Strata Control Technology

R E P O R T T O :

ASHTON COAL MINE

Subsidence Assessment for Ashton Coal Mine Longwalls 1 to 4

ASH3084

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Report To	Brian Wesley Mine Manager Ashton Underground Mine PO Box 699 SINGLETON NSW 2330
Subject	Subsidence Assessment for Ashton Coal Mine Longwalls 1 to 4
Report No	ASH3084B
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SUMMARY

Ashton Coal Operations Pty Ltd (Ashton) is proposing to mine Longwalls 1 to 4 in the Pikes Gully Seam near Camberwell in the Hunter Valley. Ashton commissioned SCT Operations Pty Ltd to undertake a subsidence assessment suitable for submission as part of the Subsidence Management Plan (SMP) Approval documentation being prepared on their behalf by Environmental Resources Management Australia Pty Ltd (ERM). This report presents the results of our subsidence assessment for the surface area above Longwalls 1 to 4.

Proposed longwall mining at Ashton in the Pikes Gully Seam is expected to cause vertical subsidence up to 65% of the seam section mined over the central part of each longwall panel. This equates to vertical subsidence of 1.6-1.8m for the 2.4 to 2.7m seam section anticipated. Only low levels of subsidence (generally less than 100mm) are expected directly over the chain pillars. The final subsidence profile will comprise a series of troughs over each longwall panel that subside independently of each other as each panel is mined.

Tilts, strains and curvature have been estimated on the basis of the Western Coalfield subsidence guidelines because the overburden depth, panel geometry and overburden stratigraphy expected at Ashton are similar to those in the Western Coalfield.

Localised high levels of strain, tilt, curvature and ground distortion are expected in areas where the overburden depth is less than about 60m which is mainly near the northern end of Longwall 1, but may also include the starting area of Longwall 1 as well.

Over most of the Application Area, the overburden depth ranges 60-120m. Maximum tilts of 80-140mm/m and horizontal strains of 20-40mm/m in tension and 30-60mm/m in compression are expected to develop as a result of the proposed mining.

Mining within the Application Area is not expected to impact on Bowmans Creek or the alluvial flats associated with Bowmans Creek or the Hunter River.

Mining subsidence is not expected to unduly impact on scattered aboriginal artefact sites or the remnant woodlands and nesting sites within these woodlands. However, surface cracking and associated ground loosening may cause some trees to become destabilised and others to be permanently tilted.

Mining subsidence is expected to cause permanent cracking in the ground surface that may need to be filled once mining is complete to avoid the potential for injury to cattle stepping into the cracks. It is recommended to

fill in any subsidence cracking on steep slopes as soon as practical after mining is completed to avoid surface runoff being diverted into the slope and potentially contributing to slope instability. Subsidence may lead to localised ponding areas following rain in flatter areas, particularly along the western edge of Longwall 4.

Steeper slopes may be subject to lateral translation in the direction of the slope. This phenomenon is expected to occur on the steep slope leading down to Glennies Creek with up to about 100mm of lateral translation of the entire slope considered possible. No cracks are expected to develop on this slope and slope stability is not expected to be affected by the lateral translation.

Most of the surface and surface infrastructure within the Application Area is owned by Ashton and improvements are therefore not required to be assessed within the SMP Approval process. However the mining impacts on most of Ashton infrastructure have been assessed within the body of this report for completeness.

A 132KV electricity line that traverses the surface above the southern end of all the panels is likely to be significantly impacted by mining subsidence movements. It is recommended to support this line on single pole structures, relocate it outside of the mining area or, in the short term, to relocate individual poles over the chain pillars recognising that as further mining takes place in the lower seams, the line may have to be moved again.

A local distribution electricity line traversing the Application Area at the northern end of Longwall 4 is supported on single pole structures. This line is likely to remain serviceable throughout mining provided the conductors are placed in sheeves and any stays are adjusted regularly as each pole is undermined to prevent them becoming overloaded.

A buried Telstra cable traverses the Application Area. Mining subsidence is likely to render this cable unserviceable. It is recommended to relocate this line outside of the mining area or to provide mobile phone coverage until mining subsidence is complete and the line is repaired.

An access road to Property No. 130 is likely to require daily maintenance for several periods while mining proceeds under it. By upgrading an alternative access road, periods where the road is impacted are likely to be limited to between 2 weeks and 5 weeks duration over each longwall panel. It is likely that the road would require regrading once or perhaps twice per day during this period to keep it serviceable for tanker and car access.

The flat at the start of Longwall 1 is not likely to be impacted by mining subsidence from Longwall 1 because Longwall 1 starts under the slope north of this flat.

Farm buildings and concrete water tanks on the Property No. 130 are located just outside of the proposed mining area and mining subsidence impacts are likely to be generally small. However monitoring is recommended and it is recommended to initiate discussions with the Mine Subsidence Board so that pre-mining surveys and any remediation required can be undertaken in a timely manner.

Mining subsidence is not expected to significantly impact on the New England Highway, adjacent electricity lines or a buried fibre optic cable located just inside Ashton property. Valley closure of less than 3mm is estimated within a cutting on the New England Highway located 250m north-east of Longwall 1. The probability that this level of valley closure would be perceptible or have any perceptible impact is considered low.

The first workings proposed as an extension to the main headings extend under the New England Highway road reserve, but not under the road itself. No perceptible subsidence is expected to occur over these main headings. The New England Highway, adjacent electricity lines, and the buried fibre optic cable are not expected to be impacted in any way by the extension of the main headings.

A program of survey monitoring is recommended to monitor subsidence movements and provide confirmation that the subsidence behaviour at Ashton is consistent with expected behaviour.

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1. INTRODUCTION

Ashton Coal Operations Pty Ltd (Ashton) is proposing to mine Longwalls 1 to 4 in the Pikes Gully Seam near Camberwell in the Hunter Valley. The mining area is bounded by the New England Highway, Glennies Creek, the Hunter River and Bowmans Creek. Ashton commissioned SCT Operations Pty Ltd to undertake a subsidence assessment suitable for submission as part of the Subsidence Management Plan (SMP) Approval documentation being prepared on their behalf by Environmental Resources Management Australia Pty Ltd. This report presents the results of our subsidence assessment for the surface area above Longwalls 1 to 4.

The report is structured to provide:

1. A description of the general area including the proposed mining geometry, overburden depth and other parameters of relevance to a subsidence assessment.

2. Specific detail of the features, both natural and man-made that have been identified as likely to be impacted by mining subsidence.

3. A review of the specific requirements of the SMP Approval process.

4. Subsidence estimates based on the previous subsidence monitoring at similar panel width to overburden depth ratios.

5. Specific assessments of the likely subsidence impacts on the surface features identified.

6. Recommendations for subsidence monitoring programs and strategies to manage the subsidence impacts identified.

2. SITE DESCRIPTION

Figure 1 shows a plan of the longwall area, the SMP Application Area defined by a 26.5° angle of draw from the extraction areas and the location of surface features superimposed onto a 1:25,000 topographic series map of the area (updated with a diversion to the New England Highway and changes to minor roads made after the map was produced in 1982). Figure 2 shows the longwall layout and Application Area superimposed onto a more recent aerial photograph.

2.1 Surface Features and Improvements

The Application Area is predominantly cattle grazing land located between Glennies Creek to the east, Bowmans Creek to the west and the Hunter River to the south. The Application Area does not include any major watercourses. The Hunter River, Glennies Creek and the channel of Bowmans Creek are located outside the Application Area.

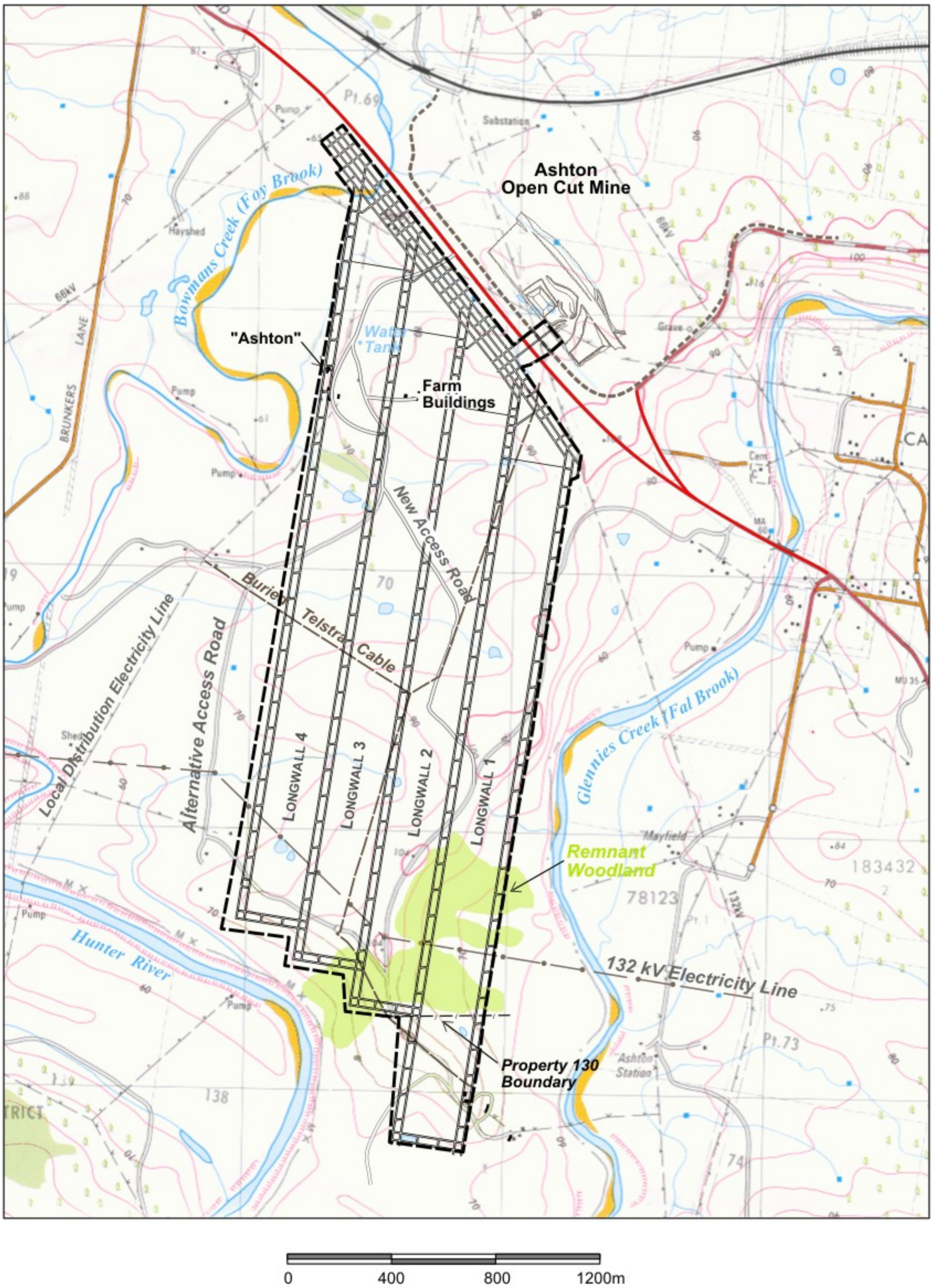


Figure 1 Plan showing location of SMP Application Area and mine plan superimposed onto 1:25,000 topographic series map updated to reflect current infrastructure.

Figure 2 Aerial photograph of the SMP Area with mine plan superimposed.

The surface area within the Application Area is almost entirely owned by Ashton. An area at the southern end of Longwalls 1 and 2 is owned privately and is referred to as "Property No. 130" (to be consistent with the Environment Impact Statement). The Application Area is crossed by an unsealed road that provides access to Property No. 130 and is used daily for milk tanker and car access.

Within the Application Area, there are several farm buildings, a house ("Ashton"), several farm dams and some water tanks and associated buried pipes. Some of these are located on Property No. 130, but most are on the Ashton property. The surface is traversed in the south by a 132KV electricity transmission line supported on dual pole structures and in the north-west by a local distribution electricity line supported on single pole structures.

The New England Highway road reserve and associated infrastructure are located outside the Application Area to the north, except in the north-west where the extension to the main headings extends under the road reserve but not the highway. Several electricity transmission lines located in the road reserve on the southern side of the highway and a buried fibre optic cable located just within Ashton property, are also outside of the Application Area (except in the north-west above the main headings extension). The New England Highway passes through a cutting to the north-east of Longwall 1 finish area. Although well outside the Application Area, the potential impacts of mining subsidence on this cutting are assessed.

2.2 Mining Geometry

Longwalls 1 to 4 are designed to mine final voids of 211m wide separated by chain pillars of 25m rib to rib with cut-throughs at 100m centres.

Figure 3 shows a plan of the overburden depth and thickness of the proposed mining section in the Pikes Gully Seam. The seam section to be mined ranges from 2.7m at the outbye end of Longwall 1 to 2.4m in Longwalls 3 and 4. The seam dips to the south-west at a grade of up to about 1 in 10.

The overburden depth ranges from 35m at the outbye end of Longwall 1 to 158m at the inbye end of Longwall 4 principally as a result of seam dip. Over most of the Application Area, the surface topography reflects the general dip of the overburden strata to the west, but, on the eastern edge of the Application Area, the surface dips steeply down to Glennies Creek.

The ratio of panel width to overburden depth ranges from 1.3-6.8 which means that each individual longwall panel is of super-critical width, in subsidence engineering terms, and would be expected to experience full subsidence of up to 65% of seam thickness over the central part of each longwall panel.

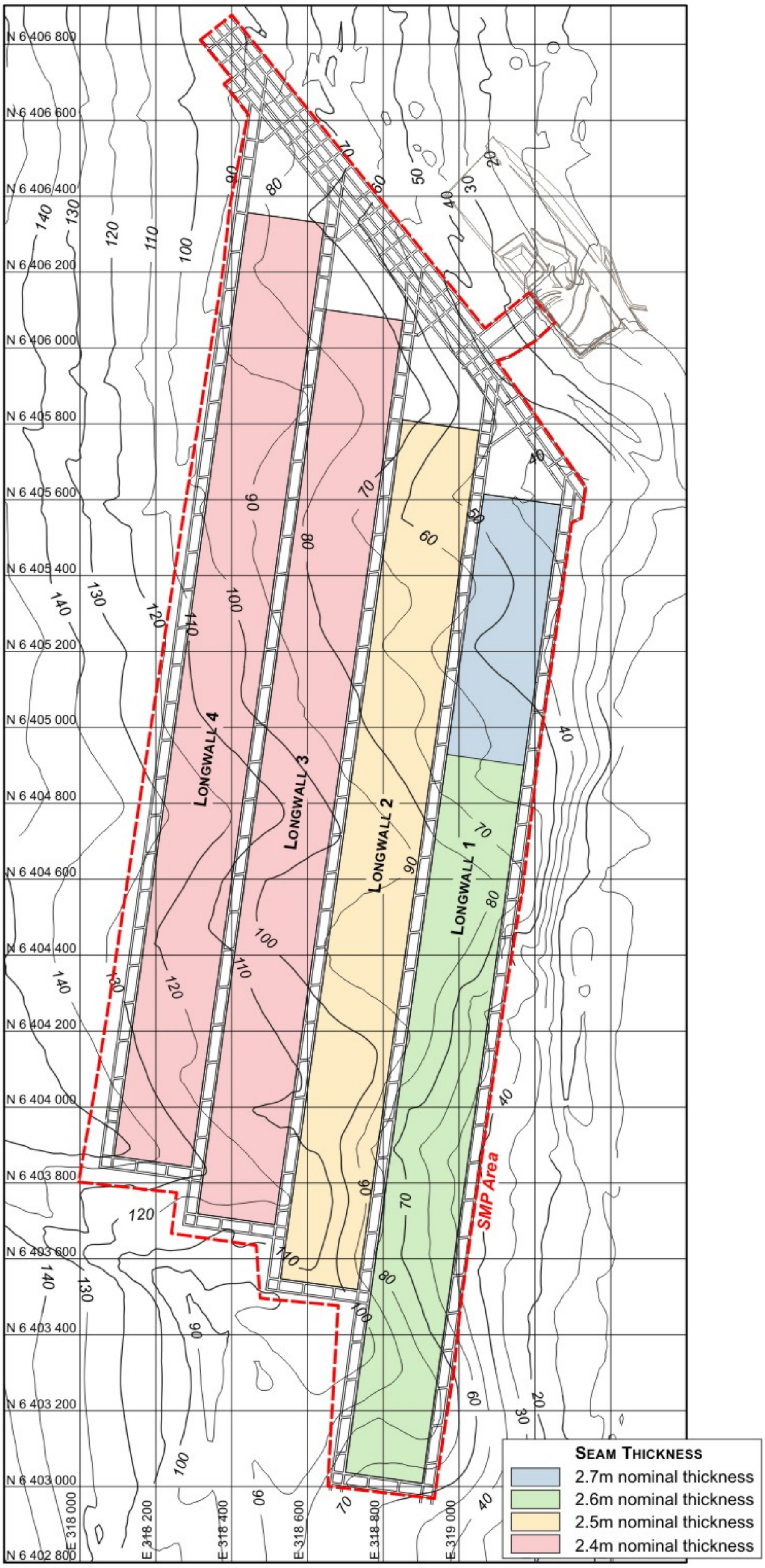


Figure 3 Plan showing overburden isopachs and seam thickness for Longwalls 1-4.

3. DESCRIPTION OF NATURAL FEATURES AND SURFACE IMPROVEMENTS

The natural features and surface improvements in the Application Area have been identified on the basis of a review of the Environmental Impact Statement, several site visits to walk over the surface, discussion with colliery personnel and discussion with other specialist groups working for the colliery. In this section, these features and improvements are described in greater detail to provide a context for the assessment of likely subsidence impacts.

3.1 General Character of Area

The Application Area is predominantly cattle grazing land owned by Ashton. The surface improvements in the area include farm roads, buildings, water supply dams, water tanks and fences associated with grazing operations, several electricity transmission lines and buried Telstra cables that traverse the area.

Figure 4 shows a photographic panorama looking south across the Application Area.

The surface topography is generally dipping to the west and is gently undulating over most of the area. In the east and south, there are some steeper slopes dipping east to Glennies Creek and south to the Hunter River. In the west, there are some flatter areas alongside Bowmans Creek. The flat areas adjacent to Bowmans Creek that are within the Application Area comprise eroded bedrock without an alluvial cover except for a small area in the south-west of Longwall 4. This area has a cover of alluvium, but the edge of the saturated alluvium is located outside the Application Area.

The portion of the surface within the Application Area that is not owned by Ashton is located above the southern end of Longwalls 1 and 2. This area is in private ownership (Property No. 130) and is currently used for dairy farming.

3.2 Natural Features

The main natural features of interest to the SMP process are the rivers and creeks and their associated alluvial flats.

3.2.1 Glennies Creek

Glennies Creek (also known as Fal Brook) is a permanent watercourse with a catchment area of several hundred square kilometres. Glennies Creek Dam is located upstream so that the flow is partly regulated. Figure 5 shows a panorama looking down onto Glennies Creek from a ridge top near the middle of Longwall 1.

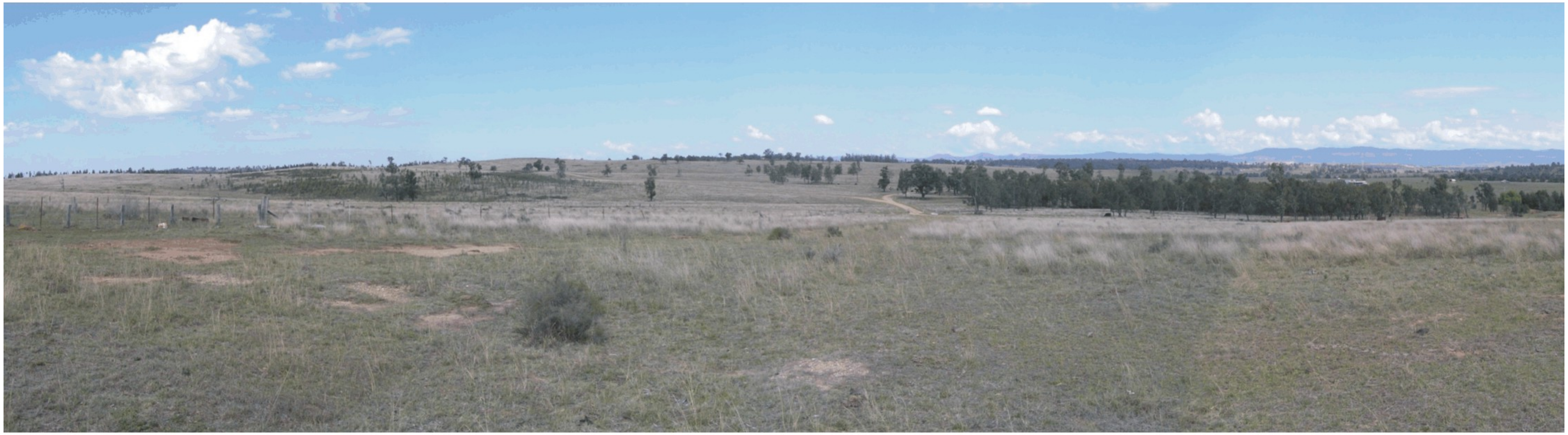


Figure 4   Panoramic photograph of the SMP Area looking south from the northern end of Longwall 3.

Figure 5   Panoramic photograph of Glennies Creek taken from atop the ridge midway along Longwall 1.

The Pikes Gully Seam outcrops below the bed of Glennies Creek over the section closest to Longwall 1. Glennies Creek is located outside of the Application Area. At its closest point, Glennies Creek is approximately 150m from the Longwall 1 goaf edge (approximately mid way along the panel). The overburden depth at the goaf edge is approximately 75m at this point.

3.2.2 Hunter River

The Hunter River is located to the south of, and outside of, the Application Area. The closest point of longwall mining is the start corner of Longwall 3 which is approximately 175m from the Hunter River. The overburden depth at this point is approximately 120m.

As shown in Figure 6, the southern end of Longwall 1 is planned to start under the slope of the hill. It does not extend under the flats adjacent to the Hunter River or under any alluvium that might be in this area.

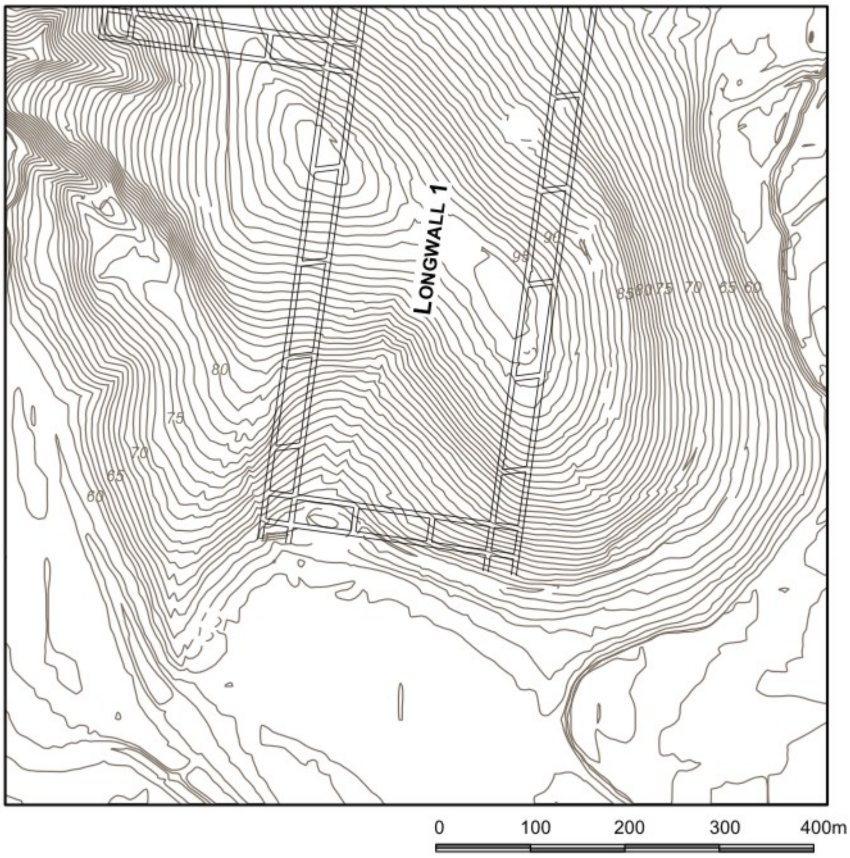


Figure 6 Surface topography (1m intervals) at the start of Longwall 1.

3.2.3 Bowmans Creek

Bowmans Creek is located to the west of, and immediately outside of, the Application Area. Longwall 4 comes within approximately 60m of the top of the bank that defines the edge of Bowmans Creek. The overburden depth at this point is approximately 100m.

Figure 7 shows a photograph of Bowmans Creek in the section closest to Longwall 4. At this point, Bowmans Creek comprises a river channel that is incised some 4-5m below the surrounding flats. The water channel comprises a series of 1-2m deep ponds retained behind pebble bars that are typically vegetated. At the times of inspection April and June 2006, minor surface flows were observed across one of the pebble bars adjacent to the middle of Longwall 4 at an estimated rate of about 0.5Ml/day.

The elevated flats adjacent to Bowmans Creek extend over Longwall 4, but drilling has indicated that these flats are not alluvial in nature and comprise eroded bedrock. Further south, there is a small area of alluvium located over the edge of Longwall 4, but this alluvium is located above the line of alluvial saturation (Dundon 2006).

Figure 7 Photograph of Bowmans Creek near the point closest to Longwall 4.

3.2.4 Remnant Woodlands

There are two areas of remnant woodland located in the SMP as well as areas of more widely distributed trees.

The main woodland area is located at the southern end of the Ashton property and is being established by Ashton as a Voluntary Conservation Area. Figure 8 shows a photograph of this area.

A second woodland area is located alongside a tributary to Bowmans Creek near the middle of Longwall 4. This woodland is somewhat more degraded and includes several areas where rubbish has been tipped. Figure 9 shows a photograph of this second woodland area.

Both areas are understood to include sites containing aboriginal artefacts and nesting sites for native birds.

3.3 Surface Improvements

The various items of surface infrastructure located within the Application Area are described in this section.

3.3.1 "Ashton" Residence

Figure 10 shows a photograph of the "Ashton" residence and the several outbuildings associated with this residence. These are all owned by Ashton and either leased or used for core sheds and the like. They are located near the edge of Longwall 4 about three quarters of the way along the panel. An above ground concrete tank is located near the house. Buried water and sewerage pipes provide services to the house. Electricity is provided by overhead wires.

3.3.2 Farm Buildings on Ashton Property

In addition to the several farm buildings shown in Figure 10, there are another group of farm buildings located over the northern end of Longwall 3. Figure 11 shows a panorama of these buildings. They are all light weight structures.

3.3.3 Ashton Concrete Water Tank

Figure 12 shows a photograph of a buried concrete water tank located near the northern end of Longwall 4. A buried polypipe has recently been connected to this tank.

3.3.4 Local Distribution Electricity Line

A local distribution electricity line supported on single timber poles traverses the northern end of Longwall 4 as shown in Figures 1 and 10. Figure 13 shows the nature of this line.

Figure 8 Panoramic photograph of the remnant woodland at the southern end of Longwalls 1 and 2.

Figure 9 Photograph of remnant woodland over Longwall 4 adjacent to Bowmans Creek.

Figure 10 Panoramic photograph of the "Ashton" residence and associated buildings.

Figure 11 Panoramic photograph of farm buildings located at the northern end of Longwalls 2 and 3.

Figure 12 Buried concrete water tank at the northern end of Longwall 4.

Figure 13 Local distribution power line supported on single pole structures at the northern end of Longwall 4.

3.3.5 132KV Electricity Line

A 132KV electricity line operated by Energy Australia traverses the southern end of Longwalls 1 to 4. Figures 14, 15 and 16 show photographs of the two and three pole structures used to support this line. There are no branches off this line within the Application Area.

3.3.6 Farm Buildings on Property No. 130

There are several farm buildings and concrete water tanks that are located within the Application Area on Property No. 130 at the southern end of Longwall 1. Figure 17 shows photographs of the two buildings located within the Application Area. These are light weight timber and steel framed structures clad in corrugated iron. One appears to be used as a hay barn, the other as an implement shed. The implement shed has a concrete floor. Several concrete water tanks are located in the vicinity of these buildings. These tanks are understood to be connected by a network of buried high density polyethylene (HDPE) pipes.

The farm worker's house and adjacent rainwater tank are located outside of the Application Area.

3.3.7 Access Road

An unsealed road traverses the surface above all the longwall panels and provides daily access to the Property No. 130 for a milk tanker and farm workers. Figure 18 shows several photographs of this road. There are various other minor roads within the Application Area but most of these are for local access to other areas of the Ashton property.

3.3.8 Farm Dams

Nine farm dams are located within the Application Area. Figure 19 shows a photograph of one of them located over the southern end of Longwall 4. The others are of similar size and construction.

3.3.9 New England Highway and Associated Service

The New England Highway is located outside the Application Area north of the longwall panels. The north-west extension of the main headings extends under the road reserve associated with the highway. The highway passes through a cutting (shown in Figure 20) approximately 250m from the finishing corner of Longwall 1 before passing along an embankment further to the west (shown in Figure 21).

Several high voltage electricity lines are located within Ashton property adjacent to the road reserve along the top of the cutting embankment and the foot of the road embankment. A buried fibre optic cable is located adjacent to the road reserve in Ashton property.

Figure 14 132kV power line traversing the southern end of the SMP Area looking east.

Figure 15 132kV power line traversing the southern end of the SMP Area looking west.

Figure 16 Three pole structure at the change of direction of 132kV power line over Longwall 2.

Figure 17 Photograph of farm buildings on Property 130 located within the SMP Area.

Figure 18 Photographs of the access at various locations over the SMP Area.

Figure 19 Photograph of a typical farm dam located within the SMP Area.

Figure 20 Photograph looking west of the road cutting on the New England Highway approximately 250m north-east of the end of Longwall 1.

Figure 21 Photograph of the road embankment on the New England Highway north of Longwall 2.

Mining subsidence is expected to be imperceptible and have no effect on the New England Highway or any of the adjacent infrastructure. However, the potential for upsidence to occur within the cutting, even though the cutting is outside of the mining area, is recognised and this potential is assessed.

4. SUBSIDENCE ESTIMATES

The subsidence estimates provided in this report are intended to be used in the context of an Application for Subsidence Management Plan Approval as outlined in the guidelines produced by the NSW Department of Mineral Resources (December 2003). These guidelines require:

1. A description of methods employed to estimate subsidence resulting from the proposed underground coal mining.

2. A discussion of all factors that may affect the development of subsidence over the application area.

3. Relevance of all input data, including results of previous relevant subsidence monitoring, which has been utilised or considered to develop the predictions.

4. Identification of all assumptions used, especially those which may significantly affect the outcome of the subsidence predictions, and discussion of their relevance.

5. Reliability of the subsidence predictions and the level of uncertainties involved, in particular, any potential deviations from the predictions due to factors such as topographic, geological or geotechnical conditions or variations.

Our assessment is aimed to address each of these issues in the following sections.

4.1 Prediction Methodology

The subsidence predictions used for assessment purposes at Ashton are based on the empirical experience at similar panel width and overburden depth. There is a large database of experience indicating that the maximum subsidence does not exceed 65% of seam thickness mined, for single seam longwall operations in New South Wales. A value for maximum subsidence of 65% of seam thickness has been used as a conservative estimate for maximum subsidence over each of Longwalls 1 to 4.

Profiles of subsidence for Ashton are based on the subsidence profiles measured in longwall panels at similar overburden depths and panel geometries. Estimates of strains and tilts are based on guidelines developed in the Western Coalfield. The Western Coalfield guidelines have been chosen because the database of experience is for similar overburden depths and panel geometries as those at Ashton.

An upper limit approach to estimating subsidence and subsidence parameters has been used. There is considered to be no potential for greater levels of maximum vertical subsidence to occur. It is anticipated that actual subsidence will be somewhat less than the maxima predicted.

4.2 Discussion of Factors that Affect the Development of Subsidence

At Ashton, the overburden depth and panel width are such that subsidence is likely to develop over each individual longwall panel, effectively independently of any subsidence that has occurred in the adjacent panels. Maximum subsidence is governed by the height of the seam section mined and is expected to reach up to 65% of this height.

For practical purposes, the subsidence profiles developed over each goaf edge are expected to be essentially similar. The dynamic profile developed over the longwall panel as it retreats may be flatter than the final goaf edge profiles developed over the start, finish and sides of each panel, but any differences are not expected to alter the impacts significantly and will tend to be temporary in nature.

Permanent strains and tilts are expected to develop over each of the longwall goaf edges. Transient tilts and strains up to near maximum values are expected above the retreating longwall face. Some permanent tilts and strains are likely to occur over the centre of each longwall panel, even though full subsidence has developed in this area.

4.3 Relevance of Input Data

The Western Coalfield experience has been used to estimate subsidence at Ashton because the overburden stratigraphy, overburden depth and longwall widths on which the Western Coalfield experience is based is essentially similar to those at Ashton. There is no site specific data available at Ashton, so maximum values from the Western Coalfield experience have been used to provide a conservative, upper bound estimate of the subsidence that is likely.

The strains and tilts are expected to be sufficiently high to cause significant disturbance to the surface and infrastructure directly over the longwall panels. Any inaccuracy in the predictions is not expected to alter this outcome.

4.4 Identification of Assumptions

The subsidence predictions at Ashton are based on the simple observation that maximum subsidence observed above longwall panels in New South Wales for single seam operations has not been recorded as exceeding 65% of the seam thickness mined. There is no basis to expect that the subsidence at Ashton would be in any way dissimilar or greater than previous experience in New South Wales would indicate.

4.5 Reliability of Predictions

The subsidence predictions and the goaf edge subsidence profiles are expected to provide an upper limit estimate of the subsidence. It is considered most unlikely that maximum subsidence would exceed predictions, but actual maximum subsidence at any one point may well be up to 30% less than predicted. This reduction may occur as a result of different bulking characteristics in the overburden strata at Ashton and near-surface horizontal subsidence movements that cause localised strata dilation and less vertical subsidence.

The magnitude of vertical subsidence over the chain pillars is not likely to be predicted with the same level of accuracy as the maximum subsidence over the centre of each longwall panel. However, because the vertical subsidence over the chain pillars is generally expected to be less than 100mm, any error in magnitude of subsidence is of little significance relative to the adjacent, much larger subsidence movements over the longwall panels themselves.

5. SUBSIDENCE ESTIMATES FOR ASHTON

The subsidence predictions used for assessment purposes at Ashton are based on the empirical experience at similar panel width and overburden depth. This experience is summarised in Figure 22 and would indicate maximum subsidence at Ashton of 1.6-1.8m of vertical subsidence for seam thicknesses of 2.4-2.7m and panel width to depth ratios mostly in the range 2 to 4 but ranging in localised areas from 1.3 up to 6.8. Actual maximum subsidence is expected to be less than 65% of seam thickness, but for prediction purposes, a conservative approach has been adopted and an upper limit of 65% has been adopted.

Empirical experience also indicates that, at overburden depths of less than 100m, only low levels of subsidence develop above the chain pillars that separate individual longwall panels. For the overburden depths at Ashton, maximum subsidence over the chain pillars is expected to be typically less than 100mm.

With 1.5-1.8m of subsidence over the centre of each longwall panel and less than 0.1m of subsidence over the chain pillars, the final subsided surface profile is expected to develop as a series of troughs that subside essentially independently of each other.

Figure 23 shows the subsidence profiles that would be expected to develop on five cross-sections above Longwalls 1-4. The locations of these cross-sections are also shown. All the sections are at right angles to the longwall panels except for Section D which follows the alignment of the 132KV electricity line.

Figure 24 shows contours of the subsidence troughs expected once mining is complete. Subsidence over each individual longwall panel is expected to be essentially independent of the subsidence over adjacent panels.

Maximum strains, tilts and curvatures are predicted on the basis of empirical relationships that have been developed from observations in the Western Coalfield (Holla 1991). This empirical dataset has been chosen because the overburden stratigraphy and longwall panel geometries at Ashton are more typical of the Western Coalfield than of the Newcastle Coalfield. The Western Coalfield guidelines give estimated strains and tilts that are higher than those indicated by the Newcastle Coalfield guidelines so the predicted subsidence values are expected to be conservative.
Strain and tilt parameters have been calculated using the formulae:

E_{max} (tensile strain) $= 1500\ S_{max} / D$
E_{max} (compressive strain) $= 2000\ S_{max} / D$
G_{max} (tilt) $= 5000\ S_{max} / D$

For the purposes of prediction of subsidence parameters, the Application Area has been divided into four domains based on representative overburden depths and seam thicknesses. There will be variations within these domains, but the subsidence parameters provide an indication of the general levels of maximum strain and tilt that would be expected.

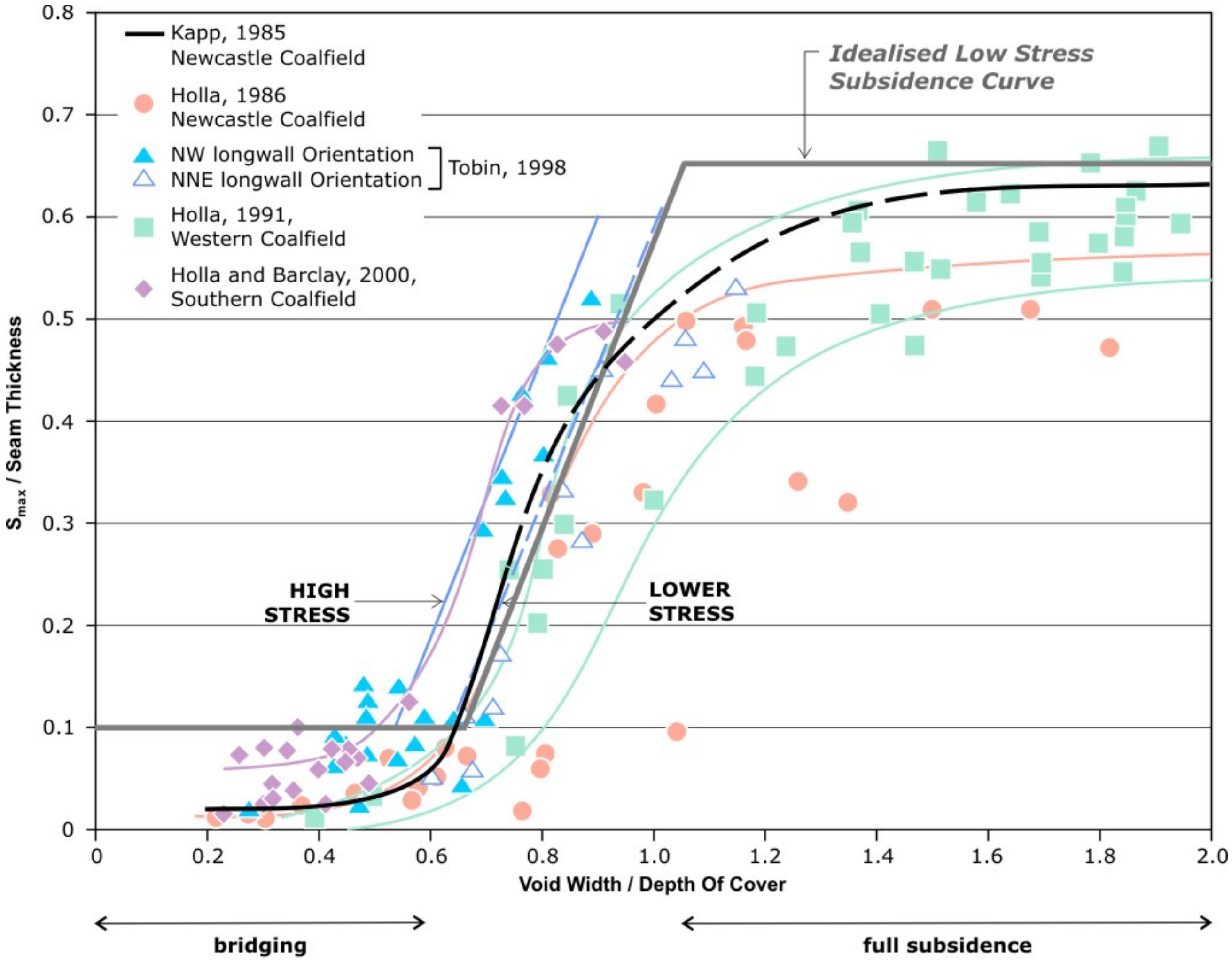
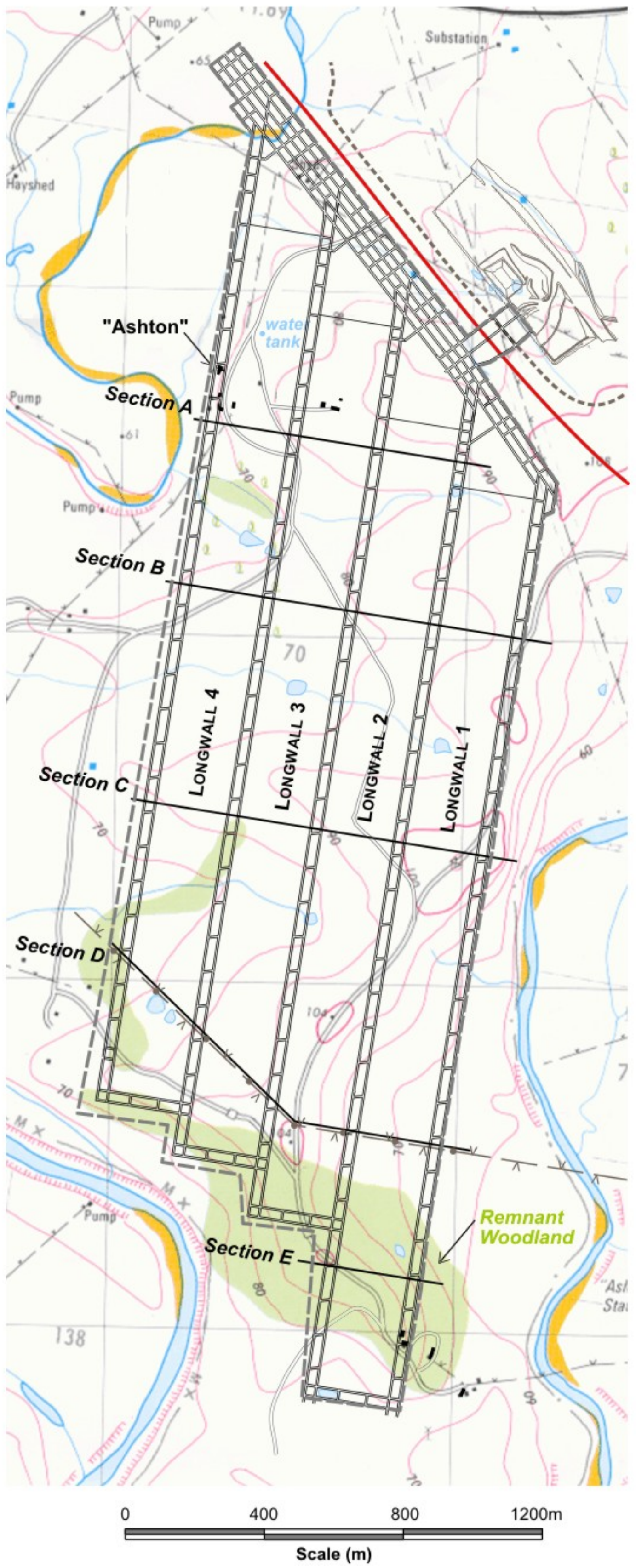


Figure 22 Summary of sag measurements in NSW.



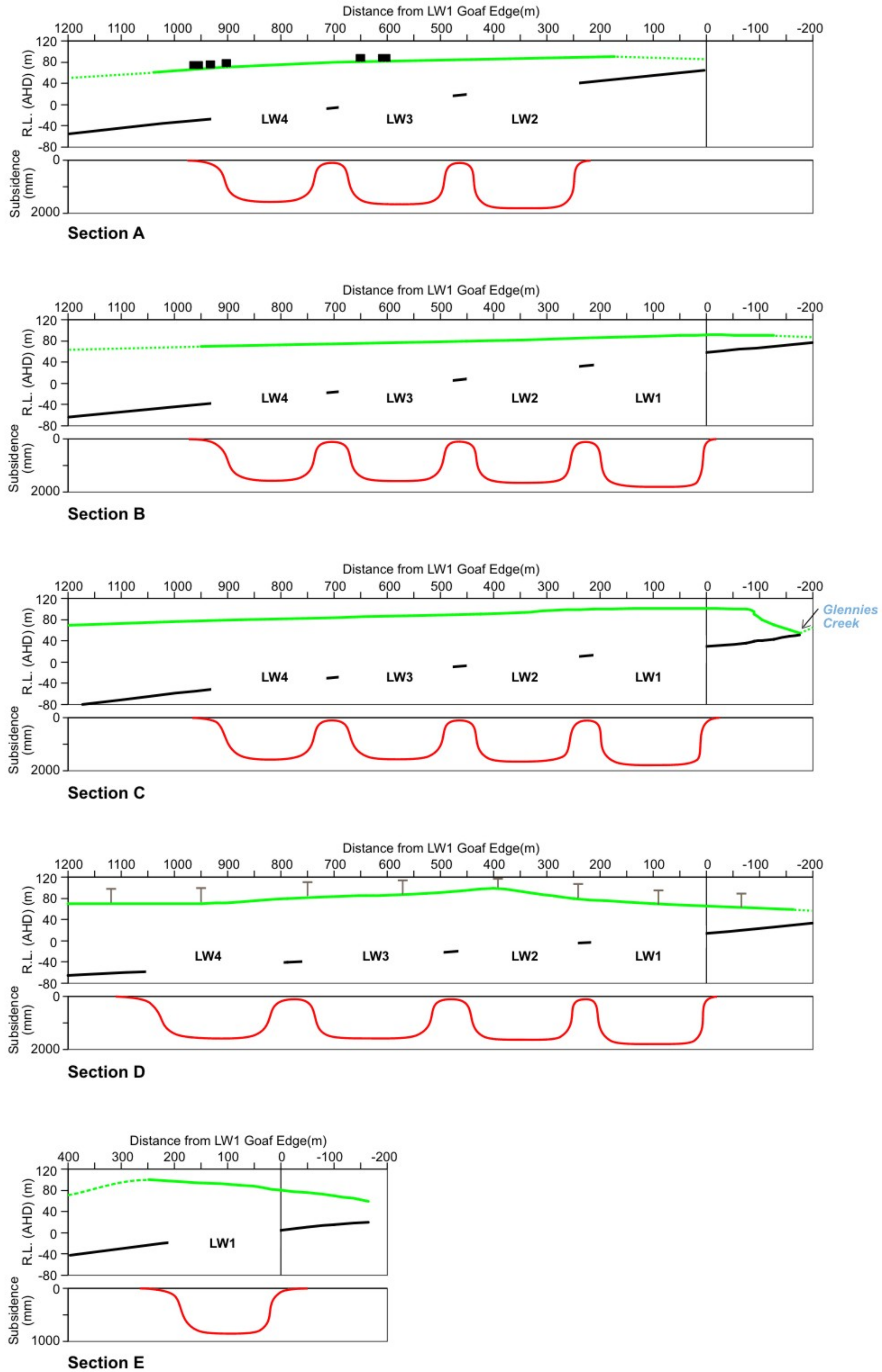


Figure 23 Cross-sections of proposed coal mining, infrastructure location and post mining subsidence profiles.

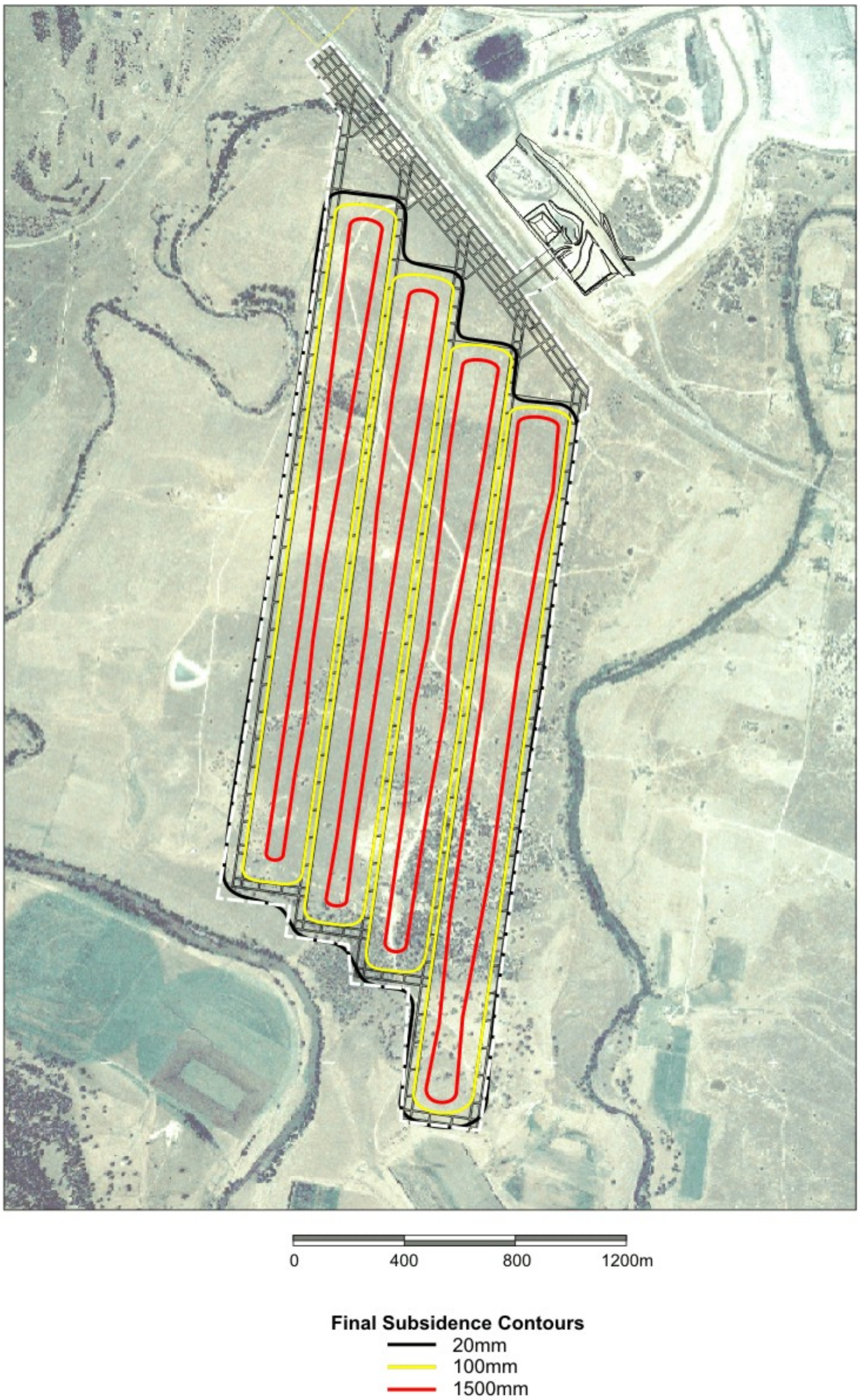


Figure 24 Contour plan of the subsidence expected within the SMP Area for the proposed longwall geometry.

Table 1: Predicted Subsidence Movements

Domain	Maximum Subsidence (m)	Maximum Tensile Strain (mm/m)	Maximum Compressive Strain (mm/m)	Maximum Tilt (mm/m)
North End of LW1	1.8	73	98	244
Remainder of LW1	1.7	42	56	141
LW2	1.6	30	41	102
LW3 and LW4	1.6	23	31	78

Minimum systematic curvature is expected to be more than 2.5km based on experience in the Western Coalfield (Holla 1991) but in the shallow areas, localised curvature may be less than 100m.

Systematic horizontal movements of greater than 0.5m are expected in the shallow areas of Longwall 1. More generally, systematic horizontal movements of 0.3-0.5m are expected, with the ground initially moving in a direction toward the approaching longwall panel and then, once the longwall face is approximately 0.2-0.3 times depth (20-30m) past, the direction of movement reverses and is toward the retreating longwall face, typically leaving a permanent offset of up to 0.2m in the direction of mining.

In areas of steeper surface topography, downslope movement of 0.2-0.5m is superimposed onto the systematic horizontal movement.

In most other areas, surface cracking of up to several hundred millimetres would be expected in the vicinity of the longwall goaf edges. Permanent tension cracks are expected to develop over all the goaf edges in a direction parallel to the goaf edge. Surface cracking is expected to occur from just outside the goaf edge and increase in magnitude with distance over the goaf reaching a peak at the largest crack located approximately 20-30m from the goaf edge. Cracks are also expected to develop in an arcuate shape around the corners of the longwall panel to become parallel with the longwall face in the centre of each panel.

A series of permanent tension cracks separated by compression humps at intervals of 10m or so may develop parallel to the longwall face. This behaviour is most likely to be evident at shallow overburden depths. Figure 25 shows an example of the compression humps that have been observed above a longwall panel at 60m overburden depth.

5.1 Extent of Subsidence Impacts

The angle of draw is the angle measured from a vertical line at the goaf edge to a point on the surface where there is less than 20mm of vertical subsidence. Vertical subsidence of 20mm is regarded as the limit of vertical subsidence because natural soil shrinking and swelling is of this order. An angle of draw of 26.5° (equivalent to half depth) has been used to define the limit of subsidence for the Application Area at Ashton.

Figure 25 Example of post-mining compression hump at 60m overburden depth.

However, it is expected that the actual angle of draw is more likely to be about 6-10° (0.1-0.2 times depth) based on experience at other sites. Thus, the vertical subsidence is expected to become insignificant at distances beyond the goaf edge of about 5-20m depending on overburden depth. Over the chain pillars, which are 25m wide, there is only likely to be very slight subsidence interaction between adjacent panels.

Goaf edge subsidence is the vertical subsidence measured directly above the goaf edge. It is expected that goaf edge subsidence will average about 70mm but may range up to 100mm.

Figure 26 shows a summary of the range of goaf edge subsidence profiles that have been measured over longwall panels at similar overburden depth in the Western Coalfield. The ground surface at Ashton is expected to drape over the solid goaf edges with subsidence profiles within the limits shown in Figure 26.

The subsidence cross-sections shown in Figure 23 are developed on the basis of the upper bound (greatest subsidence) goaf edge subsidence profiles shown in Figure 26 with allowance made on each profile for overburden depth and seam thickness.

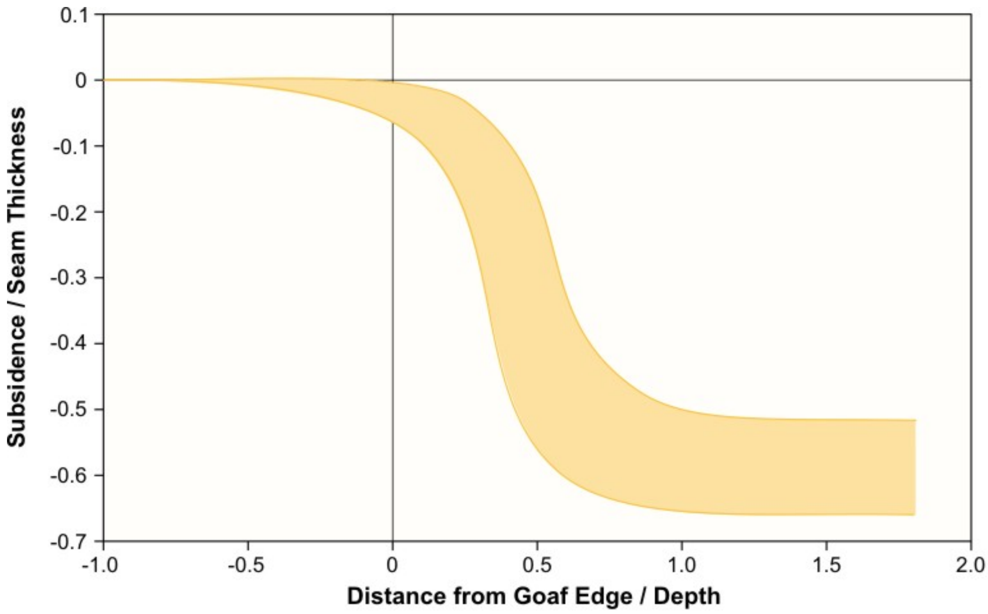


Figure 26 Summary of the goaf edge subsidence profiles measured above longwall panels mined at 40-140m overburden depth.

6. ASSESSMENT OF SUBSIDENCE IMPACTS

In this section, the impacts of subsidence on the natural features and surface improvements are assessed and described.

6.1 Natural Features

6.1.1 Glennies Creek

Glennies Creek is not expected to be impacted by mining subsidence movements. There is recognised to be a possibility of some slight leakage of water through the natural permeability of the Pike Gully Seam coal, which outcrops in Glennies Creek. The significance of this flow has been assessed by others based on field measurements.

There is also a possibility that horizontal subsidence movements may cause lateral translation of the ridge immediately to the west of Glennies Creek in a direction toward Glennies Creek. The magnitude of this movement is estimated from a method developed by Waddington and Kay (2002) for the Southern Coalfield to be up to about 260mm, but experience at other sites has shown that the method tends to provide an overestimate of lateral movement and actual movements are likely to be less than 100mm.

It is recommended to monitor the magnitude of any lateral movement using a subsidence line, but any such movement is not expected to significantly impact on Glennies Creek because of the alluvial nature of the stream channel. Any lateral movement that occurs will involve all the ground moving as one and is not expected to cause any increase in the gradient of the slope leading down to Glennies Creek or any increase the potential for slope instability above that which might already exist. Tilting associated with subsidence is expected to cause the gradient of the slope to flatten slightly, but this is likely to be a small effect.

6.1.2 Hunter River

The Hunter River is not expected to be impacted by mining subsidence.

Subsidence of up to 1.7m expected at the start of Longwall 1 would be likely to increase the vertical hydraulic conductivity between the surface and the underground workings directly above the longwall goaf. The location of the start of each of the longwall panels under the sloping ground and away from any saturated alluvium that may be located on the flats is expected to provide a barrier between any saturated alluvium and the underground workings.

The ground that slopes down to the alluvial flats is directly undermined by the start of all four longwall panels. There is likely to be significant surface cracking evident on the slopes associated with the proposed mining. This cracking is likely to be essentially similar to that which occurs elsewhere along the panels, but because there is potential for these cracks to intercept surface runoff and allow it to enter the slope, it is recommended to refill any cracks that occur as soon as practical after they develop to avoid any potential for slope instability.

Lateral translation of the slope adjacent to the start of each longwall panel is expected to occur in a downslope direction. The magnitude of this movement is likely to vary up the slope, with about 10mm of bulk lateral movement expected for each longwall panel and some greater localised downslope movements evident on the slopes above the start of each of the longwall panels.

6.1.3 Flats on Property No. 130

There is no mining proposed directly below the flats on Property No. 130 flats. Proposed mining in this area is not expected to cause any perceptible impacts on the flats. Some surface cracking and subsidence movements are expected to occur on the adjacent slopes, but with the proposed mining geometry, these impacts are not expected to extend onto the flats.

6.1.4 Bowmans Creek

Bowmans Creek itself is not expected to be directly impacted by mining subsidence movements. Longwall 4 comes within approximately 60m of the top of the bank. Vertical subsidence is not expected to be perceptible beyond a few tens of metres from the goaf edge. Horizontal movements may extend further, but given the alluvial nature of the base of Bowmans Creek, no perceptible impacts are anticipated directly from subsidence movements.

The elevated flats adjacent to Bowmans Creek extend over Longwall 4 near the oxbow and further south as well. We understand that a program of drilling has shown that these flats comprise eroded bedrock and the alluvium associated with Bowmans Creek does not extend under over Longwall 4, except in a small area near the start of Longwall 4 (Dundon 2006). The alluvium in this area is not saturated, so there is limited potential for subsidence to impact on the saturated alluvium associated with Bowmans Creek.

Depending on the proportion of clay material in the surface layers and the local surface gradients, there is potential for ponding of surface waters in this area. It is understood that this potential is being investigated by others.

6.1.5 Remnant Woodlands

Surface cracking and tilting are expected to cause some groups of trees to lean permanently at tilts of up to about 150mm/m. Some individual trees with roots directly impacting by surface cracks may fall over altogether. It may be more difficult to remediate surface cracking that occurs through the woodland areas using other than hand methods without causing further impacts. Cattle may need to be restricted in these areas to prevent injury until such times as any cracks that develop have been filled or have filled naturally.

6.2 Surface Improvements

The impacts of mining subsidence on various items of surface infrastructure located with the Application Area are described in this section. Most of the surface infrastructure is owned by the mine. An assessment of the subsidence impacts on this mine infrastructure is included only for completeness.

6.2.1 "Ashton" Residence

The "Ashton" residence is located just outside the goaf edge of Longwall 4. This structure is unlikely to be subject to significant tilting or vertical subsidence. It may experience some horizontal stretching movements particularly in the front garden. The garage and other structures located nearer to Longwall 4 may also experience more subsidence movements. The serviceability of buried services may be impacted, depending on the nature of the pipework, particularly if they are located in front of the building. The concrete tank is likely to be unaffected by mining subsidence from Longwall 4 because of its location away from the goaf edge.

6.2.2 Farm Buildings on Ashton Property

The farm buildings on the same side of the road as the "Ashton" residence may experience higher levels of subsidence impacts than the house, but not full subsidence. Given that they are light weight structures, they may remain in a serviceable condition, but impacts are likely to be perceptible.

The farm building currently used as a core shed and the farm buildings on top of the hill are likely to experience the full range of subsidence movements and their serviceability may be compromised. A farm building located to the north of the residence is already partly collapsed. Mining subsidence is not expected to significantly alter its current condition.

6.2.3 Ashton Concrete Water Tank and Buried Polypipe

The buried concrete water tank and associated buried polypipe located north-east of the “Ashton” residence is not expected to remain serviceable throughout the cycle of mining subsidence. Replacement of the tank with an above ground, plastic tank located over one of the chain pillars is recommended. Buried polypipe would need to be exhumed and laid on the surface to ensure ongoing serviceability.

6.2.4 Local Distribution Electricity Line

The single timber poles supporting the electricity line used for local distribution at the northern end of Longwall 4 are likely to experience the full range of subsidence movements and some of these poles may become tilted at up to 80mm/m. Past experience of undermining similar structures indicates that, provided the wires are isolated in temporary sheeves, the timber poles are usually able to accommodate the subsidence movements allowing the line to remain serviceable. Once subsidence is complete, it may be necessary to restraighten the poles as part of normal line maintenance.

6.2.5 132KV Electricity Line

A 132KV electricity line operated by Energy Australia traverses the southern end of Longwalls 1 to 4. Subsidence movements are expected to compromise the serviceability of the dual and triple pole structures that currently support this line. It is recommended to reroute the line around the Application Area or develop an alternative plan acceptable to the infrastructure owner. With the development of a management strategy for the power lines, it should be recognised that subsequent mining in lower seams in the future would be likely to require poles located over the mining area to be moved again given that the mining geometry in the lower seams may be different to that in the Pikes Gully Seam.

The locations of individual poles relative to Longwalls 1 to 3 are shown in Figures 1 and 23. The dimensions of these poles are summarised in Table 2.

Table 2: Dimensions of Support Structures on 132KV Power Line

Pole	Height (m)	Base (m)	Goaf Edge Distance (m)	Structure
2	13.3	4.4	99	∏
3	13.2	4.6	14	∏
4	15.8	4.9	55	III

Pole	Height (m)	Base (m)	Goaf Edge Distance (m)	Structure
5	13.5	4.3	55	∏
6	16	4.4	5	∏

As an example, Pole 2 located over the centre of Longwall 1 is expected to experience the full range of subsidence movements as the longwall face passes underneath it. The overburden depth at this location is approximately 60m, so maximum tilt across the line may reach up to 150mm/m giving a lateral movement at the top of the pole structure of up to about 2m relative to the base.

Lateral horizontal movement of the whole structure of up to about 1m may also occur. This gives total misalignment of the conductor supports relative to their original position of up to 3m. The hanging insulators are likely to accommodate some of this misalignment, but a reduction in the clearance between the conductors and the pole structure would be expected. It is considered likely that this would compromise the line clearances.

Differential tilting between the two adjacent poles is difficult to estimate accurately, but previous experience at other sites at similar overburden depths indicates that up to 10mm/m/m of differential tilt (radius of curvature of 100m) has been measured at 60m of overburden depth in relatively flat terrain. With pole spacing of 4.4m, this is equivalent to a differential tilt of 44mm/m which translated to the level of the cross beam at 13.3m above the ground would equal a differential movement of 585mm. It is considered unlikely that the "∏" pole configuration would be able to accommodate 585mm of differential movement between the two poles at the level of the cross member.

In order to accommodate the anticipated subsidence movements, it would be necessary to support the three conductors on a single pole structure so that there was up to about 3m of lateral clearance available to each conductor in addition to that required for insulation purposes. While it is conceivable that such a single pole structure could be designed, a more permanent solution would be to reroute the 132KV line around the mining area, thereby avoiding potential for outages associated with subsidence impacts and the need to reconfigure each of the poles.

Another strategy would be to reconfigure the 132KV line so that individual poles are located over the chain pillars where the differential subsidence movements are likely to be much less. The practicalities of relocating individual poles to over the chain pillars would need to be assessed given the terrain and ground clearance requirements and recognition that Ashton eventually plan to longwall mine lower seams and may not locate the chain pillars in these lower seams directly below the chain pillars in the Pikes Gully Seam.

The options to relocate the 132KV line around the mining area or to support it on single pole structures are recommended. We understand that these options are being evaluated by Energy Australia.

6.2.6 Buried Telstra Cable

Experience of mining under buried multi-core cable indicates that it can usually accommodate strains up to about 20mm/m. Predicted horizontal strains exceed 20mm/m so mining subsidence is expected to compromise the serviceability of this line. It is recommended to reroute the line around the mining area if it is required to remain serviceable or provide some alternative means of telecommunication until mining subsidence is complete and the line is replaced.

6.2.7 Farm Buildings on Property No. 130

The several farm buildings and concrete water tanks on Property No. 130 are located just outside of the mining area. These structures are expected to remain serviceable throughout mining, although some subsidence movements may occur and it is possible that the buried pipe network that connects the water tanks could be damaged by mining subsidence movements.

The farm worker's house and adjacent rainwater tank are located outside of the Application Area and would not be expected to be impacted by mining subsidence.

It is recommended to initiate discussions with the Mine Subsidence Board so that remediation and/or mitigation strategies can be put in place in a timely fashion.

6.2.8 Roads

There are several unsealed roads that traverse the surface within the Application Area. The main access road to Property No. 130 is the most critical of these because of the requirement for daily access for the milk tanker servicing the property and for regular access to the farm property generally.

Along the length of this access road, mining subsidence is expected to cause cracking and compression humps of up to several hundred millimetres, and localised changes of grade of up to an estimated 140mm/m. These changes of grade are likely to occur over short distances of 5-10m with 1.7m of subsidence accommodated over 40-50m.

The ground deformation shown in Figure 25 is typical of the compression humps that would be likely to develop at 60m overburden depth above the centre of a 250m wide longwall panel.

The ground deformations are expected to be such that regular regrading of the affected sections of road would be necessary to allow the milk tanker and light vehicles to access Property No. 130 on a daily basis. While it is possible that some sections of the road would remain negotiable without any action, the potential for reductions in ground clearance, loss of traction in rain, wheels slipping into cracks and similar would mean that regular regrading is likely to be required.

At a projected rate of mining of about 100m/week, it is likely that a different section of road would be impacted by mining subsidence each day. This would effectively mean that daily regrading of about 10-20m of the roadway would be required to maintain the road in serviceable condition, but that any regrading would only be effective for a few hours before a new section of road was impacted.

At projected rates of mining of 100m/week, mining impacts on the road from Longwall 1 would be expected to be occur over two separate periods, one of 2 weeks duration and the other of about 3 weeks duration.

Mining impacts from Longwall 2 would continue for a period of some 1400m of longwall retreat or approximately 4 months. However, some 2 weeks after Longwall 2 starts, an alternative route would become available along an existing road formation that traverses the southern ends of Longwalls 2, 3 and 4. Ongoing access to Property No. 130 would then be available via this alternative route and the main access road could be temporarily closed and regraded at less frequent intervals or as required.

Mining of Longwall 3 would affect the alternative route for about 1 week soon after mining commenced, but by using the main access track during this period, access would not be interrupted. Later in the panel, mining would impact on the main access road for about 5 weeks and on the alternative road for about 3 of these weeks. Regular regrading would be required during this period.

Mining of the northern end of Longwall 4 would be expected to impact on both routes for up to 6 weeks and regular regrading of the road is expected to be required during this period.

Other roads would be similarly affected by mining subsidence, but it is anticipated that these would be regraded from time to time to bring them back into a fully serviceable condition.

6.2.9 Farm Dams

There are some seven farm dams of various sizes located within the Application Area on the Ashton property and two on Property No. 130. There is a strong possibility that the dam walls that are directly undermined will be cracked and distorted by mining subsidence. The generally dispersive nature of clay materials used to construct the dam walls is expected to render them susceptible to erosion and disintegration once they have been undermined.

None of the dams have storage capacities that would present a hazard for inundation in the underground workings, but the uncontrolled discharge of ponded water through a fractured dam wall would best be obviated by artificially draining each dam before it is undermined.

Re-establishment of the dam after mining subsidence is complete would involve filling in surface cracks, potentially rebuilding the dam wall with recompacted material from the original dam wall and relining the dam with sealing clay. It may also be necessary to regrade the watercourses upstream and fill in any surface cracks that are diverting surface runoff into the subsurface strata.

6.2.10 New England Highway and Associated Service

The New England Highway and associated high voltage electricity lines and fibre optic cable are not expected to be affected by mining subsidence. There is a remote possibility that the cutting on the New England highway could experience horizontal closure with potential for uplifting of the pavement. The available method for estimating valley closure indicates 3mm of valley closure for this geometry. While such low levels of valley closure are at the limit of the technique to predict, they would not present a hazard to traffic on the highway. There is considered to be only a low risk that valley closure effects would be perceptible or cause any perceptible impact. Survey monitoring is recommended to ensure that any closure is identified early as Longwall 1 approaches its finish point.

An empirical approach for estimating upsidence has been forwarded by Waddington and Kay (2002). The database on which this method is based relates mainly to mining in the Southern Coalfield and therefore mining at much greater depth. It is recognised that the results might not be so relevant for longwall mining at shallow depths and therefore a cautious approach should be adopted. The method would indicate 3mm of valley closure at a distance of 250m. Such low levels of valley closure would be imperceptible and of no consequence for traffic using the highway.

The main reason for monitoring would be confirmation that the method used for estimating valley closure is relevant to this site.

The high voltage electricity lines and fibre optic cables are located on the top of the cutting and would not be subject to impacts from valley closure. They may move laterally a distance of a few millimetres, but such general body movement would be of no consequence.

The extension of the main headings to the north-west would take these headings under the New England Highway road reserve. The proposed first workings are not expected to cause any perceptible surface subsidence and therefore no impacts on the highway or adjacent infrastructure.

7. RECOMMENDATIONS FOR SUBSIDENCE MONITORING

A program of subsidence monitoring is recommended to confirm that the subsidence behaviour is developing as expected.

A cross-line with pegs spaced at 5m centres and measured in three dimensions is recommended across the centre of all the longwall panels as shown in Figure 27. Peg to peg strain measurement is not required given the high strain levels anticipated. It is recommended to survey this line for each panel once the longwall has mined at least 100m past. Additional surveys as the longwall face approaches and passes would provide useful information on the development of vertical and horizontal subsidence movements over longwall panels at Ashton.

It is recommended that this central subsidence line is extended at 10m centres outside the Application Area down to the edge of Glennies Creek to confirm the magnitude of any lateral movement of the ground between Glennies Creek and the edge of Longwall 1. The subsidence monuments should not extend above the ground surface more than 200mm, but it may be appropriate to place marker posts next to each peg to obviate the potential to spike tyres or cause injury to cattle. Alternatively, square wooden pegs set flush with the ground surface would be suitable for the short duration of mining, provided the line is extended and resurveyed immediately prior to each subsequent longwall panel.

A longitudinal subsidence line at the start of Longwall 1 is recommended to provide early confirmation that the subsidence behaviour at Ashton is as expected. This subsidence line may need to be placed so that it does not present a hazard to dairy cattle. Square wooden survey pegs, with nails, placed flush with the ground surface at 5m centres would be sufficiently robust for the 2-3 weeks that the line would be required. Optimally surveying in three dimensions would be conducted at regular intervals of 10m of face retreat starting once the longwall face had retreated 10m (giving a void width from the start of the block of some 18m). Once the longwall had retreated 200m, it would no longer be necessary to continue surveying. The line should extend 50m beyond the start of the block.

Monitoring of individual items of infrastructure is recommended on an as required basis. It is possible that the 132KV electricity line would have been relocated by the time that Longwall 1 would impact on it, but if the twin pole structure has been replaced by a single pole structure it is recommended to monitor the subsidence movements on this structure as mining occurs.

Similarly it would be helpful to establish monitoring points at the corners of the farm buildings and water tanks on Property No. 130 so that subsidence movements can be monitored and related to physical impacts to the building.

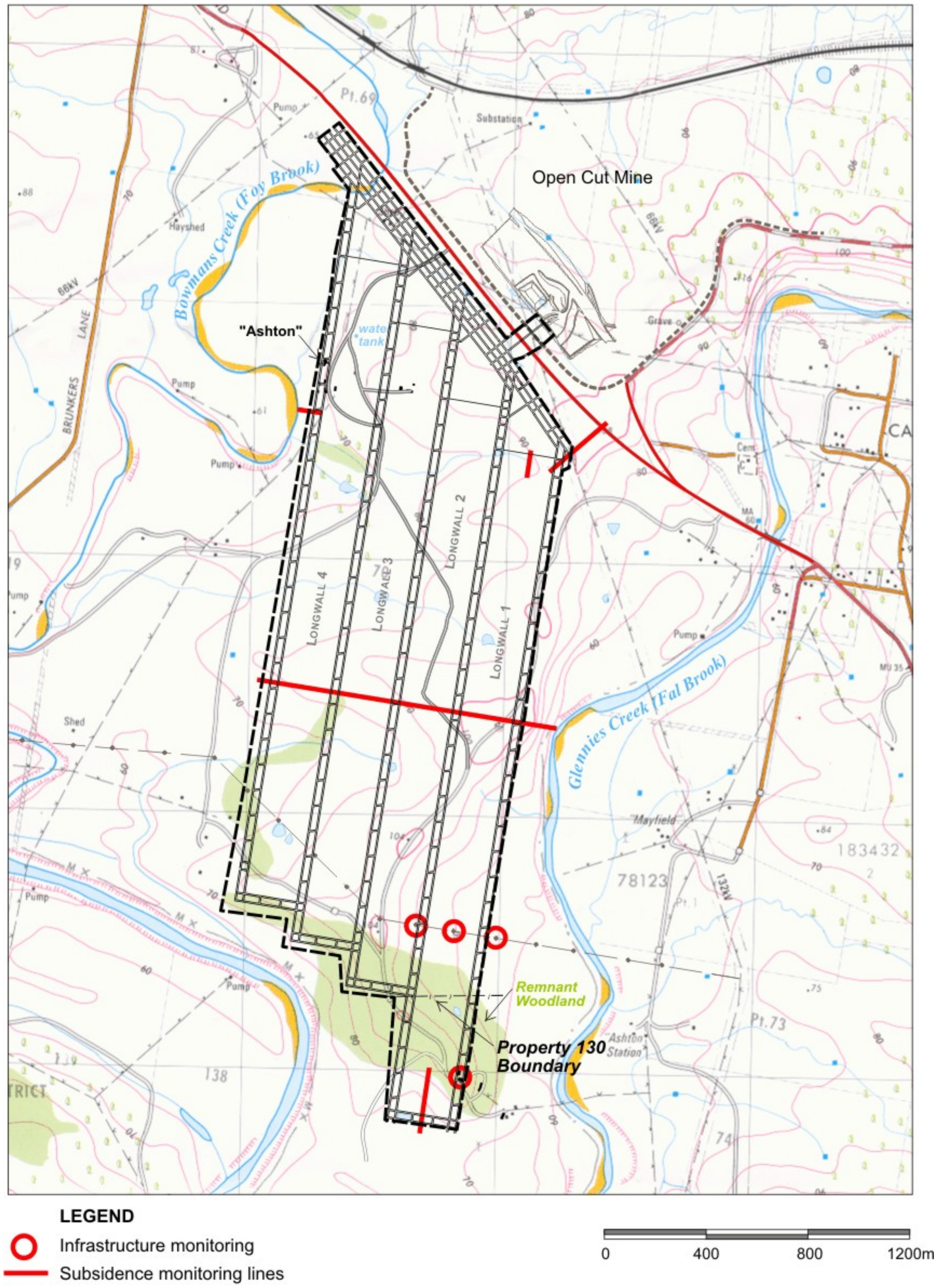


Figure 27 Recommended subsidence monitoring layout.

A survey line at the northern end of Longwall 1, extending from the corner of the panel toward the New England highway at 50m peg spacing measured in three dimensions is recommended to confirm that horizontal subsidence movements are remaining at low levels consistent with expectation.

A short longitudinal survey line at the end of Longwall 1 is recommended for the last 60m of the panel extending 20m over the solid. Square wooden survey pegs set flush with the ground surface at 2m spacing are recommended. These pegs should be surveyed in three dimensions for every 10m of longwall retreat below the line, and when the longwall supports have been removed.

A 60m long survey line extending from the oxbow at Bowmans Creek to the edge of Longwall 4 would provide confirmation of the magnitude of any impacts on Bowmans Creek.

8. CONCLUSIONS

Proposed longwall mining at Ashton in the Pikes Gully Seam is expected to cause vertical subsidence up to 65% of the seam section mined over the central part of each longwall panel. This equates to vertical subsidence of 1.6-1.8m for the 2.4 to 2.7m seam section anticipated. Only low levels of subsidence (generally less than 100mm) are expected directly over the chain pillars, so the final subsidence profile will comprise a series of troughs over each longwall panel that subside essentially independently of each other as each panel is mined.

Tilts, strains and curvature have been estimated on the basis of the Western Coalfield subsidence guidelines because the overburden depth, panel geometry and overburden stratigraphy expected at Ashton are similar to those in the Western Coalfield.

Localised high levels of strain, tilt, curvature and ground distortion are expected in areas where the overburden depth is less than about 60m which is mainly near the northern end of Longwall 1, but may also include the starting area of Longwall 1 as well.

Over most of the Application Area, the overburden depth ranges from 60-120m. Maximum tilts of 80-140mm/m and horizontal strains of 20-40mm/m in tension and 30-60mm/m in compression are expected over the longwall panels.

Mining subsidence is not expected to unduly impact on scattered aboriginal artefact sites or the remnant woodlands and nesting sites within these woodlands. However, surface cracking and associated ground loosening may cause some trees to become destabilised and others to be permanently tilted.

Mining subsidence is expected to cause permanent cracking in the ground surface that may need to be filled once mining is complete to avoid potential injury to cattle stepping into the cracks. It is recommended to fill in subsidence cracking on steep slopes that is expected to develop directly over the mining area as soon as practical after mining is completed to avoid surface runoff being diverted into the slope where it may contribute to slope instability. Subsidence may lead to localised ponding areas following rain in the flatter areas.

Steeper slopes may be subject to lateral translation in the direction of the slope. This phenomenon is expected to occur on the steep slope leading down to Glennies Creek with lateral translation of the entire slope of up to 100mm anticipated. No cracks are expected to develop on this slope and slope stability is not expected to be affected by the lateral translation.

Most of the surface and surface infrastructure within the Application Area is owned by Ashton and is therefore not required to be assessed within the SMP Approval process. However the mining impacts on most of Ashton infrastructure have been assessed within the body of this report for completeness.

A 132KV electricity line that traverses the surface above the southern end of all the panels is likely to be significantly impacted by mining subsidence movements. It is recommended to support this line on single pole structures, relocate it outside of the mining area, or, in the short term, to relocate individual poles over the chain pillars, recognising that as further mining takes place in the lower seams, the line may have to be moved again.

A local distribution electricity line traversing the Application Area at the northern end of Longwall 4 is supported on single pole structures. It is likely that this line would remain serviceable throughout mining provided the conductors are placed in sheeves and any stays are adjusted regularly as each pole is undermined to prevent overloading.

An access road to Property No. 130 is likely to require daily maintenance for several periods while mining proceeds under it. By upgrading an alternative access road, the isolated periods where the road is impacted are likely to be limited to periods of between 2 weeks and 5 weeks duration over each longwall panel. It is likely that the road would require regrading once or perhaps twice per day during this period to keep it serviceable for tanker and car access.

Farm buildings and concrete water tanks on the Property No. 130 are located just outside of the proposed mining area and mining subsidence impacts are likely to be generally small. However monitoring is recommended and it is recommended to initiate discussions with the Mine Subsidence Board so that pre-mining surveys and any remediation required can be undertaken in a timely manner.

Mining subsidence is not expected to significantly impact on the New England Highway or adjacent power lines and buried fibre optic cable. Valley closure of less than 3mm is estimated within a cutting on the New England Highway located 250m north-east of Longwall 1. The likelihood of any impacts being perceptible is considered to be low.

A program of survey monitoring is recommended to monitor subsidence movements and provide confirmation that the subsidence behaviour at Ashton is consistent with expected behaviour.

9. REFERENCES

Dundon P. 2006 Personal communication

Waddington, A.A. and Kay, D.R. 2002 ACARP Management Information Handbook on the Undermining of Cliffs, Gorges and River Systems-Version 1. Developed from ACARP Research Projects C8005 and C9067, September 2002.