ULAN COAL

GLENCORE

2023 Annual Review

Attachment D: 2022 Groundwater TARP Triggers & Investigations

Table of Contents

1. 2022 Groundwater TARP Triggers & Investigations

During the preparation of the 2022 Annual Review, Ulan Coal Mines Pty Limited (UCMPL) engaged Australiasian Groundwater & Environmental Consultants (AGE) to prepare the *Ulan Coal Mine Annual Groundwater Review 2022* (the Report).

To address the trigger exceedances identified by AGE in the Report, in 2023 UCMPL requested AGE to investigate the following:

- investigation of VWP sensors in TAL-1 and UW4, which show slight but clear declines toward the end of 2022;
- investigation into the cause of groundwater level rise in PZ10B;
- investigation of groundwater quality exceedances in North Monitoring Network (NMN) bores within the context of regional water level trends;
- investigation of groundwater drawdown exceedances in NMN bores and PB18 including comparison to groundwater model results;
- investigation of water quality trigger exceedances in PB05; and investigation of water quality trigger exceedances (pH and electrical conductivity [EC]) in NMN bores PZ09A, PZ09B, PZ10A, PZ10B, PZ14C, PZ24A, PZ28B.

A summary from the *Ulan 2022 Groundwater Exceedance Investigation* (AGE, July 2023) is provided below.

1.1 Summary of Investigations

1.1.1 TAL-1 and UW4

The 2022 Annual Review highlighted unexpected behaviour in VWP arrays TAL-1 and UW-4, in the form of rapid declines in porewater pressure near the end of 2022. The accelerated decline is observed in four of the five sensors in TAL-1 (this fifth sensor being within the Ulan coal seam and depressurised) and two sensors in UW-4, which means it is unlikely to be due to equipment malfunction. The nature of the rapid declines is consistent within the respective sites but is not consistent between the sites (i.e., the behaviour in TAL-1 is not the same as the behaviour in UW-4). The difference in the behaviour between site would suggest they are not caused by the same conditions (AGE, July 2023).

Mining is approaching the location of TAL-1 and accelerated decline is predicted by the model. The small discrepancy in timing of depressurisation of the Triassic zones in TAL-1 may simply be due to discrepancies between the mine plan timeline and the modelled timeline, or because the model does not fully capture the timing of fracture propagation above the longwall panels, and fracturing is propagating faster than the model is predicting. Regardless, depressurisation at TAL-1 is expected and does not present unexpected harm to the environment (AGE, July 2023).

UW-4 is located at the southern end of the western extend of mining and directly over longwall panel LWUW11B. AGE have previously investigated drawdown in this area in the Ulan seam (as investigation

into PZ12B declines) and attributed groundwater level declines to localised depressurisation in the Ulan Seam, but the behaviour of the shallower sensors was not investigated (AGE, July 2023).

The behaviour in the shallow Permian sensors in UW-4 appear to correlate to CRD and climate patterns (with a slight temporal delay), where below-average annual rainfall occurred from 2013 through 2020 followed by above-average precipitation in 2021 and 2022. This response to climate implies the shallow sensors in UW4 are reasonably well connected to surface conditions and that the behaviour observed is not due to mining. The additional decline observed near the end of 2022 is within the natural variability of the record but will continue to be monitored (AGE, July 2023).

1.1.1.1 Recommendations

VWP sensor arrays TAL-1, TAL-2, and UW-4 should continue to be monitored and sensor data should be audited to confirm the sensors and loggers are functioning properly (AGE, July 2023).

1.1.2 PZ10B

AGE have speculated on the cause of the behaviour in PZ10B but cannot definitively attribute it to any specific drivers (e.g., climate or mine-related). The observed behaviour may be due to issues with the bore itself, such as fouling of the screen, siltation in the bore, etc., and does not likely reflect groundwater conditions in the aquifer (AGE, July 2023).

1.1.2.1 Recommendations

A camera survey should be completed on PZ10B, and an automated pressure transducer installed to investigate the erratic groundwater levels (AGE, July 2023).

1.1.2.2 Outcomes of PZ10B Recommendations Completed in 2023

On the 22/11/2023 UCMPL completed the investigation of PZ10A and PZ10B. The downhole camera inspection of PZ10A and PZ10B proved the integrity of the bore casings are intact. There was nothing to indicate the casing at either bore is leaking or had failed.

As a result of the downhole camera investigations completed on the 22/11/2023, UCMPL can confirm PZ10A is dry and confirmed the bottom of the bore hole was at approximately 165.1m with a standing water level (SWL) at approximately 165.0m. UCMPL have equipped monitoring bore PZ10B with a data logger. A logger was installed at PZ10B on the 30 January 2024 as agreed to by DPE.

1.1.3 Groundwater Quality NMN

In 2022, five NMN bores exceeded their prescribed pH triggers (PZ10B, PZ04A, PZ10A, PZ06A and PZ09A) and five exceeded EC triggers (PZ28B, PZ08C, PZ06A, PZ09B and PZ24A).

Bores proximal to the mine footprint are expected to experience variation in groundwater conditions related to groundwater level drawdown caused by mining. Rising trends in EC are expected as drawdown occurs in bores and salts become concentrated within the reduced water volume. All bores listed in Table 7.2 (PZ10B, PZ28B, PZ10A, PZ09A, PZ09B, PZ24A), except for PZ28B, are predicted to experience significant declines ranging from 24 m in PZ12B up to 204 m in PZ09B and therefore the water quality trends do not pose unexpected harm to the environment (AGE, July 2023).

Bore PZ28B is the only bore with a trigger exceedance that is not predicted to experience any drawdown do to mining. This exceedance was investigated by comparing EC, pH, and groundwater level data (Figure 8.7). This analysis does not show any clear trends in groundwater level or pH and no clear correlation to EC. The 2022 EC value of 2800 µS/cm is within 2 standard deviations of the mean of the data and not significantly high compared to the full historic range of EC in Jurassic NMN bores which, overall, report higher EC than Triassic or Permian NMN bores. The average EC for Jurassic NMN bores in 2022 was 2269 µS/cm, compared to 542 µS/cm for Triassic bores and 1095 µS/cm for Permian bores. Therefore, the elevated EC value in 2022 likely represents natural variation around historical averages for the geologic unit and does not pose environmental risk. Monitoring at PZ28B is scheduled to continue and new data will continue to be analysed (AGE, July 2023).

1.1.3.1 Recommendations

Field water quality data (pH and EC) should continue to be collected in NMN bores and ensure that proper Standard Operating Procedures are followed, and the bores are sufficiently purged before sampling.

1.1.4 Groundwater Levels NMN

Four groundwater level exceedances were identified in the 2022 Annual Review in NMN bores: PZ06B, PZ08C, PZ09B, and PZ12B. Three of these four bores recorded groundwater levels below the prescribed trigger levels during all four quarters of 2022. The exception was PZ09B, which dropped below its prescribed trigger value only for Q3 and Q4 2022 but follows a small decline since 2016. The prescribed trigger values used in the 2022 Annual Review were derived using the MOD4 numerical model, first developed in 2017 and published in early 2018, and representing the current approved model. Since MOD4 however, an updated model has been developed (MOD6 model) that better captures the mine plan, longwall panel development, and activity of production (dewatering) bore use. This updated model predicts considerably more drawdown in all four bores and drawdown greater than the observed drawdown. The additional drawdown predicted in the MOD6 model ranges from 20 m to 155 m greater than predicted by the MOD4 model. None of the four bores recorded drawdown exceeding that predicted in by the MOD6 model (AGE, July 2023).

Groundwater declines in PZ06B are expected as the coal seams are depressurised. Groundwater level triggers in the 2022 Annual Review were based on the MOD4 model results which do not accurately capture mine-related groundwater responses. The updated MOD6 model predicts much greater drawdown in PZ06B than the currently prescribed trigger value (AGE, July 2023).

The groundwater level exceedance in PZ08C was investigated in AGE (2020[10]) with the cause of exceedance attributed to groundwater abstraction in MG26 (a nearby dewatering bore), which was not simulated in the groundwater model. MG26 has since been incorporated into the MOD6 model and the updated predicted drawdown is now approximately 35 m for PZ08C. Since PZ08C was reported dry for most of 2022 and groundwater levels are only predicted to continue to decline as mining progresses, the full drawdown of PZ08C will not be observed (AGE, July 2023).

Significant declines are expected for PZ09B, as it is located near the mine footprint and screened within the Ulan seam. Groundwater level triggers prescribed to PZ09B using the original groundwater model underpredict the expected decline in the area and within PZ09B. The updated model predicts much greater drawdown (AGE, July 2023).

1.1.4.1 Recommendations

Exceedances of NMN bore groundwater level triggers reviewed in this report were due to the prescribed triggers being outdated compared to the most-recent numerical model. Trigger values for groundwater levels were re-derived in AGE (2023[11]) using the updated numerical model and these values should be used as the new triggers (AGE, July 2023).

1.1.5 Private Bores

Only one private bore, PB18, exceeded its predicted groundwater drawdown trigger in 2022. PB18 is located west of the mine boundary and since 2013 has recorded nearly 2 m of drawdown, at a roughly steady rate.

To investigate the drawdown in PB18, observed groundwater levels were compared to both nearby private bores and to the CRD. The results, show correlation between groundwater level trends in bores near PB18 (PB16, PB17, and PB19) and a falling trend in the CRD from 2012 through 2019 (indicating below-average precipitation). Groundwater levels often show a delayed response to climate trends, so it is reasonable to conclude that PB18, as well as surrounding private bores, are responding to climate trends rather than mine operations over the period from 2012 through present. Data will continue to be collected at these private bores to observe if groundwater levels recover following above-average precipitation since 2020 (AGE, July 2023).

Exceedances for pH and EC in private bores were derived in the 2022 Annual Review based on the full historic data record and criteria laid out in the SWGWRP. Only one private bore, PB05, exceeded its trigger value in 2022. The current prescribed pH trigger for PB05 is 6.9 and the 2022 measurement was 7.6, well above the historic median and previous maximum (AGE, July 2023).

PB05 was investigated in 2022 in relation to an EC trigger exceedance and it was concluded that the EC exceedance was not attributable to mining due to the coincident increase in groundwater levels because mine-related impacts would decrease groundwater levels. This conclusion is also pertinent to the pH exceedance in that it is not related to mining because of the coincident rising groundwater level (AGE, July 2023).

Furthermore, laboratory analysis of water sampled from PB05 in 2022 recorded a pH value of 5.9, which is aligned with historic data. Discrepancies between field readings and laboratory readings of pH are common, due to several factors, but the discrepancy here provides additional evidence that the observed spike in pH is not likely due to mining and instead may be due to sampling error, such as not fully purging the bore of three bore volumes prior to sampling. Data collection at PB05 will continue and results will be investigated annually (AGE, July 2023).

1.1.5.1 Recommendations

Groundwater level data should continue to be collected from private bores. Field water quality data (pH and EC) should continue to be collected in NMN bores and ensure that proper Standard Operating Procedures (SOPs) are followed, and the bores are sufficiently purged before sampling (AGE, July 2023).

GLENCORE