MOOLARBEN COAL COMPLEX
OPEN CUT OPTIMISATION MODIFICATION

RESPONSE TO SUBMISSIONS

MOOLARBEN COAL PROJECT STAGE 1
PROJECT APPROVAL (05_0117) [MOD 14]

MOOLARBEN COAL PROJECT STAGE 2
PROJECT APPROVAL (08_0135) [MOD 3]

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1 INTRODUCTION

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

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

The Moolarben Coal Complex 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) (Figure 2).

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

MCO (2017) prepared the *Moolarben Coal Complex Open Cut Optimisation Modification Environmental Assessment* (the Environmental Assessment) that is being assessed under the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act).

The Environmental Assessment was placed on public exhibition by the NSW Department of Planning and Environment (DPE) from 7 November 2017 to 7 December 2017.

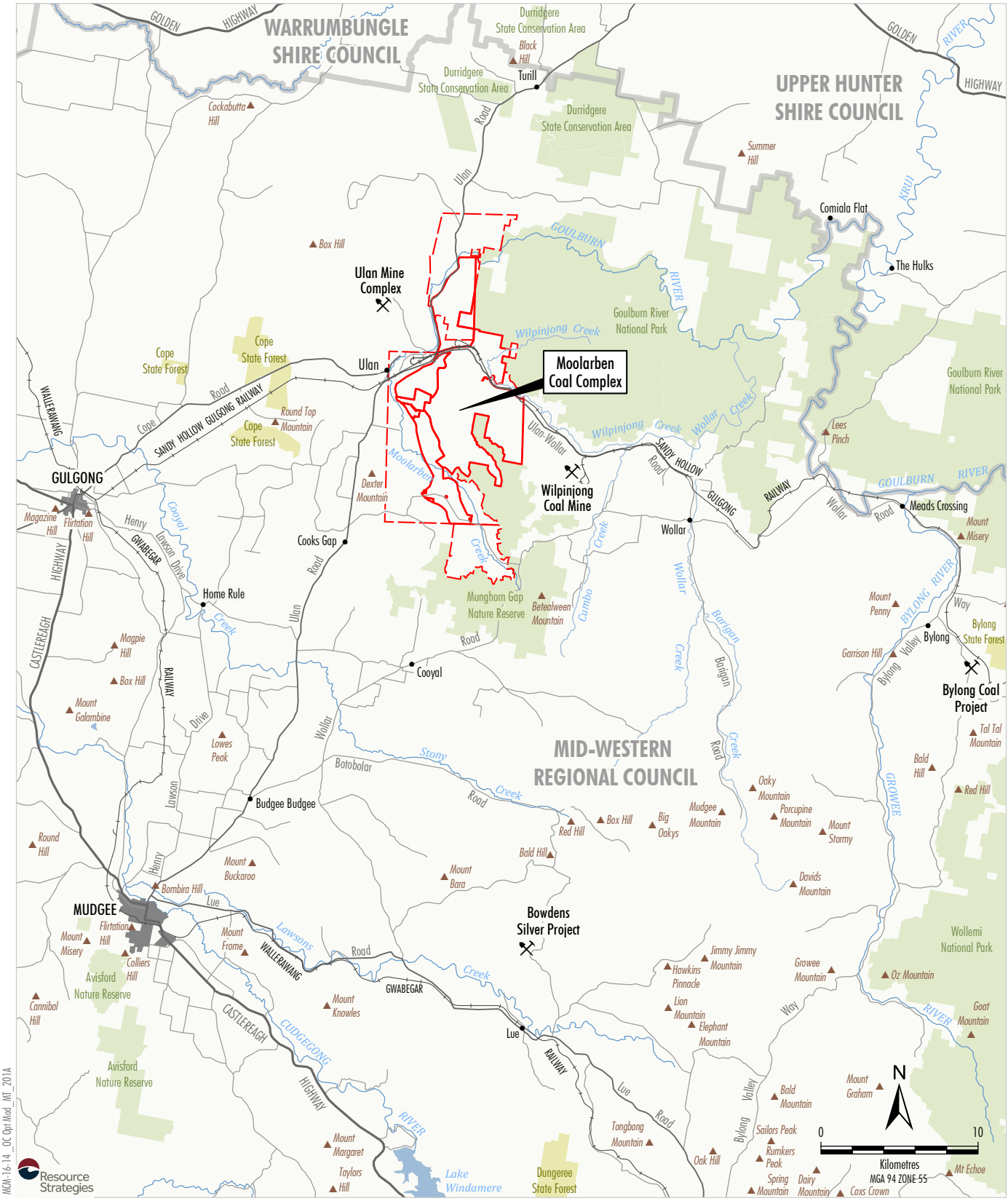
During this period, Government agencies, Non-government organisations (NGOs), businesses and members of the public were invited to provide submissions on the Environmental Assessment to the DPE.

The DPE has requested that MCO reviews and responds to the range of submissions that were received on the Environmental Assessment.

MCO's responses to submissions have been structured as follows:

- Part A – Responses to Government agency submissions (Section 6.1).
- Part B – Responses to NGO and Public Submissions (Section 6.2).

This Response to Submissions Report has been structured generally in accordance with *Guideline 5; Responding to Submissions of the Draft Environmental Impact Assessment Guidance Series June 2017* (DPE, 2017).



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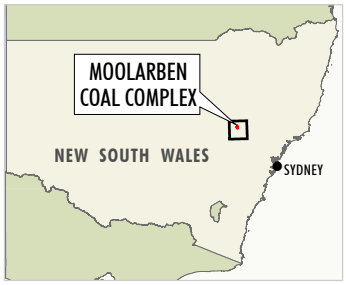
Resource Strategies



LEGEND
- State Forest
- NSW National Parks and Wildlife Service
- Local Government Boundary
- Exploration Licence Boundary
- Mining Lease Boundary
- Mining Operation

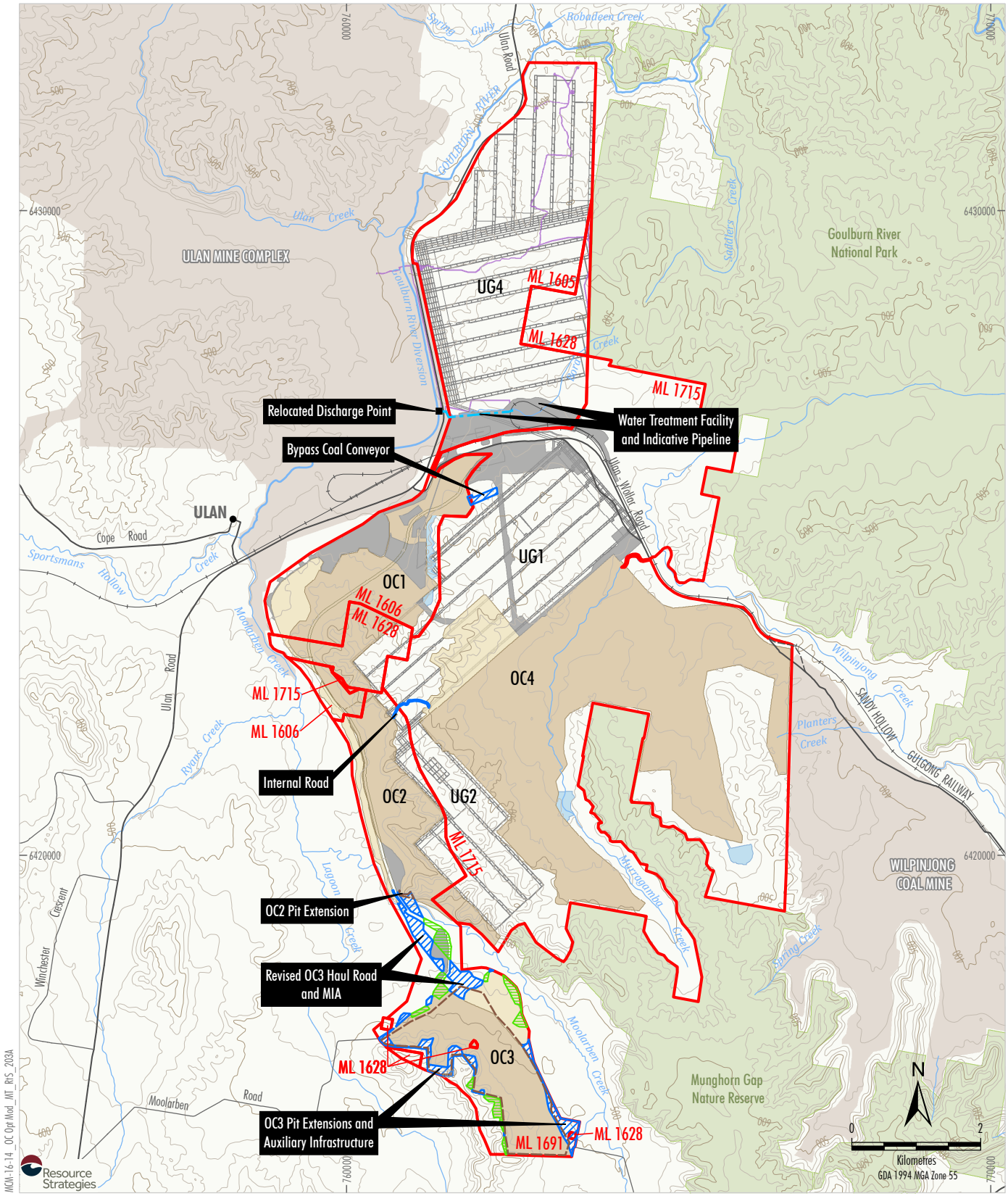
Source: NSW Land & Property Information (2017); NSW Department of Industry (2017); Office of Environment and Heritage NSW (2017)

MOOLARBENCOAL

MOOLARBEN COAL COMPLEX

Regional Location

Figure 1



LEGEND

NSW National Parks and Wildlife Service
Other Mining Operations
Mining Lease Boundary

Existing/Approved Development

Open Cut Mining Area
Out-of-pit Emplacement
Surface Infrastructure Area
Pipeline and Borefield Infrastructure
Clean Water Diversion Infrastructure
Underground Longwall Layout
Haul Road
Road Realignment (not yet constructed)

Open Cut Optimisation Modification

Approximate Extent of Revised Open Cut Mining Area
Approximate Extent of Additional Surface Development
Approved Open Cut Mining Area, Out-of-pit Emplacement and Surface Infrastructure to be Relinquished

Source: MCO (June 2017); NSW Dept of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

MOOLARBEN COAL COMPLEX

Open Cut Optimisation Modification General Arrangement

Figure 2

2 OVERVIEW OF THE MODIFICATION

The key element of the Modification is an increase in the amount of run-of-mine (ROM) coal production from the Stage 1 and Stage 2 open cuts (OC1 to OC4) and associated increase in the annual rate of coal processing and product coal production over the life of the mine. However, there would only be a minor (approximately 1%) increase in total life-of-mine ROM coal production.

The Modification also involves a minor extension to the OC2 pit limit, minor extensions and reductions of the OC3 pit limits and relocated/additional surface infrastructure (Figure 2). These elements of the Modification would require additional surface disturbance (Figure 2). However, net disturbance associated with the Modification would be reduced by the relinquishment of areas of approved disturbance, which would no longer be required for major surface infrastructure.

In addition, the approved OC3 out-of-pit emplacement would no longer be required for permanent out-of-pit rock emplacement, with waste rock extracted during the initial development of OC3 to be used as backfill material following temporary emplacement out-of-pit.

To manage predicted on-site water surpluses, water treatment facilities are proposed to be installed to support a proposed increase in controlled water releases from the currently authorised limit of 10 megalitres per day (ML/day) (as authorised by MCO's existing Environment Protection Licence [EPL] 12932) up to a maximum of 20 ML/day. Any increase to the currently authorised controlled release volume limit would be subject to a variation to EPL 12932.

The Modification **does not** involve changes to the Moolarben Coal Complex (Stages 1 and 2) for the following relevant components:

- operational mine life;
- OC1 or OC4 pit limits;
- hours of operation;
- underground coal extraction limits or mine layouts;
- blasting frequency limits;
- site access;
- method of reject disposal; and
- peak workforce.

Table 1 provides a summary of the key elements of the proposed Modification.

Table 1
Overview of the Approved Moolarben Coal Complex and the Modification

Relevant Approval Component	Moolarben Coal Complex		Moolarben Coal Complex (including the Modification)	
	Stage 1 Project Approval (05_0117)	**Stage 2 Project Approval (08_0135)**	**Stage 1 Project Approval (05_0117)**	**Stage 2 Project Approval (08_0135)**
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, 7 days per week.		Unchanged.	
Coal Extraction Limits	Up to 8 million tonnes (Mt) of ROM coal can be extracted from the open cut mining operations in any calendar year.	Up to 12 Mt of ROM coal can be extracted from the open cut mining operations in any calendar year.	Up to 10 Mt of ROM coal extracted from the open cut mining operations in any calendar year.	Up to 16 Mt of ROM coal extracted from the open cut mining operations in any calendar year.
	Up to 13 Mt (total) of ROM coal can be extracted from the open cut operations at the Moolarben Coal Complex in any calendar year.		Up to 16 Mt (total) of ROM coal extracted from the open cut operations at the Moolarben Coal Complex in any calendar year.	
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	Up to 13 Mt (total) of ROM coal from the Moolarben Coal Complex can be processed (washed) in any calendar year, except in the year 2017. Up to 13.5 Mt (total) of ROM coal from the Moolarben Coal Complex can be processed (washed) in 2017.	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.	Up to 16 million tonnes per annum (Mtpa) of ROM coal from the Moolarben Coal Complex can be processed (washed) in any calendar year.	Unchanged.
	Total coal production of 18 Mtpa.		Total coal production of 22 Mtpa.	
	All coal is to be transported from the site by rail (average of 7 trains per day and peak of 9 trains per day).		Average of 8 trains per day and peak of 11 trains per day.	
Blasting Frequency Limits	A maximum of 2 blasts per day and 9 blasts per week (averaged over a calendar year) can be carried out at the Moolarben Coal Complex.		Unchanged.	
	Blasting can be carried out on site between 9:00 am and 5:00 pm Monday to Saturday inclusive. No blasting allowed on Sundays, public holidays, or at any other time without written approval of the Secretary.			
Biodiversity Offset Strategy	The Biodiversity Offset Strategy is shown in Appendix 8 of the Project Approval (05_0117).	The Biodiversity Offset Strategy is shown in Appendix 7 of the Project Approval (08_0135).	Updated Biodiversity Offset Strategy to account for additional disturbances as required.	
Site Access	Site access via Ulan Road and Ulan-Wollar Road.		Unchanged.	

Table 1 (Continued)
Overview of the Approved Moolarben Coal Complex and the Modification

Relevant Approval Component	Moolarben Coal Complex		Moolarben Coal Complex (including the Modification)	
	Stage 1 Project Approval (05_0117)	**Stage 2 Project Approval (08_0135)**	**Stage 1 Project Approval (05_0117)**	**Stage 2 Project Approval (08_0135)**
Water Management Design and Objectives	Design, install and maintain the dams generally in accordance with the series *Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries.*		Unchanged.	
	Ensure there is sufficient water for all stages of the project in accordance with Condition 29, Schedule 3 of Stage 1 Project Approval (05_0117) and Condition 25, Schedule 3 of Stage 2 Project Approval (08_0135).			
	Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on site.			
	Mine water storage infrastructure is designed to store a 50 year average recurrence interval 72 hour storm event.	Mine water storage infrastructure is designed to store a 100 year average recurrence interval 72 hour storm event.		
	On-site storages (including tailings dams, mine infrastructure dams, groundwater storage and treatment dams) are suitably lined to comply with a permeability standard of less than 1 x 10^{-9} metres per second (m/s).	On-site storages (including tailings dams, mine infrastructure dams, groundwater storage and treatment dams) are suitably lined to comply with a permeability standard of less than 1 x 10^{-9} m/s.		
	Unless an EPL authorises otherwise, MCO will comply with section 120 of the NSW *Protection of the Environment Operations Act, 1997* (PoEO Act). (EPL 12932 currently authorises controlled releases of up to 10 megalitres per day [ML/day] to the Goulburn River)		Unchanged. Water treatment facilities to support authorised discharge under EPL water release limits and increase in maximum rate of controlled releases from 10 to 20 ML/day, when required.	
Coal rejects	Co-disposal of coal rejects with waste rock in the open cut voids.		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.	

3 ANALYSIS OF SUBMISSIONS

3.1 NUMBER OF SUBMISSIONS

A total of 75 submissions on the Modification were received from Government Agencies, NGOs, and members of the public. Graph 1 presents a summary of the number of submissions by submitter category.

3.2 GOVERNMENT AGENCY SUBMISSIONS

A total of 6 submissions were received from NSW Government Agencies, which were in the form of comments or suggested conditions.

3.3 NON-GOVERNMENT ORGANISATION SUBMISSIONS

A total of 11 submissions were received from NGOs, including environmental and community organisations, in the form of objections.

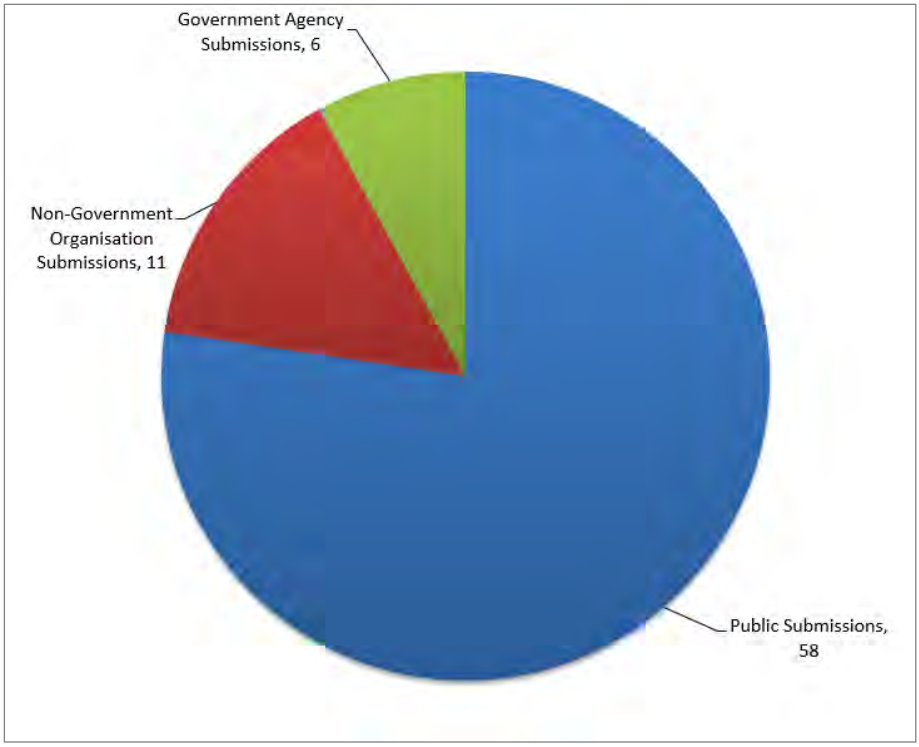
A breakdown of the locations of the NGOs that provided submissions is presented on Graph 2. Three of the 11 NGO submissions were from organisations based within the Mid-Western Regional Council (MWRC) Local Government Area (LGA), with the remaining NGOs located in other areas in NSW (outside the MWRC LGA).

3.4 PUBLIC SUBMISSIONS

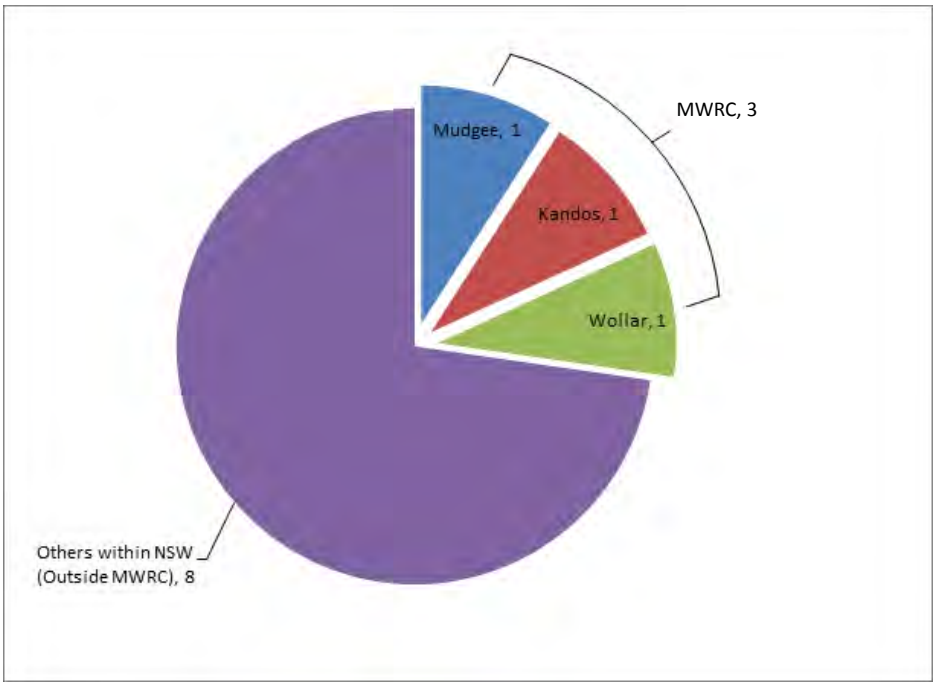
A total of 58 submissions were received from members of the public in the form of objections.

A breakdown of the locations of members of the public who provided submissions is presented on Graph 3. 28 of the 58 public submissions were from members of the public located within the MWRC LGA.

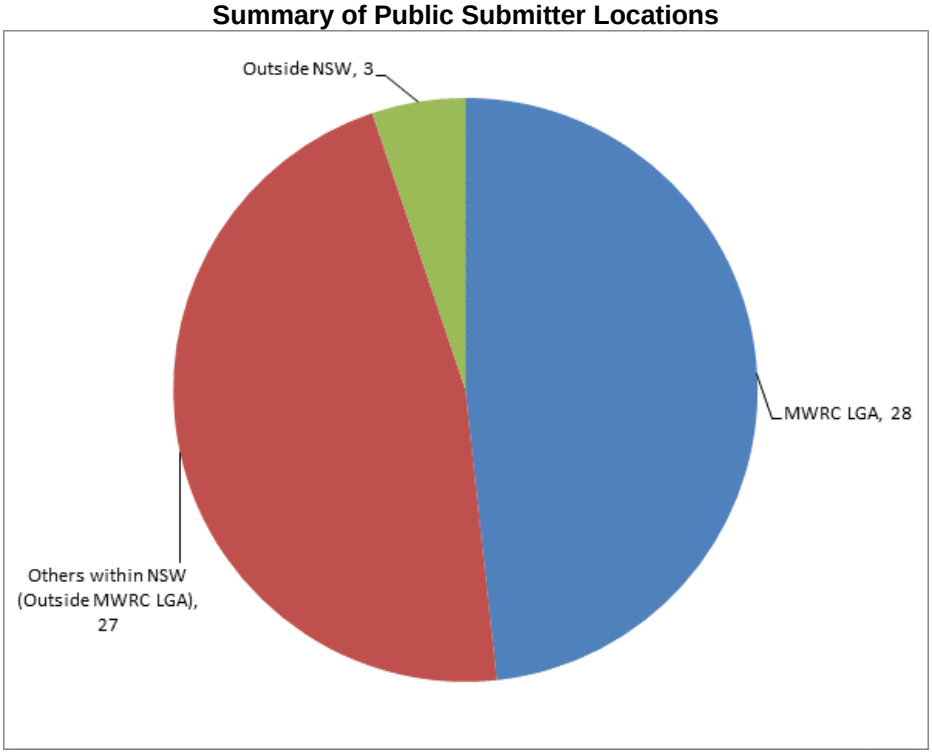
Graph 1
Summary of All Submissions



Graph 2
Summary of Non-Government Organisation Locations



Graph 3
Summary of Public Submitter Locations



3.5 KEY ISSUES RAISED IN SUBMISSIONS

While not exhaustive, the most commonly raised issues in submissions pertained to:

- potential impacts of the proposed changes to controlled releases of treated water to the Goulburn River;
- cumulative impacts of mining;
- potential impacts on biodiversity;
- potential impact of increased carbon emissions;
- cumulative socio-economic impacts on the local community; and
- potential impact of increased rail movements.

A number of issues raised in the Public/NGO submissions pertained to elements of the approved Moolarben Coal Complex that would be unchanged for the Modification.

4 ACTIONS TAKEN FOLLOWING EXHIBITION OF ENVIRONMENTAL ASSESSMENT

Subsequent to the public exhibition of the Environmental Assessment, the following additional analysis has been undertaken in response to requests by Government agencies in their submissions:

- Review of additional surface water quality monitoring data (to January 2018) upstream of the proposed relocated EPL discharge point by Advisian, to provide further analysis of upstream background metal concentrations in the Goulburn River (Attachment 1 to this RTS).
- Review of additional on-site storage water quality monitoring data (to January 2018) and surface water quality monitoring data in the Goulburn River by RGS Environmental (RGS), to provide further analysis of the ionic composition of water in on-site storages and in the Goulburn River (Attachment 2 to this RTS).
- Review of Advisian's and RGS's additional analysis (as above) by Marine Pollution Research, in regard to any potential impacts to aquatic ecology in consideration of the additional analysis (Attachment 3 to this RTS).
- Provision of additional analysis regarding the suitability of underground mine voids for the permanent storage of brine from the water treatment facilities by HydroSimulations (Attachment 4 to this RTS).

In addition, further consultation has been undertaken with the EPA in regard to their submission (meetings 8 March 2018 and 10 April 2018), in particular options for authorisation of changes to the existing EPL 12932 controlled release limits in a future EPL variation.

5 CHANGES TO THE MODIFICATION

5.1 CONTROLLED RELEASE LIMITS

The Environmental Assessment proposes to increase the volume of controlled releases of treated water to up to 20 ML/day, with no change to the existing EPL 12932 release limits for salinity (or other water quality concentration limits specified in EPL 12932).

Based on the ecological, hydrological and hydrogeochemical studies in the Environmental Assessment and this RTS, the currently authorised salinity limits of 900 µS/cm (maximum) and 800 µS/cm (50th percentile) and proposed maximum controlled release volume of 20 ML/day are considered to be scientifically justified and appropriate given:

- The salinity limits are currently authorised by EPL 12932.
- Additional analysis of ions by RGS (2018) indicated: ions would be controlled by treating water prior to release to limit salinity at the point of release; the ionic make-up of controlled release water is expected to be similar to that of existing Goulburn River flows; and there would be low risk to downstream aquatic ecology due to individual ion concentrations in the treated controlled release water.
- Review of macroinvertebrate data for 2004 to 2017 by MPR (2017) shows no observable adverse effects during current UCML releases at 900 µS/cm (maximum), and no significant impacts to aquatic ecology are expected due to MCO's proposed controlled releases.
- Review of the additional analysis of RGS (2018) by MPR (2018) confirmed the conclusions of MPR (2017) (i.e. no significant impacts to aquatic ecology expected).
- 900 µS/cm complies with Water Quality Objectives (WQOs) for the Hunter River Catchment for livestock, irrigation and drinking water (Attachment 5). Existing salinity levels in the Goulburn River (both upstream and downstream of the proposed controlled release point) would exceed the default WQO salinity trigger level for aquatic ecosystems (30 – 350 µS/cm), and so site-specific trigger levels could be developed for aquatic ecosystems as per the Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC Guideline).
- 900 µS/cm is consistent with the Hunter River Salinity Trading Scheme salinity target of 900 µS/cm (for the section of the Hunter River downstream of the confluence with the Goulburn River).
- EPA (2013) describes that 900 µS/cm is potentially appropriate as an upper level target for salinity levels.
- Advisian (2017) conducted hydrological modelling for the Environmental Assessment showing 20 ML/day releases would result in minor changes in river height and velocity, and no significant change in downstream salinity levels.
- The controlled releases are generally consistent with River Flow Objectives relevant to the Goulburn River (Attachment 5).

Notwithstanding the above, through consultation with the EPA for the Modification it is understood that any variation to EPL 12932 would likely be based on a staged increase to controlled release limits, and alternative salinity limits.

Staged Volume Limits

MCO accepts the following staged increase to volume limits in any variation to EPL 12932:

- up to 15 ML/day following commencement of first workings to UG4;
- up to 20 ML/day following commencement of secondary extraction in UG4; and
- up to 15 ML/day two years after completion of mining in UG4 (subject to site water balance review).

Salinity Limits

For the reasons provided above, the Environmental Assessment has demonstrated comprehensively that retaining the existing EPL 12932 salinity limits (i.e. 900 µS/cm) is justified on a scientific basis.

Notwithstanding this evidence-based assessment, after consultation with the EPA subsequent to lodgement of the Environmental Assessment, MCO understands EPA's intention is to alter the currently authorised EPL 12932 salinity limits in any variation of EPL 12932.

At a meeting on 10 April 2018 between the proponent, DPE and the EPA, it was agreed that water quality limits are appropriately regulated by an EPL under the POEO Act, and should not be governed by a planning approval.

In recognition of the EPA's ability to impose different water quality limits irrespective of the impact assessment, and consistent with EPA's submission, MCO's position is that the process for deriving an alternative salinity limit in any variation EPL 12932 must consider the decision tree process outlined in the ANZECC Guideline. MCO considers that it is at Step 3 of the ANZECC Guideline decision tree process.

Key steps of the ANZECC Guideline decision tree process are summarised as follows:

1. Consideration of default guideline value.
    - For salinity, the default guideline value relevant to the Goulburn River is 50 – 350 µS/cm, which is significantly below background salinity (80th percentile levels) for the majority of the length of the Goulburn River (refer to Attachment 5).
    - Accordingly, the default guideline value is not appropriate as a controlled release salinity limit for the Moolarben Coal Complex.

2. Consideration of background salinity using the 80th percentile upstream level.
    - Precedent for using the 80th percentile of baseline data (in accordance with the ANZECC Guideline) to determine release limits includes the Project Approval for the Duralie Coal Mine issued by the Land and Environment Court[1]. The relevant section of the Judgement (as made by the Land and Environment Court's Chief Judge Preston) states[2]:

        > *I consider that it is appropriate to set the trigger levels for controlling discharge from the additional irrigation areas into the unnamed tributary using the ANZECC guidelines, being trigger levels representing the 80th percentile of the data set for the unnamed tributary and the Mammy Johnsons River into which the unnamed tributary flows.*
        >
        > *The requirement to do so can be specified in the conditions of approval which require preparation of a water management plan (in Condition 29 of Schedule 3 of the revised conditions of approval). The effectiveness of the trigger level will be required to be monitored under the Water Management Plan.*

    - The data used to determine the 80th percentile salinity level **must** meet the data requirements of the ANZECC Guideline (i.e. minimum of 24 contiguous monthly samples). This is consistent with EPA's submission for the Modification, which states (refer to Issue 8):

        > *The ANZECC Guideline provides that 24 contiguous monthly samples from an appropriate reference site(s) are required to develop site specific trigger values for the receiving waters, being the Goulburn River.*

3. Consideration of the outcomes of a biological effects assessment.
    - Ongoing monitoring and analysis of the ecotoxicological effects of salinity on downstream aquatic ecosystems may support a salinity limit in any variation to EPL 12932 that is either higher or lower than the 80th percentile upstream value.

[1] Refer to Ironstone Community Action Group Inc v NSW Minister for Planning and Duralie Coal Pty Ltd (No 2) [2012] NSWLEC 14.

[2] https://www.caselaw.nsw.gov.au/decision/54a636df3004de94513d9476.

Figure 3.4.1 of the ANZECC Guideline showing the decision tree framework for toxicants is reproduced below (noting that Figure 3.2.2 of the ANZECC Guideline refers to salinity as a stressor "toxic" to biota).

It is noted that using the ANZECC Guideline decision tree process for developing trigger levels is consistent with the EPA's submission for the Modification, which states:

> *The EPA would also consider application of the ANZECC (2000) toxicant decision-tree…*

MCO considers the process of deriving an alternative salinity limit could be authorised by modification to the following Project Approval condition (underlined text), with the salinity limit to be confirmed via the EPL 12932 variation process:

> *Unless an EPL authorises otherwise, the Proponent shall comply with section 120 of the POEO Act.*
>
> *Any EPL variation that authorises controlled releases from the site exceeding 10 ML/day would be subject to review of the controlled release salinity limit. The revised salinity limit is to be determined in accordance with the decision tree process of the ANZECC Guideline.*

Additional data (i.e. 80th percentile upstream level and/or ecotoxicity data) would be provided to EPA to support any application to vary EPL 12932.

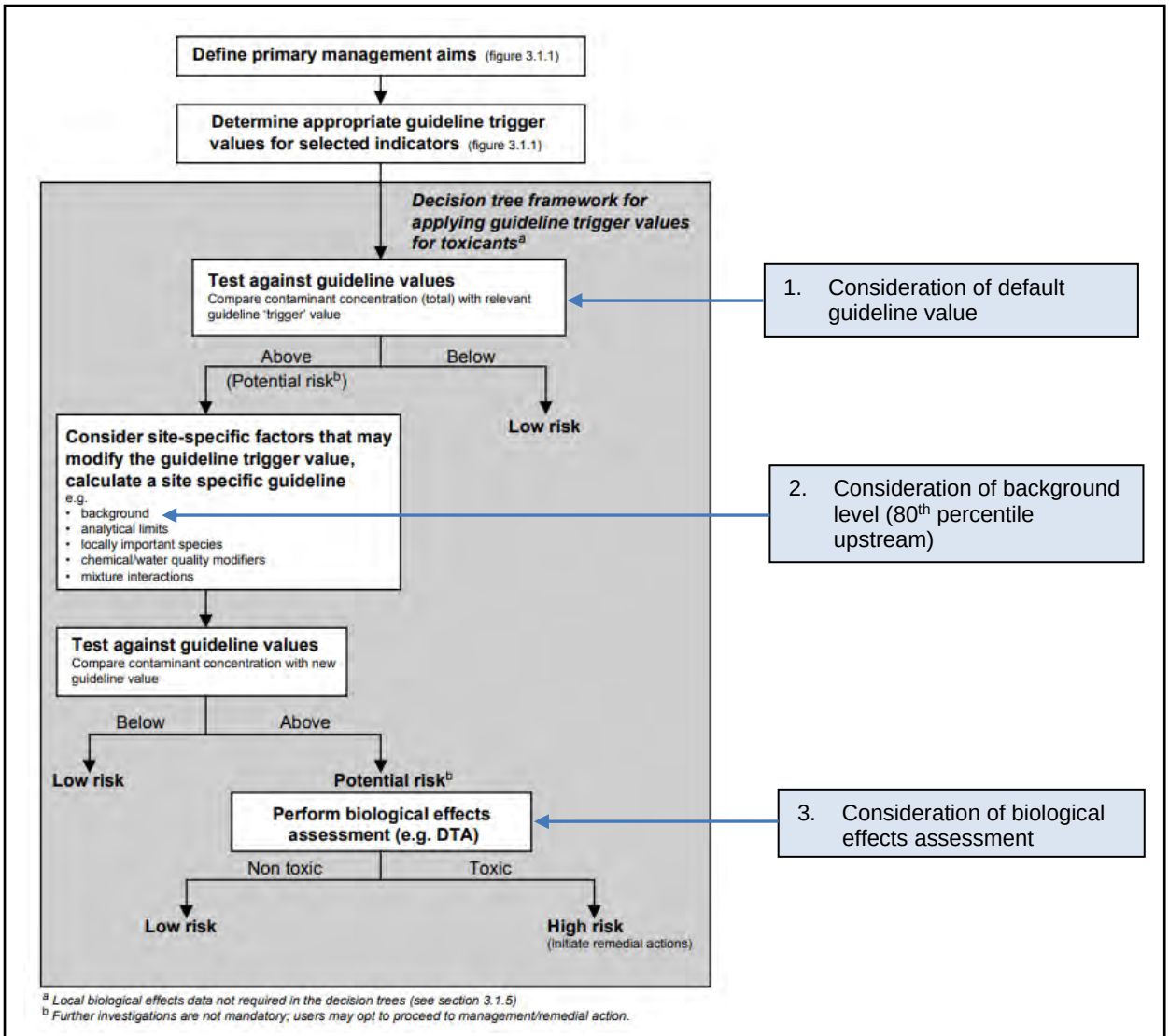


Plate 1: ANZECC Guideline – Decision Tree Process (for "toxicants")

5.2 ADDITIONAL GROUNDWATER MONITORING BORES

In response to a recommendation from the Department of Primary Industries (Crown Lands and Water), additional groundwater monitoring bores will be established adjacent to OC3 in the vicinity of Moolarben Creek. The additional monitoring bores would be documented in the Groundwater Management Plan, which would be updated for the Modification.

6 RESPONSES TO SUBMISSIONS

6.1 PART A – RESPONSES TO GOVERNMENT AGENCY SUBMISSIONS

Responses to issues raised by the following Government agencies are provided in the subsections below:

- NSW Environment Protection Authority (EPA) (Section 6.1.1).
- NSW Division of Resources and Geoscience (DRG) (Section 6.1.2).
- NSW Office of Environment and Heritage (OEH) (Section 6.1.3).
- Mid-Western Regional Council (MWRC) (Section 6.1.4).
- NSW Department of Industry (DPI) (Section 6.1.5).

6.1.1 Environment Protection Authority

The EPA considered the following in its review of the Environmental Assessment:

- air quality (Section 6.1.1.1);
- water (Section 6.1.1.2); and
- noise (Section 6.1.1.3).

6.1.1.1 Air Quality

Modelling Approach

Issue 1

In regard to the modelling methodology of the Air Quality Assessment (Todoroski Air Sciences [TAS], 2017), the EPA stated:

> *The CALMET-CALPUFF modelling suite is suitable for simulating dispersion of emissions from the proposal. The use of calendar year 2011 is indirectly justified by comparing wind roses for that year to those presented in Appendix B.*

Response 1

The EPA's comment regarding the suitability of the modelling suite is noted.

Emissions Estimation

Issue 2

In regard to the background levels adopted for cumulative assessment, the EPA stated:

> *Interpretation of predicted pollutant concentration makes use of a current case (2011) – simulation without the modification (TAS 2017, p29). The emission inventory for this case has not been provided. It is needed to understand the modification and its predicted impacts.*

Response 2

Project-only Predictions

The predicted impacts of the project-only (i.e. the Moolarben Coal Complex incorporating the Modification) have been estimated based on expected operations in 2019, 2021 and 2026, and do not make use of the 2011 emissions inventory.

Emission inventories for the 2019, 2021 and 2026 modelling scenarios are provided in Appendix C of the Air Quality Assessment.

Cumulative Predictions

The 2011 emissions inventory was used, consistent with TAS (2013), only for the purpose of estimating non-mining background dust levels for cumulative assessment for the Modification.

The 2011 emissions inventory for the Moolarben Coal Complex was modelled, with the resultant predicted levels subtracted from measured 2011 dust contributions to avoid double-counting emissions from the Moolarben Coal Complex in the cumulative assessment for the Modification.

The resultant estimation of annual average dust levels from background sources (i.e. 2011 measured levels minus 2011 contribution from the Moolarben Coal Complex) is as follows (Table 7-1, TAS [2017]):

- TSP – 13.5 µg/m^3;
- PM_{10} – 5.4 µg/m^3; and
- dust deposition – 0.6 g/m^2/month.

Issue 3

In regard to dust controls, the EPA stated:

> *Emissions estimation for the modification (TAS, 2017) uses 90% as the control factor for watering on roads. The EPA notes that 80% was used for modification 9 (TAS 2013). Detailed justification on the assumed control factors and how it will be achieved in practice should be provided to facilitate interpretation of the model predictions.*

Response 3

TAS (2013) assumed a control efficiency of 80% for haul roads in the absence of specific data at the time. Since that time, control efficiency data for the haul road management practices at the Moolarben Coal Complex have become available (TAS, 2014), and the subsequent air quality studies for the OC4 South-west Haul Road Modification (TAS, 2015a) and UG1 Optimisation Modification (TAS, 2015b) assume a control efficiency of 90%.

A haul road dust control efficiency of 90% was demonstrated at the Moolarben Coal Complex based on site-specific test work conducted by TAS (2014) as part of a Pollution Reduction Program (PRP) imposed by the EPA on NSW open cut coal mines. The study compared the measured dust levels generated by haul trucks under uncontrolled and controlled (i.e. haul road watering) operations.

The assumed control efficiency of 90% is also consistent with Best Practice Management (Katestone, 2010).

In practice, this level of dust control will be achieved via haul road watering, as assessed by TAS (2014). The site water balance modelling for the Modification (WRM, 2017) indicates the Moolarben Coal Complex will be a surplus site and that sufficient water for dust suppression will be available.

Issue 4

The EPA constructed the below table to compare emission estimates presented in TAS (2013) to those in TAS (2017):

Comparison of emissions (all in tonnes per year)

	Overburden	***Coal Loading***	***CHPP***	***Wind erosion***	***Total***
Year 6	*2443*	*1631*	*593*	*1263*	***5930***
2019	*2193*	*1458*	*953*	*834*	***5439***
difference (%)	*-10*	*-11*	*+60*	*-33*	***-8***
Year 11	*2143*	*1679*	*601*	*1458*	***5879***
2021	*1979*	*1624*	*916*	*718*	***5236***
difference (%)	*-8*	*-3*	*+53*	*-51*	***-11***
Year 16	*2646*	*1808*	*665*	*1353*	***6472***
2026	*2059*	*1301*	*807*	*601*	***4768***
difference (%)	*-22*	*-28*	*+21*	*-56*	***-26***

The EPA requested explanation for differences in estimated dust emissions between TAS (2013) and TAS (2017), in particular for the following:

- *overburden handling;*
- *handling ROM coal in stage 2 – hauling and loading trucks;*
- *the use of bulldozers at the CHPP;*
- *handling coal rejects;*
- *wind erosion from both mining areas and stockpiles.*

Response 4

A comparison of the key emissions factor equations used in TAS (2013) and TAS (2017) is provided in Table 2, below.

As shown, the key emission factor equations used are the same, with the exception of wind erosion. The emission factor equations applied in TAS (2017) are correct and consistent with the US EPA AP-42 methodology.

Table 2
Comparison of Key TSP Emission Factor Equations

Emission Source	Emission Factor Equation	TAS (2013)	TAS (2017)
Loading / emplacement overburden	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} \Big/ \frac{M}{2}^{1.4}\right) kg/tonne$	✓	✓
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45} kg/VKT$	✓	✓

Table 2 (Continued)
Comparison of Key TSP Emission Factor Equations

Emission Source	Emission Factor Equation	TAS (2013)	TAS (2017)
Dozers on overburden	$EF = 2.6 \times \frac{s^{1.2}}{M^{1.3}}\ kg/hour$	✓	✓
Dozers on coal	$EF = 35.6 \times \frac{s^{1.2}}{M^{1.4}}\ kg/hour$	✓	× $EF = 35.6 \times \frac{s^{1.2}}{M^{1.3}}\ kg/hour$
Loading / emplacing coal	$EF = \frac{0.58}{M^{1.2}}\ kg/tonne$	✓	✓
Loading product to stockpile / train	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} \Big/ \frac{M^{1.4}}{2}\right)\ kg/tonne$	✓	✓
Wind erosion on exposed areas / stockpiles	$EF = 0.4\ kg/ha/year$	✓	× $EF = 850\ kg/ha/year$

EF = emission factor, A = area of blast (m²), U = wind speed (m/s), M = moisture content (%), s = silt content (%), VKT = vehicle kilometres travelled (km), p = number of days per year when rainfall is greater than 0.25mm (days), f = percentage of time that wind speed is greater than 5.4m/s (%), sp = speed of grader (km/h).

In consideration of the differences in key TSP emission factor equations, the differences in estimated dust emissions between TAS (2013) and TAS (2017) can generally be attributed to the following:

- *Overburden Handling* – Differences occur due to different rates of activity.
- *Handling ROM coal in stage 2 – hauling and loading trucks* – Differences in handling ROM coal for hauling and loading trucks occur due to different rates of activity, differences in control factors for haul road dust control, and replacement of haul roads with a conveyor.
- *The use of dozers at the CHPP* – Differences occur due to differences in the rates of activity, and use of the AP-42 emission factor equation in TAS (2017) whereas TAS (2013) used the NPI emission factor equation.
- *Handling coal rejects* – This is a minor source (e.g. approx. 0.005% of the total) and was not considered in TAS (2013).
- *Wind erosion from both mining areas and stockpiles* – It is noted that stockpiles comprise a small part of the total exposed areas subject to wind erosion, e.g. 0.025% in Year 2019, hence total wind erosion is not significantly affected by stockpile size. Differences in wind erosion on exposed mining areas arise due to application of a different emission factor (Table 2), and different rates of activity (differences in area of exposed surfaces).

The EPA's submission included a comparison of emissions from modelling scenarios from TAS (2013) and TAS (2017). This comparison only provides a partial examination of key activities and notes lower emissions for those in TAS (2017) relative to TAS (2013). This comparison, however, did not examine the rate of activity or mine design which are the primary factors affecting dust emissions.

A more complete examination indicates that the overall total emissions per unit of activity applied in the modelling does not change significantly (Table 3). The actual emissions modelled per unit of activity shows a slight decrease in modelling years 2019 and 2021, and a more notable decrease in 2026 when open cut activity only occurs in OC4 for TAS (2017) (a more efficient pit in terms of minimised dust generation), whereas Year 16 for TAS (2013) considered open cut activities in OC4 and OC2.

Table 3
Comparison of Overall Dust Emission and Activity Rates

	Comparison 1		Comparison 2		Comparison 3	
Modelling Scenario	**Year 6 (TAS, 2013)**	**2019 (TAS, 2017)**	**Year 11 (TAS, 2013)**	**2021 (TAS, 2017)**	**Year 16 (TAS, 2013)**	**2026 (TAS, 2017)**
Total Dust Emissions (kg)	5,930,324	5,439,254	5,879,163	5,236,797	6,472,532	4,768,420
OB and Coal Activity (tonnes)	127,982,041	123,802,888	128,218,930	118,540,056	128,419,460	123,666,144
Dust (kg) / Activity (tonnes)	0.046	0.044	0.046	0.044	0.050	0.039

Table 3 indicates there is no significant difference in emissions, only differences in rates of activity and mine design, for the 2019 and 2021 scenarios (TAS, 2017) when compared to modelling scenarios in TAS (2013). For the 2026 scenario modelled in TAS (2017), all open cut activity is in OC4, a more compact, dust efficient pit. The Year 16 scenario modelled in TAS (2013) considers a significantly different case, with activity occurring in multiple open cut pits.

In summary, minor differences in the TAS (2013) and TAS (2017) emissions can be partially attributed to differences in emissions calculations, and primarily attributed to different mine designs and configurations.

$PM_{2.5}$ Assessment

Issue 5

In regard to predicted cumulative $PM_{2.5}$ concentrations, the EPA stated:

> *The method used to assess 24-hour $PM_{2.5}$ does not follow guidance in Approved Methods Modelling and is not sufficiently justified.*

In regard to methodologies for predicting 24-hour average concentrations, the EPA stated:

> *Two levels of cumulative assessment are listed in the Approved Methods Modelling – screening level dispersion modelling technique using worst-case input data; and refined dispersion modelling technique using site-specific input data. Section 5 sets out approaches to accounting for background concentrations. Refined dispersion modelling requires one year of continuous measurements contemporaneous with meteorological data. This allows the simulation to capture any correlation between background concentration and emissions.*

In regard to the annual average background $PM_{2.5}$ concentration adopted by TAS (2017), the EPA stated:

> *The EPA notes there are limited data available representing rural locations. The estimate used* [annual average background $PM_{2.5}$ from monitoring stations in Muswellbrook and Singleton] *is reasonable.*

The further information requested by EPA is as follows:

> *Assessment of 24-hour concentration of $PM_{2.5}$ using a clearly described and justified method shown to be equivalent to the contemporaneous assessment described in Approved Methods Modelling. The method must show it adequately assesses the potential for emissions to result in additional days exceeding the impact assessment criterion of 25 ug/m^3. The EPA recommends use of local observations in developing description of the background concentrations, including references to recent data.*

Response 5

Background $PM_{2.5}$ Data

As noted by the EPA there are limited data available representing rural locations for $PM_{2.5}$, and no site-specific $PM_{2.5}$ monitoring data.

In the absence of local $PM_{2.5}$ monitoring data, it is not possible to follow guidance in the *Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods Modelling) (EPA, 2016), and TAS (2017) used data from OEH $PM_{2.5}$ monitoring stations in Singleton and Muswellbrook to estimate background $PM_{2.5}$, consistent with the approach undertaken by TAS (2015c) for the Wilpinjong Extension Project Air Quality Assessment.

The EPA's comment that the use of data from Singleton and Muswellbrook (in the absence of site-specific $PM_{2.5}$ data) is reasonable is noted.

Cumulative 24-hour $PM_{2.5}$ Assessment

A Level 1 (screening) cumulative assessment was not suitable for the assessment as the 2011 data from Singleton and Muswellbrook includes days above the criteria, as noted by the EPA in its submission.

A Level 2 (contemporaneous) cumulative assessment was not possible for the assessment as there is no local or site-representative $PM_{2.5}$ monitoring data (i.e. no $PM_{2.5}$ measurement data contemporaneous with the site-specific meteorological data used for the modelling).

The approach outlined in the Approved Methods Modelling requires application of data which does not exist. As the Approved Methods Modelling cannot be applied, a similar approach outlined by the Environment Protection Authority Victoria (EPA Victoria) was adopted in TAS (2017). The approach is considered justified on the basis that it is a recognised regulatory approach applied in similar jurisdictions for similar projects in both NSW and Victoria (and other states).

As such, TAS (2017) adopted the EPA Victoria 70th percentile 24-hour average $PM_{2.5}$ concentration to estimate potential cumulative impacts consistent with the methodology undertaken for the Wilpinjong Extension Project (TAS, 2015c).

It is considered that the implication of applying this methodology would not have been significant in this case. This is because the maximum predicted project-only 24-hour $PM_{2.5}$ concentration at a privately-owned receptor of 9 µg/m^3 is for commercial receptors (IDs 9 and 26) (i.e. locations not continuously occupied over a 24-hour period), whereas the maximum predicted project-only 24-hour $PM_{2.5}$ concentration at the most impacted privately-owned dwelling is less than 5 µg/m^3, which is less than 20% of the 24-hour $PM_{2.5}$ criteria of 25 µg/m^3.

Therefore, irrespective of the cumulative assessment methodology used, due to the low maximum contribution at the sensitive receptor with the highest predicted $PM_{2.5}$ concentration (< 5µg/m^3), any cumulative exceedance of the 24-hour $PM_{2.5}$ criteria of 25 µg/m^3 would be due primarily to background sources (> 80%). As the locality has minimal anthropogenic activity (e.g. dwellings and wood heaters are relatively well spread out and separated), the risk of elevated background $PM_{2.5}$ levels in this area is low. Therefore, it is reasonable to conclude that the risk of any adverse $PM_{2.5}$ impact is low, and exceedances are unlikely to arise in the normal course of events due to the Moolarben Coal Complex incorporating the Modification.

PM_{10} Assessment

Issue 6

In regard to predicted cumulative 24-hour PM_{10} concentrations, the EPA stated:

> *Concentration of 24-hour PM_{10} was predicted to result in additional days exceeding the impact assessment criterion at five receptors, TAS (2017, table 7-4). There were no more than 2 days at any receptor in any of the three emission scenarios (years).*
> …
>
> *TAS (2017) conducted additional modelling in which emission were amended to reflect a "pause" in activities in the pit and overburden dumps. The reduction in emissions was large enough to reduce predicted concentrations at the receptors to less than the impact assessment criteria.*
> …
>
> *TAS (2017) does not provide information regarding the emissions inventory for the revised modelling.*

The EPA requested the following information:

- *Statement of which level mitigation was simulated and the reduction in total emissions;*
- *Number of occasions in the modelled year (2011) on which the simulated control would be implemented and for how long on each;*
- *Demonstration that the management scheme requires action in sufficient time to reduce emissions on the days predicting concentrations greater than the impact assessment criterion; and*
- *Tabulation of resulting increments and cumulative assessment for this simulation matching the results presented in appendix F for the standard simulations.*

Response 6

It is noted that 2 additional cumulative exceedances of the 24-hour PM_{10} criterion were predicted at commercial receptor (ID 9) owned by Orica in the 2021 scenario only. An individual would not be present in this property for a continuous 24-hour period.

For all other privately-owned receptors, it is predicted that without the implementation of real-time controls, the Moolarben Coal Complex including the Modification would result in up to an additional day per year above the 24-hour PM_{10} criteria (when considered cumulatively with background sources).

Figures 7-8 to 7-10 from TAS (2017) (reproduced as Figures 3 to 5, below) show that for the most potentially impacted privately-owned receptor (Receptor 40), the predicted cumulative PM_{10} concentration on the 1 additional day of exceedance is only marginally above the criterion of 50 $\mu g/m^3$. On this basis, TAS (2017) concluded that the modelled exceedances could be avoided in practice with the implementation of the real-time controls currently implemented at the Moolarben Coal Complex.

Real-time controls at the Moolarben Coal Complex are implemented in accordance with the approved Air Quality Management Plan (AQMP), which was developed in consultation with the EPA. The real-time controls involve real-time monitoring trigger levels set below the 24-hour PM_{10} criterion, which trigger the implementation of additional controls and/or the modification of operations (i.e. proactive and reactive mitigation measures).

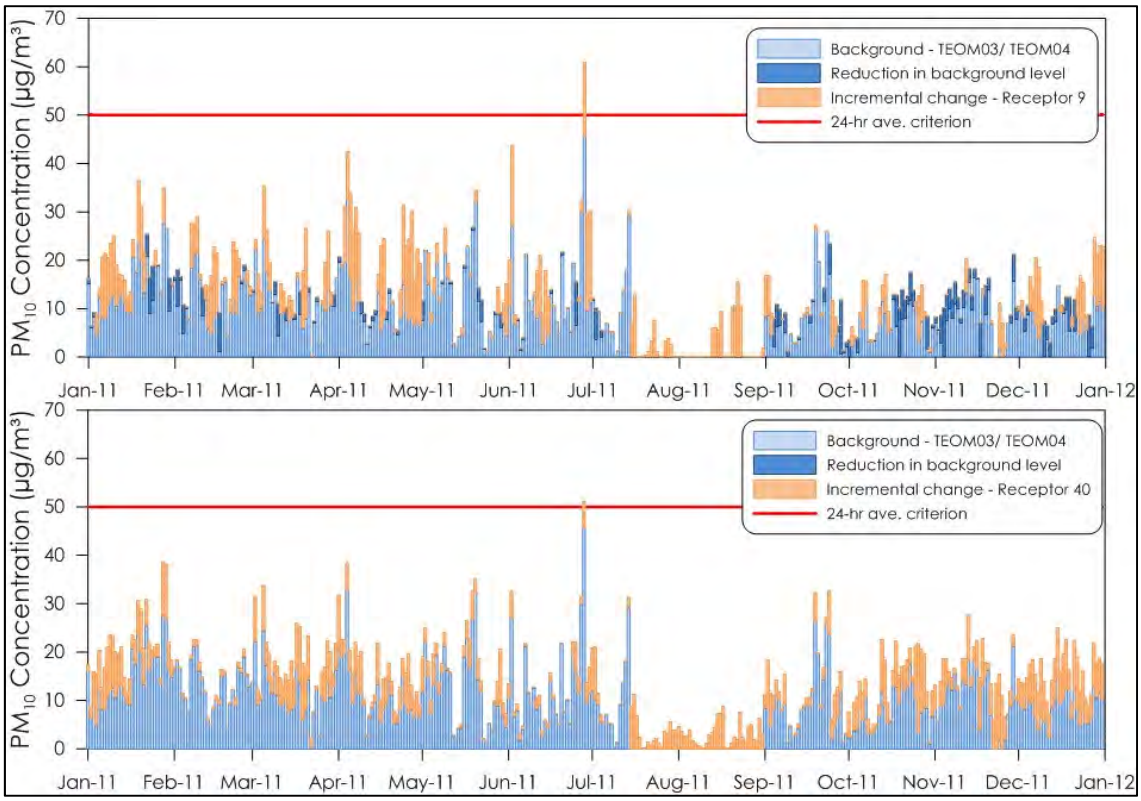


Figure 3: Predicted 24-hour average PM_{10} Concentrations for Sensitive Receptor Locations 9 and 40 in Year 2019 (unmitigated)

Source: Figure 7-8 of TAS (2017).

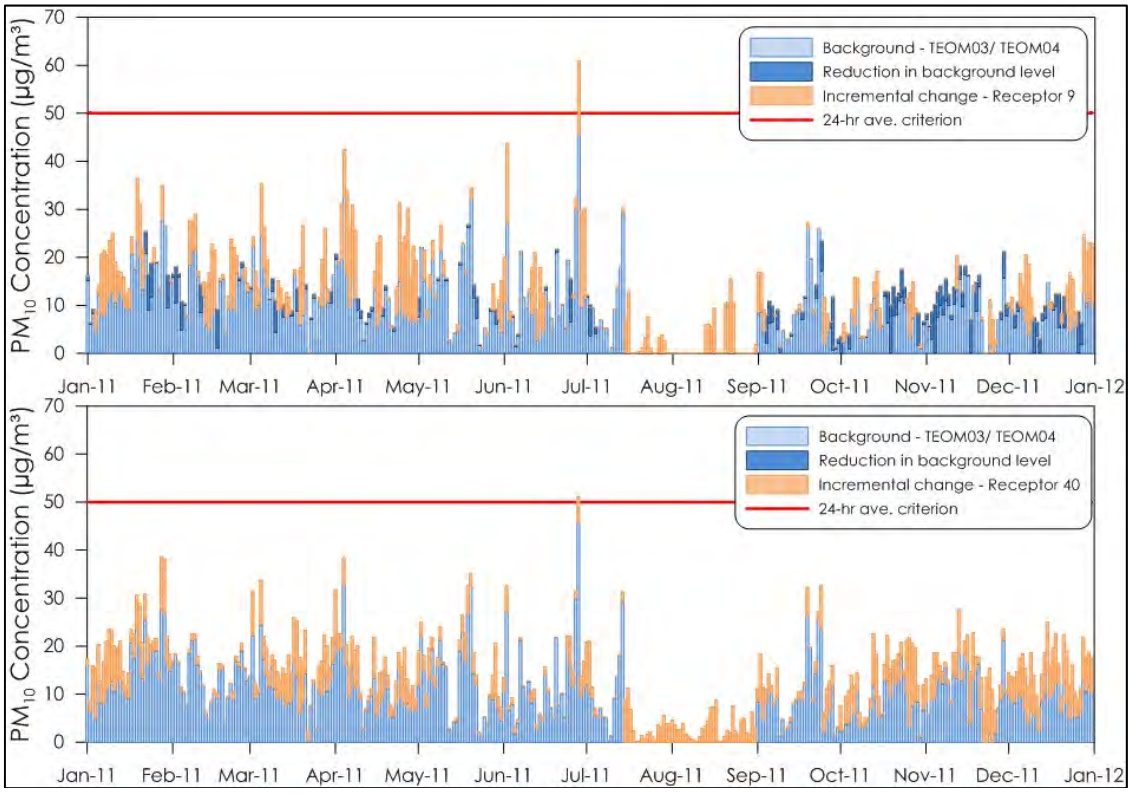


Figure 4: Predicted 24-hour average PM_{10} Concentrations for Sensitive Receptor Locations 9 and 40 in Year 2021 (unmitigated)

Source: Figure 7-9 of TAS (2017).

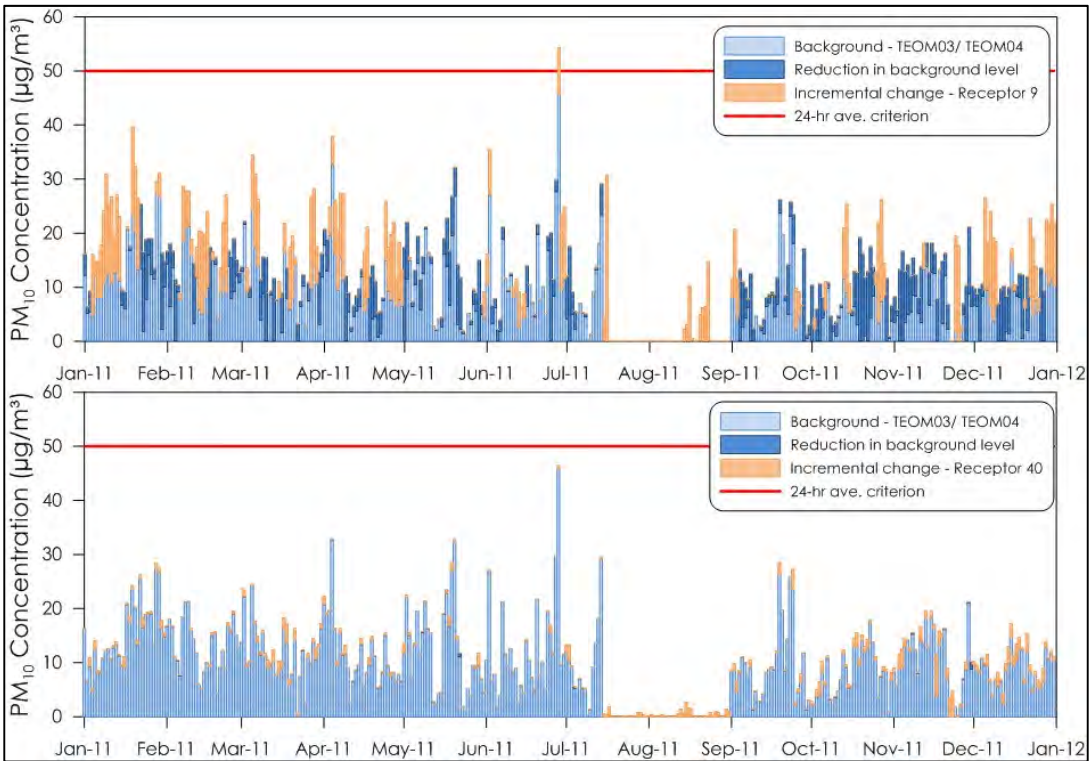


Figure 5: Predicted 24-hour average PM_{10} Concentrations for Sensitive Receptor Locations 9 and 40 in Year 2026 (unmitigated)

Source: Figure 7-10 of TAS (2017).

The Modification **would not change:**

- Project approval air quality criteria for 24-hour PM_{10} concentrations.
- MCO's ongoing implementation of the AQMP to achieve these criteria, via the use of real-time triggers and proactive and reactive mitigation measures.

The effectiveness of MCO's mitigation measures is evidenced by the strong record of compliance. Review of MCO's TEOM data for the period 2011 to 2017 shows only isolated exceedances of the 24-hour PM_{10} criteria, which are attributable to events not associated with the MCO (e.g. bushfires, controlled burning in the Goulburn River National Park and localised council road works).

In response to the EPA's specific queries:

- The activities paused in the modelled mitigation scenario were the following emissions sources: overburden removal, coal removal, dozers on overburden, dozers on coal, overburden haulage and coal haulage. In practice, MCO would generally increase controls (e.g. watering) or modify operations as required to comply with its Project Approval air quality limits, and only pause such activities if necessary for compliance.
- The activities were required to be paused in the modelling scenario during the 2 days when additional exceedances were predicted (and only one day at any private dwellings). In practice the period of modified or paused operations would be dependent on comparison of actual measured levels against the trigger levels specified in the AQMP.

MCO's strong historic compliance with its Project Approval air quality limits demonstrates the effectiveness of the mitigation measures described in the AQMP. Additionally, there is no material change to the equipment used.

The resultant cumulative assessment for the modelled mitigation scenario is that cumulative 24-hour PM_{10} concentrations for all privately-owned receptors are predicted to be 49 µg/m^3 or less (i.e. iterative modelling was conducted to achieve this result to simulate the effect of progressively implementing real-time controls). It is noted that on the day when additional exceedances were predicted at receptor ID 40, there is limited opportunity for operations from the Moolarben Coal Complex to significantly reduce cumulative PM_{10} concentrations below 50 µg/m^3 due to the large contribution from background sources (Figures 3 to 5).

6.1.1.2 Water

Site Specific Trigger Values for Discharges

Issue 7

In regard to site specific trigger values for EPL releases, the EPA stated:

> *The water treatment facility is proposed to be designed to control dissolved metal concentrations. Particularly cadmium, manganese and nickel, which may be elevated in on site storages, and are not naturally elevated in the Goulburn River (page67 Executive Summary). The EPA notes that aluminium, copper and zinc levels are slightly elevated in some on-site waste storages when compared to the ANZECC default 95% species protection trigger levels.*
>
> *Page 67 of the Executive Summary states that the design criteria for metal concentrations in the water treatment facility would be to meet ANZECC trigger levels at the point of release (i.e. either 'default' 95% species protection trigger levels, or where metal concentrations in the Goulburn River naturally exceed the 95% species protection level, 'site specific' trigger levels would be developed based on the 80th percentile concentration of historic monitoring data).*
>
> *The EPA supports this commitment.*

Response 7

The EPA's support for the commitment to control metal concentrations to ANZECC Guideline trigger levels at the point of discharge is noted.

Issue 8

In regard to the background water quality concentrations, the EPA stated:

> *The ANZECC Guideline provides that a slightly to moderately disturbed system is the relevant level of protection for the receiving waters, in this case the Goulburn River, and while the comparison of water quality results to site-specific trigger values is a recognised approach in the ANZECC Guidelines, this is only appropriate if they are developed in accordance with the approach set out in the ANZECC Guidelines. The ANZECC Guideline provides that 24 contiguous monthly samples from an appropriate reference site(s) are required to develop site specific trigger values for the receiving waters, being the Goulburn River. It should be noted that page 26 of Appendix F provides that the datasets for dissolved Aluminium concentrations are very limited and results therefore may not be adequate to characterise the water quality.*

Response 8

Additional water quality data collected by the Ulan Mine Complex at monitoring location UMC SW01 (located at the agreed upstream monitoring location) (Figure 1.1 from Advisian [2017] [reproduced as Figure 6, below]) has been analysed by Advisian (Attachment 1 to this RTS).

The dataset for UMC SW01 includes data from 36 sampling events for dissolved metals, taken at least monthly from December 2013 to July 2016 (with one month [January 2016] where sample results are not available).

As specified in section 7.4.4.1 of Volume 1 of the ANZECC Guideline, two years of contiguous monthly sampling (24 samples) is adequate to provide an indication of the local ecosystem variability and to provide a basis for derivation of 'trigger' values appropriate to conditions in a particular water system:

> *Minimum data requirements at the reference site: a minimum of two years of contiguous monthly data at the reference site is required before a valid trigger value can be established.*

Based on the ANZECC Guideline, data from UMC SW01 for the period December 2013 to July 2016 has been adopted by Advisian (Attachment 1) to identify appropriate site-specific trigger values outlined in the ANZECC Guideline, as follows:

1. Table 3.4.2 of the ANZECC Guideline recommends the use of 95% species protection levels as default, low-risk trigger values for toxicants in slightly to moderately disturbed ecosystems. These default trigger values are listed in Table 3.4.1 of the ANZECC Guideline.
2. 80th percentile values were (as recommended in the ANZECC Guideline) calculated from monitoring results recorded at UMC SW01, which included more than 24 months of contiguous monitoring data.
3. The ANZECC Guideline default trigger values were compared to 80th percentile values from UMC SW01, as Section 7.4.2.2 of the ANZECC Guideline states:

   > *For those months, seasons or flow periods that constitute logical time intervals or events to consider and derive background data, the 80th percentile of background data (from a minimum of 10 observations) should be compared with the default guideline value.*
   >
   > *This 80th percentile value is used as the new trigger value for this period **if it exceeds the default guideline value** provided in Section 3.4.3 of this document.*

4. Advisian recommended design criteria for metal concentrations for controlled release water (Table 4) based on the maximum of the ANZECC Guideline default trigger values and 80th percentile values from UMC SW01.

The design criteria for metal concentrations in the water treatment facility would be to meet the proposed Goulburn River Trigger Levels of Table 4 at the point of release.

As shown, design criteria for metal concentrations are consistent with the ANZECC Guideline default trigger values for all relevant metals, with the exception of Aluminium (where the 80th percentile value from UMC SW01 is greater than the ANZECC Guideline default value).

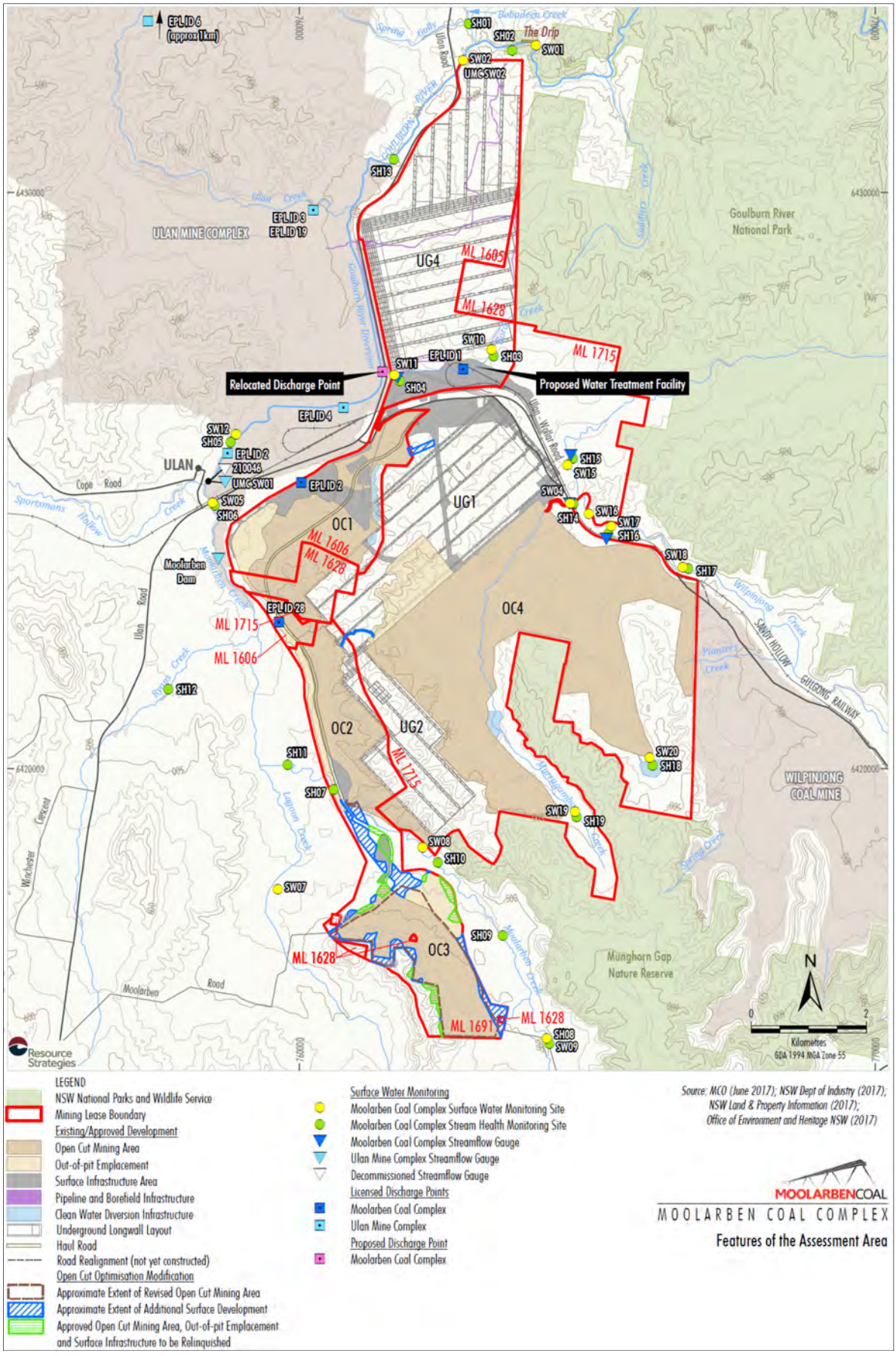


Figure 6: Features of the Assessment Area
Source: Figure 1.1 of Advisian (2017).

Table 4
Proposed Design Criteria for Metal Concentrations in Controlled Release Water

Parameter	Units	ANZECC Guideline Default Trigger Value[1]	UMC SW01 80th Percentile Value	Proposed Design Criteria for Metal Concentration in Controlled Release Water
Dissolved Aluminium	mg/L	0.055	0.14	0.14
Dissolved Manganese	mg/L	1.9	<ANZECC Default	1.9
Dissolved Nickel	mg/L	0.011	<ANZECC Default	0.011
Dissolved Zinc	mg/L	0.008	=ANZECC Default	0.008
Dissolved Cadmium	mg/L	0.0002	<ANZECC Default	0.0002
Dissolved Copper	mg/L	0.0014	<ANZECC Default	0.0014
Dissolved Arsenic	mg/L	0.013	<ANZECC Default	0.013
Dissolved Lead	mg/L	0.0034	<ANZECC Default	0.0034

After: Attachment 1 to this RTS.

[1] ANZECC Guideline default trigger values for freshwater (slightly to moderately disturbed ecosystems), 95% species protection (Table 3.4.1 ANZECC Guideline).

Issue 9

In regard to water quality trigger levels from the Moolarben Coal Complex Surface Water Management Plan (submitted for approval to DPE in 2016) described in Section 2.5 of Advisian (2017), the EPA stated:

> *The EPA notes from section 2.5 of Appendix F that the surface water trigger levels used for water quality impact assessment purposes are a combination of site-specific trigger values and the default trigger values for upland rivers in slightly to moderately disturbed ecosystems in south-east Australia.*
>
> *It is unclear to the EPA what monitoring location along the Goulburn River has been used as the basis for the development of the site-specific trigger levels nor whether it is based upon 24 contiguous monthly sample results from that location.*
>
> *Such information is requested.*
>
> *The EPA notes from Table 2.9 in the Executive Summary that an EC water quality trigger level of 900 us/cm has been established. Page 24 of Appendix F provides that the EC of the Goulburn River upstream of the proposed discharge point varies between 540 us/cm and 548 us/cm. Justification for the use of 900 us/cm as a trigger level for EC is requested.*

Response 9

This comment from the EPA refers to Section 2.5 of Appendix F, which describes downstream "triggers" in the Goulburn River as detailed in MCO's Water Management Plan. These downstream triggers are not controlled release limits (which apply at the point of discharge).

Section 5 of this RTS provides a summary of likely controlled release salinity limits, which would be specified in a variation of EPL 12932.

The downstream "triggers" in the Water Management Plan would be reviewed as a result of the Modification.

Issue 10

In regard to potential impacts to aquatic ecology, the EPA stated:

> *It should also be noted that salinity is a surrogate measure of the range of specific salinity ions. Each ion and mix of ions can have different impacts on receiving waters and aquatic ecosystems.*

Response 10

RGS Environmental has conducted additional analysis of the ionic make-up of the following (Attachment 2 to this RTS):

- Water stored in on-site storages, the Moolarben Coal Complex open pits and underground mine.
- Surface water in the Goulburn River upstream of the Goulburn River Diversion (monitoring sites MCC SW05-SW12 and UMC SW01 [Figure 6]).
- Surface water in the Goulburn River downstream of the Goulburn River Diversion (monitoring sites MCC SW01-SW02 [Figure 6]).

RGS Environmental concluded:

- Review of the available surface water monitoring data (specifically major ionic data) at sites both upstream and downstream of the proposed MCC discharge point indicates that mine affected water stored in mine storages (for measured analytes) currently has a similar ionic make-up to surface water in the Goulburn River.
- On this basis, it is expected water discharged by MCO would have a similar ionic make-up to current water flows in the Goulburn River (including at monitoring sites downstream of current licensed discharges from the Ulan Mine Complex).
- The risk of individual major ions having adverse impacts to the aquatic ecology is low, which supports the findings of MPR (2017).

MPR (2017) assessed the potential impacts of the Modification on Aquatic Ecology, including consideration of any observed impacts of the historic discharges from the Ulan Mine Complex. MPR (2017) found no significant adverse impacts to aquatic ecology have been observed over the period 2004 to 2017 due to licensed discharges from the Ulan Mine Complex.

Based on the above, MPR (2017) concluded that the proposed discharge of 20 ML/day at 900 µS/cm as sought by the Modification application would have negligible impacts on aquatic ecology habitat.

Notwithstanding, it is understood any EPL variation may result in alternative discharge salinity limits (Section 5).

Downstream monitoring in the Goulburn River would continue for water quality, flow and aquatic ecology. The results of this monitoring may be used over time to support MCO's EPL 12932 variation request in consideration of the decision tree process in the ANZECC Guidelines.

Issue 11

In regard to near-field mixing at the point of discharge, the EPA stated:

> *In developing licence conditions for metals, the EPA would consider any available near-field mixing at the point of discharge if there are no acute toxicity risks at the point of discharge. It is understood however, that the sites location high in the headwater catchments of rivers system is likely to be problematic for considering mixing zones due to low flows and the lack of dilution that can practically be achieved for such discharges.*

The EPA would consider application of the ANZECC (2000) toxicant decision-tree which provides a method to define the potential bioavailable fractions of the analytes to reduce the conservatism built into the guidelines, e.g. considering dissolved fractions for metals is a step in the decision-tree. Chemical speciation assessment and whole effluent toxicity testing are further steps.

Response 11

MCO concurs with EPA's observation that there is limited potential for a mixing zone due to the location of the Moolarben Coal Complex in the upper reaches of the Goulburn River.

On this basis, MCO will manage metals concentrations at the point of discharge to ANZECC Guideline limits (default and site specific), as outlined in Response 8.

Increase in Discharge Volume

Issue 12

In regard to predicted downstream water quality concentrations, the EPA stated:

Appendix F considers the potential impacts of the proposed increased volume of a licensed discharge on downstream flows and quality. The EA states that there would be negligible adverse change in downstream pH levels, EC or TSS concentrations (i.e. when compared to historic water quality, ANZECC trigger levels). As the EPA is unclear on the location along the Goulburn River where the trigger values have been established, the EPA cannot provide comment with respect to this statement.

Response 12

It should be noted that the downstream trigger levels referred to in Appendix F are from MCO's currently approved WMP (and are not controlled release limits at the point of discharge).

The downstream trigger levels from the currently approved WMP have been established based on monitoring data from SW01 and SW02, and the UCML release criteria (e.g. for salinity).

Issue 13

In regard to discharge requirements, the EPA stated:

The EPA is interested in a comparison between the site water balance discharge predictions provided with the 2015 modification [UG1 Optimisation Modification] *and those provided in the EA to allow it to determine what the changes in discharge volumes are.*

Response 13

The UG1 Optimisation Modification did not seek any change to the EPL discharge limits that were approved at the time (i.e. 10 ML/day), and as such, updated predictions of expected discharges were not included in the UG1 Optimisation Modification Environmental Assessment.

Issue 14

In regard to the proposed increase in EPL discharge volume from 10 to 20 ML/day, the EPA requested:

The request for a 20ML/day, is based upon the water balance model for very wet climatic conditions (1%ile). It appears that the proponent has taken a conservative approach to the assessment and has a desire to have a level of flexibility built into the water management system. While the EPA appreciates the approach taken, justification for using the 1%ile volumes rather than the 50%ile volumes are requested, as it is likely that 50%ile volumes may be a more accurate indicator of the discharge volume which are required in reality.

Response 14

The requirement for up to 20 ML/day is required under a range of climatic scenarios, not just the 1% wet climatic sequence. This requirement for up to 20 ML/day is required in particular during mining of UG4.

Any variation to the currently authorised EPL discharge volume limits would be subject to a variation of EPL 12932. Based on further consultation with the EPA, it is understood any EPL 12932 variation would likely include staged volume limits. MCO considers that the following staged increase to volume limits would be acceptable:

- up to 15 ML/day following commencement of first workings to UG4;
- up to 20 ML/day following commencement of secondary extraction in UG4; and
- up to 15 ML/day two years after completion of mining in UG4 (subject to site water balance review).

Site Water Balance

Issue 15

In regard to the site water balance, the EPA stated:

> *Page 52 of Appendix F provides discussion regarding assumptions made with regarding the water treatment plant and the likely volume of brine which will be produced. It is unclear to the EPA how brine has been accounted for in the site water balance.*

Response 15

The site water balance has predicted the volume of brine that would be generated under various climatic scenarios. MCO would implement a specific hierarchy of management measures for brine (described below) which were not explicitly represented by WRM (2017) in the site water balance.

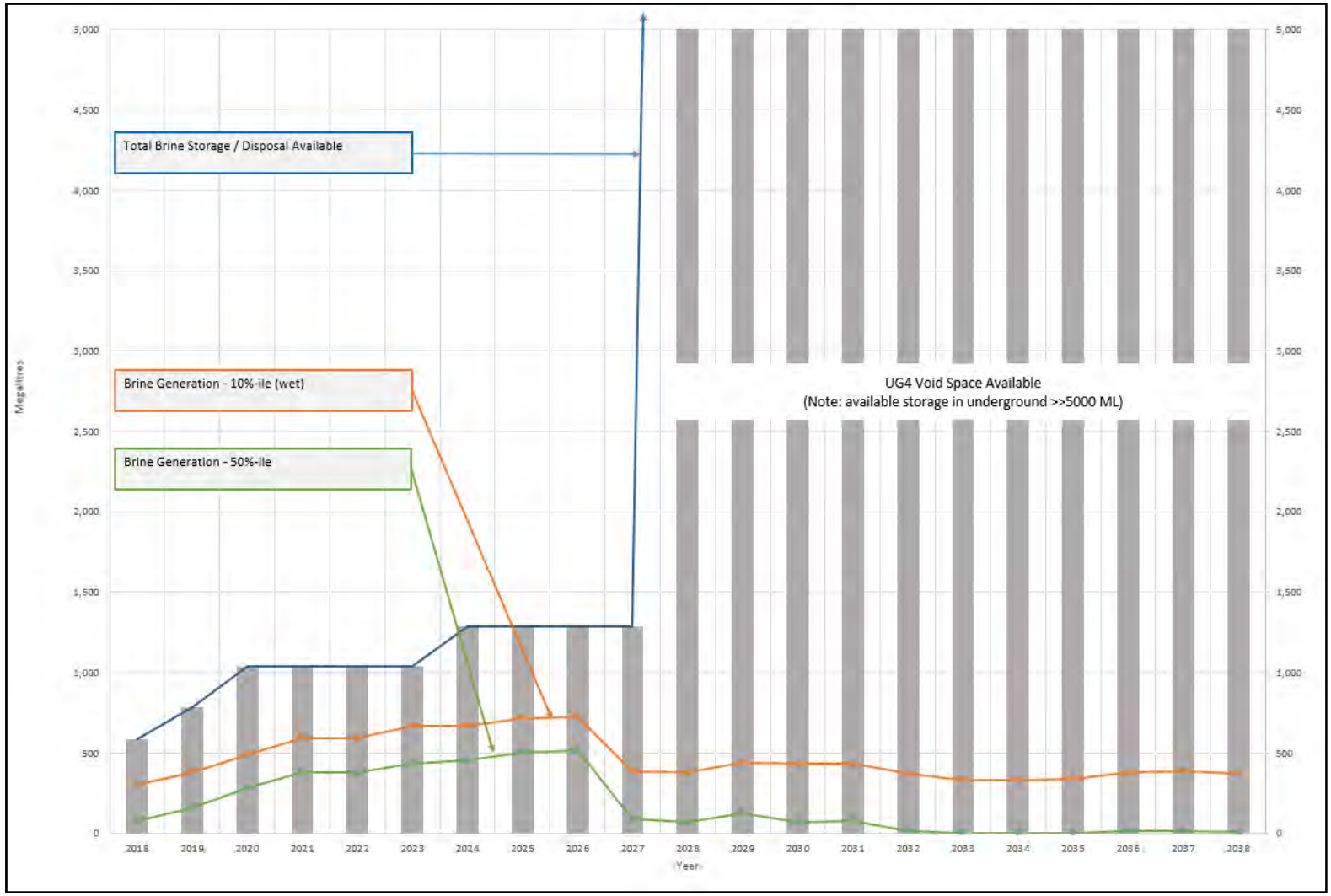
Brine generated from the treatment process would be diluted with mine water and used for dust suppression on haul roads, active mining areas and coal stockpile areas. Any runoff from dust suppression would be recaptured in the mine water dam catchments of the water management system. Residual brine would be:

- temporarily stored in dedicated by-product storage dams, or other mine water storages (e.g. OC2 and OC3 mine water dams following the completion of mining in these areas);
- reticulated to mining or waste emplacement areas draining to internal catchments with any runoff recaptured in the mine water management system; and/or
- evaporated in dams or via other evaporative techniques.

Once void space is available in the underground workings (i.e. down gradient of longwall mining) brine generated from the treatment process would be permanently stored underground within the coal seam aquifer.

The estimated annual volume of brine generated under 10th percentile (wet) and 50th percentile climatic scenarios is shown on the Graph 4, below.

Graph 4
Brine Generation and Storage



>> = much greater than.
%-ile = percentile.

As shown:

- brine production remains below available storage in all years;
- brine can be temporarily stored in the dedicated by-product dams and combined with mine water for use in controlling dust from haul roads via water carts;
- once mining is complete in OC1, OC2 and OC3, peak brine production (associated with predicted inflows to UG4) in years 2021 to 2026 can also be temporarily stored in the OC1, OC2 and OC3 mine water dams, following the completion of mining in these open cuts; and
- once mining in UG4 is complete, there is sufficient storage available in the underground void area to accommodate brine generated for the remainder of the mine life (in addition to transferring brine from other surface storages to the underground voids for permanent storage).

If brine accumulation during the period prior to permanent storage in the UG4 void exceeds the currently planned storage capacity, then additional temporary storage capacity will be constructed as required. For example, additional storages would be constructed in approved disturbance areas associated with open pits. Any additional temporary storages would be constructed consistent with existing mine water dams.

It is noted that Graph 4 conservatively does not consider:

- evaporation from storages;
- use of other disposal methods (e.g. irrigation of catchments reporting to OC4 mine water dams); and
- construction of additional temporary storage dams (e.g. in the OC4 mine footprint).

Cumulative Impacts and Load

Issue 16

In regard to potential cumulative impacts, the EPA stated:

> *The EA does not propose changes to existing water quality concentration limits currently authorised by EPL 12932 for licensed discharges but proposes instead a change to discharge volumes. Associated with an increased volume of discharge is an increased load of pollutants to the environment.*
>
> *While load considerations are included in the EA regarding the Hunter River Salinity Trading Scheme, the potential loading impacts of the proposed discharge on the receiving waters immediately downstream of the site are not considered, including the section of the Goulburn River that flows through the Goulburn River National Park.*
>
> *To appropriately assess the cumulative impact of the proposed discharge an assessment would need to include consideration of both the load and ionic impacts described above.*
>
> *It is noted that the SEARs require a cumulative assessment to be undertaken and previous planning consent requires the proponent to minimise cumulative water impacts with other mines in the region.*

Response 16

A cumulative assessment of the proposed discharges was undertaken by both Advisian (2017) and MPR (2017). Discharges from the Ulan Mine Complex were considered cumulatively with the proposed 20 ML/day releases for the Modification (in addition to background flow conditions) on surface water flows/quality and aquatic ecology.

Advisian (2017) modelled and assessed the proposed licensed discharges of 20 ML/day cumulatively with the potential discharges from the Ulan Mine Complex (i.e. the 'high flow' scenario was developed based on data that included discharges from the Ulan Mine Complex at up to 30 ML/day) and concluded there would be negligible adverse change in downstream pH levels, EC or TSS concentrations (i.e. when compared to historic water quality and/or ANZECC Guideline trigger levels).

The analysis undertaken by MPR (2017) considered the effects of both water quality concentrations and loads, including from historic discharges from the Ulan Mine Complex (at up to 30 ML/day) and found that no significant adverse impacts to aquatic ecology have been observed over the period 2011 to 2017 due to an increase in licensed discharge volume from the Ulan Mine Complex. As described in Response 10, it is expected water discharged by MCO would have a similar ionic make-up to current water flows in the Goulburn River.

Notwithstanding, it is understood any EPL variation may result in alternative discharge salinity limits (Section 5).

Downstream monitoring in the Goulburn River would continue for water quality, flow and aquatic ecology. The results of this monitoring may be used over time to support MCO's EPL 12932 variation request in consideration of the decision tree process in the ANZECC Guidelines.

EPA Licensing

Issue 17

In regard to the proposed increase in EPL discharge volume from 10 to 20 ML/day, the EPA requested:

> *… EPA needs to understand how the identified potential proposed increase in discharge volumes have been avoided or mitigated. The EPA requests further information regarding the potential for:*
>
> - *Increased onsite re-use, for example, consideration of watering of rehabilitation areas, increased dust suppression, watering of coal stockpiles;*
> - *Offsite re-use/water sharing options; and*
> - *Discharges to an alternate catchment for example the Talbragar River.*

Response 17

It is understood that any variation to EPL 12932 would involve a staged increase to volume limits (Section 5), which would be linked to operation milestones expected to result in increased water make (i.e. mining in UG4).

Avoidance and mitigation measures considered in the site water balance to minimise the volume of water to be released include:

- preferential use of mine water as per MCO's hierarchy of water use for on-site water demand;
- dust suppression of haul roads, work areas and stockpiles (where safe to do so);
- diversion of clean water around the Moolarben Coal Complex where practicable;
- progressive rehabilitation of the Moolarben Coal Complex, reducing the run-off coefficient/catchment yield; and
- irrigation of rehabilitation areas.

Updated water balance modelling (WRM, 2017) indicates the Moolarben Coal Complex (incorporating the Modification) may be a surplus site in some years under certain climatic conditions. The updated modelling also indicates that supplementary water supply from the Ulan Mine Complex is only required under the driest climatic scenarios, when water is not being discharged. These results demonstrate mine water is being used to satisfy all available water demands, and only surplus water is required to be discharged.

MCO notes that the Ulan Mine Complex has historically been a water surplus site and has historically discharged water into the Goulburn River. WCM is also a water surplus site.

As such, options to transfer surplus water to the Ulan Mine Complex or Wilpinjong Coal Mine is not considered to be feasible due to a lack of demand. Should this situation change, Moolarben would use reasonable endeavours to share surplus water with neighbouring operations and other industrial developments if possible (e.g. the proposed Bowdens Silver Project).

MCO maintains regular dialogue with neighbouring operations to identify opportunities to share water, with agreements for the sharing of water between mining complexes currently in place.

Discharges to alternative catchments have not been assessed and therefore are not proposed. Discharge via the Goulburn River Diversion is MCO's preferred release location given its proximity to the proposed water treatment facility. It is also considered more appropriate to discharge the water in the same catchment it is taken from as this offsets to some extent the potential reductions in flow due to catchment excision or potential effects on baseflow associated with the Moolarben Coal Complex.

Discharges to alternative catchments are not proposed due to the large extent of disturbance and infrastructure required to discharge to an alternative catchment.

Discharge Point

Issue 18

In regard to the proposed relocated EPL discharge point, the EPA stated:

> *The EPA notes that a spreader/diffuser is proposed to be installed with the aim of minimising the impact of the volume of water being discharged via Bora Creek. The EA considers that this will alleviate the potential scouring of the bed of the Goulburn River from the discharge. Given the height of the drop off from the bed of Bora Creek to the Goulburn River the EPA concurs that a method to reduce the impact is required. Ongoing monitoring is supported.*

Response 18

The EPA's support for the proposed spreader/diffuser at the point of discharge and the commitment for ongoing monitoring for potential scour impacts is noted.

Water Treatment Plant

Issue 19

In regard to the location of the water treatment plant, the EPA stated:

> *The EPA understands the water treatment is proposed to be located adjacent to the rail loop. The EA provides some indicative mapping regarding the location though detailed layout mapping has not been provided. It is likely that the proposed location of the water treatment plant may be in close proximity to Bora Creek or within its catchment. To understand the potential impacts of the siting of the water treatment plant including existing water management structures, further information is requested.*

Response 19

The water treatment facility (which would include the water treatment plant and associated storages) would be located within approved disturbance areas within and adjacent to the Moolarben Coal Complex rail loop. The water treatment facility would be located within the water management system for the CHPP.

To minimise the potential for uncontrolled releases, water storages required for the water treatment facility would be designed consistent with other mine water storages. In addition, any overflows from storages associated with the water treatment facility (e.g. pre-treatment facility or brine dams) would be constructed to overflow to existing storages and not directly to Bora Creek.

Issue 20

In regard to water treatment by-products, the EPA stated:

> *Section 3.7 of Appendix H discusses the pre-treatment requirements for the water treatment plant. The EPA notes that pre-treatment is proposed however the EA does not address how the sludge waste will be managed. Classification of the sludge waste will be required to inform any decisions regarding disposal.*

Response 20

Pre-treatment backwash from the water treatment facility would be:

- pumped to the CHPP from where it would be managed in conjunction with tailings. The solids would be removed through the CHPP and co-disposed with rejects in the open pits consistent with the approved disposal method for reject material from the CHPP; and/or
- dewatered and co-disposed with rejects in mine spoil.

Pre-treatment backwash may be temporarily stored in mine water dams prior to processing through the CHPP or dewatering.

Management of Brine/Treatment By-products

Issue 21

In regard to brine storage, the EPA stated:

> *The EPA does not support the proposal to dispose of brine in underground mining areas following mining. Dams used for the storage of brine will be required by the EPA to be lined and achieve a permeability standard of at least 1 x 10^{-9} m/s. Further dams may be required for the blending of brine with mine water for use for dust suppression, though no details regarding this are provided.*

Response 21

It is MCO's strong preference for brine to be permanently stored underground within the coal seam aquifer once suitable areas are available following the completion of underground mining.

HydroSimulations has provided additional analysis regarding storage of brine underground (Attachment 4 to this EIS).

In comparison to permanent storage in surface storages, permanent underground storage of brine is preferred given (HydroSimulations, 2018):

- Returning brine from the water treatment facilities would be returning these salts to the groundwater system from which they were extracted.
- Due to the depressurisation of the coal seam and overlying formations during mining, the underground mining area would remain a groundwater sink during the recovery period for 30-35 years.
- The migration of groundwater from the UG4 void would not occur for at least 30-35 years, and then at a rate governed by the lowest permeability in the stratigraphic section.
- Following recovery, it is expected that no significant change to salinity of the surrounding groundwater would occur given:
    - The density of brine would restrict the migration of highly saline groundwater, and as such, most of the brine would not move away from its point of deposition, and any brine that does migrate would have salinity significantly lower than brine.
    - Following recovery of groundwater levels, 80% of any groundwater in the UG4 void that migrates would move laterally and remain within the coal seam aquifer.
    - There would be significant dilution of any groundwater migrating from within UG4 from groundwater in the surrounding and overlying (>100m thickness) strata.

Issue 22

In regard to catchment areas receiving brine, the EPA stated:

> *Any areas reporting to storages that are sized based on Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E (e.g. overburden emplacement areas or haul roads in sediment basin areas) or rehabilitation areas should not receive by-products or blended by-products*

Response 22

MCO agrees with this statement. Catchment areas of sediment dams would not receive brine. Brine would only be disposed within catchment areas of the open pits and mine water dams.

Issue 23

In regard to brine storage, the EPA requested:

> *It is recommended that the Response to Submissions should clarify and provide appropriate mitigation options where necessary for the following issues:*
>
> - *Water management systems and storages that will receive or recapture by-product or blended by-product runoff from use or reuse should be designed to capture a 100 year ARI 72 hour storm event.*
> - *For soils within 1 in 100 year 72 hour capture areas, management of any salt affected soils, e.g. waste management, rehabilitation and mine closure.*
> - *The potential impact of by-products on the integrity of liners and the suitability of storages for holding brine, including reactivity of the liners with by-product.*
> - *Evaporative processes and management of potential impacts of residual and increasing concentration of salts in storages and on liners.*
> - *Potential impacts on groundwater from disposal of by-products in underground mining areas following completion of mining.*

Response 23

Any new temporary brine storage dams would be designed for a 100 year ARI 72 hour storm event. Other water management systems and storages that would receive or recapture brine or blended brine runoff from use or reuse would be designed consistent with the currently approved design criteria for mine water management dams (100 year ARI 72 hour event for Stage 2 storages and 50 year ARI 72 hour event for Stage 1 storages).

Brine would only be used via application to mining areas (e.g. diluted with mine water and used for haul road dust suppression). These areas would still be subject to final shaping, soil application and rehabilitation.

As brine would be preferentially used (in internally draining catchments) as per the hierarchy of use, the requirement to store brine would be minimised. Residual brine required to be stored in surface storages would be temporary, and as such, no significant impact to dam liners is expected. Notwithstanding, liner integrity would be considered in the design of any new storages.

Further justification for MCO's preferred use of underground mining voids for permanent brine storage is provided in Response 21.

Dam Sizing

Issue 24

In regard to the sizing of Dam 107, the EPA stated:

> *It appears that the project approval (08_0135) was updated to a 1 in 100 year ARI, 72 hour event at Phase 2. If this new ARI applies to dam 107 then the risk should be assessed and mitigated.*

Response 24

The construction and operation of dam 107 is conducted in accordance with the Stage 1 Project Approval (05_0117).

As per Table 11 of Project Approval (05_0117) the performance measure for 'mine water storages' is:

> *Mine water storage infrastructure is designed to store a 50 year ARI 72 hour storm event*

As such, no further assessment is required.

6.1.1.3 Noise

Issue 25

In regard to potential noise impacts, the EPA stated:

> *The EPA can support the modification with no changes to the existing noise limits in Moolarben's Environment Protection Licence.*

Response 25

The EPA's support for the Modification on the basis of no changes to existing EPL noise limits is noted.

The Modification does not propose any change to existing EPL or Project Approval noise limits.

Predicted Noise Impacts at Properties 30 and 63

Issue 26

In regard to predicted noise impacts at receiver IDs 30 and 63, the EPA stated:

> *The EPA notes there are two landholder locations (location 30 and 63) which appear early in Moolarben's Environment Protection Licence; appear in a recent consolidation approval for Moolarben, and; are listed in Appendix C2 of the Noise Assessment. However, there do not appear to be predicted noise levels for these two locations, or an explanation as to why there are none in the Noise Assessment. Figure 3 of the EIS indicates that location 30 is mine owned and location 63 is under contract/purchase agreement. However, it's not clear in the Noise Assessment if this is the reason why noise impacts were not assessed at these two landholder locations.*

Response 26

Property 30 is now owned by MCO and has been removed from EPL 12932. At the time of lodgement of the Modification, property 63 was subject to a written negotiated noise agreement.

As these properties are now owned by MCO or subject to a written negotiated noise agreement they were not applicable to the assessment of privately-owned receivers in the Noise Assessment for the Modification.

Issue 27

The EPA requested clarification in regard to low frequency noise.

Response 27

SLR's (2017) conclusion that the Moolarben Coal Complex noise emissions do not contain "dominant low frequency content" is based on the following:

- Noise measurements conducted by SLR for a duration of one week at receiver ID 175 (generally representative of the nearest Cooks Gap receivers).
- SLR's review of Independent Noise Reviews at property IDs 76 and 300 conducted by Bridges Acoustics in 2016, which considered the potential for low frequency noise from the Moolarben Coal Complex in accordance with the Industrial Noise Policy and draft Industrial Noise Guideline (now Noise Policy for Industry).
- Review of Moolarben Coal Complex monthly attended noise monitoring reports, which consider the potential for low frequency noise.

Ongoing noise monitoring will continue to be analysed for low frequency noise in accordance with the procedures outlined in the NSW Noise Policy for Industry.

6.1.2 NSW Division of Resources and Geoscience

The DRG conducted the following in its review of the Environmental Assessment:

- review of Environmental Assessment (in regard to rehabilitation outcomes) (Section 6.1.2.1); and
- Resource and Economic Assessment (Section 6.1.2.2).

6.1.2.1 Rehabilitation Outcomes

Issue 28

In regard to rehabilitation, the DRG stated:

> *The Division has determined that sustainable rehabilitation outcomes can be achieved as a result of the project and that any identified risks or opportunities can be effectively regulated through the conditions of mining authorities issued under the Mining Act 1992.*

Response 28

The DRG's comment that rehabilitation outcomes proposed for the Modification can be achieved is noted.

Issue 29

In regard to the MCO-owned Gilgal property, the DRG requested consultation be undertaken with Santos NSW, Hunter Gas and Bowdens Silver, each of which hold exploration authorisations over the property.

Response 29

The DRG's request is noted. MCO has consulted with Santos NSW, Hunter Gas and Bowdens Silver. Evidence of this consultation will be provided to DRG separately to this Response to Submissions document.

6.1.2.2 Resource and Economic Assessment

Issue 30

DRG conducted a Resource and Economic Assessment for the Modification and stated:

> *Given the constraints outlined in the proponent's EA, the Strategic Resource Assessment & Advice unit within the Division considers the Project mine plan for the open cut operations will adequately recover coal resources and provide an appropriate return to the State, within the mine footprint, giving due consideration to the particular constraints of the location.*
> …
> *the Division has calculated that in a typical full production year the State will receive around $10 million per annum in royalty and $135 million over the life of the Modification.*

Response 30

MCO notes the findings of DRG's Strategic Resource Assessment & Advice.

The DRG's estimation of the additional royalties that would result from the Modification over the life of the Moolarben Coal Complex is higher than those estimated in the Environmental Assessment. This is due to the DRG using a higher coal price forecast than the price used in MCO's economic analysis.

6.1.3 NSW Office of Environment and Heritage

The OEH considered the potential impacts of the Modification on biodiversity in its review of the Environmental Assessment, particularly in regard to:

- area to be relinquished as part of the Modification (Section 6.1.3.1); and
- proposed Biodiversity Offset (Section 6.1.3.2).

6.1.3.1 Area to be Relinquished as part of the Modification

Issue 31

In regard to the areas to be relinquished for disturbance as part of the Modification, the OEH stated:

> *OEH has reviewed the Environmental Assessment (EA) and BAR and notes that the modification involves the relinquishment of previously approved areas of disturbance. OEH notes it is proposed to reduce the overall credit liability of the modification by subtracting the area of relinquished areas from the new disturbance areas. OEH regards this approach as not being consistent with the FBA. OEH accepts that Moolarben has approval to develop the relinquishment area and an offset was established as part of the approval for that area. The impact and offsets areas at that time were area based, not credit based.*
>
> *While it appears that the credit requirement of both the development areas and relinquished areas have been calculated, it has not been demonstrated that all the development credits (type and quantum) are available within the existing offset obligation for the relinquished areas. OEH is open to the proponent identifying if the offset obligation exists on areas previously identified as offsets, and if so OEH would consider them as partly satisfying the total Optimisation Modification credit obligation.*
>
> *OEH is concerned that the proponents proposed approach may set a precedence noting that the previously approved areas were not assessed under the FBA and did not have a credit liability attached to them. OEH recommends that all development areas proposed as part of this modification be offset in full in accordance with the NSW Major Projects Offset Policy and FBA.*

Response 31

Further consultation with the OEH has focused this response to the technical and floristic comparison of the portion of the disturbance area for which the relinquishment is provided against the existing Stage 1 biodiversity offset. This is to provide additional justification that the biodiversity values of areas to be disturbed are adequately offset by the biodiversity values of the existing Stage 1 offset.

As noted by the OEH, the Modification proposes to relinquish areas approved to be disturbed as part of Stage 1 of the Moolarben Coal Complex.

These areas were approved to be disturbed, subject to the establishment of the Stage 1 biodiversity offset strategy, which is already in place. The Stage 1 offset areas comprise more than 1,700 hectares of native vegetation, part of which compensates for the approved disturbance associated with the Relinquishment areas. As OEH outlined in its submission, the impact and offsets areas for Stage 1 were area-based, not credit-based, as they pre-dated the Framework for Biodiversity Assessment.

There is environmental benefit associated with the relinquishment of these previously approved disturbance areas.

The total offset liability of the additional Modification disturbance areas was determined by subtracting portions of the Relinquishment areas (which had FBA data collected on them as part of the Modification surveys) only where it was demonstrated through credits generated by the FBA Credit Calculator (i.e. the *Credit Calculator for Major Projects and BioBanking*) the Relinquishment areas are equivalent to the Modification area.

The credits generated by the Modification disturbance area, the relinquishment area as well as any net credits are provided in Table 6 of the Environmental Assessment (repeated below [Table 5]).

To evidence the above, the Relinquishment areas comprise 15 ha of native vegetation (814 ecosystem credits). However, only 12 ha of this native vegetation (677 ecosystem credits) has been associated with vegetation communities within the Modification disturbance area. Therefore, only 677 (of the 814) ecosystem credits have been subtracted from the Modification disturbance area offset liability.

In addition, approximately 3 ha of the Central Hunter Eucalypt Critically Endangered Ecological Community (CEEC) is mapped within the Relinquishment areas (comprised of HU618), in comparison to only 2 ha of this community within the Modification disturbance area. As such, the relinquishment of this 3 ha results in a net benefit to this CEEC within the locality.

MCO does not consider it is warranted to conduct FBA-compliant surveys across the extent of the approved Stage 1 offsets, particularly given portions of the Stage 1 offset have already been transferred to National Parks and Wildlife.

Notwithstanding, following consultation with OEH, MCO has investigated the similarity between the communities mapped in the Relinquishment areas and Stage 1 offset areas. This is to further demonstrate the values of the Relinquishment areas are equal to the Stage 1 offset areas, considering contemporary offset tools/values. MCO has determined the following:

- The BVTs in the Relinquishment areas contain a similar suite of dominant flora species as the communities mapped in the Stage 1 offset areas (e.g. Black Cypress Pine [*Callitris Endlicheri*], Narrow-leaved Ironbark [*E. Crebra]* and Rough-barked Apple [*Angophora floribunda*]). This is demonstrated by the vegetation community comparisons provided in Table 6.
- Only 1 ha of the White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community (EEC) is mapped within the Relinquishment areas (comprised of HU714 and HU730) while a total of approximately 85 ha of this EEC is mapped within the Stage 1 Offset Areas (Table 6).

Table 5
Modification Credit Reconciliation

Credit Type	Credits Required by the Modification						Credits Potentially Generated by the Proposed Offset Strategy^				
	Modification Areas		Relinquishment Areas		Residual Impact		Relevant Credits Generated by the Gilgal Property*	Rehabilitation		Net Offset Credits Used	Offset Liability Met?
	Area (ha)	Credits	Area (ha)	Credits	Area (ha)	Credits		Area (ha)	Credits		
Ecosystem Credits											
HU618[1]	2	108	3.5	188	**0**	**0**	N/A	N/A	N/A	**N/A**	N/A
HU714[2]	1.5	53	0.5	18	**1**	**35**	> 35	-	-	**35**	Yes
HU730[2]	3.5	112	0.5	39	**3**	**73**	0	27	73	**73**	Yes
HU820	3	190	1[3]	40	**2**	**150**	> 150	-	-	**150**	Yes
HU843	13	827	6.5	416	**7**	**411**	> 411[4]	-	-	**411**	Yes
HU875	4	237	1	33	**3**	**204**	> 204[5]	-	-	**204**	Yes
HU883	4.5	233	0	0	**4.5**	**233**	> 233[6]	-	-	**233**	Yes
HU910	7.5	354	0.4	23	**7.1**	**331**	0	123	331	**331**	Yes
HU905	0	0	1.5	57	**0**	**0**	N/A	N/A	N/A	**N/A**	N/A
Total	**39**	**2,114**	**15^^**	**814^^**	**27^^**	**1,437^^**	**1,033**	**150**	**404**	**1,437**	Yes
Regent Honeyeater	31	2,371	10.5	803	**20.5**	**1,568**	> 1,568	-	-	**1,568**	Yes
Koala	4	94	0.5	17	**3.5**	**77**	64	4	13	**77**	Yes
Brush-tailed Rock Wallaby	37	960	10.5	267	**26.5**	**693**	> 693	-	-	**693**	Yes

Note: Totals may not sum due to rounding.

^ Credits are indicative only. The final offset strategy would be subject to approval of the additional disturbance proposed by the Modification.

^^ Only 12 ha of native vegetation (equating to 677 credits) within the Relinquishment areas can be associated with the vegetation communities within the Modification area.

* The area of a number of the communities/fauna habitats on the Gilgal property provide excess credits to that required by the Modification. MCO would only retire the credits required to offset the Modification (as identified in this table) and would hold any residual credits for future use, as required.

1 Central Hunter Eucalypt Woodland CEEC (EPBC Act). Note, the DNG does not meet the criteria to be listed as the CEEC.

2 Box-Gum Woodland EEC (BC Act)/CEEC (EPBC Act).

3 HU603 (located in the Relinquishment areas) is identified as an 'Offset Option' within the Credit Calculator report (ELA, 2017).

4 HU874 (located on Gilgal) is identified as an 'Offset Option' within the Credit Calculator report (ELA, 2017).

5 HU702 (located on Gilgal) is identified as an 'Offset Option' within the Credit Calculator report (ELA, 2017).

6 HU618 (located on Gilgal) is identified as an 'Offset Option' within the Credit Calculator report (ELA, 2017).

Table 6
Vegetation Community Comparison between the Relinquishment Area and Stage 1 Offset Area

BVT Mapped within Relinquishment Area	Area (ha)	Equivalent Vegetation Community Mapped within Stage 1 Offset Area*	Area (ha)	
HU603 Rough-barked Apple - Silvertop Stringybark - Red Stringybark grassy open forest of the upper Hunter Valley	1	Rough-barked Apple Alluvial Woodland	30	1,026.5
		Rough barked apple woodland on valley flats	7.5	
		Ironbark - Cypress - Stringybark forest	287	
		Inland scribbly gum forest	23	
		Inland Scribbly gum - narrow leaved Stringybark forest	590	
		Tumbledown Gum - Currawang Open Forest	89	
HU843 Narrow-leaved Stringybark - Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin	6.5	Ironbark - Cypress - Stringybark forest	287	1,108.5
		Inland scribbly gum forest	23	
		Inland Scribbly gum - narrow leaved Stringybark forest	590	
		Tumbledown Gum - Currawang Open Forest	89	
		Broad-leaved Ironbark - Dwyers Red Gum Low Open Woodland	16	
		Common Fringe myrtle - Kunzea Heath	11.5	
		Parramatta Red Gum - Black Cypress Pine Forest	92	
HU910 Blakely's Red Gum – Rough-barked Apple shrubby woodland of central and upper Hunter	0.4	Blakely's red gum - rough barked apple - alluvial woodland	114	1,171
		Rough-barked Apple Alluvial Woodland	30	
		Rough barked apple woodland on valley flats	7.5	
		Broad-leaved Ironbark - Dwyer's Red Gum Low Open Woodland	16	
		Ironbark - Cypress - Stringybark forest	287	
		Inland Scribbly gum - narrow leaved Stringybark forest	590	
		Inland scribbly gum forest	23	
		Common Fringe myrtle - Kunzea Heath	11.5	
		Parramatta Red Gum - Black Cypress Pine Forest	92	

Table 6 (Continued)
Vegetation Community Comparison between the Relinquishment Area and Stage 1 Offset Area

BVT Mapped within Relinquishment Area	Area (ha)	Equivalent Vegetation Community Mapped within Stage 1 Offset Area*	Area (ha)	
HU875 Narrow-leaved Ironbark – Black Pine - Sifton Bush heathy open forest on sandstone ranges of the upper Hunter and Sydney Basin	1	Ironbark - Cypress - Stringybark forest	287	1,108.5
		Broad-leaved Ironbark - Dwyers Red Gum Low Open Woodland	16	
		Inland Scribbly gum - narrow leaved Stringybark forest	590	
		Inland scribbly gum forest	23	
		Tumbledown Gum - Currawang Open Forest	89	
		Common Fringe myrtle - Kunzea Heath	11.5	
		Parramatta Red Gum - Black Cypress Pine Forest	92	
White Box Yellow Box Blakely's Red Gum Woodland EEC	1	*White Box Yellow Box Blakely's Red Gum Woodland EEC*	85	85

* Community names consistent with Stage 1 biodiversity offset surveys undertaken by ELA. Communities included are based on the presence of dominant canopy and mid-story cover species identified in the Stage 1 vegetation community where they are consistent with the dominant species of the community mapped within the Relinquishment areas.

To further demonstrate that the credits generated by the clearance of vegetation within the Relinquishment areas are available within the existing Stage 1 offset areas, an estimation of species credit species generated for the Regent Honeyeater in the Stage 1 offsets is provided based on the ratio of 7.1 species credits per hectare of potential habitat. The following two vegetation communities mapped within the Stage 1 offset areas have been considered to provide potential habitat for the Regent Honeyeater, in consideration of the vegetation associations listed in the OEH Bionet database for this species:

- Blakely's Red Gum - Rough-barked Apple flats woodland of the NSW western slopes; and
- Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands.

These communities comprise approximately 560 ha of the Stage 1 offset areas, equating to approximately 3,976 species credits for the Regent Honeyeater. This is significantly greater than the 10.5 credits required for the approved disturbance within the Relinquishment areas.

Given the disturbance associated with the Relinquishment areas has already been adequately offset, as agreed with OEH through approval of the Stage 1 offset area, MCO considers it reasonable that, should these areas no longer be proposed for disturbance, areas of equivalent biodiversity value within the Modification area (with equivalence demonstrated by the FBA calculator) should be considered to have been adequately offset.

6.1.3.2 Proposed Biodiversity Offset

Issue 32

In regard to the proposed biodiversity offset for the Modification, the OEH stated:

> *OEH notes that the proposed offset property Gilgal would satisfy all credits required by this modification except for 404 ecosystem credits and 13 credit species for the Koala. It is OEH's preference that this residual credit liability be retired through a land-based offset or by either purchasing existing credits on the Biodiversity Credits Register and/or making payments into the Biodiversity Conservation Trust Fund once established.*

Response 32

The OEH's comment is noted. MCO's preference is to use credits generated by the Gilgal property to satisfy as much of the Modification offset liability as possible, with any residual credits to be satisfied by the other mechanisms provided by the FBA.

6.1.4 Mid-Western Regional Council

The MWRC required further clarification on the following issues in its review of the Environmental Assessment:

- water treatment facilities and pipeline (Section 6.1.4.2); and
- management and mitigation measures (Section 6.1.4.3).

6.1.4.1 General Comments

Issue 33

The MWRC stated:

> *In summary, Council does not object to the Modification.*

Response 33

The MWRC's comment that it does not object to the Modification is noted.

6.1.4.2 Water Treatment Plant and Pipeline

Issue 34

In regard to the proposed pipeline to the relocated EPL discharge location, the MWRC stated:

> *As the pipeline would run through culverts under Ulan Road, Council would like to be consulted during the design and installation of this pipeline.*

Response 34

The MWRC's comment is noted. MCO would consult with MWRC in regard to the design and installation of the pipeline when consent for works within Ulan Road Corridor is sought from Council pursuant to section 138 of the NSW *Roads Act 1993.*

6.1.4.3 Management and Mitigation Measures

Issue 35

In regard to ongoing environmental monitoring, mitigation and management, the MWRC stated:

> *Council would like to ensure that appropriate monitoring controls remain in place and that management and mitigation measures continue to be incorporated in any project approval.*

Response 35

MCO would review and update its environmental management plans, as required, should the Modification be approved.

Issue 36

In regard to management and mitigation measures for The Drip, the MWRC stated:

> *As above, Council would like to ensure that appropriate management and mitigation measures remain in place to continue to protect The Drip and maintain this unique natural feature of the local area.*

Response 36

As noted by the MWRC, no impacts to The Drip are predicted due to the Modification. Existing monitoring and management measures relevant to The Drip would continue for the Modification.

6.1.5 NSW Department of Industry

Following its review of the Environmental Assessment, DPI made recommendations in regard to:

- agricultural land;
- Crown Lands;
- water sources; and
- additional information for inclusion as conditions of consent in the event of project approval.

6.1.5.1 Agricultural Land

Issue 37

In regard to potential impacts to agriculture, DPI stated:

> *The proponent should demonstrate that all ongoing significant impacts to potential agricultural land can be mitigated and rehabilitated.*

Response 37

DPI's comment is noted.

The potential impacts of the Modification to agriculture are associated with the proposed changes in final landuse in OC2 and portions of OC3 from agricultural use to native vegetation.

No significant impacts to agriculture in the region are expected due to these proposed changes to final landuse for the Modification, given:

- The reduction in area to be returned to agricultural land post-mining would be insignificant in comparison to the total area used for agriculture in the region.
- The areas within OC2 to be returned to native vegetation are within the active mining area, and are not currently used for agriculture. Therefore, returning these areas to native vegetation would not contribute to any loss of agricultural production in comparison to current practices.
- The areas now proposed to be rehabilitated to native vegetation were previously proposed to be returned to agricultural land suitable for grazing/pasture post-mining (i.e. minimum Land Capability Class VI), as opposed to higher value agricultural land suitable for cultivation.

6.1.5.2 Crown Lands

Issue 38

In regard to works on Crown Land or Crown roads, DPI stated:

> *The proponent should note that prior to commencement of any works or occupation of Crown Land or Crown roads, consent of the Minister for Lands and Forestry must be obtained.*

Response 38

DPI's comment is noted.

6.1.5.3 Water Sources

Baseflow Losses

Issue 39

In regard to baseflow losses from Moolarben Creek, DPI stated:

> *The increase in baseflow loss from Moolarben Creek should be accounted for via a Water Access License from the Upper Goulburn River Water source.*

Response 39

The predicted loss of baseflow contribution from the alluvium / palaeochannel adjacent to Moolarben Creek has been accounted in the groundwater model as licensable take from the Upper Goulburn River Water Source of the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009*.

Consistent with the existing requirements of Condition 29, Schedule 3 of Project Approval (05_0117) and Condition 25, Schedule 3 of Project Approval (08_0135), MCO will hold water access licences to account for predicted impacts over the life of the Moolarben Coal Complex as required.

Issue 40

In regard to potential impacts to groundwater levels and GDEs due to the Modification, DPI stated:

> *The proponent should provide further details regarding the impacts of this loss of baseflow on the alluvial aquifer and the corresponding groundwater dependent ecosystems.*

Response 40

The approved Moolarben Coal Complex involves mining of OC3. The Modification would not change the depth of mining in OC3, progressive backfilling of OC3 or size and location of the OC3 final void. The Modification involves minor changes (increases and reductions) to the OC3 pit limits.

As shown in Figure 23 of HydroSimulations (2017) (reproduced as Figure 7, below) the predicted change in water table levels adjacent to Moolarben Creek at the end of mining due to the Modification is minor (approximately 1 m).

On this basis (i.e. minimal changes in predicted water table levels due to the Modification), HydroSimulations (2017) concludes that potential impacts to watercourses and GDEs due to the Modification would be negligible. It is also noted that no significant GDEs have been recorded along Moolarben Creek in the vicinity of OC3.

Furthermore, the alluvial aquifers are not highly productive aquifers, being narrow in extent, shallow and containing poor quality water and there are no other users of this groundwater, high priority GDEs or high priority culturally significant sites.

As such, the Modification is within the Level 1 minimal harm criteria for water table, pressure and quality outlined in the NSW Aquifer Interference Policy (HydroSimulations, 2017).

Water Licensing

Issue 41

In regard to water licensing, DPI requested:

> *The proponent should provide a table showing proposed take of water from each water source that compares approved and proposed operations. This should be presented with figures relevant to the assessment of Moolarben Coal 1 Mod 12 and Moolarben Coal 2 Mod 2. This is important to understand the groundwater model update.*

Response 41

The Environmental Assessment identified no increase in peak annual licencing requirements due to the Modification.

Consistent with the existing requirements of Condition 29, Schedule 3 of Project Approval (05_0117) and Condition 25, Schedule 3 of Project Approval (08_0135), MCO will hold water access licences to account for predicted impacts over the life of the Moolarben Coal Complex as required.

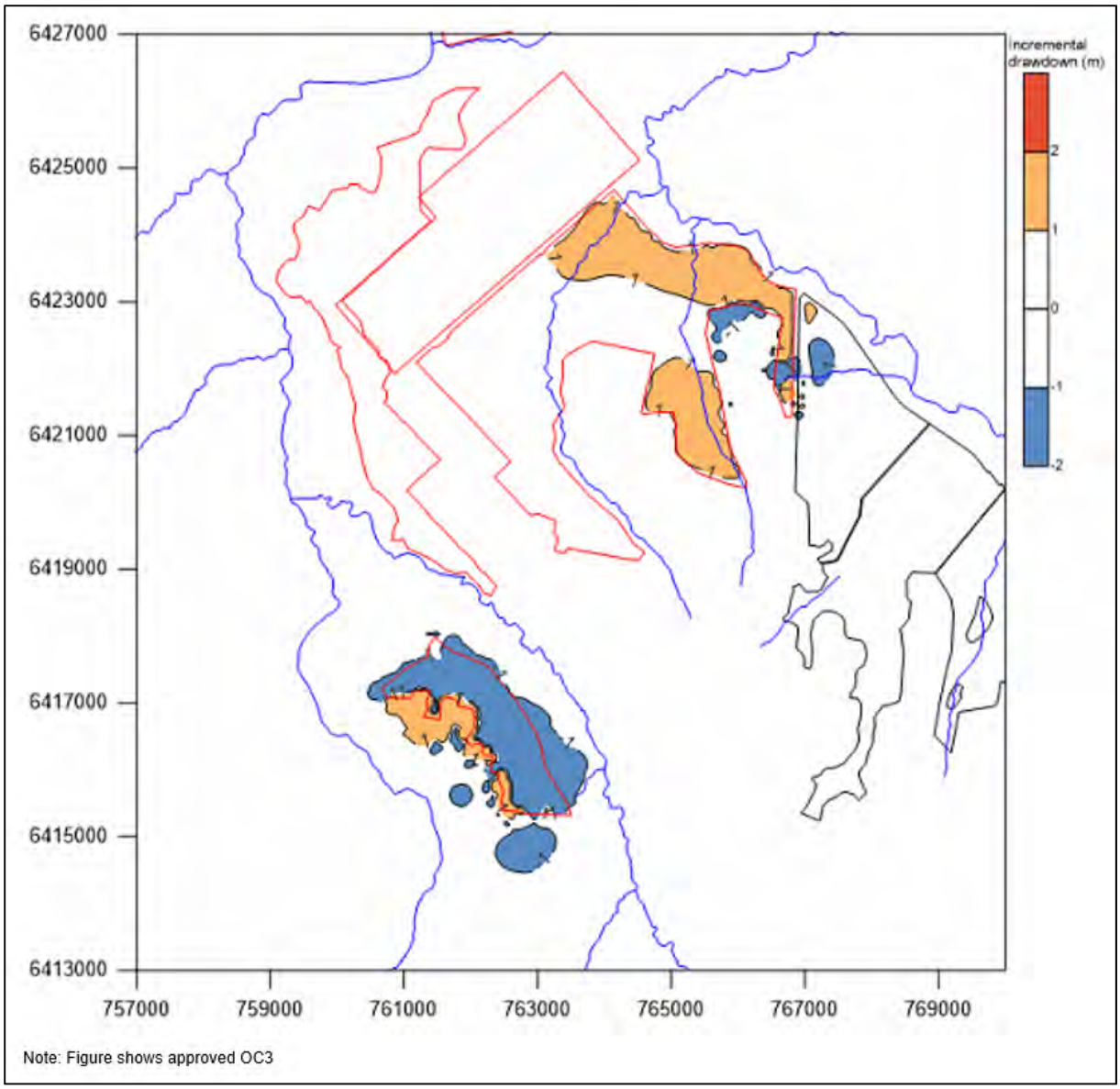


Figure 7: Incremental Water Table Drawdown (m) at the end of MCC Mining due to the Modification

Source: Figure 23 of HydroSimulations (2017).

Groundwater Bores

Issue 42

DPI requested the construction and lithology logs for PZ03.

Response 42

Figure B1 from the Stage 1 Environmental Assessment Groundwater Assessment (Peter Dundon & Associates Pty Ltd, 2006) (reproduced as Figure 8, below) provides the bore log for PZ03.

Palaeochannel

Issue 43

In regard to the isolated palaeochannel adjacent to Moolarben Creek, DPI stated:

> *The proponent should confirm whether the isolated palaeochannel has been included in the updated groundwater model for the proposed modification. If the palaeochannel has been excluded evidence should be provided to justify that the palaeochannel is hydrologically isolated from the Moolarben Creek and Quaternary alluvial aquifer. This is important to provide confidence in the updated groundwater model for predicting the impacts from the proposed modification and for estimating take of water from each relevant water source.*

Response 43

The palaeochannel has been included in previous groundwater models developed for the Moolarben Coal Complex, as shown on Figure 3.3 of RPS Aquaterra (2011) (reproduced as Figure 9, below). It is shown as running adjacent to OC3 and beneath the approved permanent out-of-pit emplacement (which is no longer required for the Modification).

The palaeochannel adjacent to Moolarben Creek has also been included in the groundwater model for the Modification. This section of isolated palaeochannel is included in layer 1 of the groundwater model and its extent is consistent with RPS Aquaterra (2011).

The palaeochannel is typically separated from the alluvium associated with Moolarben Creek by outcropping Permian Illawarra Coal Measures.

It should be noted that the alluvium in the vicinity of Moolarben Creek is not a highly productive aquifer, being narrow in extent, shallow and containing poor quality water (as evidenced by data from PZ58). There are no other users of this groundwater, high priority GDEs or high priority culturally significant sites.

As such, the Modification is within the Level 1 minimal harm criteria for water table, pressure and quality outlined in the NSW Aquifer Interference Policy (HydroSimulations, 2017).

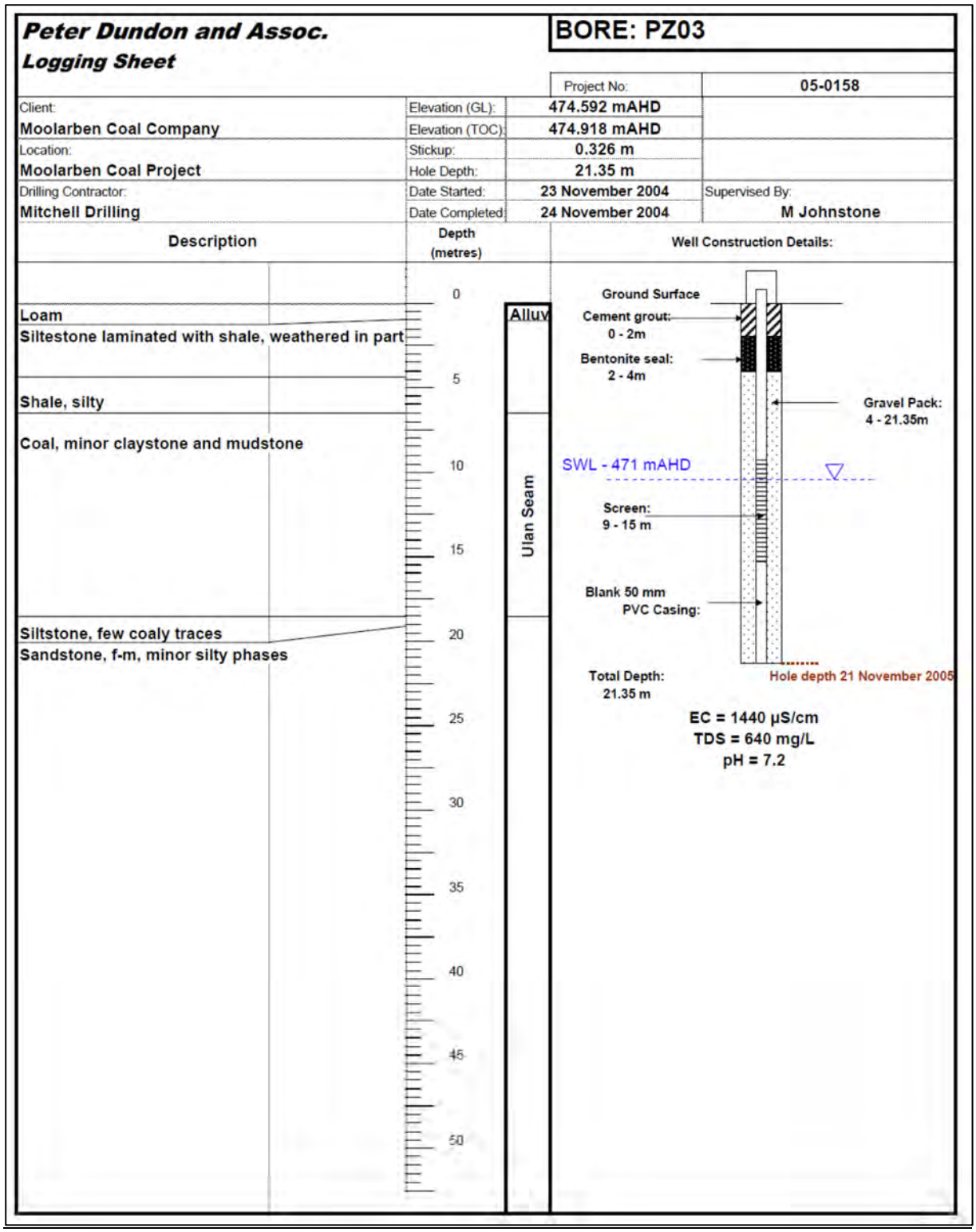


Figure 8: Bore Log – PZ03

Source: Figure B1 of Peter Dundon & Associates Pty Ltd (2006).

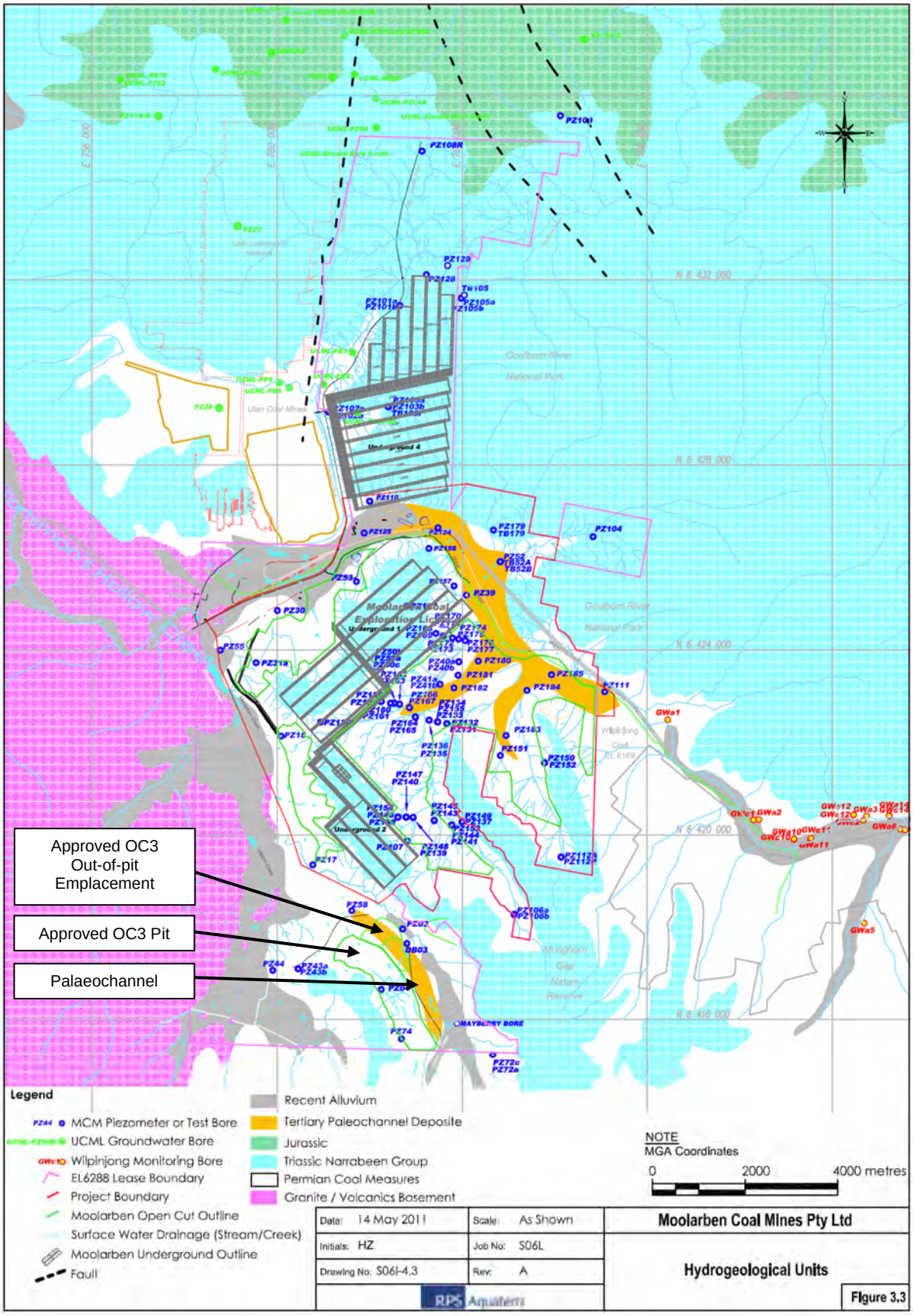


Figure 9: Hydrogeological Units
Source: Figure 3.3 of RPS Aquaterra (2011).

Issue 44

In regard to groundwater monitoring in the vicinity of Moolarben Creek, DPI stated:

> *The groundwater monitoring plan for the site should be expanded to include additional alluvial groundwater observation bores within the Moolarben Creek alluvium and isolated palaeochannel valley down gradient from the proposed modification of OC2 and OC3 pit extensions and surface modifications*

Response 44

Additional monitoring bores adjacent to OC3 will be installed and documented in the revised Groundwater Management Plan, should the modification be approved.

Due to the steep terrain between the proposed extension to the OC2 pit limit and Moolarben Creek, an additional monitoring bore in this location is not considered feasible.

Mine Inflows

Issue 45

In regard to potential changes in mine inflows due to the Modification, DPI stated:

> *The groundwater assessment indicated that the proposed modification would result in a negligible increase in mine water take. The proponent should provide information regarding the refinements to justify the assumed increase in surplus water.*

Response 45

The Statement of Commitments for Project Approval (08_0135) (Commitment 24) states that *a groundwater modelling post-audit and model re-calibration (where required) will be carried out 2 year (and 5 yearly thereafter) after commencing Stage 2 coal extraction*.

Consistent with the Statement of Commitments from Project Approval (08_0135), MCO has updated its groundwater model. The revised groundwater modelling was conducted by HydroSimulations (2017). When compared to the previous predictions by RPS Aquaterra (2011), the revised groundwater modelling predicts increased inflows for a number of reasons, including:

- changes to the sequencing of the approved underground mining areas (including the requirement to continue to dewater UG1 for the life of UG4 to maintain safe access to the UG4 workings);
- approved underground mining rate of 8 Mtpa as a result of the UG1 Optimisation Modification;
- differences in the timing of advanced dewatering of the UG4 area via the approved borefield; and
- water stored in the Ulan East Pit providing potential recharge to down-dip workings in the Ulan Seam.

These factors resulting in changes to predicted groundwater inflows are unrelated to the Modification.

The revised groundwater model (HydroSimulations, 2017) has also been used to predict groundwater inflows for the mine sequence for the Modification. In comparison to the predicted inflows for the approved Moolarben Coal Complex operations (using the revised groundwater) differences in peak inflows due to the Modification are negligible. However, there is a difference in the timing when peak inflows would occur. For example, for the Modification, peak inflows to OC3 would occur in 2022 as opposed to 2037 for the approved Moolarben Coal Complex operations due to the proposed change in mining sequence (refer to Figures 18a and 18b of the Groundwater Assessment [reproduced as Figures 11 and 12, below]).

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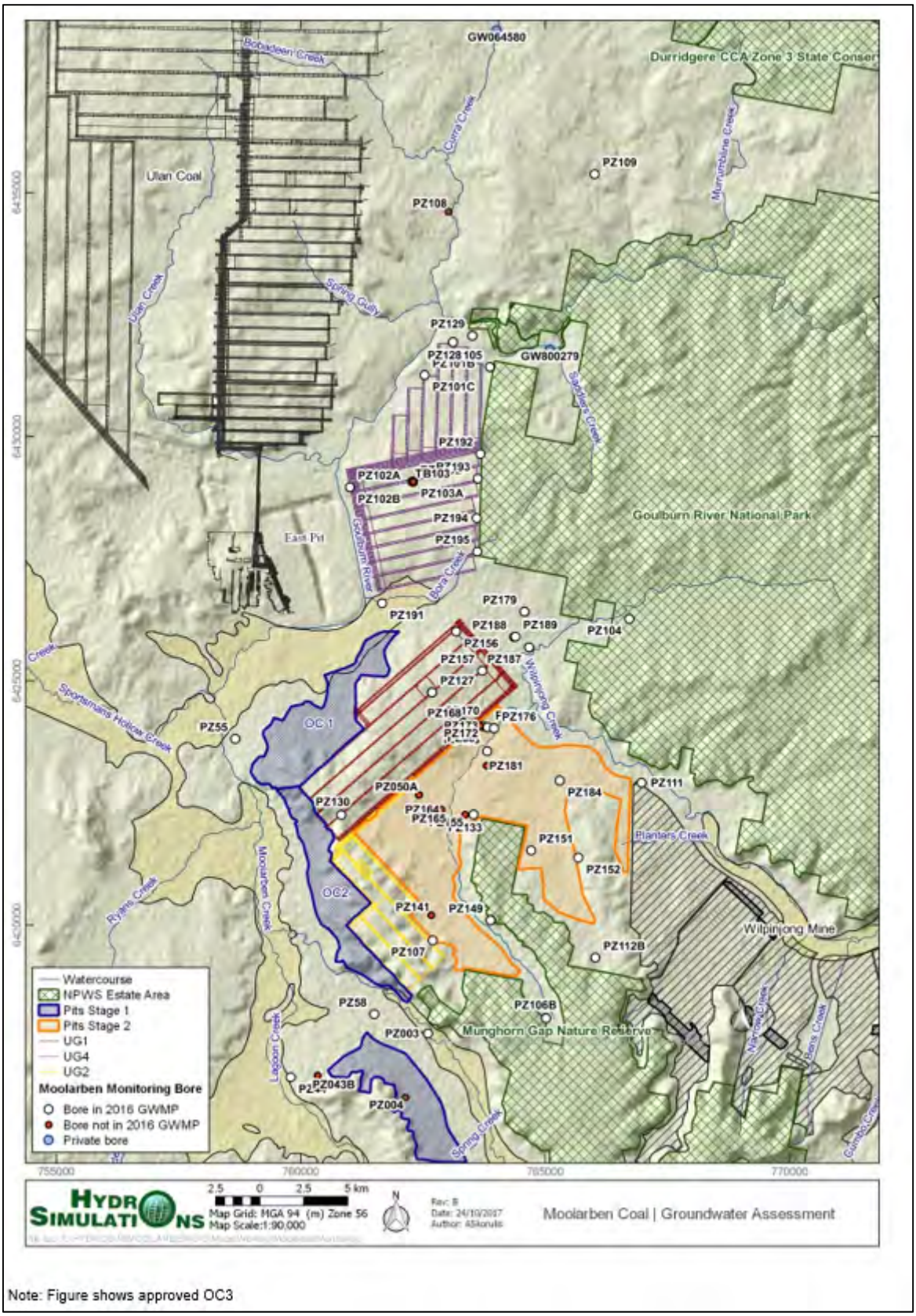


Figure 10: Moolarben Groundwater Monitoring Locations

Source: Figure 7 of HydroSimulations (2017).

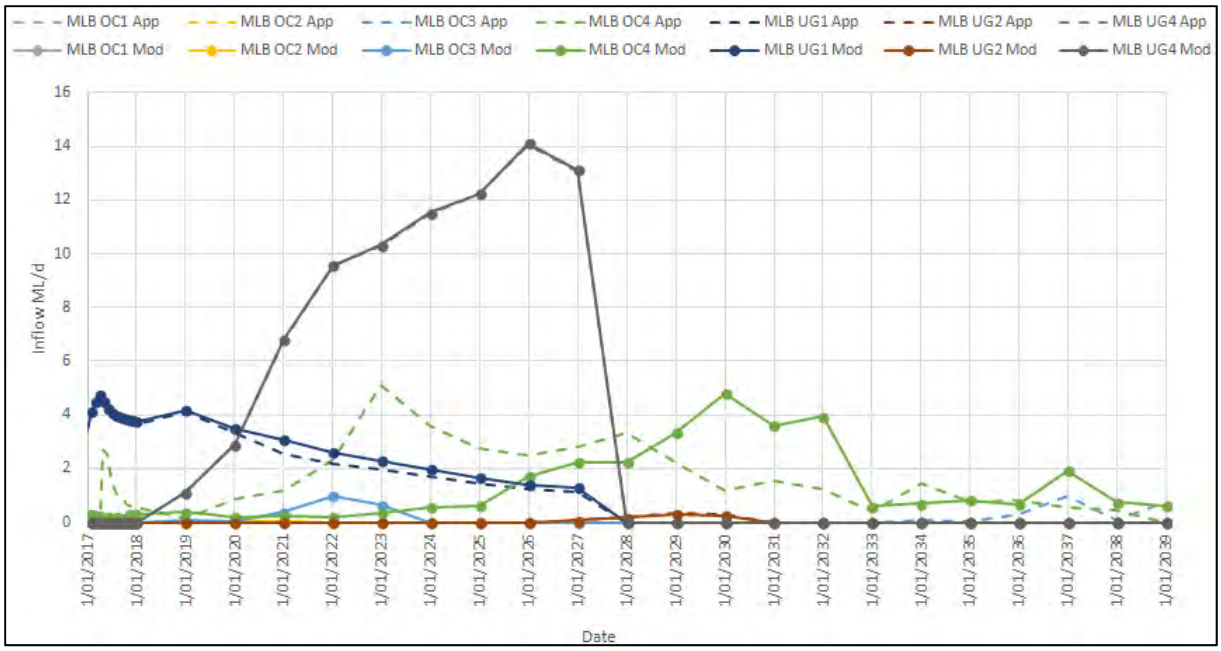


Figure 11: Predicted Moolarben Mine Inflows – Approved and Modification Scenarios
Source: Figure 18a of HydroSimulations (2017).

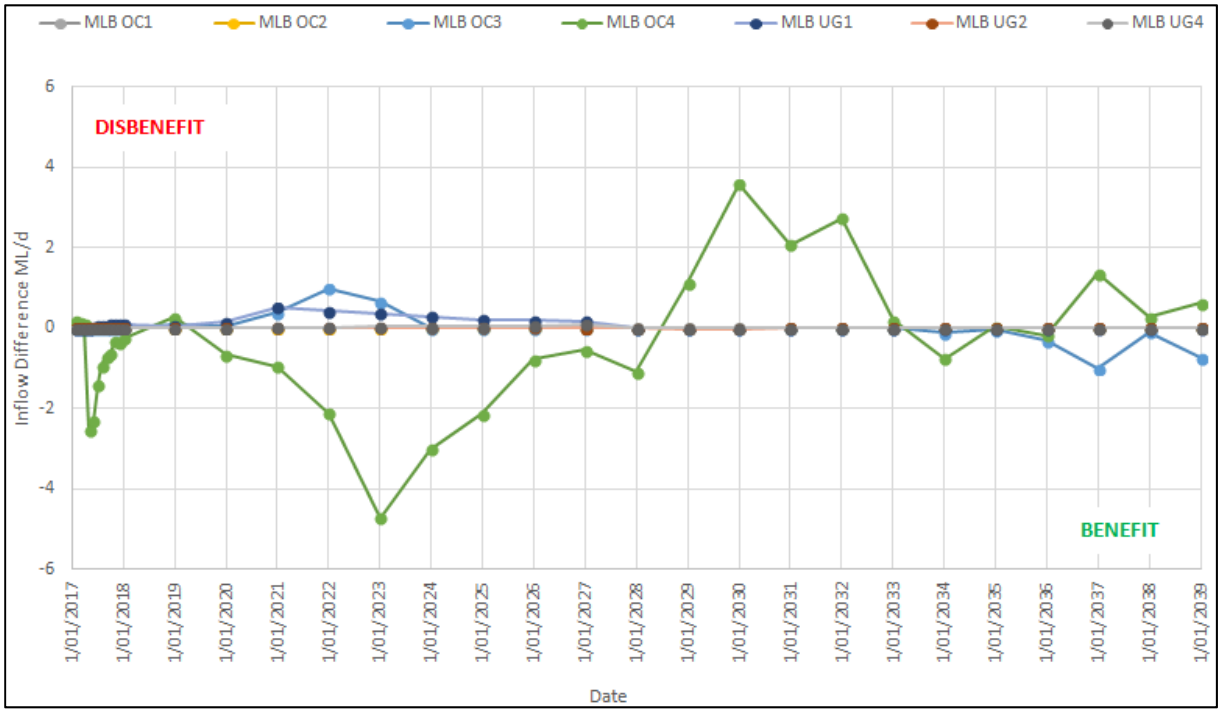


Figure 12: Predicted Changes in Moolarben Mine Inflows due to the Modification
Source: Figure 18b of HydroSimulations (2017).

Surface Works and Temporary Waste Rock Emplacements

Issue 46

DPI requested the following:

> *The proponent should provide clear schematics or a higher resolution map showing the footprint of the proposed OC2 and OC3 pit extensions and surface developments in the vicinity of Moolarben Creek and the isolated palaeochannel. The proponent should provide clear identification of any proposed works that will impact the Moolarben Creek, tributaries or palaeochannel. More details are required to assess the potential impact of surface developments on Moolarben Creek and the palaeochannel.*
>
> *The proponent should provide high resolution maps showing the proposed out-of-pit and temporary waste rock placement, in particular at the surface works area between OC2 and OC3 across Moolarben Creek.*

Response 46

The approved Moolarben Coal Complex includes a permanent out-of-pit emplacement area, a haul road crossing of Moolarben Creek and infrastructure areas (Figures 13 and 14). The Modification includes removal of the permanent out-of-pit emplacement area and inclusion of temporary out-of-pit emplacement areas, amendments to the haul road, including an amended alignment, and relocation of the OC3 Mine Infrastructure Area (generally further from Moolarben Creek).

The palaeochannel adjacent to OC3 and alluvium associated with Moolarben Creek are considered in the Groundwater Assessment for the Modification. The extents of the palaeochannel and alluvium are as per the modelling for the approved Moolarben Coal Complex conducted by RPS Aquaterra (2011) (Figure 9).

It should be noted that the alluvium in the vicinity of Moolarben Creek is not a highly productive aquifer, being narrow in extent, shallow and containing poor quality water. There are no other users of this groundwater, high priority GDEs or high priority culturally significant sites.

As such, the Modification is within the Level 1 minimal harm criteria for water table, pressure and quality outlined in the NSW Aquifer Interference Policy (HydroSimulations, 2017)

The approved Moolarben Coal Complex involves mining of OC3. The Modification would not change the depth of mining in OC3, progressive backfilling of OC3 or size and location of the approved OC3 final void. The Modification involves minor changes (increases and reductions) to the OC3 pit limits. Potential impacts associated with these minor changes are considered in the Groundwater Assessment for the Modification.

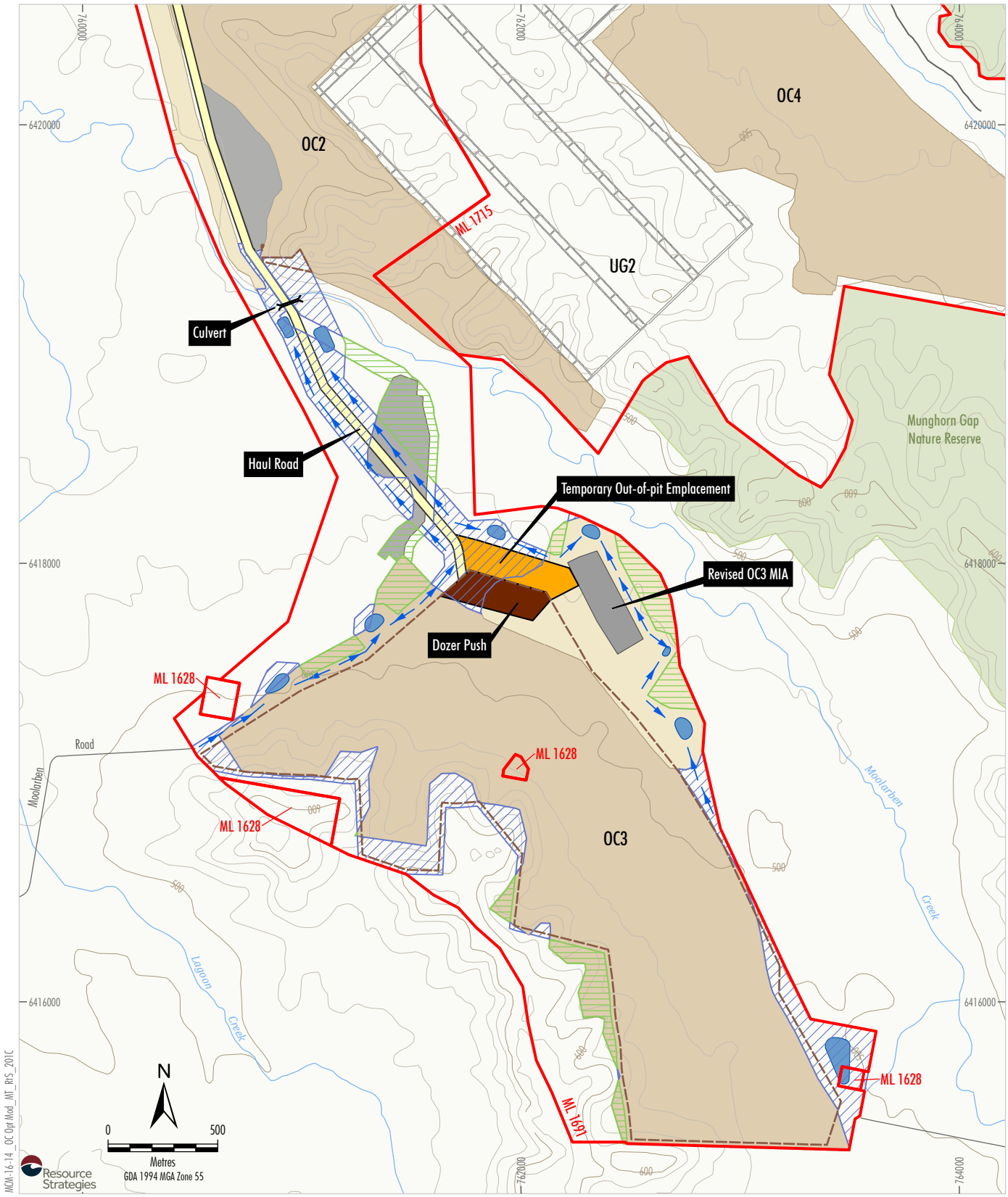
The OC3 permanent out-of-pit emplacement, which is approved to be developed above the mapped palaeochannel extent (Figure 9), would no longer be required as part of the Modification. However, infrastructure (e.g. the OC3 mine infrastructure area) has been designed to sit within the approved footprint of the out-of-pit emplacement where possible to minimise additional disturbance (Figures 13 and 14).

Groundwater Model

Issue 47

In regard to the revised groundwater modelling conducted for the Modification, DPI stated:

> *Moolarben Coal on 7 December 2017 submitted an updated Surface Water Management Plan and Groundwater Management Plan for consultation. It is understood that additional drilling was undertaken to inform these plans and includes updated recorded baseline monitoring water datasets. The proponent should confirm whether this information was also used to update the groundwater model.*



LEGEND

NSW National Parks and Wildlife Service
Mining Lease Boundary

Existing/Approved Development

Open Cut Mining Area
Out-of-pit Emplacement
Surface Infrastructure Area
Underground Longwall Layout
Haul Road

Open Cut Optimisation Modification

Approximate Extent of Revised Open Cut Mining Area
Approximate Extent of Additional Surface Development
Approved Open Cut Mining Area, Out-of-pit Emplacement and Surface Infrastructure to be Relinquished
Water Management Infrastructure

Temporary Out-of-pit Emplacement - Stage 1

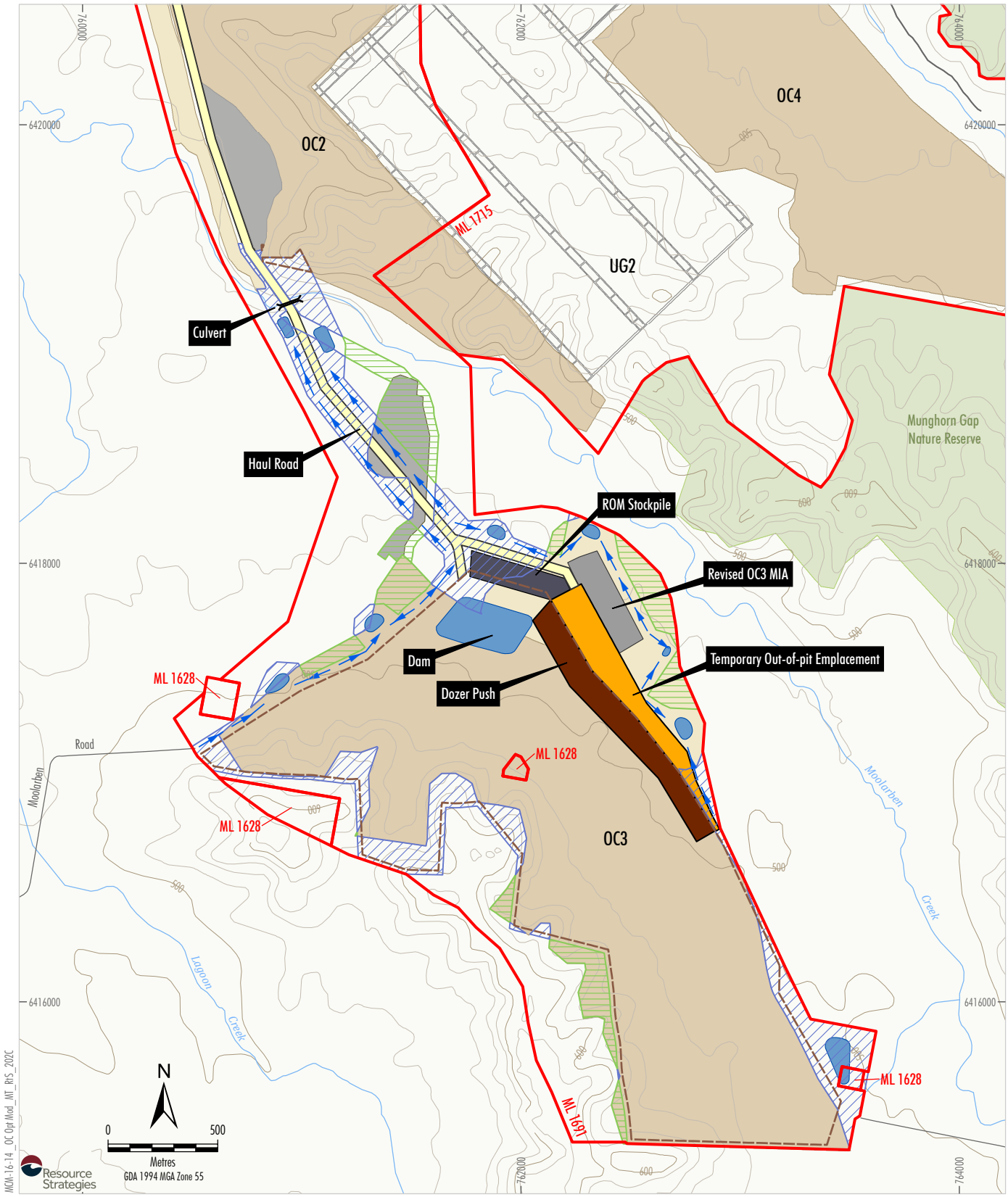
Dozer Push
Temporary Out-of-pit Emplacement
Surface Infrastructure Area
Haul Road

Source: MCO (2018); NSW Dept of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

MOOLARBEN COAL COMPLEX

Open Cut Optimisation Modification
Indicative OC3 Temporary Out-of-pit Emplacement - Stage 1

Figure 13



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LEGEND

NSW National Parks and Wildlife Service
Mining Lease Boundary

Existing/Approved Development

Open Cut Mining Area
Out-of-pit Emplacement
Surface Infrastructure Area
Underground Longwall Layout
Haul Road

Open Cut Optimisation Modification

Approximate Extent of Revised Open Cut Mining Area
Approximate Extent of Additional Surface Development
Approved Open Cut Mining Area, Out-of-pit Emplacement and Surface Infrastructure to be Relinquished
Water Management Infrastructure

Temporary Out-of-pit Emplacement - Stage 1

Dozer Push
Temporary Out-of-pit Emplacement
ROM Stockpile
Surface Infrastructure Area
Haul Road

Source: MCO (2018); NSW Dept of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

MOOLARBENCOAL

MOOLARBEN COAL COMPLEX

Open Cut Optimisation Modification
Indicative OC3 Temporary Out-of-pit Emplacement - Stage 2

Figure 14

Response 47

The revised groundwater model developed by HydroSimulations considered data up to April 2017. Piezometers installed after April 2017 to inform the Groundwater Management Plan were not available for inclusion in the groundwater model.

6.1.5.4 Information Request

Issue 48

The Department of Industry (DPI) recommended conditions of consent for the Modification regarding management plans.

Response 48

DPI's recommendations for conditions of consent for the Modification are noted.

The Water Management Plan and Biodiversity Management Plan would be updated for the Modification. Project Approval (05_0117) and Project Approval (05_0135) currently specify separate consultees, and no change to these consultees is proposed for the Modification.

A Construction Environmental Management Plan is not considered to be necessary for pipelines as this is minor infrastructure and management of any impacts during construction would be managed via MCO's existing / modified Environmental Management Plans (including the Water Management Plan, of which DPI Water is a consultee).

The Modification does not require Controlled Activity approval, however, relevant works would consider the requirements of the guidelines for Controlled Activities.

6.2 PART B – RESPONSES TO NON-GOVERNMENT ORGANISATION AND PUBLIC SUBMISSIONS

Tables 7 and 8 provide a reconciliation of the submissions received from NGOs and members of the public, respectively, and the locality of each submitter.

The comments and issues raised by NGOs and members of the public are addressed in Table 9.

The name, location and submission identification number for each NGO and public submission are presented as they appear on the NSW Major Projects website.

Table 7
NGO Objectors

Submission ID	Organisation Name	Location	Issues Raised
233012	Bathurst Community Climate Action Network	Bathurst	B2, B3, B4, B6, B7, B8, B9, B11, B12, B13, B14, B15, B16, B17, B19
233637	Central West Environment Council	Summer Hill Creek	B2, B3, B4, B6, B7, B8, B9, B12, B13, B14, B15, B16, B18, B19, B20, B33, B34, B35
234200	Environmentally Concerned Citizens of Orange	Orange	B2, B3, B7, B12, B13
234261	Hunter Communities Network	Singleton	B2, B3, B6, B7, B8, B10, B13, B14, B15, B16, B17, B21, B22, B30, B33, B34
233528	Hunter Environment Lobby Inc	East Maitland	B1, B2, B3, B6, B7, B8, B9, B12, B13, B16, B19, B30
233537	Mudgee District Environment Group	Mudgee	B3, B4, B5, B6, B12, B13, B14, B17, B18, B19, B20
234188	Orange Field Naturalist & Conservation Society	Orange	B12, B13
234294	Running Stream Water Users Association Inc	Kandos	B2, B3, B6, B7, B9, B10, B11, B12, B14, B15, B16, B17
233231	Ryde Hunters Hill Flora and Fauna	Boronia Park	B1, B3, B4, B5, B6, B7, B8, B10, B12, B13, B14, B15, B16, B17, B19, B21, B22
233222	Ryde Hunters Hill Flora and Fauna Preservation Society	Boronia Park	B1, B3, B4, B5, B6, B7, B8, B10, B12, B13, B14, B15, B16, B17, B19, B21, B22
233411	Wollar Progress Association	Wollar	B1, B2, B3, B7, B22

Table 8
Public Objectors

Submission ID	Submitters Name	Location	Issues Raised
234022	A Lohse	Gulgong	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11
234190	Adair Imrie	Paris	B2, B3, B4, B6, B7, B8, B9, B10, B11, B12, B13, B14, B15, B16, B17, B19
234024	Andrew Rutter	Running Stream	B2, B3, B6, B12, B13, B14, B15
234285	Barbara Davis	Cheltenham	B13
233729	Brigid Dowsett	Sydney	B2, B3, B4, B7, B11, B12, B13
233431	Bruce Hughes	Wollar	B2, B7, B13, B22
234263	Colin Imrie	Ulan	B2, B3, B4, B6, B7, B9, B10, B11, B12, B13, B14, B15, B16, B19
233997	Deborah Hoare	Narromine	B2, B3, B6, B12, B13, B14, B15
233815	Derek Finter	Mudgee	B1, B3, B7, B8, B12, B13, B14, B19
234167	Diane O'Mara	Gulgong	B1, B2, B3, B4, B6, B8, B9, B10, B11, B12, B13, B14, B16, B17, B19, B23, B24
234137	Donna Moore	Adamstown	B2, B3, B6, B12, B13, B14, B15
233991	Duan Rogan	Toronto	B2, B3, B6, B12, B13, B14, B15
234296	Fiona Sim	Kandos	B2, B3, B4, B6, B7, B9, B10, B11, B12, B14, B15, B16, B17
234231	Fraser Stuart	Yarrawonga	B1, B2, B3, B4, B5
234015	G Deville	Gulgong	B2, B3, B6, B12, B13, B14, B15
234028	Gail Grace	Gulgong	B2, B3, B6, B12, B13, B14, B15
234017	Gerard Gilet	Gulgong	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11
232996	James Duffy	Stanthorpe	B2, B3
234043	Jane Douse	Gulgong	B2, B3, B6, B12, B13, B14, B15
234009	Janne Robertson	Coolah	B1, B2, B3, B4
234314	Jenny Medd	Nashdale	B3, B12, B13
234019	Jill Lawson	Wollar	B2, B3, B6, B12, B13, B14, B15
234013	Joan Schiemer	Coolah	B1, B2, B3, B4, B6, B7, B8, B9, B10, B11
233838	John Boyle	West Ryde	B2, B3, B4, B7, B11, B12, B13
234149	John Evans	Avalon Beach	B2, B3, B6, B12, B13, B14, B15
234178	John Van Der Kallen	Georgetown	B12, B13, B22, B28, B29, B31
234182	John Van Der Kallen	Georgetown	B12, B13, B22, B28, B29, B31
232035	Judith Leslie	Bulga	B7, B11, B13, B17, B19, B26
234298	Julia Imrie	Ulan	B6, B7, B36, B37, B38, B39, B40, B41, B42, B43, B44, B45, B46, B47, B48
233595	Julie Favell	Lidsdale	B2, B3, B4, B12, B13, B15, B16, B28
234030	Julie Heyhorn	St Fillians	B2, B3, B4, B7, B8, B9, B10, B11, B17
234026	Keith Sheridan	Gulgong	B1, B2, B3, B4, B6, B7, B8, B9, B10, B11
234001	M Watson	Gulgong	B2, B3, B6, B12, B13, B14, B15
233102	Melissa Gray	Dubbo	B2, B3, B4, B7, B8, B9, B10, B11, B14, B15, B16, B17, B19
233989	Melissa Rogan	Toronto	B2, B3, B6, B12, B13, B14, B15
233854	Mick Fetch	Wollar	B30
234139	Paul Moore	Adamstown	B2, B3, B6, B12, B13, B14, B15
234237	Paul Stig	Mudgee	B2, B3, B4, B7, B8, B9, B10, B11, B17, B19
233836	Peggy Fisher	Killara	B3, B4, B7, B13, B14
234235	Phillip Courtney	South Perth	B1, B2, B3, B4, B6, B7, B8, B9, B10, B11
234227	Phyllis Setchell	Mudgee	B1, B2, B3, B4, B5, B6, B8, B9, B10, B11, B16, B17, B19
234005	Ray Dunns	Gulgong	B2, B3, B6, B12, B13, B14, B15

Table 8 (Continued)
Public Objectors

Submission ID	Submitters Name	Location	Issues Raised
234032	Richard Munro	St James	B2, B3, B4, B7, B8, B9, B10, B11, B17, B19
234233	Rick McGregor	Home Rule	B1, B2, B3, B4, B5
233995	Robyn Bradley	Hunters Hill	B2, B3, B4, B7, B8, B9, B11, B16, B17, B19
234011	Robyn Jones	Gulgong	B2, B3, B6, B12, B13, B14, B15
234007	Sharon Frost	Gulgong	B2, B3, B6, B12, B13, B14, B15
233063	Sharyn Munro	Wingham	B2, B3, B4, B6, B7, B9, B10, B11, B12, B16, B17, B19
233073	Stephanie Luke	Bathurst	B2, B12
234186	Tane Schmidt	Wollar	B3, B7, B13, B15, B22, B32
233919	Thomas Chailloux	Newtown	B2, B6, B7, B8, B10, B11, B12, B13, B14, B15, B17, B19, B25, B30
233921	Thomas Chailloux	Newtown	B2, B6, B7, B8, B10, B11, B12, B13, B14, B15, B17, B19, B25, B30
233993	W Ren	Cheltenham	B2, B3, B6, B12, B13, B14, B15
233999	William Norris	Winston Hills	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11
233652	*Name withheld*	Ryde	B2, B3, B4, B7, B11, B12, B13
234180	*Name withheld*	Wollar	B2, B3, B13, B22, B30
234302	*Name withheld*	Clandulla	B2, B3, B4, B6, B7, B9, B10, B11, B12, B14, B15, B16, B17
234310	*Name withheld*	Mudgee	B1, B3, B12, B13, B27

Table 9
Responses to Public Submissions

Issue ID No.	Subject	Issue Raised	Response
B1	Health and Amenity of the Drip	Concerns regarding the impact of the Modification on the health and amenity of the Drip. and concerns regarding recreational areas.	The outcomes of the Environmental Assessment and supporting studies concluded there would be no impact to the Drip. Similarly, there would be no impacts to recreational areas (e.g. those associated with the Goulburn River National Park).
B2	Water Quality, Health and Biodiversity	Concerns regarding the impact of the proposed increase in licensed discharge on water quality, ecology and downstream users of the Goulburn River.	Through consultation with the EPA, it is understood that any variation to EPL 12932 would likely be based on (Section 5): • Staged increase to controlled release volume limits. MCO considers that the following staged volume increase would be acceptable: - up to 15 ML/day following commencement of first workings to UG4; - up to 20 ML/day following commencement of secondary extraction in UG4; and - up to 15 ML/day two years after completion of mining in UG4 (subject to site water balance review). • Alternative discharge salinity limits. Notwithstanding the above, the outcomes of the Environmental Assessment and supporting studies concluded no significant impact to water quality, ecology and downstream users of the Goulburn River based on the following for controlled releases of up to 20 ML/day at 900 µS/cm (maximum): • A water treatment facility will be installed to control the quality of water prior to licensed release from the Moolarben Coal Complex. • Discharge limits have been developed based on analysis of water quality data in the Goulburn River, such that the quality of water to be released (post-treatment) would be consistent with existing water quality in the Goulburn River and/or ANZECC Guideline trigger values. • The proposed relocation of the discharge point to the confluence of Bora Creek and the Goulburn River Diversion will prevent erosion along Bora Creek. • A spreader/diffuser would be installed at the relocated discharge point to prevent scour. • Hydrological modelling conducted by Advisian (2017) confirmed that the proposed increase in discharge volume from 10 to 20 ML/day would have no significant impact to water height or velocity (including when considered cumulatively with the Ulan Mine Complex) in the Goulburn River Diversion or downstream in the Goulburn River. • MPR (2017) reviewed macroinvertebrate data collected in the Goulburn River during the period of licensed discharges from the Ulan Mine Complex at the currently approved rate of 30 ML/day and 900 µS/cm (maximum) and concluded that no adverse impacts to macroinvertebrates have been observed. On this basis, MPR (2017) concluded that the proposed discharges from the Moolarben Coal Complex would result in no significant impacts downstream aquatic ecology.

Issue ID No.	Subject	Issue Raised	Response
B3	Cumulative Impacts	Concerns that the cumulative discharge from the Moolarben Coal Complex, Ulan Mine Complex and Wilpinjong Coal Mine would increase salt levels in the Goulburn River by up to 30 tonnes/day and disrupt the natural flow regime of the river system, and that cumulative impacts have not been adequately assessed.	Cumulative impacts have been considered by both Advisian (2017) and MPR (2017) in regard to assessment of potential impacts to downstream flows, water quality and aquatic ecology.
		Concern raised that a significant change to natural variability of flow in the Goulburn River has already occurred, and the loss of seasonal flow variability would increase if the total mine discharge into the river system were increased to 65 ML/day.	The requirement for licensed discharges from the Moolarben Coal Complex is related to both groundwater inflows and rainfall runoff captured on site. The actual quantity and frequency of licensed discharges would be dependent on a number of factors, including climatic conditions. Site water balance modelling conducted by WRM (2017) indicates that the number of days that licensed discharge at 20 ML/day would be required increases for wetter climatic sequences (i.e. when natural flows in the Goulburn River would be greater). Hydrological modelling conducted by Advisian (2017) indicates that during low flow periods, water levels in the Goulburn River would increase by approximately 2 cm due to the proposed increase in discharge volume from 10 to 20 ML/day. When considered cumulatively with licensed discharges from the Ulan Mine Complex, the contribution of the proposed increase in the volume of licensed discharges from the Moolarben Coal Complex reduces. MPR (2017) considers that additional flow is a beneficial potential impact for aquatic ecology as it would result in a reduction in prolonged periods of low flow, with low flow periods typically associated with poorer water quality.

Issue ID No.	Subject	Issue Raised	Response
		Concerns raised that the increased discharge would lead to increased flooding of low-level river crossings (specifically O'Briens Crossing).	Advisian (2017) conducted HEC-RAS flow modelling in the Goulburn River as part of the Controlled Water Release Impact Assessment (Appendix F of the EA). The furthest downstream point assessed was at chainage 9400 (i.e. approximately 9.4 km downstream of the proposed relocated discharge point). At this location, the water depth due to a 20 ML/day discharge under low flow conditions (i.e. 0.02 m^3/s baseflow) would be approximate to the water depth under medium flow conditions (i.e. 0.17 m^3/s baseflow) with no discharge (Table 4.3 of Advisian [2017]). Under a high flow scenario (i.e. 0.35 m^3/s baseflow), the proposed 20 ML/day discharge would result in an increase in water depth of approximately 2 cm at chainage 9400 compared to a discharge of 0 ML/day, and by 1 cm compared to the approved discharge volume of 10 ML/day. O'Briens Crossing is the crossing of the Goulburn River by Ringwood Road and Wollara Road, more than 80 km downstream of the Drip. Downstream from the Drip, the Goulburn River receives flow from Murrumbline Creek, Durridgere Creek, Tuggeragong Creek, Wollar Creek, Munmurra River, Krui River and Rocky Creek before reaching O'Briens Crossing. Given the contribution of the proposed discharge from the Moolarben Coal Complex would be minor, some 70 km upstream, it is expected the proposed discharges would have negligible influence on the water depth of the Goulburn River when it reaches O'Briens Crossing.

Issue ID No.	Subject	Issue Raised	Response
		Concern raised that Environmental Assessment does not provide information on the cumulative impacts on land disturbance or destroyed aquifer systems over time.	Potential cumulative impacts have been assessed in the Environmental Assessment. The Modification would result in a net increase of approximately 27 ha of native vegetation clearance beyond the approved disturbance of the Moolarben Coal Complex. The change in potential cumulative impacts on threatened species and communities arising from the Modification is considered to be minimal because: • the clearance is localised compared to the wider distribution of the species (their habitats) and communities; • the loss of approximately 27 ha of native vegetation would be short-term as the Modification involves progressive re-establishment of native woodland/forest on mine rehabilitation; and • the Biodiversity Offset Strategy for the Modification (i.e. which is additional to the approved Biodiversity Offset Strategies for both Stage 1 and Stage 2 of the Moolarben Coal Complex) would compensate for the loss and increase movement corridors for genetic exchange, foraging habitat and increased breeding resources for threatened fauna species in the medium and long-term. The Modification would not change groundwater systems to be affected by approved mining at the Moolarben Coal Complex. HydroSimulations (2017) concludes the potential impacts of the Modification to groundwater would be negligible. This is supported by advice received by the IESC for the Modification, which states: *… the proposed action* [the Modification] *is adjacent to, and mostly up-dip of, already-approved open-cut operations which means that there is unlikely to be substantial additional aquifer depressurisation as a result of the action.* *…* *Based on this review, the IESC considers that the proponent's assessment of potential groundwater impacts is appropriate for a modification of this scale. Further, the avoidance, monitoring and management of potential groundwater impacts for this proposed modification are appropriate as long as these measures are implemented as proposed by the proponent.*
B4	Cumulative Impacts	Concern regarding the lack of an independent study on the cumulative impacts of mining on the upper Goulburn River.	This comment is directed at the NSW Government.
B5	Health and Amenity of the Drip	Concerns regarding MCO's ability to adhere to the NSW Government's commitment to preserve the Drip and the requirements of Project Approvals (05_0117 and 08_0135) to ensure "nil impact" to the Drip.	This comment is not considered to be relevant to the Modification.

Issue ID No.	Subject	Issue Raised	Response
B6	Health and Amenity of the Drip	Concerns regarding the deed of agreement for the Drip not being met under the agreed timeframe of March 2017.	This is not considered to be relevant to the Modification. Notwithstanding, MCO notes the following in regard to the deed of agreement for the Drip: • MCO maintains its commitment to protecting the conservation values of the Drip. • MCO signed all of the relevant documents to transfer the Drip National Park to NSW National Parks and Wildlife Service in March 2015. • The survey to create the necessary lots has been commissioned by OEH and completed. • OEH lodged the plan of subdivision to create the relevant lots with NSW Land and Property Information on 14 February 2018. • OEH has procured the plan of acquisition for the State Conservation Area (SCA) (Stage 2 acquisition). • OEH has advised that it will lodge the plan to register the SCA as soon as NSW Land Registry Services registers the new Lots 1, 2 and 3. • OEH will establish and register the SCA, SCA licence and easement following Lot registration.
B7	Water Quality	Concerns regarding the impact of increased total salt loads on the health of the Goulburn River, Goulburn River National Park, downstream users and the Hunter River Salinity Trading Scheme.	Advisian (2017) modelled and assessed the proposed licensed discharges of 20 ML/day cumulatively with the potential discharges from the Ulan Mine Complex (i.e. the 'high flow' scenario was developed based on data that included discharges from the Ulan Mine Complex at up to 30 ML/day) and concluded that under the 'high flow' scenario there would be negligible adverse change in downstream EC when compared to historic water quality. MPR (2017) considered the impacts of discharges from the Ulan Mine Complex (at up to 30 ML/day) and found that no significant adverse impacts to aquatic ecology have been observed. On this basis, MPR (2017) concluded the proposed discharges from the Moolarben Coal Complex would result in negligible impacts to downstream aquatic ecology. The HRSTS salinity goal downstream of the Goulburn River / Hunter River confluence is 900 µS/cm. The proposed discharges from the Moolarben Coal Complex would not adversely affect participants in the HRSTS (Advisian, 2017). Notwithstanding, it is understood any EPL variation may result in alternative discharge salinity limits (Section 5). Downstream monitoring in the Goulburn River would continue for water quality, flow and aquatic ecology. The results of this monitoring may be used over time to support MCO's EPL 12932 variation request in consideration of the decision tree process in the ANZECC Guidelines.

Issue ID No.	Subject	Issue Raised	Response
B8	Groundwater Modelling	Concerns that assumptions of the groundwater model do not reflect potential impacts on springs, groundwater dependent ecosystems or the upper groundwater system.	The approved Moolarben Coal Complex involves mining of OC3. The Modification would not change the depth of mining in OC3, progressive backfilling of OC3 or size and location of the approved OC3 final void. The Modification involves minor changes (increases and reductions) to the OC3 pit limits. As shown in Figure 23 of HydroSimulations (2017) the predicted change in water table levels adjacent to Moolarben Creek at the end of mining due to the Modification is minor (approximately 1 m) (by comparison, the "minimal impact" criterion in the Aquifer Interference Policy is 2 m). On this basis (i.e. minimal changes in predicted water table levels due to the Modification), HydroSimulations (2017) concludes that potential impacts to watercourses and GDEs due to the Modification would be negligible. It is also noted that no significant GDEs have been recorded along Moolarben Creek in the vicinity of OC3. The Groundwater Monitoring Program is a component of the approved Groundwater Management Plan prepared in consultation with Government agencies and to the satisfaction of DPE. In addition, it is noted DPE commissioned an independent review of the Groundwater Management Plan prior to its approval.
B9	Groundwater Modelling	Concerns that existing groundwater modelling failed to predict the actual UG1 groundwater inflows. Concerns that groundwater monitoring program is inadequate to determine the background/baseline conditions and changes to the natural flow of the river.	Re-calibration of the groundwater model for the Moolarben Coal Complex accounted for groundwater monitoring data to March 2017, which includes inflows into UG1 which commenced in April 2016. Negligible impacts to groundwater due to the Modification were predicted by HydroSimulations (2017), and as such, continuation of the current groundwater monitoring program was recommended by HydroSimulations (2017). This is supported by advice received by the IESC for the Modification, which states: *Based on this review, the IESC considers that the proponent's assessment of potential groundwater impacts is appropriate for a modification of this scale. Further, the avoidance, monitoring and management of potential groundwater impacts for this proposed modification are appropriate as long as these measures are implemented as proposed by the proponent.* Notwithstanding, MCO will install additional monitoring bores adjacent to OC3 to supplement the existing groundwater monitoring network.
B10	Water and Land	Concerns that the long-term effect of dewatering and draining the landscape above the Moolarben Coal Complex has not been adequately assessed.	As above, HydroSimulations (2017) concludes the potential impacts of the Modification to groundwater would be negligible. This is supported by advice received by the IESC for the Modification, which states: *… the proposed action* [the Modification] *is adjacent to, and mostly up-dip of, already-approved open-cut operations which means that there is unlikely to be substantial additional aquifer depressurisation as a result of the action.*

Issue ID No.	Subject	Issue Raised	Response
B11	Water Management Plan	Concerns that the updated Water Management Plan, required by October 2016, is not yet available. Concerns that a comprehensive Water Management Plan is not being implemented and adequate water monitoring is not currently being conducted.	This issue is not considered relevant to the Modification. The approved Water Management Plan was prepared in consultation with Government agencies and to the satisfaction of DPE. In addition, it is noted DPE commissioned an independent review of the Water Management Plan prior to its approval. An updated Water Management Plan was initially submitted to DPE on 31 October 2016 and was approved by DPE following subsequent revisions on 29 March 2018. MCO conducts its operations in accordance with the approved Water Management Plan, which will be reviewed and revised where necessary should the Modification be approved.
B12	Biodiversity and Biodiversity Offset Strategy	Concerns that the Modification would result in the disturbance of two critically endangered ecological communities, which provide habitat for nine threatened bird species and five threatened microbat species. Concerns that the Modification would result in the loss of potential habitat for Koala, Regent Honeyeater and Brush-tailed Rock Wallaby. Concerns that the Biodiversity Offset Strategy has not yet been finalised, is inadequate, and that no offset program could fully compensate the Modification. Concern regarding the loss of irreplaceable habitat values such as cliff lines with caves and old growth trees with hollows, which have not been accounted for in calculations.	Offsets secured in accordance with NSW Government policy would compensate potential impacts on the endangered ecological communities and threatened species within the Modification disturbance area. Assessment of the suitability of the proposed Biodiversity Offset Strategy (i.e. by way of offset "credits" required to be satisfied in accordance with the OEH's FBA Credit Calculator) includes consideration of habitat features, such as cliff lines and tree hollows.

Issue ID No.	Subject	Issue Raised	Response
B13	Greenhouse Gas and Climate Change	Concerns that increasing coal production contradicts the NSW Climate Change Policy Framework and the Paris Agreement. Concerns that an increase in coal production would result in an unacceptable increase in carbon emissions, including fugitive emissions. Concerns that the social, environmental and economic costs associated with the increase in carbon emissions have not been assessed, and the impact of actually burning the coal has not been considered. Request for DPE to recommend current coal mining companies increase usage of renewable energy in operations where possible.	The Federal Government of Australia has adopted a greenhouse gas emission reduction target to reduce emissions to 26–28% on 2005 levels by 2030 which represents a 50-52% reduction in emissions per capita and a 64–65% reduction in the emissions intensity of the economy between 2005 and 2030 under the United Nations Framework Convention on Climate Change at the 21st Conference of the Parties in Paris in 2015 (Commonwealth of Australia, 2015). The Modification would not result in a significant increase in total open cut coal production (approximately 1% increase in total life-of-mine open cut coal production), and therefore would cause negligible change in the total life-of-mine Scope 1, 2 and 3 emissions from the Moolarben Coal Complex. The Modification proposes an increase in annual open cut ROM coal production, and would result in a proportional increase in the annual rate of greenhouse gas emissions from open cut mining and process activities in years of increased ROM coal production. The emissions from combusting additional coal were considered in the annual Scope 3 emission estimates in the Environmental Assessment (based on 2017 National Greenhouse Account Factors for bituminous coal). This combustion would not physically occur in NSW or Australia. The coal at the Moolarben Coal Complex is mined to supply export market demand. If this coal was not mined at the Moolarben Coal Complex, it would likely be sourced from another mining operation. Therefore, there would be no reduction in the carbon emissions generated by the burning of coal as a result of not proceeding with the Modification. The comment regarding the use of renewable energy in operations is directed at the DPE.
B14	Socio-Economic	Concerns that the Modification will increase coal production without increasing jobs or job security. Concerns regarding Yancoal/MCO's history of cutting jobs coinciding with downturns in coal prices. Concerns raised that an increased reliance on the mining industry to provide jobs would have negative socio-economic impacts on the Mudgee area should the price of coal drop.	The increased production limits allow annual revenue from the Moolarben Coal Complex to increase, which would improve the security of the continued employment of the existing workforce and ongoing expenditure in the State and local economies. The modifications and additions to infrastructure for the Modification would create construction employment at the Moolarben Coal Complex. The make-up of the employment in the MWRC LGA and other areas is outside the scope of the Modification, and outside MCO's control.
B15	Socio-Economic	Concerns that cumulative social impacts have not been assessed. Concerns that compliance with noise and air quality limits is only achieved through the ongoing purchasing of properties which were not afforded acquisition rights in previous approvals.	The Modification would not change peak employment previously assessed for the Moolarben Coal Complex, and would not create adverse social impacts (e.g. demand for services). The Modification would not change air quality and noise limits in Project Approvals (05_0117 and 08_0135), which apply to privately-owned receivers. Compliance with these existing limits is predicted for the Modification, without the need for additional property acquisition. Accordingly, this comment is not considered to be relevant to the Modification.

Issue ID No.	Subject	Issue Raised	Response
B16	EPL Concentration Limits	Request for consistency in salinity limits for discharges from all mines in the region, equal to the 500 µS/cm limit for the Wilpinjong Coal Mine. Request that the discharge limit for Total Suspended Solids be reduced to reflect receiving waters downstream in the Goulburn River. Request that monitoring reports for discharges include regular monitoring and analysis for major ions and other pollutants.	Studies conducted by Advisian (2017), MPR (2017), RGS (2017; 2018) and RGS (2018) for the Modification considered potential downstream impacts of 900 µS/cm (maximum), cumulatively with the Ulan Mine Complex, and concluded no significant adverse impacts on the Goulburn River or its aquatic ecology would occur. Notwithstanding, it is understood any EPL variation may result in alternative discharge salinity limits (Section 5). Downstream monitoring in the Goulburn River would continue for water quality, flow and aquatic ecology. The results of this monitoring may be used over time to support MCO's EPL 12932 variation request in consideration of the decision tree process in the ANZECC Guidelines. The water treatment facility and relocated discharge location proposed for the Modification would control and limit TSS. Discharge monitoring and reporting will be conducted as required by EPL 12932.
B17	Brine Management	Concerns that brine from the water treatment plant, used for dust suppression, will drain into sediment dams designed to overflow into the Goulburn River, adding additional salt which was not accounted for in the Environmental Assessment. Concern raised that the disposal of brine from the Ulan Mine Complex and Wilpinjong Coal Mine also has a high probability of reporting to the Goulburn River. Concern raised that a plan describing how discharge of brine used for dust suppression will be managed was not included in the supporting documentation to the Environmental Assessment.	Brine is **not** proposed to be disposed by water carts in catchment areas reporting to sediment dams that can overflow and discharge to the Goulburn River (or Wilpinjong Creek). Brine would only be disposed by water carts in internally draining catchment areas reporting to mine water dams. Brine management at the Ulan Mine Complex and Wilpinjong Coal Mine is outside the scope of Modification.
B18	Environmental Management	Concerns regarding Yancoal/MCO's record of environmental management, with three court cases and five penalty infringement notices relating to breaches of consent conditions causing environmental damage.	MCO has a history of strong commitment to compliance with Project Approval and EPL conditions, as demonstrated and reported publicly in Annual Reviews and Independent Environmental Audits.
B19	Increase in Licensed Discharge	Comment that the proposed increased discharge limit of 20 ML/day is not justified as the current limit of 10 ML/day has not yet been required.	Any variation to the currently authorised EPL discharge volume limits would be subject to a variation of EPL 12932. Based on further consultation with the EPA, it is understood any EPL 12932 variation would likely include staged volume limits. MCO considers that the following staged increase to volume limits would be acceptable: • up to 15 ML/day following commencement of first workings to UG4; • up to 20 ML/day following commencement of secondary extraction in UG4; and • up to 15 ML/day two years after completion of mining in UG4 (subject to site water balance review).

Issue ID No.	Subject	Issue Raised	Response
B20	Justification of Additional Land Disturbance	Comment that additional land disturbance is not justified, due to the following: • The requirement to remove a potentially geotechnically unstable section of hill reflects poor assessment and could be achieved through a Mining Operations Plan or Rehabilitation Management Plan. • The main purpose of the proposed increased mine footprint is to access additional coal reserves missed during earlier mine planning.	The removal of the geotechnically unstable section of hill is required to ensure that the rehabilitated landform provides the most beneficial outcome for the final landform. As removal of this section of hill requires additional disturbance and a minor change to the OC2 pit, approval for this change has been sought as part of the Modification. The proposed changes to OC3 include both extension and reductions to the pit limits. Ongoing exploration activities have more clearly defined the extent of the economically accessible coal resource. Accordingly, approval to mine these resources is included as a component of the Modification, which if approved, would result in more efficient extraction of State resources and associated royalty payments.
B21	Final Void	Concern that the proposed increase in the size of the void represents an increase in the loss of land available for eventual land use as agricultural land. Criticism of retaining the final void. Concern that the long-term environmental costs and ongoing management costs for the final void have not been assessed.	The Modification does not seek to change the approved OC3 final void
B22	Rail Movements	Concern over the lack of documentation on how the increase in rail movements will be managed.	Rail movements between the Moolarben Coal Complex and the Port of Newcastle are managed by the Australian Rail Track Corporation (ARTC). MCO received written confirmation from ARTC (dated 20 October 2017) that sufficient rail capacity can be made available for the Modification.
		Concerns that rail noise was identified as exceeding the Rail Infrastructure Noise Guideline (RING) criteria under both the existing and proposed movements. Concern raised of increased health risks to residents living next to the rail line.	The predicted increase in daytime ($L_{Aeq(15\ hours)}$) and night-time ($L_{Aeq(9\ hours)}$) noise levels due to the Modification is less than 2 dB for all scenarios, and as such, is unlikely to be perceptible. It is noted this predicted increase is conservatively based on an unconstrained scenario, where in practice, total rail movements on the Sandy Hollow Gulgong Railway are currently restricted by the capacity of the Bylong Tunnel.
		Concern regarding increased waiting periods for vehicles at level crossings.	Although the Modification seeks to increase the number of rail departures from the Moolarben Coal Complex, cumulative rail traffic on the Sandy Hollow Gulgong Railway would still be constrained by the capacity of the Bylong Tunnel. GTA (2015) noted the Bylong Tunnel requires a minimum of 20 minutes between trains, subject to ventilation criteria. Therefore, the assumed theoretical maximum is three trains passing every hour. Unless an upgrade to the Bylong Tunnel were to occur (e.g. duplication), there would be no increase to the peak level crossing waiting probabilities due to the Modification. Any upgrade to the Bylong Tunnel would be subject to additional approval and assessment by the ARTC (or other proponent).
		Concerns raised of the fire risk caused by increased rail movements, which would be fought by volunteer fire fighters.	Rail movements between the Moolarben Coal Complex and the Port of Newcastle are managed by the ARTC. ARTC has been consulted in regard to the proposed rail movements for the Modification.

Issue ID No.	Subject	Issue Raised	Response
		Concern raised by residents of Wollar that trains are passing by with uncovered wagons, causing coal dust to be deposited around the village.	The modelling predictions of TAS (2017) indicate that at distances of 50 m and beyond the rail track centreline, the maximum 24-hour average increase in TSP concentration due to the two additional peak rail movements for all scenarios would be approximately 0.7µg/m³. By assuming 40% of the TSP is comprised of PM_{10}, the predicted maximum 24-hour average PM_{10} concentration would be approximately 0.3µg/m³ (compared to limit of 50 µg/m³). Further to the above, a study conducted by Ryan and Wand (2014) for the ARTC for trains travelling on the Hunter Valley network found no significant difference in the particulate matter measurements for passing freight and coal trains (loaded and unloaded). Further analysis by Ryan and Malecki (2015) suggested that a key mechanism for increased particulate levels was due to the passing trains stirring up existing dust particles settled on the tracks and nearby ground. On this basis covering wagons is not considered to be necessary for the Modification.
B23	Land Stability and Safety	Concerns that the stability of pagodas is at risk, and potential issues with easements and above-ground activities could arise due to the Modification.	It is understood this comment relates to the Drip agreement and associated easements. As such, this comment is not considered to be relevant to the Modification.
B24	Premature Commencement of Northern Borefield	Concerns that the drilling program to establish dewatering bores has commenced opposite the Drip, despite extraction from UG4 not being schedule to commence until 2022.	The Northern Borefield and UG4 are approved elements of the Moolarben Coal Complex and are not relevant to the Modification.
B25	Planning Legislation	Concern raised that the Modification seeks approval under obsolete planning legislation (Part 3A of the EP&A Act) and approval should instead be sought under new legislation. Concerns that the potential impact of the Modification on biodiversity contradicts the objects of the EP&A Act.	The Modification is being assessed under s75W of the EP&A Act, as per the Secretary's Environmental Assessment Requirements. Consideration of the Modification against the objects of the EP&A Act at the time of public exhibition of the Modification is provided in Section 6 of the Environmental Assessment.
B26	Land and Food Security	Concerns raised over the impact on food security in the Hunter Valley due to increased soil salinity caused by increased discharge and brine overflow, which has not been sufficiently considered.	Suitable storage of brine is available for the life of the Moolarben Coal Complex as illustrated in Graph 4. As such, there would be no impacts due to brine generation at the Moolarben Coal Complex on the Hunter Valley. Permanent storage of brine generated over the life of the Moolarben Coal Complex will be in the UG4 void space. As described in Response 17, use of brine for dust suppression (or in meeting other water demand needs) would be restricted to internally draining mine catchment areas reporting to mine water storages.

Issue ID No.	Subject	Issue Raised	Response
B27	Health Impacts of Current Operations	Concerns raised regarding health issues due to dust, noise and light emissions from current operations at the Moolarben Coal Complex.	SLR Consulting (2017) predicted ongoing compliance with existing Project Approval noise limits for the Modification. Similarly, TAS (2017) predicted ongoing compliance with existing Project Approval air quality limits for the Modification. There would be negligible change to lighting requirements as a result of the Modification, and no change to existing Project Approval conditions that require MCO to implement best management practices to minimise off-site light impacts. Accordingly, negligible adverse health impacts are expected due to the Modification.
B28	Aboriginal Cultural Heritage	Concerns regarding the loss of Aboriginal Cultural Heritage Sites due to the collapse of sandstone cliffs. Concerns raised over the impact to the two additional Aboriginal Cultural Heritage Sites identified within the Modification disturbance footprint, one of which was identified as having moderate scientific significance.	All disturbance associated with straightening of the OC3 western pit limit has been considered in the ACHA, which was prepared in consultation with the Registered Aboriginal Parties (RAPs). Aboriginal Cultural Heritage Sites are managed in accordance with the Moolarben Coal Complex Heritage Management Plan (HMP), developed in consultation with the OEH and RAPs. The HMP would be updated to incorporated the Modification, including the additional sites identified within the Modification Disturbance Footprint.
B29	Air Quality	Concerns regarding an increase in emissions due to increased coal production, with over 70 air quality alerts in the upper Hunter area recorded during 2017. Concerns raised that the $PM_{2.5}$ baseline records are not adequate, which would result in inaccurate predictions. Reference made to Section 7.3 of the Air Quality Assessment "no readily available $PM_{2.5}$ monitoring data collected near to the Moolarben Coal Complex". Concerns raised that PM_{10} results are unreliable as ambient levels are based on data from 2011-2012. Concern raised that mitigation measures outlined in the Environmental Assessment would be ineffective due to a history of failed mitigation measures for air quality in the upper Hunter area.	Potential increases in emissions have been considered by TAS (2017), who concluded the Moolarben Coal Complex incorporating the Modification could continue to comply with Project Approval air quality limits. Accordingly, no increase in air quality concentrations at private receivers above relevant air quality limits is expected due to the Modification. As noted by the EPA (Issue 5) there are limited data available representing rural locations for $PM_{2.5}$. In the absence of local $PM_{2.5}$ monitoring data, TAS (2017) used data from OEH $PM_{2.5}$ monitoring stations in Singleton and Muswellbrook to conservatively estimate background $PM_{2.5}$. The maximum predicted project-only 24-hour $PM_{2.5}$ concentration at the most impacted privately-owned dwelling is less than 5 µg/m³, which is less than 20% of the National Environment Protection (Ambient Air Quality) Measure and EPA 24-hour $PM_{2.5}$ air quality criteria of 25 µg/m³. Therefore, irrespective of the cumulative assessment methodology used, due to the low maximum contribution at the sensitive receptor with the highest predicted $PM_{2.5}$ concentration (< 5µg/m³), any cumulative exceedance of the 24-hour $PM_{2.5}$ criteria of 25 µg/m³ would be due primarily to background sources (> 80%). As the locality has minimal anthropogenic activity (e.g. dwellings and wood heaters are relatively well spread out and separated), the risk of elevated background $PM_{2.5}$ levels in this area is low. Therefore, the risk of any adverse $PM_{2.5}$ impact is considered low, and exceedances are unlikely to arise in the normal course of events due to the Moolarben Coal Complex (incorporating the Modification). MCO has a strong history of compliance with air quality limits and this would continue for the Modification.

Issue ID No.	Subject	Issue Raised	Response
B30	Planning and Project Approval	Concern raised over the high number of Modifications to the originally approved projects, indicating Stage 1 and Stage 2 have strongly departed from the originally approved projects. Concern raised over the continuous expansion of existing coal mines in the Mudgee region.	MCO regularly reviews its operations to identify opportunities for improvement. Through ongoing mine planning, an opportunity was identified to improve the efficiency of resource recovery (as required by mining lease conditions) and increase the rate of open cut ROM coal production with no material change to the existing mining fleet, and with increased royalties paid to the State of NSW (as described in the DRG's submission to the Modification). Any expansion of other mining operations is outside the scope of the Modification.
B31	Rehabilitation Strategy	Concern raised that successful rehabilitation of the Moolarben Coal Complex cannot be successfully achieved, as the potential impacts are not short-term and rehabilitation of mine sites has rarely been successful.	Rehabilitation of areas of the Moolarben Coal Complex has been successful to date. Rehabilitation implementation, monitoring and management at the Moolarben Coal Complex will continue to be conducted in accordance the Rehabilitation Management Plan, which would be updated for the Modification. The Modification would result in an improved final landform due to the removal of the approved OC3 permanent out-of-pit emplacement and removal of a potentially geotechnically unstable hill from the final landform of OC2 (which would improve OC2 final landform stability).
B32	Road Transport	Concerns raised regarding increased traffic on local roads due to the Modification.	There would be no increase to the peak workforce or deliveries due to the Modification. Accordingly, there would be no change to the peak road traffic movements previously assessed for the Moolarben Coal Complex, and no additional impacts on the capacity, condition, safety or efficiency of the surrounding road network are expected.
B33	Noise and Dust Generation	Disagreement with the conclusions of the Environmental Assessment that no additional noise or dust pollution will be generated by the Modification, considering a new haul road, conveyor and additional rail movements are proposed.	The new internal road is not a haul road and would be a very minor source of intermittent emissions when equipment (e.g. a dozer or excavator) is walked from OC4 to OC2 (or vice versa). In the context of the Moolarben Coal Complex, and given its distance to the closest privately-owned receivers, the bypass conveyor is a very minor source of noise and dust emissions (which has been considered in both the air quality and noise studies for the Modification). Additional rail movements have been considered in the operational noise modelling with the inclusion of an idling locomotive on the rail loop. However, as operational noise limits are on an a 15-minute basis there would be no change in comparison to the approved operations due to the proposed increase in peak and average daily rail movements (i.e. approved operations also include an idling locomotive on the rail loop in a 15-minute period). Dust emissions from train movements were considered by TAS (2017). The modelling predictions of TAS (2017) indicate that at distances of 50 m and beyond the rail track centreline, the maximum 24-hour average increase in TSP concentration due to the two additional peak rail movements for all scenarios would be approximately 0.7µg/m³. By assuming 40% of the TSP is comprised of PM_{10}, the predicted maximum 24-hour average PM_{10} concentration would be approximately 0.3µg/m³ (compared to limit of 50 µg/m³).
B34	Moolarben Creek	Concerns that the impacts on Moolarben Creek due to the changed pit limits of OC2 and modified creek crossing have not been adequately assessed.	The potential impacts of the minor increase in pit limits of OC2 have been considered in the Site Water Balance and Surface Water Assessment (WRM, 2017) and Groundwater Assessment (HydroSimulations, 2017). The haul road crossing between OC2 and OC3 was approved under the initial Moolarben Coal Project Stage 1 Project Approval (05_0117). To allow for construction of water management infrastructure required for the approved crossing, an additional buffer of disturbance has been assessed for the Modification.

Issue ID No.	Subject	Issue Raised	Response
B35	Adequacy of Biodiversity Assessment Review	Concerns that the Biodiversity Assessment Review is inadequate and the completion date two-weeks prior to exhibition indicates the assessment was written to prove a required outcome rather than considering the findings of the Environmental Assessment and providing information on the environmental impacts of the Modification. Concerns that plots for the survey efforts focussed mostly on areas previously approved for disturbance or outside the proposed additional disturbance areas. Concerns that the Relinquishment Areas could still be disturbed by infrastructure. Concerns raised over the lack of GDE mapping.	The Environmental Assessment and supporting studies (including the Biodiversity Assessment Review) were continuously revised and updated throughout the environmental assessment process, incorporating findings and conclusions from each of the studies. The date on the Biodiversity Review (25 October 2017) reflects the date that the report was approved by ELA to be put on public exhibition (i.e. finalised). The design and location of infrastructure, disturbance areas and haul roads were refined during the assessment process in consideration of the results of flora and fauna surveys (and other studies) which commenced in December 2016. This refinement process is the reason the survey extent covered an area larger than the Modification Disturbance Footprint. A larger survey area was assessed, with the location of infrastructure, disturbance areas and haul roads chosen to minimise environmental impacts in consideration of the preliminary results of the Biodiversity Assessment Review and other assessments. Plot spacing and data collection were conducted to meet the requirements of the FBA Credit Calculator. The OEH has not raised any concerns regarding survey effort in its submission to the Modification. Areas within the relinquishment areas mapped by EcoLogical Australia (2017) as having been previously cleared and disturbed may include minor infrastructure such as access tracks. Should this component of the Modification be approved, areas of native vegetation within the relinquishment areas would not be disturbed. Regarding the concerns raised over the lack of GDE mapping for the Biodiversity Assessment Review, Section 2.3.1.2 of the FBA details the following: *In addition, the FBA does not assess the direct impacts of a project that are not associated with clearing of vegetation. Examples of these impacts include, but are not limited to:* *…* *(d) downstream impacts on hydrology and environmental flows on surface vegetation and groundwater dependent ecosystems.* *…* GDE mapping and assessment of potential impacts was included in the Groundwater Assessment (HydroSimulations, 2017).
B36	Salinity in the Goulburn River	Concerns regarding the contribution of mine discharges to salt loads in the Goulburn River, with the Moolarben Coal Complex to contribute approximately 50% of the current average daily salt load at Coggan during periods of low flow in the Goulburn River.	Studies conducted by Advisian (2017), MPR (2017), RGS (2017; 2018) and RGS (2018) for the Modification considered potential downstream impacts of 900 µS/cm (maximum), cumulatively with the Ulan Mine Complex, and concluded no significant adverse impacts on the Goulburn River. Notwithstanding, it is understood any EPL variation may result in alternative discharge salinity limits (Section 5). Downstream monitoring in the Goulburn River would continue for water quality, flow and aquatic ecology. The results of this monitoring may be used over time to support MCO's EPL 12932 variation request in consideration of the decision tree process in the ANZECC Guidelines.

Issue ID No.	Subject	Issue Raised	Response
B37	EPL Concentration Limits	Concerns regarding the discharge EC limit of 900 µS/cm, as the pre-mining EC in the Goulburn River upstream of Ulan was 500 µS/cm.	It is understood any EPL variation may result in alternative discharge salinity limits (Section 5). Downstream monitoring in the Goulburn River would continue for water quality, flow and aquatic ecology. The results of this monitoring may be used over time to support MCO's EPL 12932 variation request in consideration of the decision tree process in the ANZECC Guidelines.
B38	EPL Concentration Limits	Concerns that the discharge TSS and turbidity limits (50 mg/L and 25 NTU, respectively) exceed the median and 80th percentile water quality levels based on site-specific monitoring in the Goulburn River.	The limits for TSS of 50 mg/L and 25 NTU are the existing EPL 12932 discharge limits. As discussed in Section 4.6.2 of the Environmental Assessment, in comparison to the current EPL licensed discharge regime, it is likely the Modification would reduce downstream TSS due to relocating the EPL ID1 discharge point to the confluence of Bora Creek and the Goulburn River Diversion and the construction of water treatment facilities.
B39	Groundwater Biodiversity	Concerns that no research has been conducted in regard to the impact of mine water discharges on groundwater stygofauna in the upper Goulburn River catchment.	Proposed discharges to the Goulburn River would be licensed and subject to discharge limits. In order to minimise the potential for adverse impacts to aquatic ecology and stygofauna, the proposed discharge limits are based on the existing water quality in the Goulburn River (based on 80th percentile upstream levels) and/or meeting ANZECC Guideline trigger values designed for the protection of aquatic ecology. On this basis, negligible adverse impacts to stygofauna are expected.
B40	Water Quality Monitoring	Request for monitoring of metals and organic compounds associated with Permian coal seams to be included in monitoring programs for discharges and brine water.	Metals are currently monitored as part of the Water Management Plan. Monitoring of discharge water would be in accordance with the conditions of EPL 12932.
B41	Water Management	Concerns raised that the proposed strategy for the management of water treatment plant waste product/brine carries a high risk of saline seepage and runoff contaminating surface and groundwater quality.	Brine is proposed to be permanently stored in the UG4 void to return associated salts underground. This is preferred in comparison to surface storage. No significant impact to groundwater quality beyond the UG4 footprint is expected as a result of underground brine storage. Until such time as underground storage becomes available, brine will be used/stored only in internally draining catchments reporting to mine water storages. Brine will not be used in catchments reporting to sediment dams that can discharge into the Goulburn River (or Wilpinjong Creek).
B42	Water Quality	Concern raised that comparing mine water quality to ANZECC Guideline livestock drinking guidelines is not a credible or relevant comparison for water discharging into the Goulburn River and Goulburn River National Park.	The comparison to ANZECC Guideline livestock drinking guidelines was made in the Geochemistry review. This comparison was not made to discharge water (as this comment suggests), but to mine water stored on-site. The comparisons to livestock drinking guidelines for mine water stored on-site were made for Calcium, Sulphate and Cobalt, which do not have ANZECC Guideline aquatic ecosystem (freshwater) guideline protection levels. Comparison to aquatic ecosystem (freshwater) guideline protection levels for mine water stored on-site was made for other analytes for which these guideline values were available (e.g. dissolved metals).

Issue ID No.	Subject	Issue Raised	Response
B43	The Drip and Community Consultation	Concerns raised regarding the lack of consultation with the community or downstream users to determine an appropriate level of protection for high-conservation ecosystems (including the Drip and Goulburn River National Park) as per the requirements of the ANZECC Guideline.	The environmental assessment process for the Modification has, and continues to, include consultation with stakeholders.
B44	Groundwater Modelling	Concern raised regarding the underestimation of water make in past groundwater assessments.	Consistent with the Statement of Commitments from Project Approval (08_0135), MCO has updated its groundwater model. The revised groundwater modelling was conducted by HydroSimulations (2017). When compared to the previous predictions by RPS Aquaterra (2011), the revised groundwater modelling predicts increased inflows for a number of reasons, including: • changes to the sequencing of the approved underground mining areas (including the requirement to continue to dewater UG1 for the life of UG4 to maintain safe access to the UG4 workings); • approved underground mining rate of 8 Mtpa as a result of the UG1 Optimisation Modification; • differences in the timing of advanced dewatering of the UG4 area via the approved borefield; and • water stored in the Ulan East Pit providing potential recharge to down-dip workings in the Ulan Seam. These factors resulting in changes to predicted groundwater inflows are unrelated to the Modification.
		Areas of concern in regard to the updated groundwater model include the following:	
		• Groundwater hydrographs only go as far as January 2017, prior to the main increase in UG1 water make.	Groundwater hydrographs included inflows to UG1, which commenced in April 2016. Section 3.8 of the Groundwater Assessment (Appendix I) stated the time periods used for calibration for the Groundwater Model as follows: *Transient Calibration (January 2005 – March 2017). Calibration of recharge and hydraulic properties over time (for more than 12 years) was conducted based on historical groundwater levels and mine inflows. Transient calibration was based on annual stress periods from 2005 to 2015. Monthly stress periods were used from January 2016 to March 2017 to allow calibration to monthly inflow data to the UG1 development headings.*
		• Modelled groundwater inflows for 2020 exceed MCO's maximum groundwater entitlement of 2,950 ML/year (WAL39799).	MCO would hold sufficient licences to account for predicted groundwater take as required by the *Water Management Act, 2000*.

Issue ID No.	Subject	Issue Raised	Response
		• MCO groundwater modelling uses questionable assumptions for hydraulic permeability concerning the potential impacts of subsidence and dewatering on the upper groundwater (Triassic). The hydraulic conductivity (K) of geo-hydraulic units in groundwater modelling is an estimate that can vary considerably dependent on modeller preference. MCO groundwater modelling use K values that differ by many orders of magnitude to UCML (Mackie Environmental Research, 2015) (e.g. assumed ratios for Kh/Kv for upper Triassic hydraulic unit used by UCML = 2; MCO = 5000). MCO assumes very little vertical groundwater flux despite characteristic vertical jointing in the Narrabeen Group of sedimentary rocks and proven leakage due to mine subsidence cracking at UCML.	It is noted the potential changes to groundwater impacts associated with the Modification are limited, as the Modification involves only minor extensions and reductions to the approved OC2 and OC3 pit limits and an increased rate of open cut mining. This is supported by advice received by the IESC for the Modification, which states: *… the proposed action* [the Modification] *is adjacent to, and mostly up-dip of, already-approved open-cut operations which means that there is unlikely to be substantial additional aquifer depressurisation as a result of the action.* The hydraulic properties of the model are informed by hydrogeological testwork and calibration of the groundwater model to monitored groundwater levels (including levels that have been subject to change due to previous mine stresses) and inflows. The calibration statistics are provided in Table 10 of the Groundwater Assessment (Appendix I). The key statistic is 4.6% Scaled Root Mean Square (SRMS), which is better than the groundwater modelling guideline value of 5-10% (Murray-Darling Basin Commission, 2001; Barnett *et al.*, 2012) for acceptable model calibration (HydroSimulations, 2017). The Modification does not involve any changes to approved underground mining operations. However, the groundwater model does include approved underground mining at the Moolarben Coal Complex. The hydraulic properties referred to in this comment do not include increased vertical conductivity resulting from subsurface fracturing from approved underground operations. Where relevant, changes in vertical conductivity are accounted for in the prediction phase of the model. Therefore, comparison of the hydraulic properties with any observed impacts at Ulan is not relevant.
		• Modelling ignores demonstrated impacts on groundwater in the Ulan Mine Complex which prove total depressurisation of overlying Triassic aquifers due to mine subsidence.	The modelling has been calibrated to existing groundwater levels, which includes any effect of the Ulan Mine Complex, as well as recorded inflows to both the Ulan Mine Complex and Moolarben Coal Complex.
B45	Stream Base-flow	Concern regarding modelling predictions related to loss of base flow to the Goulburn River and increasing inflows as mining progresses down-dip.	HydroSimulations (2017) has considered predicted baseflow losses and concludes that the Modification would result in negligible change to baseflow to the Goulburn River. It is noted this comment relates to approved mining in UG4, which would not change due to the Modification.
B46	Modelling of GDEs	Concern raised that MCO did not collect any baseline data or conduct any on-ground monitoring of the Drip and other GDEs, with descriptions based on generalised observations and assumptions. Request for an independent assessment of GDEs to be undertaken.	The Modification does not involve any change to approved underground mining and would not impact the Drip. HydroSimulations (2017) concludes that the Modification would not result in additional impacts to GDEs as predicted drawdown of the water table is minor. This is supported by advice received by the IESC for the Modification, which states: *… the proposed action* [the Modification] *is adjacent to, and mostly up-dip of, already-approved open-cut operations which means that there is unlikely to be substantial additional aquifer depressurisation as a result of the action*

Issue ID No.	Subject	Issue Raised	Response
B47	Monitoring	Request for real-time monitoring of fluctuations of river bed sand-sediment aquifer prior to commencement of significant bore field extraction and longwall mining dewatering.	The Northern Borefield and UG4 are approved components of the Moolarben Coal Complex and are not considered relevant to the Modification.
B48	General Errors in Controlled Water Release Impact Assessment	The following comments in regard to the Controlled Water Release Impact Assessment (Advisian, 2017):	
		• Discharges from the Ulan Mine Complex incorrectly assumed to have commenced in 2004.	Table 2.3 of the Controlled Water Release Impact Assessment (Advisian, 2017) shows discharges under the Ulan Mine Complex's EPL 394 as being approved prior to 2004.
		• Bobadeen Creek incorrectly assumed to be ephemeral. Bobadeen Creek sustains permanent flow from groundwater seepage approximately 300 m above the junction with Goulburn River.	Bobadeen Creek is approximately 10 km long, therefore, the description that Bobadeen Creek is ephemeral applies to more than 95% of the length of Bobadeen Creek. Notwithstanding, this comment does not impact the outcomes of the Environmental Assessment.
		• Figure 2.9 in Advisian (2017) was taken upstream of Bobadeen Creek, not downstream as the caption suggests.	Correction noted.

7 PROJECT EVALUATION

The Environmental Assessment described that approval of the proposed changes to the Moolarben Coal Complex for the Modification is considered to be justified given:

- The proposed increases in the rate of open cut ROM coal production could be achieved with no exceedances of the Project Approval limits for noise and air quality.
- The Biodiversity Offset Strategy for the Modification, which includes land-based offsets at the MCO-owned Gilgal property, would compensate for residual potential impacts to biodiversity.
- The Modification would result in an improved final landform due to the removal of the approved OC3 out-of-pit emplacement.
- The improved efficiency of resource recovery would result in an increase in Government royalties of approximately $82M (NPV of approximately $69M).
- The increased production limits would allow annual revenue to increase. This improves the productivity of the Moolarben Coal Complex, which improves the security of the continued employment of the existing workforce and ongoing expenditure in the State and local economies.
- The modifications and additions to infrastructure for the Modification would result in construction employment at the Moolarben Coal Complex.
- The water treatment facility would enable water to be released via licensed discharge to be treated to EPL concentration limits and reduce/control dissolved metal concentrations.
- Piping treated water to the relocated discharge point would avoid potential erosion along Bora Creek (in comparison to the current EPL discharge point).

It was predicted the proposed increase in the daily volume of controlled releases from 10 to 20 ML/day, with maximum salinity of 900 µS/cm, could occur with no significant adverse impacts to downstream water quality and aquatic ecology, and minor changes in river height and velocity.

Notwithstanding, it is understood any EPL variation may result in alternative discharge salinity limits (Section 5).

Downstream monitoring in the Goulburn River would continue for water quality, flow and aquatic ecology. The results of this monitoring may be used over time to support MCO's EPL 12932 variation request in consideration of the decision tree process in the ANZECC Guidelines.

8 REFERENCES

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ATTACHMENT 1

ADDITIONAL ANALYSIS BY ADVISIAN (2018)

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1 May 2018

Moolarben Coal Operations Pty Ltd
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By email: Graham.Chase@yancoal.com.au

Att: Graham Chase

Dear Graham

Moolarben Open Cut Modification EA: response to EPA comments site-specific trigger values for discharges

The attachment to this letter provides Advisian's responses to the matters raised by the EPA in their letter to NSW Department of Planning and Environment dated 11/12/2017 (reference: SF17/46118) following review of the *Controlled Water Release Assessment for the Goulburn River* (Advisian, 2017) which forms Appendix F to the *Moolarben Coal Complex – Open Cut Optimisation Modification*.

In response to the issues relating to site-specific trigger values for discharges raised by the EPA, Advisian has analysed additional water quality data for the Goulburn River for monitoring site UMC SW01. The analysis of the additional data has been included in the Attachment to this letter. Trigger levels, based on the approach recommended in the ANZECC Water Quality Guidelines, for dissolved metals are proposed based on the analysis presented in the Attachment.

We trust that that this response addresses the EPA's concerns. Please do not hesitate to contact the undersigned should you require any further information.

Yours sincerely

Alison Tourle

Alison Tourle
Senior Associate

Advisian

WorleyParsons Group

Attachment A – Response to EPA comments on site specific trigger values for discharges

This attachment provides Advisian's responses to the matters raised by the EPA in their letter to NSW Department of Planning and Environment dated 11/12/2017 (reference: SF17/46118) following review of the *Controlled Water Release Impact Assessment for the Goulburn River* (Advisian, 2017) which forms Appendix F to the Moolarben Coal Complex – Open Cut Optimisation Modification Environmental Assessment.

In response to the issues raised by the EPA relating to site specific trigger values for discharges, Advisian has analysed additional water quality data for monitoring site UMC SW01 on the Goulburn River. Appropriate site specific trigger values, based on the approach recommended in the ANZECC Guideline, for dissolved metals are proposed based on the analysis presented.

In regards to the analysis for dissolved metals presented in Table 2.12 of Appendix F, EPA commented:

> *The ANZECC Guideline provides that a slightly to moderately disturbed system is the relevant level of protection for the receiving waters, in this case the Goulburn River, and while the comparison of water quality results to site-specific trigger values is a recognised approach in the ANZECC Guidelines, this is only appropriate if they are developed in accordance with the approach set out in the ANZECC Guidelines. The ANZECC Guideline provides that 24 contiguous monthly samples from an appropriate reference site(s) are required to develop site specific trigger values for the receiving waters, being the Goulburn River. It should be noted that page 26 of Appendix F provides that the datasets for dissolved Aluminium concentrations are very limited and results therefore may not be adequate to characterise the water quality.*

It is noted that trigger levels for dissolved metals were not proposed in Appendix F. The surface water quality monitoring results presented in Table 2.12 were a summary of the available monitoring data in order to characterise the existing water quality of the Goulburn River, upstream and downstream of the proposed discharge point and not to be used to set trigger values.

In order to identify site specific trigger levels for dissolved metals, Advisian obtained additional data from monitoring site UMC SW01. This site is located on the Goulburn River approximately 4 km upstream of the proposed discharge point, as shown on Figure 1, and upstream from any mining related impacts. This site is considered to be close enough to the proposed discharge point to be included as an appropriate upstream reference site for the determination of trigger levels at the proposed discharge point.

The dataset for UMC SW01 includes data from 36 sampling events for dissolved metals, taken at least monthly from December 2013 to July 2016 (with one month (January 2016) where sample results are not available). One additional sampling event was undertaken in November 2017.

As specified in section 7.4.4.1 of Volume 1 of the ANZECC Guidelines, two years of contiguous monthly sampling (24 samples) is adequate to provide an indication of the local ecosystem variability and to provide a basis for derivation of 'trigger' values appropriate to conditions in a particular creek system:

Minimum data requirements at the reference site: a minimum of two years of contiguous monthly data at the reference site is required before a valid trigger value can be established.

Based on the ANZECC requirements, data from UMC SW01 for the period December 2013 to July 2016 has been adopted to identify appropriate site specific trigger values.

The results of the analysis for dissolved metals is summarised below in Table 1.

Table 1: Surface Water Quality Monitoring results for Dissolved Metals

Parameter (mg/L)	ANZECC Default Trigger Value[1]	Count	Min	20%	Mean	Median	80%	Max	LoR[2]
Goulburn River UMC SW01									
Dissolved Aluminium	**0.055**	36	0.01	0.03	0.01	0.07	**0.14**	0.36	
Dissolved Iron	**-**	36	<0.05	0.20	0.31	0.27	**0.39**	0.74	0.05
Dissolved Manganese	**1.9**	36	0.012	0.046	0.252	0.133	**0.370**	2.280	
Dissolved Nickel	**0.011**	36	<0.001	<0.001	<0.001	<0.001	**<0.001**	0.004	0.001
Dissolved Zinc	**0.008**	36	<0.005	<0.005	0.005	<0.005	**0.008**	0.012	0.005
Dissolved Cadmium	**0.0002**	36	<0.0001	<0.0001	<0.0001	<0.0001	**<0.0001**	<0.0001	0.0001
Dissolved Copper	**0.0014**	36	<0.001	<0.001	<0.001	<0.001	**<0.001**	0.003	0.001
Dissolved Arsenic	**0.013**	36	<0.001	<0.001	<0.001	<0.001	**<0.001**	<0.001	0.001
Dissolved Lead	**0.0034**	36	<0.001	<0.001	<0.001	<0.001	**<0.001**	<0.001	0.001

1 *ANZECC default trigger values for freshwater (slightly to moderately disturbed ecosystems), 95% species protection (Table 3.4.1 ANZECC Guideline)*

2 *LoR = Limit of Reporting*

Recommended Trigger Levels

Recommended trigger levels for toxicants (dissolved metals) of concern in the Goulburn River at the proposed discharge point have been developed in accordance with the ANZECC Guidelines and are presented in Table 2, below. The recommended trigger levels were developed through the following process:

1. Table 3.4.2 of the ANZECC Guideline recommends the use of 95% species protection levels as default, low-risk trigger values for toxicants in slightly to moderately disturbed ecosystems. These default trigger values are listed in Table 3.4.1 of the ANZECC Guideline, and reproduced in Table 2, below.

2. 80th percentile values were calculated from monitoring results recorded at upstream site UMC SW01, which included more than 24 months of contiguous monitoring data. These values are presented in Table 2, below.

3. Section 7.4.4.2 of the ANZECC Guideline states the following:

   Toxicant concentrations may vary seasonally. Because of this and the need to be confident about the best estimate of background concentrations, it is recommended that background data be gathered on a monthly basis for at least two years. In all respects, data requirements and collection are the same as for physical and chemical stressors, as described above. Until this minimum data requirement has been established, comparison of the test site median should be made with reference to the default guidelines identified in Section 3.4.3 of this document.

   For those months, seasons or flow periods that constitute logical time intervals or events to consider and derive background data, the 80th percentile of background data (from a minimum of 10 observations) should be compared with the default guideline value.

   This 80th percentile value is used as the new trigger value for this period if it exceeds the default guideline value provided in Section 3.4.3 of this document.

Therefore, for analytes with an 80th percentile value lower than the default trigger value, the default ANZECC trigger value is adopted as the recommended trigger value. For analytes with an 80th percentile value greater than the default trigger value, the 80th percentile value is adopted as the recommended trigger value.

In summary, based on the ANZECC Guidelines, Table 2 provides:

- the default ANZECC trigger values for the relevant dissolved metals for slightly to moderately disturbed ecosystems
- 80th percentile values for the relevant dissolved metals calculated from monitoring data recorded at UMC SW01
- recommended trigger values at the proposed discharge point in the Goulburn River based on the greater of the above.

Table 2: Recommended trigger levels for dissolved metals

Parameter	Units	ANZECC Default Trigger Value	UMC SW01 80th %ile Value	Recommended Goulburn River Trigger Level
Dissolved Aluminium	(mg/L)	0.055	0.14	0.14
Dissolved Iron	(mg/L)	-	0.39	0.39
Dissolved Manganese	(mg/L)	1.9	0.370	1.9
Dissolved Nickel	(mg/L)	0.011	<0.001	0.011
Dissolved Zinc	(mg/L)	0.008	0.008	0.008
Dissolved Cadmium	(mg/L)	0.0002	<0.0001	0.0002
Dissolved Copper	(mg/L)	0.0014	<0.001	0.0014
Dissolved Arsenic	(mg/L)	0.013	<0.001	0.013
Dissolved Lead	(mg/L)	0.0034	<0.001	0.0034

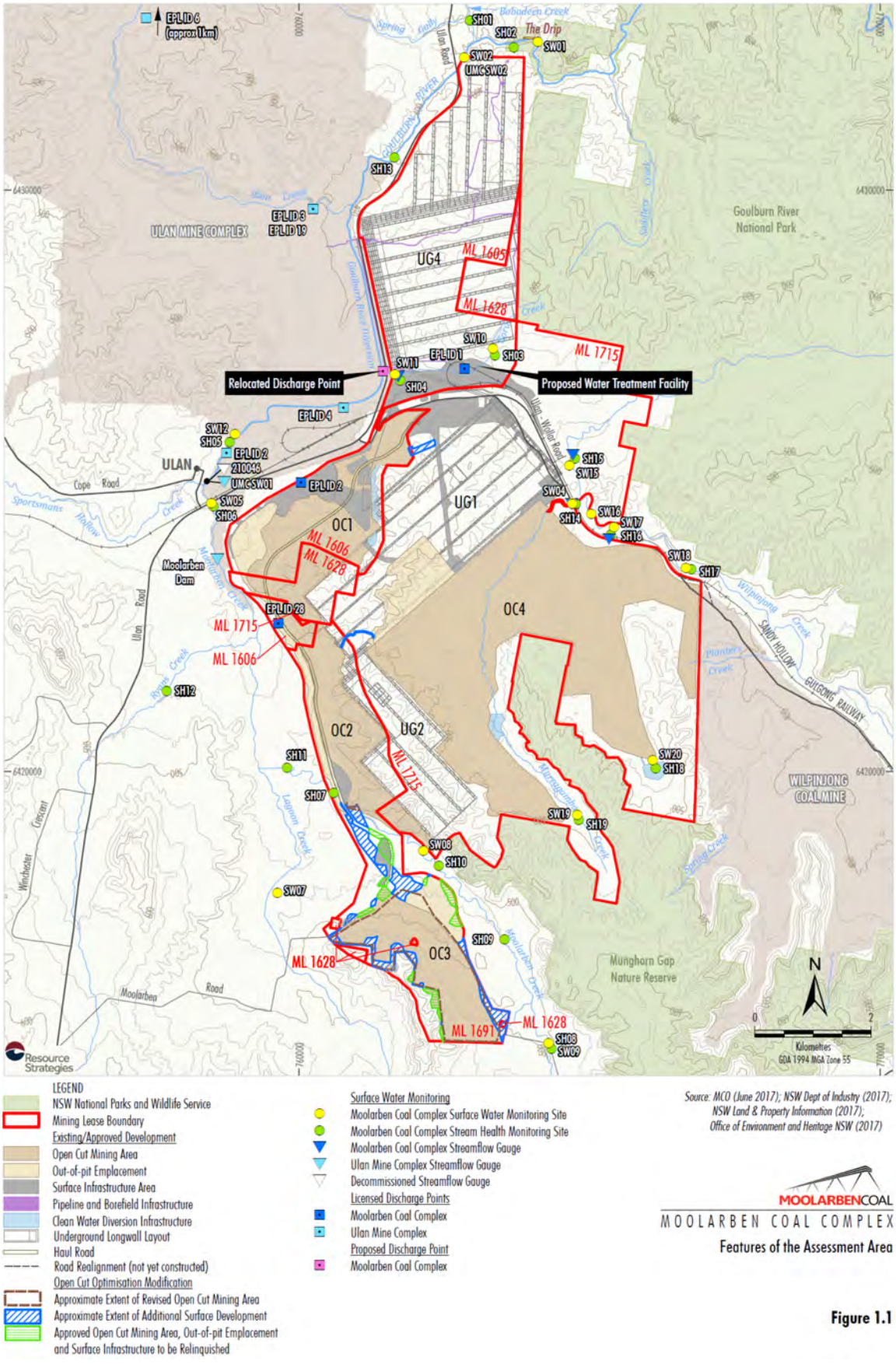

Figure 1: Water Quality Monitoring locations

ATTACHMENT 2

ADDITIONAL ANALYSIS BY RGS ENVIRONMENTAL (2018)

20 February 2018
Project Number 2018010
Technical Note 001
Moolarben Coal Operations Pty Ltd
PO Box 2216
Greenhills NSW 2323

Moolarben Coal Complex

Attention: Graham Chase (Environmental and Community Manager)

Subject: Moolarben Coal Water Quality Review

1.0 INTRODUCTION

RGS Environmental Pty Ltd (RGS) was commissioned by Moolarben Coal Operations Pty Ltd (MCO) to undertake a review of the site water quality monitoring data with respect to ionic composition. The review has been undertaken to support potential changes to controlled water releases from site.

1.1 Background

The Moolarben Coal Complex (MCC) is an approved open cut and underground coal mine, approximately 3 kilometres (km) east of the village of Ulan and 40 km north of Mudgee, New South Wales (NSW). MCO is the operator of the MCC on behalf of the Moolarben Joint Venture; Moolarben Coal Mines Pty Ltd, Sojitz Moolarben Resources Pty Ltd and a consortium of Korean power companies. MCO and Moolarben Coal Mines Pty Ltd are wholly owned subsidiaries of Yancoal Australia Limited.

The MCC comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (a coal handling and preparation plant [CHPP], raw and product coal stockpiles, a rail loop and rail loader, and office and workshop support facilities). Open cut mining utilises conventional truck, shovel and dozer methods, while underground mining will utilise longwall mining methods. MCO is currently operating OC1, OC2 and OC4, and secondary extraction from UG1 has commenced. Coal mining in OC1 commenced in May 2010.

1.2 Summary of Modification

MCO is seeking to modify Project Approvals for Stages 1 and 2 of MCC (referred to as the Open Cut Optimisation Modification [the Modification]) to allow for changes to the currently approved open cut mining operations, including:

- Increased run-of-mine (ROM) coal production from the Stage 1 (OC2/OC3) and Stage 2 (OC4) open cuts, and associated increase in product coal.
- Associated increase in annual production rate of coal reject material.

The Modification does not involve mining in new areas (only minor extensions).

Currently MCOs Environment Protection Licence (EPL) [12932, 26 May 2016] permits discharge of water from three discharge points at the site, subject to stringent water quality concentration limits:

- EPL ID1– to Bora Creek from Cockies Dam – maximum 10 megalitres per day (ML/day);
- EPL ID2 – to Goulburn River from OC1 Sediment Dam 6 – maximum 10 ML/day; and
- EPL ID28 – to Moolarben Creek from OC2 Dam – maximum 1 kilolitre per day (kL/day).

The EPL also specifies that the maximum combined discharge from the three discharge points must not exceed 10 ML/day.

MCO is seeking approval as part of the Modification for increased controlled water releases from the site (combined volume increase from 10 ML/day to 20 ML/day into the Goulburn River), and an associated water treatment facility on-site.

The neighbouring Ulan Mine Complex (UMC), which mines the same geological unit (the Ulan Seam) as MCO, is licensed to discharge up to 30 ML/day (subject to discharge criteria for water quality).

An assessment of the potential impacts of the Modification on aquatic ecology, including consideration of any observed impacts of the historical discharges from UMC has recently been undertaken by Marine Pollution Research (MPR) (MPR, 2017).

MPR completed stream-health surveys using the National River Process and Management Program (NRPMP) River Bio-assessment Manual methods (NRPMP, 1994), whereby sampling and taxa identification for aquatic macroinvertebrates conforms to the AUSRIVAS methods for 'edge' sampling and data are analysed for site aquatic macroinvertebrate diversity and site Stream Invertebrate Grade Number Average Level (SIGNAL) index. The indices are derived by correlation analysis of macroinvertebrate occurrence against water chemical analysis; specifically, water chemistry attributes including temperature, turbidity, conductivity, alkalinity, pH, dissolved oxygen, total nitrogen and total phosphorus (Chessman 2003). Similarly, a Salinity Index was used for the assessment, which is based on aquatic invertebrate relative sensitivity to increased water conductivity (Horrigan et. al 2005). MPR established that no significant adverse impacts to aquatic ecology have been observed over the period 2011 to 2017 due to licensed discharges from the UMC.

The NSW Environmental Protection Authority (EPA) has requested information regarding major ions which contribute to salinity at the MCC; specifically, the effect of individual major ions on potential toxicity to the receiving environment (i.e. Goulburn River).

1.3 Scope of Work

In response to the issues raised by the NSW EPA, the RGS scope of work includes:

- A review of on-site monitoring data at the MCC and surface water monitoring data with respect to ionic composition; and
- A comparison with potentially relevant water quality guideline criteria.

2.0 REVIEW

2.1 Geology

The MCC and UMC are located in the northern part of the Western Coalfield, on the northwest margin of the Sydney Basin and at the southern end of the Gunnedah Sub-basin.

The resource coal targeted for extraction at both mines is from the Illawarra Coal Measures, which are of Permian age (approximately 250 to 275 million years before present) and overlain by sedimentary formations of varying thickness and types including sandstones, shales and alluvium (Wells Environmental Services, 2009). Ten coal seams (nine in the west) occur within the coal measures; however, the major unit known as the Ulan Seam is the only seam of economic significance within the area.

Triassic sandstones and conglomerates of the Narrabeen Group overlie the Illawarra Coal measures, which in turn overlie either Early Permian marine sediments (Shoalhaven Group) in the east, or in the west, Carboniferous granite (Ulan Granite) and Rylstone Volcanics (Wells Environmental Services, 2009). Small plugs and remnant basalt flows of Tertiary age have been observed in outcrop in the Moolarben, Murragamba and Wilpinjong valleys. Unconsolidated and partially consolidated Quaternary sediments also occur throughout the area as valley fills and along dominant drainage lines.

Both MCC and UMC target the same coal resource (the Ulan Seam) for extraction by the same open cut and underground methods (conventional truck, shovel and dozer methods and longwall mining methods, respectively) and manage the same overburden units. It is therefore expected that if waste materials and mine affected water are managed and treated similarly for both sites, then potential discharge water qualities should show similar chemical signatures, particularly with respect to major ion concentrations.

2.2 Water Quality Data

Surface water quality monitoring has been undertaken by MCO since 2005, while more recently, mine water dams (since 2012), open cut pits (since 2014) and underground (since 2016) water qualities have been monitored. The surface water quality monitoring has been undertaken in the Goulburn River, Bora Creek, Moolarben Creek, Murragamba Creek, Lagoon Creek and Ryan's Creek. RGS has been supplied MCO and UMC site water quality data in Excel format. **Table 2-1** summarises the supplied water quality data, including the locations and periods of monitoring for the baseline water monitoring, which includes the period prior to construction at the MCC.

The data set provided to RGS was separated into four groups (ie. surface water, mine water dams, open cuts and underground) and summary statistics of the key chemical parameters (pH, EC and major ions) are shown in **Attachment A**. Similarly, the key chemical parameters are shown graphically in Piper and Durov diagrams or in a ternary diagram (where data is limited) in **Attachment B**.,

The MCC summary statistics for each of the water types was compared to a range of water quality guidelines (**Section 2.2.1**).

Table 2-1: Summary of provided water quality data for MCC and UMC

Water Quality Type	Monitoring Location	Watercourse	Range of Data		Number of Measurements^
Surface Water	Surface Water 01	Goulburn River	14/02/2005	9/03/2017	218
	Surface Water 02	Goulburn River	14/02/2005	9/03/2017	219
	Surface Water 05	Moolarben Creek	14/02/2005	9/03/2017	218
	Surface Water 06	Ryan's Creek	14/02/2005	15/03/2010	64
	Surface Water 07	Lagoon Creek	14/02/2005	9/03/2017	186
	Surface Water 08	Moolarben Creek	14/02/2005	9/03/2017	188
	Surface Water 09	Moolarben Creek	14/02/2005	9/03/2017	189
	Surface Water 10	Bora Creek	1/01/2010	17/11/2016	85
	Surface Water 11	Bora Creek	17/10/2008	9/02/2017	157
	Surface Water 12	Goulburn River	17/10/2008	9/03/2017	172
	Ulan Surface Water 01	Goulburn River	19/12/2013	15/11/2017	41
Mine Water Dams	MWD 111		13/09/2012	16/11/2016	67
	MWD 112		9/02/2015	11/01/2017	24
	MWD 113		9/02/2015	8/12/2016	17
	MWD 204		10/10/2016	11/01/2017	16
	MWD 401		10/10/2016	13/09/2016	20
Open Cut Pit	OC1 North Pit		11/09/2014	13/12/2017	26
	OC4 North Pit		16/11/2016	8/02/2017	4
Underground	Underground 1 Sump		10/10/2016	13/12/2017	18

^Measurement obtained; however, may not include complete or specific major ion data.

2.2.1 Water Quality Guidelines and Criteria

The Australian and New Zealand Environment Conservation Council (ANZECC) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) provide a national benchmark for assessing water quality in systems throughout Australia and New Zealand. The ANZECC (2000) guidelines provide guidance for developing local guidelines or strategies such as catchment water quality and river flow objectives.

The Australian Drinking Water Guidelines (ADWG, 2011) was developed by the National Health and Medical Research Council (NHMRC) in collaboration with the Natural Resource Management Ministerial Council (NRMMC) to provide a framework for the management of drinking water supplies appropriate for local conditions. The ADWG address both the health and aesthetic quality aspects of supplying good quality drinking water.

The major ion and pH trigger values for ANZECC and ADWG are summarised in **Table 2-2**. There are generally limited criteria for major ions due to their typically low/negligible toxicity, with the only major ion criteria being for sulfate (SO_4^{2-}), sodium (Na^+) and chloride (Cl^-). The relative contribution of each of the major ions to salinity is the basis of the NSW EPA's comment.

There is no default ANZECC criteria for major ions for aquatic ecology. As such, **Table 2-2** provides ANZECC criteria (where possible) for "Irrigation" and "Livestock".

Although some of the ANZECC and the ADWG criteria may not be entirely applicable to MCC and UMC site water quality, the criteria (shown in **Table 2-2**) have been compared to all the supplied data. The colour coding used in **Table 2-2** is used to highlight exceedances, for a criterion, in the water quality summary water quality statistics tables provided in **Attachment A**.

Table 2-2: Summary of ANZECC and ADWG criteria for pH and major ions

Analytes	ANZECC (2000)			ADWG (2011)	
	Aquatic	Irrigation	Livestock	Health	Aesthetic
pH	6.5-8.0	-	-	-	6.5-8.5
HCO_3^-	-	-	-	-	-
Ca^{2+}	-	-	-	-	-
Cl^-	-	700	-	-	-
K^+	-	-	-	-	-
Mg^{2+}	-	-	-	-	-
Na^{2+}	-	460	-	-	-
SO_4^{2-}	-	-	1,000	500	250

2.2.2 Water Quality Comparison

Tables A2 to **A4** show that sulphate concentrations at mine water dam, open pit and underground monitoring locations typically exceed the ADWG "Aesthetic" or "Health" criteria. It should be noted that the corresponding conductivities of this mine affected water also typically exceeds the current EPL discharge limit of 900 µS/cm, meaning that the water would first be treated by the proposed water treatment facility before being discharged to meet the salinity discharge criteria, resulting in a corresponding reduction in sulphate concentrations.

The relative distribution of ions at surface water quality monitoring sites (both upstream and downstream of the proposed MCO discharge point) is similar as shown by the Durov and Piper diagrams provided in **Figure B-1**.

Similarly, the relative distribution of Ca, Mg and HCO_3 at mine water dams is similar to the distribution shown for surface water quality monitoring sites (both upstream and downstream of the proposed MCO discharge point), as shown by the ternary diagram provided in **Figure B-2**.

Whilst the contribution of ions to a water type was typically proportionate between surface water quality monitoring sites, the concentrations of ions may vary. The majority of surface water quality measurements are within all water quality guideline values **(Table 2-2)** for major ions; however, the average sodium and chloride concentrations for SW08 and SW09 exceed ANZECC (2000) irrigation guidelines, while sulfate can be greater than the ADWG (2011) guideline (250 mg/L) for aesthetic quality aspects. Both SW08 and SW09 monitoring sites are located upstream within Moolarben Creek, which is typically subject to poor water flow and thus greater evapo-concentration of major ions.

3.0 CONCLUSIONS

MCO is seeking approval as part of the Modification for increased controlled water releases from the site (combined volume increase from 10 ML/day to 20 ML/day into the Goulburn River), and an associated water treatment facility on-site. The neighbouring UMC, which mines the same geological unit (the Ulan Seam) as MCO, is licensed to discharge up to 30 ML/day. MPR undertook analysis of stream-health surveys and established that there were no significant adverse impacts to aquatic ecology observed over the period 2011 to 2017 due to licensed discharges from the UMC. The NSW EPA has questioned the effect of major ions which contribute to salinity (used in MPR's stream-health analysis).

The review of provided water quality data has indicated:

- Water stored in on-site water storages would be treated in the proposed water treatment facility to meet salinity discharge limits at the point of release, which would reduce concentrations of major ions in the treated water.
- Review of the available surface water monitoring data (specifically major ionic data) at sites both upstream and downstream of the proposed MCC discharge point indicates that surface water in the Goulburn River currently has a similar ionic make-up to mine affected water (for measured analytes).

- On this basis, it is expected water discharged by MCO would have a similar ionic make-up (and be treated to a similar salinity) to current water flows in the Goulburn River.
- As MCC and UMC target the same coal resource (the Ulan Seam) for extraction by the same open cut and underground methods it is expected that if waste materials and mine affected water are managed and treated similarly for both sites, then potential discharge water qualities should show similar chemical signatures, particularly with respect to major ion concentrations.
- Based on the surface water major ion data reviewed as part of this assessment and the applied ANZECC (2000) and ADWG (2011) water quality guidelines, the risk of individual major ions having adverse impacts to the aquatic ecology is low. This supports the findings of MPR (2017), which reported that there were no adverse impacts due to licensed discharges from the UMC and no adverse impacts were predicted due to proposed discharges from the MCC.

4.0 LIST OF REFERENCES

ANZECC & ARMCANZ, 2000. National Water Quality Management Strategy Document 4: Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

NHMRC & NRMMC, 2011. National Water Quality Management Strategy Document 6: Australian Drinking Water Guidelines. National Health and Medical Research Council and Natural Resource Management Ministerial Council.

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Horrigan, N., Choy, S., Marshall, J. and Recknagel, F. (2005) Response of stream macroinvertebrates to changes in salinity and the development of a salinity index. Marine and Freshwater Research 56(6):825-833.Surface Water Management Plan (MCO, 2016)

Wells Environmental Services, 2009). Moolarben Coal Project Stage 2 Environment Assessment Report.

MPR (2017) Moolarben Coal Complex Open Cut Optimisation Modification: Environmental Assessment Appendix G. Aquatic Ecology Assessment. Impact Assessment for the controlled mine water release to the Goulburn River NSW: Aquatic Ecology Assessment. Marin Pollution Research (2017)

5.0 LIMITATIONS AND DISCLAIMER

This report documents the work undertaken by RGS Environmental Pty Ltd (RGS) and does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report should be read in full. While the findings presented in this report are based on information that RGS considers reliable unless stated otherwise, the accuracy and completeness of source information cannot be guaranteed, although RGS has taken reasonable steps to verify the accuracy of such source data. RGS has made no independent verification of this information beyond the agreed scope of works and RGS assumes no responsibility for any inaccuracies or omissions outside of RGS's direct control. Furthermore, the information compiled in this report addresses the specific needs of the Client, so may not address the needs of third parties using this report for their own purposes. Thus, RGS and their employees accept no liability for any losses or damage for any action taken or not taken based on any part of the contents of this report. Those acting on information provided in this report do so entirely at their own risk.

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RGS Environmental Pty Ltd

Dr. Alan Robertson
Principal Geochemist

ATTACHMENT A

Summary Tables of Water Quality

Table A1: Surface Water Quality Data

Surface water sampling location	Summary Statistics	EC (µS/cm)	pH	Alkalinity Bicarbonate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulphate (mg/L)	TDS (mg/L)
Upstream of MCC Discharge Point – Goulburn River, Moolarben Creek, Lagoon Creek, Ryan's Creek											
SW 05	Number of Samples	218	216	71	70	72	72	72	72	67	198
	Average	739.4	7.1	84.4	23.6	143.1	16.8	5.7	80.5	52	460
	Median	743	7.2	74	21.5	142	15.5	5.6	82	43	422
	Min	75	5.3	2	2.9	14	2.6	2	9	2	142
	Max	1590	8.3	656	56	323	39	11	174	200	3780
	P10	335.5	6.2	24	11.9	53.7	7.19	4.01	41.1	6	289
	P90	1110	7.7	126	41.1	238	28.9	7.7	120.9	112	629
SW 06	Number of Samples	64	64	64	64	64	64	64	64	63	64
	Average	294.3	6.6	32.7	2.1	31.5	3.4	2.4	34.2	15	206
	Median	270	6.6	32	1.55	32	3.3	2	35	15	185
	Min	40	5.3	8	0.96	4	1.9	1.1	6	2	131
	Max	630	7.8	66	10	50	5.8	9.8	43	25	536
	P10	201.5	5.8	28	1.1	22	2.4	1.43	27.3	11	160
	P90	387	7.4	37.7	3.85	42	4.5	3.44	41.7	21	249
SW 07	Number of Samples	176	176	65	65	65	65	65	65	65	161
	Average	738.1	7.1	72.4	17.7	116.9	15.4	6.9	74.9	58	438
	Median	717.5	7.1	65.5	18	93	15	6.7	71	35	408
	Min	40	4.4	2	0.96	4	1.3	1.1	5	2	118
	Max	7300	9.0	380	1800	1700	254	31	736	892	4458
	P10	263.8	6.1	26	1.78	28	3.6	2.2	29	11	203.2
	P90	1211	8.0	130	30	240	29	11	120	117	661.2
SW 08	Number of Samples	186	184	62	62	62	62	62	62	62	169
	Average	3392.	6.8	92.8	64.2	1103	162.2	20.8	485.1	290	1984.
	Median	3415	7.0	84	58	1100	149	17	481.5	270	1890
	Min	296	4.5	3	34	383	51	8	191	91	246
	Max	6990	8.0	350	230	2600	470	66	1200	980	6400
	P10	1970	5.8	32.4	47	674	93.7	13	330	178	1158
	P90	4870	7.6	145.4	79	1490	220	41.4	619	419	2884
SW 09	Number of Samples	187	186	64	64	64	64	64	64	64	168
	Average	3526.	6.9	196.9	98.4	1063	169.7	19.5	532.7	515	2133.
	Median	3760	7.0	212	94.5	1100	170	20	530	471	2200
	Min	250	5.2	25	11	92	15	1.8	53	80	181
	Max	6040	8.6	295	150	1360	250	29	716	1,020	4290
	P10	1434.	6.0	118.6	72.3	866	123	14.3	453	260	857.9
	P90	5080	7.6	267	130	1300	220	25	627.7	881	3200
SW 10	Number of Samples	56	56	3	3	2	3	3	3	0	49
	Average	84.2	6.4	10.3	1.1	12.5	0.8	2.2	5.5	-	95.4
	Median	80	6.3	12	0.94	12.5	0.64	2.8	5.8	-	82
	Min	10	5.3	3	0.58	11	0.1	0.69	1.3	-	26
	Max	180	8.1	16	1.8	14	1.8	3	9.3	-	200
	P10	50	5.9	4.8	0.652	11.3	0.208	1.112	2.2	-	51.2
	P90	123.5	7.1	15.2	1.628	13.7	1.568	2.96	8.6	-	167.6

Surface water sampling location	Summary Statistics	EC (µS/cm)	pH	Alkalinity Bicarbonate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulphate (mg/L)	TDS (mg/L)
SW 11	Number of Samples	152	151	12	12	12	12	12	12	7	134
	Average	249.8	6.9	26.9	3.1	22.3	4.9	11.6	16.8	28	423.5
	Median	192	6.9	15.5	2.15	18	4.8	8.85	18	29	251
	Min	30	4.7	5	0.96	4	0.46	2.5	2.9	7	42
	Max	2760	8.3	118	23	142	18	46	85	68	8285
	P10	80.5	6.3	10.1	1.01	11.7	2.41	2.96	9.91	17	162.2
	P90	368.6	7.5	54.6	7.94	32	9.2	20.1	24	40	570.5
SW 12	Number of Samples	172	170	24	24	24	24	24	24	16	152
	Average	453.5	7.0	53.8	12.3	78.6	9.1	5.0	49.0	27	327.3
	Median	496.5	7.1	52.5	13	78	9.45	5	49	19	324
	Min	45	5.4	2	0.94	4	0.1	3.1	4.6	5	76
	Max	1080	8.3	118	23	142	18	6.6	85	68	628
	P10	100	6.2	15.3	3.7	20.1	2.39	3.63	15.3	8	216.6
	P90	749.3	7.7	86.7	19.4	138	15	6.4	79	54	465.4
UMC Surface Water 01	Number of Samples	34	34	34	34	31	34	34	34	34	34
	Average	562.1	7.1	73.7	13.9	106.7	11.4	4.5	78.7	28	348.6
	Median	525	7.1	73.5	13	102	10	4	76.5	24	323
	Min	323	5.6	30	6	54	6	3	48	3	248
	Max	870	8.3	121	30	170	24	12	125	195	562
	P10	375.6	6.8	38.9	8.3	62	7.3	4	51	8	287.8
	P90	803.4	7.5	105.4	22.7	163	18.7	5	114.1	40	451.8
Downstream of MCC Discharge Point – Goulburn River											
SW 01	Number of Samples	218	211	69	69	69	69	69	69	69	198
	Average	683.5	7.4	93.5	21.0	84.8	16.4	8.1	76.6	95	401
	Median	720	7.6	90	20	85	16	7.5	77	84	400
	Min	95	5.4	17	7.5	25	5.2	3.2	27	18	171
	Max	1500	9.0	180	49	138	34	25	130	360	808
	P10	391	6.4	54	13.8	57	11	5.56	50.8	39	274
	P90	880	8.2	148.4	26.2	117.6	21.2	11	98.2	142	507
SW 02	Number of Samples	218	216	69	69	69	69	69	69	69	197
	Average	739.3	7.4	102.8	24.3	93.4	18.2	9.0	87.0	117	431
	Median	756	7.5	100	22	97	17	8.2	88	96	434
	Min	95	4.4	17	5.2	25	4.5	3.7	25	12	152
	Max	1560	10.1	190	54	149	35	18	130	410	790
	P10	383.5	6.3	55.4	15.8	57	12	6.26	58.8	47	310
	P90	999	8.2	162.8	36.4	130.2	29.2	12.2	110.2	212	540

Table A2: Mine Water Dams

Mine Water Dam	Summary Statistics	EC (µS/cm)	pH	Alkalinity Bicarbonate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sulphate (mg/L)	TDSs (mg/L)
MWD 111	Number of Samples	67	63	12	9	9	4	56
	Average	1356.8	7.8	121.5	49.4	43.8	261	829.3
	Median	1290	8.18	113.5	50	48	256	777.5
	Min	820	4.9	90	43	35	226	538
	Max	2320	8.84	163	52	51	305	1600
	P10	1102	6.2	93.1	47	35.8	234	621
	P90	1750	8.6	159.6	52	50.2	292	1100
MWD 112	Number of Samples	29	29	3	2	2	2	26
	Average	1318.2	8.4	148.0	53.0	37.5	203	743.3
	Median	1280	8.47	132	53	37.5	203	725.5
	Min	998	7.29	107	53	34	192	580
	Max	2070	9.97	205	53	41	214	1200
	P10	1078	7.47	112	53	34.7	194	630.5
	P90	1560	9.35	190.4	53	40.3	212	857.5
MWD 113	Number of Samples	17	17	1	0	0	1	14
	Average	1075.5	8.0	16.0	-	-	176	620.5
	Median	1030	8.12	16	-	-	176	596
	Min	758	6.84	16	0	0	176	504
	Max	1420	8.49	16	0	0	176	752
	P10	862	7.68	16	-	-	176	526
	P90	1352	8.39	16	-	-	176	739.8
MWD 204	Number of Samples	16	16	7	6	6	2	15
	Average	1214.4	8.4	113.7	45.8	49.8	225	752.4
	Median	1225	8.54	115	44.5	49.5	225	742
	Min	1040	7.34	86	42	46	216	642
	Max	1360	9.02	145	54	54	234	878
	P10	1115	8.26	87.2	42	47	218	684.2
	P90	1300	8.68	143.2	51	53	232	816
MWD 401	Number of Samples	20	19	7	5	5	2	18
	Average	1296	8.4	115.7	43.2	42.0	261	733.6
	Median	1265	8.42	115	43	44	261	711.5
	Min	999	7.82	71	36	37	135	534
	Max	1740	8.75	168	51	44	387	964
	P10	1084	8.062	74	38.8	38.6	160	640.1
	P90	1559	8.536	154.2	47.8	44	362	825.8

Table A3: Open Cut Pits

Open Cut	Summary Statistics	EC (µS/cm)	pH Lab (Unit)	Alkalinity Bicarbonate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sulphate (mg/L)	TDS (mg/L)
OC1 North Pit	Number of Samples	25	24	7	5	5	3	22
	Average	1241.9	7.3	156.0	49.2	37.6	315	695.4
	Median	1131	7.49	156	46	33	353	633.5
	Min	829	5.83	126	42	30	237	424
	Max	1920	8.71	186	60	57	355	1060
	P10	965.2	6.30	132	42.8	30.4	260	546.6
	P90	1648	8.07	174.6	57.6	49	355	954.2
OC4 North Pit	Number of Samples	4	4	2	2	2	1	4
	Average	1162.5	7.9	95.5	46.5	45.5	142	658.5
	Median	1044.5	8.20	95.5	46.5	45.5	142	600
	Min	921	6.96	71	36	41	142	534
	Max	1640	8.42	120	57	50	142	900
	P10	944.4	7.31	75.9	38.1	41.9	142	542.4
	P90	1475	8.37	115.1	54.9	49.1	142	821.4

Table A4: Underground

Underground	Summary Statistics	EC (µS/cm)	pH Field	Alkalinity Bicarbonate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sulphate (mg/L)	TDS (mg/L)
Underground 1 Sump	Number of Samples	17	18	7	6	6	3	14
	Average	1166.4	7.8	188.1	57.2	32.8	421	630.2
	Median	1070	8.11	182	55.5	32.5	238	616
	Min	988	3.38	169	46	27	170	494
	Max	2390	8.41	217	68	40	854	750
	P10	1012	7.78	172	48	28	184	563.7
	P90	1226	8.23	210.4	68	38	731	732.6

ATTACHMENT B

Piper and Durov Diagrams

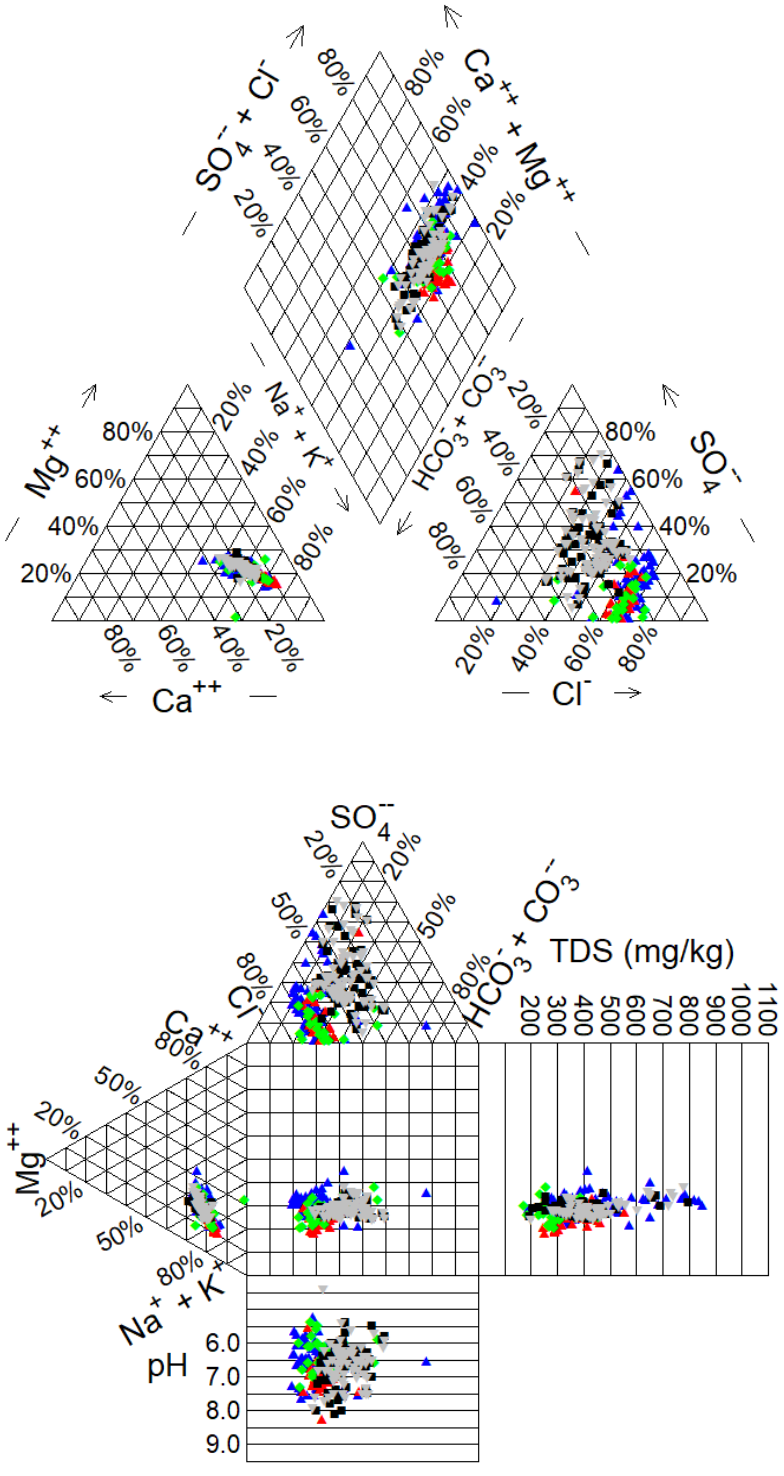


Figure B1: Selected upstream and downstream surface water data.

Upstream Sites: Red= UMC SW01; Blue= SW05; Green = SW12

Downstream Sites: SW01= Black; SW02= Grey.

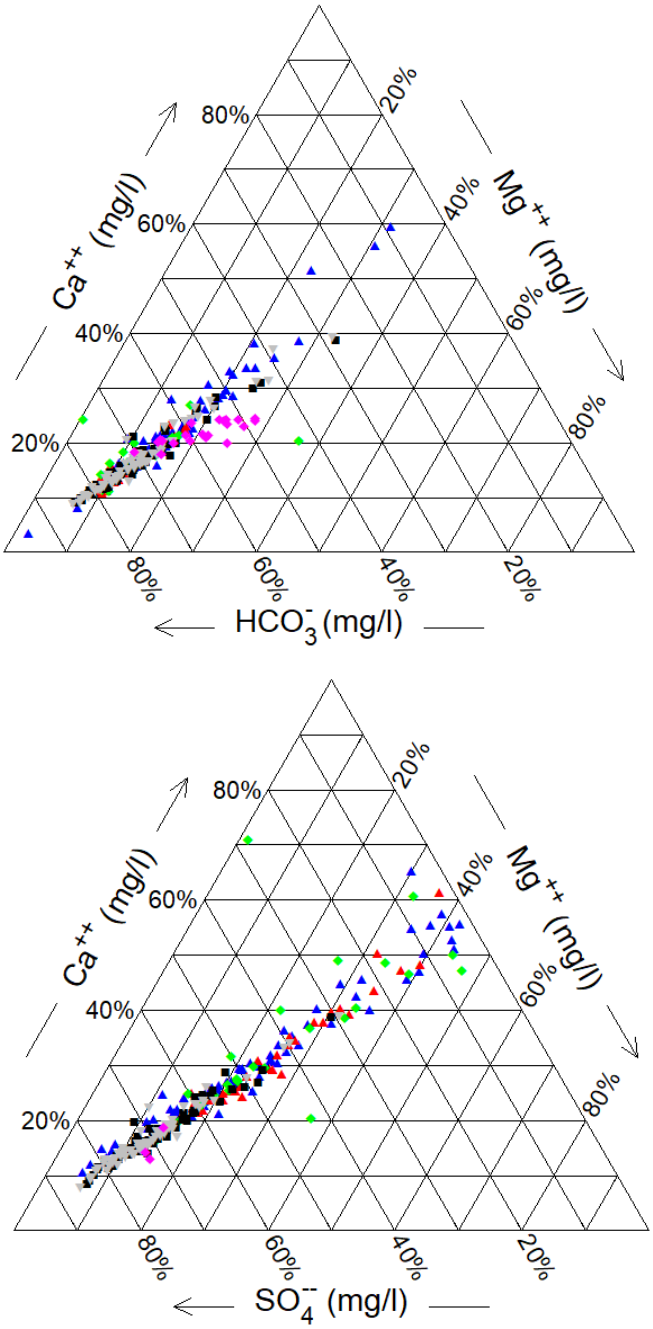


Figure B2: Selected upstream and downstream surface water data with mine water dam data.

Upstream Sites: Red= UMC SW01; Blue= SW05; Green = SW12

Downstream Sites: SW01= Black; SW02= Grey.

Mine Water Dams: 111, 112, 113, 204 and 401= pink.

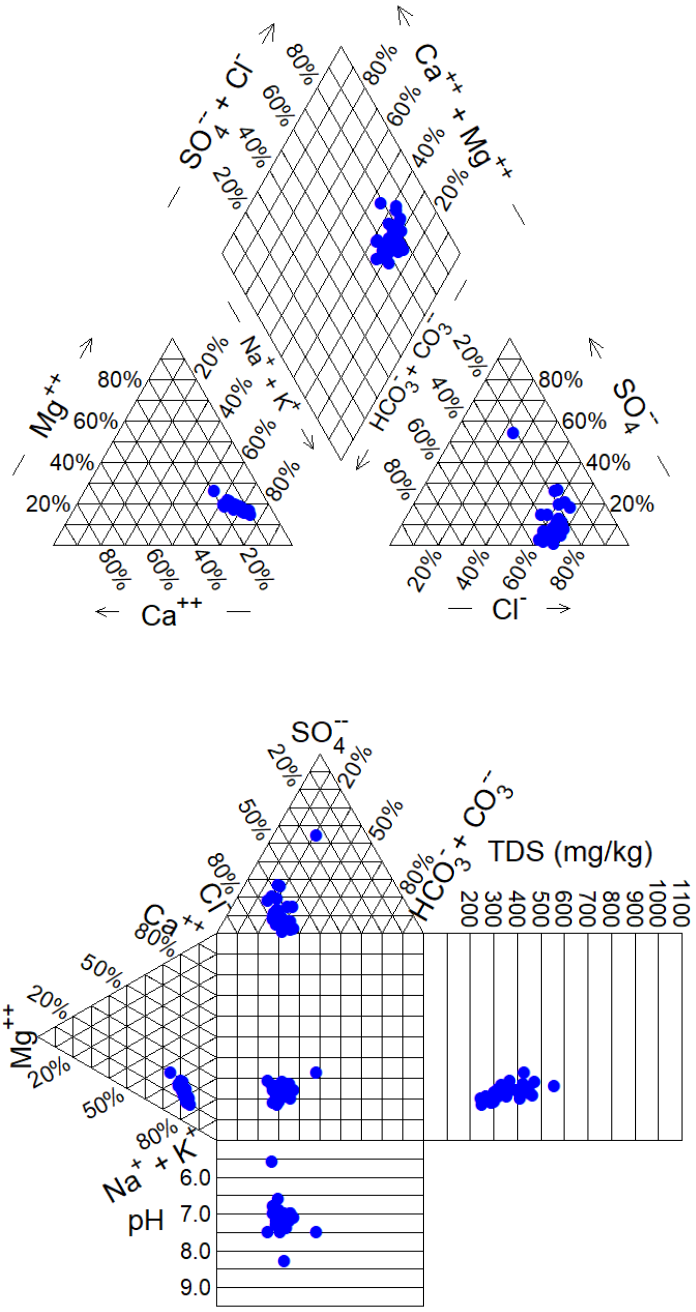


Figure B3: UMC SW01

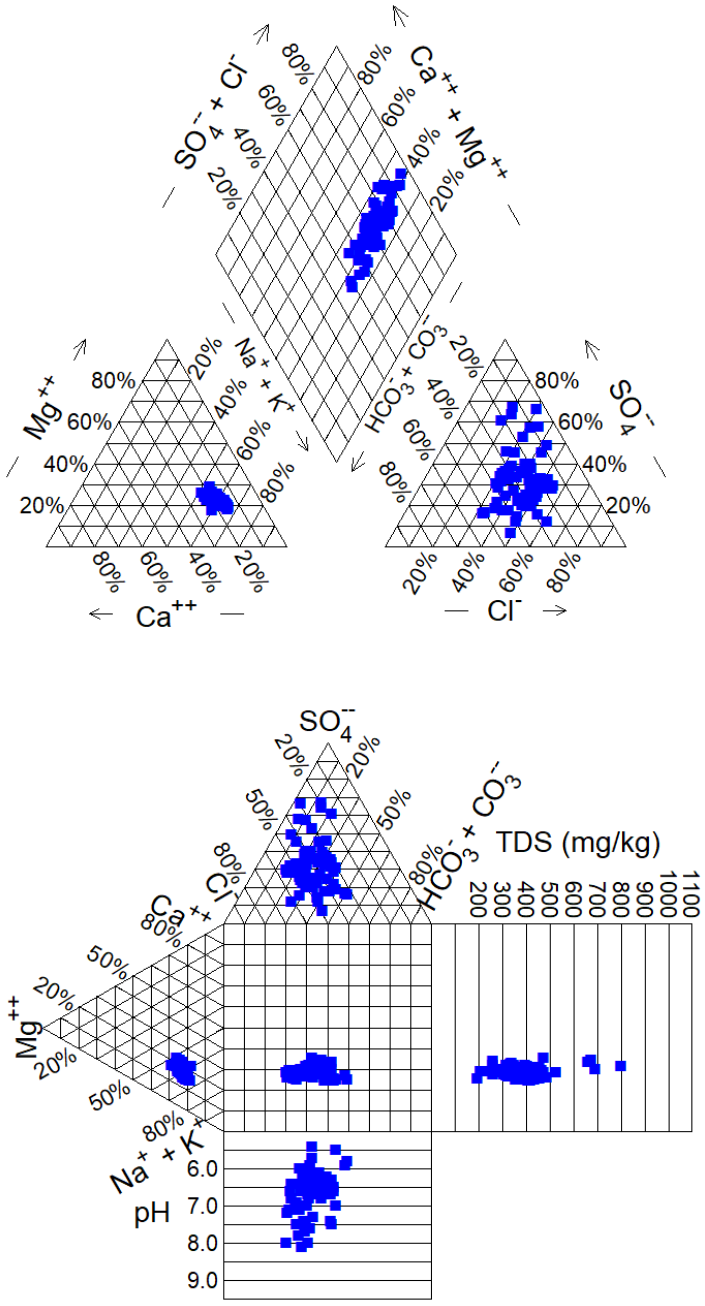


Figure B4: SW01

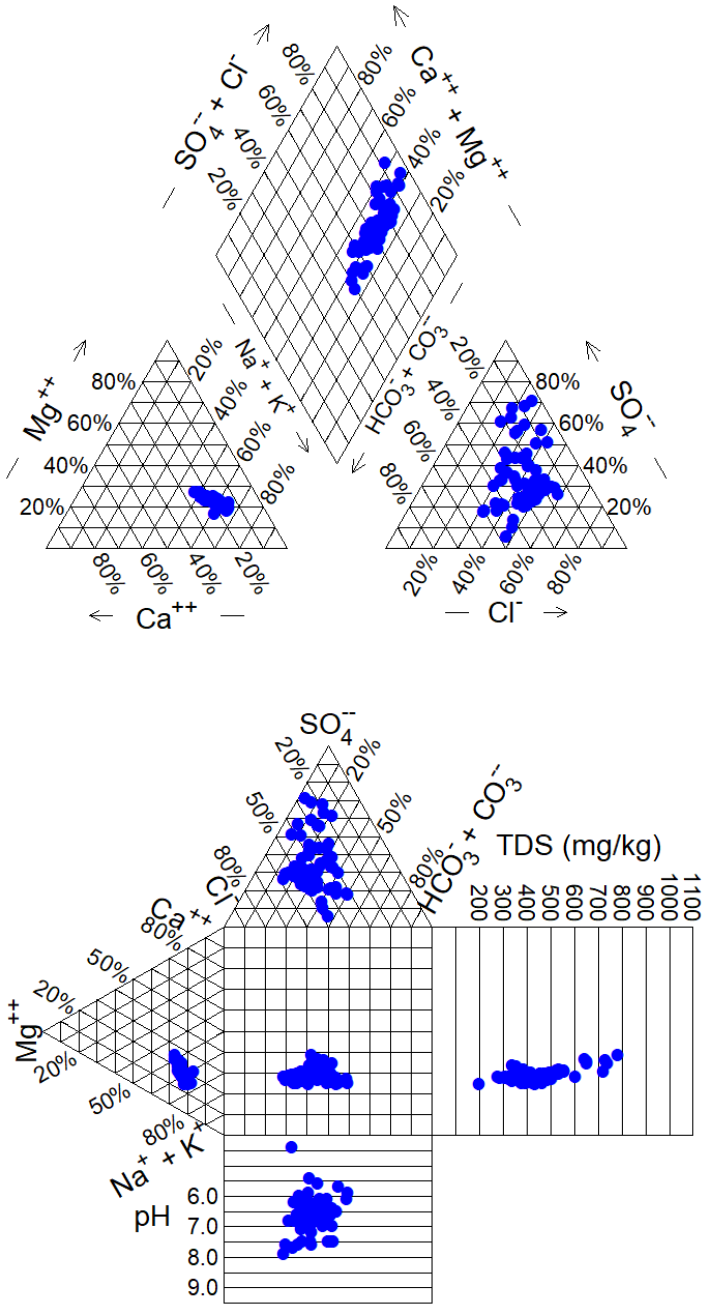


Figure B5: SW02

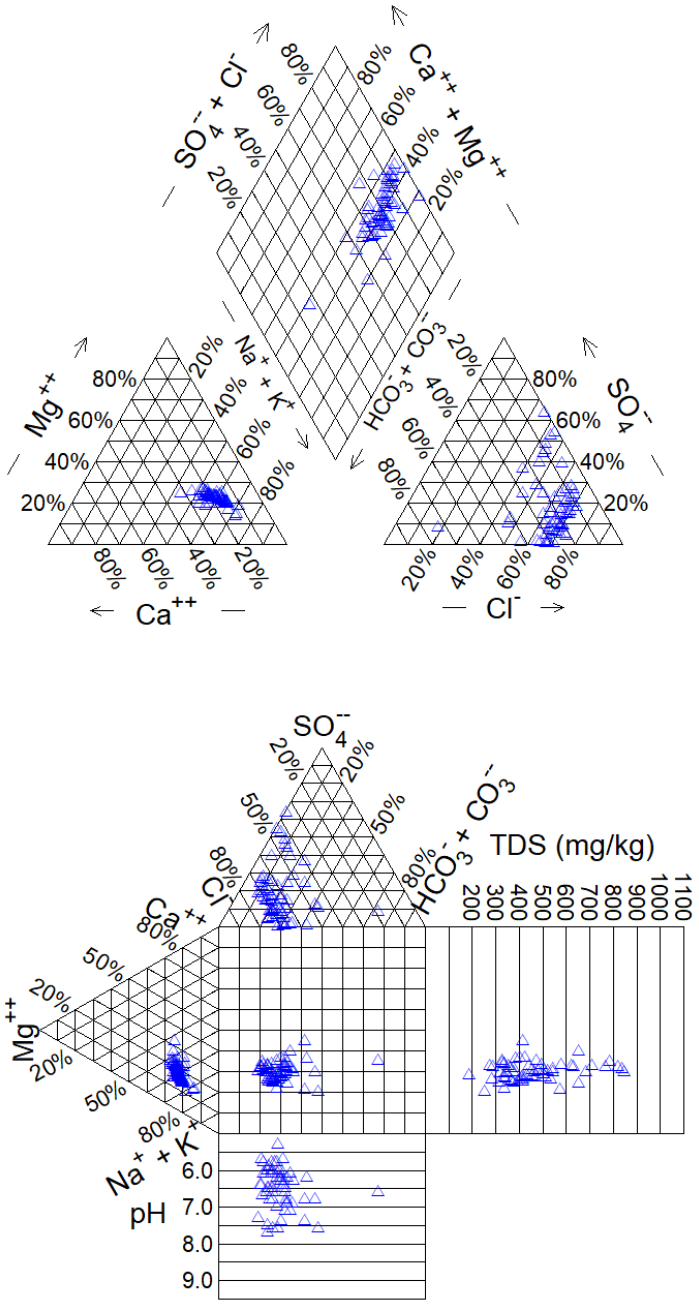


Figure B6: SW05

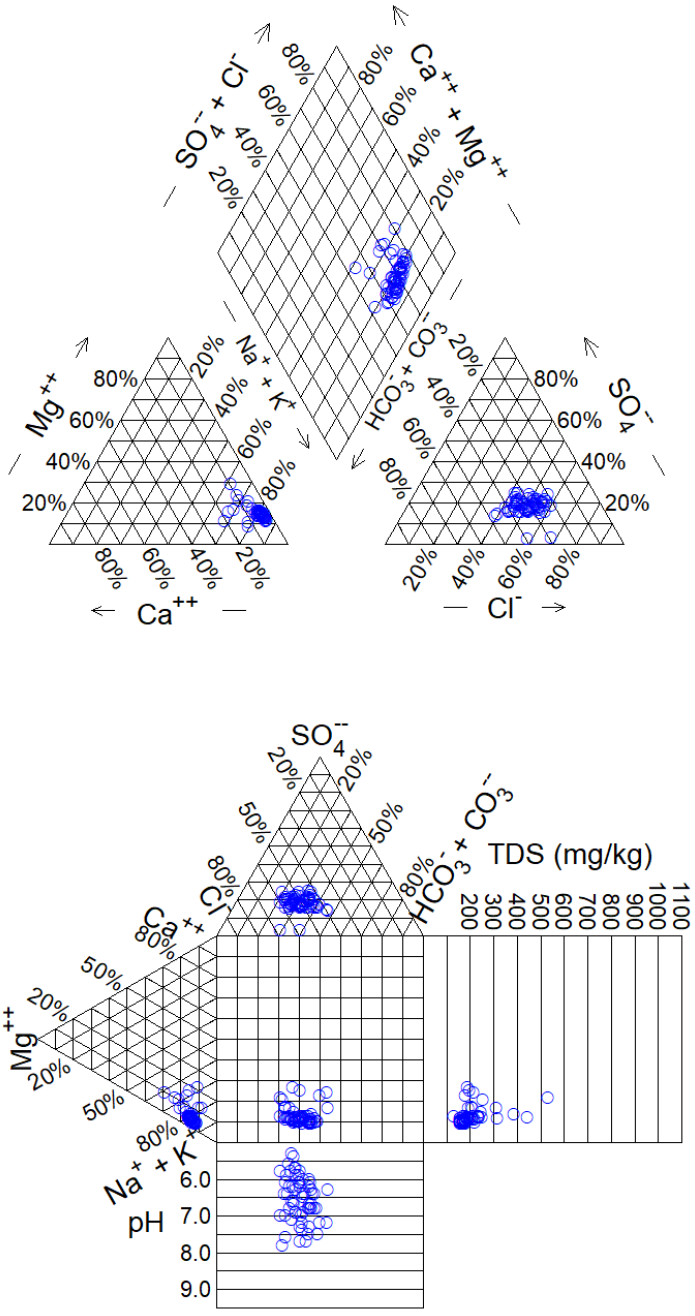


Figure B7: SW06

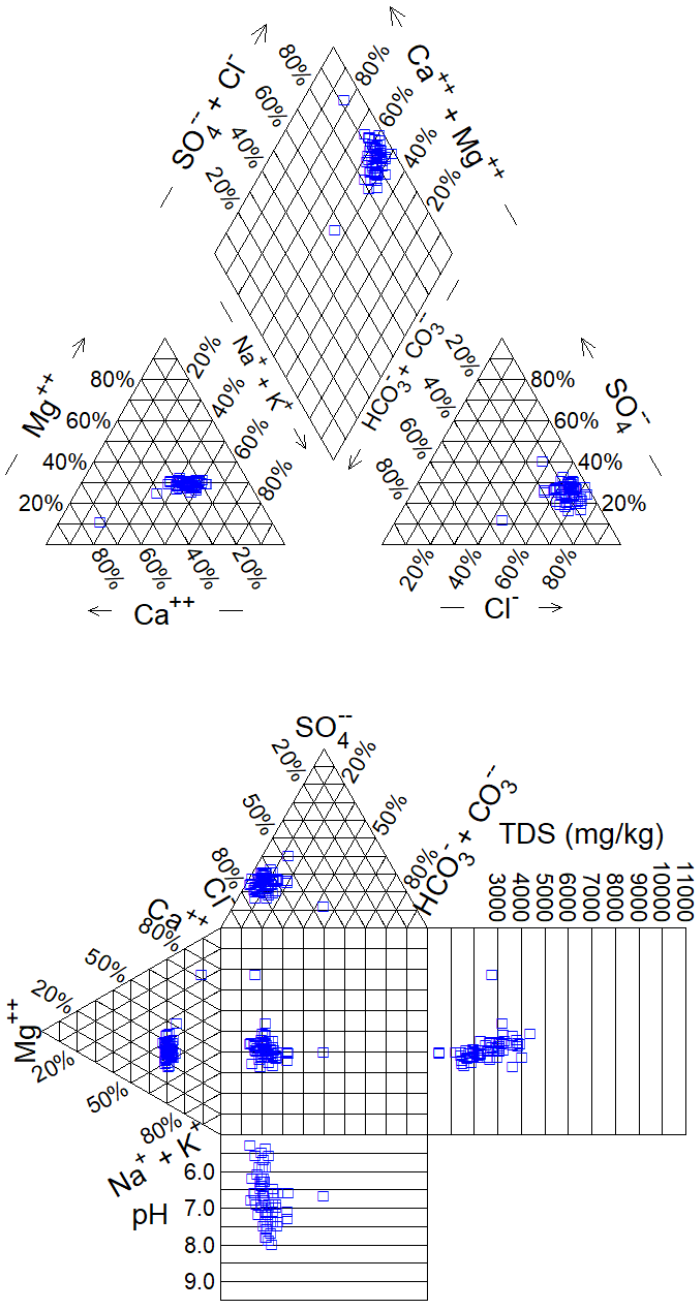


Figure B8: SW07

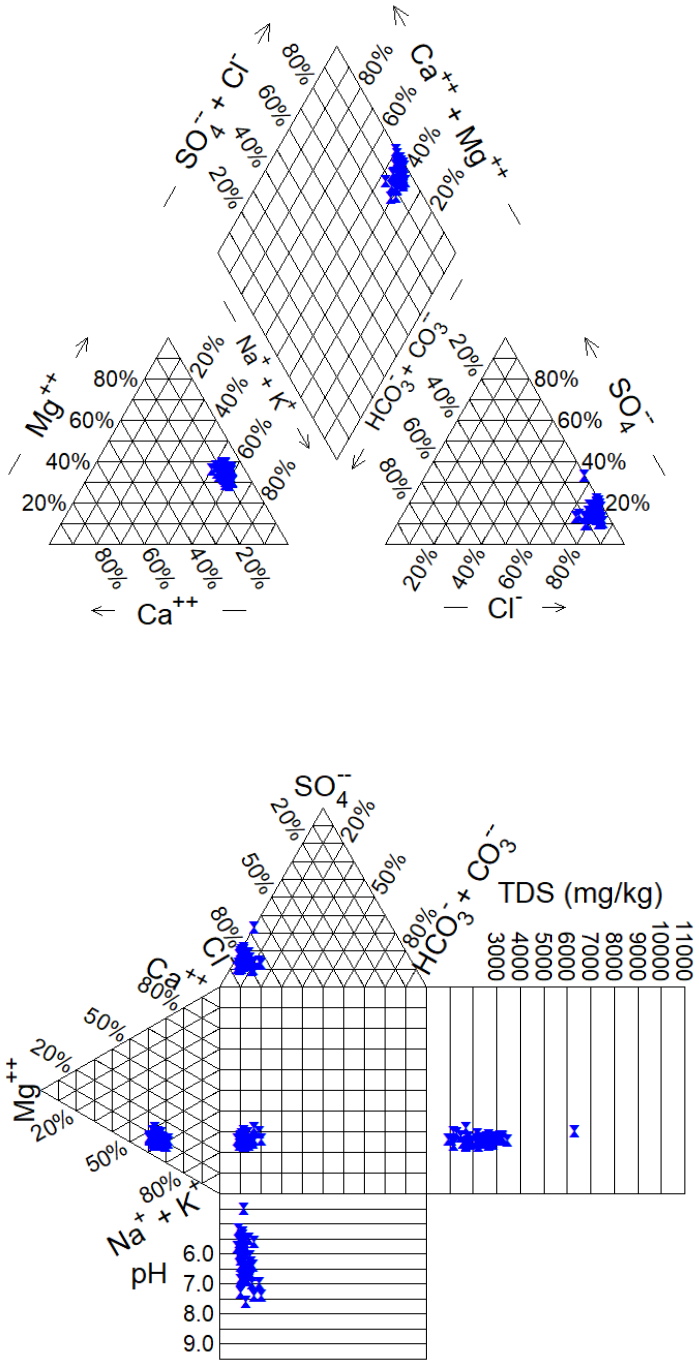


Figure B9: SW08

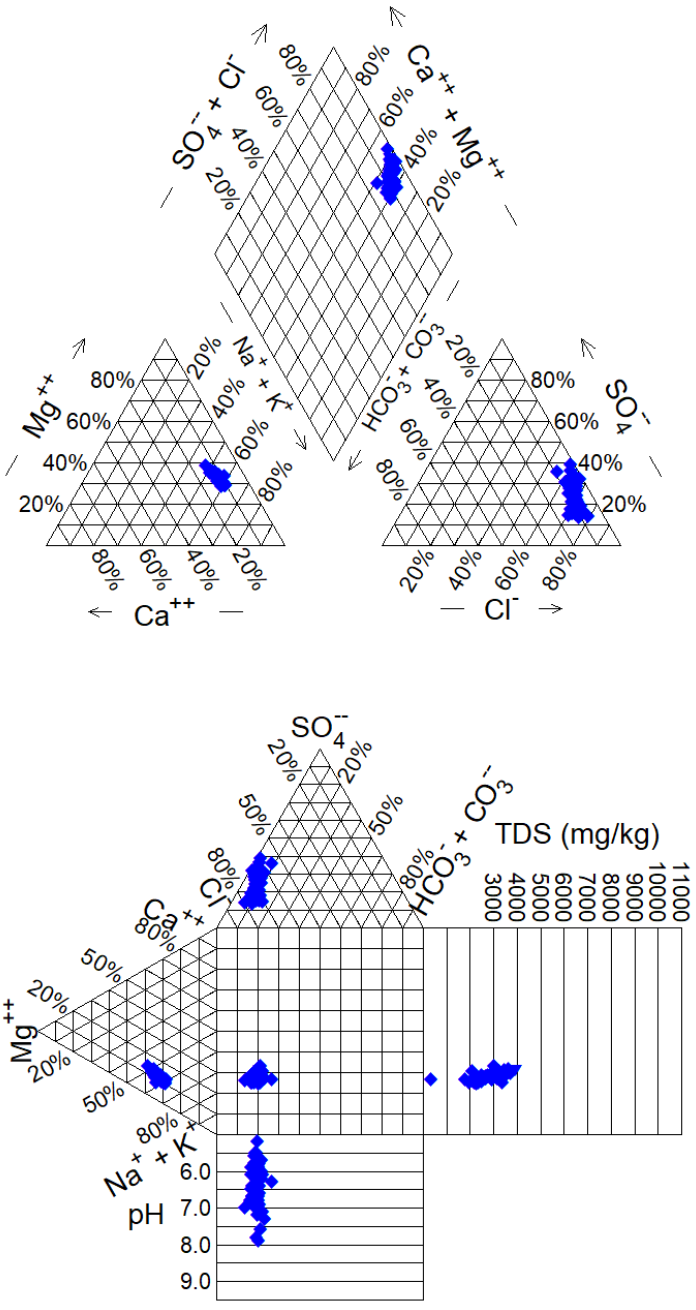


Figure B10: SW09

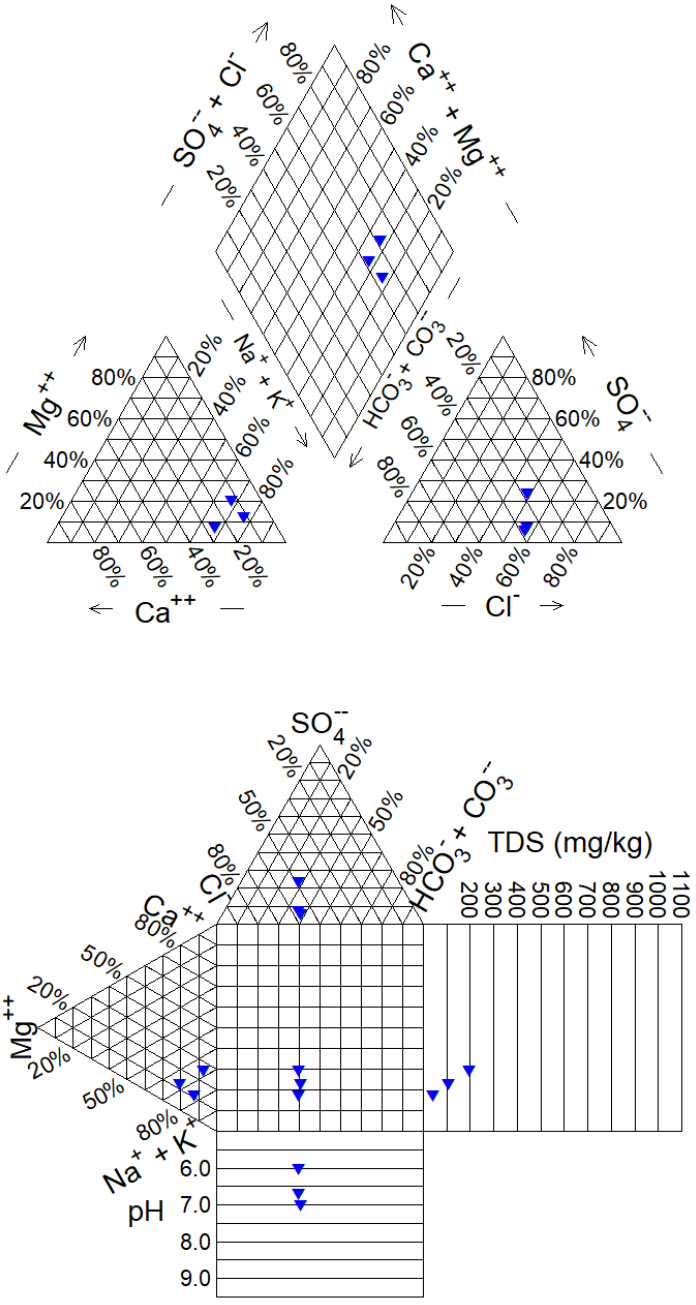


Figure B11: SW010

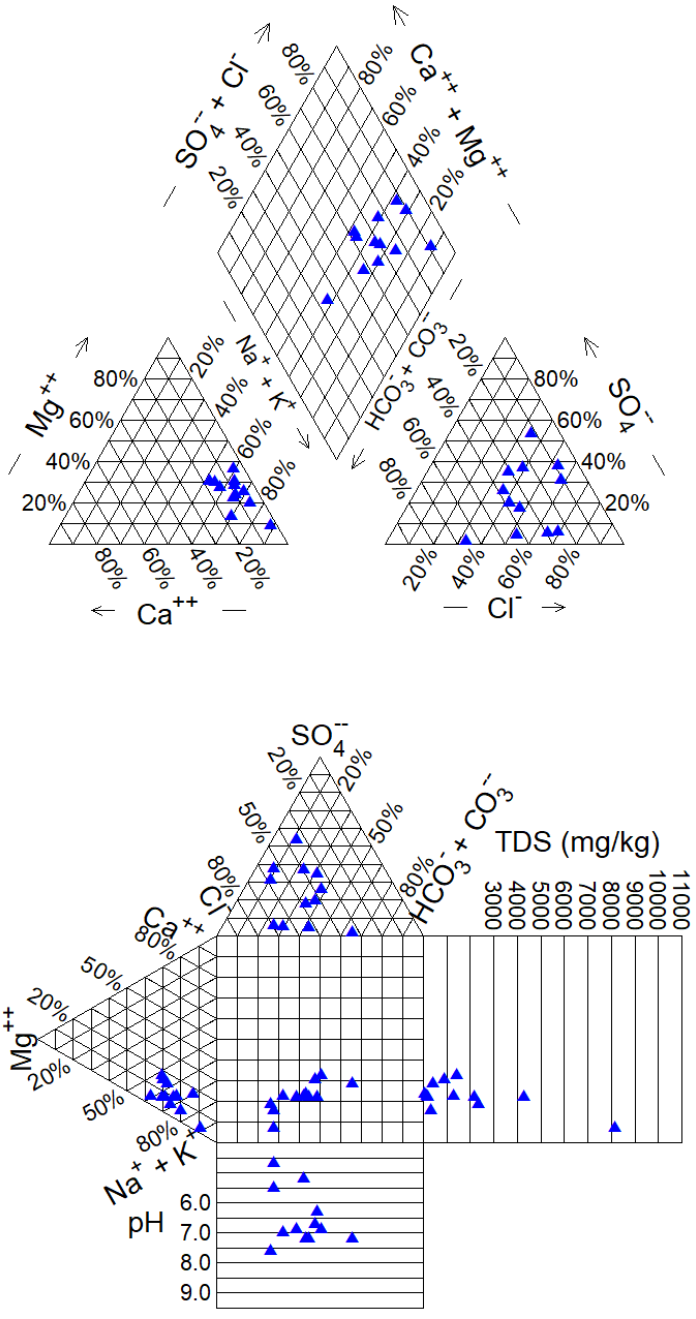


Figure B12: SW011

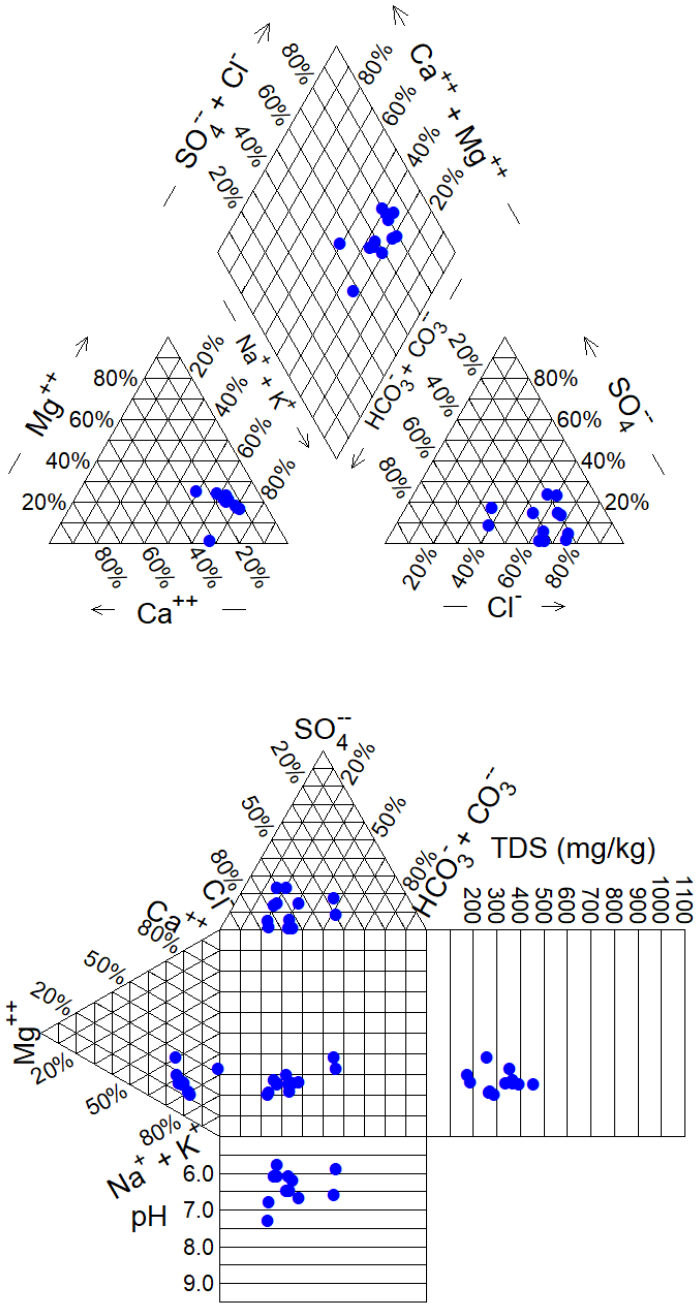


Figure B13: SW012


RGS
LEADERS IN MINING
GEOCHEMISTRY

ATTACHMENT 3

ADDITIONAL ANALYSIS BY MARINE POLLUTION RESEARCH (2018)

MARINE POLLUTION RESEARCH PTY LTD

Marine, Estuarine and Freshwater Ecology, Sediment and Water Quality Dynamics

A.B.N. 64 003 796 576

25 RICHARD ROAD SCOTLAND ISLAND NSW 2105

PO BOX 279 CHURCH POINT NSW 2105

TELEPHONE (02) 9997 6541 E-MAIL panink@iimetro.com.au

Mr Graham Chase
Environment and Community Manager
Moolarben Coal Operations

Moolarben Coal Complex Open Cut Optimisation Modification – Response to Questions regarding Potential Impacts to Aquatic Ecology from Ions

I write in relation to your request for comment on the additional query from the New South Wales Environment Protection Authority (EPA) regarding the potential for varying impacts on Goulburn River macro-invertebrates due to possible varying ionic composition of controlled releases to the river.

Background – Modification Environmental Assessment

Marine Pollution Research Pty Ltd (MPR) (2017) prepared an *Aquatic Ecology Assessment* for the Moolarben Coal Complex Open Cut Optimisation Modification Environmental Assessment (the Modification EA).

In summary the Aquatic Ecology Assessment considered:

(1) Aquatic ecology monitoring data collected at monitoring sites downstream of the proposed relocated Moolarben Coal Complex controlled release point (at the confluence of Bora Creek and the Goulburn River Diversion) and also downstream of the existing controlled releases from the Ulan Mine Complex. The review indicated that controlled release from the Ulan Mine Complex had resulted in no adverse impacts to aquatic ecology in the Goulburn River.

(2) The outcomes of the *Controlled Water Release Impact Assessment for the Goulburn River* prepared by Advisian (2017), which assessed the potential impacts of the proposed increase in controlled releases from the Moolarben Coal Complex and concluded there would be no significant impacts to downstream river height, flow velocity or water quality (particularly salinity, pH, turbidity and concentrations of dissolved metals).

Based on the review of existing Ulan Mine Complex controlled release effects and Advisian's (2017) findings, it was concluded the proposed controlled releases of 20 ML/day would have negligible impacts on the aquatic ecology of the Goulburn River.

EPA Submission to Modification EA

The EPA's submission on the Modification EA raised concern in regard to potential impacts to the Goulburn River of ions making up salinity in the proposed controlled release water.

As a result of this, RGS Environmental (2018) conducted additional analysis of the ionic make-up of mine affected water (i.e. water stored on-site at the Moolarben Coal Complex) and existing water in the Goulburn River, based on monitoring sites both upstream and downstream of the proposed controlled release point.

RGS Environmental (2018) concluded:

- Mine affected water has a similar ionic make-up to surface water in the Goulburn River.
- Mine water would be treated prior to controlled release into the Goulburn River Diversion. This would reduce salinity and the concentration of particular ions.
- The controlled release water would likely have similar ionic make-up to water currently in the Goulburn River.
- The risk of individual major ions having adverse impacts to aquatic ecology is low, which supports the findings of MPR (2017).

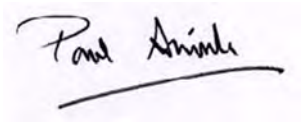
Conclusion

The analysis of ions by RGS Environmental and associated conclusions supports the findings of MPR (2017) that the proposed controlled releases at 20 ML/day would have negligible impacts on the existing aquatic ecology of the Goulburn River.

It is understood the EPA may reduce the salinity limit of the controlled release water below the currently authorised limit of 900 µS/cm (maximum). This would further reduce the risk of potential impacts to downstream aquatic ecology.

I trust that this is sufficient information for your needs at this time.

Yours Sincerely,



Paul Anink
Aquatic Ecologist
Marine Pollution Research Pty Ltd

References

Advisian (2017) *Controlled Water Release Impact Assessment for the Goulburn River*.

Marine Pollution Research Pty Ltd (2017) *Moolarben Coal Complex Open Cut Optimisation Modification Impact Assessment for Controlled Mine Water Release to the Goulburn River NSW: Aquatic Ecology Assessment.*

RGS Environmental (2018) *Moolarben Coal Water Review*. Letter dated 20 February 2018.

ATTACHMENT 4

ADDITIONAL ANALYSIS BY HYDROSIMULATIONS (2018)

NPM Technical Pty Ltd ●ABN 52 613 099 540 ●T/A HydroSimulations
PO Box 241, Gerringong NSW 2534. Phone: (+61 2) 4234 3802
noel.merrick@hydrosimulations.com

DATE: 4 May 2018

TO: Graham Chase
Environmental & Community Manager
Moolarben Coal Operations Pty Ltd

FROM: Dr Noel Merrick and Ms Becky Rollins

RE: Moolarben OC Modification - Brine Storage

OUR REF: HS2018/05c

Introduction

This memo responds to an email request of 25 January 2018 from Moolarben Coal Operations (MCO) for advice on a matter raised by the EPA in their assessment of the OC Modification.

The concern relates to storage of brine from the proposed water treatment facility in the underground UG4 void space (after the completion of mining). We understand that it is MCO's preference to store brine permanently underground rather than in surface storages, for the following reasons:

- *Suitable storage is available in underground void space to store all brine produced over the life of the Moolarben Coal Complex, removing any requirement for permanent surface storages.*
- *There are no known other users of groundwater in the Ulan Seam.*

Dilution

It is noted that the storage of salt by-product from the water treatment process underground would be returning these salts to the groundwater system from which they were extracted. That is, the proposed water treatment process is not creating new salt to be stored in the UG4 void.

During the recovery period, the UG4 void would be a groundwater sink for approximately 30-35 years after the completion of mining, preventing the migration of brine from the UG4 void. Should any salt migrate from the UG4 void after this time, it would not migrate at the concentration of brine. This is because the greater density of the brine in the UG4 void compared to the surrounding groundwater would restrict the migration of ions.

Only groundwater at significantly lower salinity than brine could migrate from the UG4 void. Any groundwater migrating from the UG4 void would be significantly diluted with groundwater from the surrounding and overlying strata.

Spatial Analysis

To assist in provision of an informed opinion, we have interrogated the groundwater model to give groundwater head patterns at the water table (**Figure 1**) and the Ulan Seam (Layer 9; **Figure 2**) at 100 years after completion of UG4 mining, and an approximate water table profile across UG4 from the Goulburn River Diversion at the Ulan Mining Complex East Pit to Saddlers Creek (**Figure 3**).

Figure 1 shows that long-term groundwater flow at the level of the water table would follow arcuate paths across the UG4 footprint towards the Goulburn River to the east, near site B. The approximate path lengths from key sites are:

- From site A: 0.7 km
- From site D: 1.1 km
- From site C: 3.3 km.

Shorter westerly paths are evident from the southern half of UG4 to the west, but the transect in **Figure 3** suggests that groundwater would remain beneath the bed of the Goulburn River Diversion.

Groundwater flow paths at the level of the Ulan Seam (**Figure 2**) would pass through the UG4 void in an easterly direction. In the southern third of the UG4 void, groundwater in the Ulan Seam would migrate to the west.

During mining, and for the period immediately following completion of mining to about 2059 (i.e. 30-35 years), the direction of groundwater flow will be into the UG4 void. This means that any brine deposited in the mine void (Layer 9) near site A cannot move out of this layer, other than down-dip to a greater depth. After 2059 the groundwater gradient would change as the mine void fills up, so that the groundwater level would increase and flow direction from the UG4 void could be upwards as well as outwards from that time (i.e. as the regional groundwater level recovers above the mined UG4 void).

To the north-east of the UG4 void, at site B, groundwater heads would remain depressurised for several decades post-mining. The head in the coal seam would exceed the water table elevation at about 2044, approximately 18 years after completion of mining. No upward migration would be possible prior to this time.

Temporal Analysis

Groundwater movement times are governed by groundwater velocities, which can be estimated from Darcy's Law on the assumption that the fluid is not dense. In reality, brine stored in the UG4 void would be denser than the surrounding groundwater and movement of the brine calculated from Darcy's Law would be overestimates and probably severe overestimates. This is particularly the case for vertical upwards migration due to the increase in salinity resulting in an increase in density.

The conservative lateral groundwater velocity is:

$$V_{LAT} = \frac{Kx}{n}\frac{dh}{dx}$$

where *Kx* is horizontal hydraulic conductivity; *n* is effective porosity; and *dh/dx* is the lateral hydraulic gradient.

The conservative vertical groundwater velocity is:

$$V_{VERT} = \frac{Kz}{n}\frac{dh}{dz}$$

where *Kz* is vertical hydraulic conductivity; *n* is effective porosity; and *dh/dz* is the vertical hydraulic gradient.

The fastest lateral velocities at the northern end of UG4 would occur at the level of the water table in weathered rock, for which relevant parameters (taken from the groundwater model) are: *Kx* ~ 0.02 m/day; *n* ~ 0.01; *dh/dx* ~ 0.016 [i.e. (393-382)m/700m at site A]. The lateral velocity estimate is 0.032 m/day (i.e. about 12 m/year).

Given significantly higher permeability in the coal seam, lateral groundwater flow through coal would occur at a higher velocity estimated at about 4 m/day (1.3 km/year).

The vertical velocity from the level of the coal seam to the level of the water table is controlled by the lowest vertical hydraulic conductivity in the stratigraphic section. For relevant parameters of *Kz* ~ 0.0002 m/day; *n* ~ 0.01; *dh/dx* ~ 0.1, the vertical velocity estimate is 0.002 m/day (i.e. about 70 cm/year).

Vertical travel time is:

$$t_{VERT} = \frac{Z}{V_{VERT}}$$

where *Z* is the distance of the coal seam to the water table at a point in the UG4 footprint.

For a height $Z \sim 100$ m, the vertical travel time would be 50,000 days (about 140 years).

The lateral and vertical mass fluxes can be calculated from the groundwater velocities and from the seam cross-sectional area (for lateral flow) and planar area (for vertical flow). The result is that approximately 80% of the volume of any salt mobilised from the brine stored underground would move laterally. However, it is expected that most of the brine, being dense, would not move away from its point of deposition.

Opinion

Based on the foregoing analysis, our findings are:

- Returning brine from the water treatment facilities would be returning these salts to the groundwater system from which they were extracted.
- As the Ulan Seam dips to the north-east, brine deposited in the UG4 void would tend to accumulate at the northern end of the UG4 void (near site A) and would back up from there towards sites D and C, depending on the volumes to be deposited.
- Due to the depressurisation of the coal seam and overlying formations during mining, the underground mining area would remain a groundwater sink during the recovery period for 30-35 years.
- The migration of groundwater from the UG4 void cannot occur for at least 30-35 years, and then (for vertical flow) at a rate governed by the lowest permeability in the stratigraphic section.
- Following recovery, it is expected that no significant change to salinity of the surrounding groundwater would occur given:
    - The density of brine would restrict the migration of highly saline groundwater, and as such, most of the brine would not move away from its point of deposition, and any brine that does migrate would have salinity significantly lower than brine.
    - Following recovery of groundwater levels, 80% of any groundwater in the UG4 void that migrates would move laterally and remain within the coal seam aquifer.
    - There would be significant dilution of any groundwater migrating from within the UG4 void by groundwater in the surrounding and overlying (>100m thickness) strata.

Yours sincerely

Dr Noel Merrick

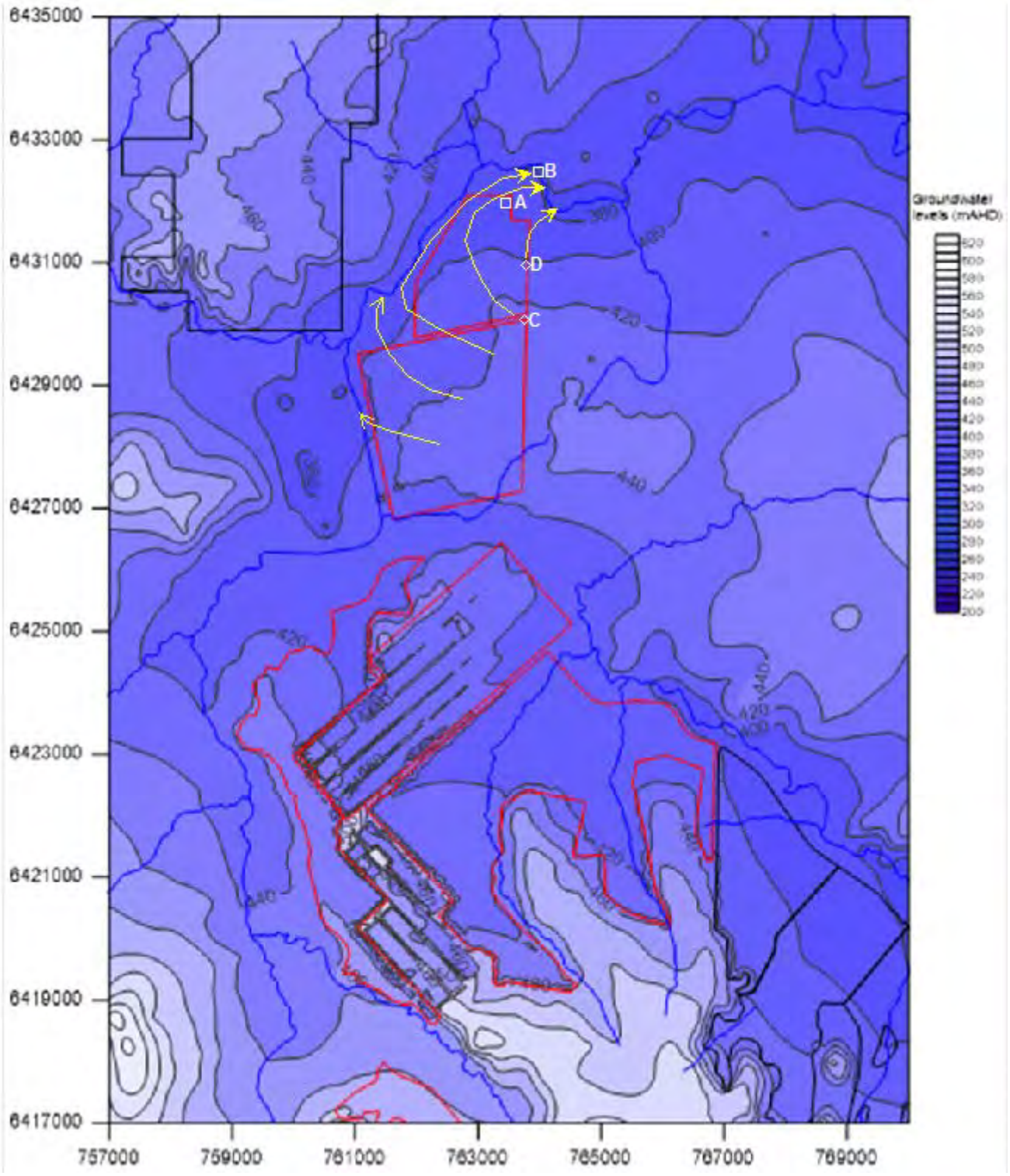


Figure 1. Predicted water table pattern and flow directions 100 years after completion of mining

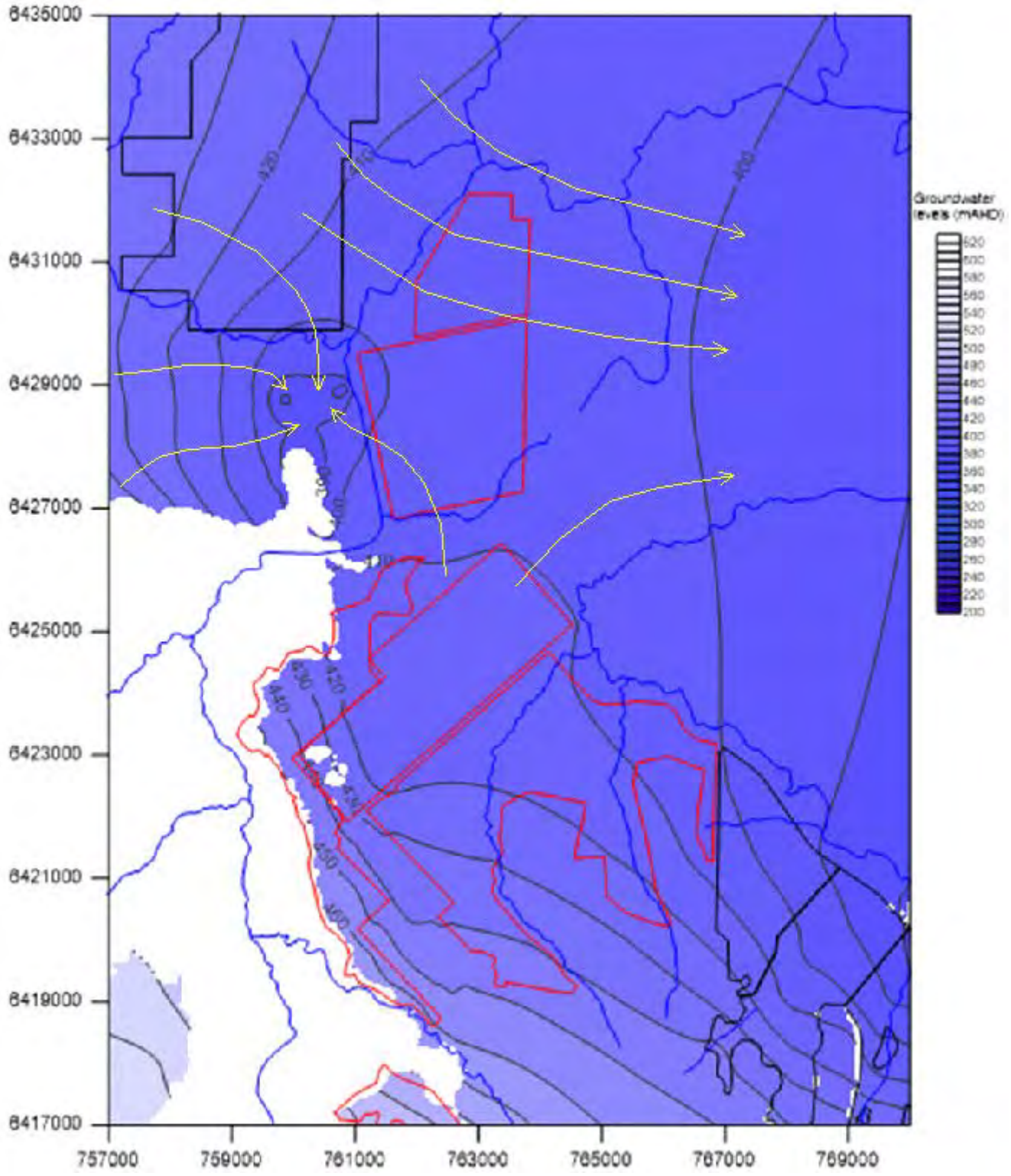


Figure 2. Predicted Ulan Seam groundwater head pattern and flow directions 100 years after completion of mining

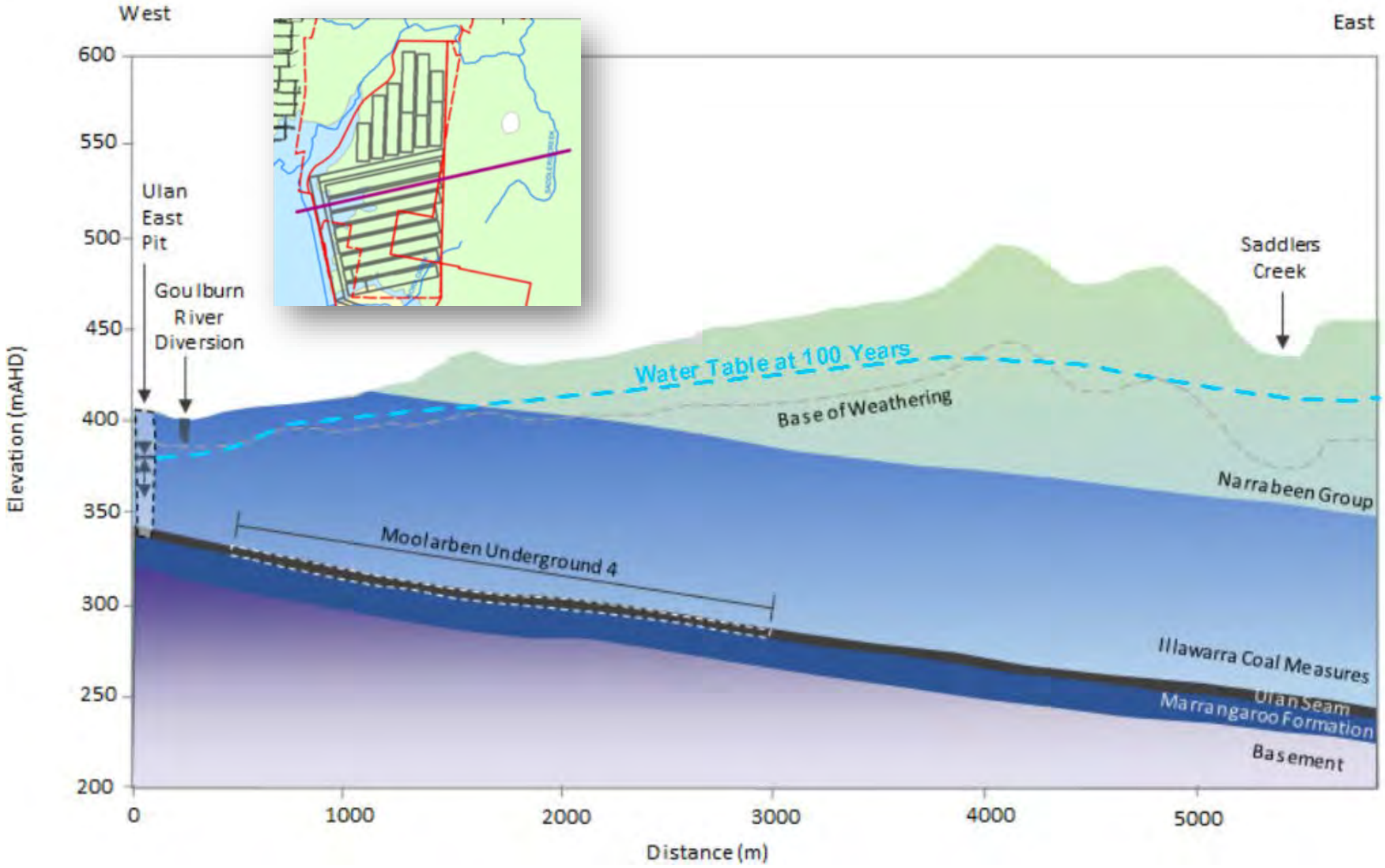


Figure 3. Predicted water table profile 100 years after completion of mining

ATTACHMENT 5

SALINITY LIMITS – SUPPORTING INFORMATION

Table A-1
Summary of Goulburn River 80th Percentile Salinity Data

Monitoring Station^	Location	Data Analysed	80th Percentile Salinity (µS/cm)
Upstream of Moolarben Dam			
SW08	Moolarben Creek	2005 – 2017 (field data)	4,856
		2005 – 2017 (laboratory analysis)	3,964
Upstream of Sportsmans Hollow/Goulburn River Confluence			
SW05	Moolarben Creek	2005 – 2017 (field data)	1,032
		2005 – 2017 (laboratory analysis)	913
Upstream of Bora Creek/Goulburn River Diversion Confluence (relocated EPL ID1) and UCML EPL ID3 and 19			
UCM SW01	Goulburn River	2007 – 2018 (continuous data daily averages)	687
		2007 – Sep 2017 (continuous data daily average)	714^^
GS 210046 (Ulan)	Goulburn River	1968 – 1988	580
SW12	Goulburn River	2005 – 2017 (field data)	657
		2005 – 2017 (laboratory analysis)	610
Downstream of Bora Creek Confluence (relocated EPL ID1) and UCML EPL ID3, 6 and 19			
UCM SW02	Goulburn River	2007 – 2018 (continuous data daily averages)	824
GS 210006 (Coggan)	Goulburn River	2012 – 2018 (continuous data daily averages)	1,247

^ Refer to Figures A-1 and A-2 for locations

^^ Data available at the time of analysis by Advisian (2017) for inclusion in the Environmental Assessment

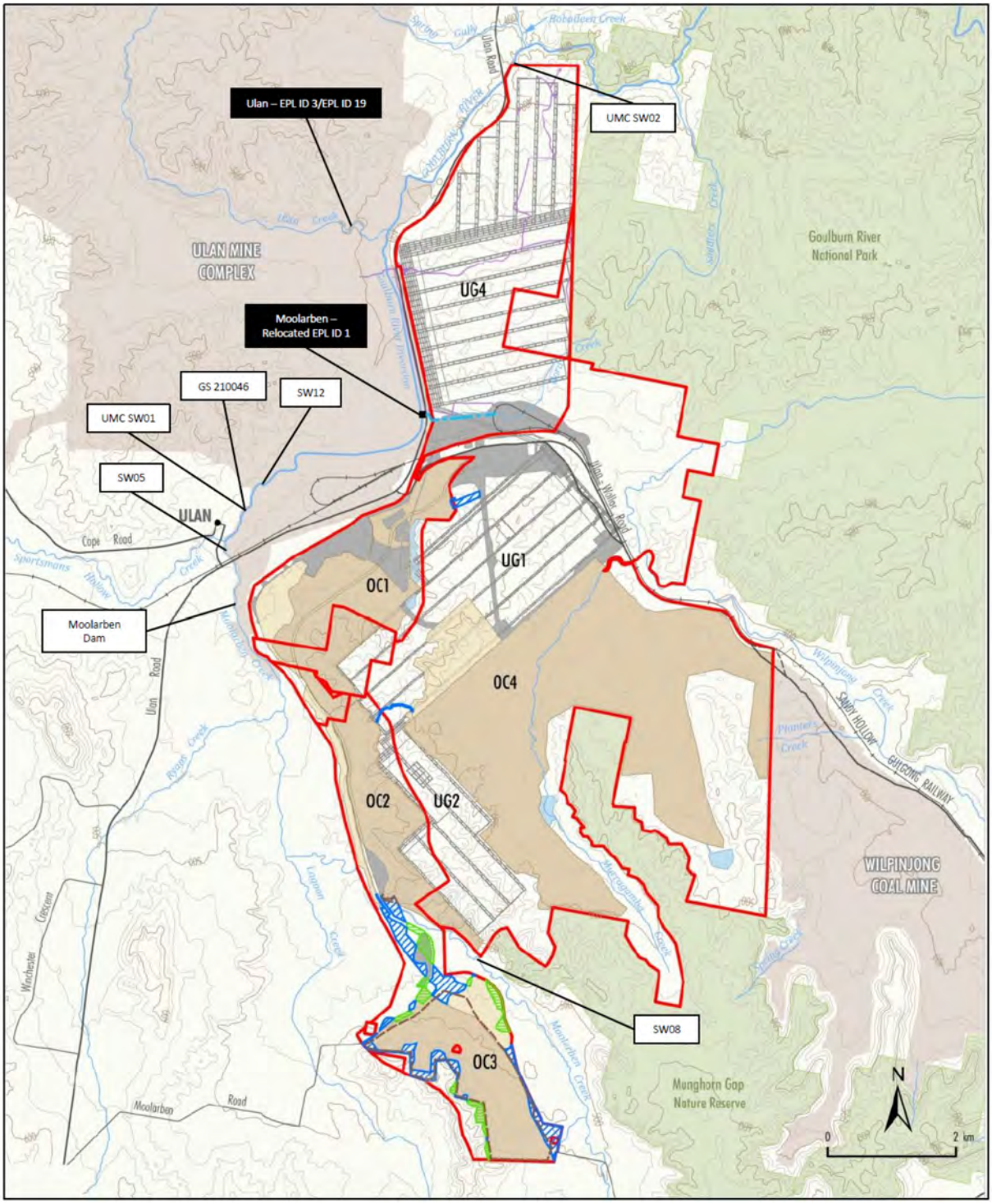


Figure A-1: Surface Water Monitoring Locations and Licenced Discharge Points

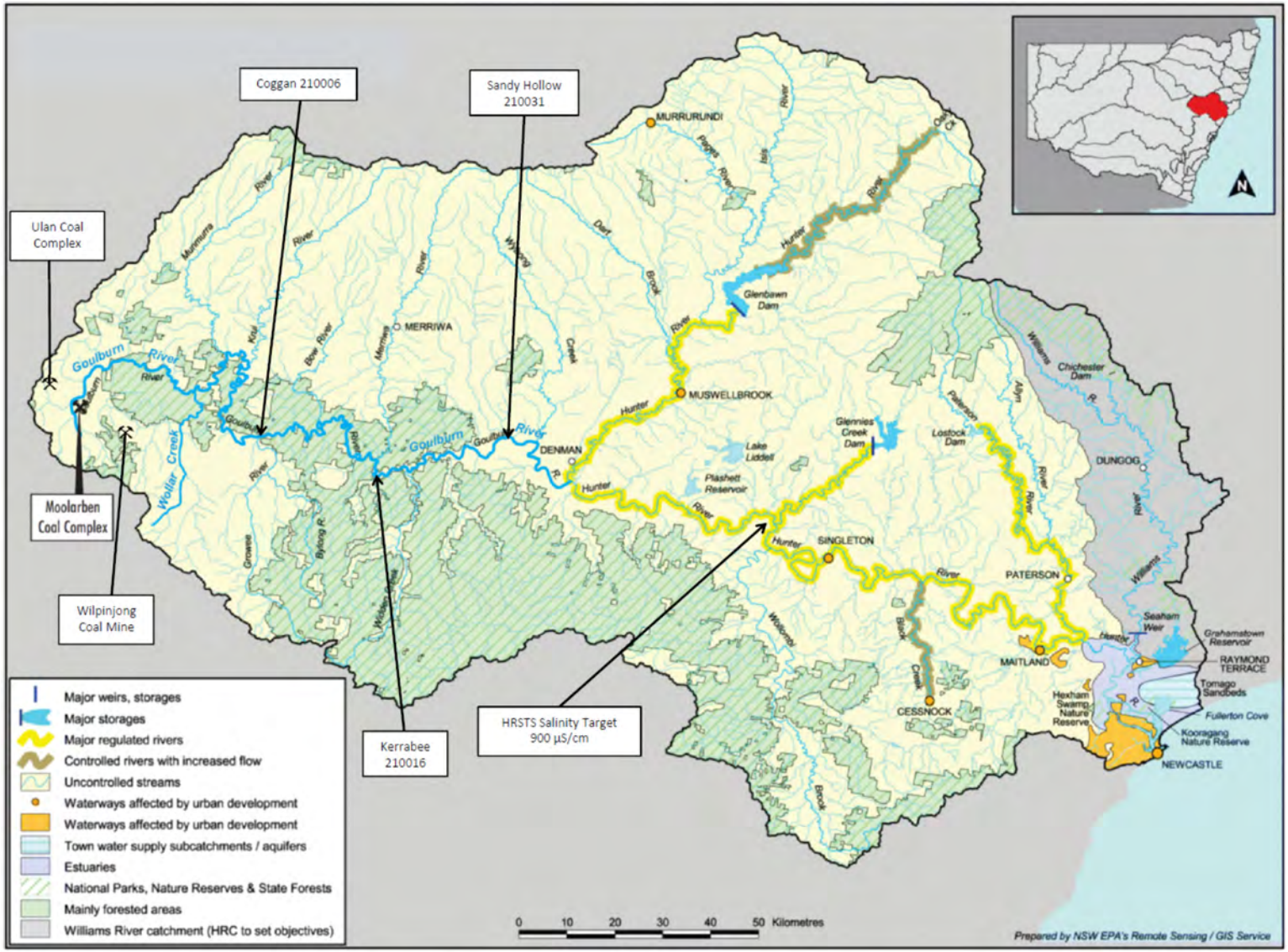


Figure A-2: Hunter River Catchment

Table A-2
Water Quality Objectives for Uncontrolled Streams (e.g. Goulburn River) in the Hunter River Catchment

Item	Salinity / Total Dissolved Solids – Default Triggers	Do Existing EPL Salinity Limits comply?
Aquatic ecosystems	30–350 µS/cm (upland rivers) It is noted existing and historic salinity in the Goulburn River does not comply with these default triggers. WQO Supporting Information^ states that where default triggers are exceeded, site specific investigation as per ANZECC Guideline is required.	x (further site specific investigation as per ANZECC Guideline)
Visual amenity	N/A (no salinity trigger)	
Primary and secondary contact recreation	N/A (no salinity trigger)	
Livestock water supply	0-2,000 mg/L (0-2,985 µS/cm) (No adverse effects expected – minimum for all livestock [Table 4.3.1 of ANZECC Guideline])	✓
Irrigation water supply	<950 µS/cm (Minimum for soil and water salinity criteria based on plant salt tolerance groups – sensitive crops [Table 4.2.4 of ANZECC Guideline])	✓
Homestead water supply	< 500 mg/L (746 µS/cm) good quality based on taste 500-1000 mg/L (746-1,496 µS/cm) - acceptable based on taste. It is noted that other key triggers are based on human health parameters (e.g. faecal coliforms)	✓ (acceptable based on taste)
Drinking water^^	< 1500 µS/cm > 800 µS/cm causes a deterioration in taste It is noted that other key triggers are based on human health parameters (e.g. faecal coliforms)	✓ (100th %-ile limit <1,500 µS/cm; 50th percentile limit = 800 µS/cm
Aquatic foods (cooked)	N/A (no salinity trigger)	

^ http://www.environment.nsw.gov.au/ieo/Hunter/maptext-03.htm#support1

^^ Disinfection only, clarification and disinfection and groundwater

Table A-3
River Flow Objectives for Uncontrolled Streams (e.g. Goulburn River) in the Hunter River Catchment

Item	Rationale^	Comment
Protect pools in dry times	*During dry times, some streams stop flowing and form pools. Pools and wetlands are refuges for aquatic plants and animals. Pumping water from these areas can make it more difficult for many species to recover after a drought.*	• Controlled releases would reduce the frequency of periods of low flow and no flow. • This may be beneficial for both the environment and downstream licensed users (refer Section 5) as controlled releases may: - Reduce the frequency when downstream licensed extraction is restricted due to low flow conditions. - Offset 'artificial drought' conditions that may result from licensed extraction and storage and provide additional water for environmental uses.
Protect natural low flows	*Water extraction and storage are high in dry times and impose long artificial droughts that increase the stress on aquatic plants and animals.*	
Protect important rises in water levels	*Rain causes peaks in river flows.* *This 'pulsing' of flows may trigger migration of animals and reproduction of plants and animals; provide over-bank flows to wetlands and floodplains; shape the river channel; control water quality and nutrients; and provide necessary freshwater inputs to estuaries.* *Water storage and extraction can alter or remove freshes, inhibiting these vital processes. The height, duration, season and frequency of higher flows are all important.*	• Controlled release volumes were modelled by Advisian (2017) to be well within the carrying capacity of the Goulburn River. • It is expected peaks in river flows would not be significantly impacted by the proposed controlled release volume (i.e. 20 ML/day is significantly lower than peak flows resulting in overbank flows). • Controlled release may offset potential impacts to river flows associated with licensed extraction.
Maintain wetland and floodplain inundation	*Floodplain and wetland ecosystems develop in response to flow patterns and the nature of the landscape between the river and wetlands or floodplains.* *Floodplain works can change the flooding patterns, which will lead to changes in habitat and vegetation. These changes can be expected to reduce or change the diversity and abundance (or both) of species in the ecosystem. In particular, they can lead to reduced numbers of native fish and to water quality problems.*	• Not applicable – the Modification does not involve floodplain works and no change to flood conditions is predicted.

Item	Rationale^	Comment
Maintain natural flow variability	*Australia's rainfall and river flows are naturally variable. The way we currently store and divert river water can reduce natural pulsing of water down rivers and maintain artificially high or stable river heights.* *Hydro-electric releases can vary unnaturally between day and night.* *In urban areas and other places where the ability of the land to absorb or detain rainfall is reduced, more water runs off rapidly, so water levels will rise higher.* *These changes often create problems with streambank stability, biodiversity and signals for breeding and migration.*	• Supporting information for this item states^: *This objective applies mainly to controlled rivers but may apply in some locations or situations in uncontrolled streams, such as in urban streams. In these areas, the objective should be addressed through stormwater management plans.* • Accordingly, this RFO is not specifically relevant to the Goulburn River (which is not considered to be either a controlled river or urban stream). • Notwithstanding, controlled releases would in practice be variable, ranging from 0 to 20 ML/day, as water stored on-site would only be released when it is surplus to meeting on-site demands (e.g. dust suppression and CHPP). • Controlled release variability would be lowest during wet periods (coincident with higher groundwater inflows, higher mine catchment surface water containment and less demand for dust suppression), however, during these periods natural river variability would also reduce, minimising the potential impact of controlled release to downstream flow variability.
Manage groundwater for ecosystems	*Some shallow groundwaters are directly linked to flows in streams and wetlands. They may provide base flows in rivers during dry periods and may be primary sources of water for wetland, floodplain and riparian vegetation. Seriously depleting groundwater in dry times may lead to unnatural recharge of groundwater from surface waters during the next flow.*	• Controlled releases would offset licensed groundwater extraction (from mining operations and other users).
Minimise effects of weirs and other structures	*Most instream structures (e.g. weirs) convert flowing water to still water, thus altering habitat and increasing the risk of algal blooms or other water quality problems. Barriers restrict the passage of plant propagules (e.g. seeds) and animals.*	• Not applicable – the Modification does not involve weirs or other instream structures.

^ http://www.environment.nsw.gov.au/ieo/Hunter/maptext-04.htm#rf01