



Blue Mountains Conservation Society Inc

ABN 38 686 119 087

PO Box 29 Wentworth Falls NSW 2782

Phone: (02) 4757 1872

E-Mail: bmcs@bluemountains.org.au Web Site: www.bluemountains.org.au

Nature Conservation Saves for Tomorrow

**Thirlmere Lakes Inquiry,
PO Box 99,
PICTON, NSW 2571**

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By email: thirlmere.lakes@environment.nsw.gov.au

Summary comments

- This is not an Executive Summary. The Thirlmere Lakes Inquiry Draft Report (TLIDR) has been closely evaluated to produce this submission. Much of this submission's content will only make sense when read in conjunction with the TLIDR.
- Sections of the TLIDR should be rewritten to embrace all the original information given to the Committee of Inquiry (CoI) and to accommodate matters raised in formal submissions to the TLIDR.
- The TLIDR is environmentally disappointing in that it has investigated much, resolved little and recommended a multi-component protracted research program, to be funded by State and Federal governments, in order to answer the questions for which the CoI was appointed.
- The State Government and the pertinent coal company could be satisfied with the TLIDR in that any resolution to the matter of the anomalous lake-levels has been deferred for 5 years or more.
- Significant deficiencies of the TLIDR are its failure to apply the Precautionary Principle in the face of uncertainty, and failure to recommend urgent remediation.

1. Introduction

The Society appreciates the opportunity to comment on the Thirlmere Lakes Inquiry Draft Report (TLIDR) dated 12 May 2012, though regrettably not available for evaluation until 27 June 2012. As always with such documents, the time permitted for evaluation of the report and the additional references paid for by Xstrata (heavily cited in the TLDR and, until relatively recently, not available to community organisations)¹ is grossly inadequate.

Although the TLIDR is termed a draft document, it is very clear from the language used that the Committee has made up its collective mind and envisages few, if any, changes. The Society will therefore focus on the broader deficiencies of the report and the adopted methodology rather than deal with matters of fine detail. The principal objective of such an approach will be to demonstrate that there is a strong case for re-writing many sections of the TLIDR such that misconceptions, the inadequate use of the Addenda to the Pells Report, and the tendency to discount aspects of the historical record, do not lead to seemingly biased findings and recommendations for protracted monitoring and research. The Society is particularly concerned that such an approach might be adopted while the Lakes and their ecosystems continue to deteriorate, and mining (the elephant in the room) continues unabated.

¹ The reports are now available at <http://www.environment.nsw.gov.au/water/Thirlmeresubmissions.htm>

2. The Society's previous submission to the Committee of Inquiry (CoI)

The Society's original submission (ThirlmereLakesInquiry_BMCSSubmission_120111.pdf) requested additional information and commitments from the Committee's members as follows:

"Although it is possible to do a Google search to find out more about the appointees, the Society hopes that a future release will clarify the particular expertise of the appointees. The Society also hopes that a resume for each member will be presented as a matter of public interest, and that each member will stipulate that he or she has no direct or indirect conflict of interest, either now or over the preceding five years."

Some additional information was subsequently available on the Inquiry's website, but stipulations regarding actual or potential conflicts of interest were never provided in respect of either current affiliations or those in the five years preceding appointment to the CoI. This apparent reluctance caused concerns prior to the release of the TLIDR. These concerns have now been heightened by the approach adopted in the analysis of data² and the tenor of the language as the CoI tiptoes around the 'elephant in the room'.

The Society concurrently emphasised that: *"...the findings...should not be compromised by political and/or economic and social constraints."* Unfortunately, any committee conducting such an inquiry would necessarily be cognisant of the political and economic considerations arising from a clear statement that Longwall mining has significantly affected the lake-levels. The present CoI (irrespective of its degree of independence) demonstrates such awareness by emphasising the role of climate, hinting at other possibilities, and recommending protracted periods (up to 5+ years) of further investigations to develop a definitive understanding of the fluctuating lake-levels. This is admirable! Yet the CoI must be fully aware of the range and time-variability³ of natural and man-induced factors influencing the groundwater regime and lake-levels such that approximations and probabilities will necessarily usurp the notion of 'definitive attributions'. In effect, the CoI has ensured that the political decision is deferred indefinitely, and that the Longwall mining and its 'community benefits' will continue, irrespective of the environmental cost.

In relation to Pells Consulting's *Report on the water levels of Thirlmere Lakes, October 2011*, the Society contended that it was (and still is!) a thorough piece of truly independent research work. **This report and its three addenda**, which were also sent to the CoI, provide a strong case for Longwall mining having a significant impact on the lake-levels. The Society reiterates that *"...there is a mining impact and this will continue while the coal seam is depressurised by extraction and mine-water make is necessarily discharged."* The Society acknowledges that the **precise percentage** of the lowered lake-levels ('lost' water) attributable to mining has not been determined, but again emphasises that *"...detailed work has demonstrated an impact from proximal Longwall mining, and that this will continue at least until mining ceases, the workings fill with water and are effectively re-pressurised, and the pre-mining flow-lines of the hydrologic regime are re-established or at least approximated."*

The bases for the CoI questioning aspects of the Pells report will be examined in subsequent sections. It is nevertheless noted that several of the adverse comments in TLIDR apparently stemmed from failure to read the addenda and/or basing the comments on reports prepared for Tahmoor Colliery (Xstrata) by Gilbert and Associates and Heritage Computing⁴, both of whom may not have accessed the addenda.

3. The TLDR Sections 1-4

3.1 Sections 1 and 2

These are background information and, although necessary, contribute little to an understanding of the factors potentially affecting the water levels in Thirlmere Lakes.

² Executive Summary p5: *"The Committee's attitude to data and information was to cross-check them with other data and information in order to test the veracity and robustness of the information."* This has resulted in the rejection of critical information, rather than (a) attempting to resolve which data-set has the greater credibility, and (b) positively applying the Precautionary Principle.

³ For example: there is a significant probability that another El Niño event will commence (or is even now in its early stage) over the next few years; there is no doubt that if Longwall mining continues the volume of 'sump-like' goaf will increase and the amount of mine-make will proportionally increase

⁴ The Gilbert and Associates and Heritage Computing reports are referred to in the CoI draft report and are respectfully dated April 12, 2012 and March 16, 2012.

Section 2.5 is of note in that it attempts to prepare the reader for the main findings of the report by stressing hydrologic complexity and the expensive and time-consuming nature of obtaining data. In essence, despite the large amounts of historical and anecdotal data, and the NOW and Pells reports, the TLIDR focuses on and in fact contributes to the uncertainty theme as a basis for carefully hedged findings and recommendations for extensive amounts of additional investigation.

3.2 Section 3 – Geomorphology and Geology

The following comments are made in relation to apparent misunderstandings:

- The stratigraphy is well known, but the CoI seems not to appreciate that many of the units have a variable thickness, coupled with lateral facies variations and lenticularity. The BHC for example varies from 6 m to >67 m in thickness (TLIDR p45). The tendency to treat the stratigraphy as a layer-cake is a misconception.
- The stratigraphic variability affects dip such that although a regional dip of 2-3° ENE is useful in constructing cross sections, local dips may vary from a couple of degrees westward to >5° ENE⁵. The main point here is not to get too precious about the depth of the BHC below Lake Nerrigorang, as drawing lines on cross sections with gross vertical exaggerations (e.g. Heritage Computing Fig. 9) involves interpretations in the original logging and interpolations between the boreholes.

Regrettably, the principal reason for the ‘preciousness’ would seem to involve discrediting the Pells Report’s BHC exposures in the valley walls above PMX3 and CPN6 and its postulation regarding erosional breaching of the BHC beneath Lake Nerrigorang. This is despite TLIDR p57 stating that the BHC could be between 48 and 78 m below Lake Nerrigorang and despite the Pells Report conveying uncertainty in Fig. 3.3 p35 and emphasising that a 50 m valley-depth was an approximation on p54.

The Society considers it ridiculous that approval has not been granted (to date) for Pells Consulting to test the postulation by drilling at no cost to government.

- In pp72-75, the TLIDR develops an hypothesis reflecting a convex stream profile and upstream-erosion capacity that questions the stability of the sediment accumulations beneath Thirlmere Lakes. This leads to further speculation about the age and origin of the lake-floor sediments and the bed-rock longitudinal profile, and terminates with a series of questions which could be the basis for a substantial research program (pp83-88).

The Society is not keen to add to the speculations because the TLIDR hypothesis could be wrong in that Blue Gum Creek would need to eat back into the steeply convex part of its profile before significantly affecting the shallower upper end (TLIDR Fig. 3-14). Furthermore, the Thirlmere Lakes system may have once flowed eastward and its headwaters may have been captured and extensively modified by westward flowing systems. All of this is fascinating, but it effectively ‘muddies the waters’ by increasing the levels of uncertainty and detracting from the proposition that mining is currently impacting the water levels in Thirlmere Lakes. Indeed, it is most debatable whether a research program designed to answer the TLIDR’s questions (pp83-88) would significantly further an understanding of mining’s impacts on the Thirlmere Lakes’ hydrologic regime.

3.3 Section 4 – Hydrology of Thirlmere lakes

Much of this section 4 involves discussion about the dimensions of the surface and groundwater catchments, annual precipitation and which rainfall gauges are strictly representative of the Lakes. It then deals with the concept of flood- and drought-dominated regimes in subsection 4.3 and the implications for Thirlmere lakes in subsection 4.3.1

Three important opinions are offered:

- (a) TLIDR p107: *“All the available evidence from the temporal rainfall data suggests that the pattern of drying identified for Thirlmere lakes over the last 100 years is entirely consistent with the pattern seen in other lakes and in the rainfall record.”*

⁵ (a) The dip values exclude the steeper monoclinical values, and (b) the local dip directions disregard can vary widely due to lenticularity, particularly when the latter is expressing cross lamination.

- (b) TLIDR p108: *“The last 4 months have been very wet. Community concerns that the lakes are not filling, even if not to capacity, seem to have some veracity, especially as the Committee’s observations suggest that Lake Nerrigorang is not filling as much as the other lakes and appears to rapidly decline in level following initial inflows.”*
- (c) TLDIR p109: *“The low water levels in Thirlmere lakes at present are consistent with the drought-dominated regimes of the last two decades. However, this correlation does not prove that the climatic regime is the sole reason for the low water level in Thirlmere lakes at the present time.”*

Despite item (a), it is clear from item (b) that the CoI accepts the reality of declining lake levels and the anomaly of even more rapid decline for Lake Nerrigorang; and it is recognised in item (b) that current correlation with a drought-dominated climatic regime does not preclude other contributory factors such as mining.

Without being too critical, it has taken to this point in the TLIDR to establish the generally accepted reason for which the CoI was set up!

4. TLIDR Section 5: Lake levels and hydrologic models

4.1 Section 5.2.1 – a simple hydrologic model

Based on a simple hydrologic model the CoI concludes that (p118) *“...the lakes are sensitive to rainfall, runoff and evaporation. Slight changes in evaporation or runoff coefficients (changes in evapotranspiration and groundwater loss) would tip the system from either a positive or negative storage system to the other.”* Although the model assumptions are simplistic, the finding that altering one of the variables can radically change the Lakes’ behaviour is not surprising. **However, the Society emphasises that one of the variables includes groundwater loss and this could easily result from a mining-induced reorientation of the flow-net as envisaged in the Pells Report.**

As an extension of the model, the CoI suggests (p118) that because the ratios of catchment area to lake area are ‘similar’, the responses of the lakes to rainfall should be ‘similar’. The CoI concludes from this that if one lake is behaving differently from the others *“...something may be influencing the rainfall-runoff-storage-evaporation relationship”*. **And as indicated in the Pells Report, this could be due to changes in the flow-rate due to erosional breaching of the BHC beneath Lake Nerrigorang.**

4.2 Section 5.2.3 – a revised model for Thirlmere Lakes

TLIDR pp121-122 indicates that a number of conceptual models have been proposed (including that in the Pells Report) in order to inform computer modelling of lake-levels through time. It then states that all such models are *“abstractions of reality”* and emphasises both the extreme difficulty of ascertaining the necessary parameters and the need for calibration. The limitations of the modelling approach, as used in the Pells Report and by Gilbert and Associates⁶, are widely recognised and are specifically acknowledged by these authors, but can nevertheless provide useful information if used appropriately.

In order to demonstrate the limitations of the methodology, the CoI produced its version of a conceptual model (the revised model) and demonstrated the dearth of supporting data (pp123-124). The approach was seemingly designed to justify the recommendations for a major work programme to support hydrologic modelling as embodied in the TLIDR Executive Summary and Section 9.2.

The matter of lake-levels as a reference is returned to in TLIDR sections 5.3 and 5.4. In this respect, as has become increasingly apparent from reading through the TLIDR, the report is grossly repetitive and in need of severe editing. The author(s) seemingly work on the principle that repetition turns opinion into fact.

4.3 Section 5.3 – Analysis of lake-level data

Section 5.4 – Evaluation of hydrologic models

4.3.1 Section 5.3 – Analysis of lake-level data

⁶ Gilbert and Associates, *Thirlmere Lakes Surface Water Balance Assessment*, 12 April 2012, 70pp. Report prepared for Tahmoor Coal Pty Ltd.

Apparently as a basis for reinforcing the limitations of modelling, TLIDR section 5.3.3 pp130-133 examines the anecdotal, historic and terrestrial imagery data relating to lake-levels. The principal thrust of this critique is that the data are inaccurate. Thus (p133): *“The suggestion the Committee wishes to make is that, even with terrestrial imagery, there are difficulties in assessing lake levels and anecdotal evidence needs to be checked at several levels. The Committee does not wish to be misinterpreted as saying the anecdotal and terrestrial imagery is of no value...However, a great deal of caution has to be applied, including to our own interpretations.”*

The problem of lake-levels is again referred to in TLIDR section 5.3.4 pp148-150. Thus (p148): *“The general trend in water levels shown in Pells (2011, p. 31) between 1955 and 1990, which is one of variations of the order of 1 to 2 metres, with a peak in 1974, is confirmed by the Committee’s analysis. The Committee also agrees that from 1990 to the present the trend has been one of rapidly declining water levels. Where the Committee disagrees is the actual height of the water levels at specific times.”* In the ensuing two paragraphs and in the Table on p150 the issue of inaccurate lake-levels was pursued through a comparison with Gilbert and Associates’ data: *“The most obvious difference in Pells (2011) and Gilbert and Associates (2012) is one of elevation, which the Committee has commented on previously. It appears that Pells (2011) has overestimated the height of lake levels.”*

The CoI noted in its conclusion (TLIDR section 5.3.7 p153): *“There are differences between lake levels estimated by the Committee, Pells (2011) and Gilbert and Associates (2012). Lake levels are critical in the modelling presented by Pells (2010) and Gilbert and Associates (2012). Uncertainty in the lake levels increases the uncertainty of the results obtained by the modelling.”*

The Society has no disagreement with the need for accuracy in the lake-levels as a basis for undertaking the hydrologic modelling. The Society also understands that the CoI elected to not undertake its own modelling. However, when there is very close agreement on lake-levels, it would seem sensible to undertake modelling and evaluate the outcomes. This was emphasised by Steven Pells⁷ as follows: *“The modelling philosophy adopted by Gilbert and Associates is similar to that adopted by Pells Consulting. The differences arise primarily on how each modeller chose to run the model, not on differences in mathematical routines or significant differences in data...It is agreed that there is significant uncertainty in the model”, however “its purpose is not to provide a deterministic review of historical levels, but to provide a tool to compare key historical events against recent ones.”*

Criticism regarding lake-levels in the Pells Report (2011) was covered in a response by Steven Pells⁷ to comment by Gilbert and Associates, in a meeting between Pells Consulting and the CoI⁸, and in Addendum 3⁹ to the Pells Report. The Society understands that the surveying amendments and Addendum 3 were in the possession of the CoI at least one month before the TLIDR was produced.

The Society strongly believes that the CoI’s Final Report must be amended to acknowledge the correct data and suitably annotated to avoid repetitive emphasis on the Pells Report’s lake-level inaccuracies.

4.3.2 Section 5.4 – Evaluation of hydrologic models

This section adds little that is new. Pages 153-154 go through the problems of hydrologic modelling with an insufficient number of parameters. Pages 155-156 are then used to comment on the two models in the Pells Report and on the model employed by Gilbert and Associates. The criticisms of the Pells Report’s hydrologic modelling that have surfaced throughout much of TLIDR sections 4 and 5, and were in some places made through comparison with Gilbert and Associates’ results, now become a more general criticism which effectively implies that the modelling to date is worthless.

In elaboration, TLIDR p156 states:

“All three models use lake level data with potentially significant errors. All three models fit to either the total data set of lake levels or a more recent component of it. There is no “right” hydrological model for Thirlmere Lakes. Pells (2011) argues that his models show the lakes have fallen more than predicted. He presents an argument that this is due to groundwater loss, particularly in Lake Nerrigorang. Gilbert and Associates (2012) argue that their model shows that the variations in lake levels are as predicted by climatic factors.”

⁷ Pells S, Comments and responses by Steven Pells, July 3 2012, on: *Report Thirlmere Lakes Surface Water Balance Assessment* Prepared for Tahmoor Coal Pty Ltd by Gilbert and Associates

⁸ Pells P, Thirlmere Lakes Record of Meeting, NPWS Office, Goulburn Street, Sydney – 23 April 2012; quote from item 5 of this document: *“Philip Pells noted that the lake level record...in the report of October 2011 has been revised based on the, now available, more accurate absolute level data for the lakes.”*

⁹ Pells P, *Thirlmere Lakes – Addendum 3 to Report of October 2011*, 47pp including appendices, 16 May 2012: refer to item 3, Corrected survey data.

“The Committee saw no benefit in trying to repeat the modelling with yet another model. The data uncertainties do not warrant another attempt and nothing would be proved. Furthermore, the hydrologic system is probably non-stationary as a result of the impact of climate change, most notably temperature rises, the impact of bushfires on rainfall, runoff and evaporation regimes and possible changes over time in catchment configuration. A non-stationary system implies that model predictions using past data sets may not be relevant to present conditions.”

The CoI then suggests there is need for a more complete hydro-meteorological set to remove “...some of the ambiguity in assessing how well the models fit the lake-level data...”, and then lists such data as could be collected over the next 3 to 5 years.

The Society is concerned about the simplistic dismissal of the results of the hydrologic modelling for the following reasons:

- Philip Pells, the Principal of Pells Consulting, is highly qualified¹⁰ and the Pells Report is a self-funded research investigation – it was not funded by Tahmoor Colliery (Xstrata) or ACIRL – it was not done for political reasons – it is not a case of ‘he who pays the piper calls the tune’!
- The Pells Report (pp73-74) demonstrates a full appreciation of the limitations of the modelling undertaken, but despite this believes that (p74) “...while the modelling is not deterministic, it presents a broad, yet rational, representation of the catchment processes.” Furthermore, the findings were made (p74) “Notwithstanding the uncertainty in modelling and subsequent to numerous iterations using various parameters...”
- The Pells Report (p74) actually states that the models which approximate historical lake-levels from 1900 to 1990 (before the onset of Longwall mining) do not simulate current (2000-2010) levels in that the lakes are lower than predicted. Conversely, when tweaked to match current levels, the models under-predict the historical levels. The interpretation of this behaviour and the timing-difference between Lake Nerrigorang and the other Lakes potentially comprises a fundamental indictment of proximal Longwall mining.
- The Gilbert and Associates’ report emphasises the uncertainty in the modelling, but notes that (p33) the model predicts recent lake-levels fairly closely, but does not consistently under-predict historical levels. In relation to this, Steven Pells⁷ noted that Gilbert and Associates replicated current levels based on climate alone, but this was achieved at the cost of their model inconsistently mismatching historical lake-levels¹¹.
- Gilbert and Associates also emphasise (p60) that their results do not eliminate the possibility of mining having an effect on lake-levels.
- In its haste to advocate long-term costly investigations, the CoI seems blinded to the implications of the Pells Report and the simple ways of testing them.

5. TLIDR Section 6: Geohydrology of Thirlmere Lakes

5.1 Sections 6.1 and 6.2 – A groundwater regime and mapping

Section 6.1 is an elegant portrayal of the obvious. The second case (shallowly dipping beds) is a less dramatic example of what happens all along the Western Escarpment of the Blue Mountains and wherever shallowly dipping permeable sequences are deeply incised by strike- trending watercourses¹².

The Society, although recognising that Fig. 6-2 is diagrammatic, makes the following comments:

- The hill tops would typically be controlled by the shallow dip of the rocks rather than being horizontal.
- The magnitude of Gv (the leakage through the aquitard) will reflect the relative hydraulic conductivities of the rocks above and within the aquitard – the CoI has **elected** to make the leakage small.

¹⁰ See <http://www.pellsconsulting.com.au/> and <http://www.psmsyd.com.au/pdf/cv/Philip%20Pells%20May%202008.pdf>

¹¹ See Gilbert and Associates p60 for their wording and interpretation.

¹² This is the general case; so, for example, as one moves around the edge of the Sydney Basin to where dips are southward or northward the incised (often subsequent) water courses will trend east-west.

In section 6.2.1 p 164, having stratified the bore data according to whether it was 1979 and older or 1980 and younger (i.e. into pre-mining and mining), the TLIDR states: “*Splitting the groundwater data set at 1980 does not necessarily imply that changes in groundwater levels between the two periods reflect the impact of mining. A number of factors may be impacting on groundwater levels in the post 1980 period, including reduced rainfall and increased pumping from the groundwater reservoirs. Mining is a potential factor, but the data do not prove a direct relation.*”

The Society acknowledges the cautionary statement as quoted, but takes exception to mining being termed a **potential factor; it is a factor!** There are of course many factors which **may** be lowering the groundwater levels in the 1980+ period. **Perhaps an assessment of the relative merits of the more probable factors should be presented in the TLIDR.**

Based on the ages of private bores, there does not seem to have been a massive post-1979 increase. So as the per annum entitlements are usually small, increased pumping (other than as related to mining) is likely to be a minor factor¹³. **Conversely, the magnitude of mine-dewatering entitlement suggests that this could be a major factor¹³.**

Nevertheless, **if** the BHC aquitard shields the upper hydrologic regime (including bores in the Hawkesbury Sandstone) from the impacts of mine-make dewatering, this would lessen the impact. The Society doubts that it does but will return to this in **sections 6.2.2 and 7.1.**

Section 6.2.2 p168 and Fig. 6-9 deal with what the CoI terms flow-lines. However, there are two concerns with this approach:

- There appears to be an assumption that all the boreholes represent a regional watertable¹⁴, whereas in view of the differing depths, drilling dates and uncertainty about the levels of aquifer intersected (TLIDR pp163-164 – this assumes that many of the bores used by the CoI were also used by Heritage Computing as implied in TLIDR p168) this assumption is unjustified.
- The flow-lines¹⁵ as portrayed require that the flow vector parallels the contoured surface (which must effectively be planar). There can be lateral deviation but no vertical deviation as the retention of parallelism is paramount. The consequence is that the CoI has automatically excluded the possibility of downward flow towards the mining. The paradox arises because the CoI has used flow-line for what is actually the flow-trend, where the latter is defined as the orientation of a vertical surface containing the flow-line.

5.2 Sections 6.3-6.6 – Groundwater and monitoring east of the Lakes and the recognised impacts from mining

Reference is made to the BHC being a significant aquitard (TLIDR p174). The Pells Report (p78) strongly emphasises that it is an aquitard and Heritage Computing (p10)¹⁶ states: “...*I know of no-one who would describe the Bald Hill Claystone as anything other than an "aquitard". The Bulli Seam Operations model...clearly allows water to pass through the Bald Hill Claystone - it is not assumed to be impermeable*”. There is clearly acceptance that the BHC is an aquitard. The question from the viewpoint of modelling behaviour is its vertical hydraulic conductivity relative to the overlying rocks

The Society will return to this and other aspects of the BHC in **section 7.1.**

¹³ TLIDR p162: “The private bores have been drilled over several decades, with the earliest recorded bore drilled on 1st October 1943 and the last recorded bore drilled on 18th August 2008. Private bores are used locally for stock and domestic water supply, with irrigation or poultry farming being the primary registered groundwater use. Groundwater entitlements attached to these bore licences typically range from 1 ML/year up to 19 ML/year, although Tahmoor Colliery has a groundwater extraction licence of 1,642 ML/year for mine dewatering.”

¹⁴ If all the bores are not tapping the same aquifer (even though they may be in the same stratigraphic unit) some bores may be showing the watertable for an unconfined aquifer, whereas others could be measuring the potentiometric surface for differing levels of confined aquifer. Contouring such differently sourced data is meaningless. See <http://web.viu.ca/earle/geol304/geol-304-c.pdf>

¹⁵ Contours on a watertable, a potentiometric surface, or a no-flow boundary above a confined aquifer define an equipotential line which lies within a three-dimensional equipotential surface. When the contoured surface is planar and the equipotential surfaces are normal to it, a true flow-line (or flow vector) will parallel the contoured planar surface and have a down-dip direction orthogonal to the contours (equipotential lines). See <http://web.viu.ca/earle/geol304/geol-304-c.pdf>

¹⁶ Heritage Computing (Dr N Merrick), *An Appraisal of Groundwater Conditions in the Vicinity of Thirlmere Lakes, NSW*, 16 March 2012, Report Number: HC2012/3 for Tahmoor Coal Pty Ltd, 33pp.

Obvious impacts from mining and directly ascribed to the passage of the longwalls are:

- **TLIDR p74:** in 1975-1978 the construction of the drifts and shafts significantly lowered the watertable within the Hawkesbury Sandstone.
- **TLIDR pp185-186:** recognises drops of up to 10 m in groundwater levels within the Hawkesbury Sandstone during the passage of certain longwalls but this is followed by total or partial recovery once the Longwall has passed. This behaviour of dilation causing groundwater lowering, followed by full or partial recovery is common.
- **TLIDR pp186-188:** confirmation of losses in some private bores as also recorded in the Pells Report (pp81-83). A linkage is suggested to the passage of longwalls in several cases. In one instance, the sudden loss of water (at least a fall of about 15 m) which took place in 2003 and probably relates to the passage of LW 21, had partly recovered by 2012 but was still down 10 m relative to 2003.

The Society sees these relatively short-term effects as having little **direct** bearing on the Pells Report's mechanism of flow-path reorientation influencing water levels in Thirlmere lakes. **Nevertheless, they are part of the broader picture of mining-induced destabilization of the hydrologic regime** (see below).

- **TLIDR pp185-186:** a vibrating wire piezometer recorded a depressurization of nearly 18 m in the BHC and 13 m in the overlying Lower Hawkesbury Sandstone, although the company consultant suggested that this might be an equilibration effect. With somewhat greater certainty¹⁷, Heritage Computing states, in relation to the shallowest Hawkesbury Sandstone records at five vibrating wire installations (see Heritage Computing Fig. 20), that (p10): *"There is no definitive mining effect at any bore, and most bores are consistent with the residual mass trend."*

The fact that other bores report no impact is consistent with: the fracture-controlled anisotropic nature of water sources (aquifers) in the Hawkesbury Sandstone, the proximity of bores to zones of structural weakness (see Pells Report p81 and TLIDR p188), and the shorter- and longer-term effects of the passage of successive longwalls on the structures and anisotropic flow regime.

The CoI principally notes in relation to the private bores that (p186): *"The water level data...confirm a groundwater gradient towards the east."* This is an important component of the CoI's 'working hypothesis' in TLIDR section 9.1.3.

The other impacts from Longwall mining relate to the caving and subsidence-related effects of Longwall mining, and the amount of mine-water make and discharge (refer to section 6.2 below).

6. TLIDR Section 8: Land-use and its impacts

Much of this section is repetitive. It covers many impacts which were addressed previously. All are possible in terms of a cumulative impact on Thirlmere Lakes, but few merit too much consideration. Indeed, it would seem that some are reported just to show that the CoI has given them consideration; others would seem to be there as 'red herrings' to take the reader's mind off the 'elephant in the room'.

6.1 TLIDR Sections 8.1-8.3 – various 'minor' impacts on the Lakes

In relation to agricultural, industrial and recreational aspects the TLIDR (p206) believes there is no evidence that these *"...have significantly influenced the surface hydrology or the volume of water in the lakes for the last 3 to 4 decades. Prior to the 1960s, the impact would have been marginal and the Committee was unable to see any link between water extraction in the early European history of the lakes and present low lake levels."*

The Society agrees with this.

Similarly, in relation to the possible effects of anthropogenic climate change, vegetation removal and bushfires, and rainfall changes stemming from land-use, TLIDR (p208) states: *"While there is some uncertainty about the impact of bushfires on the hydrology of Thirlmere Lakes catchment, there is nothing to suggest that any other land management practices within the catchment would have changed the rainfall-runoff regime of the catchment."*

¹⁷The society has no information about the basis for this 'certainty' beyond Heritage Computing's stated interpretation of Fig. 20 – BMCS in fact finds that there is some support for a mining impact (though not **definitive!**) and some support for an influence by the rainfall mass trend.

The Society accepts this. Anthropogenic climate change may have impacts over the longer term, but there is no reason to believe that the current drying of the Lakes is attributable to it.

With respect to groundwater extraction other than by mining, there are only 4 or 5 small bores directly affecting the topographic catchment for the Lakes, so their impact will be negligible. There are however many bores in the Hawkesbury Sandstone in the region to the east (i.e. down-dip) of the Lakes. Unfortunately, without information on the volumes of water pumped over time and how the groundwater levels have varied, the CoI (p209) was unable to assess the impact of the bores on the watertable and hence on the loss of water from Thirlmere Lakes. The CoI (p209) noted that pumping rates would have increased during the drought.

The Society recognises the potential of groundwater extraction to contribute to the lowering of lake-levels. However, the Society believes, based on the extraction limits (see section 5 and footnote 13), that it is a relatively minor background function which does not significantly explain the Lakes' behaviour over the past 10-15 years.

6.2 TLIDR Section 8.4 – Mining

6.2.1 Subsidence and the 'upper' and 'lower' hydrologic regimes

TLIDR pp210-225 deals with the model of subsidence associated with Longwall mining, and then looks at the possible interaction between 'lower' and 'upper' hydrologic regimes, usually separated by a less permeable unit such as the BHC or, in the Western coalfield, the Mt York Claystone. Much of the content is standard information. The Society will, however, highlight a few aspects.

- Caving and subsidence results in fracturing and marginal faulting which propagates upward until it (in terms of the conventional wisdom) is unable to induce more fracturing and the stresses are dissipated by flexing in a more ductile sequence such as the BHC. Above this ductile zone in the shallow part of the sequence fractures extend down from the surface.
- The ductile zone enables consultants to argue that there is no fracture-linked connectivity between the upper and lower zones and the consequence is that there is no vertical hydraulic connectivity between the upper and lower hydrologic regimes.
- This means that the mine-make derives from the coal seam(s) and any other fracture-affected aquifers within the lower hydrologic regime – it is not from the upper hydrologic regime so (under conventional wisdom) surface water and groundwater in the upper zone do not catastrophically enter the mine!
- Fracturing in the upper zone may cause some losses of surface water and shallow groundwater (perhaps compromising creeks and swamps), but a convenient consultant can usually make a case that losses are minor, the fractures will 'self-heal', and partial or full recovery will eventuate. Damage has to be substantial and blatantly obvious before it is accepted as 'real'!
- **From the Thirlmere Lakes viewpoint, the longwalls do not undermine the Lakes and so direct water losses through subsidence-induced fracturing and vertical connectivity (catastrophic or otherwise) is not an issue.**
- The question then becomes whether it is **an indirect process whereby the watertable to the east (down-dip) of the Lakes is being lowered, thereby accelerating eastward groundwater flow from beneath the losing Lakes;** lowering could result from: (i) a degree of vertical hydraulic connectivity between the upper groundwater regime and the longwalls (see section 6.2.2), and (ii) localised dilational processes in the Hawkesbury Sandstone (see section 5.2).
- And finally, it could be as advocated in the Pells Report – flow-net reorientation consequent upon creating a 60 m high Longwall 'sump'.

In the context of the above dot-points, the CoI emphasised (p218): *“What is undeniable is that there is structural deformation and this does, whether permanently or temporally, either to depth or to a shallow extent, impact on surface and groundwater hydrology and the connection between them.”* The CoI (pp222-224) then cited conflicting pieces of research regarding vertical connectivity.

The Society confronts a similar problem in relation to the Mt York Claystone (MYC) in the Western Coalfield. All the consultants argue that there is no connectivity based on the cessation of fracturing below the MYC and the restricted depth of penetration of surface fracturing and upsidence effects.

6.2.2 Mine-water and discharges

TLIDR p226: “Mine water inflows prior to 2009 were estimated based typically on pumping hours and nominal pumping rates; **hence it is difficult to make an accurate assessment of variability in mine water make over time**¹⁸. From January 2009 meters have been used to take direct measurement of dewatering volumes as water is extracted from the workings, and **daily inflows have typically been between 2 and 4ML/day**¹⁸. Water extracted from underground workings is pumped to the surface where it travels through a series of dams and then either evaporates, is reused on site or discharged via Tea Tree Hollow into Bargo River.”

The Society acknowledges the limitations of the data. Nevertheless, it is reasonably clear from TLIDR Figures 8-12 and 8-13 that mine-make slowly increased from 1997 through to 2003¹⁹ (**period I** – when Austral Mining was operating close to Thirlmere Lakes), was then (**period II** – mainly under Centennial’s control) fairly flat until May 2011 (Fig. 8-14), and then slightly declined under Xstrata’s management (**period III**). The following relationships **may** be significant:

- There is an inverse relationship between mine-make and rainfall during period I, and a less obvious direct relationship with rainfall over periods II and III.
- There is a crude relationship between mine-make and distance from the Lakes to the extent that LWs 14-21 were all moderately close and comprised a block of progressive extraction during period I, whereas LWs 22-26 are increasingly more distant to the NW and comprise part of a second block equating with periods II and III. The panel separating the two blocks was not exploited and presumably constitutes at least a partial barrier to the free flow of mine-water between the two blocks.

Information from Heritage Computing (p8) in relation to Bores P7 and P8 has pertinence: “Bore P7 shows clear mining effects from Longwall 24A, 25 and 26. The water level at P7 starts to recover about midway through the excavation of Longwall 25, a little earlier than the residual mass curve would suggest if the recovery were due to rainfall recharge. This indicates that recovery is occurring as mining moves away through lateral groundwater recharge. Although the amplitude of variation is about 15 m, the water levels at the start and end of Longwall 25 mining are the same. Bore P8 shows no definitive response to either mining or rainfall.”

Also of pertinence are the remarks by the CoI (pp231-232) which indicate that the Hawkesbury Sandstone is partially depressurised by the passage of the longwalls, that this has effectively steepened the gradient to the ‘east’, but that it is unknown whether this is permanent or temporary.

Based on the above two dot-points, the Heritage Computing data, and the CoI’s comments, the Society suggests that the groundwater system has three distinct but obviously interacting components. They are distinct because of differences in flow-rate, chemistry and scale over which they are operating. They are interacting because layers of lower permeability (‘aquitards’) may limit flow-rates and modify flow-paths, but they do not preclude ‘local’ changes from being accommodated within and integral too a broader system.

The three groundwater systems are:

- (a) **G1:** disruption and depressurisation of deeper aquifers by Longwall coal extraction, followed by collapse of overlying strata and development of the zone of intense and linked fracturing – this focuses groundwater from along the coal and from suitable parts of the overlying sequence – it is kept ‘open’ by pumping out the mine-make – the system will operate as long as pump-out continues, after which (given time) it will progressively fill with water and re-pressurise. Because of the way the system is driven by mining and pump-out it will have a high flow-rate (2-4 ML/day perhaps). In summary, the G1 system is high-flow, of mine-scale, and of mine-duration plus 20+ years recovery time.
- (b) **G2:** Longwall-associated subsidence in the Hawkesbury Sandstone results in bedding-normal dilatation delamination at suitable depths, and upsidence and vertical fissuring in the near-surface regions – this causes the local groundwater level to drop quite rapidly as groundwater flows to fill the voids – as the Longwall passes, some of the openings close (a form of elastic recovery), others may partially fill with ‘sediment’ reducing the cross-sectional area while others may become permanent – they may be reactivated by extraction of the next panel, but they are not driven

¹⁸ The ‘bold’ emphasis is by BMCS – the estimate of 2-4 ML/day is made over the period January 2009-August 2012 (TLIDR Fig. 8-14) – the average for the period is 2.8 ML/day (Heritage Computing p7).

¹⁹ The standard trend with mine-make is that the volume will increase as a function of the number (cumulative volume) of the panels exploited

by pump-out as with G1 – the inflow-rate will be governed by the local hydraulic conductance, while outflow could be negligible leading to repressurisation and recovery, or outflow could balance inflow if there is a suitable down-topography outlet. In summary, the G2 system will be of low to moderate flow, of ‘panel’ scale, and variable longevity (from a few months to permanent).

- (c) **G3:** this is the encompassing flow-system, which once linked regional precipitation and recharge and the watertable underpinning Thirlmere Lakes to the pre-mining discharge points²⁰. However, it has now reorientated to accommodate down-flow to the longwalls’ sump and has concurrently embraced, where spatially appropriate, the local flow-characteristics of the G1 and G2 systems. Within this G3 system, the BHC slows²¹ but does not prevent a downward flow component. In summary, G3 is a regional system on and within which mining has imposed local and mine-scale variants.

7. Some critical concerns

7.1 The BHC (Bald Hill Claystone) – permeability and mechanical effects

It has long been said in Engineering Geology that the Hawkesbury Sandstone is the ‘saviour of fools’²². Many consultants in mine subsidence and hydrogeology have similarly used the supposed properties of the BHC and MYC (Mt York Claystone) to enable them to apply the KISS principle and avoid inconvenient truths.

Those predicting the effects of subsidence have devised a range of models (some are presented in TLIDR section 8.4.1, but may be found in the specialists’ supporting reports in the appendices of most Subsidence Management Planning Applications) which depict the nature of failure when a Longwall panel is extracted. Common to most of these is a lower zone depicting an upper limit to continuous fracturing, a middle zone within which deformation is minimal and an upper zone of superficial tensile failure (e.g. TLIDR p223). Within the middle zone, emphasis is typically placed on a claystone unit which is said to have more ductile mechanical properties and thereby limit the upward propagation of brittle failure. The BHC and MYC are such units. They are said to ensure that there no continuous fracture systems joining the upper and lower zones.

The hydrogeologist then argues that the BHC or MYC is to all intents and purposes an aquiclude. It has a substantially lower hydraulic conductivity than the overlying rocks and, because its integrity is not breached by fracture zones, there is no evidence of a link between the upper and lower hydrologic regimes. Thus, the consultant argues that, despite depressurisation of the coal seam, the MYC in the Western Coalfield precludes the possibility of any vertical hydraulic connectivity between surface aquifers and the Longwall ‘sump’; Blue Mountains swamps cannot be damaged by coal mining! It is likewise argued that the BHC is a mechanical and hydraulic barrier which precludes any hydraulic link between Thirlmere Lakes and the Longwall mining. One consultant categorically stated that there is no continuous ‘pipe’ linking surface water with the goaf so there is no possibility of catastrophic failure; and of course this is correct at the level of the ludicrous. There is likewise no continuous pipe from the plughole at the bottom of the Lakes to the Tahmoor goaf so all is well.

The reality is that the BHC and MYC are heterogeneous and neither has the absolute mechanical and hydrological properties with which some consultants wish to endow them. The Pells Report has already made a strong case that the BHC is an aquitard with hydrologic properties quite close to the Hawkesbury Sandstone. The Society’s understanding is that Steven and Philip Pells have two publications in print dealing with the misconception which has long pervaded the Southern Coalfield²³. The Society also understands that aspects of the matter have been brought to the attention of Dr Riley of the CoI by Dr Peter Turner in correspondence related to his submission²⁴. The Society will not therefore carry the matter further, but would be prepared to submit additional information in the context of the MYC should the CoI request it.

7.2 The nature of the valley and sub-lake sediments

²⁰ Say for these purposes Blue Gum Creek to the west and the Nepean to the east.

²¹ The slowing is a function of its vertical hydraulic conductance relative to the various units above it, and between it and the coal measures.

²² In effect, its material properties as applied in the realm of Civil Engineering are extremely forgiving.

²³ S E Pells, P J N Pells, 2012, *Impacts of Longwall Mining and Coal Seam Gas Extraction on Groundwater Regimes in the Sydney Basin Part 2 – Practical Applications*, Australian Geomechanics Journal, in press.

²⁴ Email from Dr P Turner to some members of the CoI and copied to other parties on July 12 2012. Information received 17 July 2012.

The CoI would seem to doubt previous work on the geomorphology of the Lakes and the nature of infilling sediments. Certainly questions have been raised in the TLIDR (e.g. pp86-87) which need answering, so it is a great pity that in the extensive recommendations, the suggestion that Lake Nerrigorang be drilled at no cost to government is disregarded.

This is one of several examples where the CoI seems more concerned with faulting or discrediting work (through disbelief rather than fact) and maximising the time-frame of its program of recommendations, than it is with obtaining a piece of hard data.

The Society sincerely hopes that the CoI will see the merit of supporting Pells Consulting's approach to OEH for permission to undertake drilling.

7.3 The apparent rejection of modelling

NOW's report²⁵ was aimed at alleviating concerns within the community. It investigated what was necessary but failed to go beyond the obvious. It was initially a political success but was seen as a community and environmental failure. Much more was needed because, despite the drought breaking, the Lakes were not recovering. The Minister responded to the pressure by instigating the Committee of Inquiry, but by this time Pells Consulting had completed the main phase of its investigations. This raised the interesting question of whether Philip Pells should be on the CoI, or be passed over because of the 'bias' in his scientifically-based investigation. The answer to the original question is history, but the resulting incredulity caused concern about the degree of independence of members of the appointed CoI; stipulations were sought but remain unanswered (see **section 2**). Doubts remain despite the strong assurances made in the TLIDR section 2; there is a paradox that independence of action enables the pursuit of bias.

The CoI's approach to modelling was raised in **section 4.3.2**, but is again brought forward to emphasise the extent of the Society's concerns.

The previous comments (see **section 7.4**) adopted the approach that Pells Consulting was self-funded for this investigation which was started to scientifically evaluate the cause of the low lake-levels, that Philip was extremely well qualified to undertake the investigation and was fully cognisant of the limitations of the implemented modelling. Despite this, the CoI has largely rejected the principal finding of the Pells Report that there is a case for mining to answer, or, slightly differently, that the drought does not adequately satisfy the results.

The modelling undertaken by Gilbert and Associates generated a comparable anomaly to the Pells Report. The anomaly necessitated an explanation which was paradoxical: the Pells Report showed that its modelling predicted pre-mining lake-levels but was an inadequate portrayal of the post-mining behaviour; Gilbert and Associates showed the reverse. Clearly, the post-mining anomaly exists, regardless of how the model is 'tweaked'.

Irrespective of the modelling results, Gilbert and Associates and Heritage Computing were paid by Xstrata to evaluate the Pells Report's work. This they did and dutifully argued that the levels of uncertainty were too great to permit adequate modelling. This approach seems to have traction with the CoI.

The Society considers it most unfortunate that the CoI has focused on the negative views expounded by the consultants, and failed to adopt a constructive approach to both the Pells and Gilbert and Associates modelling exercises.

7.4 The assessment of droughts

Heritage Computing pp10-11: *"Rainfall trend analysis shows that the district has been experiencing drought conditions dating from 1992 of a severity similar to the 1935-1949 depression/war drought". "While it is possible that mining could have had a marginal effect on groundwater levels beneath the lakes, there is no definitive evidence that this has occurred. On the other hand, there is clear evidence for the drying of the lakes being coincident with a severe drought."*

TLIDR p109: *"The low water levels in Thirlmere lakes at present are consistent with the drought-dominated regimes of the last two decades. However, this correlation does not prove that the climatic regime is the sole reason for the low water level in Thirlmere lakes at the present time."*

²⁵ G N Russell, R T Green, J Spencer, J Hayes, 2010, *Thirlmere Lakes groundwater Assessment*, NSW Office of Water (NOW), Sydney 80 pp.

TLIDR p240: "...the majority of the fluctuation in lake levels can be accounted for by variations in rainfall, but there is evidence that recent fluctuations and consequent low lake-levels may have been influenced by groundwater extraction to the east, and mining..."

Pells Report p103: "The 5-year drought ending in 2006 has played a significant role in the current low water levels." "Longwall mining...has impacted on the water balance of the lakes, leading to levels that are lower than would be expected based on climate conditions."

The NOW report believed that the lake-levels reflect a rainfall deficit accumulated during the drought which terminated in about 2007. The above quotes similarly indicate that the drought was a major influence on lake-levels, but the degree of commitment to other factors is varied.

Because 'we' experienced the 5-year drought which generally ended in 2006, its magnitude and associated water restrictions are firmly imprinted in our minds such that it looms larger than would seem justified by the statistics. Reference to Heritage Computing Figure 11 shows that, in contrast to the statement on p10 (quoted above), the 1935-1949 drought was far more extreme in terms of rainfall residual mass data. The same conclusion may be reached by examining the Pells Report Figure 5.10 and his discussion and Tables in section 2.1 pp16-19.

The Society strongly contends that on any of the measures outlined in the preceding paragraph, the 2000-2006 drought was by no means 'extreme'. In fact, on any 'drought-scale' it would be unlikely to rank more than mid-range. **This should be emphasised in the final CoI report because it is all too easy to attribute things such as reduced lake-levels and surface flows, and drying out of swamps to drought²⁶**. Such an approach is especially disturbing when the 2010 lake-levels were anomalously low, despite termination of the 2006 mid-range drought (Pells Report Fig. 2.10 p31).

7.5 Recovery of the Lakes

Because the CoI is investigating the cause(s) of the anomalously low lake-levels, there is a tendency to overlook the fact that there is still an 'inadequate' level of recovery. The TLIDR addresses this matter on pp118-121 and presents an elegant explanation of the anecdotal perception that the Lakes 'fill' and then rapidly 'drain'.

The Society believes that this concept of the lake-fill 'losing' to the groundwater regime should be highlighted as the first element in a complex process, irrespective of what subsequently happens.

7.6 Remediation and compensation

7.6.1 For consideration

The Society's original submission²⁷ to the CoI stated: "Looking a few months ahead, if the committee concludes that there are climatic and mining-related inputs (as presently available data seem to indicate), will the Committee then advocate a program of further studies 'to better understand the hydrology of the Thirlmere Lakes and provide better information for future management'? If yes, then the Committee must surely address the problem of whether a destructive mining-related process should continue unabated for the duration of the additional studies. The Society is of the view that, in such circumstances, the Precautionary Principle should be implemented and mining be discontinued; but previous experience suggests that government will have no stomach for such action. So again in anticipation, would the Committee contemplate remediation through returning suitably treated mine-water to the Lakes' headwaters?"

The above-envisaged situation has now been reached.

²⁶ On Newnes Plateau in the Western Coalfield, any deterioration in swamps, surface flows, groundwater levels and vegetation throughout 2000-2007 was ascribed by the consultants to drought rather than Longwall mining. Yet when the rains returned it was argued that because surface flows were re-established and the vegetation showed less evidence of stress, it was strong evidence that Longwall mining had not significantly damaged the swamp ecosystems. Finally, when the Society was able to prove adverse impacts in specific localities, the consultants accepted the specific cases but maintained these were exceptions. The exceptions finally cost Centennial Coal \$1.45 million as an enforceable undertaking through the EPBC Act.

²⁷ Identified as ThirlmereLakesInquiry_BMCSSubmission_120111.pdf

If the fluctuations in lake-level are a truly natural phenomenon, then remediation and/or compensation are not appropriate. **Conversely, if a newly introduced factor²⁸ has contributed to lake-level variations over the past 10-15 years then remediation and/or compensation are appropriate.** Thus, allowing that: the Pells Report's modelling is approximating reality; the eastward flow of groundwater in the Hawkesbury Sandstone is part of a more complex flow regime modified by Longwall mining and subsidence (as discussed in sections 6.1, 6.2.1 and 6.2.2); and pumping for agricultural and domestic purposes has not disproportionately escalated over the past 10-15 years (section 6.1) and may be removed from the equation or at least be treated as minor; then **consideration should be given to remediation and/or compensation.**

The CoI has clearly adopted the view that a large program of additional work is necessary with various components running for periods up to 5 years (TLIDR Section 9.2). This means that the CoI should indeed address: (i) whether seemingly destructive mining-related process should continue unabated for the duration of the additional studies; (ii) the extent to which such impacts can be mitigated in the shorter term without unduly compromising the investigations; and (iii) the mechanism and need for longer term remediation and compensation if direct or indirect mining-related actions and/or pumping groundwater from Hawkesbury Sandstone aquifers to the east of the Lakes are proved to significantly contribute to lowering of the lake-levels.

Before leaving this subsection, the Society draws attention to the quotes in section 7.4 above. All seemingly accept that lake-level fluctuations are mainly caused by rainfall variations. An inevitable line of thought flowing from this is that any impacts from Longwall mining and/or abstraction of groundwater from the Hawkesbury Sandstone are 'insufficiently significant' to merit action. This is illogical! Everyone recognises that any lake-levels will vary as a function of climate. What is being considered at Thirlmere Lakes is an exacerbation of natural changes by the actions of a commercial enterprise. **It must follow that the significance of the additional impact should not be judged as a percentage of the total lake-level variations, but as 100% of the avoidable variations.**

7.6.2 Remediation

The Society notes the method mentioned in TLIDR Section 9.3 and raises the following matters:

- The CoI's viable working hypothesis is (TLIDR p240): "*...the majority of the fluctuation in lake levels can be accounted for by variations in rainfall, but there is evidence that recent fluctuations and consequent low lake levels may have been influenced by groundwater extraction to the east, and mining...*"²⁹ "*...groundwater extraction by bores, may have contributed to the change in the groundwater regime to the east.*"
- If the CoI's hypothesis is correct and (TLIDR p247) "*...enhanced groundwater flow to the east, within the Hawkesbury Sandstone aquifers is a factor in enhanced loss of water from Thirlmere Lake, an attempt to reduce this groundwater flow is warranted.*" Reference to mining now seems to have evaporated; and if so, the Society considers that the remediation might be targeting the wrong instigator.
- According to TLIDR pp248-249 and Fig. 9-1, the remediation would take the form of injecting already-treated mine-make (presently discharged into the Bargo River) into the Hawkesbury Sandstone aquifer to create a long groundwater mound approximately paralleling the Picton-Mittagong loop line.

Sourcing water from the mine would make more sense to the Society if the mine was deemed a significant instigator of the impacted lake-levels. In essence, the mine would be required to cover all the remediation costs until such time as mining ceased, the 'Longwall sumps' filled with water and the original flow-regime (or close to it) was re-established. **As currently presented, the establishment and ongoing costs would presumably be covered by government, or by those extracting the groundwater for commercial purposes.**

- Whether the groundwater mound would work is uncertain; TLIDR p250 indicates that: "*At this time the Committee knows of no other mine water injection system designed to control groundwater flow*".
- **Views on remediation differ substantially and naturally reflect whether Longwall mining is the main cause of the avoidable lake-level fluctuations. Nevertheless, the Society believes that the best way to remediate the system would be to pump mine-make (previously treated to match the receiving waters) into a catchment stream feeding one of the eastern Lakes. This would avoid the need for injection technology and, as indicated**

²⁸ The aim here is to remove rainfall variations and other 'natural' climatic events such as El Nino and La Nina, as well as 'unnatural' anthropogenic climate change and its consequences, from consideration; the principal concern is whether Longwall mining has had a demonstrable impact.

²⁹ The quoted sentence was long and cumbersome – it was broken and abridged at this point in the interests of clarification.

under dot-point 3 (above), could be continued until mining ceased and the complex flow system essentially re-equilibrated. All costs would be charged to the mining company.

7.6.3 Compensation

Although not the Society's preference, an alternative way of handling matters would be to negotiate a suitable form of compensation as an alternative to remediation.

8. TLIDR Section 9 – Conclusions and Recommendations

8.1 TLIDR Section 9.1 – The main findings

The Society acknowledges the three options (natural processes, human activity, a combination of the two) for explaining the changing levels in Thirlmere Lakes and the present anomalously low levels.

8.1.1 Natural processes

The review in TLIDR section 9.1.1 is reasonable and indicates that the hydrology of the Lakes is sensitive to small changes in water loss. The main conclusion is that (TLIDR p236): "...fluctuations in rainfall appear to account for a substantial component of the variation in lake levels, but there is some doubt about changes in the last 40 years, some of which may be related to changes in sub-catchment geometry of lakes Baraba and Couridjah."

No natural explanation is given for why the Pells Report's modelling predicted the pattern of historical variations, but differed from the known variations over the past 10-15 years³⁰. Presumably, the CoI rejects these findings.

8.1.2 Human activity

The review in section 9.1.2 pp236-239 is repetitive but introduces a few new ideas. Comments about anthropogenic climate change and bushfires perhaps contributing to recent low lake-levels might be correct, but on a 1-10 scale their significance rates in the 1-2 range.

Aspects of note are:

TLIDR p236: there are contradictory statements about the effect of groundwater pumping: (i) "*For the last 40 years pumping has been a minor component and can be dismissed as a cause for recent fluctuation*"; (ii) "*An increase in groundwater extraction would partly explain recent fluctuations in lake levels, but is unlikely to explain the fluctuations prior to 1940, the earliest date for most of the bores.*" In essence, pumping is unlikely to explain lake-level fluctuations before 1940 and after about 1970.

TLIDR p237: "*There is no evidence that the Bald Hill Claystone beneath Thirlmere Lakes has been breached or "punctured" in any way. The stratigraphic evidence suggests that it is some distance below the supposed maximum depth of the valley of Thirlmere Lakes of 50 m (245-250 mAHD).*" The Society rejects this because evidence provided in the Pells Report on BHC outcrops in Blue Gum Creek is compatible with the 50 m suggestion (see TLIDR Fig. 3-8, p57). Furthermore, the supposed 50 m valley-depth is solely based on projecting the slope of the exposed valley sides to depth.

Also TLIDR p237: "*The estimated depth of 50 m of valley fill is open to question and cannot be affirmed from recent work. There is substantive evidence of a depth of valley fill of 30 m, but, on the basis of the evidence available to the Committee, this depth is also debatable.*" The Society recognises that the 50-m depth is an interpretative construct seemingly supported by seismic data, and the 30-m depth is based on interpretation of material obtained by auger drilling. The Pells Report (pp38-40) quotes Vorst's original account³¹.

³⁰ Or vice versa in the case of the modelling by Gilbert and Associates – the last 10-15 years were predicted but the correlation with historical levels was poor.

³¹ P Vorst, 1974, *Thirlmere Lakes, NSW: Geomorphic Environment and Evolution*, Unpublished Hons Thesis, Macquarie University, Sydney.

The CoI chooses to reject the information and interpretations given in the previous two paragraphs because the data raise additional uncertainties, partly derive from an Honours Thesis, and have not been recently checked. Nevertheless, A/Professor Fanning (nee Vorst) apparently stands by her original interpretations.

TLIDR p237: in relation to the BHC, the report states: *“There is evidence that the Bald Hill Claystone has maintained its hydraulic integrity above the mines. However, it is possible that mine subsidence...has opened joints and bedding planes in the substantive sandstone beds above the Bald Hill Claystone, over the longwalls. Equally, there is the possibility of structural changes in the aquitards above the longwalls, including the Bald Hill Claystone.”*

Also: *“...groundwater lowering over the longwalls would result in more rapid discharge of water through the sandstones. No apparent increase in groundwater discharge might be seen in the mine, but groundwater discharge towards the east would increase.”*

The Society questions the statement about the BHC maintaining its integrity, particularly as the reverse possibility is acknowledged in the extended quotation. The Society also has concerns about the idea of no apparent increase in mine-make discharge as this is predicated on the BHC maintaining hydraulic integrity. These matters were discussed above in sections 6.2.1, 6.2.2 and 7.1.

TLIDR p238: the conclusion presents a scenario which cobbles together the CoI’s preferences. It particularly preserves the belief that the BHC has maintained hydraulic integrity despite also stating otherwise (see the previous paragraph)! The Society is pleased to note that the effects of mine subsidence are part of the scenario, but the CoI manages to avoid saying that the anomalous lake-levels effectively correlate with the advent of serious Longwall mining.

8.1.3 Combined natural and human-induced effects

This contains a bit of everything from sections 8.1.1 and 8.1.2, including the deficiencies of these separate possibilities. The consequence is that despite this being the CoI’s preferred hypothesis (see section 7.6.2 dot-point 1), there is little emphasis on the role of mining in facilitating eastward groundwater flow, and no significant comment on how the Longwall sumps will affect the hydrologic regime.

8.2 TLIDR Section 9.2 – Recommendations

The Society does not intend to comment on the specifics of the recommendations and their implementation (‘realisation’), but it does wish to comment on the totality of the recommendations and funding, and the perceptions these create in the Society’s membership. Nevertheless, before commencing the more general comments, the Society feels the need to comment on aspects of TLIDR section 9.2.1.

8.2.1 TLIDR Section 9.2.1

TLIDR p242: *“There were a variety of opinions on the social, cultural and economic value of the lakes expressed to the Committee, but none of these opinions had been studied in such a way that the Committee could establish the consensus view. Nobody seemed to be thinking about the values of the lakes if their low water levels were natural, or how they could be valued if they were indeed highly variable systems. Finally, there were clear economic benefits from the lakes that appeared not be realised...”*

The Society considers the above remarks to be insulting to the people of the immediate region.

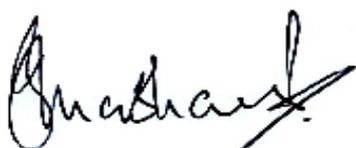
The Lakes are unique and have an easily accessible location within the south-eastern region of the Greater Blue Mountains World Heritage Area. One does not need to have things studied and statistically documented to appreciate the Lake’s social, cultural and economic values, and the feelings of ownership generated within a highly engaged community.

As the lake-levels have fluctuated considerably over historical time, such variation is an integral part of the Lakes’ values. This does not mean that people with moderately long memories and the capacity to look at the Lakes at other times are not entitled to have and express preferences in terms of the state of ‘fill’. Similarly, when people see the Lakes diminishing and their bore-levels falling at a time when the drought has broken, and are familiar with the intensive media coverage of the impacts of Longwall mining and coal-seam gas exploitation, they would be extremely complacent were they not to express concern.

No doubt there could be marketing improvements, but the Society is sure that an awareness of the benefits of ‘bundling’ the attractions of the region exists within the local and broader communities.

8.2.2 General comments on the report, and the report's recommendations and realisations

- The Society is disappointed in the TLIDR and the almost supercilious attitude conveyed by the Committee, both at meetings and in the report's text. Aspects of this should have become apparent in the previous sections of this submission and in some of the ensuing dot-points.
- Throughout the report there is an emphasis on the need for definitive data. This approach has enabled the CoI to somewhat righteously downgrade modelling and other aspects of the Pells Report where anecdotal data have been used, to reject information which has stood the test of time and become 'collective wisdom', and to make dubious statements and express preferences for which there is even less documented evidence.
- The emphasis on the need for sets of definitive data is somewhat specious; were these bodies of information already available, the answers regarding the anomalously fluctuating lake-levels would be clear cut and there would be no need for an Independent Inquiry.
- The lack of definitive data has been magnified by the occasions where the CoI has done its own analysis and used the results to highlight perceived deficiencies in the work of others. In adopting this approach and being unduly repetitive, the TLIDR has developed an aura of nit-picking. The CoI would seem to be operating on the principle that repetition enhances credibility.
- The aim of the Independent Inquiry was to investigate the cause(s) of seemingly anomalous lake-levels, and to particularly look at whether Longwall mining has played, and still is playing, a significant part. To this end, the role of mining became the elephant in the room; it is still there but the CoI has done its best to avoid mentioning it and thereby starve it out of existence.
- It is regrettable that the intensive scrutiny by the CoI of the Pells Report, but not apparently of its three addenda, was seemingly not applied to the two reports commissioned by Xstrata with the partial objective of critiquing Pells work. In fact the reverse is the case, as the CoI seemingly embraced the criticisms, despite Gilbert and Associates and Heritage Computing apparently being unaware of the Pells addenda.
- Anyone hoping for a clear-cut picture to emerge from the Inquiry is facing disappointment; in place of real answers, the TLIDR provides a catalogue of disbelief, rejection and obfuscation, culminating in a body of recommendations for protracted and costly further work.
- The actual recommendations are broadly commendable and the methods of implementation and funding are truly courageous. When all the work is completed some 5+ years from now it should provide definitive answers. But the reality is that the State and Federal governments will spend the next 5 years squabbling about who will pay for what, and managerial teams will mop up much of the funding as they attempt to determine who will do what!
- Such an indeterminate outcome could well satisfy the Minister because: the report can be shelved or passed to Treasury Departments for costing and prospective (in)action, Xstrata because mining will continue unimpeded and the company has not even been earmarked to fund parts of the work, and the CoI because it has provided few answers, made numerous recommendations, and effectively interpreted the current political climate.
- Such an indeterminate outcome is unacceptable to environmental organisations and the local community because: Xstrata will continue mining, the Precautionary Principle will be ignored and remediation options will neither be investigated nor enforced, the Lakes will be further compromised to the detriment of their environmental values, and the touristic and recreational community benefits will be foregone.



***Dr Brian Marshall,
For the Management Committee***

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