REPORT TO:

ASHTON UNDERGROUND MINE

Longwall 7A - End of Panel Subsidence Report

ASH3911A

Strata Control Technology

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REPORT TO	Phil Fletcher Technical Services Manager Ashton Underground Mine PO Box 699 SINGLETON NSW 2330
SUBJECT	Longwall 7A - End of Panel Subsidence Report
REPORT NO	ASH3911A
PREPARED BY	Craig Stemp and Ken Mills
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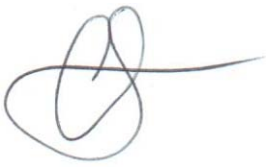

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SUMMARY

Ashton Coal Operations Pty Ltd (ACOL) has monitored surface subsidence movements during the retreat of Longwall 7A on two longitudinal subsidence lines over the start and finish of the panel and a cross-line that extends across all the panels. ACOL commissioned SCT Operations Pty Ltd (SCT) to present the subsidence results for Longwall 7A to meet the end of panel subsidence reporting requirements. This report presents results of Longwall 7A subsidence monitoring and a comparison with predictions in the SMP and Environmental Impact Assessment (EIS) (HLA Envirosciences 2001).

The subsidence behaviour observed over Longwall 7A is consistent with critical width subsidence behaviour and a transition from the supercritical width behaviour of previous longwall panels toward subcritical width behaviour with increasing overburden depth and narrower panel width.

The predicted and measured subsidence values are summarised in Table 1. The subsidence monitoring results for Longwalls 1 to 6A are presented in SCT (2008), SCT (2009), SCT (2009a), SCT (2011), and SCT (2011a). These results are presented again in this report in summary form as context for the Longwall 7A measurements.

Table 1: Subsidence Comparison with Predictions

	Predicted EIS	Predicted SMP	Maximum Measured		
North End of LW1			**CL2**	**XL8**	
Subsidence (mm)	1430	1800	1528	1500	
Tilt (mm/m)	122	244	100	103	
Horizontal Movement (mm)	-	>500	476	500	
Tensile Strain (mm/m)	16	73	40	15	
Compressive Strain (mm/m)	25	98	28	27	
Remainder of LW1			**CL1**	**XL5**	
Subsidence (mm)	1690	1700	1318	1436	
Tilt (mm/m)	60	141	60	75	
Horizontal Movement (mm)	-	300-500	480	503	
Tensile Strain (mm/m)	8	42	49	17	
Compressive Strain (mm/m)	12	56	23	24	
Longwall 2			**CL1**	**CL2**	**XL5**
Subsidence (mm)	1690	1600	1296	1513	1266
Tilt (mm/m)	91	102	40	82	78
Horizontal Movement (mm)	-	300-500	440	298	390
Tensile Strain (mm/m)	12	30	17	16	11
Compressive Strain (mm/m)	18	41	16	32	28

(Table 1 continued)

	Predicted EIS	Predicted SMP	Maximum Measured			
Longwall 3			**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1500	1600	1420	1354	1429	
Tilt (mm/m)	65	78	41	48	97	
Horizontal Movement (mm)	-	300-500	463	345	394	
Tensile Strain (mm/m)	9	23	10	17	22	
Compressive Strain (mm/m)	13	31	7	18	24	
Longwall 4			**CL1**	**CL2**	**XL5**	**XL10**
Subsidence (mm)	1430	1600	1397	1194	1546	1263
Tilt (mm/m)	46	78	36	40	53	33
Horizontal Movement (mm)	-	300-500	230	560	360	258[1]
Tensile Strain (mm/m)	6	23	10	18	9	6
Compressive Strain (mm/m)	9	31	9	67	9	10
Longwall 5			**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1430	1600	1266	1326	1376	
Tilt (mm/m)	29	67	23	29	35	
Horizontal Movement (mm)	-	300-500	399	339[2]	360	
Tensile Strain (mm/m)	4	20	21	6	5	
Compressive Strain (mm/m)	5	27	9	8	17	
Longwall 6A			**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1430	1600	1400	1280	1360	
Tilt (mm/m)	29	57	18	25	39	
Horizontal Movement (mm)	-	300-500	280	250	320	
Tensile Strain (mm/m)	4	17	7	4	8	
Compressive Strain (mm/m)	5	23	7	9	9	
Longwall 7A			**CL1**	**CL2**	**XL5**	
Subsidence (mm)	1430	1600	1415	>860	1391	
Tilt (mm/m)	29	57	24	13	23	
Horizontal Movement (mm)	-	300-500	338	118	365	
Tensile Strain (mm/m)	4	17	7.6	2.4	10	
Compressive Strain (mm/m)	5	23	9.6	>3.8	12.1	

[1] XL10 was installed after some horizontal movement associated with the previous longwall may already have occurred so not all horizontal movements were measured.

[2] Maximum measured at end of line so actual maximum expected to be greater.

The 1.39m maximum vertical subsidence measured over Longwall 7A is within the 1.4-1.6m range predicted in the EIS for Longwall 7A. The vertical subsidence measured is less than the 1.6m predicted in SCT (2010) for the revised SMP for this area.

Measured maximum tilt and maximum strain values above Longwall 7A of 24mm/m and 12mm/m respectively are within the range predicted in the SMP (70mm/m and 30mm/m respectively). Horizontal movements of up to about 365mm have been observed in the vicinity of Longwall 7A. The nominal angle of draw and goaf edge subsidence measured over the western goaf edge of Longwall 7A are 22° and 151mm respectively at an overburden depth of 180m.

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1. INTRODUCTION

Ashton Coal Operations Pty Ltd (ACOL) has monitored surface subsidence movements during the retreat of Longwall 7A on two longitudinal subsidence lines over the start and finish of the panel and a cross-line that extends across all the panels. ACOL commissioned SCT Operations Pty Ltd (SCT) to present the subsidence results for Longwall 7A consistent with the end of panel reporting requirements. This report presents results of Longwall 7A subsidence monitoring and a comparison of these results with predictions made in the SMP and Environmental Impact Assessment (EIS) (HLA Envirosciences 2001).

The report is structured to provide a brief description of the site, the monitoring undertaken, presentation of key results, and a comparison with predicted behaviour.

2. SITE DESCRIPTION

Figure 1 shows a plan of Longwalls 1-7A and the location of the subsidence lines 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 originally produced in 1982). Longwall 7A is slightly narrower at 198m compared to previous longwall panels which were 216m wide.

Figure 2 shows a plan of the overburden depth to the Pikes Gully Seam.

The seam section mined in Longwall 7A is nominally 2.5m ranging from 2.42m to 2.5m along the panel. The seam dips to the southwest at a nominal gradient of 1 in 10. The overburden depth ranges from 179m in the south western corner of the panel, to 160-180m at the position of the main subsidence line, and 160m at the north eastern corner of the panel.

The final extraction void is nominally 198m with the chain pillar on the eastern or tailgate side of the panel 35m wide (measured rib to rib) and the chain pillar on the western or maingate side chain pillar is 40m wide (measured rib to rib). The cut-throughs are at nominal 150m centres.

Longwall 7A commenced mining in March 2011 and finished in August 2011.

3. RESULTS OF SUBSIDENCE MONITORING

In this section, the results of each of the subsidence lines monitored during the retreat of Longwall 7A are presented.

3.1 XL5 – Main Cross Line

XL5 is the main cross-line over all the longwall panels. The line is located midway along the panels. The overburden depth ranges 160-180m across Longwalls 7A.

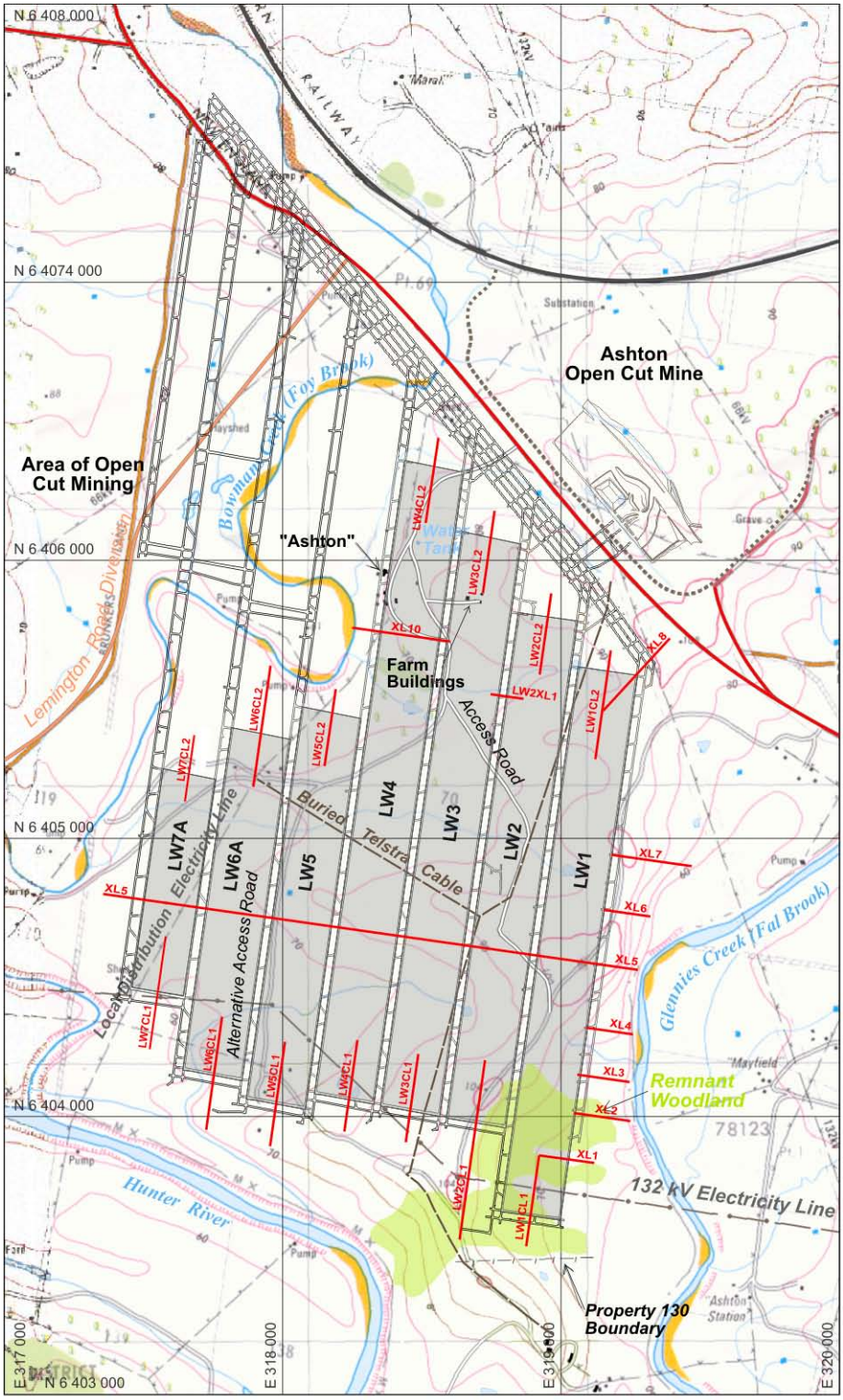


Figure 1: Site plan showing mine plan and location of the subsidence lines superimposed onto 1:25,000 topographic series map updated to reflect current infrastructure.

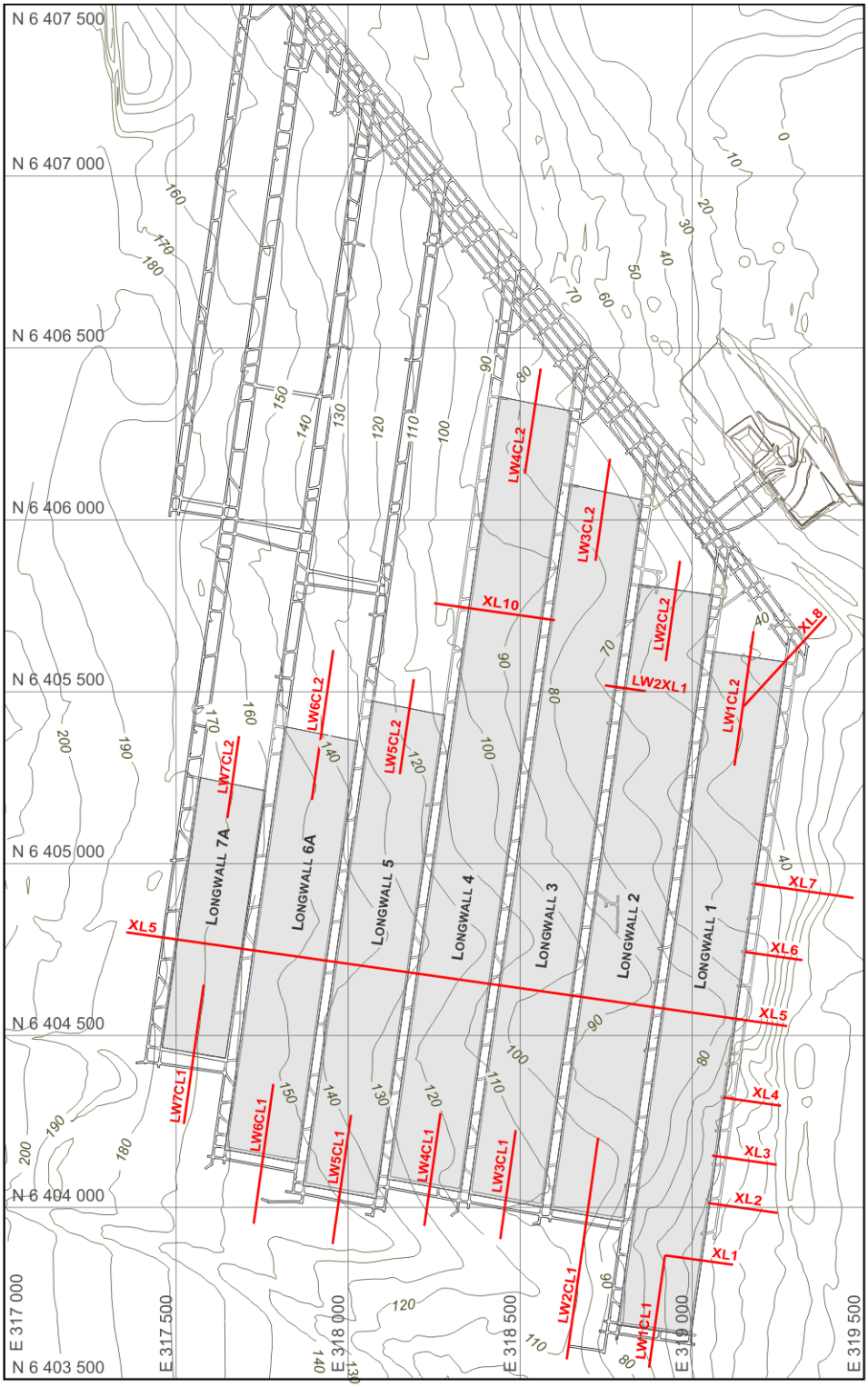


Figure 2: Overburden depth to the Pikes Gully Seam and location of subsidence lines.

Figure 3 shows a summary of the subsidence movements that have been measured on XL5. Seven resurveys were made during mining of Longwall 7A as the longwall face approached and mined past the subsidence line.

The vertical subsidence profile measured over Longwall 7A is typical of the subsidence expected in a critical width panel. The central section where full subsidence has occurred is decreasing in width as the overburden depth increases to the west reaching a minimum width above Longwall 7A. Maximum subsidence measured in the centre of Longwall 7A is 1.39m or 55% of a nominal 2.54m seam section mined. By comparison, the ratios of maximum subsidence over seam thickness mined were 54%, 53%, 57%, 59%, 55% and 54% respectively for Longwalls 1 to 6A.

Maximum tilt measured on XL5 over Longwall 7A was 23mm/m on the eastern edge of the panel.

The form of the horizontal movements above Longwall 7A is somewhat different from previous panels because there is much less offset in an easterly direction. Whereas in previous panels, a horizontal offset of approximately 200mm was evident, this offset is much more subdued over Longwall 7A. The reasons for this change are not clear.

Maximum strains measured on XL5 above Longwall 7A were 10mm/m in tension and 12mm/m in compression.

Goaf edge subsidence measured over the western goaf edge of Longwall 7A on XL5 was 151mm and the angle of draw to 20mm of subsidence was approximately 22° at an overburden depth of 180m.

3.2 CL1 – Longwall 7A Start Line

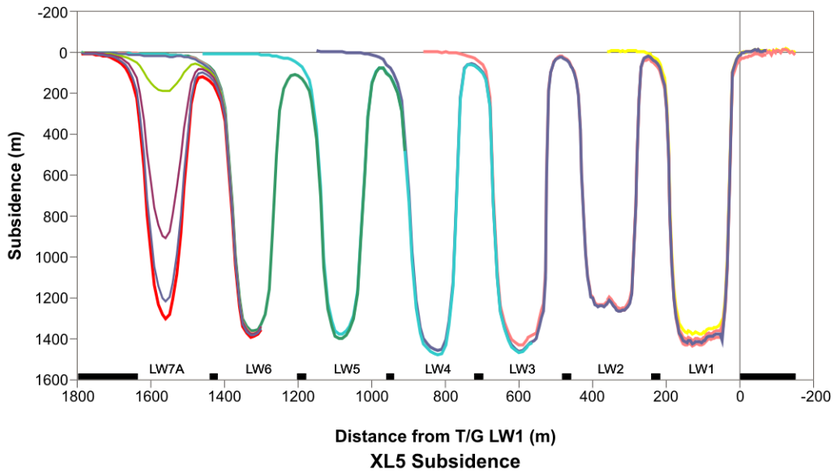
Figure 4 shows a summary of the subsidence movements measured on the centreline subsidence line CL1 located over the start of Longwall 7A. The overburden depth along CL1 is approximately 170m. The pegs are spaced at 10m centres.

The maximum subsidence measured on CL1 was 1.42m or 57% of the nominal 2.5m seam section mined. Maximum tilt occurred over the start line and reached a peak of 24mm/m.

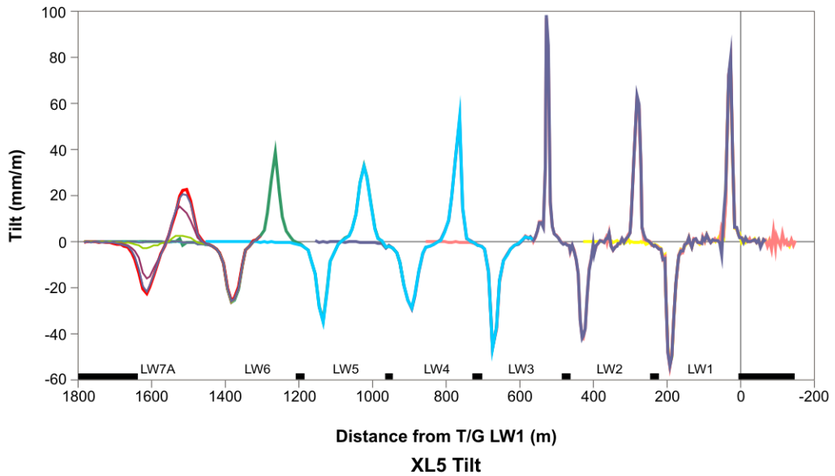
Horizontal movements occur in the direction of mining and in an upslope direction across the panel. The maximum horizontal movement of 338mm occurs in an east-northeast direction with a magnitude that is 24% of the maximum vertical subsidence.

Longitudinal horizontal strains at the start of the panel are greatest within the first 100m of longwall retreat reaching a peak of approximately 8mm/m.

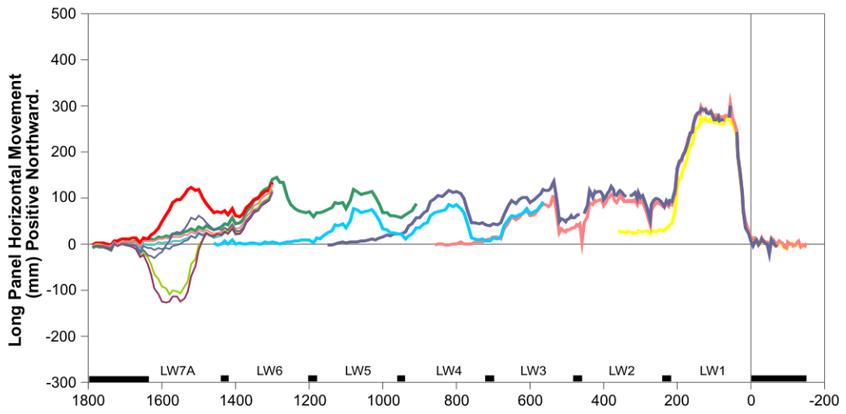
Goaf edge subsidence at the start of the panel is 101mm and the angle of draw to 20mm of subsidence is 24°.



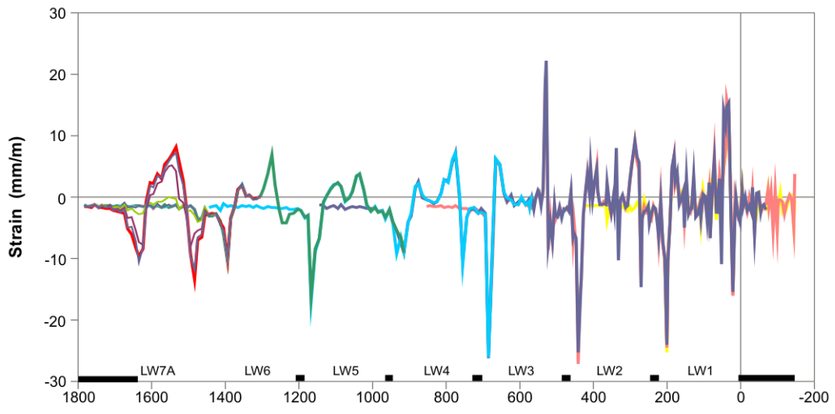
XL5 Subsidence



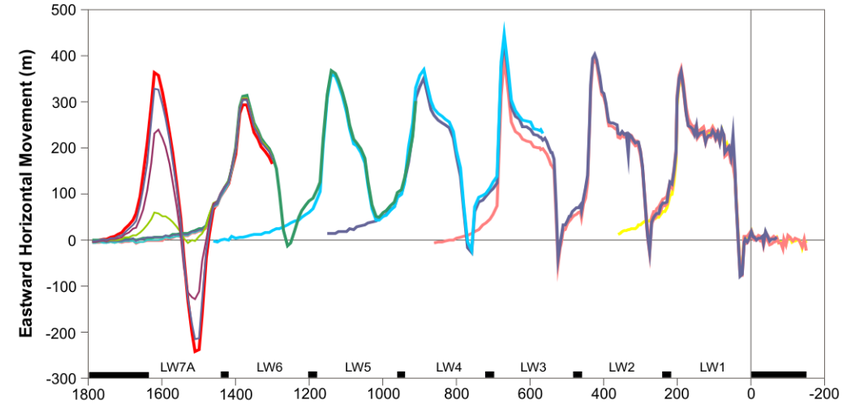
XL5 Tilt



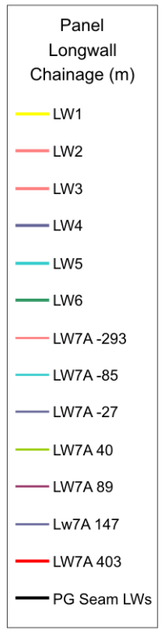
XL5 Long Panel Horizontal Movement

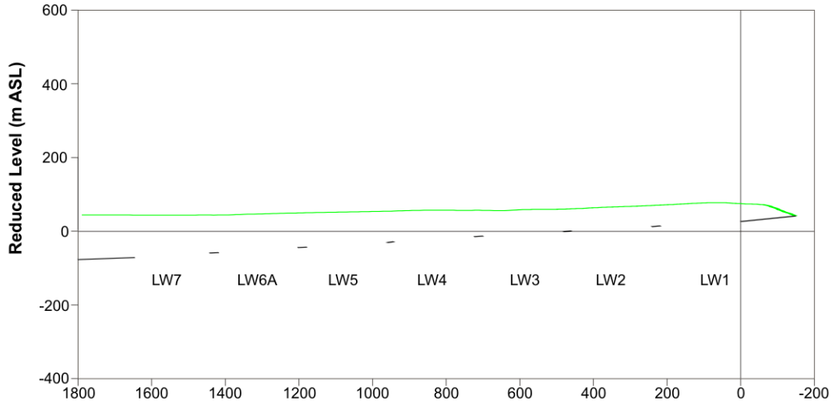


XL5 Cross Panel Strain



XL5 Cross Panel Horizontal Movement





Surface Topography

Figure 3: XL5 cross line subsidence over Longwalls 1- 7.

3.3 CL2 – Longwall 7A Finish Line

Figure 5 shows a summary of the subsidence movements measured on CL2, a longitudinal subsidence line located on the centreline of Longwall 7A at the northern end of the panel. The overburden depth in this area is approximately 170m. The subsidence monitoring pegs are spaced at 10m centres.

Maximum vertical subsidence measured on CL2 was greater than 0.86m (the maximum subsidence measured at the southern end of the subsidence line) some 34% of a nominal 2.5m mining section. Full vertical subsidence was not able to be measured because the subsidence line did not extend sufficiently far to the south to measure full subsidence.

Maximum tilt measured on CL2 was 13mm/m.

Horizontal movements at the end of Longwall 7A are toward the approaching longwall face with a peak magnitude of approximately 117mm, but the line does not extend far enough south to measure the full northward horizontal movement that develops over the longwall panel.

Maximum horizontal strains measured on CL2 are 2.4mm/m in tension over the finish line and 3.8mm in compression further along the line.

Goaf edge subsidence at the end of the longwall panel is 47mm and the angle of draw to 20mm is 14°.

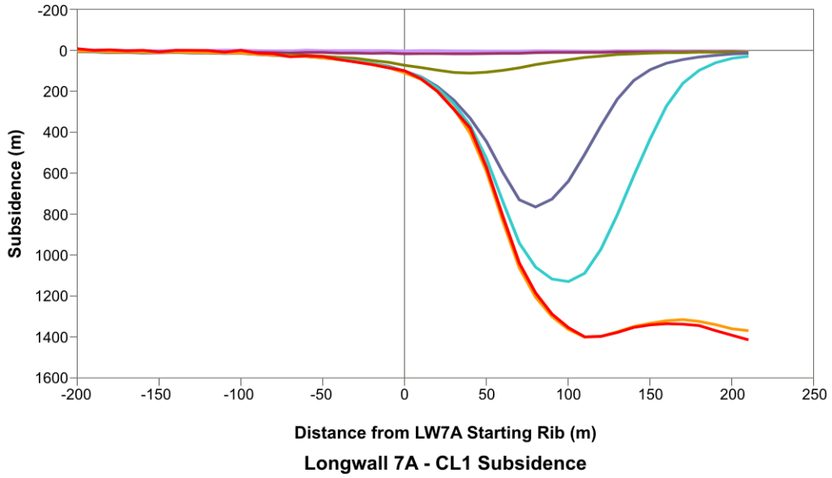
4. COMPARISON WITH PREDICTIONS

In this section, the measured subsidence movements are compared to the subsidence movements predicted in the EIS (HLA Envirosciences 2001) and the SMP (SCT 2010).

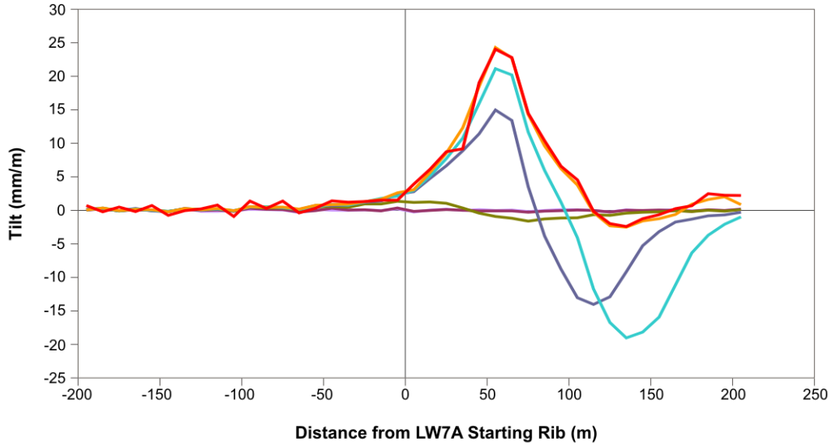
The magnitude of subsidence movements above Longwalls 1-7A at Ashton Coal Mine was predicted in Table 1 of the EIS, Table 1 of SCT (2006) and Table 3 of SCT (2010), the latter two for the SMP approval processes. The predicted and measured subsidence values are summarised in Table 1 in the summary of this report.

The maximum subsidence values of 1.39m, 1.42m, and 0.86m measured on XL5, CL1 and CL2 respectively are less than the 1.6m maximum predicted in the SMP.

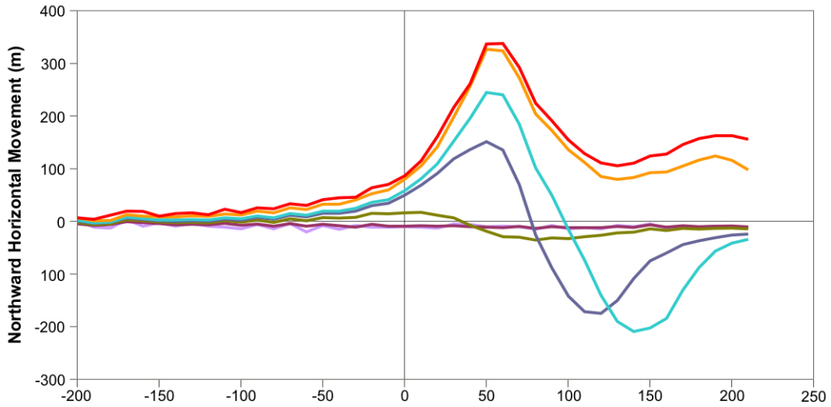
The peg spacing has increased from 5m to 10m since midway across Longwall 3. As a result, the tilts and strains measured since then are artificially lower than the predicted values because the peg spacing is greater than the standard 1/20th depth implied in the predictions. The overburden depth above Longwall 7A is approximately 170m whereas the predicted strains on a 1/20th depth peg spacing would relate to an overburden depth of 200m for 10m peg spacing.



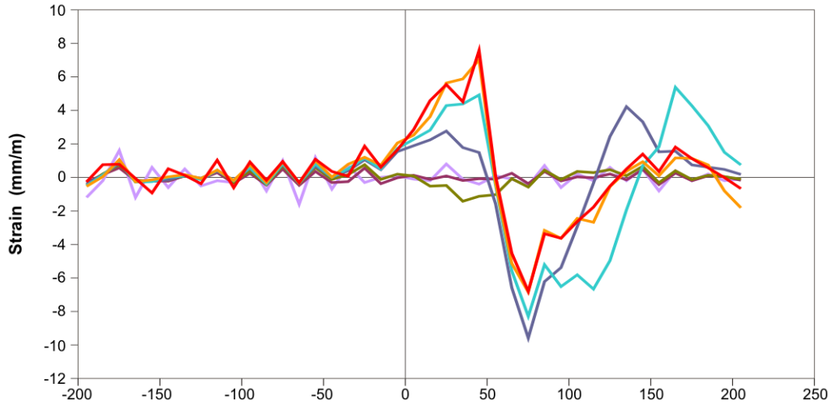
Longwall 7A - CL1 Subsidence



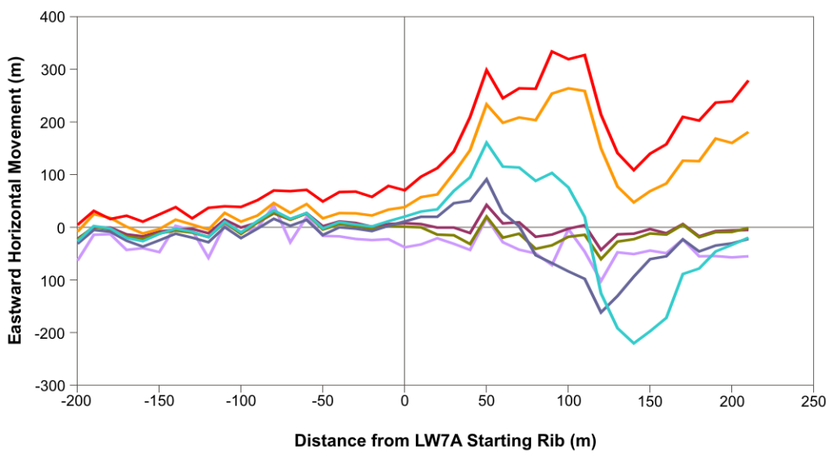
Longwall 7A - CL1 Tilt



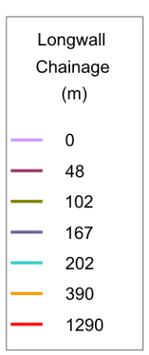
Longwall 7A - CL1 Long Panel Horizontal Movement

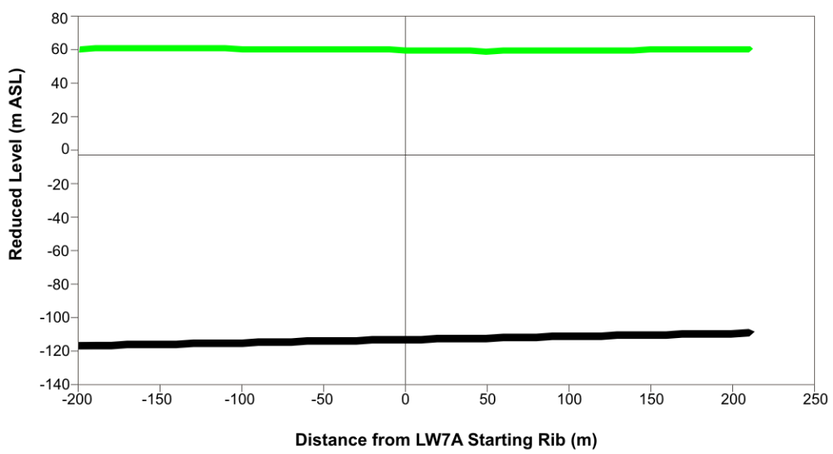


Longwall 7A - CL1 Long Panel Strain



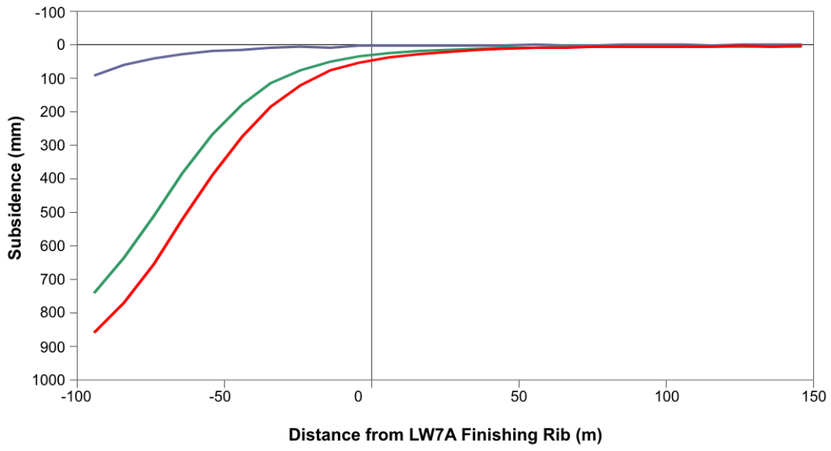
Longwall 7A - CL1 Cross Panel Horizontal Movement



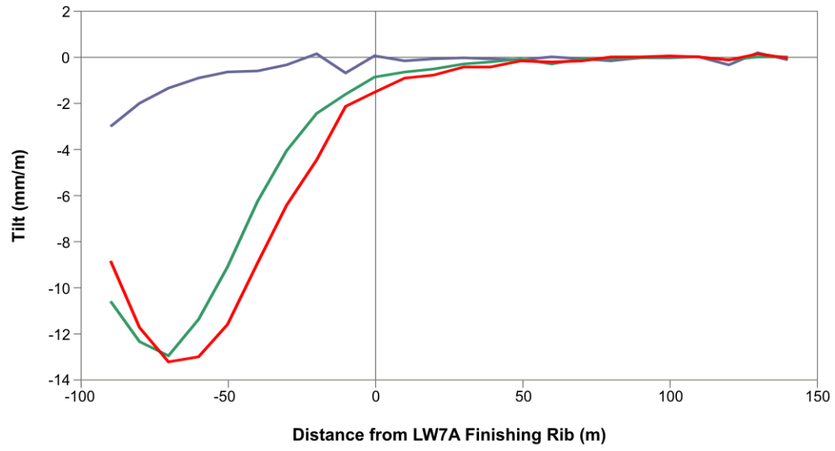


Longwall 7A - CL1 L Surface Topography

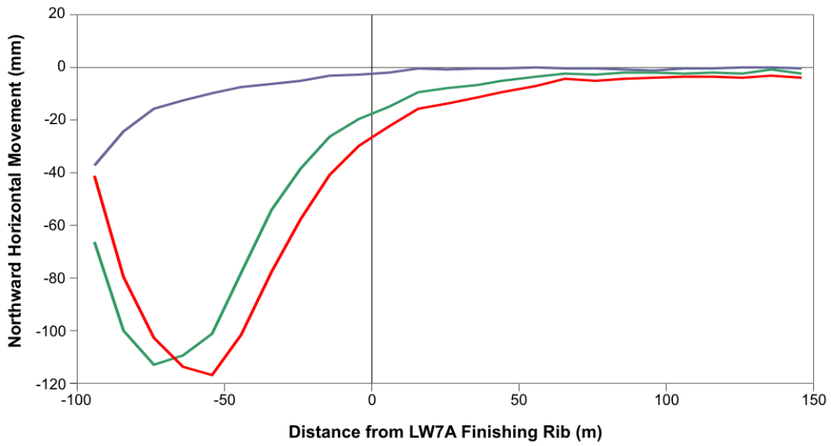
Figure 4: CL1 cross line subsidence to end of Longwall 7A.



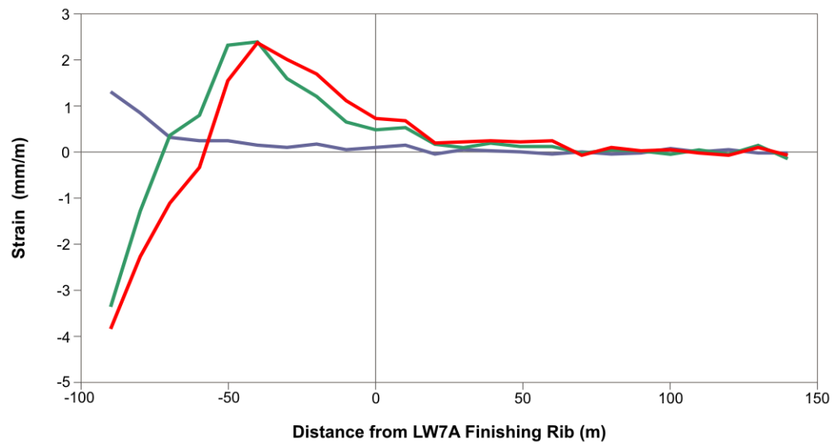
Longwall 7A - CL2 Subsidence



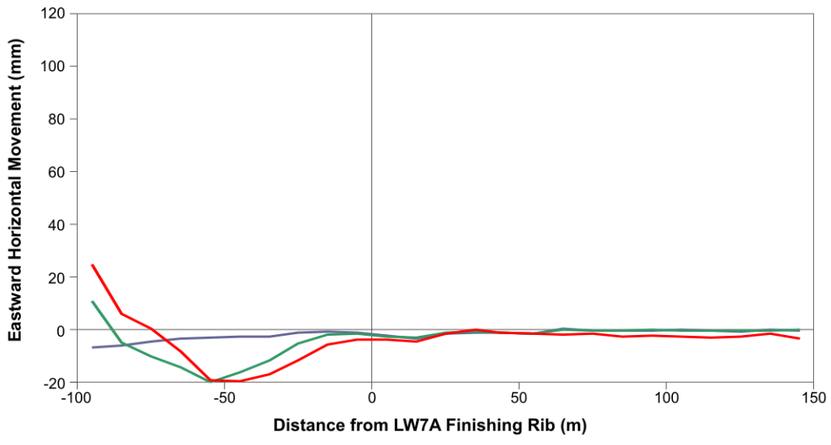
Longwall 7A - CL2 Tilt



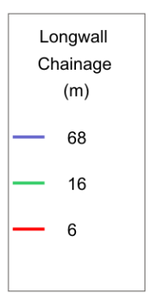
Longwall 7A - CL2 Long Panel Horizontal Movement

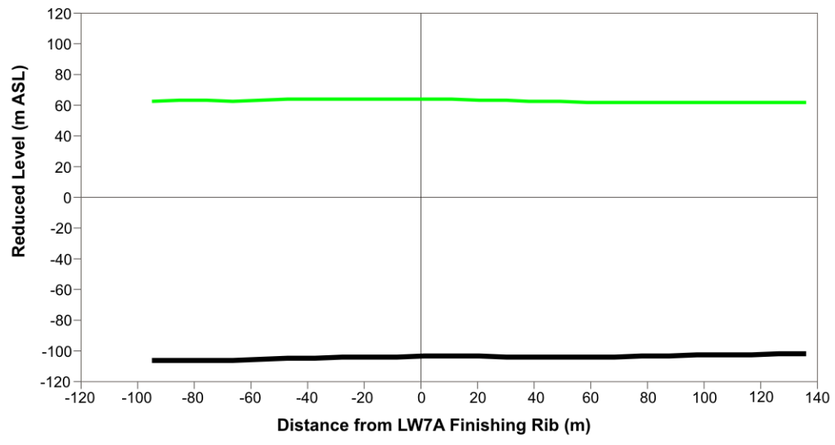


Longwall 7A - CL2 Long Panel Strain



Longwall 7A - CL2 Cross Panel Horizontal Movement





Longwall 7A - CL2 Topography

Figure 5: CL2 cross line subsidence to end of Longwall 7A.

The maximum tilt measured on XL5 was 23mm/m, but a maximum tilt value of 27mm/m (23 x 200/170) should be used for direct comparison with the 70mm/m predicted in the SMP (SCT 2010). For CL1 and CL2, maximum tilts were measured to be 24mm/m and 13mm/m respectively and allowing for peg spacing, would be 27mm/m and 14mm/m. So even allowing for longer peg spacing, the maximum tilt measured over Longwall 7A are well below the maximum predicted.

Horizontal movements measured above Longwall 7A range from 118mm to 365mm. These movements are within the 300-500mm range predicted for this panel.

Maximum strains measured above Longwall 7A were 10mm/m in tension and 12mm/m in compression. Maximum strain values adjusted for peg spacing give 11mm/m in tension and 12mm/m in compression. Both values are less than the 30mm/m predicted in the SMP.

Goaf edge subsidence measured over the western goaf edge of Longwall 7A on XL5 was 151mm and the angle of draw to 20mm of subsidence was approximately 22° at an overburden depth of 180m. The angle of draw is less than the 26.5° predicted in the SMP (SCT 2010) for this panel.

The predictions made in the EIS (HLA Envirosciences 2001) relate to a different mining geometry and so it is difficult to make direct comparisons between predicted and measured values. The measured maximum subsidence parameters are typically greater, in most cases by only a small margin, than the predictions made in the EIS for about half the measurements.

5. CONCLUSIONS

The subsidence monitoring results from Longwalls 1 to 7A provide an indication of the subsidence behaviour that can be expected over future longwall panels at the mine. The subsidence behaviour observed is consistent with the supercritical width subsidence behaviour gradually reducing to critical width subsidence behaviour as the overburden depth increases and the panel width decreases. Longwall 7A is 198m wide compared to previous panels which were 216m wide. The width of the central part of the subsidence profile where full subsidence occurs has reached a minimum over Longwall 7A and maximum subsidence in the centre of the panel would start to reduce if the overburden depth were to increase or the panel width were to be further reduced.

Subsidence has been in the range 50-60% of seam thickness mined and generally less than the maximum predicted in the EIS (HLA Envirosciences 2001). The maximum strains and tilts measured over Longwalls 1 to 7A have exceeded the maximum values predicted in the EIS in some cases, but we note that the mining geometry for which the EIS predictions were made is different to that actually mined and the subsidence behaviour is different as a result.

Table 2: Summary of Angle of Draw Measurements at Ashton

		Dist to 20mm	Depth (m)	Angle of Draw
Longwall 1	CL1	14	65	12
	CL2	-5	38	-7
	XL1	-2	45	-3
	XL2	-11	48	-13
	XL3	-6	52	-7
	XL4	5	62	5
	XL5E	-5	72	-4
	XL5W	22	88	14
	XL6	-4	64	-4
	XL7	-2	44	-3
Longwall 2	CL1	30	101	17
	CL2	0	60	0
	XL5	23	95	14
Longwall 3	CL1	48	112	23
	CL2	0	73	0
	XL5	37	108	19
Longwall 4	CL1	46	125	20
	CL2	1	80	0
	XL5	51	130	21
	XL10	34	95	20
Longwall 5	CL1	30	150	11
	CL2	7	116	3
	XL5	82	145	29
Longwall 6A	CL1	70	155	24
	CL2	16	150	7
	XL5	82	160	27
Longwall 7A	CL1	78	176	24
	CL2	26	104	14
	XL5	72	180	22

Vertical subsidence has been consistently less than the maximum predicted in the SMP (SCT 2010) for Longwall 7A.

Subsidence measurements at Ashton show that the angle of draw shows a gradual increase with overburden depth as is commonly observed at other sites. The angle of draw at the finish line of each panel (measured on CL2) is consistently smaller than the angle of draw over other goaf edges.

6. REFERENCES

HLA Envirosciences 2001 Environmental Impact Statement (EIS) prepared for White Mining Limited Ashton Coal Project, dated 1November 2001.

GHA 2001 "Ashton Coal Project – Assessment of the Impact of Subsidence from Longwall Mining" G.E. Holt and Associates Report prepared for White Mining Ltd dated 23 October 2001.

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