Submission to the EPA re BHP Endeavour Coal application to vary EPL 2504 West Cliff Mine

Dr Ann Young
22nd October 2012

Thank you for the opportunity to comment on this application, and for the information session held at Campbelltown on Thursday 18th October. I greatly appreciated the involvement of senior and expert EPA staff, as it indicated to me that the EPA is taking very seriously the views of community members.

The data presented by Dr Ian Wright confirmed my understanding that the discharge from Brennans Creek Dam (BCD) causes very significant pollution of the upper Georges River. His data showed that the plume had not diluted effectively by the site 13 km downstream of the confluence of Brennans Ck and the Georges River; and that the water quality in a very wide range of parameters was very poor in comparison to the Georges River above Brennans Ck and to the unpolluted OHares Ck.

Metals

On 4th October 2012, I visited the West Cliff site as a member of the Dendrobium CCC. I was surprised to be told that discharge from BCD is from very close to the base. The reason given was that the CO2 had not out-gassed from the deeper water and thus they could meet the pH requirement of the licenced discharge. But discharging from the base of any dam is a recipe for poor water quality - low DO, high metals, low temperature. Surely this is part of the reason the metals are high, as the water is from a poorly oxidised environment above the sediments which presumably have trapped most of the metals.

A high aluminium level is noted in the Application. Is this high Al derived from the polyaluminium chloride in Magnasol used to flocculate sediment before discharge to Brennans Creek dam? Whatever the source, it is just one of a number of metals of concern. Copper, nickel and zinc are identified also (Table 4.6 of the Supporting Material). The presentation given by Dr Wright painted an even grimmer picture:

- Al higher than the maximum reported in Table 4.6
- Zn, Ni also above the ANZECC trigger and well above the levels in comparable nearby streams

If indeed the current sampling by BHP is 12 times per year, and Dr Wright found one higher level in 6 days of sampling, then the frequency of sampling of the discharge would seem to be woefully inadequate to properly characterise the water quality.

I note the comment in the Supporting Material that the protective effect in respect of metals is a combination of adsorption onto particles, complexation of metals by organic matter (NOM), and complexation by inorganic ligands (chiefly carbonate). (Ecoengineers 2012 b). To be frank, this is not encouraging. It implies that avoiding adverse impacts is dependent on high turbidity (the particles) and high pH (the bicarbonate) or high dissolved organic matter (about which we have no information and might imply that there was an algal bloom). Protecting aquatic fauna from one species of pollutant by assuming high levels of others seems a very strange mitigation technique.

pH

The current licence condition requires pH to lie within 6.5 - 9.0. Why is the pH allowed to be so high? Given that most of the Upper Georges is in Hawkesbury Sandstone, and the Wianamatta Shale outcrops lie on the western edge, the pH naturally would be much lower than this. In general, I would expect it to be 5.5 - 6.5 and in fact I would not expect a pH of 8

- 9 outside a limestone area. The shales are unlikely to generate such pH except in very limited sites. I know they have siderite (iron carbonate) but this is as a minor component. Its weathering may well generate iron seeps but not consistently high pH. As there is often some pyrite (iron sulphide), acidic waters could occur with iron seeps also. Or - and in my opinion this is the dominant source - iron seeps could come from remobilisation of iron under the mildly acidic and anoxic conditions present in joints and bedding planes in the Hawkesbury Sandstone. Whatever the iron source, the pH is unlikely to be naturally alkaline.

I note the criticism of the OEH (2012) hypothesis that bicarbonate was the principal driver of ecotoxicity:
HCO3-concentrations in such waters ***decrease*** with increasing pH. For example, for a constant total carbonate alkalinity (Dissolved Inorganic Carbon; DIC) the mole ratio of HCO3- to DIC at pH 8.5 is about 0.96. This ratio falls steadily to about 0.82 at pH 9.5.

Similarly, it is well known that concentrations of the various cationic species of Al, Cu, Co, Pb, Ni and Zn known to be the drivers of ecotoxicity (Hofmann et al., 1995; Tessier and Turner, 1995; Paquin et al. 2002; Niogi and Wood, 2004) all ***decrease*** with increasing pH due to increased complexation by hydroxide ions (OH-) in the case of Al and carbonate ions (CO3-2) in the cases of Cu, Co, Pb , Ni and Zn-

My problem with these caveats is that they assume such high pH! The difference in mole ratio of HCO3 at 8.5 and 9.5 should not be the matter being considered. It is the ecotoxicity of metals and of high bicarbonate itself in relation to the metal levels and pH which would normally be experienced by the invertebrates in unpolluted streams which should be the consideration, not the fine details of differences at pH levels completely at odds with the normal environments of the aquatic fauna being investigated.

And indeed the Supporting Material supports this view when it comments that:
it is very important to appreciate that every single one of the now numerous laboratory ecotoxicological studies conducted on the $NaHCO_3$-type weakly saline mine waters characteristic of the Southern Coalfield over more than 13 years has invariably shown that both chronic (e.g. water fleas, mayflies) and acute (e.g. rainbow fish, glass shrimp) toxicity increases with:

- increasing holding time of the water;
- increasing loss of dissolved CO_2; and
- increasing pH.

Clearly, reducing the discharge of high pH water to Brennans Creek would reduce ecotoxicity.

The high pH is not characteristic of natural surface runoff but comes from the high bicarbonate level of water pumped from the mine. On the DCCC trip we were told that this was at the rate of 1.5ML/day, and that about 1 ML was returned underground from BCD for dust suppression and other non-potable uses. I understand that reducing pH of strongly alkaline water is not achieved by long retention, aeration or filtration or other simple means of water treatment. And clearly addition of strong acid would only create other problems. However I believe that the injection of significant volumes of highly alkaline water into a naturally acidic environment is completely unacceptable.

Salinity

The Supporting Material comments that:
In the absence of water discharges from BCD, Upper Georges River water quality is between 100µS/cm in high flow conditions to 1350 µS/cm during dry periods. The higher salinities can be ascribed to the presence of a number of naturally saline springs related to the local geomorphology and outcropping lithology whose presence would dominate pool water chemistry, particularly during prolonged dry periods (Cardno Ecology Lab & Ecoengineers Pty Ltd 2010)
The implication is that the salinities discharged from BCD are normal and compatible with the Upper Georges River. The data presented by Dr Wright do not support this implication.

Nor do other available data. While some salinity is observed in the region, it is by no means the norm.

For example, even though the Wianamatta Shale is now described as 'marine' and has high salinities, as most rainfall goes to runoff, the contribution of saline groundwater to streams from the Wianamatta can be quite small (see comments on p 23 of AGL's Groundwater Assessment for Northern Expansion of the Camden Gas Project February 2011). Although the deeper groundwater in the Wianamatta Shale near AOG Camden No 1 was high, the near-surface level was only brackish (477 microS/cm). In passing, I note that the pH was 4.7.

Ammonia

The Supporting Material comments that:

Under such conditions, the principal toxicity driver needs to be a species or suite of species whose expected ecotoxicity should rise for some well defined chemical, biogeochemical or physicochemical reason(s).

It was realised after PRP11 that a good candidate is ammonia (NH3), wherein the fraction of total ammonia comprised-of the ecotoxic un-ionized ammonia (NH3) species rises markedly with increasing pH.

Again, this assumes that high pH will continue.

Also it seems an unlikely explanation for the change of invertebrate fauna tracked by Dr Wright for over 13 km downstream of BCD. Surely any NH3 would have been lost by volatilisation long before that distance of travel. The data presented on laboratory studies on invertebrates concentrate on one pollutant. Could the synergistic effects of multiple stressors be a more likely cause of reduced populations of macroinvertebrates than simply one such chemical species?

Factors to be considered

- The issue of contention is that into an environment which is acidic, and usually of very low conductivity and nutrient status, is being discharged highly saline and alkaline water contaminated with metals that are barely detectable in the natural environment.
- While I understand that the EPA does not wish to prescribe multiple levels that would trigger potential prosecutions if breached and prefers to place the onus for avoiding pollution onto the company, the current levels need to be revised. Salinity is an obvious addition.
- I believe that the pH criterion needs to be changed from 6.5 - 9.0 to levels much closer to those of the surrounding environment. Values of 5.5 - 7.0 might be acceptable but the exact levels would need to be supported by data that I do not have readily available.
- I support ongoing PRPs to investigate ecotoxicity but this can put the cart before the horse. It seems clear that trying to tie down one single cause is not the way forward; and that valuable though ongoing research is, it's not a substitute for - nor should it be a precursor to - action on the licence conditions The discharge needs to be modified immediately to better reflect the quality of the waters into which it is going.
- Whatever is causing ecotoxicity - be it a single species such as HCO3 or NH3, or a synergistic interaction of the whole suite of identified pollutants - it is obvious that almost all the problem pollutants are derived from mine water rather than polluted surface runoff.
- While the Supporting Material asserts that Large reductions in releases from Brennans Creek dam would have adverse consequences on the aquatic ecology in the Georges River (Cardno Ecology Lab & Ecoengineers Pty Ltd 2010) I question this. Brennans Creek would have been an intermittent stream under natural conditions. The major input now is not from runoff from the surface area but the disposal of water pumped out of the mine.

Conclusion

I suggest that the whole issue of discharge of mine water to Brennans Creek be re-considered by the EPA. The treatment of surface water polluted by coal dust, oil etc is a fairly straightforward matter, but **the problem for Brennans Creek obviously comes from the poor quality of the water derived from underground. Hence the appropriate response is to require that discharge from Brennans Creek Dam of any water other than treated surface runoff be stopped.** This would mean that:

- water brought up from underground would be recycled underground or perhaps re-injected underground if there was an excess
- surface water on site would be collected, treated to remove sediment, oils etc and used for dust suppression and other non-potable uses, or mixed with mine water to be recycled underground
- BCD would change from a dual purpose water supply / pollution control operation to a single purpose water supply dam. It could still function to hold dirty water under intense rainfalls if it were to be managed as the final holding pond for water suitable to be re-used on site.
- the discharge licence from BCD would specify low TSS, low TDS, low EC, neutral or mildly acidic pH, and whatever levels for metals are considered reasonable.

Submission No 2 to the EPA re BHP Endeavour Coal application to vary EPL 2504 West Cliff Mine

Dr Ann Young
25th October 2012

You will be aware that the coal washery refuse for BHP's Dendrobium mine is emplaced at West Cliff. While I was reading the Area 3B SMP for Dendrobium, I was reminded that excess mine water is stored in old Kemira workings and then discharged. The Dendrobium AEMRs note that excess mine water is discharged at the Marley Place LDP5 - which is into Allens Creek estuarine reach near the steelworks complex at Port Kembla. The brine from the Appin mine water treatment plant is also discharged at LDP5. During rain events, water from the Kemira Valley settlement ponds also is sent to LDP5 instead of being discharged to the nearby creek.

The average pH of discharge at LDP5 is about 8 (8.2 in 2009-10; 7.8 in 2010-11). The salinity (electrical conductivity) is high (av 9353 microS/cm in 2009-10 due to the brine from Appin; 3360 in 2010-11). And limits are placed on the discharge for arsenic, copper, nickel and zinc as well s pH and oils and greases. As the discharge is into a saline environment with almost infinite buffering capacity, it is unsurprising that there is no conductivity limit.

In 2009-10 364ML was discharged and in the next year 1343 ML. I understand that about 1ML/day is discharged from Brennans Creek Dam into the upper Georges River, roughly equivalent to the 2009-10 discharge through LDP5.

It is anomalous that the company is required to discharge its excess mine water from Dendrobium not to the urban creek near the Dendrobium pit top but to the drain at Port Kembla, yet is permitted to discharge excess mine water from West Cliff to the upper Georges River. From Dendrobium, the mine water is sent after some treatment into a saline and alkaline environment in an industrial area, yet with limits on metals specified; at West Cliff it is discharged after some mixing and treatment into a naturally acidic and low conductivity environment without any metal levels being specified.

I reiterate my suggestion that no mine water from West Cliff be permitted to be discharged from Brennans Creek Dam.

Thank you
Ann Young