Water Management Moolarben Coal Complex
Stage 1 – legacy & potential impacts Stage 2
Key concerns:

1. Lack of confidence that the scale and cumulative impacts on the Goulburn River can be effectively managed

2. Lack of confidence in the effectiveness of regulations, modelling, monitoring, reporting and MCC environmental record.

3. Reliance on ill-defined parameters and criteria as a basis for adaptive management
Recommendation PAC convene:

*external expert technical panel to undertake an independent review and revision of Moolarben Coal Complex.*

*..assess risk and set clear criteria on which compliance and management is based*
Goulburn River is ‘gaining’ river system.

Water table (Triassic strata) sustains ‘base’ flows during dry periods.
Such a major expansion should not be assessed in parts – all stages and modifications should be reviewed.

Underground 4 (UG4) mine should not be ‘outside the scope of the Stage 2 project’.
Comments related to Planning Assessment

Dr KALF – KA Report Groundwater Adequacy Review

1. Modelling and inflow predictions
   Computer modelling
   ‘not reality’ – adjusted to fit data

2. Cracking of Triassic Strata impact on base flows
   There is no basis for assuming that subsidence will not crack the overlying Triassic sandstones and dewater the upper aquifer bearing strata

3. 2012 Submission – key issues not addressed
Reassess.
UG4 potential cumulative impacts on ground water and river

*NSW Office Water* -

“Triassic sandstone groundwaters depressurising to the fringe of the Goulburn River with subsequent loss of base flows”.

Requires an adaptive mine plan, that is capable of restricting or altering longwall configurations *before* permanent damage
'the Drip' is a perched aquifer system

"isolated" hydraulically from mining effects

General assumption
not based on site specific studies.

MCO Approval Conditions – Table 10 -water management performance measures

No more than negligible impact
on water supply to the Drip

Meaningless if not clearly defined criteria supported by baseline data.
THE DRIP Gorge  Two main Seeps  elevation  383-389 mAHDA

Impermeable ironstone river bed  -  foot of cliff
Case Study – The Drip GDE

ANU PhD study into “surface-groundwater interaction in the Goulburn catchment”

(ANU & NSW Office Water - Australian Research Council PROJECT ID: LP100100567)

- ‘window’ – into surface-groundwater interface
- Based on groundwater ‘signatures’ (major ions) (40 samples across catchment).
- Comparative analysis of water sources
- Hydraulic gradient – relative standing water level
Research findings:

• Drip is fed by a ‘permanent’ groundwater source
• multiple ‘aquifers’
• hydro-geochemistry ‘signature’ suggests wider recharge area

Strong bicarbonate signal and high pH
association with basalt geology > 1 km to the north

Water has similar chemical ‘signature’ to regional Triassic groundwater – (Pz24)
rather than localised short-term ‘rainfall’ driven

• Hydraulic gradient of the regional Triassic groundwater
  14m higher (SWL) than The Drip seep
Hydraulic Gradient ‘falls’ towards the River

Pz129 = 392 mAHD
Pz128 = 389 mAHD

The Drip Seep

River level 380 mAHD

Triassic groundwater level

A

B

Contour surface mAHD
Hydraulic head mAHD
Discharge
The Drip and the River
Groundwater Dependent Ecosystems

- Highly connected surface-groundwater system
- Dependent on groundwater during droughts

Over-extraction of groundwater

- Drawdown 15-20 Million Litres/day over decades
- 100-200 years for recovery
- Loss of Triassic groundwater could directly intercept flows to river, indirectly to The Drip

Impact of mine VOIDS - groundwater potable
Judge Preston: “In adaptive management,
the goal to be achieved is set
so there is no uncertainty as to the outcome
and conditions requiring adaptive management
do not lack certainty
but rather they establish a regime which would permit changes,
within defined parameters,

Commissioners found it necessary to set precise limits
‘adaptive management’ meant
changes to the mine management
not changes to the targets
Recommendations:

- expert review panel convened to assess risk and set clear criteria for compliance and adaptive management.

- Panel includes specialist in the fields of surface and groundwater hydrology, geomorphology and groundwater dependent ecosystems (GDEs).

- Panel members are independent of the mining industry with no real or perceived conflict of interests.

- Government regulators are adequately and effectively resourced.

Real time’ operational flow gauges are installed on the Goulburn River.
THE DRIP GORGE

Risk from future mining
People demand full protection

Within the Goulburn River National Park
Preamble: The key concern for the owners of GRSC is the long term protection and resilience of The Drip and Goulburn River (downstream from the UCML bridge) – maintaining ‘base flows’, water quality and the dramatic sandstone cliffs and escarpments. This landscape, influenced by the Triassic geology and its associated groundwater contains healthy intact riparian vegetation and unique geological and hydrological features such as the Drip and Corner Gorges that are outside the current boundary of Goulburn River National Park.

Surface and Groundwater Impacts from the Moolarben Coal Complex (MCC)

Key concerns:

- Lack of confidence that the scale and cumulative impacts on the Goulburn River surface and groundwater system from the MCC can be effectively managed under the proposed Approval Conditions
- Lack of confidence in the effectiveness of regulations, MCC modelling, monitoring, reporting and environmental record.
- Reliance of the draft Approval Conditions on ill-defined parameters and criteria as a basis for adaptive management

Background: The proposed expansion of the Moolarben Coal mine Complex (MCC) has a significant footprint and potential impact on the Goulburn River and water catchment (largest tributary to the Hunter River). Stage 2 (Open Cut 4) will more than double the disturbance footprint of Stage 1, while MOD 9 will involve a 25% increase in current open cut area (OC1-3) involving the removal of a major ridgeline, potential loss and interference of surface flows, increased risk mine water pollution (salts and sediment runoff) and the associated interference and extraction of groundwater that supports this system.

Such major changes and expansions should not be assessed by the addition of individual parts (projects - Stage 1+Stage 2+Stage1-MOD9) nor significant risks adequately managed if key areas such as Underground 4 (UG4) mine is assumed to be ‘outside the scope of the Stage 2 project’. The best available information indicates a greater potential groundwater impacts from subsidence impacts than recognised in the current planning approvals (UG4 approved 2007 – not commenced).

We support the NSW Office Water (NOW) recommendation that an independent review and revision of this project (Moolarben Coal Complex) by an external expert technical panel is essential to assess risk and set clear criteria on which compliance and management is based.

Recommendations:

- PAC to convene a suitable expert review panel in consultation with NOW that includes specialists in hydrology (surface and groundwater interaction), geomorphology and groundwater dependent ecosystems.
- Panel to be composed of consultant’s independent of the mining industry (no ‘real or perceived’ conflict of interests).
- Government regulators are adequately and effectively resourced, centrally located near mines and integrated with the Hunter catchment
The risks to the groundwater system of Underground 4 and conditions for an adaptive mine plan needs to be reviewed by an independent panel with the power to recommend the restriction or alteration of longwall configurations should the weight of evidence support unacceptable risks to the Goulburn River. That is the cracking of regional Triassic groundwater strata and subsequent depressurisation of associated groundwaters to the fringe of the Goulburn River (affecting base flows and flow gradients – i.e. reversal)

**Specific comments related to Department Planning Assessment**

**KA Groundwater Adequacy Review** (Dr Kalf 2012)

1. **MODELLING and inflow predictions**
   Modelling is not ‘reality’ but a simplified interpretation of a very complex system – a tool that relies on adjustment after the fact to help predict the next stage of impacts.
   KA makes the following comments (p.8)
   "both models cannot be considered to be a unique model simulation of reality".....
   different sets of parameters can seemingly ‘calibrate’ a model within an accepted error..”
   (using history matching)
   Computer modelling is far from perfect and requires continued updating, adjustment and verification using accurate measured monitoring data.

**ISSUES:**
Groundwater interference and losses will not be known until verification with reality (actual monitoring data) – i.e. ground-truthing. This appears to be in contradiction with the requirements under the Aquifer Interference Policy and has significant implications for licensing requirements under the Upper Goulburn Water Sharing Plans (NOW Submission 2012).

To rely on out-dated modelling predictions for UG4 located close to the river is a high risk strategy that may indicate only too late significant environmental damage necessitating expensive ineffectual remediation (e.g. Sugarloaf State Conservation Area subsidence) and permanent damage to this healthy natural system. There seems to be no basis for assuming that subsidence will not crack the Triassic sandstones above the Permian.

The draft approval conditions appear to rely on ‘suck it and see’ modelling without clear parameters being established.

2. **Triassic Cracking & Loss of Baseflows**
   - Dr Mackie (MER) states industry rule of thumb (vertical cracking 1-1.5 x width of the removed panel - UG4 depth 85-185 m, panel width ~208 m²)
     "cracking into the overlying Triassic is inevitable over 200m panels"
   - Subsidence history at Ulan Coal Mine (UCML) underground indicates dewatering of Triassic strata above 208m panels.
   - MER only agrees with RPS Aquaterra as to the extent of drawdowns predicted in the Ulan (Permian) seam (p.13)

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1 Kalf (2012) pg.6
2 Kalf (2012) pg. 2, 6, 14
• KA states incorrectly that **MCM underground mining has commenced** (p.6) Dundon-Aquaterra (RPS) indicated *that only 208m wide panels were used in Stage 1 in the northern part of the Moolarben site (UG4) and that no cracking to the surface has been observed.* ??

• KA does not consider the significance of cracking into the *saturated* Triassic strata in the CRITICAL area adjacent to the Goulburn River (Underground 4) and opposite The Drip.

• Dundon (Aquaterra) incorrectly assumes in Stage 2 EA³ that cracking above UG4 longwall panels *will not* affect the lower Triassic strata (and associated groundwater system)

**ISSUES** – Cracking of the Triassic strata above UG4 would affect baseflows to the Goulburn River - a ‘gaining’ river system.

Support the **NSW Office Water Submission (2012)**

*The management of impacts resulting from UG 4 must include an adaptive mine plan, able to restrict or alter longwall configurations should impacts on regional and localised Triassic sandstone groundwaters depressurising to the fringe of the Goulburn River with subsequent loss of base flows*. This may lead to a reversal of flow gradients resulting in the Goulburn River *losing into the mine goaf*.

**CONCLUSION:** This is a HIGH RISK venture considering there is an inevitable temporal delay in the impacts on groundwater flow directions and losses that could initiate a train of events – i.e. depressurisation of the Triassic system radiating out and capturing or diverting the source of water that feeds or supports the sensitive Drip GDE.

Please note the source(s) of The Drip seep *has not been proven* to be hydraulically separate from the Goulburn surface-groundwater system. This is an assumption not based on any site specific investigation but on minimal observations and extrapolations.

The requirement for *‘no more than negligible impacts on the water source for the Drip’* is a meaningless protection unless correctly defined and supported by site specific data (Draft (Stage 2 – Approval Conditions -Table 10 Water Performance Measures).

3. **KA COMMENTS** on J. Mullins Imrie Submission (2012) (p.9)

**ISSUE 1** - KA response did not address the key concerns (issues simplified and taken out of context). Recent site specific investigation by J. Imrie PhD research (ARC Project ID: LP100100567 on The Drip and the Goulburn system has identified the following:

• Hydraulic gradient of Triassic groundwater system
  - **12-14m above the Drip seep** to north river (Pz24, Pz04)
  - **9 -12 m above river bed** on southern side of the river (Pz128 & Pz129)
• There is a significant igneous plug (magnetic anomaly) and associated fault line **within the potential recharge catchment zone** for the Drip seep. It is entirely possible that these faults are influencing/directing groundwater flow paths.
• There are strong similarities between groundwater signatures (hydro-geochemistry) of The Drip seep with groundwater sources over 1 km to the north of the Drip (Pz24, Pz04).

³ Appendix E, S 6.2.3 p 58
In the event saturated Triassic strata are cracked above UG4 and significant depressurisation of the regional system occurs (as a result) the baseflows to the Goulburn River may be intercepted. Over time this would have consequences on the long term viability of the Drip as a permanent water seep and GDE.

**ISSUE 2 Damage to Goulburn River and groundwater system**

KA report misses the point entirely in the statement by saying that *baseflow is trivial compared to the surface-generated flows in the Goulburn River*. This is a misleading statement because what is key is the baseflow proportion to flows *in time of drought*.

The Goulburn River at Ulan lies within a semi-arid climate, both the riparian river system and extensive sandy alluvial bed are Groundwater Dependent Ecosystems (Serov, Kuginis et al. 2012). That is the riparian woodlands of *Angophora floribunda* and *Eucalyptus blakelyi* and understorey species along the river course plus distinctive Stygofauna contained within the alluvial aquifers. This system depends on the groundwater inflows to maintain baseflows *during extended dry periods and drought* (visible on the surface but also beneath the sandy surface). A reduction in the volume of low flows would have a direct effect on these GDEs.

**ISSUE 4 Over-extraction of groundwater resources**

The Goulburn River is a *highly connected surface-groundwater system* in a semi-arid climate (Macdonald B.C.T., White I.C. et al. 2009). Groundwater ‘make’ at UCML has resulted in the extraction of between 5-18ML/day for more than 20 years. MCC ‘water make’ may well be similar if their predictions about NOT cracking the saturated Triassic strata are proved wrong.

MCM & UCML modelling predict **100-200 years** for these groundwater systems to recover.

KA generally assumes all extracted groundwater is *brackish to saline* and not *potable or important water source*. (p.10)

Piezometers (MCM) PZ105b, PZ101, PZ103 (above UG4) have an salinity range 170 - 780µS/cm. This is good quality potable groundwater with a hydrochemical signature that links it to baseflows in the river.

4. **Impact of Voids & reclaimed mine open-cuts**

KA p. 13 Assumption that *‘after mining ceases recharge of rainfall will be higher than the surrounding rock strata and therefore it can be expected that water quality will improve within backfilled materials’*

Some initial ‘improvements’ in water quality due to removal of saline groundwater in the Wilpinjong catchment during mining cannot compare to the following decades (or centuries) of saline imbibed water seeping through refilled voids and pits of crushed coal mining spoil and washery reject material. How the subsequent throughflow and runoff of this saline water from the mined areas abutting (and within) creek-lines will be ‘mitigated’ or prevented is not adequately explained but relies on un-specified ‘adaptive management’.
CONCLUSION:

USE OF MONITORING, ADAPTIVE MANAGEMENT AND UNDERSTANDING OF RISK AND CHANGES IN THE LEGAL FRAMEWORK

It appears planning conditions applying to the MCC water management will rely mainly on ill-defined principles around adaptive management and general parameters that allow changes in the targets (allowable inflows, allowable depressurisation) to match what actually happens. According to SHCAG-v- Bowral (2013) this is not legally acceptable, Judge Preston said:

‘in adaptive management, the goal to be achieved is set, so there is no uncertainty as to the outcome and conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.’

The commissioners found that it is necessary for there to be precise limits imposed on the cumulative operations of the coal mine, and that adaptive management meant changes to the mine management not changes to the targets.

In relation to risk, the Law now says whatever the risk level, if it is reasonably possible to implement measures to reduce that ‘risk’, then those measures should be implemented.

Chief Justice Gibbs of the High Court of Australia:

"Where it is possible to guard against a foreseeable risk, which, though perhaps not great, nevertheless cannot be called remote or fanciful, by adopting a means, which involves little difficulty or expense, the failure to adopt such a means will in general be negligent"

The Precautionary Principle related to this consideration of Risk as explained by Preston CJ held in Telstra:

‘If each of the two conditions precedent or thresholds are satisfied – that is, there is a threat of serious or irreversible environmental damage and there is the requisite degree of scientific uncertainty – the precautionary principle will be activated. At this point, there is a shifting of an evidentiary burden of proof. A decision-maker must assume that the threat of serious or irreversible environmental damage is no longer uncertain but is a reality. The burden of showing that this threat does not in fact exist or is negligible effectively reverts to the proponent of the economic or other development plan, programme or project.’
Addendum:  
Examples MCO inadequate Performance and Management TRIGGERS

Trigger levels\(^4\) are set on water quality and groundwater levels to initiate further investigation into any significant variations. ANZECC (2000) guidelines state default criteria is only to be used where there is insufficient monitoring site-specific data (baseline).

- **MCC Groundwater quality Triggers** – MCO Water Management Plan (2013) has set trigger levels for investigation of groundwater EC (salinity) to equal ‘lowland rivers’ default\(^5\) of 2200 µS/cm.  
  e.g.UG4 – PZ 105 (b,c) has an EC range\(^6\) of 193 -275 µS/cm however the default trigger in the WMP is 2200 µS/cm. Applies to most groundwater monitoring bores in this unmined zone. Site specific data is available but not used.  
  This issue was raised in the December 2013 Community Consultative Committee (CCC) meeting the MCC response -  
  “DP&I has advised that baseline data is only acceptable pre MCO construction activities (pre March 2009). All data post construction is deemed “operational”. There is insufficient baseline data prior to MCO mining activities to set trigger levels.”  
  This claim was not been confirmed by the DP&I. MCO advised they would not be reviewing the trigger levels or baseline data.

- **MCC Surface Water Monitoring** and associated baseline data also contains anomalous or unrepresentative data on which baseline river water quality ‘trigger levels’ are based. For example baseline salinity for Goulburn River at The Drip includes maximum readings\(^7\) of 1500 – 1560 µS/cm.  
  Data over the 10 years shows EC range 550 - 950 µS/cm (include regular UCML releases of mine water). Note: EPL licences were suspended after a high rainfall period in 2010-11 to allow bulk mine water discharge.  
  MCO acknowledged use of ‘unverified’ field results in the RTS (MOD9 2013)\(^8\) but still includes this in stream data used to establish baselines.

**Modelling and verification of baseflows impacts.**  
Modelling requires ‘continued updating, adjustment and verification’.  
Baseflow modelling requires river flow instream gauging data plus adjacent alluvial piezometers however MCO has no ‘real time’ stream gauges in the Goulburn River on which to verify or adjust their models or accumulate data for when UG4 is mined. When this issue was raised at the December 2013 CCC, the reply

\(^4\) MCO - WMP p 58-61 s5.3 & S6.3 Table 26 & 2013 AEMR p.79.  
\(^5\) p. 59-60 WMP  
\(^6\) p. 119 MCO AEMR 2013- 9 years of data  
\(^7\) MCO AEMR p.58 Table 21  
\(^8\) Reading of 1,680 µS/cm at The Drip (SW01) recorded in the field 22 December 2009 - corresponding results from a more accurate laboratory analysis indicate a reading of 837 µS/cm. 1,560 µS/cm was recorded at The Drip Picnic Area (SW02) on 12th July 2006. No laboratory results were available for this reading.
“Baseflows reported from the groundwater model are not specifically calibrated against a baseflow recession analysis on a specific stream gauge. Baseflows were checked conceptually to make sure they are within realistic rates from visual inspection of the Goulburn River.”

There are more examples of unacceptable monitoring and releases of sediment laden water into the system. Enough to say these inconsistencies and inaccuracies in monitoring and setting of baseline data does not inspire confidence that future impacts will be detected and avoided before permanent damage is done to the river system.

Recommendations:

• Clear criteria is defined for the setting of trigger levels, monitoring data and verification of modelling predictions with results annually reviewed by an independent expert panel.
• Government regulators are adequately and effectively resourced, centrally located near mines and integrated with the water management in the Hunter catchment.
• Real time’ operational flow gauges are installed on the Goulburn River upstream and immediately downstream of MCO to measure flows, and water quality (above UCML Ulan Creek discharge point

REFERENCES:
Kalf, Dr F (2012) Moolarben Coal Project KA Groundwater Adequacy Review Update


MCO (2013) 'Moolarben Coal Annual Environmental Management Report 2012-2013.' Moolarben Coal Mines Pty Ltd YANCOAL.
MCO (June 2013) 'Moolarben Coal Water Management Plan.' YANCOAL.

Mignanelli, M (2012) NSW Office Water Submission MCO Stage 2 - Major Development Assessment