



MINING OPERATIONS PLAN

Version	Issue Date	Approval Date	Section Modified	Reason for Modification	Review Team
1	Nov 19	Dec 19	All	Original MOP	MCO
A	May 20	July 20	Section 1, 2, and 7	Amendments to mine progression and footprint	MCO
B	Sep 20	Oct 20	Section 1, 2, 5 and 8	Amendments to incorporate approved modification to Stage 1 (Mod15)	MCO

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Name of Mine: MOOLARBEN COAL COMPLEX
MOP Commencement Date: 1 January 2020
MOP Completion Date: 31 December 2022
Mining Authorisations (Lease/Licence No): ML 1605, ML 1606, ML 1628, ML 1691 and ML 1715

Name of Authorisation/Authorisation Holders: Moolarben Coal Mines Pty Ltd, Sojitz Moolarben Resources Pty Ltd*, and Kores Australia Moolarben Coal Pty Ltd

Name of Mine Operator: Moolarben Coal Operations Pty Ltd

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Date: 22 September 2020

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Version: B

* Sojitz Moolarben Resources Pty Limited agreed to transfer their interest to Yancoal Moolarben Pty Limited on 31 March 2020. The transfer registration is in progress.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_0040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

SUMMARY OF TABLES, FIGURES AND PLANS

A summary of the relevant tables and plans required by the New South Wales Department of Industry, Skills and Regional Development – Division of Resources and Energy *ESG3: Mining Operations Plan (MOP) Guidelines, September 2013* is provided below.

ESG3 Requirement	Section of MOP	Table Reference	Plan Reference	Source
Material Production Schedule during the MOP Term	Section 2.3.4	Table 3	N/A	Moolarben Coal Operations (MCO) MOP Guidelines
Domain Selection	Section 5.1	Table 10	Plans 2, 3A, 3B, 3C and 4	MCO MOP Guidelines
Rehabilitation Phases	Section 5.3	Table 12	Plans 3A, 3B & 3C	MCO MOP Guidelines
Performance Indicators and Completion Criteria	Section 6.0	Tables 14 to 18	N/A	In consideration of MOP Guidelines and Rehabilitation Management Plan
Proposed Disturbance and Rehabilitation Activities during the MOP Term	Section 7.2	Table 20	Plans 3A, 3B & 3C	MCO MOP Guidelines
Summary of Rehabilitation Areas during the MOP Term	Section 7.3	Table 21	Plans 3A, 3B & 3C	MCO spatial data MOP Guidelines
Plans	Section 11.0	N/A	All Plans	In consideration of MOP Guidelines and spatial data

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

TABLE OF CONTENTS

1.0	INTRODUCTION	6
1.1	HISTORY OF OPERATIONS.....	9
1.1.1	Moolarben Coal Complex (Stage 1).....	9
1.1.2	Moolarben Coal Complex (Stage 2).....	9
1.2	CURRENT CONSENTS, AUTHORISATIONS AND LICENCES	11
1.3	LAND OWNERSHIP AND LAND USE.....	12
1.4	STAKEHOLDER CONSULTATION	12
2.0	PROPOSED MINING ACTIVITIES.....	13
2.1	PROJECT DESCRIPTION	13
2.2	ASSET REGISTER.....	13
2.3	ACTIVITIES OVER THE MOP TERM	15
2.3.1	Exploration	15
2.3.2	Construction Activities	16
2.3.3	Mining Development and Sequence	17
2.3.4	Material Production Schedule.....	17
2.3.5	Waste Rock Management	18
2.3.6	Waste Management.....	18
2.3.7	Decommissioning and Demolition Activities.....	18
2.3.8	Water Management.....	18
2.3.9	Progressive Rehabilitation and Completion	20
3.0	ENVIRONMENTAL ISSUES MANAGEMENT	21
3.1	ENVIRONMENTAL RISK ASSESSMENT.....	21
3.2	ENVIRONMENTAL RISK MANAGEMENT	25
3.3	SPECIFIC RISKS RELATING TO REHABILITATION	25
3.3.1	Geology and Environmental Geochemistry.....	25
3.3.2	Spontaneous Combustion	26
3.3.3	Mine Subsidence	26
3.3.4	Erosion and Sediment Control	27
3.3.5	Soil Resource Management.....	27
3.3.6	Flora.....	31
3.3.7	Fauna.....	33
3.3.8	Other Risks	35
4.0	POST-MINING LAND USE.....	40
4.1	REGULATORY REQUIREMENTS	40
4.1.1	EP&A Act Project Approvals	40
4.1.2	Mining Lease Approval	42
4.1.3	Commonwealth Approvals.....	43
4.2	POST-MINING LAND USE GOAL	43
4.3	REHABILITATION PRINCIPLES AND OBJECTIVES	44

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

5.0	REHABILITATION PLANNING AND MANAGEMENT.....	47
5.1	DOMAIN SELECTION	47
5.2	DOMAIN REHABILITATION OBJECTIVES.....	47
5.3	REHABILITATION PHASES.....	50
6.0	PERFORMANCE INDICATORS AND COMPLETION CRITERIA.....	53
7.0	REHABILITATION IMPLEMENTATION	63
7.1	STATUS AT MOP COMMENCEMENT.....	63
7.2	PROPOSED REHABILITATION ACTIVITIES DURING THE MOP TERM	63
7.2.1	Domain 1 – Active Mining	64
7.2.2	Domain 2 – Water Management Area	64
7.2.3	Domain 3 – Coal Processing and Handling Facilities	64
7.2.4	Domain 4 – General Infrastructure	64
7.2.5	Domain 5 – Overburden Emplacement Area	64
7.2.6	Domain 6 – Subsidence Area.....	64
7.3	SUMMARY OF REHABILITATION AREAS DURING THE MOP TERM	65
7.4	RELINQUISHMENT PHASE ACHIEVED DURING MOP TERM	66
8.0	REHABILITATION MONITORING AND RESEARCH.....	67
8.1	REHABILITATION MONITORING.....	67
8.1.1	Monitoring Site Selection	67
8.1.2	Ecosystem Function Analysis.....	67
8.1.3	Visual Monitoring and Photo points	69
8.1.4	Monitoring Program Timing	70
8.1.5	Fauna Monitoring.....	70
8.1.6	Geochemical Monitoring.....	71
8.1.7	Rehabilitation Monitoring Records	71
8.2	RESEARCH AND REHABILITATION TRIALS	71
9.0	INTERVENTION AND ADAPTIVE MANAGEMENT.....	74
9.1	THREATS TO REHABILITATION	74
9.2	TRIGGER ACTION RESPONSE PLAN	74
10.0	REPORTING.....	80
10.1	ANNUAL REVIEW	80
10.2	ML ENVIRONMENTAL MANAGEMENT REPORTS.....	80
10.3	INCIDENT AND COMPLAINT REPORTING.....	80
11.0	PLANS.....	82
12.0	REVIEW AND IMPLEMENTATION OF THE MOP	83
12.1	IMPLEMENTATION.....	83
13.0	REFERENCES	85

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

LIST OF TABLES

Table 1 Key Approvals, Leases and Licences	11
Table 2 Asset Register	14
Table 3 Indicative Coal and Material Production Schedule	17
Table 4 Key Risks to Rehabilitation	22
Table 5 Topsoil Suitability for Rehabilitation Purposes	28
Table 6 Soil Resource Management Strategies	30
Table 7 Threatened Fauna Species Recorded at the Moolarben Coal Complex	33
Table 8 Blasting Criteria	37
Table 9 Noise Criteria dB(A)	37
Table 10 Moolarben Coal Complex Rehabilitation Domains	47
Table 11 Domain Rehabilitation Objectives	48
Table 12 Rehabilitation Phases	50
Table 13 Summary of Rehabilitation Phases Proposed for Completion at the End of the MOP Term	52
Table 14 Decommissioning Phase Performance Indicators and Completion Criteria	54
Table 15 Landform Establishment Phase Performance Indicators and Completion Criteria	56
Table 16 Growth Medium Development Phase Performance Indicators and Completion Criteria	58
Table 17 Ecosystem & Land Use Establishment Phase Performance Indicators & Completion Criteria	59
Table 18 Ecosystem & Land Use Sustainability Phase Performance Indicators & Completion Criteria	61
Table 19 Rehabilitation Status of Primary Domains at MOP Commencement	63
Table 20 Disturbance and Rehabilitation Progression during the MOP Term	64
Table 21 Summary of Rehabilitation Proposed during the MOP Term	65
Table 22 Rehabilitation Trigger Action Response Plan	75
Table 23 MOP Implementation Responsibilities	83

LIST OF FIGURES

Figure 1 Regional Location	7
Figure 2 Approved Moolarben Coal Project	10

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

LIST OF PLANS

Plan 1A – Project Locality

Plan 1B – Natural Environment

Plan 1C – Built Environment

Plan 2 – Mine Domains at Commencement of MOP

[Plan 3A – Mining and Rehabilitation \(December 2020\)](#)

[Plan 3B – Mining and Rehabilitation \(December 2021\)](#)

[Plan 3C – Mining and Rehabilitation \(December 2022\)](#)

Plan 4 – Final Rehabilitation and Post Mining Land Use

Plan 5A – Rehabilitation and Post Mining Land Use Cross Sections (OC1, OC2 & OC3)

Plan 5B – Rehabilitation and Post Mining Land Use Cross Sections (OC4)

LIST OF ATTACHMENTS

Attachment 1 – Moolarben Coal Operations Risk Matrix Tables

Attachment 2– Moolarben Coal Operations Rehabilitation Management Plan

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

1.0 INTRODUCTION

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee in the Western Coalfield of New South Wales (NSW) (**Figure 1**).

Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Sojitz Moolarben Resources Pty Ltd and a consortium of Korean power companies). MCO and MCM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and would continue to be carried out in accordance with Project Approval (05_0117) (Moolarben Coal Project Stage 1) as modified and Project Approval (08_0135) (Moolarben Coal Project Stage 2) as modified.

Mining operations at the Moolarben Coal Complex are undertaken in accordance with various approvals under the Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act).

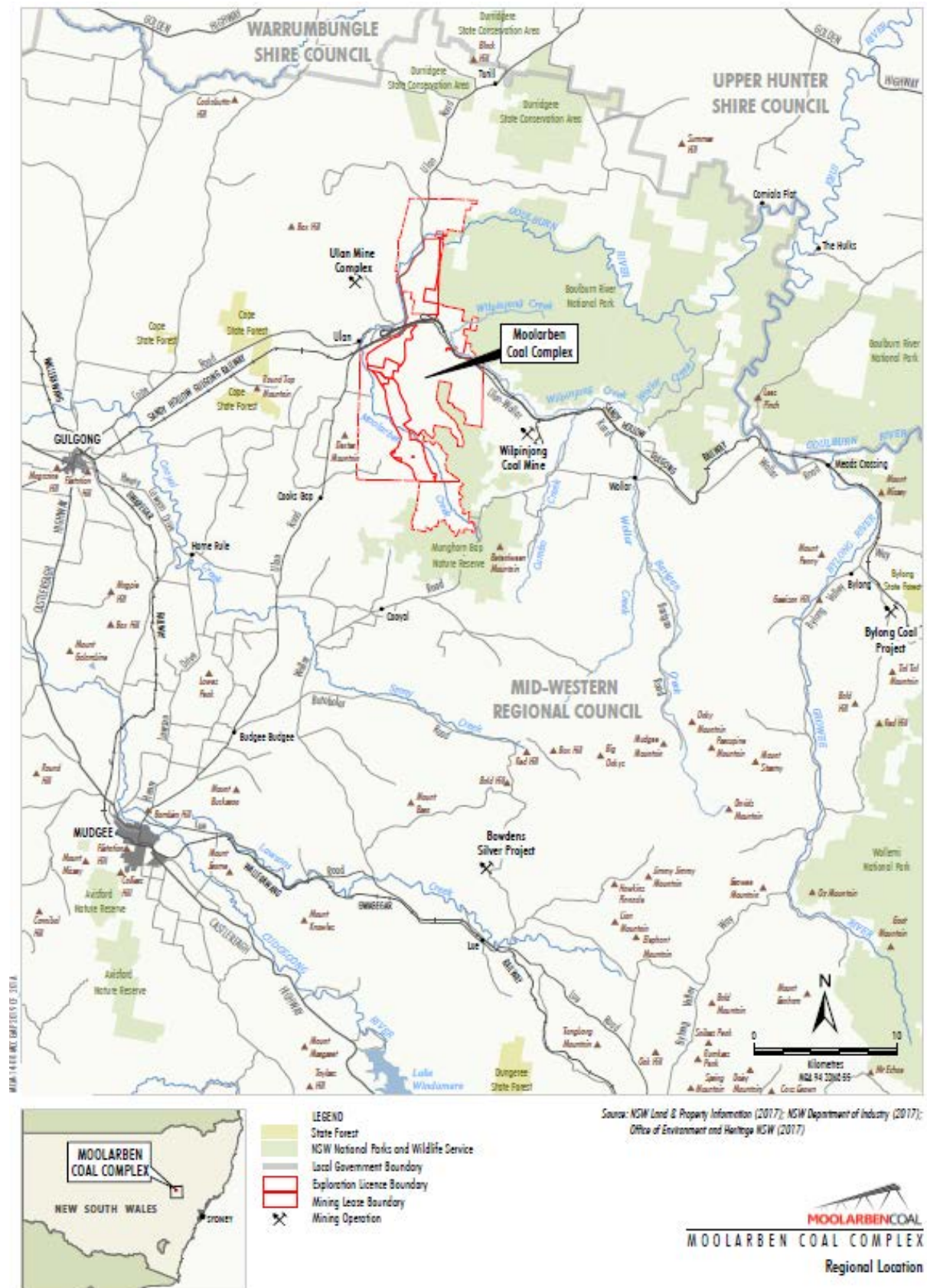
The current mining operations at the Moolarben Coal Complex are conducted in accordance with the requirements of the conditions of Mining Lease (ML) 1605, ML 1606, ML 1628, ML 1691 and ML 1715 (**Figure 2**) granted under the NSW *Mining Act, 1992*.

This Mining Operations Plan (MOP) for the Moolarben Coal Complex has been prepared by MCO in accordance with the NSW Department of Industry, Skills and Regional Development – Division of Resources and Energy (DRE) *ESG3: Mining Operations Plan (MOP) Guidelines, September 2013* (the MOP Guidelines) (DRE, 2013).

This MOP describes the proposed Stage 1 and Stage 2 Moolarben Coal Complex activities for the period 1 January 2020 to 31 December 2022 (the MOP term).

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Figure 1 Regional Location



Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

MOP Structure

In accordance with the MOP Guidelines, the MOP is structured as follows:

Section 1	Provides details of the Moolarben Coal Complex history, current Project Approvals, authorisation and licences, land use and land ownership. This section also describes the stakeholder consultation undertaken relevant to this MOP.
Section 2	Provides details of the proposed activities during the MOP term.
Section 3	Outlines environmental and rehabilitation risk identification and management methods.
Section 4	Describes the post-mining land use and rehabilitation principles and objectives.
Section 5	Presents the rehabilitation domains, objectives and phases.
Section 6	Presents performance indicators and completion criteria relevant to the rehabilitation domains.
Section 7	Describes Moolarben Coal Complex rehabilitation activities to be implemented during the MOP term.
Section 8	Describes rehabilitation monitoring and research.
Section 9	Outlines intervention and adaptive management methods to be implemented relevant to identified rehabilitation risks.
Section 10	Provides the reporting mechanisms relevant to implementation of this MOP.
Section 11	Describes the content of the MOP Plans.
Section 12	Outlines the protocol for reviewing and revising the MOP and the personnel responsible for monitoring, reviewing and implementing the MOP.
Section 13	Lists the references cited in this MOP.
Plans	Provides the Plans referenced in this MOP.
Attachments	Provide the supporting Attachments referenced in this MOP.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

1.1 HISTORY OF OPERATIONS

1.1.1 Moolarben Coal Complex (Stage 1)

The Moolarben Coal Project Stage 1 was assessed in the *Moolarben Coal Project Environmental Assessment Report* (MCM, 2006) and was approved by the NSW Minister for Planning on 6 September 2007 (Project Approval [05_0117]).

Project Approval (05_0117) has been subject to **fifteen** modifications. The modifications were generally required to reconfigure the mine layout (e.g. extension to mining areas, relocation of coal handling infrastructure and water infrastructure) and were aimed to improve the efficiency and operation of the Moolarben Coal Complex and enable access to additional economically viable coal reserves.

Stage 1 of the Moolarben Coal Complex has commenced and at full development will comprise three open cut mines (OC1, OC2, and OC3), a longwall underground mine (UG4), and mining related infrastructure (including coal processing and transport facilities) (**Figure 2**). Since commencement of coal mining operations in 2010, mining activities have occurred within OC1, OC2 and OC3 (**Figure 2**).

1.1.2 Moolarben Coal Complex (Stage 2)

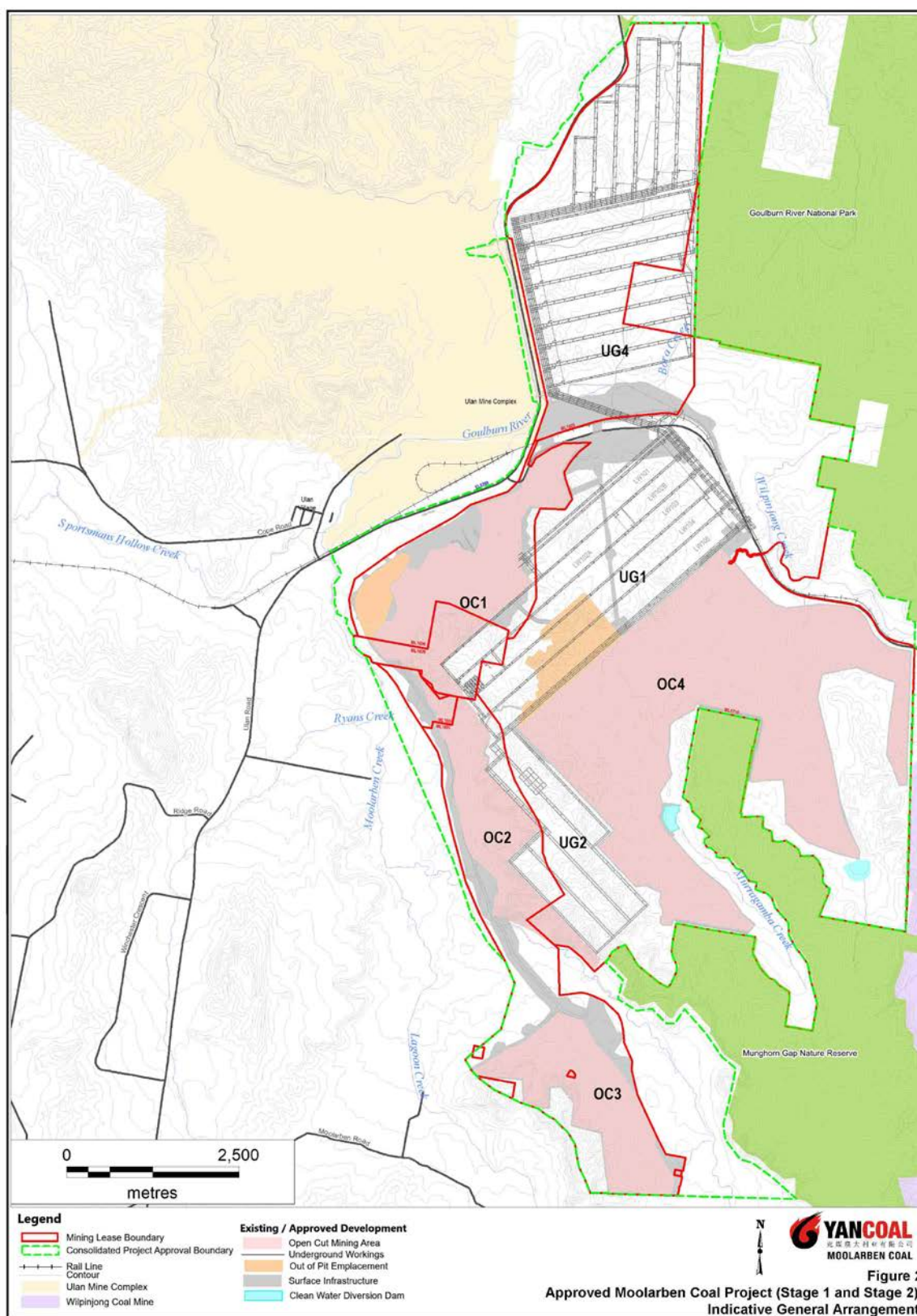
The Moolarben Coal Project Stage 2 was assessed in the Moolarben Coal Project Stage 2 Environmental Assessment Report (Wells Environmental Services and Coffey Natural Systems, 2009), and Preferred Project Report (MCM, 2012) which was exhibited from 31 January 2012 to 24 February 2012. The Moolarben Coal Project Stage 2 was approved by the Planning Assessment Commission (PAC) (as a delegate of the NSW Minister for Planning) on 30 January 2015 (Project Approval [08_0135]).

Project Approval (08_0135) has been subject to three modifications. Modifications were generally required to reconfigure the mine layout (e.g. extension to mining areas, haul roads and infrastructure) and were aimed to improve the efficiency and operation of the Moolarben Coal Complex and enable access to additional economically viable coal reserves.

Moolarben Coal Project Stage 2 commenced in 2015. At full development, there will be one open-cut (OC4), two longwall underground mines (UG1 and UG2) and mining related infrastructure (**Figure 2**).

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Figure 2 Approved Moolarben Coal Project



Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

1.2 CURRENT CONSENTS, AUTHORISATIONS AND LICENCES

The date of grant and duration of the Moolarben Coal Complex approvals, leases and licences issued by government agencies relevant to the MLs are provided in **Table 1**.

The Moolarben Coal Complex is a **Level 1** mine as defined in the MOP Guidelines (DRE, 2013).

Table 1 Key Approvals, Leases and Licences

Type	Approval	Number	Approval Authority	Date Granted	Expiry/ Renewal Date
Exploration Licences					
EL	Exploration Licence	6288	Minister for Mineral Resources	23/08/2004	22/08/2017 [^]
EL	Exploration Licence	7073	Minister for Mineral Resources	12/02/2008	12/02/2020 [*]
EL	Exploration Licence	7074	Minister for Mineral Resources	12/02/2008	12/02/2020 [*]
Mining Leases					
ML	Mining Lease	1605 ^{**}	Minister for Mineral Resources	20/12/2007	20/12/2028
ML	Mining Lease	1606	Minister for Mineral Resources	20/12/2007	20/12/2028
ML	Mining Lease	1628	Minister for Mineral Resources	24/02/2009	24/02/2030
ML	Mining Lease	1691	Minister for Resources and Energy	3/10/2013	2/10/2034
ML	Mining Lease	1715	Minister for Resources and Energy	31/08/2015	31/08/2036
Project Approvals					
PA	Project Approval	05_0117 (as modified)	NSW Minister for Planning	6/09/2007	20/12/2038
PA	Project Approval	08_0135 (as modified)	PAC as a delegate of NSW Minister for Planning	30/01/2015	31/12/2038
EPBC	EPBC Act Approval	2007/3297	Commonwealth Department of the Environment and Water Resources	24/10/2007	31/12/2027
EPBC	EPBC Act Approval	2013/6926	Commonwealth Department of the Environment (DoE)	13/11/2014	31/12/2064
EPBC	EPBC Act Approval	2008/4444	DoE	18/05/2015	31/12/2065
EPBC	EPBC Act Approval	2017/7974	Department of the Environment and Energy (DoEE)	06/09/2019	31/12/2050
Licences					
LIC	Environment Protection Licence (EPL)	12932	NSW Environment Protection Authority (EPA)	October 2019	Until the licence is surrendered, suspended or revoked. The licence is subject to review every five years after the issue of the licence.

Notes: [^] Renewal Application for EL6288 was submitted and received by the DRG on the 22 August 2017

^{*} Renewal Applications for EL7073 and EL7074 were submitted and received by the DRG on the 11 February 2020

^{**} Including the carrying out of ancillary mining activities within AMA1015

Sojitz Moolarben Resources Pty Limited agreed to transfer their interest to Yancoal Moolarben Pty Limited on 31 March 2020.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

1.3 LAND OWNERSHIP AND LAND USE

The Moolarben Coal Complex is located approximately 40 km north of Mudgee in the Western Coalfield of NSW (**Plan 1C**). Settlements located in the vicinity of the Moolarben Coal Complex include Cook's Gap and Ulan (**Plan 1C**).

The Moolarben Coal Complex MLs exist within freehold land owned by MCO (**Plan 1C**). Crown Land also occurs in the Moolarben Coal Complex MLs (**Plan 1C**).

Land use in the vicinity of the Moolarben Coal Complex is characterised by a combination of coal mining operations, ridgeline country, woodlands, nature reserves, agricultural operations and the Cooks Gap locality (**Plan 1B**).

A number of reserved areas are located in the vicinity, including the Goulbourn River National Park (abuts the north-eastern boundary) and Munghorn Gap Nature Reserve (adjoins the south-eastern boundary).

1.4 STAKEHOLDER CONSULTATION

This MOP has been developed in accordance with the MOP Guidelines.

MCO conducted comprehensive consultation programs during the Moolarben Coal Project Stage 1 and Moolarben Coal Project Stage 2 approval processes under the NSW *Environmental Planning and Assessment Act, 1979*. These consultation programs included the rehabilitation strategy for the Moolarben Coal Complex.

During these approval processes, consultation was undertaken with a range of stakeholders, including:

- NSW Department of Planning, Industry and Environment (DPIE);
- NSW Department of Planning, Industry and Environment – Resources Regulator (RR);
- NSW Department of Planning, Industry and Environment – Biodiversity and Conservation Division (BCD);
- NSW Department of Planning, Industry and Environment – Water (DPIE – Water)/Natural Resources Access Regulator (NRAR);
- NSW Environment Protection Authority (EPA);
- Transport for NSW (Formerly RMS) (TfNSW);
- NSW Department of Primary Industries (DPI) (Agriculture);
- Mid-Western Regional Council (MWRC);
- Moolarben Coal Complex Community Consultative Committee (CCC);
- Local community and landholders; and
- Members of the Aboriginal community.

This MOP has been prepared to be consistent with environmental approval documentation that formed the basis of the approval processes that the consultation outlined above was undertaken for.

In addition, stakeholders consulted during preparation of the Moolarben Coal Complex environmental management plans, strategies and programs (including those specific to rehabilitation and post-mining land use), have included key NSW regulatory agencies (including the RR and DPIE-Water/NRAR), the MWRC, the CCC and the Aboriginal community.

Ongoing consultation with the community and relevant stakeholders occurs via the CCC, Moolarben Coal Complex website, MCO's community hotline and community complaints procedure.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

2.0 PROPOSED MINING ACTIVITIES

2.1 PROJECT DESCRIPTION

Stage 1 at the Moolarben Coal Complex has been operating for several years and at full development will comprise three open cut mines (OC1, OC2, and OC3), a longwall underground mine (UG4), and mining related infrastructure (including coal processing and transport facilities) (**Figure 2**).

Stage 2 at the Moolarben Coal Complex has commenced and at full development will comprise one open cut mine (OC4), two longwall underground mines (UG1 and UG2), and mining related infrastructure (Figure 2).

Stages 1 and 2 at the Moolarben Coal Complex operate concurrently in accordance with the limits stipulated in NSW Project Approval (05_0117) and NSW Project Approval (08_0135), and are summarised as follows:

- The total run-of-mine (ROM) coal extracted from the Moolarben Coal Complex (open cut and underground mining) is no more than 24 million tonnes in any calendar year, comprising:
 - No more than 16 million tonnes of ROM coal from the open cut mining operations in any calendar year, considering:
 - No more than 10 million tonnes of ROM coal from Stage 1 open cut mining operations in any calendar year.
 - No more than 16 million tonnes of ROM coal from Stage 2 open cut mining operations in any calendar year.
 - No more than 8 million tonnes of ROM coal from the underground mining operations in any calendar year.
- No more than 16 million tonnes of coal from the Moolarben Coal Complex can be processed (washed) in any calendar year.
- No more than 22 million tonnes of coal can be transported from the Moolarben Coal Complex in any calendar year.
- All product coal is transported from the Moolarben Coal Complex by rail with:
 - No more than 8 laden trains leaving the site each day (on average when calculated over any calendar year); and
 - No more than 11 laden trains leaving the site each day.

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and would continue to be carried out in accordance with Project Approval (05_0117) as modified and Project Approval (08_0135) as modified.

2.2 ASSET REGISTER

In accordance with the MOP Guidelines, an Asset Register is provided in **Table 2** that lists a summary of the key features of each Primary Domain (**Section 5.1**) and principal activities required for decommissioning and rehabilitation that are costed in the Rehabilitation Cost Estimate (RCE). The Primary Domain area is representative of the disturbance footprint for that domain during the [second](#) year of MOP ([Plan 3B](#)).

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 2 Asset Register

Primary Rehabilitation Domain	Approximate Size (hectares [ha])	Major Assets	Proposed Decommissioning Activities During the MOP Term
Domain 1 – Active Mining	1018	<ul style="list-style-type: none"> OC1; OC2; OC3; OC4; UG1; UG4; and OC and UG water management infrastructure. 	No decommissioning activities are proposed during the MOP term.
Domain 2 – Operational Water Management Area	163	<ul style="list-style-type: none"> Clean water dams; Mine water dams; Brine water dams Sediment dams; and Clean water diversions. 	No decommissioning activities are proposed during the MOP term.
Domain 3 – Coal Processing and Handling Facilities	155	<ul style="list-style-type: none"> CHPP; CHPP administration offices; CHPP workshop; CHPP car park; overhead conveyors and gantries; CHPP dozer park up pad; CHPP dozer refill pad; fuel storage tanks; ROM coal hoppers and pads; ROM coal pads; UG1 ROM coal handling infrastructure; product coal stockpiles; rail spur and loop; rail load-out facility; Pipelines; conveyor trace; water treatment facility. 	Decommissioning and demolition activities required during the MOP term are limited to temporary offices and infrastructure.
Domain 4 – General Infrastructure	516	<ul style="list-style-type: none"> administration offices; administration carparks; workshops; UG1 MIA facilities; fuel farm; stores; training building; service bays; bathhouses; haul truck tyre slab; hardstand/laydown; access road; haul road; pipelines; temporary MIA; explosives storage facilities; sewage treatment plant. 	Decommissioning and demolition activities required during the MOP term are limited to temporary offices and infrastructure.
Domain 5 – Overburden Emplacement Area	1041	<ul style="list-style-type: none"> temporary erosion and sediment controls. temporary OC2 environmental bund; overburden emplacement areas; Haul roads. 	No decommissioning activities are proposed during the MOP term.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Primary Rehabilitation Domain	Approximate Size (hectares [ha])	Major Assets	Proposed Decommissioning Activities During the MOP Term
Domain 6 – Subsidence Limit	722	<ul style="list-style-type: none"> Stage 2 conveyor 	No decommissioning activities are proposed during the MOP term.

2.3 ACTIVITIES OVER THE MOP TERM

This section provides details of all Moolarben Coal Complex activities relevant to the MLs proposed during the MOP term including:

- Exploration (**Section 2.3.1**);
- Construction activities (**Section 2.3.2**);
- Mining development and sequence (**Section 2.3.3**);
- Material production schedule (**Section 2.3.4**);
- Waste rock management (**Section 2.3.5**);
- Waste management (**Section 2.3.6**);
- Decommissioning and demolition activities (**Section 2.3.7**);
- Water management (**Section 2.3.8**); and
- Progressive rehabilitation and completion (**Section 2.3.9**).

2.3.1 Exploration

Mine exploration activities during the term of the MOP will continue to be undertaken within MCO's MLs (**Plan 1A**). Exploration activities are scheduled to occur within and adjacent to the following approved mining areas:

- ML1691 – Underground 2, Open Cut 3 and adjacent areas;
- ML1715 - Open Cut 4, Underground 1, Underground 2 and adjacent areas;
- ML1628 - Underground 1, Underground 4, Open Cut 3 and adjacent areas;
- ML1605 – Underground 4 and adjacent areas including holes within the subsurface lease area; and,
- ML1606 – Underground 1.

The results from MCO's exploration activities will be used to investigate aspects such as geological features, seam structure and coal/overburden characteristics as input to detailed mine planning and feasibility studies.

Prior to any exploration activity commencing, a Ground Disturbance Permit (GDP) must be completed. The GDP identifies environmental, heritage and relevant regulatory obligations and management measures to mitigate and minimise potential impacts.

In addition, MCO considers the relevant requirements of *ESG5: Assessment Requirement for Exploration Activities* (DRE, 2015) during the preparation of a GDP for proposed exploration drilling activities. In conjunction with the GDP process, MCO minimise the impacts from exploration drilling activities using the following controls:

- Implement the requirements from the due diligence assessments, including heritage and ecology;
- Minimise disturbance i.e. use existing tracks and if required only slash and remove vegetation from access tracks and drill pad areas;

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Appropriate sized machinery will be utilised during site establishment, decommissioning and rehabilitation activities if required;
- Decommissioning, removal of wastes and sealing of boreholes and site rehabilitation will be consistent with the *Exploration Codes of Practice: Rehabilitation and Exploration Code of Practice: Environmental Management* (DRE, 2015); and
- Rehabilitation activities involve infilling sumps, site stabilisation, topsoil replacement, applications of ameliorants and appropriate seed mix to return to site former land use.

The GWMP prescribes MCO's groundwater monitoring programme requirements. MCO may expand its existing groundwater monitoring network by utilising specific exploration boreholes. The requirement to convert any exploration hole over to a groundwater monitoring bore will be subject to further determination from MCO's groundwater specialist and in consideration of water license requirements.

2.3.2 Construction Activities

Stage 1 Construction Activities

In addition to approved operational activities of the Moolarben Coal Complex, other approved development activities will be undertaken within the extent of the existing approved Stage 1 of the Moolarben Coal Complex. The construction activities during the MOP term will generally consist of the following:

- Water management and ancillary works;
 - Progressive expansion of the existing water management to support current mining operations will generally include the construction of mine water and sediment dams, drainage, diversion works.
 - Water treatment facilities including associated ancillary works, stockpiles and discharge point.
 - [UG dewatering bores including associated ancillary works](#)
- Moolarben Creek Crossing;
- [Bora Creek Crossing](#);
- Open Cut: Water management dams and associated pipelines and infrastructure,
- Auxiliary infrastructure for OC3 including
 - Mine infrastructure area and roads;
 - diversion drains and sediment control structures;
 - initial box cut and temporary out-of-pit emplacement area;
- Internal road between OC4 and OC2; and
- [Construction the UG4 Remote Services and Infrastructure Areas](#)
- Supporting infrastructure including laydown areas.

Stage 2 Construction Activities

The construction activities during the MOP term will generally consist of the following:

- Water diversion structure/s;
- Internal road between OC4 and OC2;

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Open Cut: Water management dams and associated pipelines and infrastructure,
- Ancillary works.

2.3.3 Mining Development and Sequence

Mining operations in OC1, OC2, OC3, OC4, UG1 and UG4 will be carried out 24 hours per day during the MOP term.

The general sequence of open cut mining is as follows:

- Vegetation clearance ahead of the mine progression in accordance with the Vegetation Clearance Protocol (VCP);
- Topsoil stripping and stockpiling;
- Drilling and blasting of waste rock and coal;
- Removal of waste rock by excavator and haulage to out-of-pit emplacement areas or in-pit behind the advancing open cut;
- Selective mining of coal seams and haulage to the ROM pad; and
- Progressive backfilling of the open pit with mined waste rock, prior to profiling and progressive rehabilitation.

Access to the UG1 Longwalls 101-105 will continue from the portal in OC1 highwall. The extraction of Longwalls 101-105 will occur from west to east. Longwalls 101-105 will be extracted using retreat mining methods for secondary extraction of panels. At the commencement of this MOP, secondary extraction of Longwall 103 was underway with secondary extraction of Longwalls 101 and 102 completed. A plunge panel had been established at the commencement of Longwall 103 as a result of a geological intrusion.

During the term of this MOP, first workings in UG1 will continue to develop Longwalls 104 and 105 including secondary extraction of Longwalls 104 and 105. First workings will also commence in UG4 in a south-west then northerly direction to develop the UG4 Mains Access. Secondary extraction in UG4 of the first Longwall LW401 is scheduled to commence in 2022.

Plans 3A, 3B and 3C show the intended sequencing of mine development for OC1, OC2, OC3, OC4, UG1 and UG4 for the MOP term. The open cut mine sequence has been developed to:

- Optimise the efficient mining of coal;
- Minimise haul lengths and permit effective overburden emplacement (both out-of-pit and in-pit); and
- Enable the progressive formation of the post-mining landform and reduce the amount of disturbed land at any one time.

2.3.4 Material Production Schedule

An indicative material production schedule for the MOP term is provided in **Table 3**.

Table 3 Indicative Coal and Material Production Schedule

Year	Stripped Topsoil (m³)	Overburden (Mbcm)	ROM Coal* (Mt)	Reject Material (Mt)	Product Coal (Mt)
2020	566,000	44.1	21.6	2.2	19.4
2021	224,000	45.6	21.8	2.5	19.4

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Year	Stripped Topsoil (m ³)	Overburden (Mbcm)	ROM Coal* (Mt)	Reject Material (Mt)	Product Coal (Mt)
2022	132,000	55.3	19.3	2.3	16.9

*ROM Coal mined from the Open Cut and Underground operations. m³ = cubic metres. Mbcm = million bank cubic metres.

2.3.5 Waste Rock Management

Waste rock (including overburden and interburden) mined in OC1, OC2, OC3 and OC4 will continue to be placed in-pit behind active mining.

2.3.6 Waste Management

Key waste streams (apart from waste rock) that will be generated during the MOP term comprise:

- Recyclable and non-recyclable general wastes;
- Sewage and effluent; and
- Other wastes from mining and workshop activities (e.g. waste oils, scrap metal and used tyres).

General waste minimisation principles (i.e. reduce, re-use and recycling) will continue to be applied at the Moolarben Coal Complex to minimise the quantity of wastes that require off-site disposal.

All general domestic waste (e.g. general solid [putrescibles] and general solid [non-putrescible] waste as defined in *Waste Classification Guidelines Part 1: Classifying Waste* [EPA, 2014]) and general recyclable products will continue to be collected by an appropriately licensed contractor.

Discharge from all on-site sewage management systems are licensed by EPL 12932.

MCO will maintain a register of regulated waste collected by the licensed waste contractor for disposal.

2.3.7 Decommissioning and Demolition Activities

Decommissioning and demolition activities required during the MOP term are limited to temporary offices and infrastructure.

2.3.8 Water Management

An approved Water Management Plan (WMP) has been developed for the Moolarben Coal Complex as required by Project Approval (05_0117) and Project Approval (08_0135).

The key objectives of the surface water management system design for the Moolarben Coal Complex are to:

- Preferentially segregate clean water runoff, sediment water runoff, mine water and brine generated from mining operations and rainfall events;
- Minimise the volume of mine water generated by the Moolarben Coal Complex;
- Preferentially reuse mine and brine water for dust suppression and coal washing;
- Provide sufficient on-site storage to avoid unapproved water discharges;
- Capture sediment water from unrehabilitated overburden areas to settle coarse suspended solids;
- Release of water in accordance with EPL 12932 conditions; and,
- Maximise diversion of clean water runoff where practicable.

Water Storages

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Water at the Moolarben Coal Complex will be stored in surface dams, open cut pits, mining voids (when available) and sediment dams. Water storages will be progressively constructed as mining operations progress.

Up-catchment Runoff Control

Surface water infrastructure has been designed to facilitate the diversion of clean water (i.e. run-off from undisturbed or rehabilitated catchments) away from the active open pit where practicable. New diversion drains will be designed to cater for a 100 year Annual Recurrence Interval (ARI) flood.

Erosion and Sediment Control

Erosion and sedimentation control will be undertaken in accordance with the Surface Water Management Plan (SWMP) component of the WMP.

Specific erosion and sediment controls to be implemented at the Moolarben Coal Complex are as follows:

- Clean water diversion drains and banks;
- Silt fences (or equivalent control);
- Buffer strips; and
- Sediment dams.

All erosion and sediment control strategies and techniques will be designed and operated in accordance with the requirements of Landcom 'Managing Urban Stormwater: Soils and Construction Volume 1 (2004), Volume 2A – Installation of Services (DECC, 2008), Volume 2C – Unsealed Roads' (DECC, 2008) and 'Volume 2E Mine and quarries' (DECC, 2008).

Water Sharing

Where practical, MCO seeks to maximise use of surplus mine water from neighbouring mines in preference to importing raw water from other sources for mining related purposes (such as process water and dust suppression) and has agreement with UCML for the supply of 1,000ML/year of surplus mine water from the Ulan Mine Complex. MCO will also work cooperatively with other operations including Wilpinjong Coal Mine to share surplus water.

Controlled Release and Water Treatment

To assist with managing excess water on-site, water treatment facilities would be constructed to allow surplus water stored on-site to be discharged in accordance with water quality concentration limits of EPL 12932 and provide water for on-site use.

Water Demand and Supply

Water demands at the Moolarben Coal Complex include the following:

- The water used in the CHPP, including water lost to product and rejects, water for stockpile dust suppression, wash down and MIA water usage;
- Haul road dust suppression;
- Underground water demands;
- Miscellaneous water usage such as potable water, irrigation, vehicle wash down and MIA water usage.

These water demands are met through a combination of the following water sources:

- Groundwater inflows to open cut and underground mining operations;

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Water imported from the Ulan Mine Complex under agreement with Ulan Coal Mine Limited;
- Runoff captured from the footprint of the mining disturbance area by the water management system; and
- Water supply from groundwater borefields.

2.3.9 Progressive Rehabilitation and Completion

In accordance with Condition 66, Schedule 3 of Project Approval (05_0117) and Condition 54, Schedule 3 of Project Approval (08_0135), areas disturbed by mining at the Moolarben Coal Complex will be progressively rehabilitated following completion of active mine operations.

Rehabilitation at the Moolarben Coal Complex has commenced and includes permanent and temporary rehabilitation of spoil emplacement areas, environmental bunds, rail loop and completed construction areas. Rehabilitation areas in OC2 will transition from agriculture to native vegetation following the approval of open cut optimisation modification. Ongoing monitoring and maintenance of rehabilitated areas at the Moolarben Coal Complex is undertaken, where required.

A description of rehabilitation activities proposed during the MOP term is provided in **Section 7.2** and rehabilitation progression is shown on Plans 3A, 3B and 3C.

The performance indicators and completion criteria for the Moolarben Coal Complex are outlined in **Section 6**.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

3.0 ENVIRONMENTAL ISSUES MANAGEMENT

3.1 ENVIRONMENTAL RISK ASSESSMENT

Environmental risks and controls for current operational areas, rehabilitation areas and offset areas have been identified and assessed in accordance with MCO's risk management processes which follow the general principles outlined in *ISO 31000:2009 Risk Management – Principles and Guidelines*. The method used for the risk assessment encompassed the following key steps:

1. Establish the context for the risk assessment process;
2. Identify risks and potential impact;
3. Analyse risks; and
4. Evaluate risks to determine the necessary controls for mitigation.

The environmental risks and controls for current operational areas are documented in the *Moolarben Coal Operations Pty Ltd Review of Broad Brush Risk Assessment* (HMS Consultants Australia Pty Ltd [HMS], 2012a) and *Coal Handling Preparation Plant Broad Brush Risk Assessment* (HMS, 2012b) undertaken for OC1 and the CHPP respectively and Broad Brush Risk Assessments conducted periodically by MCO.

A preliminary environmental risk assessment was held in November 2012 to identify and assess the environmental risks associated with the cumulative impacts of mining activities at OC1 and OC2 including the Stage 1 extension areas (EMM, 2013a). This risk assessment was revised in May 2013 to assess the residual predicted impacts following implementation of additional controls nominated in the *Moolarben Coal Project Stage 1 Optimisation Modification Environmental Assessment* (EMM, 2013a). This risk assessment has been reviewed in the development of this MOP. A summary of the key risks to rehabilitation identified in this risk assessment is provided in **Table 4** below.

A copy of the MCO risk matrix tables is included as **Attachment 1**.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 4 Key Risks to Rehabilitation

Risk	Consequence	Probability	Inherent Risk ¹ Rating	Proposed Risk Controls
Inappropriate bushfire management regime leading to widespread failure of revegetation or continued sustainability of offset area ecosystems and mine rehabilitation areas.	3	C	13 (H)	Selection of fire-tolerant species for revegetation and rehabilitation and adoption of standard fire prevention measures. Mosaic burning and monitoring of areas following fires, with follow-up replanting/reseeding if indicated by monitoring results. Maintain contingency supplies of seed for key native species.
Major storm event resulting in flooding, geotechnical instability, major erosion and/or widespread damage to rehabilitated area.	3	C	13 (H)	Design final landforms, structures and revegetation to cope with major storm events. Monitoring of rehabilitation/offset areas following a major storm and replanting /reseeding as necessary.
Severe and/or prolonged drought leading to widespread failure of revegetation/rehabilitation.	3	C	13 (H)	Selection of drought-tolerant species within species mix for revegetation and rehabilitation (where appropriate). Monitoring of rehabilitation/offset areas and replanting/reseeding as necessary. Maintain contingency supplies of seed for key native species. Where practical, delay revegetation activities until adequate soil moisture availability. Replanting contingency plan.
Inadequate or insufficient topsoil and subsoil (regolith) to create/enhance the desired ecological communities on offset areas and mine rehabilitation areas.	3	C	13 (H)	Develop procedures for topsoil management, overburden and substrate management and soil testing. Topsoil inventory developed i.e. mapped at stripping and return. Assess stripped topsoil for weed contamination and limit spread of weed contaminated topsoil on or near areas of good native ground cover. Soil type matched to enhanced or rehabilitated vegetation association. Subsoil (regolith) material assessed for use as a suitable growing media. Identify soil ameliorants (e.g. biosolids) that could be used as a topsoil substitute.
Inadequate weed and pest animal control leading to widespread failure of revegetation or rehabilitation or continued sustainability of offset area ecosystems.	3	C	13 (H)	Targeted weed management and control program developed and implemented. Pest animal management and control program developed and implemented. Educate persons undertaking weed control to the major weed threats in the area and on site. Visual inspections/cleaning of vehicles entering sensitive areas to mitigate risk of weed dispersal. Ensure cover crops are non persistent and non-invasive.
New regulatory requirements or evolving community expectations leading to difficulties negotiating or attaining completion criteria.	3	C	13 (H)	Monitor trends and developments in legislation and changes to community and regulatory expectations.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Risk	Consequence	Probability	Inherent Risk ¹ Rating	Proposed Risk Controls
Insect attacks (e.g. locusts and beetles) leading to failure of revegetation or rehabilitation or continued sustainability of offset and mine rehabilitation area ecosystems.	3	C	13 (H)	Planting to avoid insect prone periods. Use of endemic species which are suited to localised insect predation. Monitoring program results to identify if further plantings required. Develop a replanting contingency plan.
Inappropriate planting and/or direct seeding techniques resulting in a failure of revegetation or rehabilitation or continued sustainability of offset area ecosystems.	3	C	13 (H)	Conduct site investigation and review active mining and rehabilitation methodology records for the area to determine possible contributing factors. Implement mitigation measures relevant to identified contributing factors/cause. Develop a replanting contingency plan.
Local fauna impacts resulting from the delay in establishing existing habitat values of cleared vegetation in revegetated areas (e.g. connectivity, hollows, fallen timber, litter).	3	C	13 (H)	Annual fauna monitoring program. Install hollow/nest boxes of similar dimensions in vegetation that won't be cleared. (Note hollows /nest boxes should not be placed in patches with a healthy hollow occurrence as it increases aggression and competition for resources). Increase fauna habitat features (logs, litter and debris) from cleared timber to create ground cover habitat elements in revegetated and habitat depauperate rehabilitation areas.
Inadequate depth of inert material to encapsulate reject emplacement areas resulting in spontaneous combustion within rehabilitation areas.	3	C	13 (H)	Rejects are capped with at least 5m of inert material as required by Table 15 of this MOP.
Inappropriate fertiliser application (type and rate) leading to failure of revegetation or rehabilitation or continued sustainability of offset area ecosystems.	3	D	9 (M)	Revise fertiliser application program to match vegetation needs.
Frost leads to high mortality rates of revegetation and rehabilitation (average of 42 days frost/year).	2	C	8 (M)	Monitoring program results to identify if further plantings required. Contingency plant material propagated and used in maintenance programs. Avoid plantings in frost season.
Inappropriate grazing (native species, pests and livestock) (once grazing re-introduced to agricultural rehabilitation areas) regime leading to failure of revegetation or rehabilitation or continued sustainability of offset area ecosystems.	2	C	8 (M)	Fencing of offset areas and rehabilitation to exclude grazing of domestic stock under normal situations. Crash grazing (of offset areas) may be required to reduce fuel loads and to minimise the risk of a bushfire. Use of deterrent substances on tube stock prior to use. Use of plant tubes (i.e. tree guards) to protect seedlings from grazing e.g. hares.
Damage from unauthorised entry into offset and rehabilitation areas.	2	C	8 (M)	Fencing and signposting of offset areas and rehabilitation. Lock gates at access points with access managed by the environmental department, where possible. Security patrols.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Risk	Consequence	Probability	Inherent Risk ¹ Rating	Proposed Risk Controls
Rehabilitation Management Plan (RMP) implementation delayed/limited due to land use changes – changes in mine plan.	2	C	8 (M)	RMP to be regularly reviewed and reflect current mine plans while meeting obligations. Communicate with mine planners on the restrictions of accessing/mining offset areas. Communicate with mine planners the requirement for continual rehabilitation works.
Competition from other native vegetation.	2	C	8 (M)	Targeted monitoring program. Implementation of select control program to remove invasive native species in early phases of the revegetation programs.
Incompatible neighbouring land owner practices leading to failure of rehabilitation and revegetation works.	3	D	9 (M)	Communicate the RMP with neighbouring properties, the CCC and local community.
Planning - insufficient provision of financial, human and equipment resources leading to failure to meet completion criteria, including increased maintenance costs and timeframe.	3	D	9 (M)	Budgetary allocation sufficient to cover requirements with resources available to implement RMP.
Inadequate or insufficient (incorrect species mix/quality) seed/seedlings for enhancement/revegetation of offset areas and rehabilitation works.	2	C	8 (M)	Species list reflective of target vegetation community. Use of local provenance seed and/or seedlings. Depending upon seed viability may require identification of suitable alternate seed sources from similar soil landscapes. Long-term revegetation strategy to consider composite seed provenancing (i.e. sourcing seed from dryer/warmer areas). Seed collectors are familiar with the species for which seed is required. Monitoring to measure achievements on a time scale, and against completion criteria.
Unforeseen impact to vegetation communities on land above underground workings due to subsidence.	2	D	5 (L)	Subsidence monitoring provides timely provision of data relating to impact of subsidence. Contingency budgetary allocation for remedial works associated with subsidence. Subsidence Management Plan ² to address impacts on vegetation.

¹ Inherent risk is relevant to pre-mitigation risk.

² Now the Extraction Plan.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

3.2 ENVIRONMENTAL RISK MANAGEMENT

A comprehensive environmental management system has been established at the Moolarben Coal Complex which includes implementation of environmental management commitments contained within a number of management plans, strategies and protocols which have been prepared in accordance with relevant approval conditions. The environmental management plans, strategies and programs required at the Moolarben Coal Complex are:

- Environmental Management Strategy (EMS);
- Noise Management Plan (NMP);
- Blast Management Plan (BMP);
- Brine Management Plan;
- Air Quality Management Plan (AQMP);
- Extraction Plan¹ (EP), incorporating:
 - Built Features Management Plan (BFMP);
 - Water Management Plan (WMP);
 - Biodiversity Management Plan (BioMP);
 - Land Management Plan (LMP);
 - Heritage Management Plan (HMP); and
 - Public Safety Management Plan (PSMP).
- Rehabilitation Management Plan (RMP);
- Biodiversity Management Plan (BMP);
- Water Management Plan (WMP), incorporating:
 - Site Water Balance (SWB);
 - Surface Water Monitoring Program (SWMP); and
 - Groundwater Management Plan (GWMP).
- Heritage Management Plan (HMP);
- Greenhouse Gas Minimisation Plan (GHMP); and
- Pollution Incident Response Management Plan.

These plans are progressively updated with the latest version available on the Moolarben Coal website <http://www.moolarbencoal.com.au>

An overview of the interaction of the plans listed above, the Project Approval (05_0117) and Project Approval (08_0135) and other licences is provided in the EMS. The RMP is provided in **Attachment 2** of this MOP.

During the MOP term the Moolarben Coal Complex environmental management plans will be reviewed and revised as necessary. The DRG will be consulted as required during revision of the relevant environmental management plans. The revision of these plans will be reported in the Annual Review.

3.3 SPECIFIC RISKS RELATING TO REHABILITATION

3.3.1 Geology and Environmental Geochemistry

Description of Mine Geology

¹ In accordance with Condition 77, Schedule 3 of Project Approval (05_0117) and Condition 5, Schedule 4 of Project Approval (08_0135) the Extraction Plan will be submitted to the Secretary of the DP&E prior to the commencement of second workings.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

The Moolarben Coal Complex is located in the northern part of the Western Coalfield, on the northwest margin of the Sydney Basin (Wells Environmental Services and Coffey Natural Systems, 2009).

Coal occurs in mid to late Permian age (approximately 250 to 275 million years before present) sediments collectively known as the Illawarra Coal Measures (also referred to as Permian coal measures). The Ulan Seam is **the main seam** targeted at the Moolarben Coal Complex.

Narrabeen Group sediments (sandstones and conglomerates) of Triassic age (approximately 200 to 250 million years before present) overlie the coal measures, which in turn overlie older basement rocks of sedimentary (Shoalhaven Group) and igneous origin. Small intrusive plugs and remnant Tertiary-age (approximately 5 to 65 million years before present) basalt flows also outcrop in the area. Unconsolidated and partially consolidated Tertiary-age palaeochannel and Quaternary-age (less than approximately 5 million years before present) sediments occur as valley fill and along dominant drainage lines (Wells Environmental Services and Coffey Natural Systems, 2009).

Environmental Geochemistry

An assessment of the geochemical characteristics of the waste rock material associated with the development of the Moolarben Coal Complex is provided in the Moolarben Coal Project Stage 1 Geochemical Assessment (Environmental Geochemistry International Pty Ltd, 2006) and the Moolarben Coal Project Stage 2 Geochemical Assessment (Environmental Geochemistry International Pty Ltd, 2008).

Results of geochemical testing suggest that the bulk of the Moolarben overburden and floor material is likely to be non acid forming. Potentially acid forming (PAF) overburden materials were identified as being associated with the Moolarben Seam, and the roof and floor of the Ulan Seam.

PAF Management Procedures

Landform design and surface water management are designed to minimise the potential for reconstructed landforms to generate acid mine drainage (AMD). Management measures adopted by MCO to minimise the potential generation of AMD include:

- Blending overburden to avoid emplacement of PAF-low capacity material in concentrated areas;
- If required, treatment of dispersive materials (e.g. with lime) if exposed on dump surfaces or used in engineered structures to minimise the potential to expose acid generating substrate; and
- Treatment and isolation of PAF coal rejects to minimise infiltration and subsequent leachate.

3.3.2 Spontaneous Combustion

Spoils will be selectively handled to manage the potential risk of spontaneous combustion. As required by the RMP, should any outbreaks of spontaneous combustion occur during mining operations, available details of the materials involved, location, date, time and climatic conditions will be recorded on surveyed plans. These areas will be monitored and assessed at closure to put in place appropriate mitigation measures to minimise the likelihood of spontaneous combustion occurring post mine closure. These areas will also be included as part of the ongoing inspection and monitoring that will be required following closure of the mine and before final lease relinquishment.

3.3.3 Mine Subsidence

Subsidence is the vertical and horizontal movement of the land surface as a result of the extraction of underlying coal. These land surface movements are generically referred to as subsidence effects. The type and magnitude of the subsidence effects is dependent on a range of variables (e.g. mine geometry, topography and geology).

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Mine subsidence impacts are the physical changes to the ground and its surface caused by the subsidence effects described above. Potential subsidence impacts include:

- Surface cracking;
- Changes in stream bed gradients;
- Ponding and changes in stream alignment; and
- Slope instability and erosion.

MCO visually monitor the surface and drainage lines during the extraction of UG1 (and UG4 once commenced) longwalls, so that any significant cracking identified can be remediated (where required) by infilling, regrading, re-compacting, and revegetating the surface. Further details of MCO's subsidence management strategies associated with UG1 and UG4 at the Moolarben Coal Complex are provided within the respective Extraction Plan².

3.3.4 Erosion and Sediment Control

Erosion and sediment control measures will be implemented for the life of the operation to minimise the potential impact on the surrounding environment. Erosion and sediment control strategies at the Moolarben Coal Complex, are outlined in the approved SWMP.

Prior to site disturbance a GDP needs to be authorised by the Environment and Community Manager (ECM) or delegate. This GDP needs to include the erosion and sediment controls that must be established prior to disturbance.

Erosion and sediment control measures and techniques will be designed and operated in accordance with the requirements of Landcom 'Managing Urban Stormwater: Soils and Construction including Volume 1 (2004), Volume 2A – Installation of Services (DECC, 2008), Volume 2C – Unsealed Roads' and 'Volume 2E Mine and quarries' (DECC, 2008). Specific erosion and sediment controls to be implemented at the Moolarben Coal Complex include, but not limited to:

- Clean water diversion drains and banks;
- Silt fences (or equivalent control);
- Grass buffer strips; and
- Sediment dams.

The strategies outlined for the control of erosion and sedimentation will be inspected regularly.

3.3.5 Soil Resource Management

Soil resource management strategies at the Moolarben Coal Complex are outlined in the approved RMP (**Appendix 3**), and summarised below.

Soil Resource Characterisation

Soil resources for rehabilitation have been identified and characterised for the *Moolarben Coal Project Stage 1 Environmental Assessment Report* (Wells Environmental Services, 2006), *Moolarben Coal Project Stage 1 Optimisation Modification Environmental Assessment* (EMM, 2013a) and *Moolarben Coal Project Stage 2 Environmental Assessment Report*³.

² In accordance with Condition 77, Schedule 3 of Project Approval (05_0117) and Condition 5, Schedule 4 of Project Approval (08_0135), an Extraction Plan must be submitted and approved prior to the commencement of second workings.

³ Wells Environmental Services and Coffey Natural Systems, 2009

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Field and laboratory tests indicate that the soils are mainly acid in nature, have low organic matter content, are deficient in all major nutrients (such as phosphorus, sulphur and nitrogen) and are highly erodible⁴. They are generally non-saline ($EC_{se} < 2$ dS/m) but may be prone to dryland salinity outbreak (there is some occurrence of saline discharge from soils within OC4)⁴.

The suitability of the soil types for rehabilitation, the chemical and physical characteristics for each soil type and proposed soil stripping depth is summarised in **Table 5**.

Table 5 Topsoil Suitability for Rehabilitation Purposes

Soil Type	Soil Horizon	Rehabilitation Suitability	Physical and Chemical Characteristics	Stripping Depth (cm)
Yellow Solodic	A1	Suitable if ameliorated	Acid pH with severe dispersive qualities, excessive Mg levels (low Ca:Mg ratio), poor fertility, low Ca	30*
	A2	Suitable if ameliorated	Acid pH with severe dispersive qualities, excessive Mg levels (low Ca:Mg ratio), poor fertility, low Ca	
	B	Not suitable	Dispersive clay, excessive Mg and Na levels	
Yellow Podzolic	A1	Suitable if ameliorated	Acid pH with severe dispersive qualities, excessive Mg levels (low Ca:Mg ratio), poor fertility	30*
	A2	Suitable if ameliorated	Acid pH with severe dispersive qualities, excessive Mg levels (low Ca:Mg ratio), poor fertility	
	B	Not suitable	Dispersive clay	
Earthy Sands	A1	Suitable for blending only.	Acid pH, elevated Al levels, high sand content	100
	A2	Suitable for blending only	Acid pH, elevated Al levels, high sand content with moderate dispersive qualities	
	A3	Suitable for blending only	Acid pH, elevated Al levels, high sand content with severe dispersive qualities	
	B	Not suitable	Dispersive clay, high Na and Mg levels	
Red Podzolic	A1	Suitable if ameliorated	Acid pH with severe dispersive qualities, elevated Al levels, poor fertility	25*
	A2	Suitable if ameliorated and blended	Acid pH with severe dispersive qualities, excessive Mg levels (low Ca:Mg ratio), poor fertility, sand gravel content exceeds 60%	
	B	Not suitable	Dispersive clay, high Na and Mg levels.	
Red Earth	A1	Suitable for blending only	Acid pH, elevated Al levels, high sand gravel content	100
	A2	Suitable for blending only	Acid pH, elevated Al levels, high sand gravel content	
	B	Suitable for blending only	Acid pH, elevated Al levels, high sand gravel content	
Alluvial	A1	Suitable if blended and ameliorated	Acid pH with moderate dispersive qualities, elevated Mg levels, poor fertility	45
	A2	Suitable if blended and ameliorated	Acid pH with moderate dispersive qualities, excessive Mg levels (low Ca:Mg ratio), poor fertility, sand gravel content levels are high	
Euchrozem	A1-B	Highly suitable	Neutral to alkaline pH, low erosion hazard, moderate to high fertility, potentially elevated Mn at depth	100 [#]

Source: Wells Environmental Services and Coffey Natural Systems (2009).

Notes: * Stripping depth has incorporated the blending of the top 10 to 20 centimetres (cm) of the A2 horizon to increase topsoil volume. # Subject to investigation prior to disturbance.

Soil Stripping

Soil resources are stripped at the relevant depth for the soil type (**Table 5**) based on soil mapping data and site verification. All suitable and available soil resources will be salvaged for re-use in rehabilitation. Soil and other organic matter will then be removed from cleared areas and either directly respread on rehabilitation areas or stockpiled for future reuse.

Topsoils and subsoils will be stockpiled separately and will be managed to optimise the overall quality of growth media resources. Selective subsoil materials (tuffaceous claystone seams located in interburden) that may enhance re-establishing *White Box – Yellow Box – Blakely's Red Gum Woodland*

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

and Derived Native Grassland may also be stripped and stockpiled separately for re-use in Box Gum Woodland rehabilitation areas where confirmed to be beneficial. Where practicable, cleared vegetation not retained for habitat augmentation on rehabilitation areas may be mulched on site and mixed into topsoil during the stripping process to provide a soil conditioner.

Soil Stockpile Management

MCO soil stockpile management strategies aim to preserve the soil resource and improve overall soil health. Management practices used to optimise the long-term viability of stockpiled soil resources include:

- Soil stockpiles are generally constructed to a maximum of height of 3m, with a rough friable surface to reduce erosion, increase infiltration, and minimise anaerobic conditions at the base of the stockpile.
- Long-term stockpiles are preferentially located outside of mine disturbance areas away from slopes and drainage lines.
- Soil stockpiles [that are inactive for longer than 6 months are](#) fertilised and seeded with native grass or non-invasive exotic pasture species to reduce erosion and maintain soil structure, organic content and microbial activity.
- Sodic soils may be ameliorated (as necessary) while stockpiled to minimise dispersion and loss of structure.
- Soil stockpiles are managed to minimise weed growth. Prior to re-spreading soils, stockpiles may be scalped to remove weeds and minimise the transfer of weed seeds into rehabilitation areas. Topsoil stockpiles are de-compacted prior to soil re-spreading by deep ripping.

A summary of the soil resource management strategies implemented at the Moolarben Coal Complex is provided in **Table 6**.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 6 Soil Resource Management Strategies

Soil Characterisation and Quantification	Soil Stripping and Handling	Soil Stockpile Management	During the Rehabilitation Program
<ul style="list-style-type: none"> Quantification of soil resources. Characterisation of the suitability of soil resources for rehabilitation works. Subsoil material that may potentially enhance the revegetation works would be investigated, with suitable materials to be stockpiled and used in the revegetation works. Formulation of stripping specifications including location of areas to be stripped, appropriate stripping depths and scheduling. 	<ul style="list-style-type: none"> Stockpile selectively stripped material. Stockpile soils in a manner that reduces the impact on the long-term viability of the soil resource. Soil stockpiles will be preferably located outside of proposed mining areas. Vehicular traffic will be kept to a minimum on the soils to be stripped. Stockpiles will be constructed with a "rough" surface condition to reduce erosion hazard, improve drainage and promote revegetation. Stockpiles will be generally no more than 3 m in height in order to minimise potential for anaerobic conditions. 	<ul style="list-style-type: none"> Implement measures to manage long-term viability of stockpiled soil resources (and manage soil salinity) as follows: <ul style="list-style-type: none"> Where necessary fertilise and seed stockpiles which will be inactive for longer than 6 months to maintain soil structure, organic matter and microbial activity. Where necessary, install silt fences around the downslope perimeter of stockpiles to control potential soil loss and downstream sedimentation. Where necessary, apply appropriate soil ameliorants (lime/ gypsum) to dispersive soil stockpiles. Implement appropriate weed control strategies particularly for any priority weeds. 	<ul style="list-style-type: none"> Deep rip stockpiles (inactive for longer than 6 months) to establish aerobic conditions prior to reapplication of stockpiled soil for rehabilitation. Topsoil conditioning involving the addition of lime, gypsum or fertiliser will be used where required. On completion of landform contouring, topsoiling and erosion and sediment control works, a vegetative cover will be applied as soon as practicable. Depending on the proposed post-mining land use, this will involve direct seeding of selected shrub, grass and tree species. Implement appropriate weed control strategies particularly for any priority weeds. Immediate revegetation will provide vegetative competition to assist with control of undesirable plant species.

Topsoil Re-spreading and Seedbed Preparation

Topsoil will be re-spread on contoured areas typically at a depth of 10 cm deep, or at a depth to match the pre-mining topsoil depth. Once re-spread, ameliorants (e.g. lime, gypsum, fertiliser and organics) will be applied (if necessary) at the recommended rate per hectare [with](#) the area then ripped on the contour to assist incorporating the ameliorants. Light-ripping or harrowing will be undertaken for agricultural rehabilitation areas, and deep-ripping undertaken for native vegetation rehabilitation areas including Box Gum Shrubby Woodland, Box Gum Grassy Woodland and Sedimentary Ironbark Forest communities.

Ripping creates a roughened, friable surface which encourages rainfall infiltration and reduces run-off, and optimises soil/seed contact, enhancing vegetation establishment and persistence. This is particularly beneficial in periods of drought and low rainfall areas (both applicable to local area).

The use of soil ameliorants is designed to prevent surface crusting, increase organic content, infiltration and moisture retention and buffer surface temperatures to improve germination.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

3.3.6 Flora

The flora management strategies at the Moolarben Mine Complex are outlined in the approved BioMP and summarised below.

Vegetation Clearance and Seed Collection

A Vegetation Clearance Protocol (VCP) has been developed and is implemented to minimise impacts on threatened species during native vegetation clearing at the Moolarben Coal Complex. A detailed description of the VCP is provided in the BioMP. Key components of the protocol include:

- Delineation of areas to be cleared;
- Pre-clearing procedure (i.e. GDP, pre-clearance survey, habitat feature salvage);
- Fauna impacts management; and
- Vegetation clearance procedures.

Prior to site disturbance a GDP needs to be authorised by the ECM or delegate. This GDP needs to clearly identify the area to be disturbed and identify any environmentally sensitive features within and/or adjacent to the area to be disturbed.

In conjunction with the GDP process and prior to native vegetation clearing with habitat potential at the Moolarben Coal Complex, a pre-clearance survey will be conducted by an appropriately trained and suitably qualified ecologist. For further details regarding pre-clearance surveys refer to the BioMP.

MCO undertake local provenance seed collection, where practical and feasible. Seed collection and propagation activities are further outlined in the approved BioMP and RMP, which consider the requirements of the Florabank Guidelines (2000).

A detailed description of the revegetation species to be used in the rehabilitation program is provided in the RMP (**Appendix 3**).

Threatened Vegetation Communities and Flora Species

Three threatened ecological communities have been recorded at the Moolarben Coal Complex (Moolarben Biota, 2006; Ecovision Consulting, 2008 and 2009; EMM, 2013a and b; Cumberland Ecology, 2012; EcoLogical Australia, 2016):

- *White Box – Yellow Box – Blakely’s Red Gum Woodland and Derived Native Grassland*, listed as an Endangered Ecological Community (EEC) under the NSW *Biodiversity Conservation Act, 1995* (BC Act) and Critically Endangered Ecological Community under the EPBC Act (herein referred to as the Box Gum Woodland EEC). This community has been recorded within both the surface disturbance and underground mining areas at the Moolarben Coal Complex (Figure 4).
- *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions*, listed as an EEC under the BC Act. This community has been recorded in the underground mining areas at the Moolarben Coal Complex (Figure 4).
- *Central Hunter Valley Eucalypt Forest and Woodland*, listed as a CEEC under the EPBC Act. This community has been recorded in the UG1 underground mining area. This CEEC was listed in May 2015 and does not apply to the approved Stage 1 and Stage 2 mining operations pursuant to section 158A of the EPBC Act.

Five threatened flora species have been recorded at the Moolarben Coal Complex, including (Moolarben Biota, 2006; Ecovision, 2008; EMM, 2013a and b):

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- *Diuris tricolor* (Pine Donkey Orchid) – vulnerable under the BC Act.
- *Eucalyptus cannonii* (Capertee Stringybark) – vulnerable under the BC Act.
- *Eucalyptus scoparia* (Wallangarra White Gum) – endangered under the BC Act and vulnerable under the EPBC Act.
- *Leucochrysum albicans* var *tricolor* (Hoary Sunray) – endangered under the EPBC Act.
- *Pomaderris queenslandica* (Scant Pomaderris) – endangered under the BC Act and vulnerable under the EPBC Act.

Management strategies relevant to vegetation communities and flora species are provided in the BioMP.

Weed Management

Weed management strategies at the Moolarben Coal Complex are outlined in the approved BioMP. Weed control strategies include:

- Regular inspections of MCO-owned lands to identify areas requiring the implementation of weed management measures;
- Consultation with adjoining land owners adjacent to operations and relevant government stakeholders regarding regional weed management strategies;
- Implementation of appropriate weed management measures which may include mechanical removal, application of approved herbicides and biological control;
- Control of priority weeds, when identified on MCO-owned land in accordance with the relevant DPI control category and the relevant regional weed management plan;
- Regular inspections and maintenance of topsoil stockpiles;
- Identification of weed infestations adjacent to or within the proposed disturbance area during preclearance surveys;
- Follow-up inspections to assess the effectiveness of the weed management measures implemented and the requirement for any additional management measures; and
- Minimising the potential for spreading weeds by minimising the transport of weed species (e.g. limiting vehicle access and minimising stock access to relevant areas onsite).

Revegetation of Degraded Land and Riparian Areas

Consistent with the rehabilitation objectives (Section 4.1.1), MCO has outlined management strategies in the BioMP to improve connectivity between existing conservation reserves and large areas of remnant native vegetation outside the mine disturbance footprint, surrounding the Moolarben Coal Complex.

For these areas, natural regeneration of native species will be supported and will include implementing relevant land management measures to improve degraded and eroding areas for example. Measures may include:

- Fencing and exclusion of stock from larger vegetation remnants on its land leased to agricultural users (note in some cases stock may not be able to be excluded due to the need/use of vegetation patches as shade for stock, etc.);
- Revegetation or regeneration of areas not required for agricultural purposes;
- Fencing and exclusion of stock along strategic and/or degraded sections of Moolarben Creek;

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Riparian corridor enhancement along degraded areas of Moolarben Creek, Wilpinjong Creek and Murragamba and Eastern Creeks on MCO-owned land (measures may include restoring channel stability, planting riparian vegetation, placement of large woody debris and other measures to improve the riparian and aquatic ecosystem function and provide compensatory aquatic habitat);
- Creation of new areas/patches of trees in consultation with leasees in areas that complement their agricultural enterprises (e.g. shade and shelter belts);
- Weed and pest control on vegetation remnants and revegetation areas; and
- Bushfire management measures.

Riparian corridor enhancement⁴ along selected degraded areas of Moolarben Creek, Wilpinjong Creek and Murragamba and Eastern Creeks would be undertaken in consideration of the rehabilitation principles within the NOW's *Guideline for Riparian Corridors on Waterfront Land* and *Guideline for Vegetation Management Plans on Waterfront Land*.

Implementation of these measures would lead to improved connectivity between the Munghorn Gap Nature Reserve (MGNR) and surrounding biodiversity offset areas by improving or creating "stepping stones" and refuges for mobile fauna such as birds and mammals. Ecological connectivity is also important for enhancing the colonisation of native species, particularly fauna, into rehabilitation areas.

3.3.7 Fauna

The fauna management strategies at the Moolarben Coal Complex are outlined in the approved BioMP and summarised below.

Threatened Fauna

Across the Moolarben Coal Complex and surrounds, a total of 32 threatened and/or migratory fauna species, consisting of seven mammal species (including six microbat species) and 25 bird species have been recorded by Moolarben Biota (2006), Ecovision (2008) and EMM (2013a and b). These threatened species are listed in **Table 7**.

No threatened fauna populations are present at the Moolarben Coal Complex.

Table 7 Threatened Fauna Species Recorded at the Moolarben Coal Complex

Common Name	Scientific Name	Conservation Status ¹	
		BC Status	EPBC Status
Square-tailed Kite	<i>Lophoictinia isura</i>	V	-
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	-
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	-
Powerful Owl	<i>Ninox strenua</i>	V	-
White-throated Needletail	<i>Hirundapus caudacutus</i>	-	M
Rainbow Bee-eater	<i>Merops ornatus</i>	-	M
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	-
Speckled Warbler	<i>Chthonicola sagittata</i>	V	-
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V	-
Painted Honeyeater	<i>Grantiella picta</i>	V	-
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	-

⁴ Note that a number of the above investigative actions (where considered practical and feasible to implement) would need to be undertaken in consultation with and the agreement of the lessee.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Common Name	Scientific Name	Conservation Status ¹	
		BC Status	EPBC Status
Gilbert's Whistler	<i>Pachycephala inornata</i>	V	-
Rufous Fantail	<i>Rhipidura fuliginosa</i>	-	M
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	-	M
Dusky Wood Swallow	<i>Artamus cyanopterus cyanopterus</i>	V	-
Diamond Firetail	<i>Stagonopleura guttata</i>	V	-
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	-
White-fronted Chat	<i>Epthianura albifrons</i>	V	-
Scarlet Robin	<i>Petroica boodang</i>	V	-
Spotted Harrier	<i>Circus assimilis</i>	V	-
Masked Owl	<i>Tyto novaehollandiae</i>	V	-
Flame Robin	<i>Petroica phoenicea</i>	V	-
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	-
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	-
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V
Little Pied Bat	<i>Chalinolobus picatus</i>	V	-
Large Bent-winged bat	<i>Miniopterus schreibersii oceanensis</i>	V	-
Greater Long-eared Bat	<i>Nyctophilus timoriensis</i>	V	V
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	V	-

Notes: ¹ Conservation status under the BC Act and the EPBC Act (current as at January 2019).

Habitat Management

The BioMP describes management strategies to minimise impacts of vegetation clearance on fauna habitat.

Habitat Features

Prior to site disturbance a GDP needs to be authorised by the ECM or delegate. In conjunction with the GDP process a pre-clearance survey will be conducted and will identify potential habitat features, nesting sites, hollows etc. For further details regarding pre-clearance surveys refer to the BioMP.

Trees containing features with the potential to provide significant nesting/roosting habitat resources (i.e. numerous hollows suitable for nesting/roosting) for birds, bats and/or arboreal mammals will be clearly marked as habitat trees and retained for reuse in the rehabilitation program where practical and feasible.

Habitat features will be salvaged and stockpiled for reuse in rehabilitation areas or relocated to adjoining areas of remnant vegetation, where practical and feasible. Remaining tree limbs, stumps, shrubs and other woody vegetation may be mulched or used in whole or in part in rehabilitation areas.

When salvaged, habitat features will be reused in native vegetation rehabilitation areas, as follows:

- Stag trees – hollow bearing timber for vertical placement within rehabilitation for avian species or arboreal mammals, and bark retained timber for arboreal microbats.
- Coarse Woody Debris – horizontal placement of hollow logs or small piles of timber and rocks creating cavities for habitat by small ground dwelling mammals and reptiles placed for interconnectivity across rehabilitation areas.
- Habitat trees and non-habitat trees used generally as coarse woody debris.

Management of Pest Animals

Management strategies of exotic pest animals at Moolarben Coal Complex is outlined in the BioMP. Pest animal control program will consider:

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Using a range of appropriate pest control measures to minimise collateral damage to native animals is (e.g. the destruction of rabbit burrows, feral cat and goat trapping and baiting of foxes and wild dogs and wild pigs);
- Follow-up inspections to assess the effectiveness of control measures implemented and the requirement for any additional control measures; and
- Mandatory pest control for any declared pests (i.e. rabbits, pigs and wild dogs) known to occur on MCO owned land.

Pest animal species will be managed in consultation with the Hunter Local Land Services, and in accordance with the *Local Land Services Act, 2013* and *Biosecurity Act, 2015*.

Measures to control exotic animals will be implemented by an appropriately qualified person. A summary of the exotic pest animal management and monitoring results will be reported in the Annual Review.

3.3.8 Other Risks

Slopes and Slope Management

The design of the outer batters of the overburden emplacements and final voids are described in **Section 5.2**.

Air Quality

Air quality management and monitoring strategies at the Moolarben Coal Complex are outlined in the approved Air Quality Management Plan (AQMP). The air quality management measures described in the AQMP are designed to minimise the impact on the surrounding environment due to on-site activities. The measures to control dust emissions at the Moolarben Coal Complex may include:

- Employee awareness;
- Review mining activities in adverse weather conditions;
- Minimise disturbance areas;
- Progressive rehabilitation;
- Use of water carts as necessary;
- Speed limits;
- Enclosed conveyor transfers;
- Predictive meteorological forecasting; and
- Real time air quality monitoring.

Further details regarding air quality management and monitoring strategies are provided in the AQMP. Air quality monitoring results are documented in the Annual Review available on the Moolarben Coal Complex website.

Surface Water & Groundwater

Surface water management strategies at the Moolarben Coal Complex are outlined in the approved Water Management Plan (WMP). The WMP has been prepared to manage surface water and groundwater related impacts associated with open cut and underground mining, operation of the CHPP and the supply of water to the operations.

The approved Surface Water Management Plan (SWMP), a component plan of the WMP, outlines the framework which describes how MCO will assess, manage, monitor and mitigate impacts from the surface water system. The key objectives of the surface water management system design for the Moolarben Coal Complex are to:

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Preferentially segregate clean water runoff, sediment water runoff, mine water and brine generated from mining operations and rainfall events;
- Minimise the volume of mine water generated by the Moolarben Coal Complex;
- Preferentially reuse mine and brine water for dust suppression and coal washing;
- Provide sufficient on-site storage to avoid unapproved water discharges;
- Capture sediment water from unrehabilitated overburden areas to settle coarse suspended solids;
- Release of water in accordance with EPL 12932 conditions; and,
- Maximise diversion of clean water runoff where practicable.

The approved Groundwater Management Plan (GWMP), a component plan of the WMP, outlines the framework which describes how MCO will assess, manage, monitor and mitigate impacts from groundwater systems surrounding the Moolarben Coal Complex.

The approved Site Water Balance (SWB) a component plan of the WMP, outlines the operational water management system, sources and security of water supply, water use and management of water at the Moolarben Coal Complex.

The results from MCO's surface water and groundwater monitoring programs and site water balance review are provided in the Annual Review, available of the Moolarben Coal Complex websites.

Contaminated Land

A detailed Mine Closure Plan (MCP) will be developed for the Moolarben Coal Complex prior to mine closure and will include a demolition and decommissioning strategy. The MCP will also include a land contamination assessment. Issues expected to be addressed by this assessment will include, but not be limited to, decontamination of areas such as those impacted by carbonaceous material (e.g. coal spillage, coal storage), hydrocarbon spillage (e.g. workshops, fuel storage areas) or by sedimentation (e.g. dams which have directly received pit water).

Hazardous Materials

Hydrocarbon compounds will continue to be stored in bunded areas in accordance with the requirements of Australian Standard (AS) 1940:2004 *The Storage and Handling of Flammable and Combustible Liquids*.

All explosives will continue to be stored in accordance with the requirements of AS 2187:1998 *Explosives – Storage Transport and Use – Storage*.

No chemicals or hazardous materials will be permitted on site unless accompanied by the appropriate Material Safety Data Sheet (MSDS).

Greenhouse Gases

In accordance with Condition 20(b), Schedule 3 and Condition 21(b), Schedule 3 of the Project Approval (05_0117) and Project Approval (08_0135), MCO will implement all reasonable and feasible measures to minimise the release of greenhouse gas emissions from the Moolarben Coal Complex.

MCO have developed a Greenhouse Gas Minimisation Plan⁵ which outlines reasonable and feasible measures to minimise the release of greenhouse gas emissions from underground operations at the Moolarben Coal Complex. Moolarben monitor greenhouse gas emissions by direct and indirect monitoring. The greenhouse gas monitoring program will involve direct measurement of fugitive emissions from the underground mine and the results reported in the Annual Review.

⁵ Condition 9, Schedule 4 of Project Approval (05_0117).

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Blasting

Blast management and mitigation strategies are outlined in the approved Blast Management Plan (BMP) for the Moolarben Coal Complex. The BMP describes the management of blasting associated with open cut operations (including management of overpressure, vibration, flyrock and fume) at the Moolarben Coal Complex.

Table 8 outlines MCO's blasting criteria for airblast overpressure and ground vibration. Blasting for open cut operations is only carried out at the Moolarben Coal Complex between 9.00 am and 5.00 pm Monday to Saturday inclusive. No blasting is allowed on Sundays, public holidays, or at any other time without the written approval of the Secretary of the DPIE.

Table 8 Blasting Criteria

Location	Airblast Overpressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance
Residence on privately owned land, churches and schools	120	10	0%
	115	5	5% of the total number of blasts over a period of 12 months
All public infrastructure	-	50 (or a limit determined by the structural design methodology in AS 2187.2-2006, or its latest version, or other alternative limit for public infrastructure, to the satisfaction of the Secretary)	0%

Notes: These criteria do not apply where MCO has a written agreement with the private landowner or public infrastructure authority and has advised the terms of this agreement to DPIE.

The approved BMP outlines the management and mitigation strategies for blast fume⁶.

Blast monitoring (ground vibration and overpressure) and fume monitoring is conducted for each blast at the Moolarben Coal Complex. Blast monitoring results and reportable fume events are documented in the Annual Review available on the Moolarben Coal Complex website.

Noise

Noise management and mitigation strategies are outlined in the approved Noise Management Plan (NMP) for the Moolarben Coal Complex. MCO undertakes attended noise monitoring in the surrounding community to assess compliance with noise impact assessment criteria, additional noise mitigation criteria, land acquisition criteria and cumulative noise goals. MCO also operates real time noise monitoring units to assess ongoing performance of the operation. **Table 9** outlines noise criteria as outlined in the Project Approval.

Table 9 Noise Criteria dB(A)

Land Number	Day L _{Aeq} (15min)	Evening L _{Aeq} (15min)	Night	
			L _{Aeq} (15min)	L _{A1} (1min)
63	39	39	39	45
70	37	37	37	45
75	36	36	36	45

⁶ Blasting activities has the potential to generate nitrogen oxides as a result of the use of ammonium nitrate-based explosives.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

MOOLARBEN COAL OPERATIONS

All other privately owned residences	35	35	35	45
Ulan Primary School	35 (internal) when in use			-
Ulan Anglican Church	35 (internal) when in use			-
Goulburn River National Park Munghorn Gap Nature Reserve	50 when in use			-

MCO has implemented management and control measures to identify and manage noise impacts to ensure noise from Moolarben Coal Complex is managed to acceptable levels, through a combination of the following, but not limited to:

- Employee and staff awareness and understanding of noise issues;
- Review mining activities in weather adverse conditions;
- All machinery and plant used on site will be maintained regularly to minimise noise generation;
- Procurement of sound attenuated principal equipment;
- Use of targeted acoustic bunding around the site (specifically targeting haul roads); and
- Noise monitoring will include a combination of real-time and attended monitoring of mine-generated noise.

The effectiveness of noise management measures at the Moolarben Coal Complex are assessed through real-time and attended noise monitoring. Noise monitoring results are documented in the Annual Review and available on the Moolarben Coal Complex website.

Visual and Lighting

Progressive rehabilitation of mine disturbance areas will be undertaken in order to reduce the contrast between the Moolarben Coal Complex landform and the surrounding environment.

Management measures that will be implemented by MCO to mitigate adverse night lighting impacts include:

- All external lighting for the project will comply with AS 4282 (INT):1995 – *Control of Obtrusive Effects of Outdoor Lighting*;
- Shielding floodlights in the open cut area to the maximum extent practicable;
- Orienting lighting plant away from receivers where possible while maintaining adequacy to meet safe working practices;
- Using low brightness floodlights where possible; and
- Establishing native vegetation on the OC1 environmental bund to enhance visual screening.

Heritage

Aboriginal heritage and historic heritage management strategies are outlined in the approved Heritage Management Plan (HMP) for the Moolarben Coal Complex.

The HMP includes protocols for the involvement of the Aboriginal community, procedures for heritage surveys, recording and salvaging and management strategies for all identified heritage sites within the Moolarben Coal Complex. Known heritage sites are shown on Plan 1C.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Bushfire

Bushfire management strategies are outlined in the Bushfire Management Plan (BFMP) for the Moolarben Coal Complex. MCO maintains water carts with fire fighting equipment capable of extinguishing fire outbreaks. This fire fighting equipment, together with graders and bulldozers used for mining, provides effective bushfire fighting capability.

MCO will liaise with the Cooks Gap Rural Fire Service as required, so that both parties are aware of fires in and adjoining the area of the Moolarben Coal Complex. All fires identified on or near the Moolarben Coal Complex will be immediately reported to the ECM and the General Manager.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

4.0 POST-MINING LAND USE

4.1 REGULATORY REQUIREMENTS

MCO's regulatory requirements are contained in the following and include requirements relevant to MCO's post-mining and rehabilitation goals, as outlined in **Sections 4.1.1 to 4.1.3**:

- The conditions of Project Approval (05_0117) (as modified) and Project Approval (08_0135) (as modified);
- The conditions of Commonwealth Approvals EPBC (2007/3297), EPBC (2013/6926), EPBC (2008/4444), and EPBC (2017/7974); and
- Relevant licences and permits, including conditions attached to the MLs and the conditions of EPL 12932.

4.1.1 EP&A Act Project Approvals

Rehabilitation Objectives

Condition 65, Schedule 3 of Project Approval (05_0117) and Condition 53, Schedule 3 of Project Approval (08_0135) outline the rehabilitation objectives for the Moolarben Coal Complex. Condition 65, Schedule 3 of Project Approval (05_0117) states:

Rehabilitation Objectives

65. The Proponent shall rehabilitate the site to the satisfaction of the DRG. This rehabilitation must be generally consistent with the proposed rehabilitation described in the EA (and depicted conceptually in the figure in Appendix 8), and comply with the objectives in Table 13.

Table 13: Rehabilitation Objectives

Feature	Objective
Mine site (as a whole)	<ul style="list-style-type: none"> • Safe, stable and non-polluting; • Constructed landforms are to drain to the natural environment (excluding the final voids); • Final landforms are to be consistent with the surrounding topography of the area, taking into account relief patterns and principles; and • Minimise visual impact of final landforms as far as is reasonable and feasible.
Final Voids	<ul style="list-style-type: none"> • Minimise the size and depth of final voids so far as is reasonable and feasible, subject to meeting the objectives below; • Minimise the drainage catchment of the final void so far as is reasonable and feasible; • Negligible high wall instability risk; • The size and depth of the final voids must be designed having regard to their function as long-term groundwater sinks, to ensure that groundwater flows across the back-filled pit towards the final void; and • Minimise risk of flood interaction for all flood events up to and including the Probable Maximum Flood level.
Water Quality	<ul style="list-style-type: none"> • Water retained on site is fit for the intended land use (s) for the post-mining domain(s) • The potential ecological, hydrological and geomorphic impacts from post-mining water discharges on receiving creeks are assessed and appropriate mitigation measures are effectively implemented as part of the closure plan.
Surface infrastructure	<ul style="list-style-type: none"> • To be decommissioned and removed, unless the Executive Director, Mineral Resources agrees otherwise.
Agricultural land	<ul style="list-style-type: none"> • Establish agricultural land in areas indicated in the figure in Appendix 8 to a similar agricultural suitability to that existing prior to mining.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Feature	Objective
Other Land	<ul style="list-style-type: none"> Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprised of: native forests and woodland, including EECs; habitat for threatened fauna species; and wildlife corridors (as indicated in the figure in Appendix 8).
Community	<ul style="list-style-type: none"> Ensure public safety; and Minimise the adverse socio-economic effects associated with mine closure.

Condition 53, Schedule 3 of Project Approval (08_0135) states:

Rehabilitation Objectives

53. The Proponent shall rehabilitate the site to the satisfaction of the DRG. This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in the EA (and depicted conceptually in the figures in Appendix 10), and comply with the objectives in Table 17.

Table 17: Rehabilitation Objectives

Feature	Objective
Mine site (as a whole)	<ul style="list-style-type: none"> Safe, stable and non-polluting; Constructed landforms drain to the natural environment (excluding final voids); and Minimise visual impact of final landforms as far as is reasonable and feasible. Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems that is compatible with the conservation values of the adjacent Munghorn Gap Nature Reserve and Goulburn River National Park, that is comprised of: <ul style="list-style-type: none"> 1502 ha of open woodland including Grey Box – Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin; Scribbly Gum – Brown Bloodwood woodland of the southern Brigalow Belt South; Rough-barked Apple – Coast Banksia shrubby woodland on Warkworth Sands of the central Hunter Valley, Sydney Basin; and White Box Yellow Box Blakely's Red Gum Woodland (EEC); aquatic habitat areas (within the diverted creek lines and retained water features); habitat for threatened fauna species; and wildlife corridors.
Final Voids	<ul style="list-style-type: none"> Minimise the size and depth of final voids so far as is reasonable and feasible, subject to meeting the objectives below Minimise the drainage catchment of the final void so far as is reasonable and feasible; Negligible high wall instability risk; The size and depth of the final voids must be designed having regard to their function as long-term groundwater sinks, to ensure that groundwater flows across the back-filled pit towards the final void; and Minimise risk of flood interaction for all flood events up to and including the Probable Maximum Flood level.
Water Quality	<ul style="list-style-type: none"> Water retained on site is fit for the intended land use (s) for the post-mining domain(s) The potential ecological, hydrological and geomorphic impacts from post-mining water discharges on receiving creeks are assessed and appropriate mitigation measures are effectively implemented as part of the closure plan.
Surface infrastructure	<ul style="list-style-type: none"> To be decommissioned and removed, unless the Secretary Industry agrees otherwise.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Feature	Objective
Degraded riparian areas along Wilpinjong Creek and along Murragamba and Eastern Creeks downstream of the mined areas to the boundary of the Wilpinjong mine.	<ul style="list-style-type: none"> Restore channel stability; Restore riparian and aquatic ecosystem function; and Include compensatory aquatic habitat areas.
Community	<ul style="list-style-type: none"> Ensure public safety; and Minimise adverse socio-economic effects associated with mine closure.

Rehabilitation Management Plan

Condition 68, Schedule 3 of Project Approval (05_0117) and Condition 56, Schedule 3 of Project Approval (08_0135) require the preparation of a RMP for the Moolarben Coal Complex (**Attachment 3**). The RMP describes the management of rehabilitation at the Moolarben Coal Complex (including Stage 1 and Stage 2) associated with PA05_0117 and PA08_0135.

Progressive Rehabilitation

Conditions 66 and 67, Schedule 3 of Project Approval (05_0117) and Condition 54, Schedule 3 of Project Approval (08_0135), require rehabilitation to be conducted progressively. Rehabilitation progression and monitoring is documented in the Annual Review available on the Moolarben Coal Complex website.

Conditions 66 and 67, Schedule 3 of Project Approval (05_0117) state:

Progressive Rehabilitation

66. The Proponent shall rehabilitate the site progressively. That is, as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim rehabilitation strategies shall be employed when areas prone to dust generation cannot yet be permanently rehabilitated.

Note: It is accepted that some parts of the site that are progressively rehabilitated may be subject to further disturbance at some later stage of the project.

67. The Proponent shall progressively landscape the environmental bunds on site.

Condition 54, Schedule 3 of Project Approval (08_0135) states:

Progressive Rehabilitation

54. The Proponent shall rehabilitate the site progressively as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim rehabilitation strategies shall be employed when areas prone to dust generation cannot be permanently rehabilitated.

Note: It is accepted that some parts of the site that are progressively rehabilitated may be subject to further disturbance at some later stage of the project.

Statement of Commitments

Appendix 3 of Project Approval (05_0117) and Project Approval (08_0135) outline MCO's Statement of Commitments relevant to the Moolarben Coal Complex which include commitments relevant to rehabilitation.

4.1.2 Mining Lease Approval

Rehabilitation requirements are prescribed in the conditions of MLs.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Each ML for the Moolarben Coal Complex includes a condition relevant to rehabilitation, which requires MCO to rehabilitate disturbed land to the satisfaction of the Secretary of Industry.

4.1.3 Commonwealth Approvals

Condition 3 of the Stage 1 Commonwealth Approval (EPBC 2007/3297) includes requirements relevant to rehabilitation. Condition 3 states:

3. *In order to protect the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed ecological community, the person taking the action shall prepare and implement a detailed Rehabilitation and Offsets Management Plan for the project to the satisfaction of the Minister for the Environment and Water Resources. The proponent shall progressively rehabilitate the site to the satisfaction of Minister for the Environment and Water Resources and the NSW Department of Primary Industries, in general accordance with the proposed Rehabilitation and Offset Management Plan. The Rehabilitation and Offset Management Plan must include:*
 - (a) *the rehabilitation objectives for the site, vegetation offsets and landscaping;*
 - (b) *a description of the short, medium, and long term measures that would be implemented to:*
 - *rehabilitate the site;*
 - *implement the vegetation offsets; and*
 - *landscape the environmental bunds;*
 - (c) *performance and completion criteria for the rehabilitation of the site, implementation of the vegetation offsets, and landscaping of the environmental bunds;*
 - (d) *a detailed description of the measures that would be implemented over the next 3 years including the progressive rehabilitation of mining areas and progressive implementation of the vegetation offset areas referred to in Condition 2.*
 - (e) *a program to monitor the effectiveness of these measures, and progress against the performance and completion criteria (see (c) above);*
 - (f) *a description of the potential risks to successful rehabilitation and/or revegetation, and a description of the contingency measures that would be implemented to mitigate these risks; and*
 - (g) *details of who would be responsible for monitoring, reviewing, and implementing the plan.*

Coal mining operations must not commence until the plan has been approved. The approved plan must be implemented.

The RMP addresses the requirements of Condition 3 of the Stage 1 and Commonwealth Approval (EPBC 2007/3297) and considers EPBC 2017/7974. Commonwealth Approvals (2008/4444 and 2013/6926) do not contain any conditions relevant to rehabilitation.

4.2 POST-MINING LAND USE GOAL

The principal post-mining land use vision at the Moolarben Coal Complex is to:

- Enhance biodiversity by providing a net increase in native vegetation and improving connectivity with adjacent woodland and forest communities at Munghorn Gap Nature Reserve and Goulburn River National Park; and
- Reinstate pre-mining land use on areas of OC3 by re-establishing agricultural land.

It is envisaged that the rehabilitated Murrumbidgee and Eastern Creeks will be used for conservation, passive recreation and environmental education purposes. Some infrastructure may also be retained post-mining for future exploration/mining purposes or for passive recreation, educational and transport purposes.

Final post-mining land uses will be subject to consultation with relevant regulatory authorities and key stakeholders, including surrounding landholders.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Plan 4 shows the proposed post-mining land use for the Moolarben Coal Complex.

A description of the post-mining land use goals relevant to biodiversity enhancement and agriculture is provided below.

Biodiversity Enhancement

MCO is committed to enhancing regional biodiversity values by creating long-term north-south and east-west habitat corridors linking Goulburn River National Park and Munghorn Gap Nature Reserve. Enhanced linkages will be achieved by the rehabilitation of disturbed lands (including riparian areas) with native vegetation to develop habitats similar to the existing undisturbed environments.

Native vegetation rehabilitation areas will be a mosaic of Box Gum Shrubby Woodland, Sedimentary Ironbark Forest and Box Gum Grassy Woodland communities (**Plan 4**). Box Gum Woodland associations will be consistent with key species associated with the Box Gum Woodland Endangered Ecological Community. The type of woodland or forest community will ultimately be dependent on the post-mining landform slope and overburden material characteristics. Box Gum Woodland associations will be consistent with key species associated with the Box Gum Woodland Endangered Ecological Community.

Native vegetation will be established across the majority of OC1, OC2 and OC4 footprints and along the steeper areas of OC3 where the final landform approaches the ridge to the west, to integrate with remnant stands of vegetation and enhance habitat connectivity.

Agriculture

MCO will re-establish lands suitable for agriculture on portions of the OC3 final landforms (**Plan 4**). Agricultural rehabilitation areas will be predominantly rehabilitated with pasture species suitable for grazing.

4.3 REHABILITATION PRINCIPLES AND OBJECTIVES

The rehabilitation principles and objectives for the Moolarben Coal Complex are outlined below.

The performance indicators and completion criteria for the Moolarben Coal Complex are outlined in **Section 6**.

Rehabilitation Principles

Successful rehabilitation of the Moolarben Coal Complex will be achieved through the application of the following guiding principles (which have been developed based on the rehabilitation principles in MCM [2011; 2012] and independent specialist input):

- Develop mine completion criteria using landform design, erosion control, drainage, soil processes, flora, fauna and ecosystem function indicators that are based on select analogue sites.
- Develop a detailed rehabilitation plan, which is in accordance with the progressive mine sequence.
- Re-shape the land to create a stable, adequately drained landscape that complies with rehabilitation and erosion control guidelines and post-mining land use objectives, and which is visually compatible with adjacent landforms, suitable for the long-term land use and self-sustaining.
- Reinststate natural drainages in areas where they have been altered or impaired, where practicable.
- Strip and retain topsoil for respreading on disturbed areas.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Determine the suitability of soil and overburden materials for enabling successful establishment of native plant species.
- Identify limiting factors (such as topsoil availability, soil fertility, local seed stocks, water availability, soil water retention and surface preparation).
- Clear and mulch non-habitat vegetation for collection with topsoil, or stockpiling for respreading on disturbed areas, where practicable.
- Seed and manage topsoil stockpiles with appropriate species.
- Remove and retain habitat trees (such as hollows) and large woody debris to be placed back into the rehabilitated landscape, where practicable.
- Minimise erosion and include functional sediment controls designed to an appropriate critical storm duration.
- Develop and implement a pest and weed control program to prevent the introduction of pests and noxious weeds in rehabilitated areas and their spread into adjoining conservation areas.
- Fence off rehabilitation areas to exclude stock and damage from unauthorised access, where necessary.
- Consider relevant strategic regional land use policy provisions and implement regulatory rehabilitation guidelines as appropriate.
- Use an adaptive management approach with continuous improvement.
- Provide necessary access for the suppression of fires, control of competitive native and exotic fauna and noxious weeds, and monitoring of rehabilitated areas.

Rehabilitation Objectives

The overall rehabilitation objective for the Moolarben Coal Complex is to restore mine-disturbed land to a naturally vegetated state including biodiversity enhancement areas and areas suitable for grazing. In addition, MCO will also improve existing degraded and cleared land within its ownership outside the mine disturbance footprint.

In addition to the objectives outlined in Project Approval (05_0117) and Project Approval (08_0135) (**Section 4.1.1**), specific rehabilitation objectives for the Moolarben Coal Complex (which have been developed based on the rehabilitation objectives in MCM [2011; 2012] and independent specialist input) include:

- Creating natural looking, stable and adequately drained post-mining landforms that are visually consistent with surrounding areas.
- Creating a self-sustaining and ecologically diverse post-mining landscape that includes areas compatible with the conservation values of the adjacent Munghorn Gap Nature Reserve, Goulburn River National Park and areas suitable for sustainable grazing, which are comparable to selected analogue sites.
- Revegetating and enhancing remnant vegetation on non-mined MCO-owned land with endemic native species so as to increase the amount and diversity of native woodlands.
- Creating effective wildlife corridors and habitat links between existing remnant vegetation in the Munghorn Gap Nature Reserve, Goulburn River National Park and other surrounding areas by increasing the continuity of woodland vegetation.
- Maintaining the diversity and genetic resource of flora currently existing within the locality.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Maintaining and enhancing habitat for native fauna, including threatened fauna.
- Realigning and rehabilitating Murragamba and Eastern Creeks to be hydraulically and geomorphologically stable and ecologically diverse.
- Rehabilitating degraded riparian areas along Wilpinjong Creek, Moolarben Creek and along Murragamba and Eastern creeks downstream from mined areas within MCO-owned land.
- Reinstating subsidiary surface drainage.
- Improving soil condition and the native soil seed bank.
- Minimising soil erosion and sedimentation.
- Providing access for monitoring and adaptive management, control of competitive native and exotic flora and fauna species and suppression of fires.
- Rehabilitate areas within OC2 and/or OC3 to generate residual ecosystem and species credits.
- Progressing towards meeting closure and post-mining land use objectives (to be developed in consultation with stakeholders and described in a Mine Closure Plan) in a timely and cost effective manner.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

5.0 REHABILITATION PLANNING AND MANAGEMENT

5.1 DOMAIN SELECTION

Consistent with contemporary rehabilitation guidelines, conceptual rehabilitation domains have been developed for the Moolarben Coal Complex. In consideration of the rehabilitation planning concepts in the MOP Guidelines, **Table 10** outlines the Primary and Secondary domains relevant to the Moolarben Coal Complex.

Table 10 Moolarben Coal Complex Rehabilitation Domains

Code	Primary Domains	Code	Secondary Domains
1	Active Mining	A	Woodland
2	Operational Water Management Area	B	Forest
3	Coal Processing and Handling Facilities	C	Grassy Woodland
4	General Infrastructure	D	Agricultural
5	Overburden Emplacement Areas	E	Post Mining Water Management Area
6	Subsidence Limit	F	Final Void
		G	Retained Infrastructure ¹

Notes: ¹ Subject to agreement with relevant regulatory authorities, some infrastructure may be retained at mine closure.

Plans 2, 3A, 3B and 3C show the Primary rehabilitation domains relevant to the Moolarben Coal Complex. Plan 4 shows the proposed final landform and post-mining land use Secondary domains for the Moolarben Coal Complex. In accordance with Project Approval (05_0117 and 08_0135) a 50 m buffer zone exists between the open cut mining and the Munghorn Gap Nature Reserve.

MOP Plan(s) 5 show the secondary rehabilitation domains and post mining land use cross sections.

5.2 DOMAIN REHABILITATION OBJECTIVES

Rehabilitation objectives have been developed for each domain based on relevant Project Approval and ML conditions and the rehabilitation objectives presented in **Section 4.3**. The domain rehabilitation objectives for each rehabilitation phase are outlined in **Section 6**.

A description of the rehabilitation objectives for each of the primary and secondary rehabilitation domains is provided in **Table 11**.

The overall rehabilitation objectives and domain rehabilitation objectives of the Moolarben Coal Complex (**Section 4.3** and **Table 11**) are subject to ongoing consultation with relevant regulatory authorities (e.g. **RR**, **DPIE**, **BCD** and **MWRC**) and key stakeholders including surrounding landholders and the CCC. Consultation will continue to be undertaken as part of the rehabilitation planning process and MOP and RMP review process.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 11 Domain Rehabilitation Objectives

Domain	Code	Rehabilitation Objective
Primary Domains		
Active Mining	1	<p>Backfilled open cut pit/final void is safe, profiled for long-term stability and non-polluting.</p> <p>Final void low walls will be battered back generally to between 10 degrees (°) and 18°. High walls will be constructed and stabilised in accordance with design criteria developed by geotechnical engineers and approved by relevant regulatory agencies.</p> <p>Final void batters will be rehabilitated with suitable vegetation, and the OC4 final void maintained post open cut mining to allow ongoing access to potential coal reserves (until agreed otherwise with relevant regulatory authorities).</p>
Operational Water Management Area	2	<p>Clean water will be diverted around operational areas, where practical.</p> <p>Mine water and sediment laden (mine) water run-off from disturbance areas will be captured and diverted to mine water and mine water dams.</p> <p>Mine water and mine water will be preferentially used for operational requirements such as dust suppression and earthworks.</p> <p>No mine water will be discharged from site without a license.</p> <p>Water management structures will be designed and constructed prior to disturbance, in accordance with best practice guidelines including Landcom (2004) <i>Managing Urban Stormwater: Soils and Construction Volume 1</i> and DECC (2008) <i>Managing Urban Stormwater: Soils and Construction Volume 2</i>.</p> <p>Sediment dams and associated water management structures will remain in place until the catchment is rehabilitated and discharge water quality is similar to comparable undisturbed landforms.</p>
Coal Processing and Handling Facilities	3	<p>At mine closure all CHPP infrastructure and facilities (including the ROM hopper/conveyors, rail load out facilities and rail balloon loop) are proposed to be dismantled and decommissioned (unless an alternate purpose is agreed with relevant regulatory authorities and key stakeholders). The area will then be rehabilitated in accordance with relevant Secondary Domain rehabilitation objectives.</p>
General Infrastructure	4	<p>Built infrastructure (including administration buildings and workshops), fixed plant and services will be progressively decommissioned when no longer required and the area rehabilitated in accordance with relevant Secondary Domain rehabilitation objectives.</p>
Overburden Emplacement Areas	5	<p>Final landforms will be safe, stable, adequately drained and non-polluting.</p> <p>Final landforms will be shaped to be appropriate for the final land use, have slopes with gradients generally 10° to 18° (and no more than 20° without DRG approval), and integrate with the surrounding landscape.</p>
Subsidence Area	6	<p>Land affected by mine induced subsidence will be safe, stable and non-polluting.</p> <p>Land affected by mine induced subsidence will not present a risk to achieving final land use options.</p>

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 11 Domain Rehabilitation Objectives (cont.)

Domain	Code	Rehabilitation Objective
Secondary Domains		
Rehabilitation Area – Woodland	A	<p>Establish native vegetation consistent with Box Gum Shrubby Woodland associations cleared by development of the Moolarben Coal Complex, and which include stands of <i>Allocasuarina</i>.</p> <p>Box Gum Shrubby Woodland associations will be generally consistent with the Box Gum Woodland Endangered Ecological Community.</p> <p>Box Gum Shrubby Woodland rehabilitation areas will contribute to habitat linkages between Munghorn Gap Nature Reserve and Goulburn River National Park.</p>
Rehabilitation Area – Forest	B	<p>Establish native vegetation comparable to Sedimentary Ironbark Forest communities in adjacent undisturbed areas, including stands of <i>Allocasuarina</i>.</p> <p>Sedimentary Ironbark Forest rehabilitation areas will contribute to habitat linkages between Munghorn Gap Nature Reserve and Goulburn River National Park.</p>
Rehabilitation Area – Grassy Woodland	C	<p>Establish native vegetation comparable to Western Slopes Grassy Woodland communities in adjacent undisturbed areas.</p> <p>Box Gum Grassy Woodland rehabilitation areas will contribute to habitat linkages between Munghorn Gap Nature Reserve and Goulburn River National Park.</p>
Rehabilitation Area – Agricultural	D	<p>Agricultural rehabilitation areas will be rehabilitated to achieve a minimum Land Capability Class VI that is capable of supporting sustainable grazing.</p> <p>Pasture rehabilitation areas will be top-dressed with appropriate topsoil (or topsoil substitutes), rock raked where required and ameliorated to produce a growth medium with properties capable of sustaining long-term pasture growth.</p> <p>Pasture areas will be vegetated with a mix of native and non-invasive perennial pasture species.</p> <p>Management inputs required to sustain grazing will not be significantly greater than analogue sites.</p>
Post Mining Water Management Area	E	<p>The final landform drainage including the rehabilitated diversions of Murragamba and Eastern Creeks will integrate with the surrounding catchments and be comparable to selected creek analogue sites.</p> <p>Sediment dams/water storages identified for retention in the final landform landscape (to provide water resources for fauna habitat or for agricultural purposes) will be de-silted and stabilised (if required).</p> <p>Permanent final landform drainage structures will be designed and constructed in accordance with best practice guidelines including Landcom (2004) <i>Managing Urban Stormwater: Soils and Construction Volume 1</i> and DECC (2008) <i>Managing Urban Stormwater: Soils and Construction Volume 2</i>.</p>
Final Void	F	<p>Final voids will be safe, profiled for long-term, stability and non-polluting.</p> <p>Low walls will be battered back generally to between 10° and 18°.</p> <p>High walls will be constructed and stabilised in accordance with design criteria developed by geotechnical engineers.</p> <p>Final void batters will be rehabilitated with suitable vegetation, and the OC4 final void maintained post open cut mining to allow access to potential coal reserves (until agreed otherwise with relevant regulatory authorities).</p>
Retained Infrastructure (subject to agreement with relevant regulatory authorities)	G	<p>Retain some infrastructure (e.g. water supply and distribution structures and access tracks) for future exploration/mining purposes or for passive recreation, educational and transport purposes.</p>

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

5.3 REHABILITATION PHASES

Overview of Rehabilitation Phases

Consistent with the rehabilitation planning concepts in the MOP Guidelines, rehabilitation of disturbed lands will be undertaken sequentially (or in phases) to achieve the final land use. A description of these phases of rehabilitation relevant to the Moolarben Coal Complex is provided in **Table 12**.

Table 12 Rehabilitation Phases

Phase	Description
Decommissioning	The process of removing plant and equipment from active services and rendering the area safe.
Landform Establishment	The process of shaping unformed rock or other sub-stratum material into a desired land surface profile. This includes earthworks activities such as cut and fill, rock raking, water storage, installation of habitat features, and drainage construction.
Growth Medium Development	The process of establishing and enhancing the physical structure, chemical properties and biological properties of a topsoil and subsoil (or regolith) stratum suitable for plant growth. This includes placing and spreading soil and applying ameliorants.
Ecosystem and Land Use Establishment	The process of seeding, planting and transplanting plant species. Incorporates management actions such as weed and feral pest control to achieve species establishment and growth to juvenile communities.
Ecosystem and Land Use Sustainability	The process of applying management techniques to encourage an ecosystem to grow and develop towards a desired and sustainable post-mining land use outcome. Incorporates features including species reproduction, nutrient recycling and community structure.

Notes: After: DTIRIS-DRE (2013).

Preliminary completion criteria for the rehabilitation phases are provided in **Section 6**.

A general overview of the rehabilitation methodology for each rehabilitation phase is provided below.

Decommissioning Phase

Detailed mine closure planning will include an assessment of all structures to be decommissioned and demolished. A demolition strategy will be prepared in accordance with *Australian Standard AS2601-2001: The Demolition of Structures* (or its latest version) to determine the appropriate demolition techniques, equipment required, and the optimal decommissioning sequencing.

All fixed plant, built infrastructure, equipment and services will be progressively decommissioned when infrastructure items and plant become redundant. All mining related infrastructure will be removed at mine closure, however some infrastructure may be retained to support future post-mining land uses (**Section 4.2**). Key decommissioning activities include:

- Disconnection of all above ground and buried services and removal of associated infrastructure;
- Removal of all built surface infrastructure, plant and equipment;
- Removal of all underground mine infrastructure, plant and equipment;
- Sealing of all underground mine portals and ventilation shafts;

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- Decommissioning of water management structures not required for water management in the final landform;
- Removal of all wastes and hazardous materials; and
- Removal (or on-site remediation) of any contaminated soils in accordance with a contaminated land assessment (where required).

Landform Establishment Phase

Landform establishment is the process of shaping the final landform to a safe, stable and free draining landform that is appropriate for the desired final land use and consistent with the surrounding landscape.

Key landform establishment activities include:

- Constructing and shaping completed/backfilled open cut pits and overburden emplacements in accordance with design criteria (such as desired grade, compaction and select surface layers);
- Constructing surface drainage features required for water management in the final landform landscape consistent with best practice guidelines;
- Installing habitat augmentation features (such as hollow bearing timber and logs salvaged during Vegetation Clearance Protocol [VCP] activities) in native vegetation rehabilitation areas to improve habitat opportunities for native fauna; and
- Selective material handling to manage risks associated with PAF materials and spontaneous combustion (including blending PAF material, placing coal rejects in deeper areas of the open cut pits and capping with a sufficient depth of inert material).

Growth Medium Development Phase

Growth medium development includes activities to reinstate soils (including subsoil/regolith soils) with the physical, chemical and biological characteristics required for vegetation establishment and growth. Soil management methodologies are described in **Section 3.3.5**.

Ecosystem and Land Use Establishment Phase

Ecosystem and land use establishment includes activities to establish the desired floristic composition (species diversity and density relevant to the post-mining land use/secondary domain). Activities will include:

- Seeding, tubestock planting and/or transplanting (as required); and
- Activities to enhance successful vegetation establishment such as weed and pest management, erosion control and bushfire mitigation.

Ecosystem and Land Use Sustainability Phase

The (former) Commonwealth Department of Industry, Tourism and Resources (DITR) publication *Leading Practice Sustainable Development Program for the Mining Industry - Mine Rehabilitation* (DITR, 2006) defines a functional ecosystem as one that is:

- Stable (not subject to high rates of erosion);
- Effective in retaining water and nutrients; and
- Self-sustaining.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

The Ecosystem and Land Use Sustainability Phase is therefore considered to involve those activities necessary to develop ecosystems that are self-sustaining and assist the area to meet the nominated completion criteria.

Key activities in the Ecosystem and Land Use Sustainability Phase include:

- Rehabilitation monitoring (**Section 8**);
- Rehabilitation maintenance including:
 - weed and feral animal control of rehabilitation;
 - maintenance of erosion control works;
 - maintenance fertilizing and re-seeding (where required);
 - repair of fence lines, access tracks and other general related land management activities; and
- Intervention and adaptive management (Section 9).

Rehabilitation Phases during MOP Term

A summary of the rehabilitation phases proposed for completion at the end of the MOP term is provided in **Table 13**.

Table 13 Summary of Rehabilitation Phases Proposed for Completion at the End of the MOP Term

Rehabilitation Phase	Domain					
	Active Mining	Water Management Area	Coal Processing and Handling Facilities	General Infrastructure	Overburden Emplacement Area	Subsidence
Decommissioning	x	x	x	x	✓	x
Landform Establishment	x	x	x	x	✓	✓^
Growth Medium Development	x	x	x	x	✓	x
Ecosystem and Land Use Establishment	x	x	x	x	✓	x
Ecosystem and Land Use Sustainability	x	x	x	x	✓	x

Notes: ^ Refers to subsidence remediation undertaken in accordance with the Extraction Plan.

Plans 3A, 3B and 3C show the status of the rehabilitation areas (according to the rehabilitation phase) during the MOP term.

The proposed rehabilitation activities during the MOP term are described in **Section 7.2**.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

6.0 PERFORMANCE INDICATORS AND COMPLETION CRITERIA

Tables 14 to 18 list rehabilitation objectives, performance indicators, and completion criteria for each rehabilitation phase for the Moolarben Coal Complex rehabilitation domains (including both primary and secondary domains).

Development of the rehabilitation performance indicators and completion criteria will be an iterative process, whereby monitoring results will be used to refine the completion criteria in future revisions of the RMP. Rehabilitation performance and completion criteria for the vegetation communities to be established in the rehabilitated OC2 and/or OC3 landforms to generate the residual ecosystem and species credits for Koala will be developed within 12 months of commencing works under Modification 14.

Rehabilitation performance will be considered to be satisfactory when monitoring data indicates the completion criteria have been met.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 14 Decommissioning Phase Performance Indicators and Completion Criteria

Domain	Domain Objective	Performance Indicator	Completion Criteria
Domain 1 – Active Mining Areas (no active mining areas will remain at the decommissioning phase)	NA	NA	NA
Domain 2 – Operational Water Management Areas	Mine water dams and sediment dams are decontaminated prior to removal or re-use as clean water dams in the final landform.	Hazardous materials.	Sediments accumulated in mine water and sediment dams is removed from the dam floor and emplaced in the final void.
			Mine water dams are emptied and discharge water disposed of in final void.
		Mine water structures decommissioned.	All water management structures that are not required as part of the post-closure land use have been decommissioned (drained and decontaminated).
	Clean water diversion structures are removed where no longer required.	Restore clean water flows.	Clean water diversion structures are removed where no longer required.
Domain 3 – Coal Processing and Handling Facilities	All surface infrastructure is decommissioned and removed (except where to be retained with approval of relevant regulatory authorities).	Demolition of infrastructure.	All surface infrastructure has been demolished and removed from the site including buildings and fixed plant, conveyors, open drains, ROM and product stockpiles, bitumen car parks, and waste oil/lubricant storage areas, rail loader and rail loop.
			All demolition work has been carried out in accordance with AS2601-2001: <i>The Demolition of Structures</i> or its latest version.
		Disconnect Services.	All site services have been removed where not required (electricity, telecommunications etc.).
	All hazardous and contaminated materials area appropriately removed or remediated.	Carbonaceous material.	All carbonaceous material has been removed from the footprint of the CHPP including ROM and product stockpile areas and emplaced in spoil.
		Hazardous materials.	All hazardous materials (e.g. petroleum, chemicals and explosive products) have been remediated or removed from site.
		Contamination assessment.	A contamination assessment has been undertaken and any contaminated areas have been remediated.
Domain 4 – General Infrastructure	Progressively decommissioning surface infrastructure	Decommission and remove infrastructure.	All surface infrastructure has been demolished and removed from the site including buildings and fixed plant, bitumen carparks, sewerage treatment plants, water truck fast fill, bulk explosive magazines.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Domain Objective	Performance Indicator	Completion Criteria
			All demolition work has been carried out in accordance with AS2601-2001: <i>The Demolition of Structures</i> or its latest version.
			Internal haul roads, access tracks and hardstands have been removed when no longer required.
			Environmental bunds have been re-graded in accordance with final landform design.
		Contamination assessment.	A contamination assessment has been undertaken and any contaminated areas have been remediated in accordance with recommendations of the contamination site assessment.
Domain 5 – Overburden Emplacement Area	All mining plant and equipment associated with the construction of the overburden emplacement will be dismantled, decommissioned and removed from site.	Removal of Plant and Equipment	All plant and equipment has been dismantled, decommissioned and removed from the overburden emplacement areas.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 15 Landform Establishment Phase Performance Indicators and Completion Criteria

Domain	Domain Objective	Performance Indicator	Completion Criteria
All Primary Domains	Final landform will be suitable for the intended land use and consistent with the surrounding landscape.	Landform compatibility.	Constructed landforms are assessed to be consistent with the surrounding topography.
	Final landforms are safe, stable, non-polluting and drain to the local environment.	Slopes.	Landform regraded to a stable grade, with slopes generally 10° to 18° and no more than 20° without DRG consent.
		Landform stability.	Reconstructed landforms are stable with no evidence of slumping.
		Non-polluting landform.	Mine water run-off is captured, treated and discharged in accordance with the EPL and Water Management Plan.
		Free draining landform.	Landforms are free draining (excluding retained water storage dams and final voids).
Domain 5 – Overburden Emplacement Area	Bury overburden materials hostile to tree root growth deep within emplacements for revegetation failure.	Overburden characterisation	Overburden materials hostile to tree root growth are buried deep within emplacements.
	Final landform will be suitable for the intended land use and consistent with the surrounding landscape (however some isolated faces may be retained as agreed with DRE to enable the final landform profile to comply with required gradients).	Landform compatibility.	In-pit overburden emplacements are back-filled to the disturbance line against adjacent ridge lines. Retained isolated faces constructed to the satisfaction of the DRG.
	Final landforms are safe, stable, non-polluting and drain to the local environment.	Reject emplacement.	Rejects are capped with at least 5m of inert material.
		Stability.	Gullies and rills occurring in Landscape Function Analysis 50 m transects are assessed to be limited and stabilising.
		Erosion.	Active erosion (soil loss due to gully and rilling) is assessed to be minimal.
Secondary Domains A, B and C – Woodland, Forest and Grassy Woodland Rehabilitation Areas	Habitat features are salvaged and re-used in rehabilitation areas to provide fauna habitat resources.	Habitat features.	Habitat features are incorporated into rehabilitation areas (including within watercourses and retained dams) where appropriate.
Secondary Domain E – Post Mining Water Management Areas	Final landforms are safe, stable, non-polluting and drain to the local environment.	Final landform drainage design.	Final landform water management structures and storages have been designed and constructed in accordance with 'Blue Book' (i.e. Landcom [2004] <i>Managing Urban Stormwater: Soils and Construction Volume 1</i> and DECC [2008] <i>Managing Urban Stormwater: Soils and</i>

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Domain Objective	Performance Indicator	Completion Criteria
			<p>Construction Volume 2) requirements and the approved final landform drainage design.</p> <p>Drop structures are designed to convey 1:50 Annual Recurrence Interval (ARI).</p> <p>Channel banks and drains are designed to convey 1:20 ARI with max slope 1% (unless lined).</p> <p>Re-aligned sections of Murragamba and Eastern Creeks constructed in accordance with approved design.</p>
Secondary Domain F – Final Void	Final voids are safe, profiled for long-term stability and non-polluting.	Slopes.	Landform regraded to a stable grade, with slopes generally 10° to 18° and no more than 20° without DRG consent.
		Non-polluting landform.	No carbonaceous materials are exposed in the final void floor.
		Stability.	The final void highwalls and low walls are constructed in accordance with an approved Final Void Geotechnical Design.
			The final void highwalls and low walls have been assessed by a qualified geotechnical engineer to validate long-term stability.
		Public safety.	Void perimeter bunding and safety fencing is constructed.
			Suitable signs, clearly stating the risk to public safety and prohibiting public access are erected at intervals along the entire length of the fence.
		Surface and Ground Water Management.	Clean water diversion structures are constructed in accordance with the approved final void design.
			Size and depth of final voids is in accordance with the approved final void design.
Domain 6 - Subsidence	Final landforms are safe and stable.	Subsidence cracking	No subsidence surface cracks remaining that present a risk to the environment, safety and the final land use objectives.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 16 Growth Medium Development Phase Performance Indicators and Completion Criteria

Domain	Domain Objective	Performance Indicator	Completion Criteria
All Domains	Effective use of topsoil and subsoil to assist in improved rehabilitation.	Topsoil/subsoil depth.	Topsoils and subsoils are re-spread on rehabilitation areas at appropriate depth for final land use.
	Suitability of topsoil, topsoil substitutes and subsoil for post-mining land use.	Topsoil/subsoil characterisation.	Physical properties (texture, structure and Emerson Aggregate assessment) of topsoils, topsoil substitutes and subsoils have been assessed for suitability for post-mining land use.
			Chemical properties (pH, salinity, nitrogen and phosphorus) of topsoils, topsoil substitutes and subsoils have been assessed for suitability for post-mining land use.
			Biological properties and organic content of topsoils, topsoil substitutes and subsoils have been assessed for suitability for post-mining land use.
	Topsoils and subsoils are salvaged and managed to retain physical, chemical and biological properties.	Topsoil/subsoil salvaging.	Topsoil and subsoils are stripped and re-spread or stockpiled for later use in accordance with soil stripping and stockpiling procedures.
			Topsoil and subsoils (and topsoil substitutes) are selectively stripped and managed according to post-mining land uses.
	Growth media is suitable for establishing desired vegetation association.	Soil amelioration.	Appropriate soil ameliorants (e.g. gypsum, fertilisers, mulch) have been applied in accordance with specifications and recommendations of soil characterisation reports.
		Soil management.	Topsoil is re-spread to a minimum of 10 cm (or at the pre-mining depth).
			Topsoiled areas are lightly ripped along the contour (min 200 mm) to key topsoil into subsoils and/or spoils.
	Erosion is minimised.	Erosion and sediment control structures.	Temporary erosion and sediment control structures are installed prior to topsoil resspreading.
			Topsoiled rehabilitation areas are sown with a non-persistent cover crop at recommended sowing rate/ha.
			Permanent erosion control features (e.g. rock armouring) installed where required.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 17 Ecosystem & Land Use Establishment Phase Performance Indicators & Completion Criteria

Domain	Domain Objective	Performance Indicator	Completion Criteria
All Domains	Weeds and pests are controlled on MCO-owned lands.	Weed species presence and density.	No evidence of significant priority weed infestations.
		Pest animal density.	Pest animal populations are not causing significant damage to rehabilitation areas.
	Minimise and manage risk of bushfire in rehabilitation areas.	Bushfire risk management.	Mitigation actions (fuel loads, fire-breaks, firefighting access, etc.) are implemented in accordance with the internal Bushfire Management Plan and in consultation with the NSW Rural Fire Service.
Secondary Domains A, B and C—Woodland, Forest and Grassy Woodland Rehabilitation Areas	Establish native vegetation comparable to Box Gum Shrubby Woodland communities, including stands of <i>Allocasuarina</i> spp. within OC1	Species composition.	There are one to three overstorey species that are present in analogue sites by Years 5 to 7.
			Stands of <i>Allocasuarina</i> spp are present in Box Gum Shrubby Woodland rehabilitation areas by within OC1 Years 5 to 7.
			A minimum of four native ground cover species that are present in analogue sites are present by Years 5 to 7.
		Vegetation structure.	Indicator species plant densities are trending towards plant densities of analogue sites at Years 5 to 7.
	Establish native vegetation comparable to Sedimentary Ironbark Forest communities, including stands of <i>Allocasuarina</i> spp. within OC1	Species Composition.	There are two to three overstorey species that are present in analogue sites by Years 5 to 7.
			Stands of <i>Allocasuarina</i> spp are present in Sedimentary Ironbark Forest rehabilitation areas within OC1 by Years 5 to 7.
			A minimum of four native ground cover species that are present in analogue sites are present by Years 5 to 7.
		Vegetation structure.	Indicator species plant densities are trending towards plant densities of analogue sites at Years 5 to 7.
	Establish native vegetation comparable to Box Gum Grassy Woodland communities.	Species composition.	There are one to three overstorey species that are present in analogue sites by Years 5 to 7.
			A minimum of four native ground cover species that are present in analogue sites are present by Years 5 to 7.
		Vegetation structure.	Indicator species plant densities are trending towards plant densities of analogue sites at Years 5 to 7.
			Indicator species plant densities are trending towards plant densities of analogue sites at Years 5 to 7.
	Establish vegetation communities in the rehabilitated OC2 and/or OC3 landforms to generate the residual ecosystem	Species composition.	Native Plant Species Richness is ≥ 10.25 at year 10 post land form establishment.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Domain Objective	Performance Indicator	Completion Criteria
	credits for HU730 618) and HU910 (PCT1696) and species credits for the Koala.	Vegetation structure.	Native Over Storey Cover between 1.88 and 40% at year 10 post landform establishment*
			Native Mid-Storey Cover between 1 and 20% at year 10 post landform establishment.
			Native Ground Cover, Grass between 1.5 and 50% at year 10 post landform establishment.
			Native Ground Cover, Shrubs between 0.25 and 10% at year 10 post landform establishment.
			Native Ground Cover, Other between 1 40% at year 10 post landform establishment.
			Total Length Fallen Logs (m) is 1 at year 10 post landform establishment.
			Exotic Plant Cover (% of total cover) is <50% at year 10 post landform establishment.
			Overall Site Value Score (OEI, 2015) (average of plots in vegetation zone) is ≥6.9 at 10 years post landform establishment.
Secondary Domain D – Agricultural Areas	Restore sustainable agricultural land use.	Seed sowing rate.	Approved pasture species mix is sown at the specified rate per hectare.
		Species presence.	Species present are representative of the analogue site.

* The rehabilitation of PCT618 would include flora species characteristic of *White Box-Yellow Box-Blackely's Red Gum Grassy Woodland and Derived Native Grassland*, and of foraging habitat for the Large-eared Pied Bat (*Chalinolobus dwyeri*), Swift Parrot (*Lathamus discolor*), Painted Honeyeater (*Grantiella picta*), Corben's Long-eared Bat (*Nyctophilus corbeni*) and Spotted-tail Quoll (*Dasyurus maculatus maculatus*) (SE mainland population). The rehabilitation of PCT1696 would include species characteristic of foraging habitat for the Large-eared Pied Bat.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 18 Ecosystem & Land Use Sustainability Phase Performance Indicators & Completion Criteria

Domain	Domain Objective	Performance Indicator	Completion Criteria
All Domains	Soil profile development is self-sustaining.	Topsoil chemistry.	Soil nitrogen and phosphorous levels are within 20% of the analogue sites by Year 10.
			EC and pH of replaced topsoil is within 20% of mean values of analogue sites at Year 10.
	Run-off water quality is considered clean water run-off.	EC of run-off water.	Run-off EC is less than 1,200 micro Siemens per centimetre ($\mu\text{S}/\text{cm}$) after 5 to 7 years.
Secondary Domains A, B and C—Woodland, Forest and Grassy Woodland Rehabilitation Areas	Ecosystem is self-sustaining.	Species composition.	Species diversity for each stratum (canopy, mid storey and ground cover) is comparable to analogue sites at Year 15.
		Vegetation structure.	Canopy, mid storey and ground cover plant densities are comparable to analogue sites.
			Woody plant density is comparable to analogue sites by Year 15.
		Bare ground	90% of soil covered by ground cover vegetation and/or leaf litter.
		Natural regeneration.	There is evidence of regeneration potential (i.e. plants are flowering and setting viable seed) of at least 4 species representative of the target vegetation association by Year 15 (these species may be different for each vegetation association).
		Fauna species.	Records indicate usage of rehabilitation areas by key fauna indicator species including woodland birds, microbats and reptiles by Year 15.
	Establish vegetation communities in the rehabilitated OC2 and/or OC3 landforms to generate the residual ecosystem credits for HU730 618) and HU910 (PCT1696) and species credits for the Koala.	Species Composition	Native Plant Species Richness is ≥ 20.5 at year 10 post mining.
		Species Composition for Koala Credits	$\geq 15\%$ of the total number of trees are the regionally relevant species** within koala FBA species credit areas
		Vegetation Structure	Native Over Storey Cover between 3.75 and 80% at year 10 post mining operations *
			Native Mid-Storey Cover between 1.25 and 40% at year 10 post mining operations.
			Native Ground Cover, Grass between 3 and 100% at year 10 post mining operations.
			Native Ground Cover, Shrubs between 0.5 and 20% at year 10 post mining operations.
			Native Ground Cover, Other between 2 and 80% at year 10 post mining operations.
			Total Length Fallen Logs (m) is 1.25 at year 10 post mining operations.
			Exotic Plant Cover is $<45\%$ at year 10 post mining operations.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Domain Objective	Performance Indicator	Completion Criteria
			Overall Site Value Score (OEI, 2015) (average of plots in vegetation zone) is \geq 13.8 at 10 years post mining operations.
Secondary Domain D – Agricultural Areas	Rehabilitation of portions of OC3 for agricultural outcomes.	Species composition.	Pasture species composition is comparable to the relevant analogue site.
		Natural regeneration.	Evidence of natural regeneration of at least four pasture species by Years 5 to 7.
	Return land disturbed by mining to pre-mining Rural Land Capability.	Rural Land Capability.	Agricultural Rehabilitation Areas are assessed to have a Rural Land Capability Class VI or better.
Secondary Domain E – Post Mining Water Management Areas	Final landforms are safe, stable, non-polluting and drain to the local environment.	Final landform drainage design.	Final landform water management structures and storages are operating as designed (Table 15).
			Drop structures, channel banks and drains are operating as designed (Table 15).
		Landform stability.	Drainage structures are assessed to be stable with no significant gully heads, tunnel erosion or bank failure.
Secondary Domain F – Final Void	Final voids are safe, profiled for long-term stability and non-polluting.	Public safety, Stability, Non-polluting landform.	The final voids are constructed in accordance with design (Table 15) and are safe, stable and non-polluting.

* The rehabilitation of PCT618 would include flora species characteristic of *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*, and of foraging habitat for the Large-eared Pied Bat (*Chalinolobus dwyeri*), Swift Parrot (*Lathamus discolor*), Painted Honeyeater (*Grantiella picta*), Corben's Long-eared Bat (*Nyctophilus corbeni*) and Spotted-tail Quoll (*Dasyurus maculatus maculatus*) (SE mainland population). The rehabilitation of PCT1696 would include species characteristic of foraging habitat for the Large-eared Pied Bat.

** Regionally relevant koala food tree species include *Angophora floribunda*, *Eucalyptus albens*, *E. blakelyi*, *E. crebra*, *E. melliodora*, *E. moluccana* and *E. tereticornis*.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

7.0 REHABILITATION IMPLEMENTATION

7.1 STATUS AT MOP COMMENCEMENT

MCO has undertaken rehabilitation activities over more than 350 ha of the completed portions of the environmental bunds and overburden emplacement.

In addition, interim/temporary rehabilitation in the form of landscaping and planting has been completed around the main offices, rail loop, environmental bunds and entry to the operational areas. External batters on dam walls and rail loop embankments have also been temporarily rehabilitated.

These areas will continue to be monitored during the MOP term.

A summary of the rehabilitation status of each of the primary domains is provided in **Table 19**.

Table 19 Rehabilitation Status of Primary Domains at MOP Commencement

Primary Domain	Status
Domain 1 – Active Mining	Active
Domain 2 – Water Management Area	Active ¹
Domain 3 – Coal Processing and Handling Facilities	Active ¹
Domain 4 – General Infrastructure	Active ¹
Domain 5 – Overburden Emplacement Area	350ha of completed portions of the overburden emplacement area have been rehabilitated.
Domain 6 – Subsidence Area	Active ¹

Notes:¹ Interim/temporary rehabilitation activities (e.g. landscaping/stabilisation) have been undertaken in some areas.

7.2 PROPOSED REHABILITATION ACTIVITIES DURING THE MOP TERM

This section describes the proposed rehabilitation activities to be undertaken during the MOP term.

In accordance with the MOP Guidelines, **Table 20** provides a summary of the proposed disturbance and rehabilitation activities.

The proposed rehabilitation activities to be implemented over the MOP term for each domain are described in the sub-sections below.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 20 Disturbance and Rehabilitation Progression during the MOP Term

Year	Total Disturbance Area (ha) ¹	Incremental Rehabilitation Area (ha) ^{2, 3}	Cumulative Rehabilitation Area (ha) ^{2, 3}
Start of MOP term (1 January 2020)	1,710	-	375
31 December 2020	1,993	-10	365
31 December 2021	2,100	57	422
31 December 2022	2,171	44	466

¹ Total disturbance area includes areas of land which are within the Active phase. ² Rehabilitation Area includes areas of land which are within Landform Establishment and Growth Medium Development Ecosystem and Land Use Establishment, and Ecosystem and Land Use Sustainability phases. ³ Excludes areas of land which are temporarily rehabilitated.

7.2.1 Domain 1 – Active Mining

No rehabilitation activities will occur in the active mining area during the MOP term.

7.2.2 Domain 2 – Water Management Area

No rehabilitation activities will occur in the water management area during the MOP term.

7.2.3 Domain 3 – Coal Processing and Handling Facilities

No permanent rehabilitation activities will occur in the coal processing and handling facilities area during the MOP term. Temporary rehabilitation will be undertaken as construction areas are completed.

7.2.4 Domain 4 – General Infrastructure

No rehabilitation activities will occur in the general infrastructure area during the MOP term.

Temporary rehabilitation will be undertaken as construction areas are completed.

7.2.5 Domain 5 – Overburden Emplacement Area

Cumulative, approximately 466 ha of overburden emplacement area will be under either Ecosystem and Land Use Establishment/Sustainability at the end of the MOP term (Plans 3A, 3B and 3C).

Rehabilitation will progress in the backfilled OC1, OC2, OC3 and OC4 emplacement areas (Plans 3A, 3B and 3C).

7.2.6 Domain 6 – Subsidence Area

Rehabilitation activities in this domain will be undertaken as outlined by the relevant Extraction Plan. In summary, remediation of surface cracking will be undertaken where practicable and accessible, using conventional earthmoving machinery and include infilling of surface cracks with soil and suitable material or locally re-grading and re-compacting the surface.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

7.3 SUMMARY OF REHABILITATION AREAS DURING THE MOP TERM

In accordance with the MOP Guidelines, a summary of the change in size of the areas of rehabilitation within each domain (according the rehabilitation phase) is provided in **Table 21**. Plans 3A, 3B and 3C provide a conceptual view of the status of rehabilitation at the Moolarben Coal Complex (according to rehabilitation phase) and show the proposed rehabilitation activities during the MOP term.

Table 21 Summary of Rehabilitation Proposed during the MOP Term

Primary Domain	Secondary Domain	Code	Rehabilitation Phase	Area at the start of the MOP (ha)	Area at the end of the MOP (ha)
Active Mining (1)	Secondary Domains (A) Rehabilitation Woodland	1A	Active	247	181
	Secondary Domains (B) Rehabilitation Forest	1B	Decommissioning		
	Secondary Domains (C) Rehabilitation Grassy Woodland	1C	Landform Establishment		
	Secondary Domains (D) Rehabilitation Area Agricultural	1D	Growth Medium Development		
	Secondary Domains (E) Post Mining Water Management Area	1E	Ecosystem Establishment		
			Ecosystem Sustainability		
			Land Relinquishment		
			Total	247	181
Water Management Area (2)	Rehabilitation Area – Box-Gum Woodland (A)	2A	Active	146	155
	Rehabilitation Area – Sedimentary Ironbark Forest (B)	2B	Decommissioning		
	Rehabilitation Area – Grassy Woodland (C)	2C	Landform Establishment		
	Rehabilitation Area – Agricultural (D)	2D	Growth Medium Development		
	Post Mining Water Management Area (E)	2E	Ecosystem Establishment		
			Ecosystem Sustainability		
			Land Relinquishment		
			Total	146	155
Coal Processing and Handling Facilities (3)	Rehabilitation Area – Box-Gum Woodland (A)	3A	Active	150	155
	Rehabilitation Area – Sedimentary Ironbark Forest (B)	3B	Decommissioning		
	Rehabilitation Area – Grassy Woodland (C)	3C	Landform Establishment		
	Rehabilitation Area – Agricultural (D)	3D	Growth Medium Development		
	Post Mining Water Management Area (E)	3E	Ecosystem Establishment		
	Secondary Domains (F) Final Void	3F	Ecosystem Sustainability		
			Land Relinquishment		
			Total	150	155

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Primary Domain	Secondary Domain	Code	Rehabilitation Phase	Area at the start of the MOP (ha)	Area at the end of the MOP (ha)
General Infrastructure (4)	Rehabilitation Area – Box-Gum Woodland (A)	4A	Active	441	492
	Rehabilitation Area – Sedimentary Ironbark Forest (B)	4B	Decommissioning		
		4C	Landform Establishment		
	Rehabilitation Area – Grassy Woodland (C)	4D	Growth Medium Development		
	Rehabilitation Area – Agricultural (D)	4E	Ecosystem Establishment		
	Post Mining Water Management Area (E)	4F	Ecosystem Sustainability		
	Secondary Domains (F)		Land Relinquishment		
	Final Void				
			Total	441	492
Overburden Emplacement Area (5)	Rehabilitation Area – Box-Gum Woodland (A)	5A	Active	730	1189
	Rehabilitation Area – Sedimentary Ironbark Forest (B)	5B	Decommissioning		
		5C	Landform Establishment		
	Rehabilitation Area – Grassy Woodland (C)	5D	Growth Medium Development		
	Rehabilitation Area – Agricultural (D)	5E	Ecosystem Establishment		
	Post Mining Water Management Area (E)		Ecosystem Sustainability		
			Land Relinquishment		
			Total	730	1189
Subsidence (6)	Existing Woodland	6	Active	418	904
			Decommissioning		
			Landform Establishment		
			Growth Medium Development		
			Ecosystem Establishment		
			Ecosystem Sustainability		
			Land Relinquishment		
			Total	418	904

7.4 RELINQUISHMENT PHASE ACHIEVED DURING MOP TERM

No lands are proposed for relinquishment during the MOP term.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

8.0 REHABILITATION MONITORING AND RESEARCH

Rehabilitation monitoring and research at the Moolarben Coal Complex is conducted in accordance with the RMP and reported annually in the Annual Review made available on the Moolarben Coal website.

8.1 REHABILITATION MONITORING

Annual rehabilitation monitoring will be undertaken to:

- Measure the progress and success of the rehabilitation program against performance indicators and completion criteria;
- Inform the continuous improvement process and refine rehabilitation methodologies and completion criteria; and
- Identify when rehabilitation is not trending toward completion criteria in an appropriate timeframe, triggering adaptive management.

A description of the rehabilitation monitoring program methodologies is provided in the sections below. Rehabilitation monitoring program results will be reported and assessed within an annual rehabilitation monitoring report. A summary of the monitoring results, including any trend analysis and any proposed modifications to the monitoring program will be reported in the Annual Review.

8.1.1 Monitoring Site Selection

Permanent transects at a number of representative monitoring sites have been established in rehabilitation areas and corresponding analogue sites. To date, rehabilitation transects have been established across OC1 rehabilitation areas. Rehabilitation transects will continue to be established on rehabilitation areas within 24 months of the rehabilitation areas being seeded. Each transect is established using the following technique:

- The site is randomly selected within the desired vegetation type.
- A 50 m transect is laid down-slope (according to the requirements of the Ecosystem Function Analysis [EFA] methodology).
- A metal star picket is securely fixed at the start and finish of each transect.
- Each transect/star picket is numbered (with aluminium tag or plate).
- Each star picket is marked with a length of high visibility flagging tape (or similar) to maximise the visibility of the transect. The location of each end of the transect is recorded with a GPS and photographed.

Corresponding analogue sites representative of Box Gum Grassy Woodland, Sedimentary Ironbark Forest and riparian rehabilitation areas have been established in the Durrigere State Conservation Area and Goulburn River National Park at sites A1A and A1B, A5A and A5B and A2A and A2B, respectively. Analogue sites have also been established in woodland areas relevant to potential subsidence areas associated with UG4 (i.e. sites A6A and A6B).

A baseline assessment of agricultural lands associated with the OC3 footprint will be undertaken prior to mining. These baseline results will be used to determine representative performance indicators and completion criteria for agricultural rehabilitation areas.

8.1.2 Ecosystem Function Analysis

The EFA methodology will be used to assess rehabilitation success and comprises the following components:

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

- LFA;
- Landscape Organisation Index (LOI);
- Soil Surface Assessment (producing Stability, Infiltration and Nutrient Indices); and
- Vegetation Dynamics including assessment of:
 - canopy cover for overstorey components;
 - ground cover components (plant basal cover, bare ground and leaf litter);
 - woody species density;
 - woody species richness;
 - woody species function/health;
 - habitat complexity; and
 - disturbance factors.

Each of these components are assessed to individually characterise key elements of an ecosystem, as well as establish the relationships between these elements to provide a more comprehensive picture of the relative health of an ecosystem. EFA will be used to assess the status of rehabilitation areas and to demonstrate that the site is on a trajectory toward self-sustainability.

Ground flora monitoring will also be undertaken in permanent quadrats established along the EFA transects. At least three transects will be established in a rehabilitation area (where possible) to provide statistical rigour. All visible ground cover plants within the quadrat are recorded to determine the species abundance and diversity. Dominant species present are compared to those of analogue sites to determine if rehabilitation is progressing toward the targeted vegetation community.

Woody species density, richness and habitat complexity will be quantified using the plot-less technique described by Tongway and Ludwig (2011).

Landscape Function Analysis

LFA is the primary component of the EFA monitoring methodology. It assesses ecosystem functionality at the soil landscape level in terms of the landscape's ability to retain water and nutrients within the system. In terms of LFA, a soil landscape on the trajectory toward self-sustainability (in context of vegetation cover and soil stability) would have:

- A high LOI. That is, a low number of bare soil patches (interpatches) between obstruction components (patches) in the soil landscape, which would affect wind and water movement and the introduction and transportation of resources into and out of the system.
- High Soil Surface Assessment indices, indicating that the site had favourable nutrient, infiltration and stability characteristics.

Vegetation Dynamics

Vegetation dynamics assesses the functional role of vegetation in each stratum in the rehabilitation area. Measurements of plants on the EFA transects are used to calculate density of plants in each stratum and total canopy area. Measurements are used to derive the total canopy volume and wind amelioration index (i.e. the wind shielding capacity of the canopy).

Habitat Complexity

In addition to the vegetation dynamics parameters, presence of desirable habitat features including leaf litter, rocks and logs and water availability are measured to derive a habitat complexity index

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

score. The habitat complexity index is a measure of the development of suitable habitat and resources for arboreal fauna.

Vegetation Monitoring

Vegetation monitoring is the other component of the EFA monitoring tool. This component is not undertaken in agricultural/pasture areas as woody vegetation is not represented in these areas.

An assessment of woody species density, species richness and canopy cover all contribute to the findings of the LFA in terms of available nutrients, soil stability and water infiltration. In terms of vegetation dynamics, a landscape that is on a trajectory to self-sustainability in context of vegetative cover would have:

- High percentage ground cover vegetation and/or leaf litter components with a corresponding low percentage of bare soil areas;
- High percentage canopy cover;
- High density of woody species; and
- Ideally high species richness (particularly pertinent to habitat complexity components).

Ephemeral Drainage Line Assessment and Monitoring

Prior to completion of construction of the realigned Murragamba and Eastern Creeks, MCO will develop, in consultation with suitable qualified specialists, a methodology for monitoring and assessment of the re-constructed creeks. An additional EFA tool for assessment of stability and function of ephemeral watercourses is described in Tongway and Ludwig (2011). MCO will consider use of this tool (and any other suitable methodologies) to assess performance of the realigned creeks.

8.1.3 Visual Monitoring and Photo points

Visual Monitoring

Visual monitoring of rehabilitation areas will be undertaken in addition to EFA and will involve a field based rapid assessment to visually assess and rate landscape contributors to rehabilitation. Components assessed will include:

- Vegetation components (overstorey, understorey and ground cover);
- Surface stability and erosion issues;
- Habitat complexity; and
- Disturbance factors.

Each of these subcomponents is scored to generate an overall score for each site. This allows comparison between different sites and over time. It also allows the identification of areas requiring remediation as indicated by low scores.

Photo points

Photographic records of rehabilitation transects will be undertaken in addition to EFA to visually assess rehabilitation progress.

A permanent photo point will be established at each star picket that designates the start of each EFA transect. The photo will be taken at the star picket, facing down the transect. An additional photo of the transect number tag/plate will be taken just prior to taking the transect photo to assist with documentation of each image with the relevant transect.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

The photos will be reviewed to assist with documenting rehabilitation progress including (but not limited to):

- Surface stability and erosion issues;
- Presence of weed species;
- Vegetation function/health (e.g. die-back, or flowering); and
- Evidence of pest animal presence/disturbance.

8.1.4 Monitoring Program Timing

The flora component of the monitoring program will be undertaken as follows:

- The LFA monitoring will be undertaken annually, generally in the lead up to spring (August – September) for areas of active regeneration.
- Given vegetation dynamics (i.e. densities, height and cover) is not expected to change drastically on an annual basis, particularly for woody strata, sampling will be undertaken every four years in areas of established vegetation (starting no sooner than Year 5 [2020]).
- The LFA will be implemented reactively immediately after an event such as intense rainfall events or a bushfire, to sample any changes in landscape scores.
- The ground cover floristic quadrat monitoring will be undertaken annually, one year during spring and the next year during autumn. This will note seasonal species and growth rates and impacts from adverse weather conditions. Burrows (1999) noted in the south-west slopes that while most floristic diversity was accounted for in spring surveys, there were several species that were only recorded during autumn.

Furthermore, the NSW Department of Environment, Climate Change and Water (DECCW) guidelines for assessing Box Gum Woodlands recommends autumn survey, as one of the key criteria for assessing the presence of the community is the dominance of native perennials in the ground layer. These are most evident in autumn when they are not shrouded with annual exotics which predominantly grow in winter and spring.

8.1.5 Fauna Monitoring

Since existing rehabilitation at OC1 is very immature, fauna monitoring completed to date has been limited beyond monitoring fauna groups likely to utilise the juvenile vegetation. When habitat complexity develops (which would be expected by Years 5 to 7 [i.e. 2020 to 2022]), fauna monitoring will be expanded in rehabilitation areas to include hair funnels, trapping, nest box inspections and night time spotlighting.

Fauna monitoring techniques will be:

- Consistent with industry standards;
- Scientifically robust (methodology will be repeatable);
- Compliant with legislation regarding animal ethics and welfare;
- Safe for operators and site staff; and
- Cost effective for collecting data appropriate for monitoring needs.

Fauna monitoring techniques are summarised in the RMP (**Appendix 3**). The exact number and location of data collection points (e.g. trap sites) are subject to modification based on site constraints and suitability as appropriate. Fauna monitoring will include monitoring for feral animals.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

The fauna component of the monitoring program will be undertaken as follows:

- Diurnal Birds:
 - Undertake monitoring annually in spring (October/November).
- Nocturnal Birds:
 - Undertake the monitoring annually in spring (October/November).
- Mammals:
 - Undertake monitoring annually in spring (October/November).
- Bats:
 - Undertake monitoring annually in spring (October/November).
- Reptiles:
 - Undertake monitoring annually in spring to summer (November to March).
- Amphibians:
 - Undertake the monitoring annually during late spring (November).

8.1.6 Geochemical Monitoring

Geochemical monitoring has been undertaken at analogue sites and rehabilitation areas to measure soil chemical characteristics (including pH, EC and cation exchange capacity) of the soil profile, and will continue to be undertaken for any new rehabilitation areas.

Results are analysed to assess if soils:

- Have the desired chemical properties required to support the intended post-mining land use; and
- Are trending toward self-sustaining soils with similar geochemical properties to those of undisturbed soils without the need for additional ameliorants.

Soil samples are taken to a minimum depth of 300 mm and samples taken from the 100 mm, 200 mm and 300 mm intervals. The samples are taken at the rehabilitation monitoring transects and will be sampled every three years commencing in the year that the transect is established.

8.1.7 Rehabilitation Monitoring Records

Details of the rehabilitation monitoring records database are provided in the RMP.

8.2 OC2 / OC3 REHABILITATION MONITORING (ECOSYSTEM AND SPECIES CREDITS)

For the rehabilitated areas in the OC2 and / or OC3 landforms which will generate specific residual ecosystem and species credits, monitoring sites will be selected in accordance with Section 7.1. MCO will track performance every three years' post landform establishment by conducting the following monitoring:

Years 1 to 10 LFA (see Section 7.2) and drone/aerial surveillance for any material areas of vegetation establishment failure.

Years 3 to 5 Single FBA plot* in each PCT (randomly selected).

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Years 6 to 9 FBA plots required in accordance with the vegetation zone size (i.e. 4 plots in PCT 618 and 5 plots in PCT1696).

* Refer to Section 5.3.2 of the FBA (OEH, 2014).

This approach will provide for the early detection of any material areas of rehabilitation failure, track progress against the performance and completion criteria and allow for the implementation of corrective measures where this may be required.

In addition to the above, the following sampling method will be used to identify *highly suitable koala habitat* as per the *Koala Habitat Protection Guideline: Implementation the State Environmental Planning Policy (Koala Habitat Protection) 2019* (DPIE, 2020):

Quadrats can be selected within each PCT either randomly or along a selected transect. Quadrats need to be of sufficient size to enable a minimum of at least 20 trees to be counted (at least 20 x 20 metres) and of sufficient number to allow a robust statistical determination of the percentage of tree species present in the lower, mid and upper stratum. The number and size of quadrats chosen will depend on the size of the site and the vegetation present

...

Results of the sampling within each PCT must be shown separately and not summed for the overall site.

..

Notes about the vegetation survey:

- *A “tree” is taken to be a plant with a diameter at breast height over bark (DBHOB) of 10 cm or greater.*
- *Appendix A of this Guideline provides a list of the tree species as per Schedule 2 of the SEPP.*
- *Only the trees listed for the relevant region must be surveyed for.*
- *The calculation of the percentage of tree species must be completed within each vegetation community present on the site area and not averaged or totalled across the site. A result of 15% or greater in any individual vegetation community meets the definition of highly suitable koala habitat.*

It is anticipated that the performance and completion criteria for the generation of credits would be subject to change over the life of the operation based on increased knowledge and feedback from monitoring.

8.3 RESEARCH AND REHABILITATION TRIALS

Rehabilitation trials and studies will be undertaken to refine the rehabilitation methodologies and validate rehabilitation performance indicators and completion criteria.

In consideration of the dispersive nature of stockpiled soil resources, future rehabilitation trials and research will include investigation into optimal soil amelioration measures and application rates (e.g. gypsum application) to improve the suitability of soil resources for future rehabilitation use.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

The outcomes of any future rehabilitation trials will be reported in the Moolarben Coal Complex Annual Reviews.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

9.0 INTERVENTION AND ADAPTIVE MANAGEMENT

9.1 THREATS TO REHABILITATION

As described in **Section 3.1**, a preliminary environmental risk assessment was held in November 2012 to identify and assess the environmental risks associated with the cumulative impacts of mining activities at OC1 and OC2 including the Stage 1 extension areas (EMM, 2013a). This risk assessment was revised in May 2013 to assess the residual predicted impacts following implementation of additional controls nominated in the *Moolarben Coal Project Stage 1 Optimisation Modification Environmental Assessment* (EMM, 2013a). A summary of the key risks to rehabilitation identified in this risk assessment is provided in **Section 3.1 (Table 4)**.

The outcomes of the *Moolarben Coal Project Stage 1 Optimisation Modification Environmental Assessment* (EMM, 2013a) have been reviewed in the context of the Stage 2 activities (i.e. UG1 and OC4) and the risks identified and proposed controls are considered to be relevant to the Stage 2 activities.

9.2 TRIGGER ACTION RESPONSE PLAN

A trigger, action, response plan (TARP) (**Table 22**) has been developed based on potential risks to rehabilitation as identified in **Section 3.1 (Table 4)**.

All notification and reporting will be undertaken in accordance with **Section 10**.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Table 22 Rehabilitation Trigger Action Response Plan

Domain	Threat to Rehabilitation Success	Trigger	Action/Response to Mitigate, Remediate and/or Compensate any Identified Impacts	How Impact will be Monitored
All	Inappropriate bushfire management regime leading to widespread failure of revegetation or continued sustainability of offset area ecosystems and mine rehabilitation areas.	Occurrence of unplanned bushfire in rehabilitation area results in loss of revegetation.	Selection of fire-tolerant species for revegetation and rehabilitation (where appropriate) and adoption of standard fire prevention measures. Mosaic burning and monitoring of areas following fires, with follow-up replanting/reseeding if indicated by monitoring results. Maintain contingency supplies of seed for key native species.	Regular visual inspection of rehabilitated areas and ongoing rehabilitation monitoring using LFA methodology.
	Major storm event resulting in flooding, geotechnical instability, major erosion and/or widespread damage to rehabilitated area.	Rehabilitation monitoring indicates widespread damage to rehabilitation area as a result of major storm event.	Review design of final landforms, structures and revegetation to cope with major storm events. Monitoring of rehabilitation/offset areas following a major storm and replanting/reseeding as necessary.	Regular visual inspection of rehabilitated areas and ongoing rehabilitation monitoring using LFA methodology.
	Severe and/or prolonged drought leading to widespread failure of revegetation / rehabilitation.	Rehabilitation monitoring indicates revegetation species failure as a result of drought conditions.	Selection of drought-tolerant species within species mix for revegetation and rehabilitation. Monitoring of rehabilitation/offset areas and replanting/reseeding as necessary. Maintain contingency supplies of seed for key native species. Where practical, delay revegetation activities until adequate soil moisture availability. Replanting contingency plan.	Regular visual inspection of rehabilitated areas and ongoing rehabilitation monitoring using LFA methodology.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Threat to Rehabilitation Success	Trigger	Action/Response to Mitigate, Remediate and/or Compensate any Identified Impacts	How Impact will be Monitored
All	Inadequate or insufficient topsoil and subsoil (regolith) to create/enhance the desired ecological communities on offset areas and mine rehabilitation areas.	Rehabilitation planning and review of topsoil inventory indicates insufficient topsoil resources to create/enhance the desired ecological communities.	Develop procedures for topsoil management, overburden and substrate management and soil testing. Topsoil inventory developed i.e. mapped at stripping and return. Assess stripped topsoil for weed contamination and limit spread of weed contaminated topsoil on or near areas of good native groundcover. Soil type matched to enhanced or rehabilitated vegetation association. Subsoil (regolith) material assessed for use as a suitable growing media. Identify soil ameliorants (e.g. biosolids) that could be used as a topsoil substitute.	Regular stocktake of topsoil inventory. Regular visual inspection of remediated area and ongoing rehabilitation monitoring using LFA methodology.
	Inadequate weed and pest animal control leading to widespread failure of revegetation or rehabilitation or continued sustainability of offset area ecosystems.	Rehabilitation monitoring indicates revegetation failure as a result of significant weed infestation and/or pest animals.	Review targeted weed management and control program developed and implemented. Review the pest animal management and control program developed and implemented. Educate persons undertaking weed control to the major weed threats in the area and on site. Visual inspections/cleaning of vehicles entering sensitive areas to mitigate risk of weed dispersal. Ensure cover crops are non persistent and non-invasive.	Regular visual inspection of remediated area and ongoing rehabilitation monitoring using LFA methodology.
	New regulatory requirements or evolving community expectations leading to difficulties negotiating or attaining completion criteria.	New regulatory requirements are imposed on the Moolarben Coal Complex.	Monitor trends and developments in legislation and changes to community and regulatory expectations.	RMP review and ML Environmental Management Reporting procedures.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Threat to Rehabilitation Success	Trigger	Action/Response to Mitigate, Remediate and/or Compensate any Identified Impacts	How Impact will be Monitored
All	Insect attacks (e.g. locusts and beetles) leading to failure of revegetation or rehabilitation or continued sustainability of offset and mine rehabilitation area ecosystems.	Rehabilitation monitoring indicates failure as a result of significant insect attacks.	Planting to avoid insect prone periods. Use of endemic species which are suited to localised insect predation. Monitoring program results to identify if further plantings required. Develop a replanting contingency plan.	Regular visual inspection of remediated area and ongoing rehabilitation monitoring using LFA methodology.
	Inappropriate planting and/or direct seeding techniques resulting in a failure of revegetation or rehabilitation or continued sustainability of offset area ecosystems.	Rehabilitation monitoring indicates die-back and/or poor growth and development of revegetation.	Conduct site investigation and review active mining and rehabilitation methodology records for the area to determine possible contributing factors. Implement mitigation measures relevant to identified contributing factors/cause. Develop a replanting contingency plan.	Regular visual inspection of remediated area and ongoing rehabilitation monitoring using LFA methodology.
	Local fauna impacts resulting from the delay in establishing existing habitat values of cleared vegetation in revegetated areas (e.g. connectivity, hollows, fallen timber, litter).	Fauna monitoring indicates limited usage of rehabilitation areas by key fauna species.	Annual fauna monitoring program. Install hollow/nest boxes of similar dimensions in vegetation that won't be cleared. (Note hollows /nest boxes should not be placed in patches with a healthy hollow occurrence as it increases aggression and competition for resources). Increase fauna habitat features (logs, litter and debris) from cleared timber to create ground cover habitat elements in revegetated and habitat depauperate rehabilitation areas.	Annual fauna monitoring program and rehabilitation monitoring (in particular habitat complexity results from EFA monitoring).
All	Inappropriate fertiliser application (type and rate) leading to failure of revegetation or rehabilitation or continued sustainability of offset area ecosystems.	Rehabilitation monitoring indicates poor/slow growth and development of revegetation.	Review fertiliser application program consistent with revegetation requirements.	Regular visual inspection of remediated area and ongoing rehabilitation monitoring using LFA methodology.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Threat to Rehabilitation Success	Trigger	Action/Response to Mitigate, Remediate and/or Compensate any Identified Impacts	How Impact will be Monitored
	Inadequate depth of inert material to encapsulate reject emplacement areas resulting in spontaneous combustion within rehabilitation areas.	Rehabilitation monitoring indicates heating and/or other signs of spontaneous combustion.	Rejects are capped with at least 5m of inert material as required by Table 15 of this MOP. Spoils are selectively handled and blended to avoid emplacement of PAF material in concentrated areas, and to manage the potential risk of spontaneous combustion.	Regular visual inspection of rehabilitation and overburden areas.
	Frost leads to high mortality rates of revegetation and rehabilitation (average of 42 days frost/year).	Rehabilitation monitoring indicates high mortality rates of revegetation and rehabilitation as a result of frost.	Monitoring program results to identify if further plantings required. Contingency plant material propagated and used in maintenance programs. Avoid plantings in frost season.	Regular visual inspection of remediated area and ongoing rehabilitation monitoring using LFA methodology.
	Damage from unauthorised entry into offset and rehabilitation areas.	Rehabilitation monitoring indicates revegetation damage likely due to unauthorised access.	Fencing and signposting of offset areas and rehabilitation. Lock gates at access points with access managed by the environmental department, where possible. Security patrols.	Regular visual inspection of remediated area and ongoing rehabilitation monitoring using LFA methodology.
	RMP implementation delayed/limited due to land use changes – changes in mine plan.	Review indicates rehabilitation is not undertaken in accordance with the RMP.	RMP to be regularly reviewed and reflect current mine plans while meeting obligations. Communicate with mine planners on the restrictions of accessing/mining offset areas. Communicate with mine planners the requirement for continual rehabilitation works.	RMP review and ML Environmental Management Reporting procedures.
All	Incompatible neighbouring land owner practices leading to failure of rehabilitation and revegetation works.	Rehabilitation monitoring indicates failure of rehabilitation and revegetation work likely as a result of neighbouring land owner practices.	Communicate the RMP with neighbouring properties, the CCC and local community.	Ongoing/follow-up communications with neighbouring land owners and the CCC.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Domain	Threat to Rehabilitation Success	Trigger	Action/Response to Mitigate, Remediate and/or Compensate any Identified Impacts	How Impact will be Monitored
	Planning - insufficient provision of financial, human and equipment resources leading to failure to meet completion criteria, including increased maintenance costs and timeframe.	Rehabilitation planning indicates insufficient resources to meet completion criteria.	Budgetary allocation sufficient to cover requirements with resources available to implement LMP ¹ .	Internal rehabilitation planning procedures.
	Inadequate or insufficient (incorrect species mix/quality) seed/seedlings for enhancement/revegetation of offset areas and rehabilitation works.	Rehabilitation planning indicates potential for insufficient seed/seedling resources.	Species list reflective of target vegetation community. Use of local provenance seed and/or seedlings. Depending upon seed viability may require identification of suitable alternate seed sources from similar soil landscapes. Long-term revegetation strategy to consider composite seed provenancing (i.e. sourcing seed from dryer/warmer areas). Seed collectors are familiar with the species for which seed is required. Monitoring to measure achievements on a time scale, and against completion criteria.	Ongoing rehabilitation planning procedures.
All	Unforeseen impact to vegetation communities on land above underground mine areas due to subsidence.	Rehabilitation monitoring indicates impact to vegetation communities on land above underground areas.	Subsidence monitoring provides timely provision of data relating to impact of subsidence. Contingency budgetary allocation for remedial works associated with subsidence. Subsidence Management Plan ² to address impacts on vegetation.	Regular visual inspection and monitoring of subsidence areas.

¹ Now the Extraction Plan.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

10.0 REPORTING

10.1 ANNUAL REVIEW

In accordance with Condition 4, Schedule 5 of Project Approval (05_0117) and Condition 4, Schedule 6 of Project Approval (08_0135), MCO will prepare an Annual Review prior to the end of March each year (unless otherwise agreed with the Secretary of the DPIE) to review the environmental performance of the Moolarben Coal Complex.

The Annual Review will report on the following aspects relevant to this MOP:

- Rehabilitation works conducted during the previous calendar year (including mapping of rehabilitation status) and the works proposed for the next reporting period as described in the MOP;
- Results of rehabilitation monitoring and the status of rehabilitation against the performance indicators and completion criteria;
- Any maintenance or contingency measures implemented during the previous calendar year to remediate poor rehabilitation performance;
- Construction, mining development and exploration works undertaken for the previous year and those proposed for the next reporting period;
- Any decommissioning works undertaken; and
- Any trends occurring in the performance of rehabilitation and the effectiveness of the rehabilitation practices and measures.

The Annual Review will be made publicly available on the Moolarben Coal website in accordance with Condition 11, Schedule 5 of Project Approval (05_0117) and Condition 11, Schedule 6 of Project Approval (08_0135).

10.2 ML ENVIRONMENTAL MANAGEMENT REPORTS

In accordance with the requirements the Moolarben Coal Complex MLs, MCO will prepare annual Environmental Management/Rehabilitation Report which will report on:

- Compliance with the MOP;
- Progress in respect of the rehabilitation completion criteria; and
- The extent of compliance with regulatory requirements.

The annual Environmental Management/Rehabilitation Report will have regard to any relevant guideline adopted by the Division of Resources and Geosciences.

10.3 INCIDENT AND COMPLAINT REPORTING

In accordance with Condition 3, Schedule 6 and Condition 3, Schedule 5 of Project Approval (05_0117) and Project Approval (08_0135), respectively, MCO has developed protocols for managing and reporting the following:

- Incidents;
- Complaints;
- Non-compliances with statutory requirements; and
- Exceedances of Project Approval criteria.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

These protocols are described in detail in the Moolarben Coal Complex EMS. A summary of incident and non-compliance reporting procedures is provided below.

Incidents

An incident is defined as a set of circumstances that causes or threatens to cause material harm to the environment and/or breaches or exceeds the limits or performance measures/criteria in the NSW Project Approvals.

In the event that an incident associated with the Moolarben Coal Complex occurs, which causes or threatens to cause material harm to the environment, the incident will be managed in accordance with relevant regulatory approvals and statutory obligations.

The reporting of incidents will be conducted in accordance with Condition 7, Schedule 5 and Condition 7, Schedule 6 of the NSW Project Approvals (05_0117 and 08_0135, respectively). MCO will notify the Secretary of the DPIE, and any other relevant agencies immediately after MCO becomes aware of the incident which causes, or threatens to cause material environmental harm to the environment. For any other incident associated with the project, MCO will notify the Secretary and any other relevant agencies as soon as practicable after becoming aware of the incident.

In the event of a pollution incident, notification will also be conducted as per the processes outlined in the Pollution Incident Response Management Plan (prepared as part of MCO's holding EPL 12932), in accordance with the protocol for industry notification of pollution incidents under Part 5.7 of the POEO Act. Notification includes the EPA, **DPIE & RR**.

In accordance with ML1715, MCO will notify the Department on becoming aware of a breach of these Mining Lease conditions or breached of the Mining Act or Regulation.

Within seven days of the date of the incident, MCO will provide the Secretary of the DPIE and any relevant agencies with a detailed report on the incident. The report will:

- Describe the date, time and nature of the exceedance/incident;
- Identifies the cause (or likely cause) of the exceedance/incident;
- Describes what action has been taken to date; and
- Describes the proposed measures to address the exceedance/incident.

Compliance

A protocol for the managing and reporting of non-compliances with statutory requirements has been developed as a component of the EMS and is described below.

A review of MCO's compliance with all conditions in the NSW Project Approvals, mining leases and environmental protection licences will be undertaken prior to (and included within) each Annual Review. The Annual Review will be made publicly available on the Moolarben Coal Website in accordance with Condition 11, Schedule 5 and Condition 11, Schedule 6 of the NSW Project Approvals (05_0117 and 08_0135, respectively).

In accordance with Condition 9, Schedule 5 and Condition 9, Schedule 6 of the NSW Project Approvals (05_0117 and 08_0135, respectively), an independent environmental audit will be undertaken by the end of December 2015, and every three years thereafter. The most recent independent environmental audit was conducted by Pitt & Sherry during October 2018. A copy of the independent environmental audit will be provided to the Secretary of the DPIE and made available on the Moolarben Coal Website. The independent environmental audit will be conducted by suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary of the DPIE.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

11.0 PLANS

The following plans have been prepared in consideration of the Plan requirements in the MOP Guidelines and are attached:

- Plan 1A – Project Locality
- Plan 1B – Natural Environment
- Plan 1C – Built Environment
- Plan 2 – Mine Domains at Commencement of MOP
- Plan 3A – Mining and Rehabilitation (December 2020)
- Plan 3B – Mining and Rehabilitation (December 2021)
- Plan 3C – Mining and Rehabilitation (December 2022)
- Plan 4 – Final Rehabilitation and Post Mining Land Use
- Plan 5A – OC1, OC2, OC3 Cross Sections
- Plan 5B – OC4 Cross Sections

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

12.0 REVIEW AND IMPLEMENTATION OF THE MOP

The rehabilitation principles and targets described in this MOP will continue to be tracked via MCO's internal review and tracking systems and the reporting and auditing mechanisms. Any proposed changes to the MOP that would potentially require an amendment to this MOP would be discussed with the DRG in accordance with the MOP Guidelines.

The results of environmental performance monitoring undertaken during the MOP term will contribute to refining future MOPs.

12.1 IMPLEMENTATION

A general overview of the responsibility of MCO personnel regarding the monitoring, review and implementation of this MOP is provided in **Table 23**.

Table 23 MOP Implementation Responsibilities

Position	Responsibilities
General Manager	Take overall leadership and responsibility for compliance with all environmental approvals.
	Provide adequate resourcing (personnel and financial) to enable full implementation of the MOP.
	Approve subsequent revisions of the MOP.
Environmental and Community Manager	Report any land related incidents in accordance with legal requirements.
	Identify rehabilitation risks and budget for sufficient resources to effectively manage those risks
	Effectively implement the GDPs and VCP procedures.
	Provide training to all employees and contractors in environmental awareness, legal responsibilities and MCO's rehabilitation requirements.
	Restrict access to rehabilitation areas.
	Oversee communication of conditions of approval to relevant site personnel and contractors.
	Oversee implementation of the MOP.
	Oversee all regulatory reporting in relation to the MOP.
	Coordinate relevant reviews of the MOP.
Environmental and Community Superintendent	Oversee all monitoring in relation to the MOP.
	Evaluate results of monitoring programs and longer trends and where appropriate advise Environmental and Community Manager of changes to management measures and controls
	Approve GDPs.
	Coordinate progressive site rehabilitation as final landforms become available.
	Coordinate topsoil management strategies.
	Coordinate all regulatory reporting in relation to the RMP.
	Coordinate relevant reviews of the RMP.
Environmental and Community Coordinator(s)	Coordinate implementation of the MOP.
	Coordinate regulatory reporting in relation to the MOP.
	Check GDPs are effectively completed by relevant site personnel or contractors and approved by the Environmental and Community Manager prior to surface disturbance.
	Coordinate internal reporting on the performance of rehabilitation.
	Coordinate pre-clearance surveys.
	Coordinate implementation of fauna impact mitigation actions.
	Coordinate native seed collection and planting.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Position	Responsibilities
	Coordinate monitoring of rehabilitation and regeneration areas.
	Coordinate weed and pest control for rehabilitation areas (where required).
Open Cut Technical Services Manager	Oversee planning and scheduling of clearing, topsoil stripping, and topsoil stockpiling
	Oversee overburden placement and reshaping design.
Open Cut Manager	Oversee clearing, topsoil stripping, and topsoil stockpiling and habitat/resource salvage
	Oversee implementation of landform shaping and establishment
	Oversee topsoil placement
Project Manager	Delineate areas to be cleared/disturbed.
	Initiate GDPs approval process.
	Implement VCP procedure.
	Implement fauna habitat salvage strategies.
	Implement topsoil management strategies.

Document	Version	Issue	Effective	Review	Author	Approved
MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

13.0 REFERENCES

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MOOLARBEN COAL COMPLEX
MOP PLANS

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ATTACHMENT 1
MOOLARBEN COAL OPERATIONS
RISK MATRIX TABLES

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Consequence Ratings

Effect / Consequence					
Loss Type	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
Environmental Impact	Environmental nuisance – trivial or negligible, short term impact to area of low significance, minimal or no physical remediation required Cost < \$1,000	Minor environmental harm – short term impact to area of limited local significance, limited physical remediation Costs \$1,000 - \$5,000	Serious environmental harm – medium term impact to area of local conservation value, medium term physical remediation, actual community health impacts or significance or pollution or contamination Costs \$5k - \$50k	Major environmental harm – long term reversible impacts to area of regional conservation significance, health statistics in community alter as a result of this incident or pollution or contamination Costs \$50k - \$500k	Extreme environmental harm – irreversible impacts on environmental values of extreme & widespread areas, or those of national conservation significance, community fatalities or pollution or contamination Costs > \$500k
Asset Damage and Other Consequential Losses	Slight damage < \$0.1M or < 1 shift disruption to operation	Minor damage \$0.1M - \$1.0M. or 1 Shift – 1 day disruption to operation	Local damage \$1.0M - \$5.0M or 1 day - 1 week disruption to operation	Major damage \$5.0M - \$25.0M or 1 week – 1 month Partial loss of operation	Extreme damage > \$25.0M or > 1 month Substantial or total loss of operation

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MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal

Risk Matrix

Likelihood	Level of Risk				
	Consequence				
	1	2	3	4	5
A (Almost Certain)	11 (M)	16 (H)	20 (H)	23 (E)	25 (E)
B (Likely)	7 (M)	12 (M)	17 (H)	21 (E)	24 (E)
C (Possible)	4 (L)	8 (M)	13 (H)	18 (H)	22 (E)
D (Unlikely)	2 (L)	5 (L)	9 (M)	14 (H)	19 (H)
E (Rare)	1 (L)	3 (L)	6 (M)	10 (M)	15 (H)

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ATTACHMENT 2
MOOLARBEN COAL OPERATIONS
REHABILITATION MANAGEMENT PLAN

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MCO_ENV_PLN_040	B	Sept 20	Oct 20	Jan 21	MCO	S Archinal