INDEPENDENT EXPERT ADVISORY PANEL FOR MINING

ADVICE RE:

ULAN COAL EXPANSION PROJECT (08_0184)

Modification 6

29 October 2024

IEAPM Report No. 202410-1

EXECUTIVE SUMMARY

On 4 October 2023, the NSW Department of Planning, Housing and Infrastructure (DPHI) requested advice from the Independent Expert Advisory Panel for Mining (IEAPM – the Panel) in relation to the Ulan Coal Mine (MP08_0184-Mod 6). The Modification Application is seeking to extend and widen the longwall panels and for minor changes to surface infrastructure.

The Scope of Advice stated that

…the Department requests targeted advice from the Panel in relation to groundwater impacts and modelling, specifically the scale and likelihood of potential subsidence, water-related impacts and environmental consequences on the Colluvial, Alluvial and Jurassic water sources.

The Panel should also feel free to provide any other advice it considers would assist the Department in reviewing the modification application.

Based on the material presented to the Panel and the supplementary information supplied by Ulan Coal Mines Pty Limited, the Panel has made the following conclusions and recommendations:

SUMMARY CONCLUSIONS

The Panel is satisfied that the proposed mine plan for the Ulan Mod. 6 Amendment will result in subsidence effects and impacts within the range of predictions within the Modification Application and that these will generally fall within the level of impacts already experienced above previous longwall panels at Ulan.

With respect to groundwater monitoring, the Panel concludes that:

- The North Monitoring Network provides reasonable spatial coverage but additional shallow (alluvial) and deeper (Triassic and Permian) piezometers are required in the Mona Creek catchment closer to the Talbragar River and additional piezometers are required in the Jurassic Pilliga Sandstone north of the amended project area.
- The current groundwater level trigger locations included in the TARPs in the WMP are inadequate to effectively monitor spatial impacts to the important alluvial and regional (Triassic and Jurassic) sandstone groundwater systems and to action responses.
- The annual voluntary monitoring of groundwater levels for privately owned bores is inadequate to identify or confirm mining-induced impacts.

With respect to groundwater modelling, the Panel concludes that:

- The current groundwater model appears to be fit for purpose for the amended mine plan and the updated rehabilitation plan for the open cuts.
- The model results appear to be sensible for mine inflows and regional drawdowns in the Triassic formations and the alluvial deposits overlying the Triassic.
- The model lacks resolution of possible long-term impacts on the Jurassic groundwater and therefore, groundwater monitoring is required for the long-term to assess the validity of the model predictions for the Jurassic formations.
- While the impacts on Mona Creek are predicted to be less than the original modification of the mine plan, there is still a risk of significant drawdown beneath the creek in all underlying groundwater systems. There is therefore a need for ongoing monitoring of the groundwater conditions in all groundwater systems in this locality and the performance of the pools in the stream.
- A formal peer review report should be provided that provides an assessment of the groundwater model against the available guidelines.

SUMMARY RECOMMENDATIONS

The Panel makes the following recommendations to the Department for consideration of determining Ulan Modification 6.

Subsidence Prediction and Monitoring

1. It is recommended that the subsidence predictions should be reviewed on a panel-by-panel basis, and recalibrated as required, as subsidence monitoring data is collected and analysed.
2. The subsidence monitoring program should extend well beyond the expected angle of draw to capture potential effects and impacts out to at least a 45^0 angle of draw or greater, as required.
3. The monitoring program should be designed to incorporate special attention to the Mona Creek rock shelters during the mining of panels LW W9 and LW W10.

Groundwater Monitoring and Modelling

4. The north monitoring network be expanded by adding deeper nested piezometers next to MCMB04, and constructing new nested piezometers or a VWP monitoring bore close to the confluence of Mona Creek with the Talbragar River
5. The WMP and the SWGWMP should be updated within 6 months of the approval to:
   - ensure there are no inconsistencies between the latest modelling predictions and monitoring commitments,
   - reflect the current and expanded groundwater monitoring network,
   - increase the frequency of monitoring water levels in private water bores to minimum 6-monthly and preferable quarterly,
   - align the triggers and TARPs with the latest modelling drawdown predictions in private water bores,
   - increase the number of groundwater level trigger sites to include more alluvial, Triassic Wollar Sandstone and Jurassic Pilliga Sandstone sites north of the amended project area,
   - revise or develop appropriate response actions with appropriate timeframes.
6. The updated WMP should be the primary groundwater management plan and require DPHI approval
7. A formal groundwater model peer review report should be provided that provides an assessment of the updated groundwater model against the available guidelines
8. As new monitoring data are collected detailed reviews every three years of the adequacy of the groundwater conceptual model should be undertaken. Where deviations from expected behaviour for the Jurassic Pilliga Sandstone, the Triassic Wollar Sandstone and the Talbragar/Mona Creek alluvium and stream channel are observed, appropriate updates to the conceptual and numerical model should be undertaken to assist the interpretation of the new information.

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1.0 SCOPE OF WORKS

1.1. DEPARTMENT REQUEST FOR ADVICE

The NSW Department of Planning, Housing and Infrastructure (DPHI – the Department) has established the Independent Expert Advisory Panel for Mining (IEAPM - the Panel). The Panel's purpose is to give DPHI and the Independent Planning Commission access to specialist knowledge and expert advice when assessing mining proposals under the *Environmental Planning and Assessment Act 1979*.

On 4 October 2023 DPHI (formerly Department of Planning and Environment) requested advice from the Panel in relation to a modification application for Ulan Coal Expansion Project – Modification 6, (refer to Appendix A).

The required Scope of Advice stated that:

> *To assist it in assessing the modification application, the Department requests targeted advice from the Panel in relation to groundwater impacts and modelling, specifically the scale and likelihood of potential subsidence, water-related impacts and environmental consequences on the Colluvial, Alluvial and Jurassic water sources.*

The catalyst for requesting the Panel's advice is concerns raised by the Department's Water Group (now Department of Climate Change, Energy, the Environment and Water (DCCEEW)) regarding the conceptualisation of the groundwater model and the input data used for calibration. There is uncertainty surrounding the connectivity of water sources where the extended longwall panels are proposed, specifically where water take from Mona Creek and the associated colluvial/alluvial water sources would exceed modelled predictions. The Independent Expert Scientific Committee on Unconventional Gas Development and Large Coal Mining Development (IESC) raised similar concerns.

The Chair of IEAPM (Em. Professor Jim Galvin) convened the following Panel for this purpose:

- Em. Professor Bruce Hebblewhite - Subsidence and Mining (and Ulan Panel Chair)
- Mr John Ross – Groundwater
- Professor Rae Mackay – Groundwater

More background on Panel members is provided in Appendix B.

1.2. PROJECT BACKGROUND

Ulan Coal Complex (UCC) is an established mine 38km north-east of Mudgee and 19km north-east of Gulgong. The UCC is owned by Glencore Coal Pty Limited and operated by Ulan Coal Mines Pty Limited, a subsidiary of Glencore. The UCC currently operates under 08_0184 since 2010. The Approved mining operations within the UCC consist of underground mining in the Ulan Underground and Ulan West Underground and associated coal handling, processing and transport through to 30 August 2033. The open cut operations of UCC are currently in care and maintenance.

The proposed modification seeks:

- extension of Ulan Underground longwall (LW) panels LWW9 to LWW11 to the west
- widening of Ulan Underground LWW11 by approximately 30 metres
- extension of Ulan West LW9 to LW12 to the north • the continuation of mining at the UCC for an additional 2 years.

The modification application is also proposing some minor changes to surface infrastructure to support underground mining activities including provision of:

- three additional ventilation shafts and associated infrastructure corridors
- five additional dewatering bores and associated infrastructure corridors
- an alternate access track

- an infrastructure corridor and service borehole (to deliver gravel and other construction materials and to provide access and power to the underground mine) to the south-west of Ulan West
- other associated infrastructure required to service the approved and proposed underground mining operations

The location of the mining complex and proposed extension area is detailed in Figure 1 below.

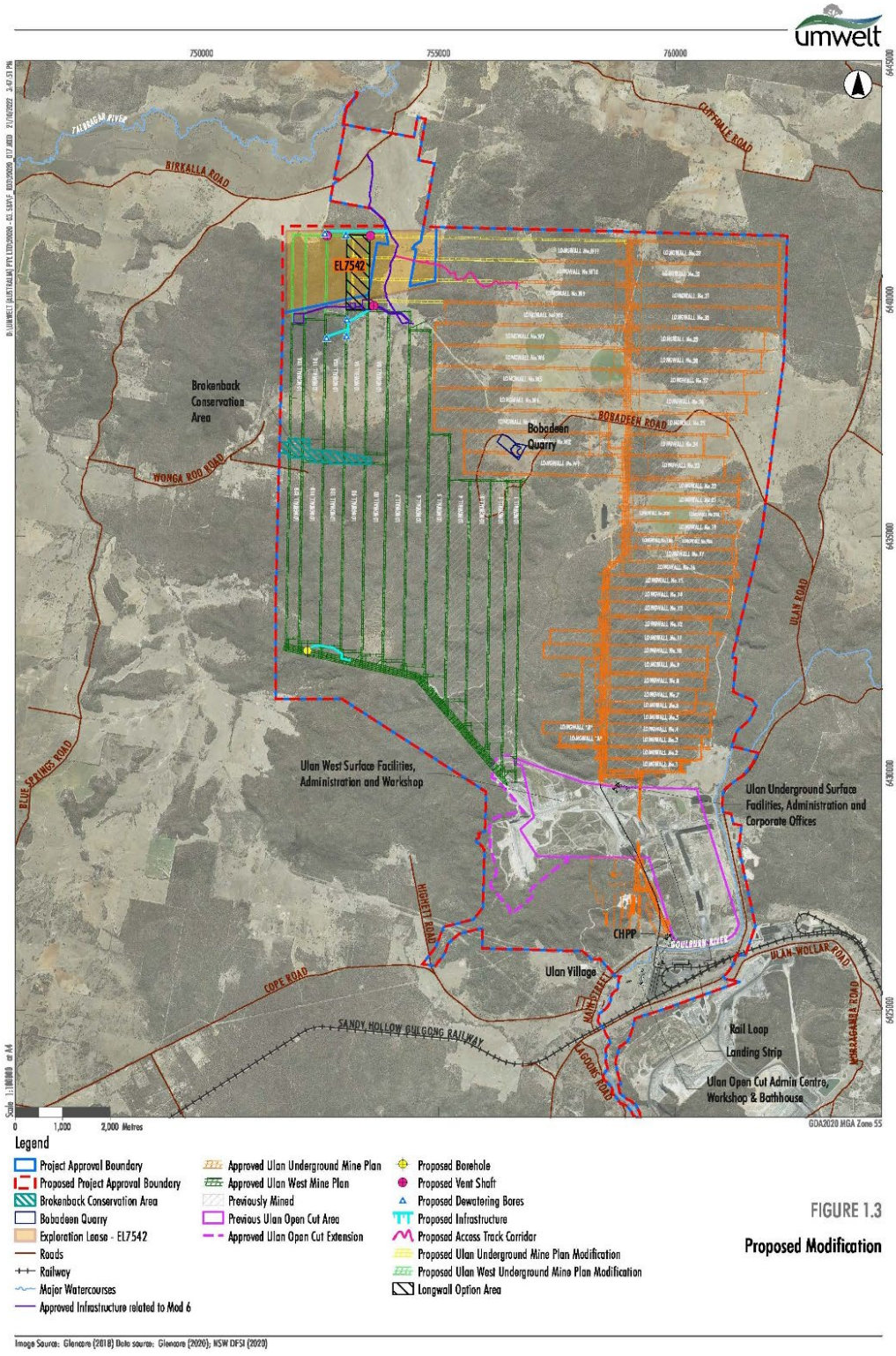

Figure 1: Proposed Modification

2.0 METHOD OF OPERATION

The Panel convened by videoconference during the preparation of its advice and was administratively supported by Secretariat staff provided by DPHI - Major Projects Advisory.

The Panel convened on 16 October 2023 and received the supply of initial documentation. A virtual briefing by the Department was held on 6 November 2023 and additional information was supplied to the Panel shortly after this. A site visit was conducted on 5 December 2023, which generated some follow up questions with information supplied to the Panel on 18 December 2023.

The amended assessment documents were received on 16 May 2024.

Further advice was received from Ulan on 20 September 2024 in response to questions raised by various government agencies.

A wide range of documents was provided for review by the Panel in preparing this advice, with the principal documents listed in Table 1.

Table 1: Key documents reviewed by the Panel

Stage	Document Reference	Document Name
Initial Documentation	Assessment documents from Ulan Coal Mines Pty Ltd – October 2024	**Modification Report** 1. Ulan Coal Expansion Modification 6 – Modification Report 2. Ulan Coal Expansion Modification 6 – Modification Report – Appendix 7 Subsidence Assessment 3. Ulan Coal Expansion Modification 6 – Modification Report – Appendix 8 Groundwater Assessment 4. Ulan Coal Expansion Modification 6 – Modification Report – Appendix 9 Surface Water Assessment **Submissions Report** 5. Ulan Coal Expansion Modification 6 – Submissions Report 6. Ulan Coal Expansion Modification 6 – Submissions Report – Appendix 3 Groundwater 7. Ulan Coal Expansion Modification 6 – Submissions Report – Appendix 4 Surface Water
	Agency Advice	1. DCCEEW Advice on Modification Report – Ulan Coal Expansion Modification 6. 2. DCCEEW Advice on Response to Submissions for Ulan Coal Expansion Modification 6. 3. Independent Expert Scientific Committee Advice
Supplementary Information	Additional Information from Ulan – dated 28 November 2023	1. Letter Response to queries from IEAPM pertaining to subsidence predictions for MOD6. 2. Ulan Coal Mine Briefing Slide pack 3. Ulan Coal MOD6 Groundwater 4. Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Developments Advice. 5. Independent Review of groundwater modelling and assessment – EMM including follow up letters.

Stage	Document Reference	Document Name
	Information from Ulan following site visit – received 18 December 2023	1. Glencore - IEAPM Inspection Slide Pack 2. AGE Ulan Amended Groundwater 3. Heritage Avoidance Map 4. Inspection Route Map 5. Subsidence Impact Map 6. Ulan Coal – Glencore - Water Management Plan V11
	Amendment assessment documents – dated 16 May 2024	1. Ulan Coal Expansion Modification 6 – Amendment Modification Report 2. Ulan Coal Expansion Modification 6 – Appendix 1 Updated Project Description 3. Ulan Coal Expansion Modification 6 – Appendix 2 Statutory Compliance Tables 4. Ulan Coal Expansion Modification 6 – Appendix 3 Updated Mitigation Measures 5. Ulan Coal Expansion Modification 6 – Appendix 4 Amended Subsidence Assessment 6. Ulan Coal Expansion Modification 6 – Appendix 5 Amended Groundwater Impact Assessment 7. Ulan Coal Expansion Modification 6 – Appendix 6 Amended Surface Water Impact Assessment 8. Ulan Coal Expansion Modification 6 – Appendix 7 Amended GHG Assessment 9. Ulan Coal Expansion Modification 6 – Appendix Amended Economic Assessment 10. Letter response to queries from IEAPM pertaining to subsidence predictions for Mod6 following site visit.
	Agency Advice	1. DCCEEW Advice on Amendment Report for Ulan Coal Mine Mod 6 2. EPA Advice on Amendment Report for Ulan Coal Mine Modification 6
	Ulan response to Agency questions	Ulan Coal response dated 20 September 2024

2.1. SITE VISIT, SUBSEQUENT INFORMATION AND MEETINGS

2.1.1. Site Visit

On 5 December 2023, the Panel undertook a site inspection. The inspection involved a briefing at the Ulan site office by UCC staff followed by inspection of the surface location above the proposed underground mining area and surrounding topography. Figure 2 shows the locations inspected by the Panel during the visit.

The Panel was accompanied by UCC staff and its relevant consultants, plus Department representatives, during its inspection.

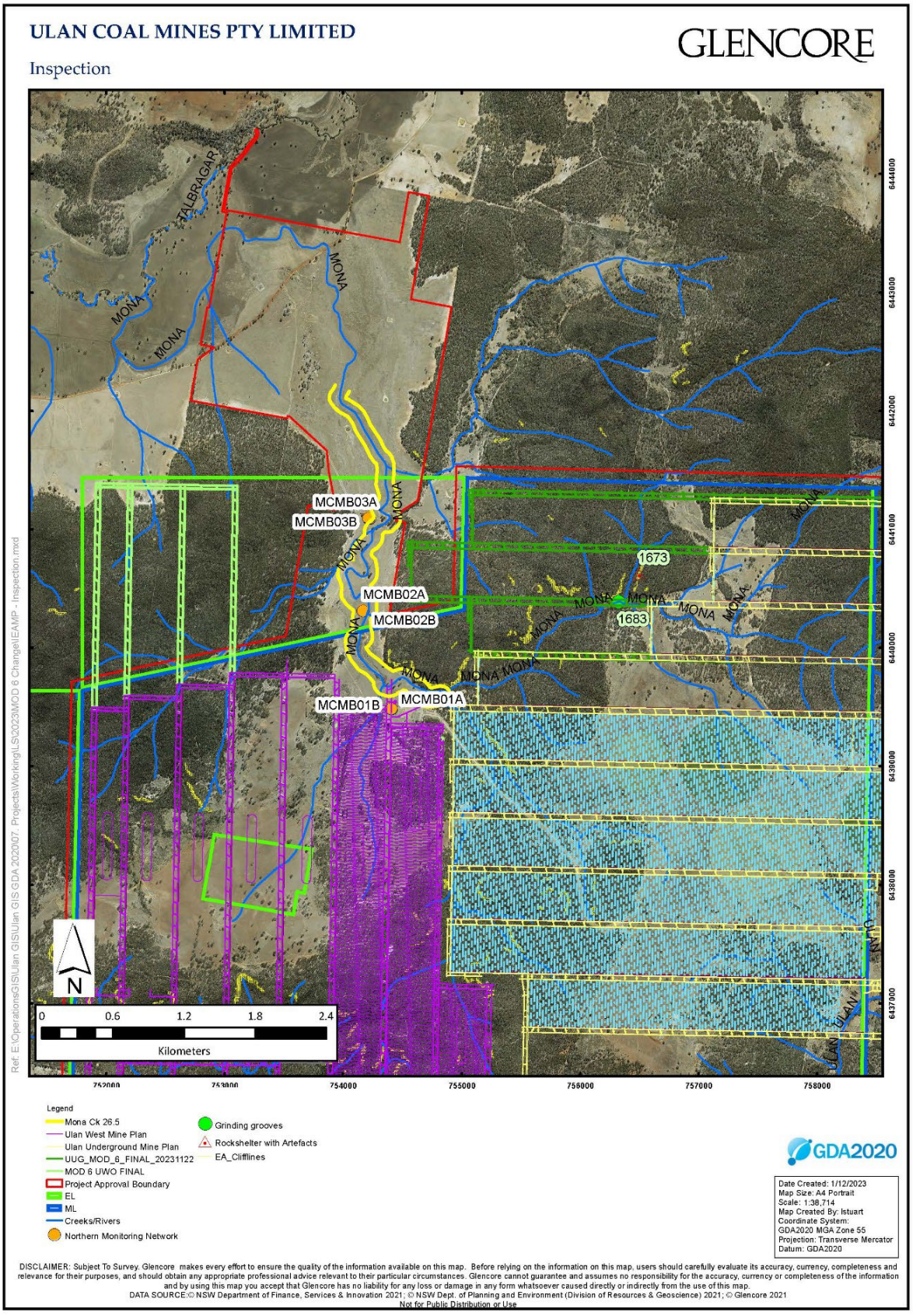

Figure 2: Site inspection map

2.1.2. Meetings

The Panel convened several times over the course of preparing its advice. Table 2 summarises the schedule of meetings held in chronological order.

Table 2: Schedule of meetings held

Meeting Date	Meeting Information
16 October 2023	Briefing
6 November 2023	Panel – Glencore Briefing
5 December 2023	Site Visit
29 May 2024	Panel members discussion
2 October 2024	Panel members discussion
29 October 2024	Panel members – review of draft report

3.0 PRIMARY FOCUS OF THIS ADVICE

During the course of the Panel review process, further changes were made to the proposed mine plan by Ulan (subsequent to the initial documentation and plans under consideration at the time of the site visit). The modified mine plans were provided to the Panel in May 2024, together with responses to the questions raised during and immediately following the site visit in December 2023.

The content of this Panel Report is now based on the revised/updated mine plans, with a primary focus on:

- Groundwater impacts and modelling
- Scale and likelihood of potential subsidence and the resulting water-related impacts and environmental consequences on the Colluvial, Alluvial and Jurassic water sources.

4.0 PANEL COMMENTARY

4.1. SUBSIDENCE EFFECTS AND IMPACTS

The Ulan Coal Expansion Project – Modification 6 (Amendment) provides subsidence prediction and assessment above the proposed longwall panels in both Ulan Underground Mine (LW W9, LW W10 and LW W11) and Ulan West Mine (LW10A, LW11A and LW12A). The proposed location and extent of these panels is shown, relative to the current longwall panels and the surface topography, in Figure 3.

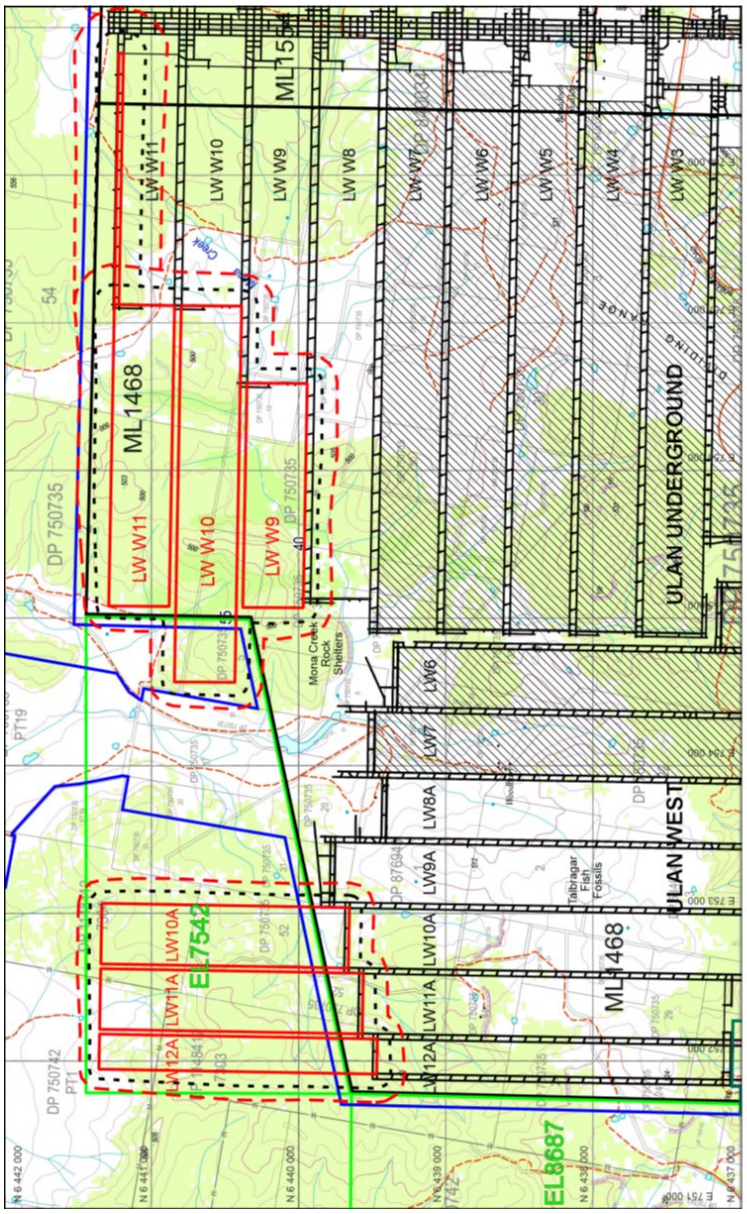

Figure 3: Ulan Mod. 6 Amended Mine Plan

(source: Ulan Mod. 6 Amendment Report, Appendix 4)

The Panel notes that the Amendment made by Ulan in late 2023 to the original 2022 Mod. 6 mine plan has involved shortening of the proposed Ulan Underground longwall panels for a number of reasons, which included avoiding undermining the Mona Creek 4th order stream. The amended panel boundaries are now set back beyond a 26.5^{0} angle of draw from the stream banks. This is considered by the Panel to be a prudent measure to minimise any subsidence-related impacts on the stream and associated surface and near-surface groundwater issues.

The subsidence prediction contained in the Ulan documentation has been conducted by SCT Operations Pty Ltd (SCT). The SCT predictions are contained in Appendix 4 to the Ulan Mod. 6 Amendment Report (SCT (2024b)). In support of this subsidence assessment report, SCT also provided responses to questions raised by the Panel in two letter reports (SCT (2023b) and SCT (2024a)).

SCT has conducted the subsidence prediction based on an empirical model developed from experience with monitoring multiple (at least forty) previous longwall panels at the Ulan site covering a range of depths and panel widths. The use of such an extensive empirical methodology for predictions is considered appropriate in this application, provided the empirical database used is representative of conditions encountered in the location for which the predictions are being made. This includes geometric and geological/geotechnical conditions. On this occasion, the Panel has been advised and accepts that this is the case for the proposed Mod 6 longwall panels.

SCT has used the empirical database to provide an upper-bound prediction of subsidence effects. Their methodology includes the addition of a further 10% margin on predicted vertical subsidence to ensure a conservative upper bound prediction.

In response to a request from the Panel regarding validation of the SCT prediction methodology, copies of the 2021 and 2022 annual review reports of subsidence monitoring (SCT (2022) and SCT (2023a)) were provided, which include comparisons of monitoring results against the previous SCT subsidence predictions. The conclusions of these reports show subsidence behaviour consistent with predictions and maximum values of vertical subsidence, tilt and strain all below the predicted values. Based on this validation evidence the Panel is satisfied that the empirical prediction methodology is appropriate.

The predictions reported (SCT (2024b)) for the Amended Mod. 6 mine plans are as follows:

Table 3: Predicted Subsidence

Overburden Depth	130 m	250 m
Vertical Subsidence (m)	2.1	1.7
Tilt (mm/m)	85	40
Compression Strain (mm/m)	35	20
Tensile Strain (mm/m)	25	15

SCT also reports against the full range of performance measures from the EA documentation in Table 2 of their report.

It is significant to note that maximum subsidence may be as high as 2.1m and tensile strains of up to 25 mm/m, which will undoubtedly result in significant open surface cracking, especially over the shallower depths of mining. This is consistent with what the Panel observed over Ulan West LW7 during the site inspection.

SCT predicts that there is the potential for surface water to migrate through surface cracks into the underground workings. They further state that fracturing of the full overburden strata section is expected over the proposed panels from seam to surface, resulting in full depressurisation of the groundwater within the overburden sequence above all panels. The Panel agrees with this prediction and further understands that the mechanism is likely to involve depressurisation followed by drainage of groundwater from the unconfined Quaternary colluvial/alluvial and Triassic sandstone groundwater systems.

In terms of non-conventional subsidence effects and impacts (including valley closure, surface steps and uplift, and far-field horizontal movements), SCT concludes that the likelihood of this type of behaviour is low, with the exception of valley closure, which is expected to occur in some locations, up to a level of 900mm.

In terms of far-field horizontal movements (which generally have minimal adverse impacts), these are quite common at Ulan, associated with angles of draw for measured vertical subsidence of up to 45^0 or more. Special attention should be given to the presence of the Mona Creek rock shelters, to the south-

west of the end of LW W9. Whilst these fall outside of the conventional 26.5^0 angle of draw, they are likely to fall within a region of greater angle of draw and associated potential horizontal movements.

All of the above effects and impacts are expected to be similar to previous experience at Ulan.

The Panel is satisfied that the proposed mine plan for the Ulan Mod. 6 Amendment will result in subsidence effects and impacts within the range of predictions by SCT and that these will generally fall within the level of impacts already experienced above previous longwall panels at Ulan.

4.1.1. Recommendations

- It is recommended that the subsidence predictions should be reviewed on a panel-by-panel basis, and recalibrated as required, as subsidence monitoring data is collected and analysed.
- The subsidence monitoring program should extend well beyond the conventional angle of draw to capture potential effects and impacts out to at least a 45^0 angle of draw or greater, as required.
- The monitoring program should be designed to incorporate special attention to the Mona Creek rock shelters during the mining of panels LW W9 and LW W10.

4.2. GROUNDWATER ISSUES AND IMPACTS

This portion of the Panel's advice focuses on the predicted water-related impacts on the colluvial, alluvial and Jurassic water sources in the amended project area, the environmental consequences, and the adequacy of the current groundwater modelling and proposed groundwater monitoring network.

4.2.1. Groundwater Systems and Issues

The important groundwater systems overlying and immediately adjacent to the longwall panels in the amended Modification 6 area are the:

- Quaternary alluvium of the Talbragar River floodplain,
- Triassic Wollar Sandstone, and
- Jurassic Pilliga Sandstone

These systems contain productive aquifers that support a range of beneficial uses and maintain important groundwater dependent ecosystems. Drawdown within these groundwater systems and the loss of groundwater for consumptive and environmental use is an important focus of the Groundwater Impact Assessment (GIA) reports (AGE 2022, AGE 2024), agency submissions and this Panel advice to DPHI.

The unconsolidated sediments along Mona Creek comprise mostly thin colluvial deposits in the close vicinity of the proposed longwalls with more substantial alluvium occurring downstream closer to the confluence with the Talbragar River. This creek system contains a less-productive aquifer that does not sustain any private water bores or groundwater dependent assets.

Impacts to private water bores and groundwater dependent assets have been identified as potential issues associated with the amended project. The Unnamed Spring and Kellys Spring (located more than 5 km north of the project area) and The Drip (located more than 12 km southeast of the project area) have been mentioned in IESC and community submissions as requiring additional focus and protection (such as described in Umwelt 2024c).

There is sufficient evidence provided in AGE 2022, AGE 2024 and Umwelt 2024b for the Panel to concur that:

- The Unnamed Spring is most likely derived from a perched aquifer being the contact between the Jurassic Pilliga Sandstone and the underlying Purlewaugh Formation
- Kellys Spring is most likely derived from a perched aquifer zone within the Jurassic Pilliga Sandstone
- The Drip is most likely derived from a perched aquifer within the Triassic Wollar Sandstone

These shallow environmental assets are highly unlikely to be impacted by mining-induced drawdown in the regional groundwater systems associated with the amended project. Consequently, the Panel does not recommend inclusion of these features in any updated monitoring network or management plan.

Impacts to water levels in private bores to the north in the Triassic Wollar Sandstone and west in the deeper Permian coal measures are likely dependent on their depth and distance from the amended project. Based on modelling predictions, the predicted drawdowns are substantial in some instances and are tabulated in the latest impact assessment (Table 5.6 of AGE 2024) and the WMP (Table 5.10 of Glencore 2024a).

Predicted impacts to the Talbragar River alluvium are more problematic given the river is incised into the Triassic Wollar Sandstone in the vicinity of its confluence with Mona Creek. Additional monitoring of the alluvial, Triassic sandstone and Permian coal measure groundwater systems is warranted.

The amended project has been designed to avoid undermining Mona Creek and its shallow groundwater system. However given the depressurisation of the Permian strata and the dewatering of the Triassic sandstones, some drawdown in this shallow groundwater system is still predicted (see Section 4.2.3). Depressurisation of the Permian and Triassic strata extend towards the Talbragar River, hence the necessity to monitor and obtain additional water level data in this area.

The following text provides targeted advice and recommendations in relation to the groundwater modelling, drawdown predictions, and environmental risks to the important groundwater systems, and the established monitoring network to gauge drawdown impacts.

4.2.2. Groundwater Monitoring Network

There is a reasonable groundwater monitoring network in place in the vicinity of the amended project area. The network comprises a number of nested standpipe/piezometer locations and deeper VWP locations that effectively monitor all the important groundwater systems except the Talbragar alluvium. Summary details of the existing network within a 3 km radius of the new longwalls are provided in Table 4 and these locations are shown in Figure 4.

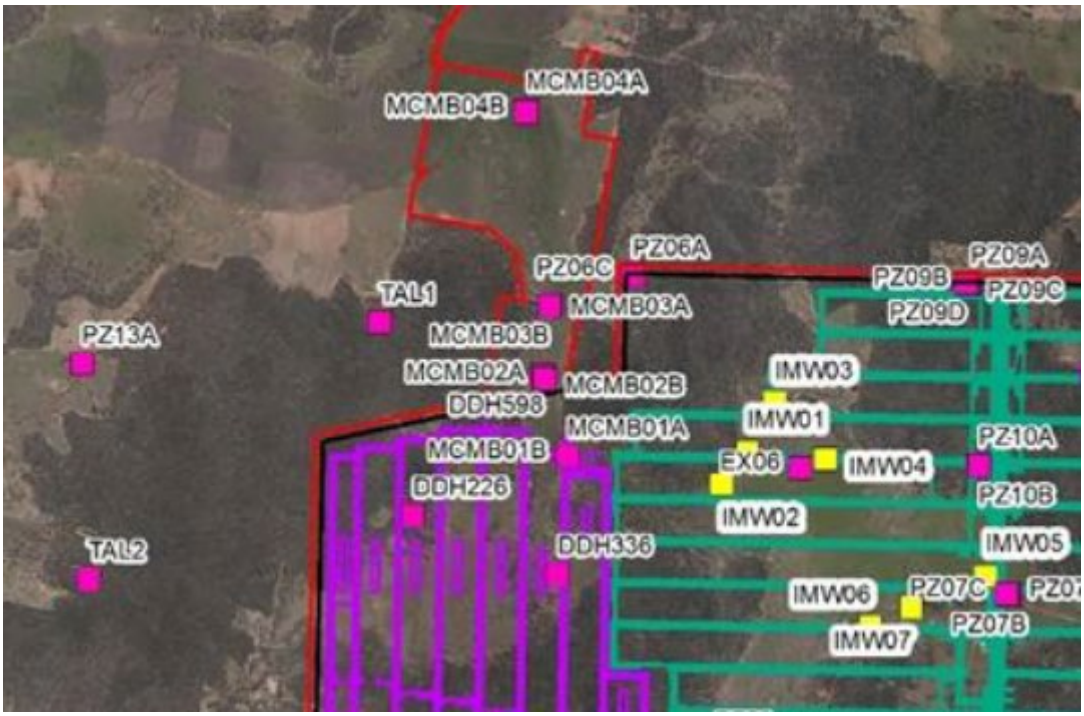

Figure 4: Current Northern Groundwater Monitoring Network
(partial reproduction from Figure 5.2 of Glencore 2024a)

There is good spatial coverage but given the extent and magnitude of predicted drawdown to the north west towards the Talbragar River in the Permian and Triassic groundwater systems, and potential

baseflow reductions to the alluvium from these depressurised groundwater systems, it would be useful to establish deeper nested piezometers in the Permian overburden and Ulan Seam next to monitoring site MCMB04, and to construct new nested piezometers or a VWP monitoring bore (across the alluvium, Triassic sandstone, and Permian overburden and Ulan Coal Seam) close to the confluence of Mona Creek with the Talbragar River.

UCC has also committed to the installation of one or more bores into the Jurassic Pilliga and Purlewaugh formations to the north of the amended project area (Glencore 2024a) however the exact locations and the timing of these installations are not known.

All these monitoring sites are primarily required to monitor water level/pressure declines in the respective groundwater systems. The standpipe piezometer sites are also suitable for monitoring water quality trends.

Table 4 – Existing groundwater monitoring locations within 3 km of the amended project area.

Bore ID	Depth (metres)	Descriptive Location	Formation	Monitoring Type
MCMB01A	6.37	Central Mona Creek	Colluvium	Nested Piezometers
MCMB01B	30.45	Central Mona Creek	Triassic	
MCMB02A	Unknown	Central Mona Creek	Colluvium	Nested Piezometers
MCMB02B	Unknown	Central Mona Creek	Triassic	
MCMB03A	14	Central Mona Creek	Colluvium	Nested Piezometers
MCMB03B	30	Central Mona Creek	Triassic	
MCMB04A	9.7	Lower Mona Creek	Alluvium and Colluvium	Nested Piezometers
MCMB04B	24	Lower Mona Creek	Triassic	
PZ06A, B, C	169, 159, 71	North – Ulan UG	Lower PCM Ulan Seam Triassic	Nested Piezometers
PZ09A, B, C, D	330, 310, 165, 80	North East – Ulan UG	Lower PCM Ulan Seam Triassic Jurassic	Nested Piezometers
PZ10A, B	165, 46	East – Ulan UG	Triassic Jurassic	Nested Piezometers
MC VWP1	~145	Project area - Centre	Lower PCM Ulan Seam	5 Sensor VWP
TAL1	140	Project area – West	Triassic Lower PCM Ulan Seam	5 Sensor VWP

Bore ID	Depth (metres)	Descriptive Location	Formation	Monitoring Type
DDH266	192	South West – Ulan West UG	Triassic Lower PCM Ulan Seam	3 Sensor VWP
DDH336	197	South – Ulan West UG	Triassic Lower PCM Ulan Seam	8 Sensor VWP
DDH598	152	Project area – Centre	Triassic Lower PCM Ulan Seam	3 Sensor VWP
EX06	34	South East – Ulan UG	Unknown	VWP

This monitoring network is supplemented by a number of private water supply bores tapping aquifers in the Triassic sandstones and Permian sediments. At least a 6-monthly monitoring frequency (and, preferably, quarterly frequency) is preferred to the annual program nominated in the current Water Management Plan (WMP) (Glencore 2024a).

Further details of the established groundwater network and monitoring parameters and frequency are provided in the WMP (Glencore 2024a). The Panel notes that the UCC has committed to updating this WMP later in 2024 at the completion of the groundwater model update and recalibration, and the installation of new monitoring bores.

Both the WMP and the complementary Surface Water and Groundwater Response Plan (SWGWRP) (Glencore 2024b) contain triggers and responses (TARPS) for water level and water quality performance indicators at numerous monitoring bore and private bore sites.

The TARPS focus on EC and pH water quality parameters and actual/predicted drawdowns at private bores. The Panel considers these to be reasonable performance indicators. Those private bores with a predicted drawdown in excess of 2 m are summarised in Table 5.6 of AGE 2024, however the locations do not align with those listed in Table 5.10 of the WMP or Table 3.5 of the SWGWRP. This inconsistency needs to be corrected in the revised WMP. The response actions are reasonable, but no timeframes are provided for these actions.

Similarly, the triggers for the dedicated monitoring network are water quality (an expanded set of parameters is provided in Table 3.6 of the SWGWRP) and actual/predicted drawdowns. The number of water quality parameters appears excessive in this plan and could be reduced to just EC and pH (as tabulated in Table 5.12 of the WMP). Key sites should be identified and nominated as depressurisation / drawdown and water quality sites rather than the whole of the North Monitoring Network (Table 5.4 in the WMP and Table 3.6 in the SWGWRP).

The Panel notes that only two sites (PZ06 and PZ09) in the amended project area are nominated in the WMP (Table 5.13) as groundwater level trigger sites and that the two plans do not align. However the WMP does state:

"Baseline data is still being collected for the Mona Creek Monitoring Bores (MCMB bores) and triggers maybe established once there is sufficient baseline information" and that *"an update of the MCMB triggers will be provided in the forthcoming Annual Review."*

Again, the response actions are reasonable, but no timeframes are provided for these actions.

The Panel concludes that:

- The North Monitoring Network provides reasonable spatial coverage but additional shallow (alluvial) and deeper (Triassic and Permian) piezometers are required in the Mona Creek

catchment closer to the Talbragar River and additional piezometers are required in the Jurassic Pilliga Sandstone north of the amended project area.

- The current groundwater level trigger locations included in the TARPs in the WMP are inadequate to effectively monitor spatial impacts to the important alluvial and regional (Triassic and Jurassic) sandstone groundwater systems and to action responses.
- The annual voluntary monitoring of groundwater levels for privately owned bores is inadequate to identify or confirm mining-induced impacts.

4.2.3. Groundwater Modelling

The groundwater model was developed using the Unstructured Grid version of Modflow (ModFlow – USG). The model extends about 40 km north and east of Ulan mining complex and about 20 km to the south and west to minimise the impact of the lateral model boundary conditions on the model results in the vicinity of the mine. The south-west boundary is defined by the outcrop of the effectively impermeable bedrock.

The major hydrostratigraphic units in the region spanning the colluvium/alluvium at surface through the Tertiary, Jurassic, Triassic and Permian lithologies are used for vertical discretisation into nineteen layers with a variable number of layers per lithology. The conceptual connections between the modelled groundwater system and the external domain are highly simplified as presented in Appendix A of the Groundwater Impact Assessment (GIA) report (AGE 2022, which is Appendix 8 of the Modification Report (Umwelt, 2022)). All lateral boundaries are no flow. Inflows are defined to be net recharge rates distributed over the surface of the model domain and applied directly to the groundwater table. Natural outflows are defined to be baseflow to the streams and rivers across the model domain. The connections with the stream network do not permit leakage to groundwater from the streams to occur, thereby approximating ephemeral stream systems. Non-natural outflows arise from the drainage in the mines and borehole discharges. Mine outflows are controlled by drainage controlled by the base of the mine workings and through alteration of hydraulic properties to reflect the cracking above the mine workings due to subsidence. The simplicity of the regional boundary conditions adopted in the model has implications for interpretation of the model results that are discussed later.

Hydraulic properties for each hydrostratigraphic unit were assigned ranges initially and modified during automatic calibration to yield the best fit model. Pilot points were used in the automatic fitting to allow for spatial variation of properties within each layer. The latest GIA report (AGE, 2024) submitted as part of the Amendment suggests that the original 2022 description of the model concepts is correct but offers the following rather different description in its conceptual model statement: *System stresses include inputs (i.e. rainfall recharge and river leakage) and outputs (i.e. upward and downward leakage, evapotranspiration, interception through mine dewatering, and baseflow discharge to surface drainages)*.

The differences between these two conceptualisations is substantial and raises questions about the reliability of the reporting. As the Amendment report notes that the model's boundary conditions were unchanged for the amendment apart from mining changes, the conceptualisation presented in the Modification report, Appendix 8 (Umwelt, 2022) is assumed to be correct. Responses to the submission of the original Modification 6 report (Umwelt, 2022) from DPE Water and the IESC noted the following concerns (summarised here) about the Groundwater Modelling.

DPE Water:

1. Lack of model assessment against the most recent water level monitoring data. The model had been calibrated using data up to 2019 but further data to November 2022 was available prior to submission of the EIS.
2. Observations in boreholes where drawdown exceeds the predictions and the implications of the differences. Specific mention was made of borehole PZ10A with a drawdown 15 m greater than predicted.
3. Drawdown in the Jurassic sediments showing mining impacts not predicted by the groundwater modelling.

4. Possible deficiencies in the modelling of impacts to perched water and groundwater changes in the colluvium/alluvium.
5. Lack of a clear demonstration that the modelling meets the requirements of the NSW and Australian guidelines (NSW minimum groundwater modelling requirements for SSD/SSI projects (DPE 2022), Australian Groundwater Modelling Guidelines (2012)).
6. Lack of inclusion of the independent third-party review.

IESC:

7. Requirement for improved representation of the hydraulic connection between surface water and groundwater to better predict potential changes to ecologically important flow components, further consideration of climate-change impacts through an analysis using RCP8.5
8. Predicted groundwater drawdown needs to show the maximum drawdown and mounding (spatial extent, magnitude and timing) so that potential impacts can be identified as recommended by the peer review of the groundwater model.
9. The groundwater model is not able to adequately represent the complexity where subsidence and connected fracturing occur beneath Mona Creek or simulate local surface water-groundwater interactions.
10. Model uncertainty analysis has not fully explored potential worst-case impacts on groundwater resources, including exploring ranges for storage and recharge and better communicated outcomes of uncertainties on baseflow changes and mounding that are key impacts of the projects.
11. Potential cumulative impacts to surface water and groundwater interactions, and changes to these, are not assessed, particularly in the context of effects on ecologically important components of flow regimes or changes to directions and/or magnitudes of surface water-groundwater exchanges in the hyporheic zone of Mona Creek when it is flowing or a string of pools.

Appendix 3 of the Response to Submissions report prepared for the Ulan 6 Modification in August 2023 (AGE,2023) provides responses to DPE-Water's questions.

UCC's response to IESC submissions is provided in Umwelt (2024b), while final commentary in response to submissions from Agencies in relation to the revised amendment report (Umwelt, 2024a) is provided in Umwelt (2024c).

While Umwelt (2024c) includes commentary on all additional agency advice, the additional advice on groundwater aspects and groundwater modelling, in particular, do not materially alter or extend the original observations prepared by DPE-Water and IESC.

The concerns around the groundwater modelling raised by DPE-Water and the IESC were extended in preliminary questions raised by the Panel covering:

1. The significance of observed water levels for the Private Bores being frequently well-above the modelled results.
2. The lack of detail on the way in which the model uncertainty analysis was approached.
3. How fracturing above the longwalls was included in the uncertainty analysis.
4. The lack of model information on the impacts beyond the end of mining.
5. The presentation of mine inflows for comparison of modelled and observed inflows.

The amendment report (Umwelt, 2024a) describes amendments to the mine plan involving truncating the planned longwall extensions so that Mona Creek and associated alluvial/colluvial sediments are not undermined. This reduction in mining has reduced the predicted impacts on the creek and has also reduced the predicted mine inflows as well as baseflow losses to the regional watercourses. The groundwater modelling has been updated to reflect the changed mine development plan. Recalibration of the model has not been undertaken, but the fit of the model to the monitoring observations up to 2022 has been assessed, essentially restating the commentary in Appendix 3 of the Response to Submissions, AGE (2023), but without including the hydrographs for all piezometers provided in AGE (2023). The other significant change proposed by UCC is the backfill of open voids post mine closure. This reduces the long-term risk of mounding of the groundwater table and the resulting potential for impacts on the

surface water systems. Commentary is also provided in the Amendment report on the issues raised by the Panel.

The Panel has reviewed the amendment report in relation to the over-arching concerns raised by DPE Water, the IESC and the Panel. These concerns effectively cover the other agency's concerns. The Panel's review addresses the following aspects of the groundwater modelling.

1. Modelled versus observed water levels.
2. The underprediction of drawdowns in monitoring bores
3. Surface water/Groundwater interactions
4. Jurassic Sediments and perched aquifer groundwater predictions
5. Model uncertainty analysis
6. Peer review report

Modelled versus observed water levels

The comparison of modelled to observed water levels was extended to cover the period from 2019 (the end of calibration) to 2022. The additional observations have been used to verify the model. The global statistical fit of the model including the verification data is improved compared to just the calibration period. The scatter of the verification modelled versus observation data appears to match the scatter of the calibration dataset, though a few modelled results significantly underpredict the observations. Underprediction of water levels in the upper formations is a feature of the model with underprediction of the Jurassic formation water levels a specific model feature. This is a consequence of a higher modelled vertical connectivity between the Jurassic sediments and the underlying Triassic sediments than is apparent from water level observations and reflects the modelling decision to concentrate calibration and prediction on the Triassic sediments and the coal formations that are more impacted by mining. This feature of the modelling is not a specific problem if impacts on the Jurassic sediments and water features connected to the Jurassic sediments are not of interest.

To date mining impacts on the Jurassic sediments have been observed to be minimal. If significant impacts are observed in the future, then improved modelling of the hydraulic connection between the Triassic and Jurassic formations will be required to determine if there are possible long term affects requiring mitigation or offsetting.

The statistics used to assess model performance for the individual formations and for the model overall do not provide particularly useful evidence of the quality of the model given the natural trends in water level regionally and the biases in model predictions for the different formations. However, visual review of the modelled and observed borehole hydrographs including the verification data indicates (AGE, 2023) that there would be little value in recalibrating the model with the verification data. The modelling, without recalibration, is generally fit for purpose for the assessment of impacts to the Triassic and Permian groundwater systems from the mining.

Underprediction of drawdowns in monitoring bores

AGE (2023) highlights that the model has limitations regarding the timing of drawdown responses to mining. The apparent significant underprediction for PZ10A can be attributed to a lag in the model's drawdown response relative to the observations. The likely magnitude of the delayed drawdown response predicted by the model appears reasonable when compared with the available drawdown data. The underprediction highlights the limitations of the model in representing vertical connections between formations at a local scale. The vertical piezometer array at DDH336 illustrates the complex behaviours at different depths both prior to mining and in response to mining (AGE, 2023 and AGE,2022 Figure 5.12). The model can capture the overarching behaviours but not the detailed timings illustrated by the observations. This is reasonable.

Surface Water/Groundwater interactions

All surface water connections to the groundwater in the model are conceptualised to be gaining streams only. With this conceptualisation, the model can simulate groundwater flow to the streams but cannot simulate stream water flow to the groundwater (Section A4.6.2 in AGE, 2022). This approximation appears to have been adopted to represent the ephemeral stream network in proximity to the mine. It is

a reasonable approximation for the case of predominantly dry streams. This approximation also assumes that leakage from permanent and semi-permanent streams will either not occur or be minor and is related to the modelled alluvium recharge rates, which are a significant control on the groundwater heads local to the stream network. If the alluvial recharge rates are correct, the simulation of no leakage from the permanent streams yields conservative (i.e. higher) predictions of drawdown in the alluvial formations than might be expected in practice. The reliability of the adopted alluvial recharge rates warrants further investigation. Overall, the surface water/groundwater interactions adopted in the model are highly simplified and, therefore, the groundwater model results should not be used to characterise impacts on groundwater dependent ecosystems for either the permanent or ephemeral stream network.

The decision to pull mining back from Mona Creek and the adjacent alluvium/colluvium reduces the need for a more detailed groundwater model for this locality. The impacts predicted by the model for this location are now much reduced from the forecast when the mine was expected to extend beneath the creek. Nevertheless, the model does predict drawdowns in all formations below Mona Creek and in the alluvium/colluvium for the amended mine plan and appropriate monitoring is still required to confirm the scale of predicted impacts.

Streamflow impacts are predicted to be insignificant with the Mod 6A amendments. Despite the limitation of the model representation of stream-aquifer interactions, the model appears to be fit for purpose for the amendment given the much-reduced impact on Mona Creek compared with the original Mod 6.

Jurassic Sediments and perched aquifer groundwater predictions

The regional groundwater in the Jurassic sediments is considered to be perched (cf Figure 5.25, AGE (2022)). While localised perching in and above the Jurassic is apparent from the presence of the springs, a review of the regional data suggests that considering the regional Jurassic groundwater to be perched above the Triassic overstates the apparent disconnection between the Jurassic and Triassic formations below. The groundwater data shows limited vertical flows between the Jurassic and Triassic formations and does appear to show continuous hydraulic connection between these two formations rather than perching. Given this interpretation, it could be expected that drawdowns in the Triassic will over the long term extend up to the Jurassic and may modify to a limited degree the groundwater balance in the Jurassic. The extent of the modification of flows and water levels in the Jurassic will depend on the vertical permeability and the primary discharge locations from the Jurassic to surface. The groundwater model has not been constructed to model the Jurassic groundwater system in any detail. The modelling assumption for the Jurassic formation is that it is effectively just a transmission pathway for surface recharge to the deeper aquifers. The groundwater model results cannot be used at the current stage of model development to predict accurately the drawdowns and flows in the Jurassic Pilliga Sandstone aquifer and the effectiveness of the Jurassic Purlewaugh Formation aquitard.

AGE (2024) recognises the limitations of the model for the prediction of water table changes in the Jurassic but notes that the limited extent of Jurassic above the mine area and the tightness of the formations, particularly the underlying Purlewaugh Formation, restricts the area of potential impact on the Jurassic.

Despite the model's limitations the prediction that groundwater level declines of more than 2 m will not occur in the Jurassic is presented as a model output. At this stage, this prediction should be treated cautiously, and long-term ongoing monitoring of the Jurassic bores maintained.

Model uncertainty analysis

Model uncertainty analysis has been updated for the amendment report and includes significantly more detail than was supplied for the Mod 6 modelling. An assessment of the convergence of the results with the number of converged simulations has also been included in the analysis. Results for drawdown in PB33 (lying to the East of Ulan mine) and total baseflow are used to demonstrate that convergence is achieved. Whilst the meaning of baseflow loss for this assessment is not transparent, the results do indicate convergence for the two pieces of data shown. The model uncertainty analysis does include better descriptions of the model parameters that have been varied and the selection of prior distributions for the parameters for input to the uncertainty analysis. Importantly, it does include both storage and

recharge variations that were not clearly incorporated in the Mod 6 uncertainty analysis and were of concern in the IESC assessment of the Mod 6 groundwater modelling.

The uncertainty analysis also identifies the way in which height of fracturing above the longwalls was incorporated. The chosen approach is to maintain the relationship between height of fracturing and the formation properties developed for Ulan and to allow height of fracturing to change solely because of changes to the formation properties in the uncertainty analysis. This seems a reasonable approach given the general level of uncertainty in the model outputs.

Peer review report

The original peer review of the Mod 6 Groundwater Model completed by Doug Weatherill of EMM has been adopted as appropriate for the Mod 6A modelling. One of the issues raised by DPE Water in the assessment of Mod 6 was the lack of inclusion of the full 3rd Party peer review with the groundwater modelling report. Only the issues raised by the peer review were addressed in the Mod 6 groundwater modelling report. However, the lack of peer review inclusion has not been rectified in the submission of the Amendment report. While it is accepted that the peer review was specifically written for the Mod 6 groundwater model, for it to be adopted as appropriate for the Mod 6A modelling it should still be capable of being included in full in an appendix to the revised modelling report.

It is important that the peer review report is formulated to clearly demonstrate that the modelling meets the requirements of both the NSW and the Australian Guidelines to provide confidence in the model's conceptualisation, design and performance relative to the available supporting data.

The Panel concludes that:

1. The current groundwater model appears to be fit for purpose for the amended mine plan and the updated rehabilitation plan for the open cuts.
2. The model results appear to be sensible for mine inflows and regional drawdowns in the Triassic formations and the alluvial deposits overlying the Triassic
3. The model lacks resolution of possible long-term impacts on the Jurassic groundwater and therefore, groundwater monitoring is required for the long-term to assess the validity of the model predictions for the Jurassic formations.
4. While the impacts on Mona Creek are predicted to be less than the original modification of the mine plan, there is still a risk of significant drawdown beneath the creek in all underlying groundwater systems. There is therefore a need for ongoing monitoring of the groundwater conditions in all groundwater systems in this locality and the performance of the pools in the stream.
5. A formal peer review report should be provided that provides an assessment of the groundwater model against the available guidelines.

4.2.4. Recommendations

The Panel recommends that the following be included in the consent conditions for Modification 6 – underground mining extension:

1. The north monitoring network be expanded by adding deeper nested piezometers next to MCMB04, and constructing new nested piezometers or a VWP monitoring bore close to the confluence of Mona Creek with the Talbragar River
2. The WMP and the SWGWMP should be updated within 6 months of the approval to:
    - ensure there are no inconsistencies between the latest modelling predictions and monitoring commitments,
    - reflect the current and expanded groundwater monitoring network,
    - increase the frequency of monitoring water levels in private water bores to minimum 6-monthly and preferable quarterly,

- align the triggers and TARPs with the latest modelling drawdown predictions in private water bores,
- increase the number of groundwater level trigger sites to include more alluvial, Triassic Wollar Sandstone and Jurassic Pilliga Sandstone sites north of the amended project area,
- revise or develop appropriate response actions with appropriate timeframes.

3. The updated WMP should be the primary groundwater management plan and require DPHI approval
4. A formal groundwater model peer review report should be provided that provides an assessment of the updated groundwater model against the available guidelines
5. As new monitoring data are collected detailed reviews every three years of the adequacy of the groundwater conceptual model should be undertaken. Where deviations from expected behaviour for the Jurassic Pilliga Sandstone, the Triassic Wollar Sandstone and the Talbragar/Mona Creek alluvium and stream channel are observed, appropriate updates to the conceptual and numerical model should be undertaken to assist the interpretation of the new information.

5.0 SUMMARY CONCLUSIONS

The Panel is satisfied that the proposed mine plan for the Ulan Mod. 6 Amendment will result in subsidence effects and impacts within the range of predictions by SCT and that these will generally fall within the level of impacts already experienced above previous longwall panels at Ulan.

With respect to groundwater monitoring, the Panel concludes that:

- The North Monitoring Network provides reasonable spatial coverage but additional shallow (alluvial) and deeper (Triassic and Permian) piezometers are required in the Mona Creek catchment closer to the Talbragar River and additional piezometers are required in the Jurassic Pilliga Sandstone north of the amended project area.
- The current groundwater level trigger locations included in the TARPs in the WMP are inadequate to effectively monitor spatial impacts to the important alluvial and regional (Triassic and Jurassic) sandstone groundwater systems and to action responses.
- The annual voluntary monitoring of groundwater levels for privately owned bores is inadequate to identify or confirm mining-induced impacts.

With respect to groundwater modelling, the Panel concludes that:

- The current groundwater model appears to be fit for purpose for the amended mine plan and the updated rehabilitation plan for the open cuts.
- The model results appear to be sensible for mine inflows and regional drawdowns in the Triassic formations and the alluvial deposits overlying the Triassic.
- The model lacks resolution of possible long-term impacts on the Jurassic groundwater and therefore, groundwater monitoring is required for the long-term to assess the validity of the model predictions for the Jurassic formations.
- While the impacts on Mona Creek are predicted to be less than the original modification of the mine plan, there is still a risk of significant drawdown beneath the creek in all underlying groundwater systems. There is therefore a need for ongoing monitoring of the groundwater conditions in all groundwater systems in this locality and the performance of the pools in the stream.
- A formal peer review report should be provided that provides an assessment of the groundwater model against the available guidelines.

6.0 SUMMARY RECOMMENDATIONS

The Panel makes the following recommendations to the Department for consideration of determining Ulan Modification 6.

Subsidence Effects and Impacts

1. It is recommended that the subsidence predictions should be reviewed on a panel-by-panel basis, and recalibrated as required, as subsidence monitoring data is collected and analysed.
2. The subsidence monitoring program should extend well beyond the expected angle of draw to capture potential effects and impacts out to at least a 45^0 angle of draw or greater, as required.
3. The monitoring program should be designed to incorporate special attention to the Mona Creek rock shelters during the mining of panels LW W9 and LW W10.

Groundwater Issues and Impacts

4. The north monitoring network be expanded by adding deeper nested piezometers next to MCMB04, and constructing new nested piezometers or a VWP monitoring bore close to the confluence of Mona Creek with the Talbragar River
5. The WMP and the SWGWMP should be updated within 6 months of the approval to:
    - ensure there are no inconsistencies between the latest modelling predictions and monitoring commitments,
    - reflect the current and expanded groundwater monitoring network,
    - increase the frequency of monitoring water levels in private water bores to minimum 6-monthly and preferable quarterly,
    - align the triggers and TARPs with the latest modelling drawdown predictions in private water bores,
    - increase the number of groundwater level trigger sites to include more alluvial, Triassic Wollar Sandstone and Jurassic Pilliga Sandstone sites north of the amended project area,
    - revise or develop appropriate response actions with appropriate timeframes.
6. The updated WMP should be the primary groundwater management plan and require DPHI approval.
7. A formal groundwater model peer review report should be provided that provides an assessment of the updated groundwater model against the available guidelines.
8. As new monitoring data are collected detailed reviews every three years of the adequacy of the groundwater conceptual model should be undertaken. Where deviations from expected behaviour for the Jurassic Pilliga Sandstone, the Triassic Wollar Sandstone and the Talbragar/Mona Creek alluvium and stream channel are observed, appropriate updates to the conceptual and numerical model should be undertaken to assist the interpretation of the new information.

7.0 REFERENCES

AGE (2022) Ulan Coal Mines Modification 6 (MOD 6) Groundwater Impact Assessment. Version 3.01 dated November 2022.

AGE (2024) Ulan MOD6 Amendment Groundwater Assessment. Version 3.03 dated 10 May 2024

Glencore (2024a) Water Management Plan. Version 11 dated 11 January 2024

Glencore (2024b) Surface Water and Groundwater Response Plan. Version 10 dated 11 January 2024

SCT (2022) 2021 Annual review of subsidence monitoring at Ulan West and Ulan Underground Mines. Report No. ULA5408, 23 March 2022.

SCT (2023a) 2022 Annual review of subsidence monitoring at Ulan West and Ulan Underground Mines. Report No. ULA5559, 29 March 2023.

SCT (2023b) Response to queries from IEAPM pertaining to subsidence predictions for Mod6. Report No. ULA5692, 28 November 2023.

SCT (2024a) Response to queries from IEAPM pertaining to subsidence predictions for Mod6 following site visit. Report No. ULA5692A, 11 January 2024.

SCT (2024b) Subsidence Assessment for Amended Modification 6 Application. Report No. ULA5698, 24 February 2024 (included as Appendix 4 to Ulan Mod. 6 Amendment Report).

Umwelt (2022) Ulan Coal Modification 6 – Underground Mining Extension – Modification Report dated November 2022

Umwelt (2024a) Ulan Coal Modification 6 – Underground Mining Extension – Amendment Report Final dated May 2024.

Umwelt (2024b) Ulan Coal Modification 6 Amendment – Underground Mining Extension - Response to Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development Advice, Final dated August 2024.

Umwelt (2024c) Ulan Coal Modification 6 Amendment – Response to Agency Advice. Letter to DPHI dated 20 September 2024.

APPENDIX A – DPHI REQUEST FOR ADVICE

APPENDIX B – PANEL BIOGRAPHY

Professor Bruce Hebblewhite (Ulan Mod 6 Panel Chair)

Bruce Hebblewhite is an Emeritus Professor and was formerly the Professor of Mining Engineering at the University of New South Wales until his retirement from UNSW in 2020. He has over 45 years of international mining experience, specialising in the fields of underground mining systems, geomechanics, mine safety and risk management. He has held senior positions with Australian Coal Industry Research Laboratories (ACIRL Ltd), has served 25 years at the University of New South Wales including 12 years as the Head of Mining Engineering, and was also the Secretary General of the international Society of Mining Professors. He was also the Chair of the NSW Independent Panel for the Southern Coalfield Inquiry (2008).

Professor Rae Mackay

Emeritus Professor Rae Mackay was until 2024 the Executive Chair of the Victoria's Mine Land Rehabilitation Authority. He has over 40 years of experience as a practicing engineer, hydrogeologist and academic. Before his previous role he was the Latrobe Valley Mine Rehabilitation Commissioner (2017-2020). Professor Mackay was also a member of the Victoria Technical Review Board, which had oversight of ground stability issues across the state's mines and quarries. Before moving to Australia, he served 15 years as the Head of Hydrogeology at Birmingham University in the United Kingdom.

Mr John Ross

John Ross is a Senior Principal Hydrogeologist with over 40 years' experience specialising in water resource, site contamination, infrastructure, mining and natural resource impact assessment and management. His specialty is sedimentary basin hydrogeology, particularly the Great Artesian Basin, Sydney-Gunnedah and Gloucester basins here in NSW. John has held specialist management roles in public and private corporations and environmental consultancies. He has a Bachelor of Science (Geology) and a Certificate in Engineering Hydrology and Groundwater Hydrology.

John provides technical hydrogeological expertise and advice across the spectrum of water resource development, environmental/water planning, assessment and management projects, including environmental impact assessments, environmental audits and technical peer reviews, monitoring programs, remedial action plans, modelling and groundwater licensing matters. John also has extensive experience in community and regulatory consultation across the eastern seaboard.

Emeritus Professor Jim Galvin (IEAPM Chair) – Ex-officio

Professor Galvin is an Emeritus Professor (University of New South Wales) in Mining Engineering and former member of the NSW Planning Assessment Commission. He has professional qualifications in science, engineering and mine management and extensive international experience in mining and geotechnical engineering, risk management and workplace health and safety. Professor Galvin is one of the world's foremost experts on underground coal mining and ground subsidence. He was a member of the Independent Panel for the Southern Coalfield Inquiry (2008), several subsequent reviews of mining projects in the Southern Coalfield and most recently, Chair of the Independent Expert Panel on Mining in the Catchment.