



# Moolarben Coal Complex UG2 Modification

## SUBMISSIONS REPORT



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## 1 INTRODUCTION

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee in the Western Coalfields of NSW within the Mid-Western Regional Local Government Area (Figures 1 and 2).

Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex (Figure 1) on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben Pty Ltd [YM] and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

The Moolarben Coal Complex comprises of the Moolarben Coal Project Stage 1 and the Moolarben Coal Project Stage 2.

Stage 1 of the Moolarben Coal Complex comprises open cut operations in OC1, OC2 and OC3, underground operations in UG4 and coal processing and transport facilities. Stage 2 of the Moolarben Coal Complex comprises open cut operations in OC4 and underground operations in UG1 and UG2. All run-of-mine (ROM) coal produced by the Stage 2 operations is transported to the Stage 1 coal processing and transport facilities.

The Moolarben Coal Project Stage 1 operates in accordance with Project Approval (05\_0117) (as modified), approved by the New South Wales (NSW) Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 6 September 2007.

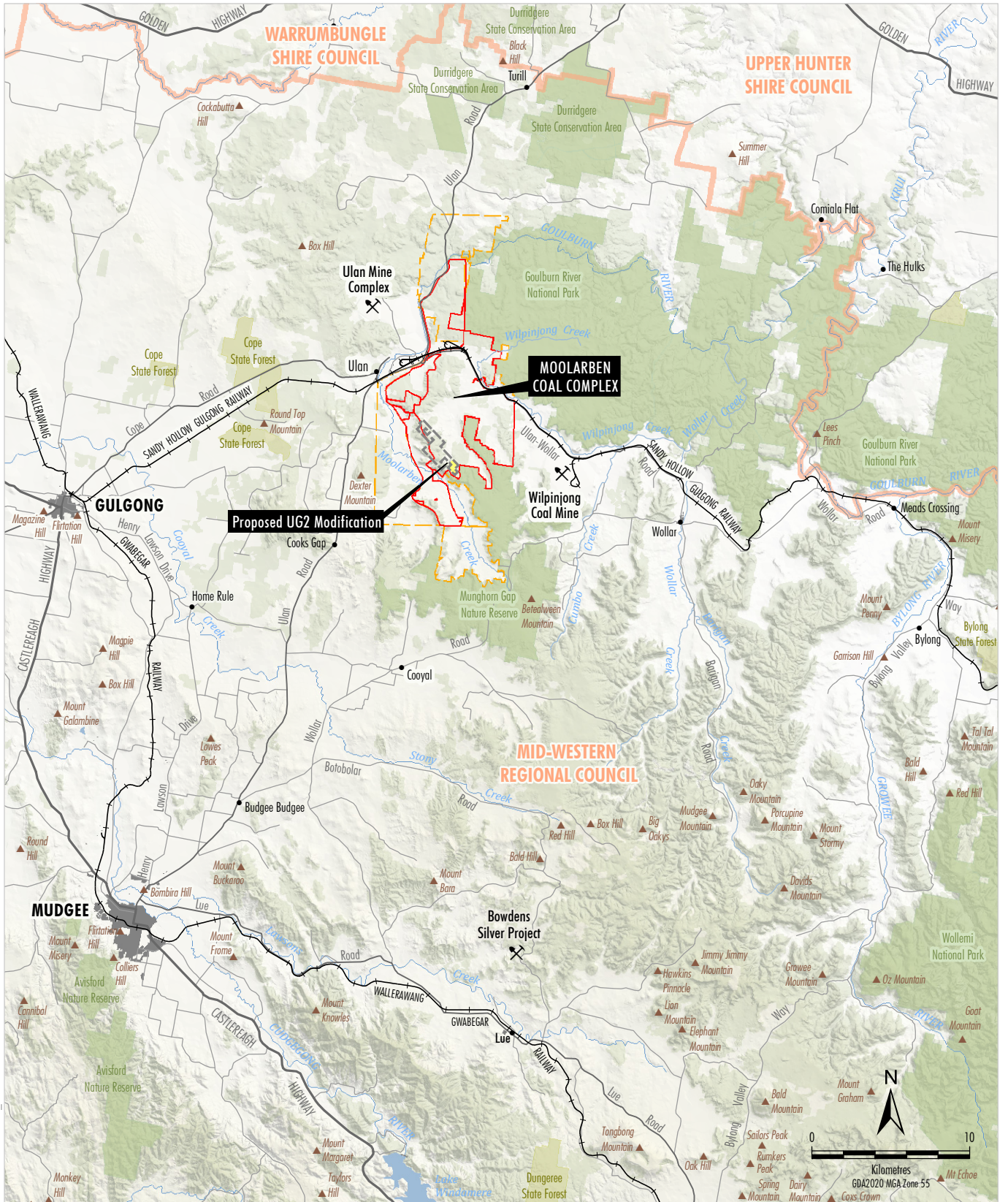
MCO is proposing to modify the Stage 2 Project Approval (08\_0135) to incorporate adjustments to the mine layout for the approved underground mine “UG2” (hereafter referred to as the UG2 Modification [the Modification]). A Modification Report was submitted in December 2021 to support this proposal under section 4.55(2) of the EP&A Act.

The Modification Report was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) (now Department of Planning and Environment [DPE]) from 3 December 2021 to 16 December 2021. During and following the public exhibition period, submissions on the Modification were received from NSW Government agencies and relevant local councils.

On 21 December 2021, DPE requested that MCO prepare and submit a Submissions Report for the Modification (this Report). Accordingly, this Submissions Report provides MCO’s responses to issues raised in submissions on the Modification. It has been prepared in consideration of the *State significant development guidelines – preparing a submissions report* (DPIE, 2021).

The remainder of this Submissions Report is structured as follows:

<b>Section 1</b>	Provides an introduction and overview of the Modification.
<b>Section 2</b>	Provides an analysis of the submissions received by DPE during the public exhibition period.
<b>Section 3</b>	Summarises the actions taken since lodgement of the Modification Report, including additional engagement activities and further refinements and assessment of the Modification.
<b>Section 4</b>	Provides responses to aspects raised in submissions.
<b>Section 5</b>	Provides an updated evaluation of the Modification.
<b>Section 6</b>	Lists the documents referenced in the Submissions Report.



AMCA-20-18 UG2 AIOD RTS - 2014

Source: NSW Spatial Services (2021)

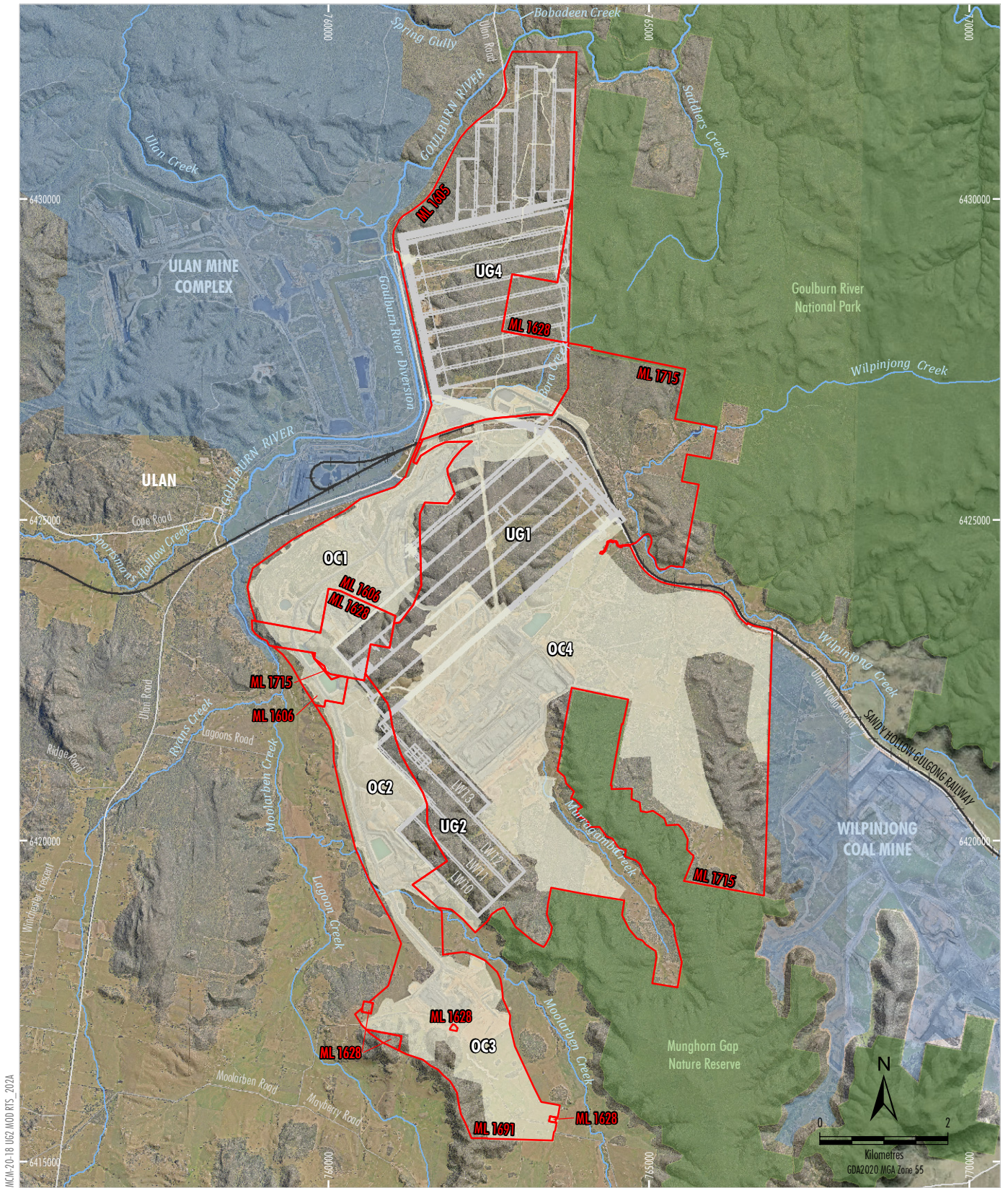


- LEGEND**
- State Forest
  - National Parks/Nature Reserves
  - Local Government Boundary
  - Exploration Licence Boundary
  - Mining Lease Boundary
  - Mining Operation
  - Proposed UG2 Modification
  - Approximate Extent of Proposed Modified Longwalls
  - UG2 Longwall Extension Area

  
**MOOLARBEN COAL COMPLEX**  
 Regional Location

**Figure 1**





MCM-20-18 UG2 MOD RTS - 2024

- LEGEND**
- National Parks/Nature Reserves
  - Other Mining Operation
  - Mining Lease Boundary
  - Existing/Approved Development
  - Underground Longwall Layout
  - Moolarben Coal Complex Disturbance Footprint

Source: MCO (2021); NSW Spatial Services (2021)  
 Orthophoto: MCO (Jan 2021)

  
**MOOLARBEN COAL COMPLEX**  
 Approved General Arrangement

**Figure 2**



## 1.1 PROJECT OVERVIEW

The Moolarben Coal Complex Stage 2 Project Approval (08\_0135) (as modified) is currently approved to:

- undertake mining operations until 31 December 2038 in underground mining domains UG1 and UG2, and open cut OC4;
- undertake mining operations 24 hours per day, seven days per week;
- extract up to 16 million tonnes (Mt) of run-of-mine (ROM) coal from open cut operations in any calendar year;
- extract up to 8 Mt of ROM coal from underground mining operations in any calendar year; and
- operate related supporting infrastructure.

Stage 2 operations are currently occurring in UG4 and OC4.

## 1.2 MODIFICATION OVERVIEW

In summary, the Modification would include the following changes to the approved Moolarben Coal Complex:

- optimisation of the approved UG2 layout (including the extension of two approved longwall panels);
- increased UG2 extraction height from 3.0 metres (m) to 3.5 m;
- revised UG2 mining sequence;
- increased total UG2 ROM coal production from 9.4 Mt to 13.9 Mt;
- construction and operation of a remote services infrastructure area (indicatively two UG2 service boreholes/drop holes) within the approved OC4 disturbance footprint to support UG2 operations;
- development of an additional non-subsiding gate road along the southern boundary of the UG1 mining area to assist with ventilation in UG2; and
- small reduction in the approved OC4 extent to accommodate the optimised UG2 layout, if UG2 is mined as proposed for the Modification.

No other changes to the approved Moolarben Coal Complex (including disturbance footprint) would be required for the Modification.

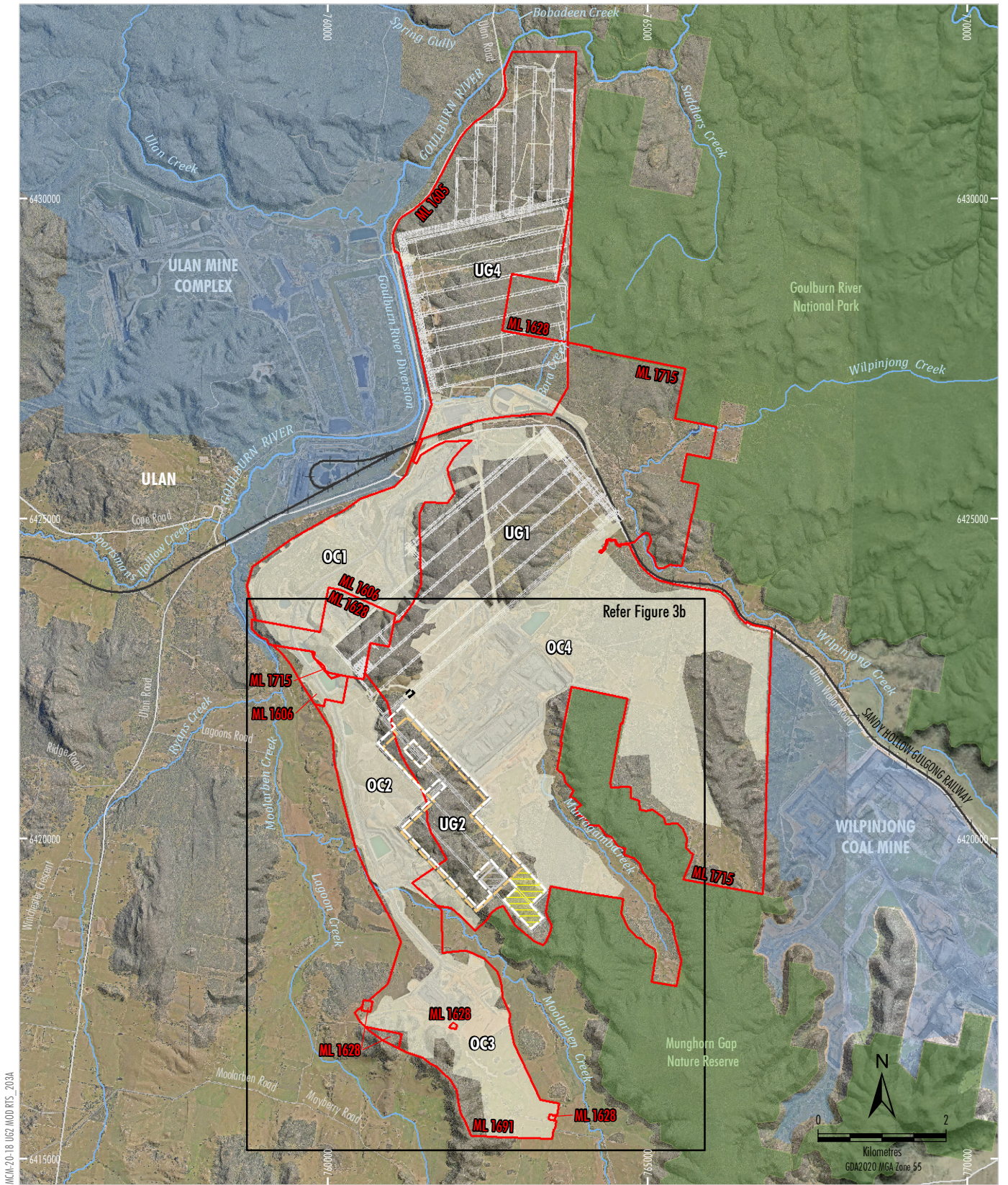
The modified UG2 general arrangement is shown on Figures 3a and 3b.

Table 1 provides a summary comparison of the existing and approved Moolarben Coal Complex Stage 2 Project Approval (08\_0135) (as modified) and the proposed Moolarben Coal Complex Stage 2 Project Approval (08\_0135) (including the UG2 Modification).

**Table 1**  
**Summary Comparison of the Approved and Modified Moolarben Coal Complex Stage 2**

Relevant Project Component	Moolarben Coal Complex Stage 2 Project Approval (08_0135) (as modified)	Moolarben Coal Complex Stage 2 Project Approval (08_0135) (including this UG2 Modification)
Project Boundary	As per Appendix 2 of Project Approval (08_0135).	Unchanged.
Operational Mine Life	Mining operations can be carried out until 31 December 2038.	Unchanged.
Hours of Operation	Mining operations can be carried out 24 hours per day, seven days per week.	Unchanged.
Coal Extraction Limits	Up to 16 Mt of ROM coal can be extracted from the Stage 2 open cut mining operations in any calendar year.	Unchanged.
	Up to 16 Mt (total) of ROM coal extracted from the open cut operations at the Moolarben Coal Complex (Stage 1 and Stage 2 cumulatively) in any calendar year.	Unchanged.
Underground Coal Extraction Limits	Up to 8 Mt (total) of ROM coal can be extracted from the underground mining operations at the Moolarben Coal Complex in any calendar year.	Unchanged.
Coal Processing and Offsite Transport	The Proponent shall ensure that all coal extracted from the site is sent to the Moolarben Stage 1 mine surface infrastructure area for processing (washing) and/or transport to market.	Unchanged.
Site Access	Site access via Ulan Road and Ulan-Wollar Road.	Unchanged.
Employment	Peak operational workforce of 740 personnel. Average operational workforce of 667 personnel. Peak construction workforce of 250 personnel. Average construction workforce of 120 personnel.	Unchanged.
UG2 Layout	As per Figure 4.1 of Stage 2 Project Approval (08_0135).	Minor augmentations to the approved UG2 layout within the approved UG2 mining area. Extensions to two of the approved UG2 longwall panels outside the approved UG2 mining area. Development of an additional non-subsiding gate road along the southern boundary of the UG1 mining area to assist with ventilation in UG2.
UG2 Extension Height	3.0 m.	Increased extraction height across the entire UG2 mining area to 3.5 m.
UG2 ROM Coal Production	Total of 9.4 Mt of ROM coal.	Increased total ROM coal production from 9.4 Mt to 13.9 Mt.
UG2 Surface Infrastructure	No specific UG2 surface infrastructure required.	Construction and operation of a remote services infrastructure area (indicatively two UG2 service boreholes/drop holes) within the approved OC4 disturbance footprint to support UG2 operations.
OC4 Pit Limit	As per Figure 4.1 of Stage 2 Project Approval (08_0135).	Small reduction in the approved OC4 extent to accommodate the optimised LW 201 if it is mined as proposed.
Onsite Biodiversity Offset Area	Approved UG2 mining area contains part of an approved Onsite Biodiversity Offset Area.	Increase in Onsite Biodiversity Offset Area within UG2 footprint due to longwall extensions.






MCN-20-18 UG2 MOD RTS\_2023A

- LEGEND**
- National Parks/Nature Reserves
  - Other Mining Operation
  - Mining Lease Boundary
  - Existing/Approved Development
  - Underground Longwall Layout
  - Approximate Extent of UG2 Longwalls
  - Moolarben Coal Complex Disturbance Footprint

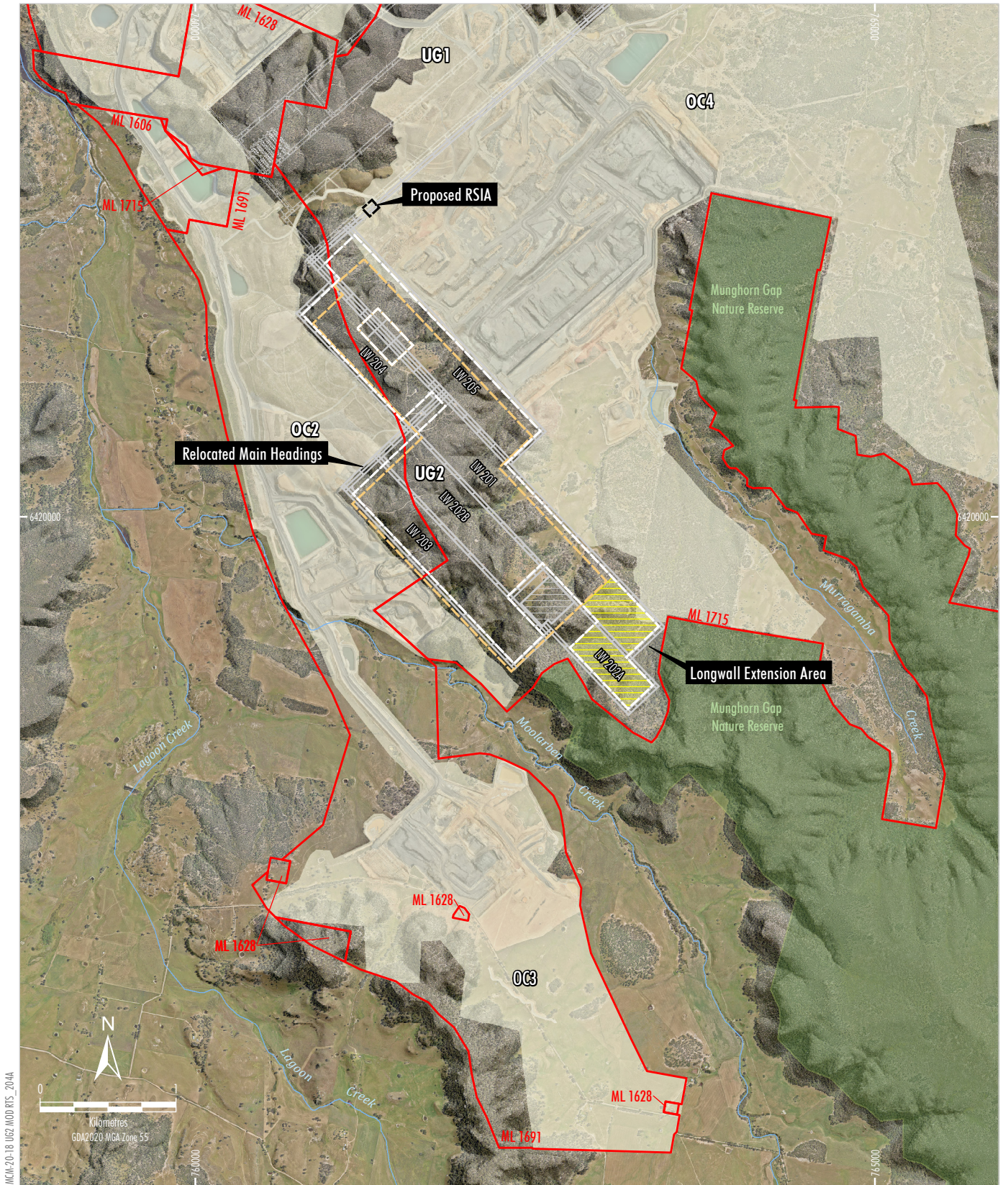
- Proposed UG2 Modification**
- Optimised UG2 Longwall Layout
  - UG2 Longwall Extension Area
  - Non-subsiding UG2 Secondary Workings
  - Approximate Extent of Proposed Modified Longwalls
  - Proposed Extent of RSIA

Source: MCO (2021); NSW Spatial Services (2021)  
Orthophoto: MCO (Jan 2021)

  
**MOOLARBEN COAL COMPLEX**  
 Proposed Modified  
 General Arrangement

**Figure 3a**





MCN-20-18 UG2 MOD RTS\_20-4A

**LEGEND**

- National Parks/Nature Reserves
- Mining Lease Boundary
- Existing/Approved Development
- Underground Longwall Layout
- Approximate Extent of UG2 Longwalls
- Moolarben Coal Complex Disturbance Footprint

Proposed UG2 Modification

- Optimised UG2 Longwall Layout
- UG2 Longwall Extension Area
- Non-subsiding UG2 Secondary Workings
- Approximate Extent of Proposed Modified Longwalls
- Proposed Extent of RSIA

Source: MCO (2021); NSW Spatial Services (2021)  
Orthophoto Mosaic: MCO (Jan 2021)



MOOLARBEN COAL COMPLEX

Proposed Modified  
General Arrangement  
Inset

**Figure 3b**



The Modification **does not** involve changes to the Moolarben Coal Complex under the Stage 1 Project Approval (05\_0117).

In summary, there would be no change to the following approved elements of the Moolarben Coal Complex:

- Stage 2 Project Boundary;
- mining tenements;
- operational mine life;
- open cut or underground coal extraction limits;
- OC1, OC2 or OC3 pit limits;
- UG1 or UG4 layouts;
- waste rock management;
- blasting activities;
- coal processing activities or limits;
- coal reject disposal;
- offsite product coal transport (i.e. train movements);
- water management infrastructure design and objectives;
- site access;
- hours of operation; and
- peak workforce.

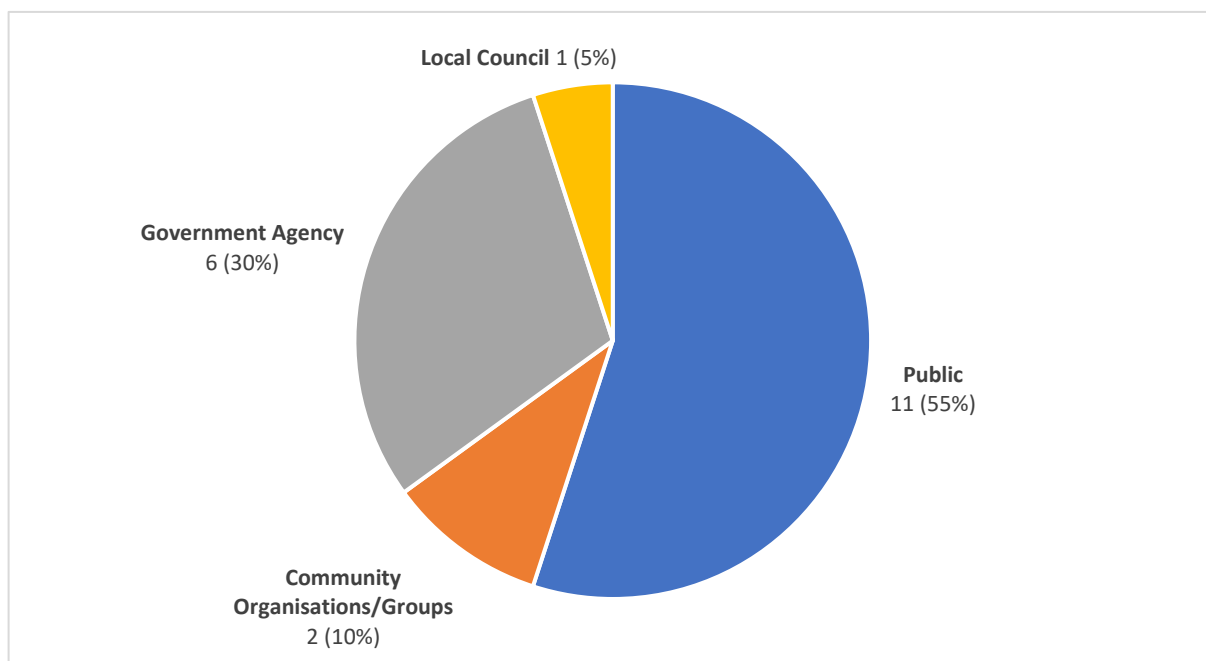
## 2 ANALYSIS OF SUBMISSIONS

### 2.1 NUMBER OF SUBMISSIONS

A total of 20 submissions on the UG2 Modification Report were received from NSW Government agencies, local council (Mid-Western Regional Council), community organisations/groups and members of the public. Chart 1 presents a summary of the number of submissions by submitter category. Key aspects raised in submissions are summarised in Section 2.5.

A register of submitters is provided in Attachment 1.

**Chart 1**  
**Summary of All Submissions**



### 2.2 SUMMARY OF GOVERNMENT AGENCY SUBMISSIONS

A total of six (6) submissions were received from NSW Government agencies. A submission was also received from the local council (Mid-Western Regional Council).

The following Government agencies and the Mid-Western Regional Council advised they had no comment on the UG2 Modification, and hence, no formal response from MCO is provided in the Submissions Report:

- Heritage Council of NSW;
- Heritage NSW; and
- Mid-Western Regional Council.

The following agencies provided comments on the UG2 Modification, or recommended post-approval management requirements:

- Department of Regional NSW – Mining, Exploration & Geoscience (MEG);
- NSW Environment Protection Authority (EPA);
- Biodiversity, Conservation and Science Directorate (BCS); and
- DPE – Water.

### 2.3 SUMMARY OF COMMUNITY ORGANISATION/GROUP SUBMISSIONS

A total of 2 submissions were received from community organisations/groups for the UG2 Modification, comprising one supporting submission and one objecting submission.

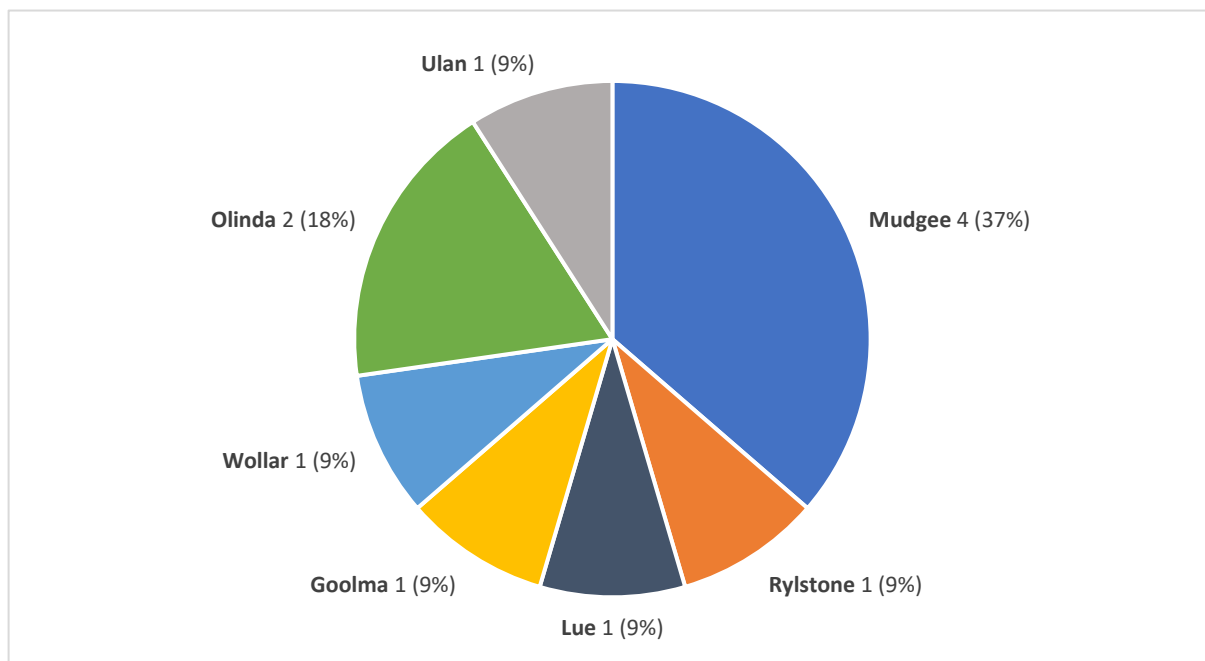
### 2.4 SUMMARY OF PUBLIC SUBMISSIONS

A total of 11 submissions were received from members of the public. All of the submissions objected to the UG2 Modification.

#### *Locations of Public Submitters*

Public submissions were from a range of locations surrounding the Moolarben Coal Complex (Chart 2). All public submissions were received from the Mid-Western Region local government area.

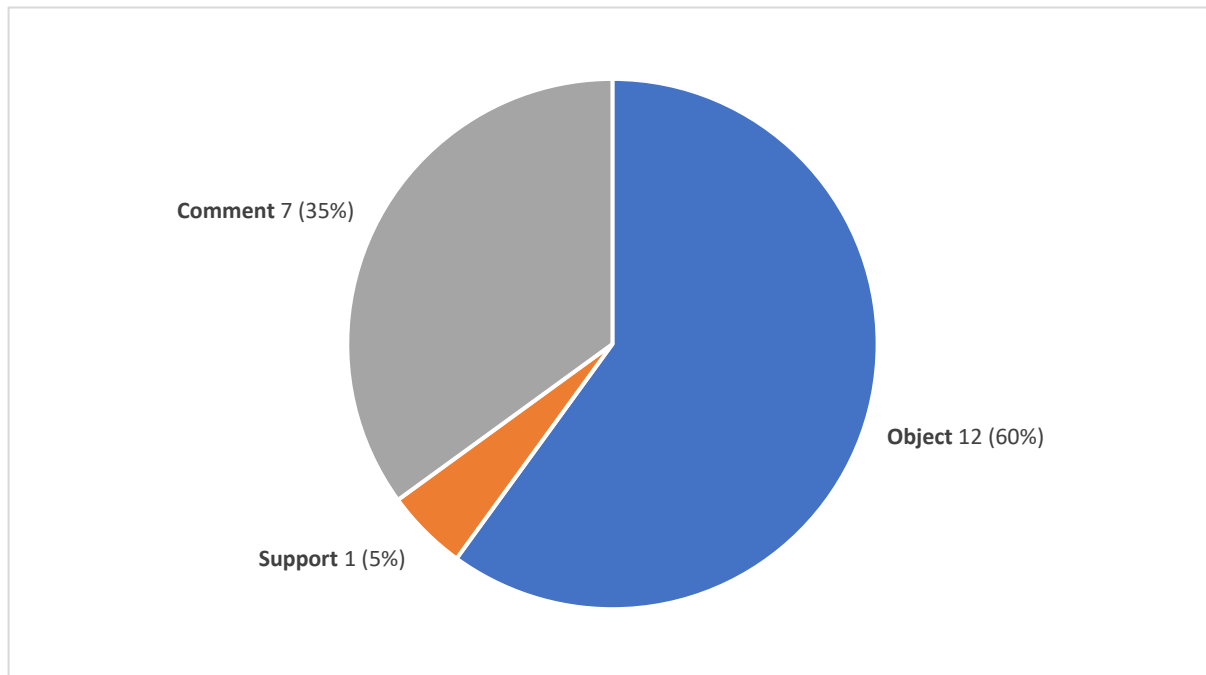
**Chart 2  
Summary of Public Submission Location**



## 2.5 KEY ISSUES RAISED IN SUBMISSIONS

From the total submissions (20), 12 were in objection, 1 was in support and 7 made comments (Chart 3).

**Chart 3**  
**Summary of Submission Type**



MCO notes the supporting submissions pertained to:

- employment opportunities, including the potential for the Moolarben Coal Complex employment to offset recent mine closures or reductions in other mine workforces in the region;
- potential economic growth or flow-on effects to the local and regional economies;
- benefits that mining employment can provide, including royalties to the State of NSW; and
- continued future employment opportunities for current employees of the Moolarben Coal Complex.

## 2.6 CATEGORISING ISSUES

Consistent with the *State significant development guidelines – preparing a submissions report* (DPIE, 2022), MCO has reviewed the issues raised in submissions to categorise them into broad categories (e.g. submissions relating to the Modification layout, design or activities; environmental matters and procedural matters).

Based on this review, MCO considered that all of the issues raised were either procedural or environmental matters.

### **3 ACTIONS TAKEN SINCE EXHIBITION**

#### **3.1 REFINEMENT OF THE PROJECT**

No refinements of the UG2 Modification are proposed to address the submissions received.

#### **3.2 ENGAGEMENT ACTIVITIES**

Since the lodgement of the UG2 Modification application, MCO has continued to consult with the community regarding the UG2 Modification.

An overview of key recent consultation is provided below.

##### ***Community Consultative Committee***

An update on the UG2 Modification was provided at the Community Consultative Committee (CCC) meetings held in November 2021, March 2022, June 2022 and September 2022. MCO provided an overview (and subsequent updates) of the UG2 Modification, an overview of the Modification assessment process and an opportunity for CCC members to ask questions in relation to the UG2 Modification.

Meeting minutes for the CCCs are publicly available on the MCO website.

##### ***Public Consultation***

The MCO website ([www.moolarbencoal.com.au](http://www.moolarbencoal.com.au)) provides regular updates on the Moolarben Coal Complex, and provides access to relevant environment and community information, including compliance reports and approval documents.

The Moolarben Coal Hotline (1800 556 484) allows members of the public to contact MCO with enquiries or complaints.

A copy of the UG2 Modification report is available on the MCO website.

##### ***Local Community***

MCO notified the local community of the UG2 Modification via a community newsletter on future proposed projects which was distributed in June and July 2021.

MCO also notified the local community of lodgement and exhibition of the UG2 Modification via an additional community newsletter, which also provided an overview of other proposed projects for the Moolarben Coal Complex. The newsletter was distributed in March 2022 and is also available on the MCO website.

### 3.3 FURTHER ENVIRONMENTAL ASSESSMENT

In support of this Submissions Report, MCO has commissioned the following additional technical specialist advice to assist in responding to some NSW Government agency submissions:

- Mine Subsidence Engineering Consultants (MSEC) – response to subsidence matters raised by BCS (Attachment 2).
- Australasian Groundwater and Environmental Consultants (AGE) – preparation of a Technical Memorandum to summarise updates to groundwater modelling (Attachment 3).
- Jacobs Group (Australia) Pty Limited – preparation of a peer review of the Groundwater Review report and Technical Memorandum prepared by AGE (Attachment 4).

The outcomes of this additional technical specialist advice is provided in Section 4. None of the additional advice or assessment clarification has altered the findings of any key environmental assessment matters, but it provides further clarification on relevant assessment matters.

## 4 RESPONSES TO SUBMISSIONS

The matters raised in the submissions were related to the environmental and social impacts associated with the modified Project (Section 2.2). Responses to these issues are provided below.

### 4.1 BIODIVERSITY

#### *Biodiversity Offset Liability*

##### Issue

BCS requested that a full Biodiversity Development Assessment Report (BDAR) be prepared for the Onsite Biodiversity Offset Area which overlies the approved UG2 mining area, that MCO determine an offset liability for subsidence-related prescribed impacts to threatened species as a result of the Modification and provide an offset strategy.

BCS and some public submitters also requested that there be no further extension to underground mining beneath the existing onsite Biodiversity Offset Area.

##### Response

##### *Summary of Submission*

BCS's submission on the Modification has requested the following:

- Determine an offset liability for non-endangered ecological communities native vegetation due to indirect impacts from surface expression of subsidence (e.g. surface cracking).
- Provide an offset credit requirement for residual prescribed impacts to threatened species as a result of subsidence.
- That there is no further extension of mining under the Onsite Biodiversity Offset Area, notwithstanding that the approved UG2 mining layout would undermine the Offset Area.
- Undertake detailed biodiversity surveys and impact assessment for the Onsite Biodiversity Offset Area which overlies the approved UG2 mining area in accordance with the Biodiversity Assessment Method (BAM), and update the BDAR accordingly.
- Clarification of potential for far field subsidence impacts within the Munghorn Gap Nature Reserve and request for additional subsidence monitoring.
- Provide further detail on potential impacts to groundwater resources within the Munghorn Gap Nature Reserve and increase the current groundwater monitoring network accordingly.

Further detail on the relevant statutory framework, BDAR outcomes, existing subsidence performance measures and monitoring and mitigation approach is provided below.

MSEC (2021) predicted that sensitive environmental features within the Munghorn Gap Nature Reserve would not experience any impacts as a result of far-field subsidence effects due to the Modification. Notwithstanding, MCO would investigate additional subsidence monitoring along the boundary of the Munghorn Gap Nature Reserve adjacent to the extended UG2 mining area, which would be described in the UG2 Extraction Plan. Attachment 2 provides further clarification from MSEC (2022) for the potential for far-field subsidence effects.

There has been extensive depressurisation of porous rock aquifers in the vicinity of the UG2 mining area, as a result of previous and current mining operations. The Triassic strata overlying the UG2 mining area are unsaturated, either naturally or from depressurisation caused by previous mining activities. Hence there is minimal additional groundwater drawdown predicted in the Triassic and Permian Overburden as a result of the Modification (AGE, 2021), which is largely focused over the extended UG2 mining area. Consideration of potential impacts to water resources is described in further detail in Section 4.2 of this Submissions Report.

### Response Overview

- The DPE assessment of the approved Moolarben Coal Complex Stage 2 Project (Stage 2) concluded there would be negligible biodiversity impacts from subsidence as a result of longwall mining in the approved UG2 mining area.
- Consequently, no biodiversity offsets were required for these subsidence-related impacts.
- Biodiversity offsets for Stage 2 were required to be provided due to vegetation clearance for open cut (OC4) operations and associated direct impacts on species habitat, such as for the Regent Honeyeater.
- The Stage 2 offsets included revegetation of the OC4 surface disturbance area and long-term conservation of onsite land-based offset areas, including above the approved UG2 mining area.
- The primary purpose of these offset requirements was to create a vegetation corridor to strengthen habitat connectivity between the Goulburn River National Park to the north and the Munghorn Gap Nature Reserve and onsite offset areas to the south.
- In the unlikely event that actual biodiversity impacts from subsidence due to longwall mining in the UG2 mining domain are greater than negligible (i.e. following longwall mining), MCO is required to remediate the impacts in accordance with the Stage 2 Project Approval (08\_0135).
- If this remediation is unsuccessful, then MCO is required to provide an offset for the impacts.
- In accordance with Section 30A of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*, the Modification is considered a transitional project.
- On this basis, for the Modification, MCO prepared a BDAR for the extended UG2 mining area, and provided a review of any potential change to the approved impacts in the approved UG2 mining area.
- The revised layout of the UG2 mining domain will not result in any direct vegetation clearing and is not subject to the standard BDAR offsetting obligations under the BAM.
- The Modification may still trigger the requirement for biodiversity offsets if the relevant prescribed matters – see Section 6.3 of the *Biodiversity Conservation Act 2016* and Clauses 6.1(a)(i), 6.1(a)(ii) and 6.1(d) of the *Biodiversity Conservation Regulation 2017* – result in adverse impacts on threatened species or their habitat.
- In this case, however:
  - MCO has avoided key habitat features to the greatest extent practicable; in particular, Cliff Line C9.
  - Detailed assessment of the relevant prescribed matters (i.e. cliff features, rock outcrops and hydrology) has concluded the subsidence of the extended UG2 mining area will result in negligible impacts on threatened species or their habitat, consistent with the subsidence impact performance measures for the approved UG2.
  - There will also be no adverse impacts on the onsite offset area above UG2, particularly since its primary purpose is to provide connectivity (along with rehabilitation of OC4) between the vegetated areas to the north and south in the medium to long term.
- In other words, the predicted impacts for the Modification are expected to be the same as the approved impacts, but would be experienced over an extended area.
- Therefore, it is considered reasonable that the modified UG2 mining domain should be subject to the same biodiversity obligations as the approved UG2 mining layout.
- These obligations include:
  - Ensuring longwall mining in the UG2 mining domain results in negligible impacts on threatened species and their habitat.
  - Preparation of a detailed Extraction Plan to minimise the impacts of the UG2 mining domain, including on threatened species and their habitat. The Extraction Plan would outline specific monitoring to confirm if performance measures are being achieved and Trigger Action Response Plans to inform implementation of mitigation measures.
  - Detailed monitoring of actual impacts from longwall mining in the UG2 mining domain.
  - Remediation of any residual adverse impacts identified as a result of detailed monitoring.
  - Providing offsets for these residual impacts in the unlikely event that they are greater than negligible, and remediation is unable to be completed or unsuccessful.



- These obligations are proportionate with the likely scale of the predicted impacts (i.e. negligible), but also acknowledges there is inherent uncertainty associated with subsidence predictions associated with underground longwall mining and includes suitable safeguards to address impacts on biodiversity in the unlikely event they should occur.

#### Statutory Framework

Section 6.3 of the NSW *Biodiversity Conservation Act 2016* (BC Act) states that the biodiversity offsets scheme applies for impacts as a result of clearing native vegetation, as well as other impacts prescribed by the NSW *Biodiversity Conservation Regulation 2017* (BC Regulation):

#### **6.3 Impacts on biodiversity values to which biodiversity offsets scheme applies**

*The impacts of actions on biodiversity values that are subject to assessment and offset under the biodiversity offsets scheme are as follows—*

- (a) *the impacts of the clearing of native vegetation and the loss of habitat,*
- (b) *the impacts of action that are prescribed by the regulations.*

The UG2 Modification does not involve any clearing of native vegetation, and accordingly Section 6.3(a) of the BC Act does not apply.

With respect to Section 6.3(b) of the BC Act, the relevant ‘prescribed’ impacts for the Modification are subsidence-related impacts to “karst, caves, crevices, cliffs and other geological features of significance” and “rocks” that provide habitat features for threatened species, and “water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities”, as per Clause 6.1(1)(a) and Clause 6.1(1)(d) of the BC Regulation:

#### **6.1 Additional biodiversity impacts to which scheme applies (sections 6.3 and 6.6(2))**

- (1) *The impacts on biodiversity values of the following actions are prescribed (subject to subclause (2) as biodiversity impacts to be assessed under the biodiversity offsets scheme—*
  - (a) *the impacts of development on the following habitat of threatened species or ecological communities—*
    - (i) *karst, caves, crevices, cliffs and other geological features of significance,*
    - (ii) *rocks,*
    - ...
  - (d) *the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development),*

However, Clause 6.1(2) of the BC Regulation states that offset credits for prescribed impacts do not need to be calculated in a Biodiversity Assessment Report, and that prescribed impacts “may” be taken into account when determining offset credits for a planning approval (i.e. determining offset credits is not mandatory or required for decision making) (underlined for emphasis):

#### **6.1 Additional biodiversity impacts to which scheme applies (sections 6.3 and 6.6(2))**

- ...
- (2) *The additional biodiversity impacts prescribed by this clause—*
    - (a) *are prescribed for the purposes of assessment and biodiversity assessment reports under the Act, but are not additional biodiversity impacts for the purposes of calculating the number and class of biodiversity credits that are required under a biodiversity assessment report to be retired to offset the residual impact on biodiversity values of proposed development, proposed clearing of native vegetation or proposed biodiversity certification of land, and*
    - (b) *may be taken into account in the determination of the biodiversity credits required to be retired (or other conservation measures required to be taken) under a planning approval or vegetation clearing approval or under a biodiversity certification of land.*

### *Approach to and Outcomes of the UG2 Modification BDAR*

As described above, there is no clearance of native vegetation or habitat as a result of the Modification.

The Modification incorporates avoidance measures for potential prescribed impacts to key threatened species habitat associated with cliff features. In particular, the longwalls have been designed to setback from Cliff Line C9 which would previously have been subject to subsidence impacts.

The Modification is expected to result in no increase in impacts to biodiversity values within the approved UG2 mining area relative to the approved UG2 layout. Therefore, the scope of the BDAR for the Modification focused on the extended UG2 mining area, as discussed with DPE and BCS during the consultation process for the Modification, and as outlined in the Scoping Letter for the Modification.

Biodiversity surveys undertaken to inform the BDAR identified potential habitat for threatened species that may be impacted by 'prescribed' impacts (as detailed in Clause 6.1(1) of the BC Regulation), including rocky outcrops and rocky areas. No water bodies or hydrological processes within the extended UG2 mining area sustain threatened entities.

The BDAR concluded that, within the extended UG2 mining area, residual prescribed impacts as a result of the Modification would comply with the existing subsidence impact performance measure for threatened species in the Stage 2 Project Approval (08\_0135) (i.e. Condition 1, Schedule 4).

### *Subsidence Impact Performance Measures in the Stage 2 Project Approval (08\_0135)*

Given the inherently minor nature of subsidence-related impacts on biodiversity values (e.g. compared to clearance activities) there is significant uncertainty associated with predicting the magnitude of residual prescribed impacts to threatened species (i.e. identifying in advance if impacts would occur at all).

The Moolarben Coal Complex Stage 2 Project Approval (08\_0135) addresses this uncertainty by prescribing:

- A subsidence impact performance measure for threatened species and ecological communities requiring “negligible subsidence impacts or environmental consequences”, consistent with the predicted level of subsidence-related impact in the BDAR.
- The requirement to monitor actual impacts from subsidence during secondary extraction.
- A provision to remediate observed impacts if they occur, and/or offset impacts where monitoring indicates they are greater than predicted and remediation measures are unlikely to be successful.

### *On-site Biodiversity Offset Area*

The Onsite Offset Area was established and approved in full knowledge that it would partially overlie an approved longwall mining area (i.e. the approved UG2 mining area).

This is recognised in the in-perpetuity conservation mechanism. The offset area has been secured by registering on the title of the land a 'Positive Covenant' instrument and a 'Restriction on the Use of Land by a Prescribed Authority' instrument executed under section 88E(3) of the *Conveyancing Act 1919* and allows for underground mining beneath the offset area.

The Modification would extend the portion of the Onsite Offset Area that would be undermined, however the nature of subsidence-related impacts in the extended area are predicted to be the same as those contemplated for the approved UG2 layout when the offset area was approved and the security mechanism finalised.

The Onsite Offset Area would continue to be managed for long term conservation purposes in accordance with the Stage 2 Project Approval (08\_0135), a Biodiversity and Offset Management Plan required under *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Approval (EPBC 2008/4444) and the terms of the in-perpetuity conservation mechanism.

### *Proposed Approach for the UG2 Modification*

MCO is of the view that the existing framework under the Stage 2 Project Approval (08\_0135) should continue to be applied to the modified Project, given:

- Key threatened species habitat features potentially subject to subsidence-related prescribed impacts have been avoided (i.e. Cliff Line C9).

- The BDAR concludes that the Modification would comply with the existing subsidence impact performance measure for threatened species and endangered ecological communities.
- There is no requirement for the consent authority to impose an offset liability for prescribed impacts.
- The nature of potential impacts for the Modification is similar to that assessed and approved for the currently approved operations, hence it is logical that the mitigation, monitoring and management framework of the Stage 2 Project Approval (08\_0135) should continue to apply.

MCO would develop a monitoring program to validate the subsidence predictions and potential adverse impacts described in the BDAR, along with trigger action response plans and contingency mitigation measures. This would be detailed in an Extraction Plan which is required to be approved by DPE prior to commencement of secondary extraction.

#### Issue

MEG requested that Yancoal consider potential resource sterilisation should any future biodiversity offset areas be considered for the Modification within mining tenements.

#### Response

The Modification does not require additional surface disturbance or infrastructure beyond that already approved or previously cleared. Accordingly, the Modification does not propose a biodiversity offset area.

## **4.2 WATER RESOURCES**

### ***Predicted Surface Water and Groundwater Water Take***

#### Issue

DPE - Water, BCS and some public submissions requested further clarification regarding groundwater and surface water take due to subsidence from the Modification and any associated potential increase in treated water discharge to the Goulburn River.

#### Response

##### *Surface Water*

##### *Drainage Lines Overlying UG2*

Drainage lines that overlie the UG2 mining area are ephemeral so water typically flows during and for short periods after a rainfall event (Appendix C of the Modification Report).

MSEC (2021) concluded that the potential subsidence impacts to the drainage lines as a result of the Modification would be similar to those assessed for the approved UG2 mining area. While some surface cracking of the beds of drainage lines is predicted, in times of heavy rainfall, the majority of the surface water runoff would be expected to flow over any surface cracking and only a small proportion of flow would be diverted into the fractured and dilated strata below. In times of low flow, however, a larger proportion of the surface water flow could be diverted into the strata below the beds and this could affect the quantity of water flowing through the drainage lines. Nevertheless, during high flow or low flow times, this small quantity is expected to have little impact on the overall quantity of water flowing out of the drainage lines (WRM, 2021).

The annual volume of surface water losses due to subsidence-related surface fracturing is not expected to be quantifiable or measurable.

If required, surface cracking would be remediated by infilling with soil or other suitable materials, or by locally regrading and compacting the surface. Remediation of surface cracking would only be undertaken where the works would not create a greater impact than the subsidence impact. Observations of the rate of self-healing of any surface cracks would also inform remediation requirements.

Licensed Release via Environment Protection Licence (EPL) 12932

The Modification application does not seek to modify treated water release volumes or quality from the Moolarben Coal Complex. The controlled release of treated water from the Moolarben Coal Complex is undertaken in accordance with Environment Protection Licence (EPL) 12932, the Stage 1 Project Approval (05\_0117) and the approved complex-wide Surface Water Management Plan.

*Groundwater*

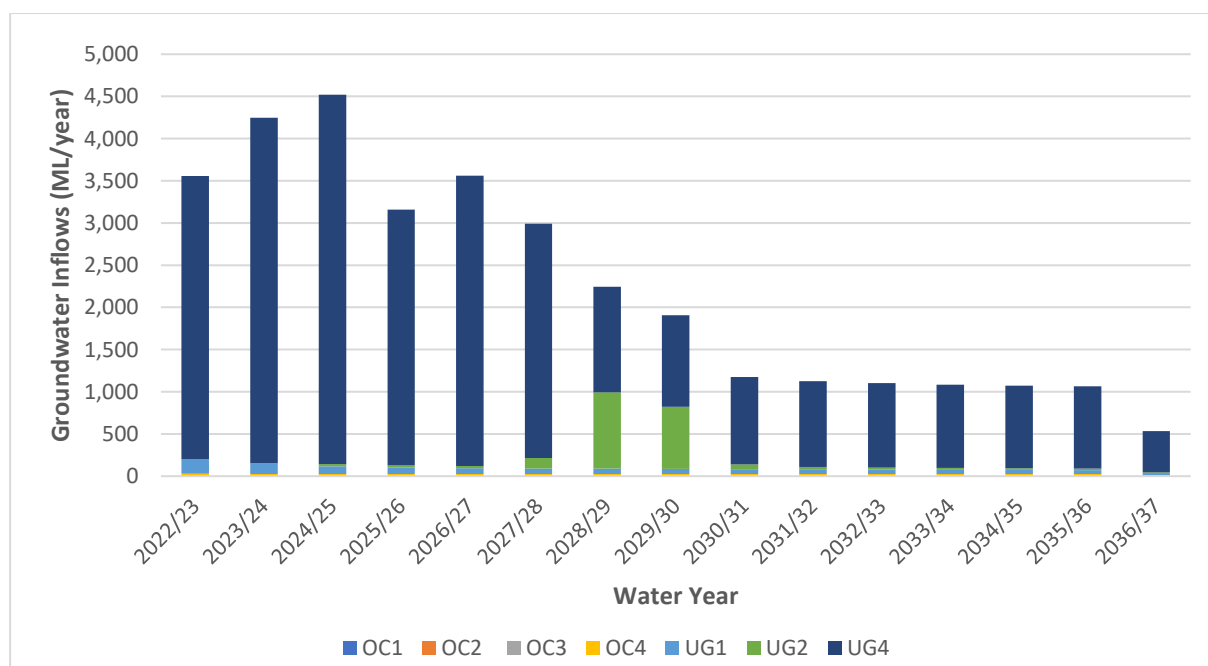
Groundwater modelling undertaken by AGE (2021) considered modelling scenarios for both the approved UG2 mining layout as well as the Modification layout, including the proposed increase in extraction height and extended longwall panels (Appendix B of the Modification Report).

Irrespective of the Modification, the predicted height of subsurface fracturing for the approved UG2 mining layout would extend into any saturated strata that may exist above the longwall panels. Therefore, while the Modification would increase the height of theoretical subsurface fracturing, the strata would already be depressurised for approved operations.

The potential for the Modification to affect the surrounding groundwater system is limited by the proximity of the UG2 mining area to the existing OC2, OC3 and OC4 open cut mining areas and the UG1 underground mining area. The Permian and Triassic strata above the longwalls also dip away from the UG2 mining area towards the north east. Groundwater modelling by AGE (2021) indicates that the Modification would result in some minor incremental depressurisation occurring in the Permian and Triassic strata. Cumulative depressurisation contours (including mining at the Moolarben Coal Complex, Ulan Mine Complex and Wilpinjong Coal Mine) for these two model layers are provided in Attachment 3. No incremental drawdown/depressurisation is predicted in the alluvium, colluvium, palaeochannel or Ulan Seam (AGE, 2021).

The Modification would not change the maximum water licensing requirements for the approved Moolarben Coal Complex, which are predicted to occur during mining of the approved UG4 domain (Appendix B of the Modification Report). The total groundwater inflows reporting to the Moolarben Coal Complex mining domains are shown on Chart 4, which demonstrates that the maximum groundwater inflow occurs at UG4 prior to commencement of mining in UG2.

**Chart 4  
Moolarben Coal Complex Groundwater Inflows**



## **Groundwater Modelling**

### Issue

DPE - Water requested MCO undertake an independent peer review of the groundwater model used to inform the Groundwater Review (Appendix B of the Modification Report). Some public submissions also raised concerns that the Groundwater Technical Report which supports the UG4 Extraction Plan is not yet publicly available.

### Response

AGE (2021) used an updated version of the Moolarben Coal Complex numerical groundwater model to assess the incremental impacts of the Modification (when compared to the approved operations) consistent with the Australian Groundwater Modelling Guidelines (Barnett et.al, 2012).

Given the limited changes to the approved Moolarben Coal Complex associated with the Modification and the extensive modelling and monitoring undertaken to date, a new Groundwater Assessment was not warranted to support the Modification. This level of assessment is consistent with that outlined in the Scoping Letter for the Modification.

Since lodgement of the UG2 Modification Report in 2021, AGE has completed a Groundwater Assessment for the OC3 Extension Project Environmental Impact Statement (AGE, 2022). For the Groundwater Assessment, AGE refined and recalibrated the Moolarben Coal Complex numerical groundwater model to match historical groundwater levels at observation locations and recorded inflows at both Moolarben Coal Complex underground operations and the neighbouring Ulan Mine Complex. In a peer review of the OC3 Extension Project Groundwater Assessment, Brian Barnett concluded the model is fit for the purpose of impact quantification and assessment (Jacobs Group [Australia] Pty Limited, 2022).

AGE has undertaken additional modelling using the recalibrated model (AGE, 2022) and prepared a Technical Memorandum to consider changes to the modelling predictions for the UG2 Modification (Attachment 3). Overall, AGE concludes that the updated modelling predictions are commensurate with previous predictions in the 2021 Groundwater Review report.

In addition, Brian Barnett has undertaken a peer review of the initial Groundwater Review report for the UG2 Modification (AGE, 2021), as well as the Technical Memorandum (Attachment 3), and overall concluded the model is able to meet the modelling objective of quantifying drawdown impacts associated with the proposed UG2 Modification (Attachment 4).

The UG4 Extraction Plan and associated Groundwater Technical Report (approved by DPE in July 2022) are available on the MCO website.

## **Groundwater Dependent Ecosystems**

### Issue

One public submission requested further clarification on the adequacy of assessment of groundwater dependent ecosystems (GDE's), noting they considered the relevant Water Sharing Plan to be outdated.

### Response

There is minimal additional groundwater drawdown predicted in the Triassic and Permian Overburden as a result of the Modification (AGE, 2021), which is largely focused over the extended UG2 mining area.

As described in Section 6.2.3 of the Modification Report, the closest 'high priority' GDE listed in the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* to the Moolarben Coal Complex is the Wappinguy Spring, which is located approximately 28 km north from the Goulburn River at its closest point. Therefore, there are no 'high priority' GDEs regulated under this plan in the vicinity of the Modification.

Water sharing plans are subject for review every 10 years under the NSW *Water Management Act 2000*. The current *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* is nearing expiry and a draft replacement has been prepared and was proposed to take effect from 1 July 2022 (although this has not occurred at the time of writing). A draft GDE map has been prepared for the updated Plan, which does not show any high-priority GDE's within the vicinity of the Modification.

Niche Environment and Heritage Pty Ltd (Niche) (2021a) reviewed the Bureau of Meteorology's GDE Atlas for the Modification. The GDE Atlas identifies a regionally mapped patch of Central Tableland Ribbon Gum-Apple Gully Forest within the Modification area as having moderate potential for groundwater interaction. None of the surveyed vegetation communities mapped within the subject land are consistent with the regionally mapped Central Tableland Ribbon Gum-Apple Gully Forest or exhibit groundwater dependent traits. On this basis Niche concluded that no GDEs are present or likely to be impacted by the Modification (Niche, 2021a).

### ***Potential Impacts to Water Resources within the Munghorn Gap Nature Reserve***

#### Issue

BCS requested MCO provide further detail on potential impacts of the Modification to water resources within the Munghorn Gap Nature Reserve and increase the current groundwater monitoring network accordingly.

#### Response

There has been extensive depressurisation of porous rock aquifers in the vicinity of the UG2 mining area, as a result of previous and current mining operations (Figure 4). The Triassic strata overlying the UG2 mining area are unsaturated, either naturally or from depressurisation caused by previous mining activities (Figure 5). Perched watertables might be sustained at higher elevations in the Munghorn Gap Nature Reserve due to the presence of occasional mudstone/siltstone beds between the sandstone layers (Figure 6) (HydroSimulations, 2015; AGE, 2021).

There is minimal additional groundwater drawdown predicted in the Triassic and Permian Overburden as a result of the Modification (AGE, 2021), which is largely focused over the extended UG2 mining area.

Additional groundwater monitoring (specifically a line of bores along the boundary of the Munghorn Gap Nature Reserve) is not practical due to difficulties associated with access to undertake the drilling (i.e. steep terrain and lack of access tracks).

Groundwater monitoring would be considered further during preparation of the UG2 Extraction Plan prior to commencement of secondary extraction.

### ***Water Licensing, Monitoring and Reporting Requirements***

#### Issue

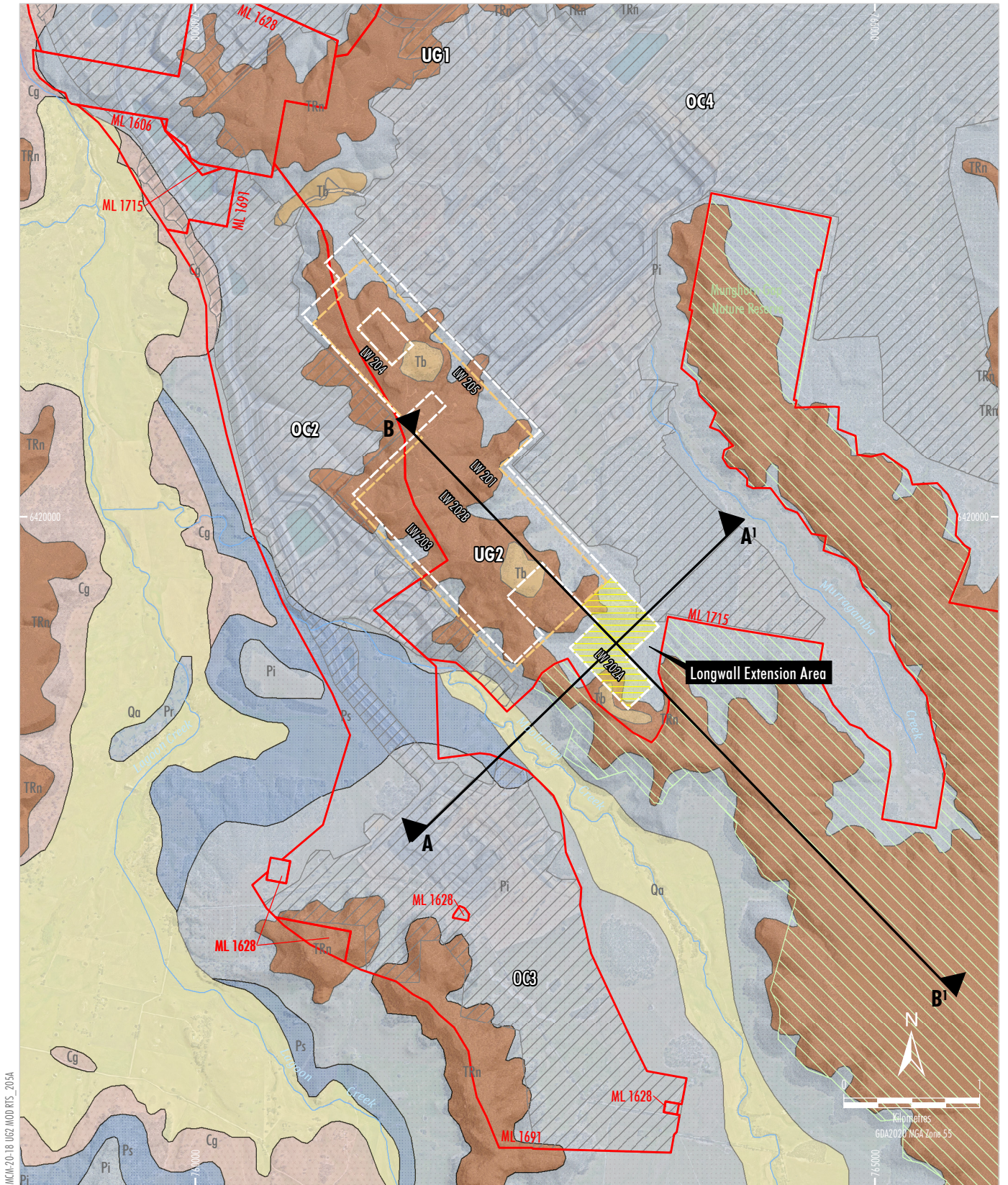
DPE-Water, BCS and EPA raised several post approval requirements regarding ongoing monitoring, the approved Water Management Plan and NSW *Water Management Act 2000* approvals.

#### Response

The surface water and groundwater monitoring and management measures outlined in the approved complex-wide Water Management Plan would continue to be conducted for the Moolarben Coal Complex (incorporating the Modification) (Sections 6.2.4 and 6.3.4 of the Modification Report). The Water Management Plan would also be reviewed and, where necessary, updated to incorporate the Modification in consultation with relevant agencies.

In accordance with the Stage 2 Project Approval (08\_0135), MCO is required to prepare an Extraction Plan prior to commencement of secondary extraction in the UG2 mining area. The Extraction Plan would include a specific Water Management Plan that provides detailed monitoring measures and Trigger Action Response Plans to inform implementation of mitigation measures.





MCN-20-18 UG2 MOD RTS\_2024

- LEGEND**
- NSW National Parks and Wildlife Service
  - Mining Lease Boundary
  - Existing/Approved Development
  - Moolarben Coal Complex Disturbance Footprint
  - Approximate Extent of UG2 Longwalls
  - Proposed UG2 Modification
  - UG2 Longwall Extension Area
  - Approximate Extent of Proposed Modified Longwalls

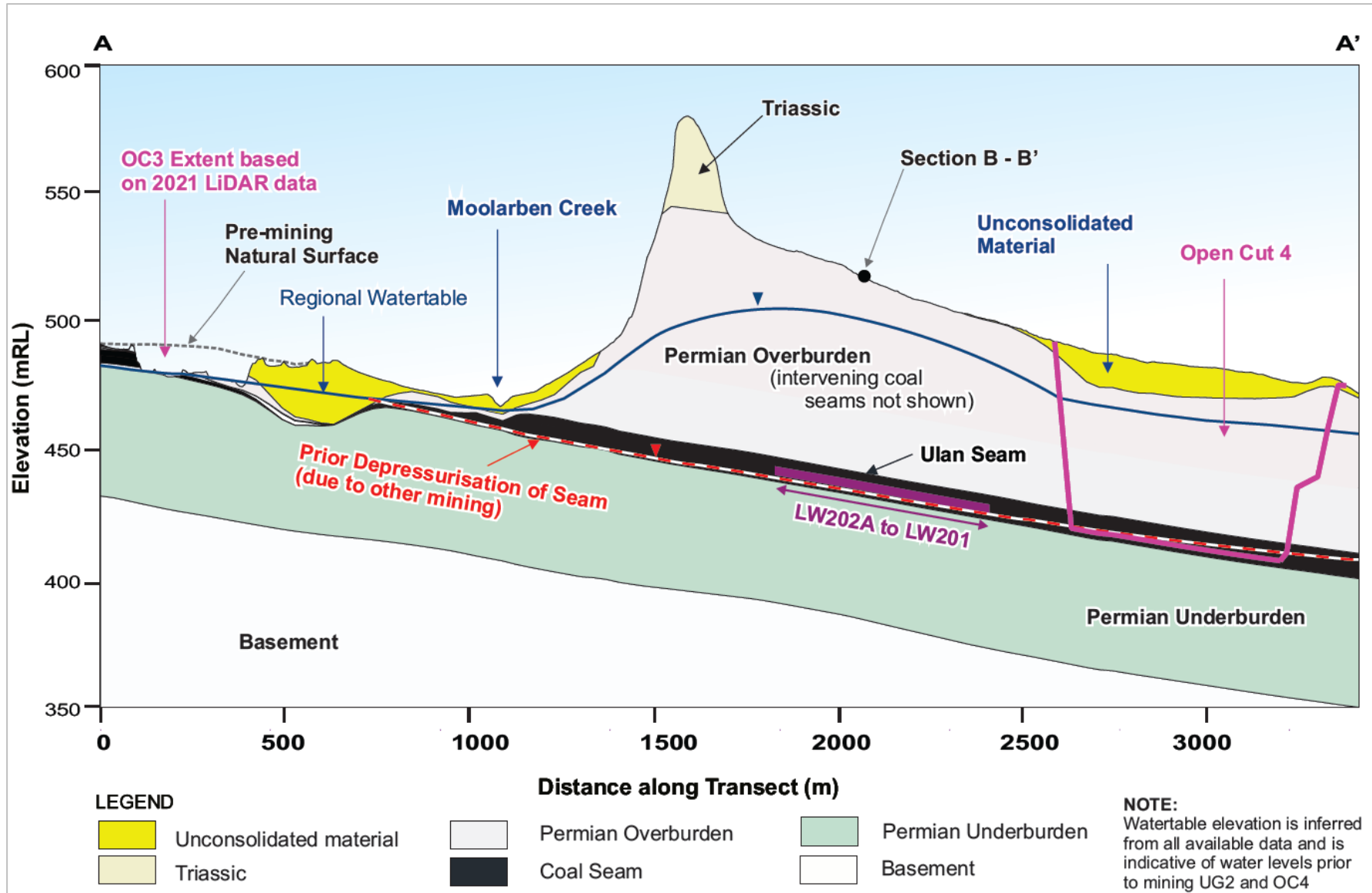
- Alluvium (Qa)
- Tertiary Basalt (Tb)
- Narrabeen Group (TRn)
- Illawarra Coal Measures (Pi)
- Shoalhaven Group (Nile Subgroup) (Ps)
- Rhyolite Volcanics (Pr)
- Carboniferous Granite (Cg)

Source: MCO (2021); NSW Spatial Services (2021); NSW Department of Primary Industries - Western Coalfields (2012)  
 Orthophoto Mosaic: MCO (Jan 2021)

**YANCOAL**  
 亞煤礦大有限公司  
 MOOLARBEN COAL  
 MOOLARBEN COAL COMPLEX  
 Regionally Mapped Surface Geology  
 and Hydrogeological Conceptual  
 Section Locations

**Figure 4**







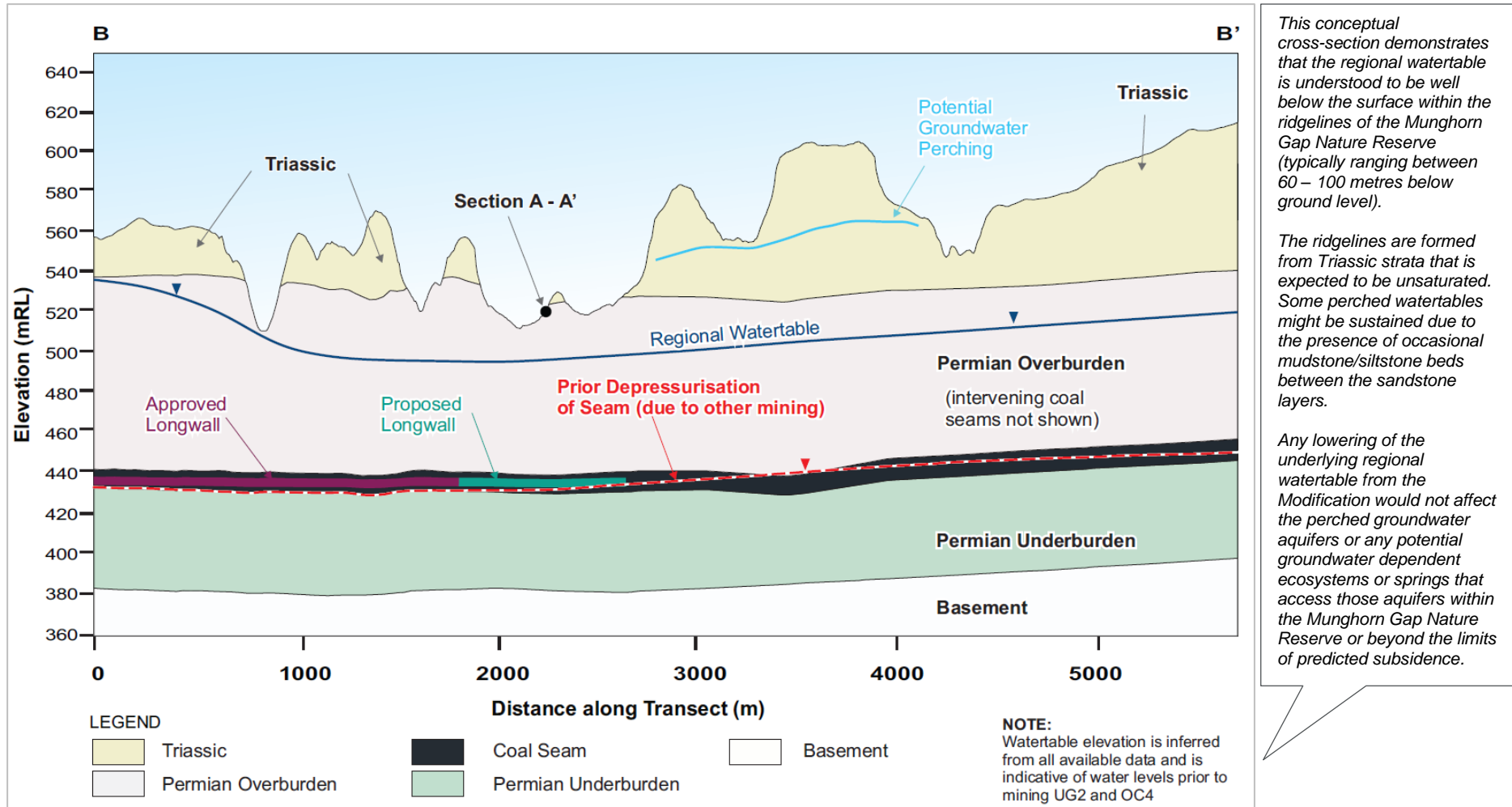


Figure 6 - Hydrogeological Conceptual Section B-B' (Source: AGE)

Consistent with Condition 4, Schedule 6 of the Stage 2 Project Approval (08\_0135), MCO would review the environmental performance of the Moolarben Coal Complex (including the Modification) and report monitoring results in an Annual Review. The Annual Review will include a summary of water take and licensing requirements for the reporting period.

The Modification would not change the maximum predicted peak inflow for the Moolarben Coal Complex, which is predicted to occur during the mining of approved UG4 domain and prior to longwall extraction commencing in UG2 (AGE, 2021). Notwithstanding, consistent with Condition 25, Schedule 3 of the Stage 2 Project Approval (08\_0135), MCO would obtain sufficient water entitlements for the modified Project (where required), and if necessary, adjust the scale of the modified Project to match its available water supply.

Controlled releases of treated water from the Moolarben Coal Complex to the Goulburn River are unrelated to the Modification and would continue in accordance with the release limits in EPL 12932 and the Stage 1 Project Approval (05\_0117).

### **4.3 ABORIGINAL CULTURAL HERITAGE**

#### ***Potential Impacts to Known Aboriginal Cultural Heritage Sites***

##### Issue

Some public submissions and the Mudgee District Environment Group (MDEG) requested further clarification of the potential impacts of subsidence to Aboriginal cultural heritage sites, including cumulative impacts on Aboriginal cultural heritage in the wider region.

##### Response

Heritage NSW stated that they support the management and mitigation measures provided in the Aboriginal Cultural Heritage Assessment (ACHA) prepared for the Modification (Appendix E of the Modification Report) and consider that the approved complex-wide Heritage Management Plan provides a robust framework to manage impacts to Aboriginal cultural heritage.

There would be no additional surface development as a result of the Modification and therefore no associated direct impacts to Aboriginal cultural heritage sites in both the approved and extended UG2 mining areas. It is also unlikely that open artefact sites such as scattered artefacts or isolated finds would be directly impacted by subsidence.

Aboriginal cultural heritage sites within the approved UG2 mining area (including the high significance rock shelter, artwork and artefact scatter site S2MC236) would either experience no change or a decrease in the approved level of subsidence impact as a result of the Modification (Niche, 2021b). Therefore, the Modification would not result in any change to the existing subsidence performance measure for S2MC236 of “negligible subsidence impacts or environmental consequences” provided in the Stage 2 Project Approval (08\_0135).

Five (5) Aboriginal heritage sites have been identified within the extended UG2 mining area (all rock shelters with one or more components [artefacts and/or potential archaeological deposits]). Three (3) of the sites are considered unlikely to experience subsidence impacts as they would not be undermined and two (2) sites are predicted likely to experience subsidence impacts as they would be directly undermined (Niche, 2021b).

Potential cumulative impacts of the Modification to Aboriginal cultural heritage have been assessed in Section 7.5 of the ACHA (Appendix E of the Modification Report).

There are more than 550 known Aboriginal heritage sites across the Moolarben Coal Complex, more than 1,500 known sites across the nearby Ulan Mine Complex and more than 700 known sites across the Wilpinjong Coal Mine. These known Aboriginal cultural heritage sites are managed in accordance with the respective Site’s approved management plans and in consultation with the Aboriginal community.

Niche (2021b) concluded that the Modification, with incorporation of appropriate management and mitigation measures as recommended in the ACHA (Appendix E of the Modification Report), would not result in a significant increase in cumulative impacts to archaeological values of Aboriginal cultural heritage.

Notwithstanding the above, MCO recognises that any potential impact to known Aboriginal cultural heritage sites has significance to the Aboriginal community.

### ***Further Consideration of the Landscape Context and Associated Cultural Significance***

#### Issue

Some public submitters requested further clarification of potential impacts to the landscape context (in particular the sandstone ridgeline and cliff features) and associated cultural significance.

#### Response

MCO acknowledges that the Subject Area assessed for the ACHA (Appendix E of the Modification Report), including both the UG2 Approved Mining Area and UG2 Extended Mining Area, has social and cultural value to the Registered Aboriginal Parties (RAPs) and other stakeholders.

During preparation of the ACHA (Appendix E of the Modification Report), RAPs provided input on the cultural significance of the landscape within the Subject Area.

RAPs noted the Subject Area has aesthetic values associated with views at and from some rock shelter sites and from elevated landforms across Murragamba Creek and Moolarben Creek valleys (Niche, 2021b). Views and outlook were considered as part of the character of a number of rock shelter sites recorded by the RAPs during the archaeological survey and the assessment of significance of these sites has considered the determination of character. There would be no change to the visual landscape and views of the ridgeline undermined by the UG2 domain due to the Modification.

### ***Proposed Mitigation and Management Measures***

#### Issue

Some public submitters requested justification of the proposed mitigation and management measures for Aboriginal cultural heritage.

#### Response

MCO would implement the management and mitigation measures recommended in the ACHA (Appendix E of the Modification Report). These measures are consistent with the protocols of the approved Heritage Management Plan and consider feedback received from RAPs. The Heritage Management Plan would be reviewed and updated to incorporate the Modification.

In accordance with the Stage 2 Project Approval (08\_0135), MCO is required to prepare an Extraction Plan prior to commencement of secondary extraction in the UG2 mining area. The Extraction Plan would include a specific Heritage Management Plan that provides detailed monitoring measures and Trigger Action Response Plans for S2MC236 to inform implementation of mitigation measures in consideration of monitoring outcomes.

MCO would continue to liaise with the RAPs throughout the assessment and activities associated with the Modification, including monitoring and implementation of mitigation or management measures.

### ***Potential Impacts to 'The Drip'***

#### Issue

Some public submissions requested further information on potential impacts to 'The Drip' in regard to its Aboriginal cultural heritage significance.

#### Response

'The Drip' is located over 10 km from the UG2 mining area and would not be impacted by the Modification. Existing monitoring and management measures relevant to 'The Drip' would continue throughout the life of the Moolarben Coal Complex.

## ***Consultation with the Aboriginal Community***

### Issue

Some public submissions requested justification that consultation with the Aboriginal community and RAPs for the Modification was adequate.

### Response

Aboriginal community consultation for the ACHA (Appendix E of the Modification Report) was undertaken in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water [DECCW], 2010) and NSW *National Parks and Wildlife Regulation 2019*. The RAPs consulted for the Modification have been involved in Aboriginal cultural heritage at the Moolarben Coal Complex since 2004.

Consultation with the RAPs for the Modification included meetings and information sessions, attendance at archaeological surveys, verbal and written correspondence and an opportunity to review and provide comments on the draft ACHA. RAPs were invited to provide details of cultural values, management and mitigation options and any other information they considered relevant to the ACHA throughout the consultation process.

A detailed account of the consultation process for the ACHA is provided in Appendix E of the Modification Report. Ongoing consultation with the RAPs would continue for the life of the Moolarben Coal Complex in accordance with the existing Heritage Management Plan.

## **4.4 PUBLIC INTEREST**

### ***Greenhouse Gas Emissions and Climate Change***

#### Issue

Some public submissions raised concerns regarding increased coal production from the Modification, associated greenhouse gas emissions and potential impacts on climate change.

#### Response

The Modification would not change the approved annual coal production rates or intensity of mining, and therefore there would be no change in annual emissions from the Moolarben Coal Complex due to the Modification over the life of the mine.

MCO would continue to monitor and manage Scope 1 and Scope 2 greenhouse gas emissions in accordance with the Greenhouse Gas Minimisation Plan, which would be updated to incorporate the Modification as required. Reporting of energy consumption and Scope 1 and 2 greenhouse gas emissions would continue in accordance with the National Greenhouse and Energy Reporting Scheme (NGERS).

The Modification would allow for the extraction of an additional 4.5 Mt of coal with no material change in environmental outcomes within the UG2 mining area.

Scope 3 emissions from the end use of product coal would not physically occur in NSW or Australia as product coal would be exported to overseas customers. Combustion of the additional 4.5 Mt of product coal extracted for the Modification by downstream users would result in an incremental increase in Scope 3 emissions of approximately 11.75 Mt carbon dioxide equivalent (CO<sub>2</sub>-e) over the life of the mine (based on the 2021 National Greenhouse Accounts Factors emission factor for anthracite coal).

Scope 3 emissions from the end use of product coal overseas would be managed in accordance with customer countries commitments under the Paris Agreement and would not contribute to Australian greenhouse gas emissions or factor into Australian greenhouse gas reduction targets.

## **Stakeholder Consultation**

### Issue

Some public submissions requested further justification of the adequacy of consultation during the preparation of the Modification Report.

### Response

Engagement undertaken for the Modification is detailed in Section 5 of the Modification Report and included key State Government agencies, local councils, the local community, Aboriginal stakeholders and operators of neighbouring mines.

The local community were provided with an overview of the proposed Modification via a Moolarben Coal Complex newsletter which was distributed in June and July 2021. A copy of the Modification Report has been provided on the MCO website.

MCO conducted briefings with the CCC throughout 2021 (in March, June, September and November) and 2022 (in March and June), providing an overview (and subsequent updates) of the Modification and proposed scope of environmental assessment.

Following lodgement of the Modification, the CCC was notified during a meeting on Tuesday 30 November 2021 that the Modification had been lodged and that the public exhibition period would commence later that week on Friday 3 December 2021.

Consultation with the Aboriginal community is described above in Section 4.3.

## **Modification Exhibition Period and Timing**

### Issue

A number of public submissions raised concerns regarding the length of the public exhibition period.

### Response

It is noted this comment is directed at DPE.

In accordance with Clause 10 of the EP&A Act, there is a minimum public exhibition period of 14 days for an application for modification of development consent. The Modification was exhibited by DPE for 14 days (from 3 December to 16 December 2021).

## 5 PROJECT EVALUATION

This Submissions Report provides responses to issues raised by submissions from government agencies, local council, community organisations/groups and members of the public during the exhibition period for the Modification Report, and has been prepared in consideration of the *State significant development guidelines - preparing a submissions report* (DPIE, 2022).

A total of 20 submissions on the Modification were received as follows:

- Six (6) submissions were received from government agencies;
- one (1) submission was received from local council;
- two (2) submissions were received from community organisations/groups; and
- 11 submissions were received from members of the public.

The Moolarben Coal Project Stage 2, incorporating the Modification, would remain substantially the same as the development that was originally granted for the Moolarben Coal Project Stage 2, as last modified under section 75W of the EP&A Act (i.e. Modification 3). The Moolarben Coal Project Stage 2 (as modified) would continue to comply with existing criteria, subsidence performance measures and limits described in the Stage 2 Project Approval (08\_0135).

The Modification Report provides an evaluation of the Modification in Section 7. This evaluation concluded that in weighing up the main environmental impacts (costs and benefits) associated with the Modification, as assessed and described in the Modification Report, the Modification is, on balance, considered to have merit.

Since lodgement of the Modification Report, MCO has reviewed the submissions on the Modification, continued to consult with members of the community and government agencies and has also sought additional advice from technical specialists. As such, MCO has concluded that the key potential impacts and benefits of the Modification and the justification for the Modification remain consistent with the conclusions presented in Section 7 of the Modification Report, which are that the Modification would:

- Contribute to the financial resilience of the Moolarben Coal Complex through efficient development of existing available resources and with no change to the existing infrastructure.
- Facilitate Ecologically Sustainable Development, as economic efficiencies can be achieved with no change to the currently accepted environmental performance measures and no increase in the duration of existing impacts of the Moolarben Coal Complex.
- Avoid and minimise potential impacts on biodiversity and cultural heritage items as a result of the Modification as far as practicable.
- Contribute to increased NSW export income and royalties.
- Extend the duration of employment for the underground workforce.
- Be developed in a manner that incorporates community engagement, with a wide range of stakeholders consulted through the preparation of the Modification Report.

## 6 REFERENCES

- Australasian Groundwater and Environmental Consultants Pty Ltd (2021) *Groundwater Review for UG2 Modification*.
- Australasian Groundwater and Environmental Consultants Pty Ltd (2022) *Moolarben Coal Complex OC3 Extension Project Groundwater Assessment*.
- Barnett et al. (2012) *Australian groundwater modelling guidelines*. Waterlines report, National Water Commission, Canberra. June 2012.
- Department of Environment, Climate Change and Water (2010) *Aboriginal cultural heritage consultation requirements for proponents 2010*.
- Department of Planning, Industry and Environment (2022) *State significant development guidelines – preparing a submissions report*.
- HydroSimulations Pty Ltd (2015) *Wilpinjong Extension Project – Groundwater Assessment*.
- Jacobs Group (Australia) Pty Limited (2022) *Moolarben Coal Complex OC3 Extension Project - Groundwater Peer Review*
- Niche Environment and Heritage Pty Ltd (2021a) *Biodiversity Development Assessment Report - Moolarben Coal Complex UG2 Modification NSW*.
- Niche Environment and Heritage Pty Ltd (2021b) *Aboriginal Cultural Heritage Assessment Report – Moolarben Coal Complex UG2 Modification NSW*.
- Mine Subsidence Engineering Consultants Pty Ltd (2021) *Moolarben Coal Complex UG2 Modification – Subsidence Assessment*.
- Mine Subsidence Engineering Consultants Pty Ltd (2022) *Response to Subsidence Matters Raised by BCS*.
- WRM Water & Environment Pty Ltd (2021) *Moolarben Coal Complex UG2 Optimisation Modification – Surface Water Assessment*.

**ATTACHMENT 1**  
**REGISTER OF SUBMISSIONS**



**Table A1-1  
Register of Submissions**

<b>Group</b>	<b>Name</b>	<b>Where Comments are Addressed (section)</b>
Agencies	Biodiversity, Conservation and Science Directorate	4.1, 4.2
	Heritage Council of NSW	-
	Heritage NSW	-
	Mining, Exploration and Geoscience	4.1
	NSW EPA	4.2
	DPE - Water	4.2
Council	Mid-Western Regional Council	-
Community Organisation/Group	Mudgee District Environment Group	4.3 and 4.4
	WesTrac NSW	-
Public	Derek Finker	4.4
	Haydn Washington	4.3 and 4.4
	Name Withheld	4.1 and 4.4
	Lyn Coombe	4.3 and 4.4
	Rod Pryor	4.1 and 4.4
	Jean Ellis	4.4
	Beverly Smiles	4.2, 4.3 and 4.4
	Name Withheld	4.4
	Name Withheld	4.3 and 4.4
	Name withheld	4.3 and 4.4
	Julia Imrie	4.2, 4.3 and 4.4

Note: Section references are only presented for objecting or commenting public submissions.

**ATTACHMENT 2**

**MSEC RESPONSE TO SUBSIDENCE MATTERS RAISED BY BCS**

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PO Box 302  
Chatswood NSW 2057  
Tel +61 2 9413 3777  
enquiries@minesubsidence.com  
www.minesubsidence.com



30 March 2022

Moolarben Coal Operations Pty Ltd  
Locked Bag 2003  
Mudgee NSW 2850

Reference: MSEC1167-100

For the attention of: Michael Moore, Manager - Approvals

Dear Michael,

**RE: Moolarben Stage 2 – UG2 Modification (MOD4)  
Response to Submission**

Further to your request, Mine Subsidence Engineering Consultants (MSEC) have undertaken a review of recommendations provided by Biodiversity, Conservation and Science Directorate (BCS) in Planning Industry & Environment letter Reference DOC2/1073889 dated 22 December 2021. The focus of the review was limited to mine subsidence related matters in the recommendations.

A summary table of relevant mine subsidence related recommendations from BCS and responses from MSEC is provided below.

I trust that this letter is of assistance. If you have any questions, please do not hesitate to email or call me on (02) 9413-3777.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Peter DeBono', with a long horizontal flourish extending to the right.

Peter DeBono  
Mine Subsidence Engineering Consultants

Moolarben Stage 2 – UG2 Modification (MOD 4)

Responses to Biodiversity, Conservation and Science Directorate (BCS) Submission 22 December 2021

Biodiversity, Conservation and Science Directorate (BCS) Recommendation		Response
12.1	<i>The subsidence assessment be updated to appropriately consider the significant increase to subsidence resulting from the proposed MOD 4. This should include, as a minimum, a comparative description of the surface expression of subsidence that is likely to occur, comparing the entirety of the unmodified and modified layouts and their associated subsidence impacts.</i>	It is considered that the subsidence assessment adequately considers the increased subsidence resulting from the proposed MOD4 and compares the entirety of the unmodified and modified layouts and their associated subsidence impacts.
12.2	<i>The potential risk and effects of subsidence interaction with individual geological structures; i.e. faults, lineaments, dykes (etc) be specifically addressed, including those associated with the adjoining Munghorn Gap Nature Reserve.</i>	The potential risks and effects of known geological structures are provided in the subsidence assessment report. Section 5.0 of the subsidence assessment report notes that aside from basalt, there are no other areas of significant geological interest within the Study Area. There are no known geological features of significance within the Munghorn Gap Nature Reserve.
12.3	<i>The potential risk and effects of non-conventional subsidence effects (upsidence and valley closure) to impact Munghorn Gap Nature Reserve be specifically addressed.</i>	Not a relevant issue. There are no drainage lines extending into the Munghorn Gap Nature Reserve near the UG2 Study Area.

Biodiversity, Conservation and Science Directorate (BCS) Recommendation		Response
16.1	<i>Assess the potential far-field subsidence that will occur within Munghorn Gap Nature Reserve. This should include at minimum a subsidence prediction line at the border of the Nature Reserve adjacent to the extension area.</i>	<p>Section 16 of the submission, paragraph 4, incorrectly quotes 70mm far-field horizontal movement as 70 mm subsidence. The subsequent paragraph, paragraph 5, appears to also misinterpret vertical subsidence and horizontal movement by indicating potential for greater than 20 mm vertical subsidence, where the context should be horizontal movement. The predicted limit of vertical subsidence is taken as the 20mm subsidence contour which is shown in Drawing No. MSEC1167-01 in the subsidence assessment report. The Study Area is calculated as the further extent of the 26.5° angle of draw and 20mm predicted subsidence contour. Drawing No. MSEC1167-01 shows that the predicted 20mm subsidence contour is inside the Study Area boundary.</p> <p>It is considered that far-field effects are adequately addressed in the subsidence assessment report. The subsidence assessment report notes that the far-field movement database predominately includes measurements from the Southern Coalfield where mining depths are greater and mining subsidence related effects including far-field horizontal movements typically extend further from extracted panels compared to mining at shallow depths of cover. However, the model is updated with far-field data from Ulan Coal Mine and monitoring from Moolarben Coal Complex undertaken during extraction of UG1 longwalls. In addition, the model was revised to account for depth of cover in addition to distance, thereby negating the dominance of observed southern coalfield data. The observed far-field horizontal movements from UG1 monitoring are significantly lower than the observed far-field horizontal movements in the database, particularly at closer proximity to extracted longwalls. Nevertheless, predicted far-field horizontal movements are conservatively based on the upper limit of observed movements in the database. As discussed in the subsidence assessment report, impacts to surface features are the result of differential movements. It is recognised that differential movements associated with far-field effects are generally of a minor nature and do not result in impacts to surface features unless they are very sensitive to differential horizontal movements. The subsidence assessment report includes assessment of features within Munghorn Gap Nature Reserve that may be considered sensitive to far-field movements including Cliff C10 and bat habitat. There is extensive experience of mining adjacent to but not directly beneath cliffs in the NSW Coalfields which indicates that the likelihood of impacts is very low. There have been no large cliff instabilities where the cliffs have been wholly located outside the extents of mining.</p>
17.1	<i>Appropriately assess the natural and geodiversity features present within Munghorn Gap Nature Reserve. This should include as a minimum the assessment of all features present within the 300 m far-field subsidence buffer depicted in Figure 3.</i>	Similar to Section 16, Section 17 appears to misinterpret horizontal movements with vertical subsidence in the context of far-field effects. The subsidence assessment report addresses relevant features within the Munghorn Gap Nature Reserve including Cliff C10 and bat habitat.
18.1	<i>The subsidence monitoring network should be increased. This should include, as a minimum, an intensive line of global navigation satellite system (GNSS) survey stations along the boundary of Munghorn Gap Nature Reserve where it is adjacent to the proposed extension area.</i>	The monitoring recommendations in section 5.4.4 of the subsidence assessment report refer specifically to Cliff C7 and C9 and associated features. A comprehensive monitoring program will be developed for the UG2 Extraction Plans. Comments on monitoring along the boundary of the Munghorn Gap Nature Reserve where it is adjacent to the proposed extension area will be taken into consideration when the monitoring program is developed.

**ATTACHMENT 3**

**UG2 MODIFICATION GROUNDWATER TECHNICAL MEMORANDUM PREPARED BY AGE**



# Memorandum

Project number	MOO1622F
To	Michael Moore
Company	Yancoal
From	AGE Consultants
Date	23 November 2022

**RE: Moolarben UG2 Modification**

## 1 Introduction

The numerical groundwater model for the Groundwater Review for the UG2 Modification (AGE, 2021) at Moolarben Coal Complex (MCC) was updated prior to the assessment of the proposed OC3 extension. This update involved refining the model mesh around the proposed OC3 pits as well as consolidating the Jurassic-aged Pilliga and Purlewaugh formations into a single model layer, consolidating the Permian underburden and the Carboniferous Gulgong Granite formation into a single layer, and other minor adjustments to reduce the overall cell count.

Following the rebuild, the numerical model's hydraulic parameters were re-calibrated to match historical groundwater levels at observation locations and recorded inflows at both MCC underground operations and the neighbouring Ulan Mine. The re-calibration resulted in a reduction of the scaled root mean squared error (SRMS) from 6.1% to 4.5%, indicating an improvement to predictive capability of the model. The model was also peer reviewed by Brian Barnett (Jacobs) and found to be fit for purpose.

## 2 UG2 Modification

The rebuilt model was used to re-assess the impact of the UG2 Modification compared to the approved UG2 mine plan, identical to work undertaken for the Groundwater Review for UG2 Modification (AGE, 2021). This re-assessment was to confirm that impacts predicted by the previous iteration of the numerical groundwater model are commensurate with the predictions made by the rebuilt model.

Potential impacts of the Modification have been assessed by simulating a 'no Modification' model run and comparing that to a model scenario that incorporates the proposed changes to the UG2 longwall layout. The predicted inflows to the UG2 mining area (with and without the Modification) per water year are shown on Figure 1.

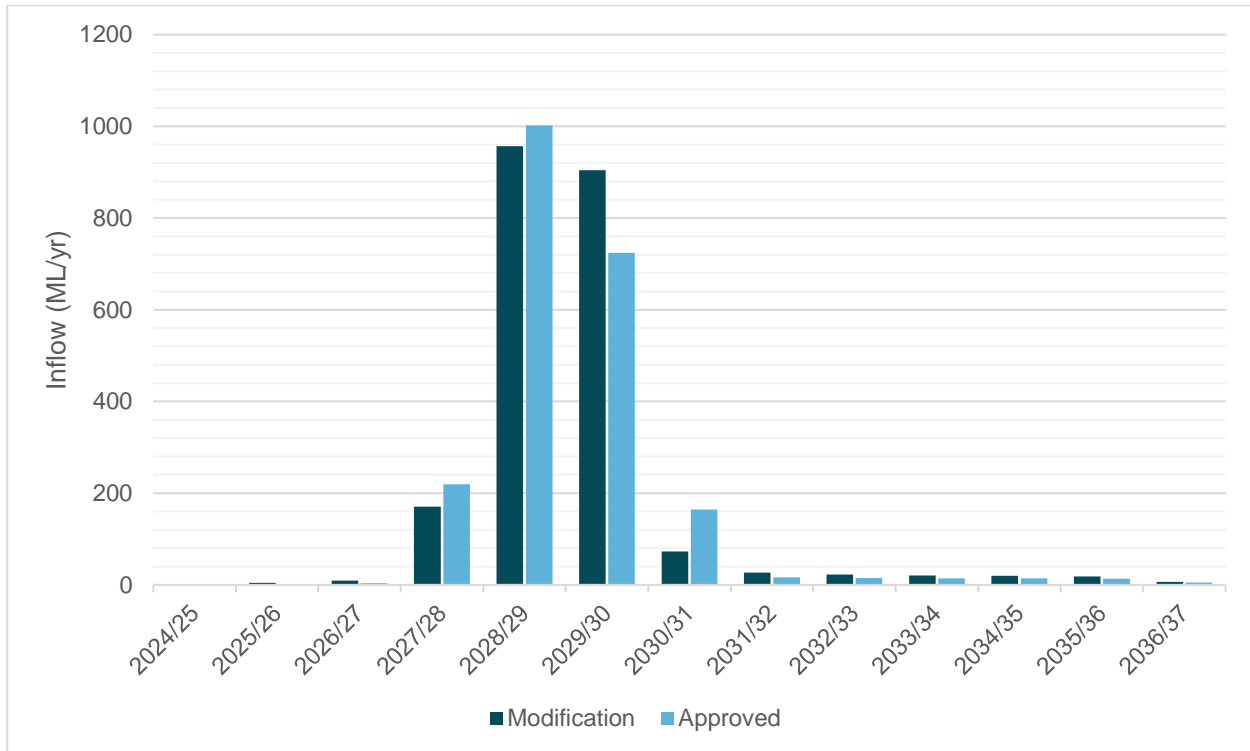


Figure 1 Predicted inflows to the UG2 mining area (with and without the Modification)

The Modification would result in an increase in the peak inflow to the UG2 mining area of 180 megalitres per year (ML/year) in water year 2029/30.

Figure 2 presents the predicted inflows to the UG2 mining area alongside the sum of predicted inflows to all MCC mining areas including the UG2 Modification.



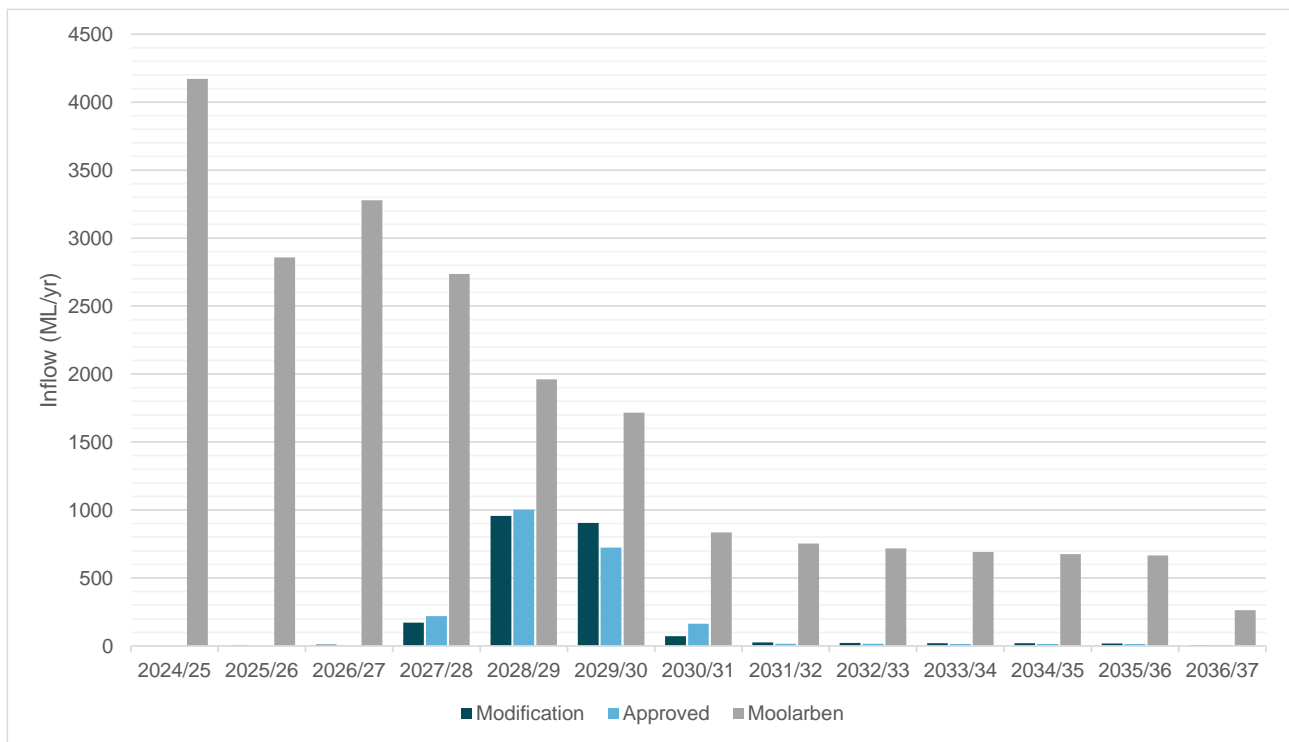


Figure 2 Predicted inflows to the UG2 mining area and the whole of Moolarben

Figure 3 to Figure 6 show the incremental drawdown/depressurisation due to the Modification in the key hydrostratigraphic units. The incremental drawdown maps demonstrate that:

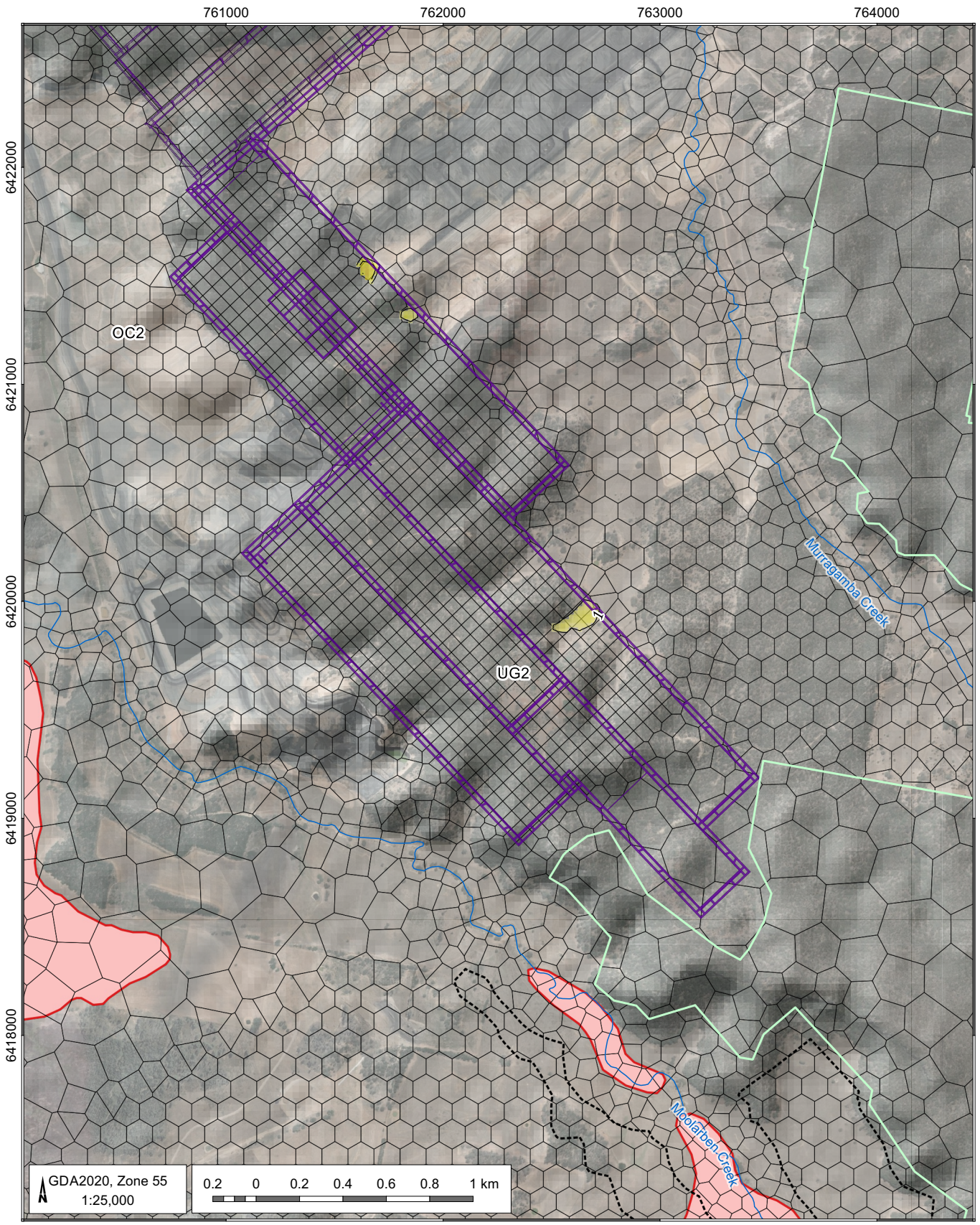
- There is very little additional drawdown expected within the alluvium/colluvium, palaeochannel sediments, or the Ulan Seam as a result of the Modification (Figure 3 and Figure 6).
- There is minimal additional drawdown expected in the Triassic quartzose sediments as a result of the Modification. Additional drawdown is confined to within approved UG2 mining area (Figure 4).
- An additional 1 m of groundwater drawdown within the Permian overburden is not expected beyond 300 m from the extended UG2 mining area (Figure 5).
- Minor additional drawdown within the Permian overburden (i.e. up to approximately 10 m) is expected to occur over the approved UG2 mining area and extended UG2 mining area due to a combination of longwall panel alignment changes and an associated increase in fracture height due to the minor increase in panel widths (Figure 5).

It should be noted that these figures only show the areas where additional drawdown is expected to occur due to changes in UG2 and do not show areas where a reduction in drawdown is expected to occur (i.e. due to panel alignment changes).

Figure 7 and Figure 8 show the cumulative drawdown resulting from the neighbouring Ulan and Wilpinjong mine operations as well as all MCC mining areas including the UG2 Modification.

Predicted inflows into UG2 increased for both approved and the Modification for the updated numerical model, and this increase is also seen in slightly higher magnitudes of the predicted drawdown contours. This is a response to re-calibrated hydraulic parameters and recalculated initial heads which have resulted in a better SRMS result. Overall, these predictions are commensurate with previous predictions in the Groundwater Review for the UG2 Modification Report (AGE, 2021).





LEGEND

- Drawdown contour (m)
- UG2 Modification
- Drainage
- - - OC3 proposed extension
- Alluvium extent
- Moolarben Coal Mines property boundary
- Model mesh

Drawdown (m)

- 1
- 2
- 5
- 10
- 20
- 50
- 100
- 200
- 500

Moolarben (MOO1622F)

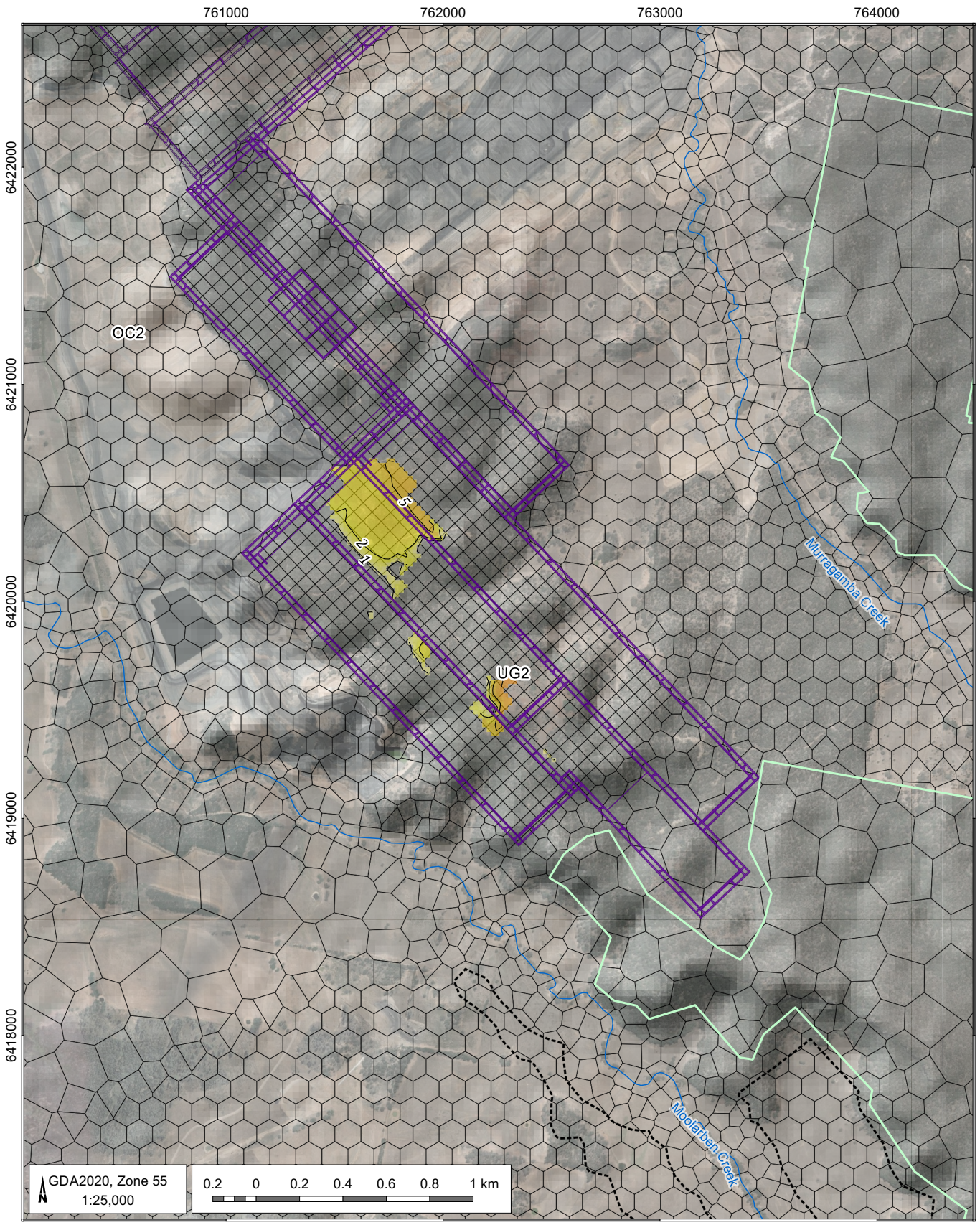
**Drawdown in the alluvium/colluvium and palaeochannel sediments due to UG2 Modification at end of UG2 mining for the updated numerical model**



DATE  
23/11/2022

FIGURE No:  
**3**





LEGEND

- Drawdown contour (m)
- UG2 Modification
- Drainage
- - - OC3 proposed extension
- Moolarben Coal Mines property boundary
- Model mesh

Drawdown (m)

- 1
- 2
- 5
- 10
- 20
- 50
- 100
- 200
- 500

Moolarben (MOO1622F)

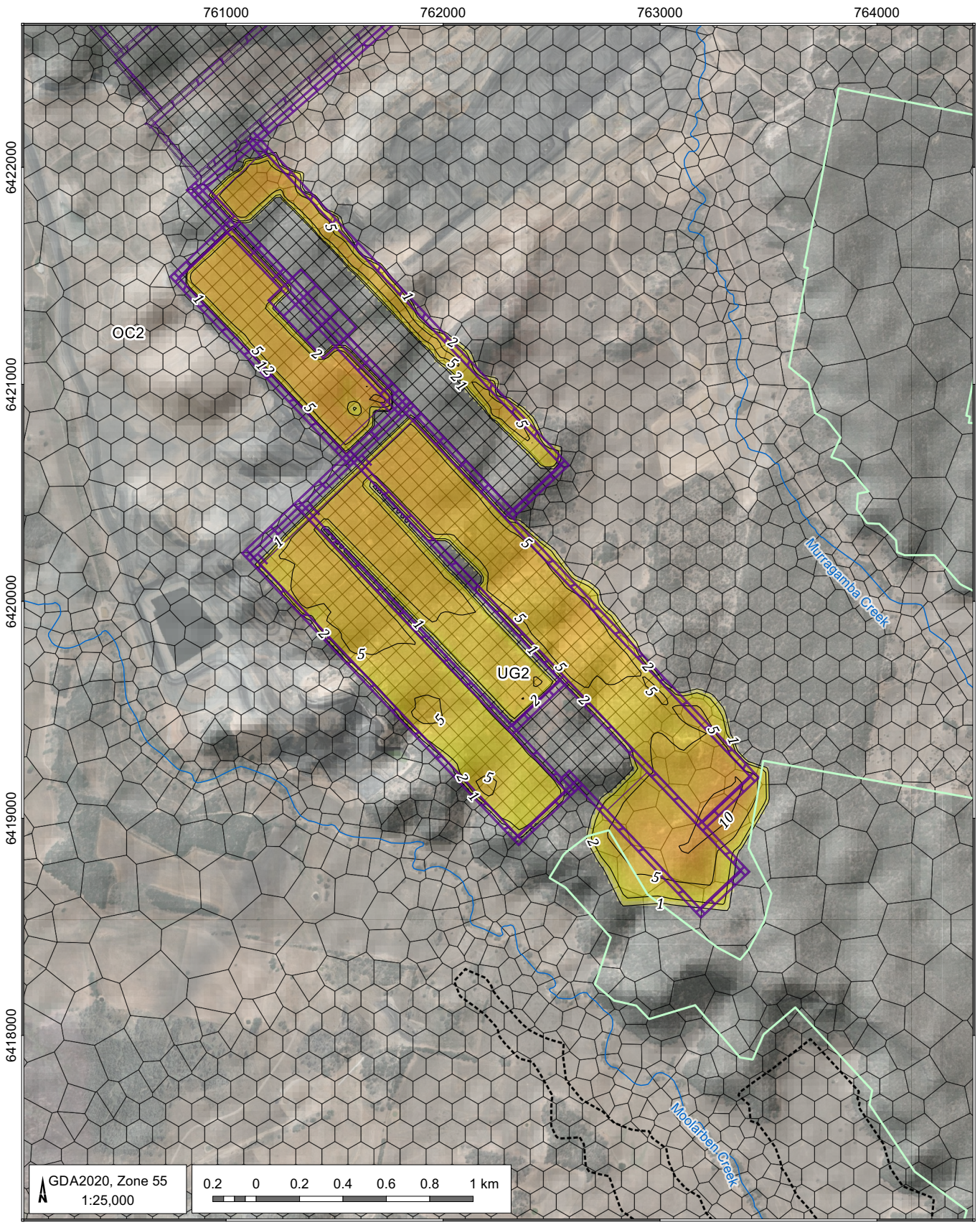
**Drawdown in layer 7 (base of Triassic quartzose) due to UG2 Modification at end of UG2 mining for the updated numerical model**



DATE  
23/11/2022

FIGURE No:  
**4**





LEGEND

- Drawdown contour (m)
- UG2 Modification
- Drainage
- - - OC3 proposed extension
- Moolarben Coal Mines property boundary
- Model mesh

Drawdown (m)

- 1
- 2
- 5
- 10
- 20
- 50
- 100
- 200
- 500

Moolarben (MOO1622F)

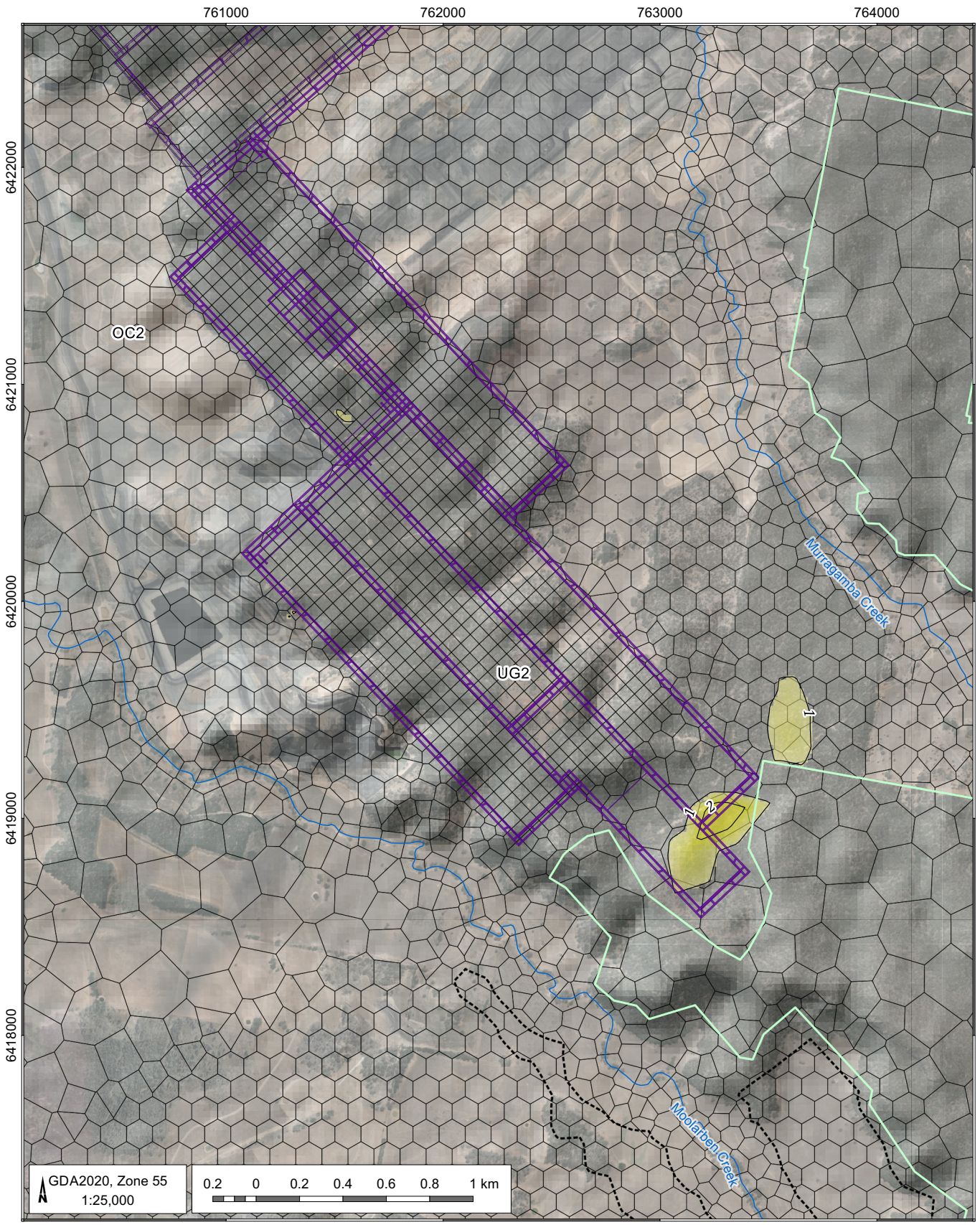
**Drawdown in layer 14 (base of Permian overburden) due to UG2 Modification at end of UG2 mining for the updated numerical model**



DATE  
23/11/2022

FIGURE No:  
**5**





LEGEND

- Drawdown contour (m)
- UG2 Modification
- Drainage
- - - OC3 proposed extension
- Moolarben Coal Mines property boundary
- Model mesh

Drawdown (m)

- 1
- 2
- 5
- 10
- 20
- 50
- 100
- 200
- 500

Moolarben (MOO1622F)

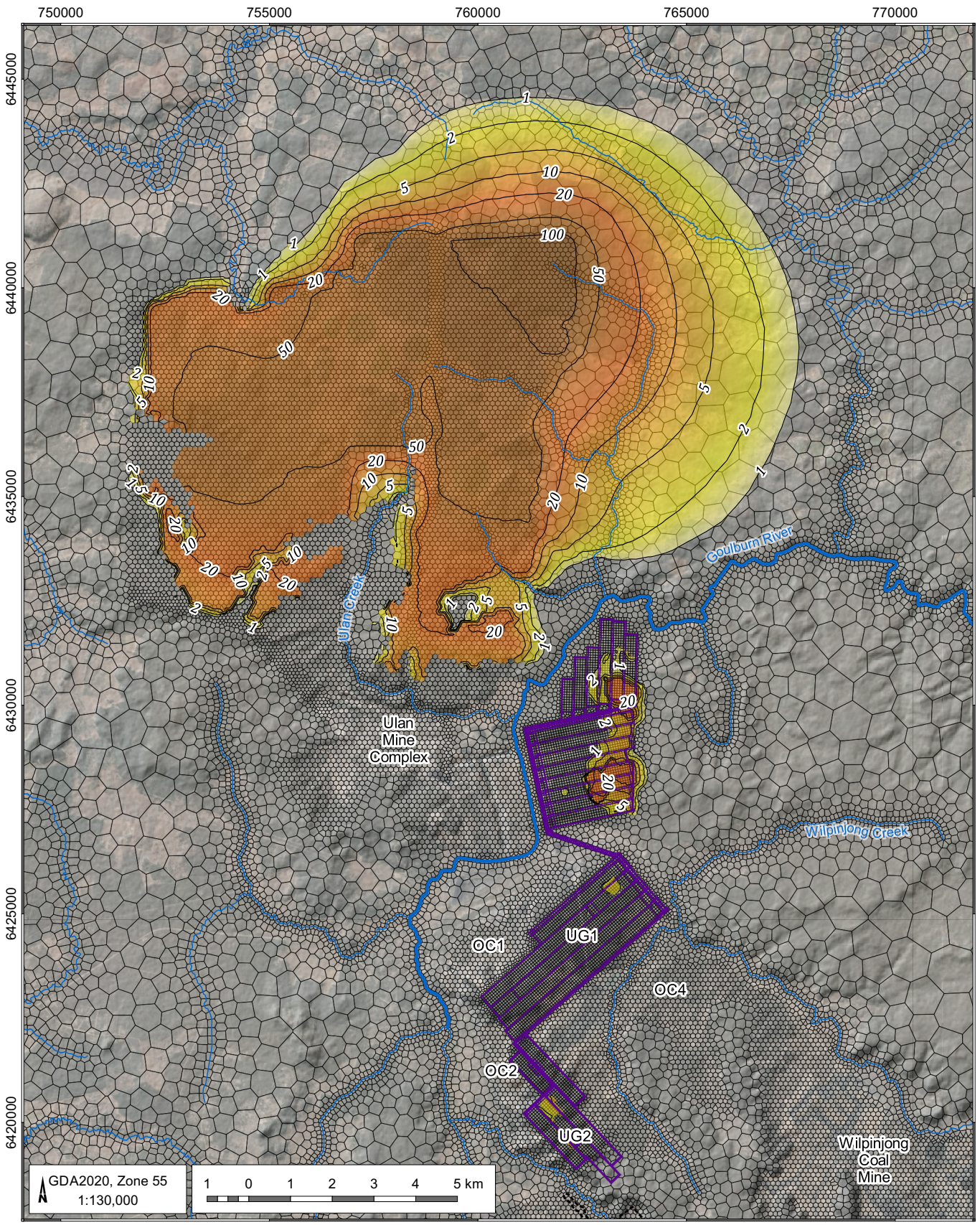
**Drawdown in layer 17 (Ulan Seam WS2) due to UG2 Modification at end of UG2 mining for the updated numerical model**



DATE  
23/11/2022

FIGURE No:  
**6**

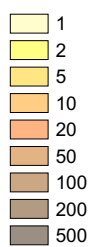




LEGEND

- Drawdown contour (m)
- UG2 Modification
- Drainage
- - - OC3 proposed extension
- ▭ Moolarben Coal Mines property boundary
- ▭ Model mesh

Drawdown (m)



Moolarben (MOO1622F)

**Cumulative drawdown in layer 7 (base of Triassic quartzose) for the updated numerical model**

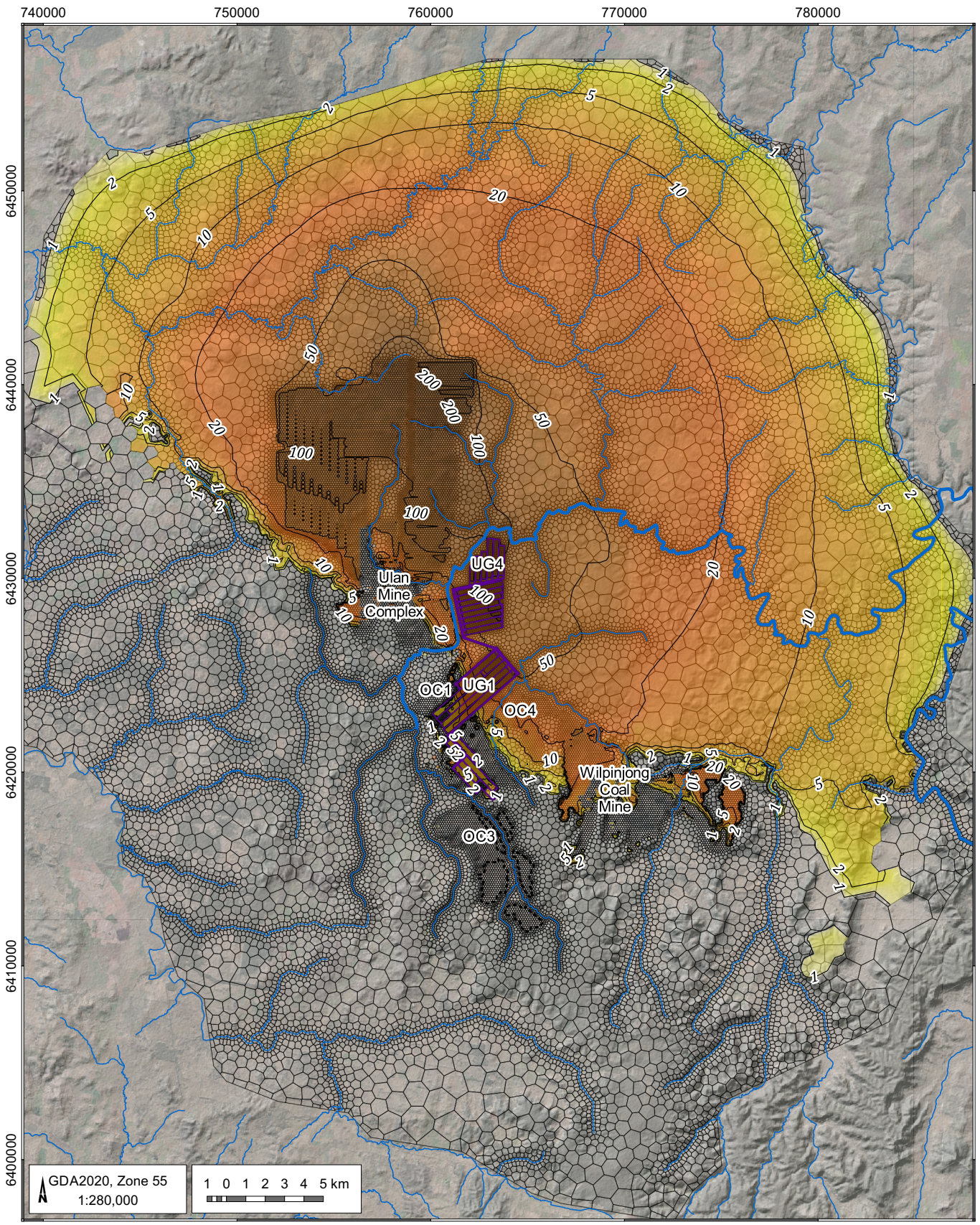


AGE

DATE  
23/11/2022

FIGURE No:  
**7**

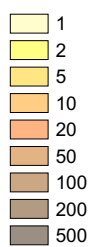




LEGEND

- Drawdown contour (m)
- UG2 Modification
- Drainage
- - - OC3 proposed extension
- ▭ Moolarben Coal Mines property boundary
- ▭ Model mesh

Drawdown (m)



Moolarben (MOO1622F)

**Cumulative drawdown in layer 14  
(base of Permian overburden) for the  
updated numerical model**



DATE  
23/11/2022

FIGURE No:  
**8**



**ATTACHMENT 4**  
**GROUNDWATER PEER REVIEW OF UG2 MODIFICATION**



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<b>Subject</b>	<b>Groundwater assessment of UG2 Modification – Review</b>	<b>Project Name</b>	Moolarben UG2 Modification
<b>Attention</b>		<b>Project No.</b>	IA279100
<b>From</b>	Brian Barnett		
<b>Date</b>	18 November 2022		
<b>Copies to</b>			

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## 1. Introduction

This document provides final peer review comments on groundwater assessments recently undertaken for the proposed Moolarben UG2 (Underground 2) modification as reported in the Moolarben Coal Complex, UG2 Modification, Appendix B Groundwater Review by Australasian Groundwater and Environmental (AGE) Consultants Pty Ltd., version 01.03 dated November 2021 (AGE, 2021).

Following revision and re-calibration of the numerical groundwater model of the Moolarben Coal Complex in 2022 for the proposed OC3 (Open Cut #3) Extension, the groundwater impact predictions were updated and reported in the technical memorandum *re: Moolarben UG2 Modification* prepared by AGE and dated 9 November 2022 (AGE, 2022b). My review addresses both of these documents and draws on my recent review (Jacobs, 2022) of the Groundwater Technical Report for Moolarben OC3 Extension Groundwater Impact Assessment by AGE, version 01.07 dated November 2022 (AGE, 2022a).

In summary, I have reviewed the following documents:

- AGE, 2022a provides a detailed description of the latest version of the numerical groundwater model. Refer to Jacobs, 2022 for a detailed review of this work.
- AGE, 2021 describes the proposed UG2 Modifications along with a conceptual assessment of how the proposal may impact groundwater. It summarises the statutory requirements for the proposed developments and discusses components of the hydrogeological conceptualisation that are relevant to the UG2 Modification. Predictive scenarios have been run and reported in this document and have been subsequently updated and reported by AGE, 2022b.
- AGE, 2022b reports the updated predictive scenarios aimed at quantifying groundwater impacts associated with the proposed UG2 Modification using the latest version of the model.

I am a hydrogeologist and groundwater modeller with more than forty years of consulting industry experience. My qualifications and experience are summarised in Appendix A: Curriculum Vitae.

I believe I am suitably independent as I:

- Have no pecuniary interest in the project.
- Have never worked for the proponent either as an employee or consultant, other than in a peer review capacity.
- Have never worked or collaborated with the proponent's specialists (AGE Consultants), other than in a peer review capacity.
- In the last ten years I have not worked on another nearby project that may have material cumulative impacts with the Moolarben Project, other than in a peer review capacity.

Given that I have recently reviewed the development, application and reporting of the groundwater model of the Moolarben Coal Complex, the focus of my current review is the updated predictive scenarios used to quantify the incremental impacts of the UG2 Modification.

The Moolarben Coal Complex is a combined open cut and underground coal mining operation located approximately 40 km north of Mudgee in New South Wales. It comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities). Mining has been on-going since 2010 and the mine is currently operated by subsidiaries of Yancoal Australia Limited.

The Moolarben Coal Complex is set in the Western Coalfield, which is located on the northwest margin of the Sydney-Gunnedah-Bowen Basin. It is located in an established coal mining area with significant nearby operations including the Ulan Mine Complex and Wilpinjong Coal Mine.

The mine is located within the headwaters of the Goulburn River system which drains to the east and into the Hunter River catchment. The nearest surface water features, including Moolarben Creek, Murdering Creek, Wilpinjong Creek and their tributaries, many of which are ephemeral, flow into the Goulburn River.

## 2. Modelling Objectives

The UG2 Modification modelling objectives are not explicitly stated in the reports – but can be inferred from the reported work scope as follows:

- *Review of previous groundwater assessments and relevant monitoring data*
- *Preparation of a conceptual groundwater model for the UG2 mining area and identification of potential impact pathways for the Modification*
- *Updated numerical groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett et.al, 2012); and*
- *Review of existing groundwater management and monitoring measures and consideration of their suitability for the Moolarben Coal Complex (incorporating the Modification).*

### 3. Model development and calibration

My previous review (Jacobs, 2022) of the model provides a description of the model design including information on the modelling software, model architecture, boundary conditions and climatic (recharge and evapotranspiration) stresses applied to simulate the pre-mining, mining and post-mining conditions.

Calibration has been undertaken in a transient history matching of measured groundwater responses making use of measured groundwater heads in observation wells that illustrate head changes caused by historic mining at Moolarben and neighbouring mines. The process has been undertaken with a combination of manual testing and automated (PEST) methods with pilot points used in all model layers to establish spatial variability in hydraulic conductivity throughout the model domain.

Initial calibration to measured groundwater head responses was followed by an assessment of model predicted fluxes to measured or estimated inflows to the Ulan and Ulan West mines, to the Moolarben UG1 and UG4 operations and to the estimated groundwater discharge rates from the Drip (a spring located about 10 km north of the proposed UG2 Modification). The model-predicted heads and fluxes provide an excellent representation of the measured heads and fluxes indicating that the model is well calibrated.

By using both head and groundwater flux calibration data, the non-uniqueness in model parameters can be substantially reduced and the resultant model confidence improved. The approach adopted by AGE represents an appropriate use of available data to constrain model parameters through calibration that uses historical observations at the site and elsewhere in the model domain.

I have concluded that the calibration approach and outcomes meet all reasonable expectations (including guiding principles outlined in Australian Groundwater Modelling Guidelines).

### 4. Predicted impacts

The proposed UG2 Modification includes a number of relatively minor changes (in a hydrogeological sense) to the currently approved UG2 operations. The modifications include the following components that are expected to influence groundwater behaviour:

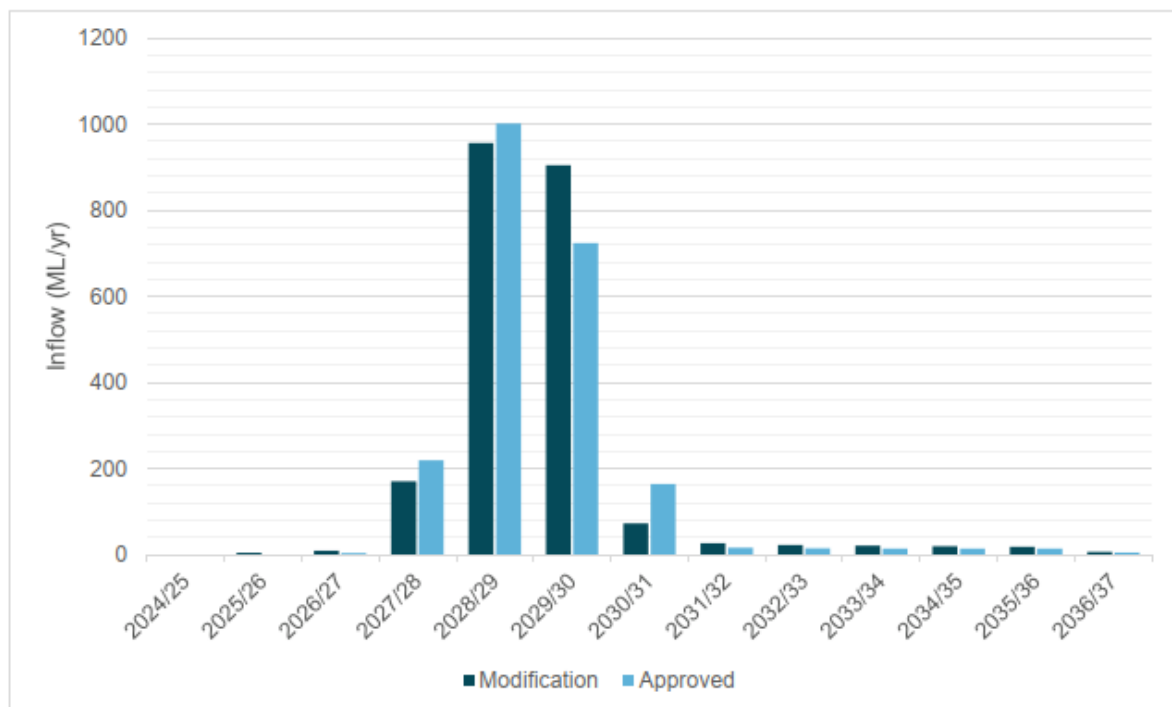
- Optimisation of the approved UG2 layout (including the extension of two approved longwall panels to the southeast).
- Increased UG2 extraction height from 3.0 metres (m) to 3.5 m.
- Revised UG2 mining sequence.
- Small reduction in the approved OC4 extent to accommodate the optimised UG2 layout.

To assess the impacts of the UG2 Modification, two predictive scenarios were developed and run as follows:

- A baseline scenario (null case scenario) that includes all approved mining at the Moolarben Coal Complex (including the approved UG2 mining) and at the neighbouring Wilpinjong and Ulan Mines.

- A scenario that includes all approved mining at Moolarben and neighbouring mines included in the baseline scenario with the UG2 Modification in place of the currently approved UG2 mining.

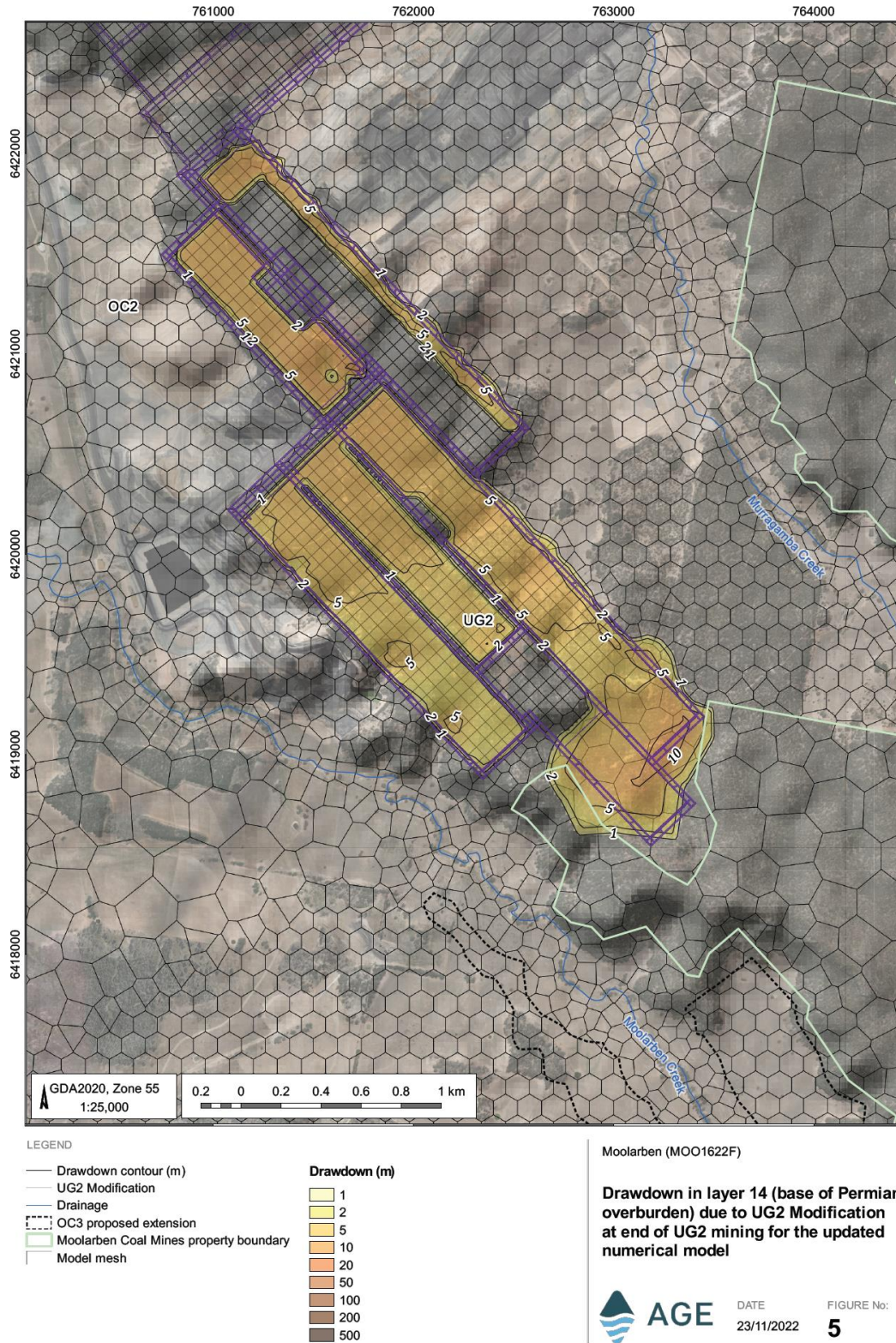
The incremental impacts associated with the UG2 Modification have been obtained from the difference in groundwater responses to the two scenarios. Results are reported in AGE, 2022b. They illustrate a quantum of predicted inflows to the workings that is almost unchanged from those expected for the approved UG2 development. The major difference between the inflows predicted for the Modification and those for the approved UG2 mining is in the timing of the inflows. Inflows to the Modification are expected to be higher in 2029/2030 and lower than or similar to the approved operation in all other years. The result is illustrated in Figure 1 below.



**Figure 1** – Predicted inflows to the UG2 mine working with and without the Modification (after AGE, 2022b Figure 1).

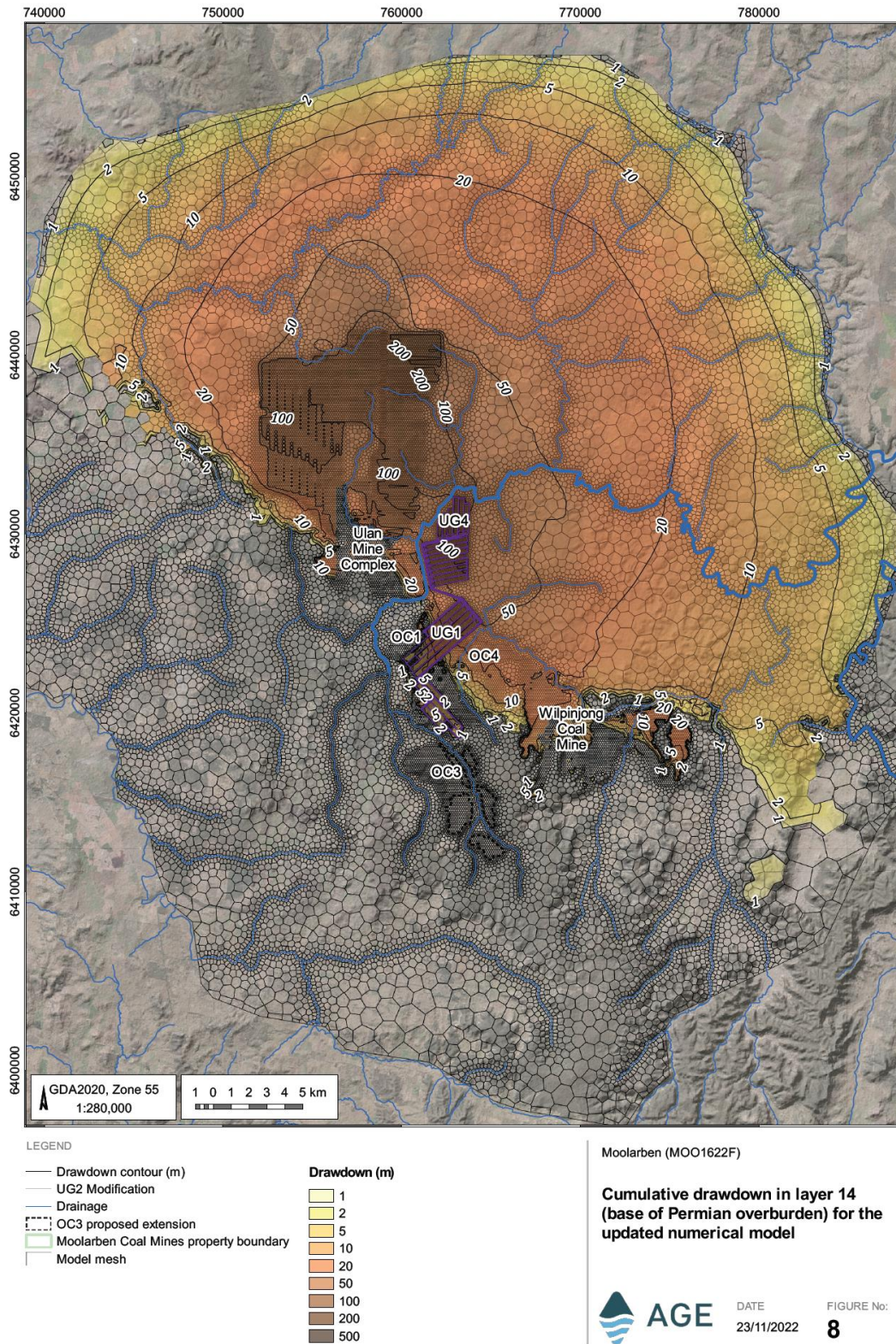
Predicted drawdown caused by the UG2 Modification is greatest in model Layer 14 at the base of the Permian overburden with a maximum of about 10 m drawdown expected in a small area above the extended UG2 workings. This can be seen in Figure 2 below. The figure illustrates the model calculation mesh is less refined in the area of the UG2 extension to the southeast of the currently approved UG2. It is interesting to note that the drawdown during mining is predicted to spread marginally more in the coarser model elements than in the finer elements that encompass the approved UG2 mining extent. The result suggests the marginally greater drawdown impacts predicted in the area of coarser elements is a modelling artefact. Figure 3 shows the predicted drawdown at the end of mining caused by all approved mining operations. When the drawdown caused by the UG2 Modification shown in Figure 2 is compared with the predicted drawdown when all currently approved mining is considered, as shown in Figure 3, it can be seen that the additional impact of the Modification is negligible.





**Figure 2** – Drawdown predicted at the end of mining at the base of the Permian overburden due to the Modification (After Figure 5 of AGE, 2022b).





**Figure 3** – Cumulative drawdown predicted at the end of mining at the base of the Permian overburden due to all approved mining (After Figure 8 of AGE, 2022b).

### 5. Uncertainty Analysis

Although there is no uncertainty analysis presented specifically for the UG2 Modification, AGE, 2022a presents an uncertainty analysis focussed on the proposed OC3 Extension that can be expected to illustrate the level of predictive uncertainty associated with the incremental impact predictions presented in AGE, 2022b. In other words, the uncertainty in predicted inflows and associated drawdown of up to  $\pm 30\%$  illustrated for the OC3 Extension is likely to be equally applicable to the predicted impacts at the nearby, proposed UG2 Modification.

As noted in Jacobs, 2022, the uncertainty analysis has adopted an approach described as a *deterministic scenario analysis with subjective probability assessment* (Middlemis and Peeters, 2018) which explores predictive uncertainty given a number of assumptions on the potential variability (uncertainty) in key hydrogeological parameters. In this approach the modeller uses experience from the calibration process and other knowledge of the hydrogeological characteristics to create an ensemble of predictive model realisations. Parameter selection is considered subjective as it relies on the judgement of the modeller to define parameters that provide a reasonable representation of uncertainty. The realisations are aimed at illustrating the potential range of modelling outcomes that may be expected when key parameters are varied within a plausible range. The key drawback of this approach is that the selected model realisations are not tested by calibration and some may not be consistent with historically observed groundwater behaviour. In some respects, this issue can be negated by choosing conservative parameters to illustrate that, even with the worst possible combination of parameters, it is unlikely that significant adverse impacts may arise.

The method is considered to be the simplest approach to predictive uncertainty analysis and is usually considered appropriate for those modelling studies in which the predicted impacts are relatively modest or where the consequences of having poorly defined predictive uncertainty are not severe. In my opinion the approach is suitable for the current study in which incremental impacts of the UG2 Modification are negligible when compared to existing and anticipated future impacts predicted for the currently approved mining.

### 6. Peer Review Findings

1. The predictive modelling for the UG2 Modification is based on a model developed by AGE to assess potential impacts of the nearby OC 3 Extension. I have recently reviewed this model in detail and have concluded it is fit for the purpose of predicting mining related impacts within the Moolarben Coal Complex.
2. Methods used to simulate the mining disturbance associated with the UG2 Modification appear to be aligned with current industry practice.
3. While I note that the model mesh is relatively coarse within the planned extension of UG2, I am of the opinion that this, in itself, will not impact on the reliability of the predictive assessment. Results suggest that the coarser modelling mesh generates slightly conservative outcomes in that predicted drawdown in this part of the model is marginally more widespread than in areas where the mesh is more refined.
4. AGE has used the model to simulate potential impacts of the proposed UG2 Modification by simulating the mining activities with and without the proposed modifications. Impacts are then obtained as the difference in groundwater responses simulated in these two scenarios. The approach is supported by the Australian Groundwater Modelling Guidelines and is considered best practice for isolating the incremental impacts of the proposed activity.
5. The results presented in the report indicate minimal impacts are predicted. It appears that the area is already de-pressured due to nearby underground and open cut operations targeting the same coal seams as those that will be mined in the UG2 Modification.



6. The results suggest that the planned UG2 Modification is expected to cause drawdown to propagate through sediments and formations overlying the UG2 workings and that drawdown impacts are likely to be limited to the region immediately above longwall panels.

I have concluded that the model is fit for the purpose of impact quantification and assessment and, in particular, it is able to meet the modelling objective of quantifying drawdown impacts associated with the proposed UG2 Modification. While I note that a deterministic Uncertainty Analysis has been undertaken that provides a relatively crude assessment of predictive uncertainty, I am happy that the approach is consistent with guidance provided by Middlemis and Peeters, 2018 and is appropriate in this instance given the relatively small impacts predicted to accompany the proposed development.

## 7. References

AGE, 2021. Moolarben Coal Complex, UG2 Modification, Appendix B Groundwater Review by Australasian Groundwater and Environmental (AGE) Consultants Pty Ltd., version 01.03 dated November 2021.

AGE, 2022a. Groundwater Technical Report for Moolarben OC3 Extension Groundwater Impact Assessment by AGE, version 01.07, dated November 2022.

AGE, 2022b. *re: Moolarben UG2 Modification*. Technical Memorandum prepared by AGE, dated 9 November 2022.

Barnett B, Townley LR, Post V, Evans RE, Hunt RJ, Peeters L, Richardson S, Werner AD, Knapton A and Boronkay A., 2012, *The Australian Groundwater Modelling Guidelines*. Waterlines Report #82, National Water Commission, Canberra.

HydroSimulations. (2017). Moolarben Coal Open Cut Optimisation Modification. Groundwater Assessment. Prepared for Moolarben Coal Operations Pty Ltd. Included as Appendix I of the Moolarben Coal Complex Open Cut Optimisation Modification – Groundwater Assessment. Date October 2017.

Jacobs, 2022. *Moolarben Open Cut #3 - Groundwater Technical Report Review*. Technical Memorandum prepared by B Barnett. 3 November 2022.

Middlemis, H and Peeters, LJM, 2018. *Uncertainty Analysis – Guidance for groundwater modelling within a risk management framework*. A report prepared by the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2018.

### Appendix A: Curriculum Vitae

#### Brian Barnett



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#### Qualifications:

Bachelor of Engineering (Civil), University of Auckland, 1980

#### Relevant Experience:

**Jacobs Group (Australia) Pty Ltd. (Prior to December 2013 SINCLAIR KNIGHT MERZ, AUSTRALIA)**

**May 2000 to present**

Senior Hydrogeologist and Geothermal Reservoir Engineer SKM, Melbourne, Australia.

Responsible for groundwater modelling and geothermal studies. Major projects include:

- ***Australian Groundwater Modelling Guidelines. National Water Commission.*** Project manager and principal contributor to an Australian Groundwater Modelling Guideline that is planned to supersede the current Murray Darling Basin Commission guidelines. The project was completed in March 2012 and the document was published in June 2012.
- ***Frieda River Mine Dewatering Investigations. Xstrata Copper.*** Groundwater modelling of a proposed copper mine in Papua New Guinea. Groundwater models were used to estimate the dewatering pumping requirement for the mine and to provide an assessment of the environmental impacts that may accompany mine dewatering.
- ***New Acland Coal Mine. New Hope Group.*** Developed a groundwater model of the New Acland Coal Mine to assist with gaining environmental and industry approvals for expanding coal mining operations. The model was used to predict the likely future inflows to the mining pits and to assess potential impacts that may arise from the inflows and associated drawdown in groundwater



heads. The work has included expert witness appearance in recent Queensland Land Court proceedings.

- ***Wards Well Coal Mine. BMA.*** Supervising the modelling of an underground coal mine in Queensland. The model includes time varying material properties that represent deformation of formations above long wall mine panels.
- ***Kulwin Mineral Sands Mine Dewatering Investigations. Iluka Resources Ltd.*** Detailed numerical groundwater models were developed to help design the mine dewatering system. Investigations were aimed at depressuring the local groundwater system to expose the mineral sand deposits to allow dry mining of the resource. The models paid particular attention to vertical flow processes in and around the deposit and hence incorporated multiple (27 layers in total) horizontal layers.
- ***Pardoo Iron Ore Mine Dewatering Investigations. Atlas Iron.*** Groundwater models were developed in the FEFLOW numerical modelling code to estimate the mine dewatering requirements of an iron ore mine in the Pilbara region of Western Australia.
- ***Northern Murray Basin Environmental Effects Statement. Iluka Resources Ltd.*** Preparation of a water management report that formed part of the EES for the Kulwin and WRP deposits in the Northern Murray Basin Project. Work included the development of regional groundwater flow models to assess environmental impacts of dewatering and water disposal.
- ***Mine dewatering for Murray Basin Titanium Ltd for the Wemen Mineral Sand Mine.*** Numerical groundwater models were formulated and calibrated in order to help optimise a dewatering plan for a mineral sand deposit in Northern Victoria. The models were also used to assess the likely impacts of dewatering and associated water disposal on the Murray River.
- ***Mine water management consultant for Murray Basin Titanium Ltd for the Prungle Mineral Sand Mine.*** Responsibilities included the development of numerical groundwater models to assist in designing a groundwater supply scheme to provide water for a dredge mining operation in Northern Victoria. Investigations also included the assessment of groundwater extraction and disposal on local and regional surface water and groundwater resources.
- ***Murray Darling Basin Sustainable Yields Project. CSIRO.*** Groundwater modelling team leader for a major project covering groundwater resources in Queensland, New South Wales, Victoria and South Australia. SKM was contracted by CSIRO in 2007 to undertake the groundwater resource assessment for the entire Murray Darling Basin. The project involved the numerical modelling of all major fresh water aquifers in the basin. Twelve finite difference numerical models were run for the study. Results were used to quantify the available groundwater resources of the basin and to assess the impacts of future climate change and impacts of groundwater development on river flows.
- ***Northern Sewer Project, Groundwater Models.*** Groundwater flow models were developed for the NSP1 and NSP2 sewer tunnels in north Melbourne. The models were used to assess inflows into the tunnels and to determine the likely impacts of groundwater drawdown on the aquifer and on

the associated loss of base flow to local streams and rivers. Models were constructed to assess both the construction and operational phases.

- ***Lindsay River Groundwater Modelling. DNRE Victoria.*** Development of a three dimensional finite element groundwater model of the aquifers within the Lindsay River Anabranche of the Murray River. The model was developed in the FEFLOW modelling code and is being used to design a salt interception scheme.
- ***Numerical Water Trade Models. Mallee CMA Victoria.*** Project manager and leader of modelling team to develop, calibrate and run predictive scenario models for the Nangiloc Colignan and Wemen irrigation areas in northern Victoria. Models were aimed at quantifying the impact on salinity in the River Murray associated with the trading of irrigation water.
- ***South East Queensland Effluent Reuse Study – Darling Downs.*** Brisbane City Council. The impacts associated with future use of treated effluent for irrigation in the Darling Downs was investigated through the development and calibration of large scale three dimensional groundwater flow and solute transport models. Impacts under investigation included changes in groundwater head, changes in the groundwater interaction with rivers and streams and the water quality changes in the aquifer.
- ***Lake Toolibin Groundwater Modelling. CALM WA.*** A three dimensional finite difference groundwater model was formulated to assess the dewatering performance of a network of pumping bores designed to reduce groundwater heads beneath Lake Toolibin. The project is aimed at minimising salinisation of the lake by reducing groundwater discharge through the lake bed.
- ***Barwon Downs Groundwater Modelling. Barwon Water, VIC.*** This project involved the development and calibration of a large three dimensional finite difference groundwater flow model to assess the safe long term yield from the Barwon Downs borefield. Models were calibrated over a thirty year period of observation and were run in predictive mode for 100 years.

### **KINGSTON MORRISON LIMITED, AUCKLAND**

#### **1997 to May 2000**

In July 1999, Kingston Morrison Ltd joined the Sinclair Knight Merz Group.

- **Senior Geothermal Reservoir Engineer.** Responsible for all aspects of geothermal reservoir assessment and well testing. Also responsible for all hydrogeological investigations and groundwater modelling.

### **SUMIKO CONSULTANTS COMPANY LIMITED, TOKYO, JAPAN**

#### **1991 to 1997:**

**Geothermal Reservoir Engineering Manager.** Responsible for the enhancement of geothermal reservoir engineering and mineral resource evaluation capabilities in Sumiko Consultants through the acquisition of reservoir and well bore simulation codes and the application of geostatistical methods and software.

### **GEOTHERMAL ENERGY NEW ZEALAND LIMITED (GENZL), AUCKLAND**

**1981 to 1991:**

**Reservoir Engineer.** Responsible for all geothermal reservoir engineering studies including extended assignments in Indonesia, Kenya and Japan.

### **HAWKES BAY REGIONAL WATER BOARD**

**1979 to 1981:**

**Groundwater Engineer.** Duties included the investigation of hydraulic and chemical characteristics of aquifers in the Hawkes Bay region and the preparation of resource management plans.



## Memorandum

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