Submission to Thirlmere Lakes Inquiry

Tahmoor Coal Pty Ltd (Tahmoor Coal) welcomes the opportunity to make a submission to the Committee in relation to the Thirlmere Lakes Inquiry (Inquiry).

Tahmoor Coal values its environmental record and places great importance on environmental management. Having considered the Terms of Reference for the Inquiry Tahmoor Coal and also the level of community interest Tahmoor Coal engaged Dr Noel Merrick of Heritage Computing and Mr Tony Marszalek of Gilbert & Associates to consider the groundwater and surface water aspects of the Terms of Reference respectively. Dr Merrick and Mr Marszalek have each undertaken a comprehensive technical assessment of all the available data to assist the Inquiry in its deliberations. This includes undertaking a comprehensive review of the NSW Office of Water Report and also the report prepared by Dr Phillip Pells.

Both reports have similar conclusions in that the see the most likely cause of the lack of water in the lakes over the past few years is related to climatic conditions during this time.

We enclose the reports of Dr Merrick and Mr Marszalek as our submission to the Inquiry.

Since Xstrata Coal assumed ownership and management of Tahmoor Colliery in 2007, we have commenced the implementation of a comprehensive regional groundwater monitoring network. Since 2007, we have:

- Maintained and expanded the near surface (Hawkesbury Sandstone) groundwater water quality and level monitoring program, established over the current mining areas prior to the commencement of longwall mining within the Tahmoor North lease area in 2004.

- Established five (5) cement / bentonite sealed exploration bores down to the Bulli Seam in the Tahmoor North mining area, which were sequentially installed with vibrating wire piezometers arrays (6-8 piezometers per hole) between August 2008 and June 2010.
Established a further three (3) cement / bentonite sealed exploration bores down to the deeper Wongawilli Seam in the Tahmoor South (formerly referred to as Bargo) exploration area, which were also sequentially installed with vibrating wire piezometers arrays from June 2010 to date.

Proposed to install an additional seven (7) exploration bores with vibrating wire piezometers arrays down to the Wongawilli Seam when drilled in the near future, as part of the Tahmoor South exploration program.

Commissioned Dr Noel Merrick to develop and maintain a comprehensive regional groundwater model, utilising the increasing level of data now available from the expanding network of groundwater monitoring locations.

Tahmoor Coal is committed to the continual improvement of the groundwater monitoring network.

Finally we would appreciate an opportunity to meet with the Committee to discuss our submission. We also confirm that Dr Merrick and Mr Marszalek will both be available to attend this meeting.

We look forward to meeting with the Committee in the near future.

Should you have any questions regarding our submission, please contact Dave O’Brien on 0419 281 121 or email dobrien@xstratacoal.com.au

Yours sincerely

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Response to Questions from Thirlmere Lakes Inquiry

1. **If there is mine subsidence which is evident on the surface, will this also reduce the effectiveness of the Bald Hill Claystone as a seal? (see Heritage, p4).**

   Subsidence at the land surface is not sufficient evidence for reducing the performance of the Bald Hill Claystone. Its effectiveness as a seal will be reduced only if the fractured zone (above mine workings) breaches the claystone. This height (h) is related to longwall panel width (w) through the h/w ratio, which is expected to be about 0.6. For w=300m, h=180m. It should be noted that the Pells Report identifies h=60m. Figure 1 shows the clearance between the floor of the Bald Hill Claystone and the top of the fractured zone (if 180m in height). The clearance ranges from about 15m to about 50m over worked panels.

2. **Does the Newport/Garie Formation separate the Bald Hill claystone from the Hawkesbury? p3.**

   Yes it does. However, the formations are reported only in 45% (Newport) and 57% (Garie) of exploration holes. Where reported, the formations are only a few metres thick. These formations add an additional zone of lower permeability between the Bald Hill Claystone and the Hawkesbury Sandstone.

3. **Would you bring the bore logs for TNC26, PMX3 and CPN6, referenced to AHD?**

   See attached files TNC026.PDF, PMX-3 Extract.PDF, CPN6.PDF.

4. **Your Figure 10 suggests that there is a regional dip on the Bald Hill claystone towards the east of 2.5%. Is this correct?**

   It is of that order. Attached Figure 2 shows how the regional dip varies spatially.

5. **Where is the Thirlmere monocline in your stratigraphic section Fig 9.**

   At A4 scale, it is about 1mm to the right of the western edge of the Mining Footprint on the left figure and about 4mm to the right of the western edge of the Mining Footprint on the right figure. It coincides with a bulge at the base of the Bulgo Sandstone in the geological model.

6. **Is residual mass filtering really appropriate for temperature, which is a state not a mass or quantity?**

   Yes it is. It is nothing more than a low-pass filter that suppresses high frequency information. It is often called "cumulative deviation from the mean". When applied to rainfall, it has "mass" connotations.
Why was there such a low mine inflow in July 2010? (Fig 12)

Data for the period 1 June to 6 July 2010 was affected by a data logger malfunction, resulting in data loss. Pumping from underground would have continued at similar levels to that occurring immediately before and after the data loss (ie 3-4 ML/day)

Why do you say there is a groundwater divide between the lakes and mine when the contours (Fig 13) suggest otherwise?

The contours do not suggest otherwise. Figure 3 shows the contours at 2m contour interval. Although field measurements are sparse, there must be a groundwater divide somewhere near the lakes because the Blue Gum Creek elevations fall away to the west, while the rest of the land surface grades to the east. It is probable that the divide occurs at the elevated ridge between the lakes and the mine.

Why does the difference in the NOW shallow and deep bores piezometric surface indicate vertically downward flow and not two separate aquifers (p6)?

It would be more correct to say there is a potential for vertically downward flow. It is possible that the upper measurement is for a perched aquifer, but that would require the regional water table to be more than 13m deep (screen base) (p8).

How confident are you of your surveying of lakes given that Pells suggests Lake Barraba is higher and lakes Gandangarra, Werri Berri and Couridjah appear to be one connected system at higher levels with an outlet through Baraba to Nerrigorang to Blue Gum Ck.

Registered surveyors DTS were engaged to prepare a survey of the lakes. Comments on the accuracy of the survey are contained in the attached letter from DTS which reinforces our confidence in the survey. Contour plans (0.5m interval) are attached. The lowermost contours in each lake were obtained directly from survey. However, lowermost areas of most Lakes were unable to be reached by the surveyor, so levels were estimated by extrapolation - the lowest level in each lake was estimated to be 0.5m lower than the lowest contour. Upper contours were not continuous because of difficulties in obtaining a GPS fix due to heavy vegetation at some points in the Lake perimeters. The contours were completed/made continuous around the Lake perimeter by using contours from available 1:25,000 scale Department of Lands photos as a guide (smooth contours were drawn using computer software). A plan of these contours is also attached.

How sure are you that the outlet of Nerrigorang is less than 300mAH?

This was picked up by the survey referred to in our answer to Question 10 and we refer to the attached longitudinal section.

Your estimate of lake volume gives an average depth of 2m for all the lakes. Do you think this is correct, and why?

The estimated capacity of the 5 Lakes combined to their spill levels is approximately 1074 ML (refer report Section 8.2.2). The estimated surface area of the 5 Lakes to their spill levels is approximately 0.52 km². Dividing these two numbers gives an “average” depth of 2.07m. As indicated in Q10 above, the lowest points in each Lake were estimated to be 0.5m below the lowest survey contour. The combined calculated volume of the 5 Lakes at the first survey contour is 6.3 ML. If the lowest points were assumed to be 1m below the lowest survey contour (instead of 0.5m), this volume would increase to 12.6 ML - an increase of 0.6% of the estimated total Lake volume - a very small change.
The area of O'Hares Creek catchment is 73km² and Bungonia Creek has a catchment area of 164km², which is a bit larger than what we are looking at with Thirlmere Lakes. Do you think the order of magnitude difference in area will have an effect on transposing parameters i.e. is there a scale effect that has been ignored in your modelling?

The catchment of Thirlmere Lakes is estimated at 4.44 km². In terms of using the calibrated O'Hares Creek catchment yield model the following points should be borne in mind:

(a) The O'Hares Creek catchment is a nearby (regionally) hydrologically similar catchment with similar topography, geology and vegetation;

(b) As far as we are aware it comprises the best available data for estimating catchment yield to the Thirlmere Lakes;

(c) The Pells (2011) catchment yield models do not appear to have been explicitly calibrated to any recorded streamflows. Rather, the catchment yield model and the groundwater leakage rates appear to have been varied as part of calibration. If true we believe this would make our model prediction of Lake water levels less uncertain than the Pells model.

(d) Scale effects in catchment yields typically occur at more than two or three orders of magnitude, so there may indeed be some scale effect. This may introduce some uncertainty in historical predictions of lake water level behaviour but in our opinion would be likely to be less significant than the uncertainty over historical Lake level estimation and groundwater leakage rates.

How far west did drilling to relieve methane gas (coal seam gas) extend from the longwall nearest to the lake?

Pre-mining drainage of coal seam gas (predominantly carbon dioxide with some methane) occurs before the underground access roadways (first workings) are driven. This drainage occurs within the Bulli seam and is contained within the coal lease boundary. Drill holes are surveyed to confirm their location and length. The attached plan shows this drilling, first workings and proximity to the Thirlmere Lakes.

What disadvantages and advantages do you identify in the application of SWMM and AWBM to hydrologic modelling in the area?

We do not see any advantage in adopting either model. The SWMM model could have been used to calibrate against flows at the O'Hares Creek gauge and could also be used to estimate catchment yield to the Thirlmere Lakes. We used the AWBM because we are most familiar with that model, its proven use in Australian catchments and the published existence of calibrated model parameters for O'Hares Creek.

How did you determine the elevation of the lakes and outlets?

By terrestrial survey – see answers to Q10 & Q11 above.

Could you bring to our meeting the sequence of aerial photographs you used to estimate lake levels?

Yes copies will be provided to the Inquiry (please note these are from the Department of Lands and are therefore copyright).
How did you estimate height of water from the aerial photos? Was it interpolation of known points?

For each aerial photograph the following steps were taken:

a. The aerial photo was scanned and imported to a computer aided drafting program (AutoCAD).

b. The aerial photo was scaled in the graphics program using co-ordinates of prominent points (e.g. buildings) obtained from Google Earth.

c. Survey contours were overlaid on the aerial photograph for verification. Note that the aerial photograph did not always ‘centre’ over the Lakes’ location on the contour plan - this is due to inherent distortion of the aerial photograph (this was verified with Map & Air Photo Sales personnel at NSW Government Land and Property Information).

d. A line was traced around the boundary of the Lake water level on the aerial photograph and the surface area of the resulting shape was calculated. This surface area was used to find the lake water level by reading off RL vs Volume vs Surface Area table (derived from the Lake contour plan).

e. Where a number of aerial photographs were available for a given year, the photograph in which the Lakes were most centred on the photo were selected in an attempt to minimise known distortion effects.

As we understand it you allocated subcatchment components of each of the stores C1, C2, C3 prorata subcatchment area (p22)?

The three stores in the AWBM do not necessarily physically represent portions of the catchment. The capacities (C1, C2 and C3) and relative areas (A1, A2 and A3) are determined as part of the calibration process using multiple linear regression techniques. The calibration is undertaken to obtain a best fit to the recorded data (i.e. to minimise error).

As we understand it, the estimated recharge rates (table 5.3, p27) were required in order to fit the model to the historical water levels?

Yes these were set in order to obtain a reasonable fit to the estimated historical Lake water levels. By setting these to vary only between lake full and empty levels (i.e. head dependent) these were constrained to be fairly uniform rates. These were not varied with time. Importantly there is no trend evident in the model in over or underestimating the estimated historical Lake water levels with time, which would be the case if there was a significant increase in recharge rates with time (refer p53 of Gilbert & Associates Report).

A pumping rate of 5.5ML/d over 6 weeks would represent a volume of 231ML, or 20% of lake volume based on your estimate of 1074ML or several times the volume of Lake Nerrigorang (50ML on your Fig 3.1)?

We agree that this rate is high. This is based on a rate of 1000 gal/min given in Pells (2011) – and we adopted this for consistency. In the model this pumping “demand” is imposed upon Lake Nerrigorang but is only withdrawn when there is predicted to be surface water in the Lake (no withdrawal occurs when the Lake is dry). In the model, Lake Nerrigorang was unable to keep up with the 5.5 ML/d demand, as evidenced by Table 6-2 which shows that only 16ML was withdrawn for the period of simulation. This highlights the difficulty in relying upon anecdotal evidence.
Figure 1. Estimated Clearance Between the Floor of the Bald Hill Claystone and the Top of the Fractured Zone (Assumed 180 m Height)
Figure 2. Floor Elevation Contours for Bald Hill Claystone [mAHD]
Figure 3. Observed and Inferred Water Table Contours in the Vicinity of the Lakes [mAHD]
Attachment 2 - Full Contour Plan including Extrapolated Contour (Lt Brown colour)
Attachment 3 - Plan Location of Lake Nerrigorang Longitudinal Section (North is to the right)
Attachment 4 - Lake Nerrigorang Longitudinal Section