APPENDIX 12

Seedsman Geotechnics – Peer Review

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REF: umwelt - 1

Mr P Jamieson
Director
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Dear Peter,

RE: Austar

You have requested a review of the subsidence predictions for the Austar Part 3A submission on proposed longwalls A6 to A17. The brief was to review the Mine Subsidence Engineering Consultants (MSEC) report (MSEC309-B), assess the prediction methods, and to provide an independent prediction of the maximum vertical subsidence. The brief was not to provide a new set of predictions.

Predictions of systematic subsidence

The MSEC report includes 2 sets of predictions for systematic subsidence. The first (prediction) is based on the application of their Incremental Profile method from the Newcastle coalfield and the second (upper bound) is simply that prediction scaled so that the maximum subsidence is 65% of the extracted seam thickness. The basis for this 65% is not understood as the more relevant data is Holla series data for chain pillars that shows that the maximum subsidence for a series of longwalls is 50% of the extraction thickness.

The Incremental Profile method is an empirical method that relies on having a large enough database so that all mine geometries, seam geometries, and all overburden geologies have been included. The conditions at Austar will be outside the MSEC database in that the proposed depths are well in excess of the Australian experience, there is a very thick sequence of massive sandstones down from the surface, and a thick coal seam is to be mined. The fact that longwall top coal caving is the mining method is not considered to be a material difference. There is only one other mine in the MSEC database that is similar – the adjacent Ellalong colliery.

Inspection of the Sandy Creek Road subsidence line above Ellalong (Figure 1) shows that a relatively smooth subsidence profile has been recorded (thick red line) with no evidence of localised sags above the extraction panels. A similar lack of sag can be seen in the monitoring line above LW10-12A. The more recent data from Southland (LWSL1) does show sag above a wider shallower panel. The proposed Austar panels have a width/depth ratio more similar to the Ellalong cases than the Southland case.

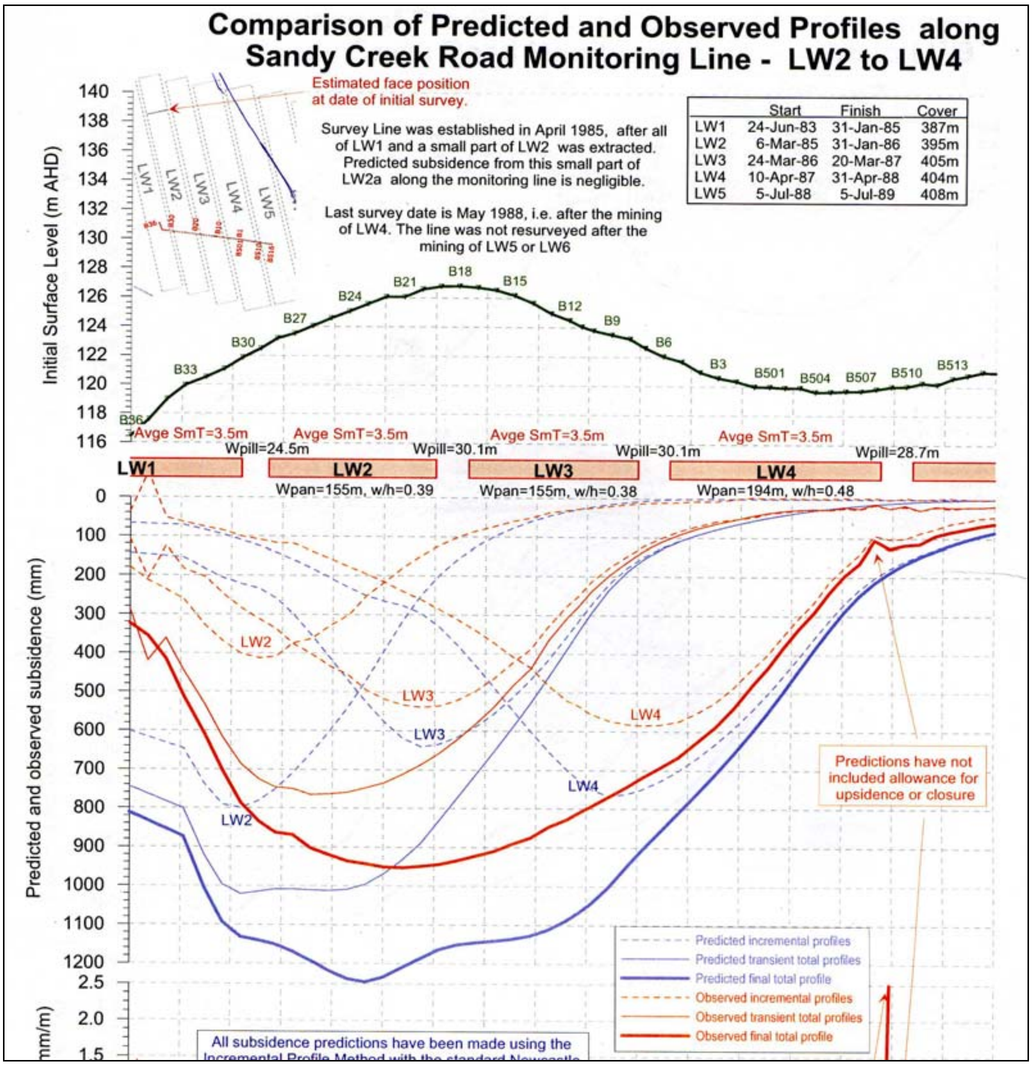

Figure 1 Extracted from MSEC report, Figure F.01

The interpretation of these data is that the massive sandstones within the Branxton Formation are capable of spanning across extraction panels with no noticeable deformation, and that the subsidence of the surface is related to the deformation of the coal pillars and the immediately adjacent roof and floor.

It can be shown that the deformation of coal pillar/roof/floor systems is dominated by the deformation of the coal pillar itself (about 80% of the total). To deform the coal by the required amounts to explain the surface subsidence (say 1m for a 3m high coal pillar – 33% strain) it is apparent that the pillar must be yielding - if not failing. This conclusion is certainly consistent with the design approach used by the mining engineers when specifying the pillar dimensions for the tailgate of the longwall panel itself.

The yielding of coal pillars has been examined in the laboratory and to a very small extent in the field (Figure 2). The results are fairly complicated but there are a number of key observations:

- Firstly, pillars with small width to height ratios behave differently to those with large width to height ratios. The slender ones fail in a brittle manner, while the squat ones can continue to carry load after yielding. At Austar, we are only interested in squat pillars.
- Before yield, the pillar undergoes small deformations.
- After yield, the deformations increase significantly with relatively small increments of load.
- At very large deformations, there is a steepening of the curve – the coal starts to work harden.

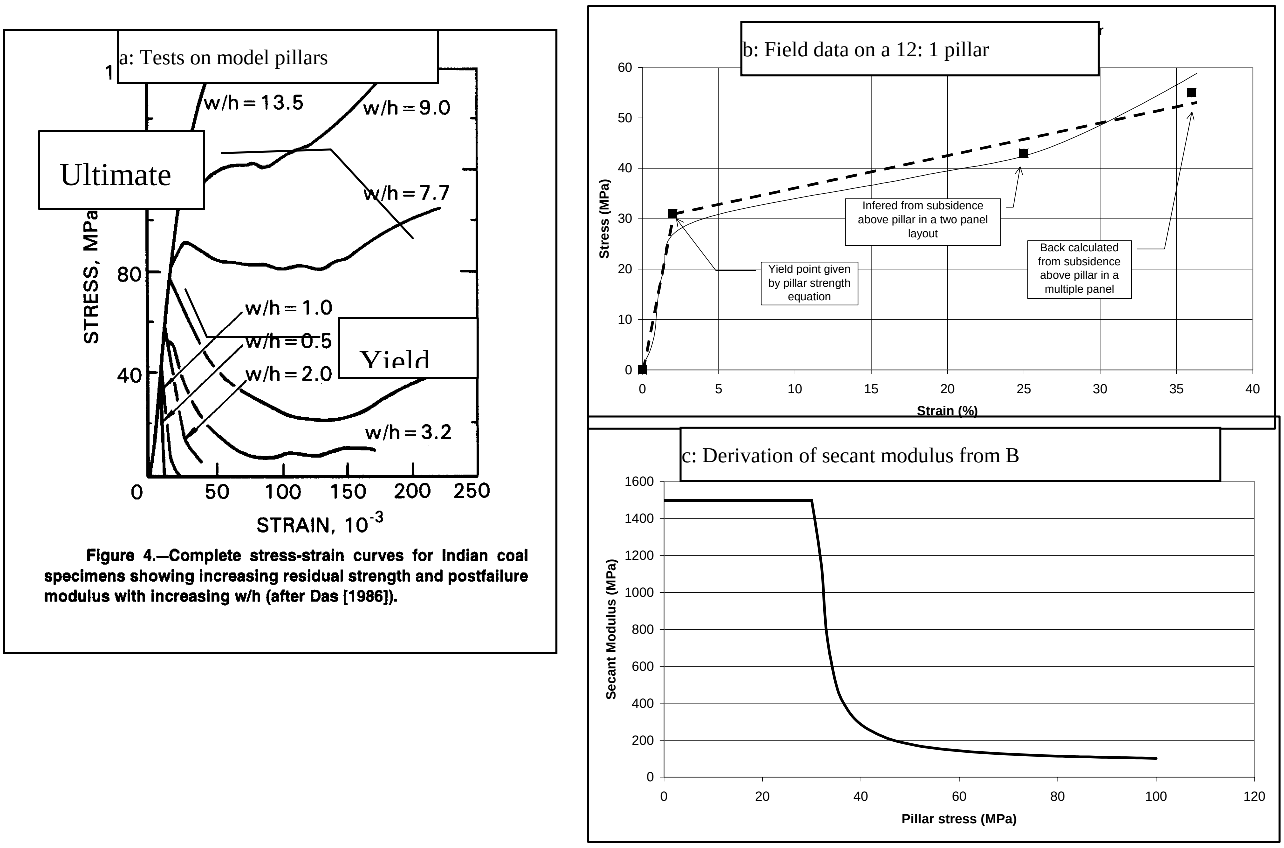

Figure 2 Concepts of pillar behaviour. (a) Laboratory results that show slender pillars (w/h<3.2) failing and shedding load, and squat pillars (w/h>7.7) yielding and then work hardening (b) application of laboratory concepts to subsidence in the Southern Coalfield (c) derivation of the secant modulus implied by (b).

Using the limited amount of the required geotechnical information contained within the MSEC report, I have applied these 2 concepts (lack of sag over narrow/deep panels and pillar compression) to the Austar geometry. Figure 3 presents the results for the base of a subsidence bowl developed over a number of contiguous longwalls. As expected the subsidence increases with depth and beyond 550m the impact of individual walls cannot be seen.

There are 2 significant model uncertainties behind this simple prediction. Firstly, I have not included consideration of yield of the coal above and below the pillar horizon. Secondly, I have not included the possibility of work hardening that is likely to develop at the greater depths. The former would increase subsidence and the latter would reduce it.

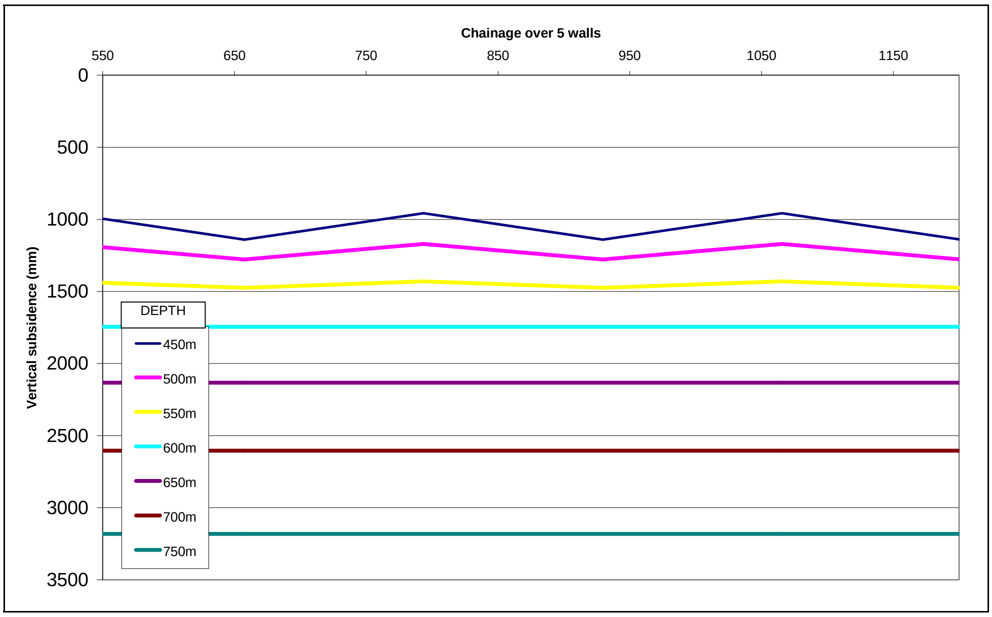

Figure 3 Subsidence predicted from the panel sag and pillar compression

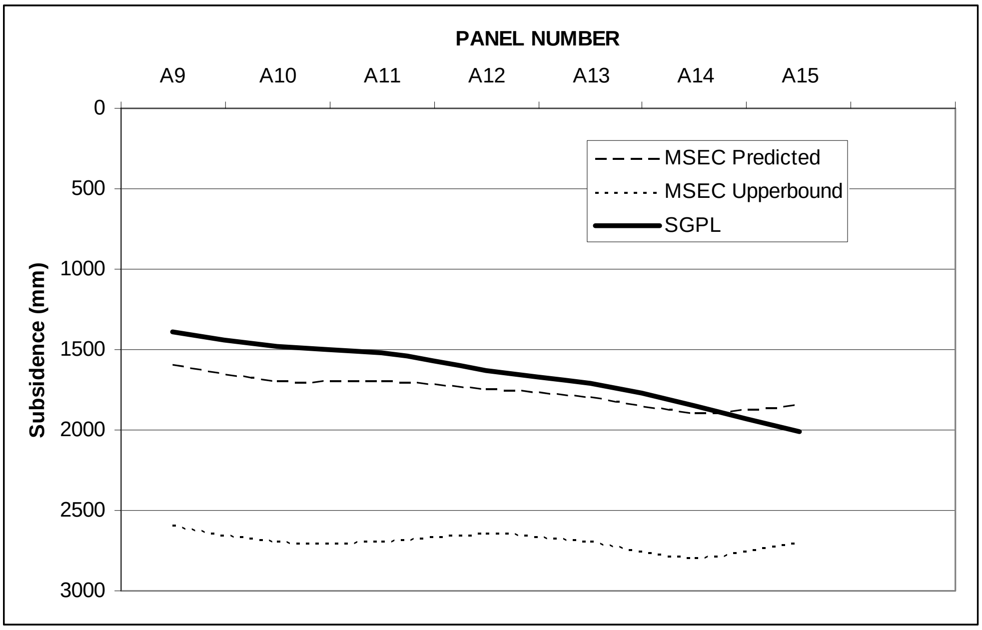

Figure 4 Comparison of predictions for panels where the unmined boundaries do not impact

Figure 4 compares the subsidence predictions above the panels in the vicinity of the MSEC prediction line B. In this case the maximum depth of cover considered is about 635m[1]. The SGPL prediction is less than the MSEC prediction for depth less than about 610m and is always less than the MSEC Upper bound.

In summary, it is assessed that the MSEC prediction for systematic subsidence represents a suitable base case for the maximum vertical subsidence for the Part 3A process with the understanding that the small scale undulations between panels (predicted by MSEC to be in the order of 100mm amplitude) are unlikely to develop. A worst case of say 120% of the MSEC prediction should be used in a formal risk assessment. The MSEC upper bound is considered to be needlessly conservative.

Disordered subsidence

Localised geological or geomorphological features can disrupt the systematic subsidence patterns discussed above. The prediction of disordered subsidence is very difficult as it requires knowledge of the spatial distribution of relatively small scale geological features –in many cases, the impact is best managed through a risk- based approach

Faults can produce a step in the subsidence profile. Often, fault locations can be identified during exploration or during longwall panel development and the mining modified.

The presence of discrete bedding surfaces close to the surface can also result in disordered subsidence. Shear along bedding can result in the lifting of thin slabs with associated very localised high tilts and strains. At a much large scale, shear along bedding has been implicated in the far-field upsidence and valley closure seen in the Southern Coalfield

Impacts Assessment for Austart

The impacts of the predicted systematic subsidence are well documented in the technical literature and the MSEC report represents the current "state of the art."

The massive nature of the sandstones in the Branxton Formation that are reported to be present in the near surface mitigates against the presence of bedding surfaces. It is considered unlikely that the extreme valley closure and upsidence events seen elsewhere will eventuate at Austar.

Yours truly,

Ross Seedsman

[1] The MSEC predictions for deeper panels incorporate the boundary effects of the unmined coal. This means that their predictions are not directly comparable with the simple SGPL model present above.