Ulan Coal Mine Mod 4 Submission (addition to presentation 19 June 2019)

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The analysis and comments in this submission draw from my personal and professional observations and PhD research on the Goulburn River, NSW. I have lived on the Goulburn River since 1975 and recently submitted a PhD thesis to Australian National University, titled;

"Changing land use in an uncertain climate – impacts on surface water and groundwater in the Goulburn River".

1. Introduction

Ulan Coal Mod 4 represents an expansion in coal mining that will prolong and extend the long term drawdown and depressurisation of the groundwater system while increasingly exposed to climate uncertainty and chaos. The impacts on groundwater and offsite discharge require a review and reassessment of associated conditions of approval and licences. The longer the regional groundwater system remains artificially suppressed by mining the greater the interference to the upper aquifer system, and interception of groundwater flows away from the both river and The Drip GDE. Treating this modification as an incremental insignificant impact is disingenuous. All mine modifications and expansions must allow further scrutiny and assessment as to the effectiveness and success of relevant past approvals.

The extraction of coal proposed in the Mod 4 expansion would be hydraulically down dip from previous workings. Extended mining in the northern area (LW30-33) prolongs the depressurisation and lowering of the regional groundwater system over the mine footprint and beyond for an additional 9 months[1]. Dewatering would require the continued interception and extraction of around 5,000 million litres of groundwater (> 18 ML/day), the treatment of water contaminated by the mining process with disposal of brine waste into the east pit (a key part of the current water management strategy) and discharge into Ulan Creek of up to 30 million litres per day mine water (maximum EC 900 µS/cm). Over 9 months this equates to the potential export of up to 18 tonnes of salt/day or ~4 - 5000 tonnes into the Goulburn Hunter River system.

2. **Curryall Creek and Green Hills Fault** (PPt - Slide 14)

Curryall Creek is a permanent spring fed creek providing good quality potable water that is readily accessible by locals and RFS from the Ulan Road at Green Hills. The catchment to this creek is located in the North-east, within the 5-10 m drawdown predicted for Triassic groundwater. This valuable natural community asset is at serious risk. In addition landholder access to potable

[1] Mine plan UG3; MOD 3 complete June 2028 – Mod 4 March 2029 = 9 months delay

groundwater sources are lost. There appears to be no assessment of this spring fed creek or the significance of the Green Hills and Curra Creek fault to groundwater flow and storage. This, plus the feasibility of the '*make good measures*' policy for landholder whose bores fail, needs to be fully investigated and resolved before any mining approval can be granted.

3. The Drip and Goulburn River

The repeated claim that the Drip is perched aquifer unconnected to the regional groundwater system is inconclusive and as such unproven. The lack of groundwater monitoring between UG3 footprint and The Drip (and Goulburn River) since underground longwall mining commenced in 1990s is a substantial omission. Only in 2016 was a vibrating wire piezometer installed (referred to as PZ29 and PZ36) to monitor more recent changes in the water- bearing strata.

Reported SWLs (mbgl[2]) for the different monitoring points for PZ29 are shown by UCML on hydrographs at a scale where changes <2 meters are difficult to detect (Figure 7.7 UCML 2018 AR). As stated in the Ulan Mod 4 Subsidence report depressurisation of the upper groundwater system may occur gradually over many years (SCT Operations Pty Ltd., 2019). The hydraulic gradient of the regional groundwater system over time has clearly been reversing resulting in a flattening of the hydraulic gradient to the north and west of the Drip (SLIDE 16 PPt). There appears to be a ~1 metre decline in Triassic water levels since 2016. Groundwaters from the upper aquifers are pulled towards the regional sink created by the mining via tortuous fracture network and natural joints.

4. Drip Hydrochemistry

The character of groundwater discharging at The Drip indicate a dominance of bicarbonate, sodium and magnesium ions, type Na (Mg), HCO_3, a slightly alkaline pH ~ 8 and a relatively low EC in the range 380-580 µS/cm. Calcium levels are similar to some of the NMN Triassic bores. Monitoring results of the groundwater type found at R755, PZ07C and PZ01A (NMN) exhibit similar characteristics to The Drip seep (see Table 1, Figure 1). This could be interpreted as the result of a mixing of Triassic groundwater with basalt groundwater associated with the extensive Tertiary basalt geology intrusions that lie about a kilometre to the north of The Drip. The longer the groundwater flow path and residency time the greater contact and interaction with geological strata and opportunity for ion exchange and mineralisation (Fetter, 2001; Freeze and Cherry, 1979). Alternatively fresh rainfall recharged Triassic springs fed from very local sources exhibit Na, Cl type water. These are located more often at higher elevations closer to the Great Dividing Range (Munghorn Gap and Wollar).

[2] mbgl- meters below ground level

Table 1: Hydrochemistry (mg/L) of groundwater from The Drip and NMN (Data sourced from UCML Annual Reports)

	Ca	Mg	Na	K	CO2	HCO_3	Cl	SO_4	TDS	EC	pH
R755	16	22	37	7	0	133	59	7	293	410	6.5
PZ08C	17	37	53	4	1	141	137	2	431	679	8.0
PZ07	15	25	47	3	0	144	83	3	364	693	6.5
PZ01C	29	14	49	13	0	121	90	10	347	560	6.7
The Drip	18	34	49	1	5	213	65	4	393	563	8.2

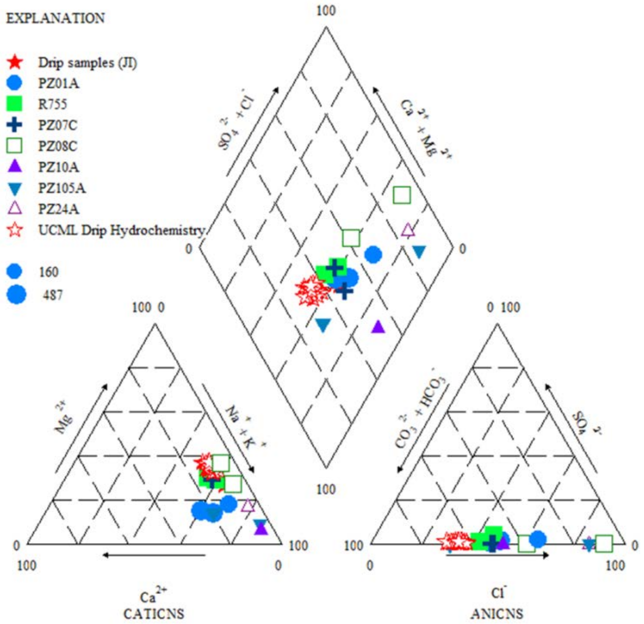

Figure 1 (SLIDE 19 PPt): Piper diagram showing the groundwater Hydrochemistry (% meq/L) from The Drip and the North Monitoring Network (NMN) collected by UCML

The diversion and interception of groundwater flow away from The Drip and Goulburn River threatens the long term viability and resilience of this highly valued groundwater dependent feature. Once impacts become obvious it will be too late to prevent permanent irreversible damage. The precautionary principle states if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. This principle is relevant when considering the risk from increased depressurisation and interference to the groundwater system and need to ensure the long term protection of groundwater sources feeding The Drip GDE and river base flow.

5. Modelling estimates of loss of base flow to the Goulburn River

The groundwater divide above Ulan West and UG3 extends well to the west of the Great Dividing Range or topographical divide[3]. (SLIDE 8 PPt). Thus the groundwater hydraulic gradient over most of the underground footprint dips and flows towards the Goulburn River. However the topographical divide has been used in the mine water modelling to allocate groundwater loss on a catchment basis (in accordance with licensing requirements for Water sharing Plans). The real loss of base flows affecting the Goulburn system must be greater than predicted by the current modelling.

The loss of natural low flows from groundwater inputs has meant the river is now reliant on mine water discharges. The proxy regulation of river flow can be seen by the close correlation between stream flow and mine water discharge at the Ulan DS gauge (SW02) both in 2014 (SLIDE 11 PPt) and more recently. When mine discharge ceased in late 2017, early 2018 the river stopped flowing and water levels in the river bed dropped below the sand to unprecedented levels. Conversely stream flow data 1968 -1982 at Ulan GS 210046 pre-mine (Figure 2) show persistent flow in the upper Goulburn at Ulan (GS210046). This includes one of the worst recorded periods of drought in the early 1980s (1980 = 449.7 mm) (NSW-Department-Water-Resources, 1994).

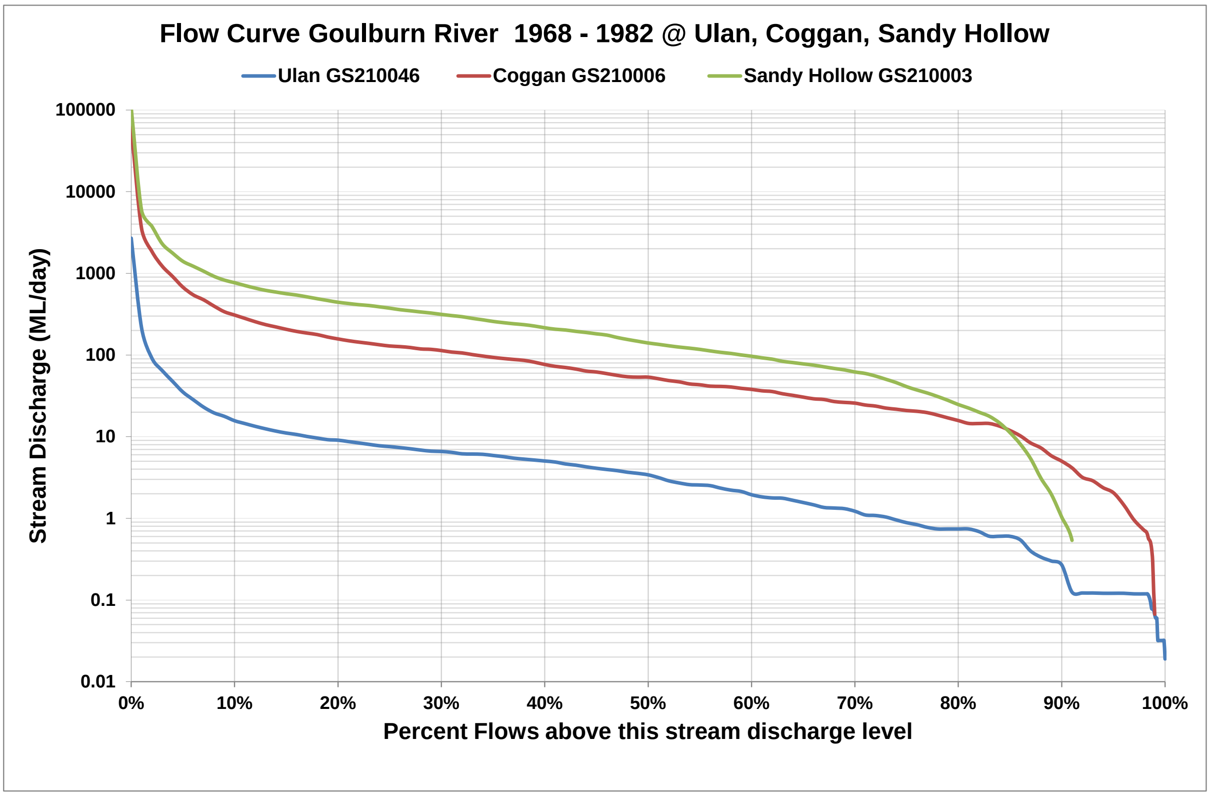

Figure 2 – Flow curve for stream discharge showing persistent flows recorded at Ulan (210046) but not at Coggan (210006) or Sandy Hollow (210031) between 1968 and 1982 (pre-mining expansion at Ulan)

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[3] Source: Appendix 3 Groundwater Assessment – Modifications to Ulan West Mine Plan 2015 – Mackie Environmental Research

6. Management of EAST PIT (SLIDE 21 PPt)

Management of east pit post mining is a significant issue and relevant to this latest MOD 4 expansion of which it is an essential component. The RtS (AGE s 3.9 p. 16) fails to include some critical inputs and outputs from the East Pit, claiming it is closed and water levels a function of rainfall, groundwater and evaporative loss. It is my understanding that the waste brine concentrate from the RO plant is pumped into the East pit. Paradoxically water is also pumped out of the East pit for discharge into Ulan Creek/Goulburn River. In order to comply with EPL394 (EC < 900 µS/cm) it is mixed with RO permeate and fresher groundwater (extracted from the UG workings). The aim appears to be export the maximum amount of salt to the Goulburn River held in the East pit by increasing the relative volumes of discharge water. The discharged cocktail of water with its significant salt load is exposed to evaporation and further concentrated during the 225 kilometre journey downstream to the Hunter River.

The outcome is UCML is disposing of 1,000s tonnes per year of additional salt into the Goulburn River that has been directly activated and mobilised by mining activities. To reduce this impact the salinity (EC) limit for all mine water discharges should not exceed 500µS/cm in line with background pre-mining salinity levels (NSW-Department-Water-Resources, 1994). The headwaters of the Goulburn River should not be used as a convenient dumping point to dispose of salt produced by coal mining.

There is also a potential for interaction between the river and the east pit through the old river bed river alluvium (bed of the River ~ 400mAHD). Connectivity and seepage of groundwater between these water sources is possible if groundwater levels recover to pre mining levels, or during an extreme rainfall event and flooding. The SWLs in the East pit are currently kept below 370 mAHD by active pumping to prevent leakage via the coal seam. Investigation into both the location of the old river bed alluvium and possible saline seepage from old open cut one is urgently needed and should be regularly reported. **Water quality in the east pit and surrounding alluvium has the potential to have a have an ongoing impact on water quality in the Goulburn River, especially post mining when active water management ceases. The management of water in the East pit requires investigation and long term solutions, especially considering the proximity of the Moolarben Coal mine UG4.**

7. Ulan Coal contribution to salt loads in the Goulburn River

Table 2 is a comparison of salt loads[4] in the Goulburn River at the three stream gauges for the period 2012- 2016 when real time continuous salinity monitoring commenced[5]. It shows the mean, geometric mean and median daily salt loads increased down-stream with increasing catchment area (as expected). The similarity of the median and geometric mean salt loads at a particular site suggests salt load is approximately log normally distributed. However the geometric mean salt loads/km^2/day in the lower catchment at Kerrabee and Sandy Hollow are 0.0066 and 0.0064 respectively, lower than for Coggan (0.0082). The higher geometric mean specific salt load at Coggan suggests an additional source of salinity in the upper Goulburn.

Table 2 Comparison of salt load results for three Goulburn stream gauges, for the period 2012-16

Property	Sandy Hollow	Kerrabee	Coggan
Salt Load (tonnes/day)			
Mean	99.7	71.0	47.7
St Dev	286.3	263.0	137.9
CV	2.9	3.7	2.9
Geometric Mean	45.1	31.5	27.4
Minimum	0.87	1.17	1.67
Median	46.3	36.3	24.4
Maximum	7528	7625	3369
Specific Salt Load (tonnes/km^2/day)			
Mean	0.015	0.014	0.014
St Dev	0.042	0.053	0.041
CV	2.87	3.71	2.89
Geometric Mean	0.0066	0.0064	0.0082
St Dev	±1.04	±1.05	±1.04
Minimum	0.00013	0.00024	0.00050
Median	0.0068	0.0073	0.0073
Maximum	1.106	1.540	1.009
Correlations			
Correlation EC-Q	-0.206	-0.315	-0.251
Correlation EC-ln(Q)	-0.516	-0.746	-0.821

Figure 3 plots the percentile distributions of daily SL/A for the three gauging sites for the period 2012-16. Coggan has a notably higher specific salt load than the other two stations below

[4] Salt load were based on daily EC and flow reported for each gauge. TDS was determined from the empirical relationship between measured EC and known TDS, using best fit linear proportionality representative water quality samples for the Goulburn , TDS = 0.68.EC.

[5] Analysis based on only available continuous EC data for Coggan that commenced in May 2012. Grab measurements of EC and spot measurements of Q are available 1969 to 2007 for the Goulburn at Coggan. No regular measurements of EC were collected during the late 1980s – early 1990s when significant discharge from mines in the upper Goulburn commenced.

percentile 0.4. The higher geometric mean SL/A for Coggan in Table 2 reflects the higher SL/A values below percentile 0.4 at Coggan gauge which is an indication of either mine water discharges or increased groundwater discharge. The magnitude of this extra salinity source can be estimated if it is assumed that the geometric mean daily specific salt load at Sandy Hollow and Kerrabee is the natural salt load at Coggan (0.0065 tonnes/km^2/day). If so the geometric mean daily salt load would be 21.7 tonnes/day. The actual geometric mean specific salt load at Coggan is 27.4 tonnes/day (0.0082 tonnes/km^2/day). This suggests an additional source of salt in the upper catchment of 5.7 tonnes/day, or 2,080 tonnes/year. The tonnage of salt exported by UCML in mine discharge water averaged 2,758 tonnes/year in 2012-2016[6] (12,871 tonnes over 4.7 years). In 2017 UCML discharged 5,606 ML of mine water into the Goulburn. At an average EC 800µS/cm this equates to over 3,000 tonnes of salt or 8.2 tonnes salt /day (UCML, 2017).

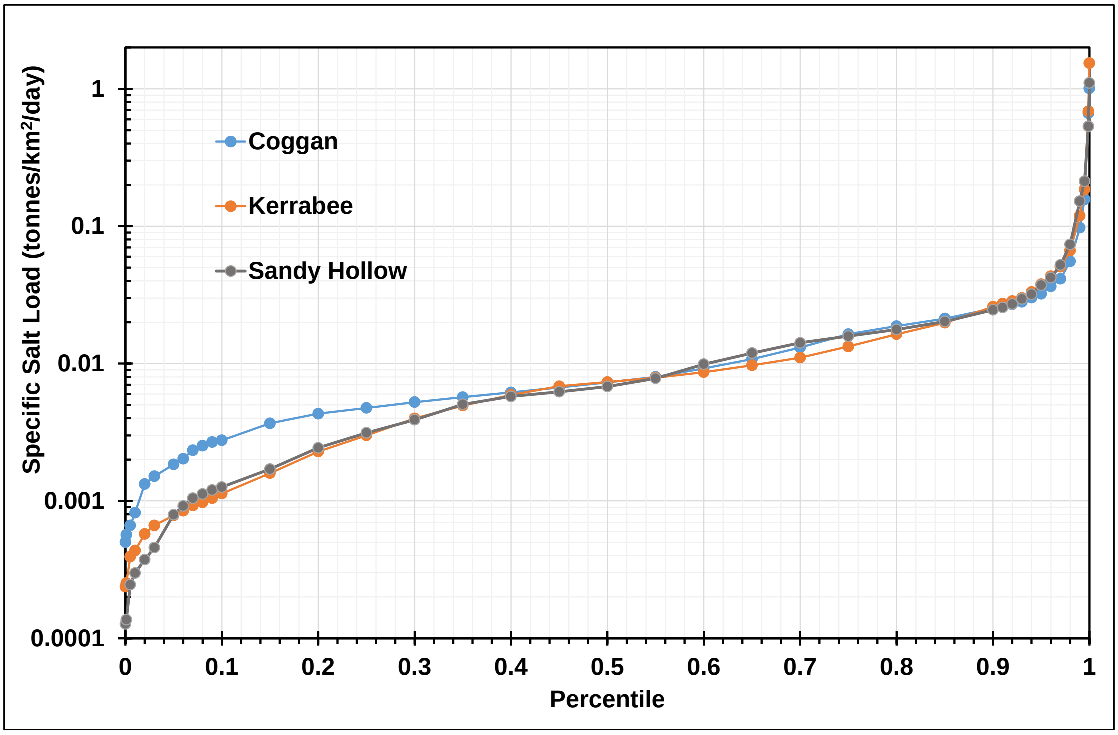

Figure 3 Percentile distribution of daily specific salt load at three gauging sites on the Goulburn River for the period 2012-2016.

In summary any approval of Mod 4 should be dependent on significant improvements to surface water and groundwater management. This includes;

- Lowering EC of discharge water to background levels 500 µS/cm

[6] Based on daily mine water discharge and EC measurements May 2012 to December 2016 as reported in UCML Annual Reports 2012-2016

- Prioritising the health of the Goulburn River over irrigation and mine operational needs. Low flows in the river must be sustained during dry conditions as was the situation pre-mining.
- The management of water and water quality in the East pit requires well planned, long term solutions. Disposal of RO saline wastewater into the East pit cannot continue.
- A plan for post-mining water management and an overall vision for the mined site to take us through to the post-coal era are urgently required.

The community want to see a future for this area that is sustainable, not watch a disaster unfolding, and a landscape robbed of its valuable water resources.

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NSW-Department-Water-Resources, 1994. Station 210046 Goulburn River at Ulan, Newcastle.

SCT Operations Pty Ltd., 2019. *Appendix D - Modification 4 Subsidence impact assesssment* Ulan Coal Mine Limited.,

UCML, 2017. *Ulan Complex Annual Review*, GLENCORE, Mudgee, NSW.