Rhodes grass, green panic grass. - Natural grassland TEC: parthenium (*Parthenium hysterophorus*), parkinsonia (*Parkinsonia aculeata*), prickly acacia (*Acacia nilotica* subsp. *indica*), buffel grass, Columbus grass (*Sorghum* x *almum*), Rhodes grass, and green panic *(Megathyrsus maximus*). - King blue-grass: parthenium (*Parthenium hysterophorus*) and parkinsonia (*Parkinsonia aculeata*). - Bluegrass: Coolatai grass (*Hyparrhenia hirta*), lippia (*Phyla canescens*) and African lovegrass (*Eragrostis curvula*). ▶ An integrated weed control program including where possible and effective the combination of fire management, biological, chemical and mechanical removal with consideration of suitability for each MNES.	3	2	M
4. Reduce degradation of MNES/ habitat for MNES by pest animals, and reduce potential predation of squatter pigeon and Australian painted snipe by pest animals.	▶ Increase in the abundance of (or signs of) pest animals in habitat for MNES. ▶ Observation of (or signs of) a pest animal species not previously recorded in the Project site. ▶ Predation of squatter pigeon and Australian panted snipe by pest animals.	▶ A pest management is not developed and/or implemented for the Project. ▶ Inappropriate waste management practices. ▶ Pest animals on site are not controlled.	3	2	M	▶ Pest animals will be managed in accordance with the Project's pest management plan which will be developed by suitably qualified ecologists. Implementation of the plan will commence within six months from commencement of construction. ▶ Pest management actions detailed in the pest management plan will focus on rabbits, feral pigs, foxes and cats as these pests have been identified on site and pose a potential threat to MNES and their habitat. However, should any additional pests be identified, these will also be included in the pest management plan as required. ▶ Pest management will include a combination of shooting, trapping, fencing and baiting in line with best practice guidelines. ▶ The pest management plan will include requirements for: - Appropriate waste management. - Reporting framework to ensure sightings of pest animals are recorded. - Site induction program to include information on pest animal control issues and reporting on pest animals seen during construction and operation activities	2	2	L

Objectives for MNES management	Risk	Event or circumstance	Initial risk rating			Control strategies	Residual risk rating		
			Likelihood	Consequence	Overall Risk Rating		Likelihood	Consequence	Overall Risk Rating
5. Minimise impact of dust deposition on MNES/ habitat for MNES as a result of the construction and/or operation of the Project.	▶ Dust deposition levels exceed the guideline of 120 mg per square metre per day, averaged over one month when measured at a sensitive receptor. ▶ Visual inspections of vegetation adjacent to the Project footprint indicate visible signs of dust deposition.	▶ Disturbed areas are left exposed for long periods of time. ▶ Disturbed areas are not watered down regularly. ▶ Speed limits along internal roads are not observed. ▶ Vehicles drive over disturbed areas (e.g. overburden dumps).	4	1	L	▶ Dust suppression for coal mining operations in Queensland is governed by the *Coal Mining Safety and Health Act 1999* (CMSHA) and the Coal Mining Safety and Health Regulation 2017 (CMSHR). ▶ Dust and dust suppression of mine roads is prescribed in Section 129 of the CMSHR which states that a surface mine must have a standard procedure for maintaining and watering mine roads. ▶ Speed limits on mine roads for vehicles, mobile plant and equipment is regulated under the CMSHA and CMSHR. ▶ In addition to the rigorous requirements under the CMSHA and CMSHR, the following dust suppression measures will be implemented: - Minimise disturbed areas by limiting clearing to what is necessary. - Progressively rehabilitating disturbed areas. - Removal and dumping of overburden as soon as practicable after blasting (i.e. minimising drying time by retaining as much inherent moisture as possible). - Restrict vehicle access, other than mining machinery on overburden dumps.	3	1	L

Objectives for MNES management	Risk	Event or circumstance	Initial risk rating			Control strategies	Residual risk rating		
			Likelihood	Consequence	Overall Risk Rating		Likelihood	Consequence	Overall Risk Rating
6. Minimise degradation of MNES/ habitat for MNES as a result of increased risk of fire due to Project activities and management actions.	▶ An uncontrolled fire occurs. ▶ Biomass monitoring indicates risk of fire due to increased fuel loads. ▶ Controlled burns occur outside of the specified frequency for each RE.	▶ Project activities result in a fire occurring. ▶ Fuel loads are not managed in areas of MNES habitat. ▶ Guidelines for frequency of controlled burns are not adhered to.	3	2	M	▶ Fire management for coal mining operations in Queensland is governed by the *Coal Mining Safety and Health Act 1999* (CMSHA) and the Coal Mining Safety and Health Regulation 2017 (CMSHR). ▶ One of the major hazards identified to coal mine workers present during coal mining operations is fire and the CMHSR prescribes both prevention, preparedness and management of fire hazards for surface and underground mines. ▶ These prescriptions are detailed in Section 37 of the CMSHR, which details amongst other things that a Safety and Health Management System (SHMS) must provide for the following at the mine (where mine is defined as the Mining Lease tenure as a whole): - Fire prevention and control - An effective fire- fighting capability - The safety of persons fighting fires - A risk assessment to identify all potential fire hazards at the mine ▶ The system must also provide for the following: - The availability at the mine, at all times, of equipment that is appropriate and sufficient to extinguish any potential fire identified in the risk assessment - The location of portable fire extinguishers on or near equipment and installations identified as potential fire hazards by the risk assessment - The compatibility, throughout the mine, of all fire- fighting equipment ▶ The coal mine must have a standard operating procedure for action to be taken when a fire is discovered at the mine. ▶ Fire management of the site will consider appropriate fire management regimes for the vegetation type including: - no fires in areas of Brigalow TEC - controlled burns in RE 11.8.11 (natural grasslands TEC, potential blue grass and king blue-grass habitat) occur at an interval greater than 5 years - controlled burns in RE 11.8.5 and 11.8.15 (squatter pigeon habitat) occur every 6 – 10 years. ▶ Fuel loads will be minimised through weed control as specified in the weed management plan. ▶ Weed management actions will target high biomass exotic grasses (e.g. buffel grass).	1	2	L
7. Minimise degradation of habitat for the Australian painted snipe and squatter pigeon as a result of changes to water quality in Naroo Dam.	Water quality exceeds trigger levels set out in Table F8 of the Project's EA.	▶ Dirty or contaminated water enters Naroo Dam.	2	3	M	▶ No dirty or contaminated water will be permitted to enter Naroo Dam. ▶ Water quality monitoring is required to be undertaken in accordance with the Project's EA.	1	3	L
8. Minimise noise and vibration impacts in areas of squatter pigeon and Australian painted snipe habitat.	When measured, noise and vibration levels exceed criteria set out in Tables D1 and D2 of the Project EA.	▶ Plant and equipment is poorly maintained. ▶ Engine covers are left off while engines are in operation. ▶ Blasting occurs at night.	2	1	L	▶ All plant and equipment will be regularly serviced and maintained to minimise machinery noise. ▶ All engine covers will be kept closed while equipment is operating. ▶ Blasting will only occur between 7am and 6pm.	2	1	L

Objectives for MNES management	Risk	Event or circumstance	Initial risk rating			Control strategies	Residual risk rating		
			Likelihood	Consequence	Overall Risk Rating		Likelihood	Consequence	Overall Risk Rating
9. Minimise potential for mortality or injury to squatter pigeons and Australian painted snipe as a result of the construction and operation of the Project (e.g. from clearing activities, vehicle strikes etc.).	▶ Injury or mortality of a squatter pigeon or Australian painted snipe.	▶ Squatter pigeon or Australian painted snipe is struck by vehicle or machinery.	1	1	L	▶ Environmental awareness training will be provided to all workers as part of site induction, including specific topics on MNES, risks and protective measures, and identification of squatter pigeons and Australian painted snipe. ▶ A fauna spotter catcher will be present during clearing activities. ▶ Speed limits on mine roads for vehicles, mobile plant and equipment is regulated under the CMSHA and CMSHR. ▶ Vehicle movements will be restricted in areas of squatter pigeon and Australian painted snipe habitat.	1	1	L

DECLARATION OF ACCURACY

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Matters of National Environmental Significance Management Plan for the Meteor Downs South Coal Project (Revision 6) is complete, current and correct.

2. I am duly authorised to sign this declaration on behalf of the approval holder.

3. I am aware that:

a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.

b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.

c. The above offences are punishable on conviction by imprisonment, a fine or both.

Signed

MR DAVID LYLE RICHARDSON

U&D MINING INDUSTRY (AUSTRALIA) PTY LTD

Date 20/ 06/2019