MOOLARBEN COAL PROJECT

Response to Submissions

APPENDIX A8

Subsidence Response

STRATA ENGINEERING

Consulting and Research Engineering

A.B.N. 26 074 096 263

1st December, 2006

Mr Ian Callow
Project Manager
C/- Moolarben Coal Project
PO Box 205
EAST MAITLAND
NSW 2323

Report No. 06-002-WHT/1

Dear Ian,

Subject: Preferred Project Report for the Proposed Longwalls 1 to 14 in the No. 4 Underground Area, Moolarben (Stage 1)

1.0 Introduction

This report provides an assessment of the preferred project mining layout now proposed by Moolarben Coal Mines Pty Ltd (MCM) in regards to the No. 4 UG Area, Moolarben.

The report will discuss the modifications made to the original mining layout presented in the Environmental Assessment (EA) Report and the effect that these changes are likely to have on the features within the study area.

This report only discusses the changes to previously assessed impacts for the features addressed in the EA, and in most cases, the likelihood of damage is likely to be reduced, particularly in respect of:

- The Goulburn River Gorge cliff lines (including The Drip and Corner Gorge) and creek bed.
- The cliff line (CL3) above LW13/14.
- The Aboriginal archaeological sites.

The impact of proposed LWs 1 to 8 on the dams in the southern areas of No.4 UG has also been included in this report. All other impacts will be similar to the outcomes discussed in **SEA, 2006**.

2.0 The Preferred Project Layout

The preferred project layout is shown in **Figures 1** and **2** and has been changed as follows to reduce the likelihood of subsidence impact on sensitive surface features:

- The starting positions of longwall blocks LW 13 and 14 in the northern area have been moved 240 m and 575 m south respectively.
- Original longwall block LW8 in the northern area has now been deleted and the starting position of LW 9 moved 135 m south.
- Another longwall block (the new LW8) has been added to the longwalls proposed in the southern area of the site.
- The starting position of LW 5 in the southern area has been moved 50 m towards the west.
- Longwalls 1 to 8 have been moved 72 m towards the north. The barrier between the east-west main headings and LW8 ribside has been subsequently reduced from 60 m to 35.5 m and the 6 heading mains (35.5 m centres) have been reduced to a 5-heading layout.
- The general mining geometry in regards to the subsidence predictions presented (eg. panel widths and extraction heights), remain unchanged.

3.0 Subsidence Predictions

Predictions of maximum subsidence impact parameters due to the preferred layout of the Moolarben longwalls generally remain unchanged, with some adjustments due to cover depth variation. The predicted maximum values for the preferred layout panels are:

- Vertical subsidence between 1.84 and 2.44 m.
- Tilts between 23 mm/m and 96 mm/m.
- Uniform tensile and compressive strains between 4 mm/m and 45 mm/m.

The predicted credible worst-case subsidence contours and parameter profiles for the preferred project layout are presented in **Figures 3** to **16**.

A summary of the predicted results for the preferred layout and a 4.2 m extraction height at the crossline locations (XL 1 to 10) shown on **Figure 3,** is presented in **Table 1**.

Table 1 - Predicted First and Final Subsidence Impact Parameters (Credible Worst-Case or U95%CL)

LW Panel No.	Distance from Start LW (m)	Cover Depth D (m)	Chain Pillar Width w (m)	Maximum Massive Strata Unit Thickness t (m)	Strata Unit Height above Seam y (m)	W/D Ratio	Unit Location Factor (y/D)	SRP	MG First Goaf Edge S_{ge} (m)	First Panel S_{max} (m)	First Pillar S_p (m)	Final S_{max} (m)	Final Max Tilt T_{max} (mm/m)	Final Max Curv (km^{-1})	Final Maximum Strain (mm/m)*	
															Compres-sive	Tensile
1.1	1740	90	35	27	40	2.89	0.44	Mod	0.18	2.44	0.34	2.44	96	4.55	46	36
1.2	1340	110	35	25	50	2.36	0.45	Mod	0.18	2.44	0.40	2.44	72	3.05	30	24
1.3	935	130	35	28	55	2.00	0.42	Mod	0.18	2.44	0.45	2.44	57	2.17	22	17
1.4	535	150	35	35	60	1.73	0.40	Mod	0.17	2.44	0.50	2.44	46	1.61	16	13
1.5	200	160	35	35	65	1.63	0.41	High	0.13	2.01	0.57	2.18	30	1.08	11	9
2.1	1815	110	35	24	70	2.36	0.64	High	0.17	2.44	0.40	2.44	66	2.86	29	23
2.2	1415	140	35	18	95	1.86	0.68	Mod	0.17	2.44	0.47	2.44	51	1.86	19	15
2.3	1010	150	35	28	100	1.73	0.67	High	0.13	2.13	0.51	2.25	34	1.27	13	10
2.4	610	155	35	28	115	1.68	0.74	High	0.13	2.10	0.52	2.23	32	1.18	12	9
2.5	150	190	35	28	125	1.37	0.66	High	0.12	1.91	0.61	2.13	24	0.78	8	6
3.1	1890	140	35	17	115	1.86	0.82	Mod	0.17	2.44	0.47	2.44	51	1.86	19	15
3.2	1490	150	35	40	100	1.73	0.67	High	0.13	2.14	0.51	2.25	34	1.28	13	10
3.3	1085	165	35	50	97	1.58	0.59	High	0.13	2.02	0.56	2.18	29	1.02	10	8
3.4	685	165	35	50	110	1.58	0.67	High	0.13	2.02	0.56	2.19	29	1.02	10	8
3.5	155	175	35	38	125	1.49	0.71	High	0.13	2.01	0.61	2.23	28	0.93	9	7
4.1	1960	150	35	30	110	1.73	0.73	High	0.13	2.14	0.49	2.24	34	1.27	13	10
4.2	1560	160	35	60	100	1.63	0.63	High	0.13	2.05	0.53	2.18	30	1.08	11	9
4.3	1155	175	35	70	100	1.49	0.57	High	0.12	1.89	0.58	2.07	27	0.90	9	7
4.4	755	180	35	70	105	1.44	0.58	High	0.12	1.96	0.61	2.18	26	0.85	9	7
4.5	225	195	35	45	120	1.33	0.62	High	0.13	1.90	0.64	2.15	24	0.79	8	6
5.1	1985	150	35	50	100	1.73	0.67	High	0.13	2.15	0.48	2.23	33	1.26	13	10
5.2	1585	160	35	55	105	1.63	0.66	High	0.13	2.06	0.51	2.18	30	1.08	11	9
5.3	1180	175	35	50	125	1.49	0.71	High	0.13	2.00	0.57	2.17	27	0.90	9	7
5.4	780	190	35	60	115	1.37	0.61	High	0.13	1.93	0.62	2.15	25	0.79	8	6
5.5	250	190	35	45	110	1.37	0.58	High	0.13	1.94	0.65	2.20	25	0.81	8	6

Table 1 (Continued) - Predicted First and Final Subsidence Impact Parameters (Credible Worst-Case or U95%CL)

LW Panel No.	Distance from Start LW (m)	Cover Depth D (m)	Chain Pillar Width w (m)	Maximum Massive Strata Unit Thickness t (m)	Strata Unit Height above Seam y (m)	W/D Ratio	Unit Location Factor (y/D)	SRP	MG First Goaf Edge S_{ge} (m)	First Panel S_{max} (m)	First Pillar S_p (m)	Final S_{max} (m)	Final Max Tilt T_{max} (mm/m)	Final Max Curv (km^{-1})	Final Max Strain (mm/m)*	
															Compres-sive	Tensile
6.1	2105	140	35	40	95	1.86	0.68	High	0.14	2.26	0.45	2.31	41	1.51	15	12
6.2	1705	150	35	40	105	1.73	0.70	High	0.13	2.16	0.48	2.24	36	1.27	13	10
6.3	1300	165	35	30	125	1.58	0.76	High	0.13	2.04	0.53	2.18	30	1.01	10	8
6.4	900	180	35	40	115	1.44	0.64	High	0.12	1.98	0.58	2.18	26	0.85	9	7
6.5	370	200	35	38	105	1.30	0.53	High	0.13	1.89	0.66	2.15	25	0.79	8	6
7.1	2180	130	35	35	95	2.00	0.73	High	0.15	2.39	0.41	2.41	49	1.84	18	14
7.2	1780	140	35	30	105	1.86	0.75	High	0.14	2.26	0.46	2.32	42	1.52	15	12
7.3	1375	155	35	20	115	1.68	0.74	High	0.16	2.44	0.50	2.44	44	1.44	14	11
7.4	975	170	35	25	110	1.53	0.65	High	0.16	2.44	0.54	2.44	40	1.21	12	10
7.5	445	190	35	30	100	1.37	0.53	High	0.13	1.95	0.61	2.16	25	0.79	8	6
8.1	2250	110	300	30	95	2.36	0.86	High	0.17	2.44	0.10	2.44	73	2.89	29	12
8.2	1850	135	300	20	105	1.93	0.78	Mod	0.17	2.44	0.10	2.44	47	1.50	15	6
8.3	1445	145	300	10	105	1.79	0.72	Mod	0.17	2.44	0.10	2.44	42	1.29	13	5
8.4	1045	155	300	20	105	1.68	0.68	High	0.16	2.42	0.10	2.42	38	1.20	12	5
8.5	515	175	300	20	100	1.49	0.57	High	0.16	2.39	0.10	2.39	32	0.95	10	4
9.6	250	140	35	30	110	1.86	1.86	Mod	0.14	2.26	0.45	2.31	41	1.51	15	12
9.7	480	140	35	27	115	1.86	1.86	High	0.13	2.16	0.48	2.24	36	1.27	13	10
10.6	1100	150	35	20	100	1.73	1.73	Mod	0.13	2.04	0.53	2.18	30	1.01	10	8
10.7	860	160	35	28	120	1.63	1.63	High	0.12	1.98	0.58	2.18	26	0.85	9	7
10.8	240	170	35	26	100	1.53	1.53	High	0.13	1.89	0.66	2.15	25	0.79	8	6
11.6	1300	165	35	30	100	1.58	1.58	High	0.15	2.39	0.41	2.41	49	1.84	18	14
11.7	1100	170	35	30	105	1.53	1.53	High	0.14	2.26	0.46	2.32	42	1.52	15	12
11.8	500	165	35	40	105	1.58	1.58	High	0.16	2.44	0.50	2.44	44	1.44	14	11

Table 1 (Continued) - Predicted First and Final Subsidence Impact Parameters (Credible Worst-Case or U95%CL)

LW Panel No.	Distance from Start LW (m)	Cover Depth D (m)	Chain Pillar Width w (m)	Maximum Massive Strata Unit Thickness t (m)	Strata Unit Height above Seam y (m)	W/D Ratio	Unit Location Factor (y/D)	SRP	MG First Goaf Edge Sge (m)	First Panel S_{max} (m)	First Pillar S_p (m)	Final S_{max} (m)	Final Max Tilt T_{max} (mm/m)	Final Max Curv+ (km^{-1})	Final Maximum Strain (mm/m)*	
															Compres-sive	Tensile
12.7	1700	180	35	50	100	1.44	0.56	High	0.12	1.86	0.41	2.06	26	0.85	8	7
12.8	1100	170	35	45	105	1.53	0.62	High	0.13	1.89	0.35	2.06	28	0.95	10	7
12.9	600	150	35	23	115	1.73	0.77	High	0.13	1.99	0.29	2.10	35	1.26	13	10
12.10	150	170	300	50	95	1.53	1.86	Mod	0.16	2.44	0.54	2.44	40	1.21	12	10
13.7	1650	180	35	55	100	1.44	0.56	High	0.12	1.87	0.41	2.07	26	0.85	9	7
13.8	1050	165	35	40	115	1.58	0.70	High	0.13	1.90	0.33	2.04	30	1.01	10	8
13.9	550	160	35	30	105	1.63	0.66	High	0.13	1.93	0.32	2.07	31	1.08	11	9
13.10	150	140	300	22	105	1.86	0.75	Mod	0.17	2.44	0.08	2.44	53	1.81	18	14
14.7	1300	180	300	50	100	1.44	0.56	High	0.12	1.83	0.08	1.84	23	0.76	8	6
14.8	700	160	300	40	100	1.63	0.63	High	0.13	1.92	0.08	1.93	29	1.02	10	8
14.9	200	160	300	30	100	1.63	0.63	High	0.12	1.92	0.08	1.93	29	1.01	10	8

Notes:
- SRP = Subsidence Reduction Potential of the massive strata unit (i.e. Low, Moderate, High).
- First S_{max} = maximum subsidence over a longwall panel after it is first extracted (including previous chain pillar effects).
- Final S_{max} = maximum final subsidence for a given panel (including subsequent chain pillar effects), after adjacent panels have been extracted.
- *Italics:* Final S_{max} does not exceed 0.58 x Extraction Height (T).
+ - Final Max Curv = Concave curvature magnitudes derived for compressive zones. Convex curvatures may be 1 to 2/3 times the concave curvatures.
* - Values shown are uniform or 'smooth profile' strains, which are relatively even or uniform between pegs (i.e. no cracking). When cracking occurs the uniform strains can increase by 2 to 3 times (i.e. concentrated strains). Cracks usually occur when uniform strain exceeds 2 mm/m.

4.0 Revised Impact Assessment

4.1 The Goulburn River Gorge Cliff Lines (including The Drip) and Creek Bed.

The northern cliff face of the Goulburn River Gorge (The Drip) and the "Corner Gorge" cliff faces will now be = 450 m away from the north ends of LWs 13 and 14, where the cover depth is about 145 to 150 m, see **Figure 2**.

It is estimated that there is a very low possibility (1 to 5% probability) that there could be up to 20 mm of *en-masse* far-field horizontal displacement at The Drip and Corner Gorge cliffs.

Further, a maximum differential displacement of 4.5 to 5.5 mm (opening) is feasible across the cliffs, based on a 50 m wide valley, which would imply a very small tensile strain of 0.1 mm/m.

Theoretically, tensile strains of > 0.3 mm/m would be the minimum systematic strain required to cause fracturing of massive near-surface rock exposures. Existing joints and bedding plane shear movements, however, tend to increase the minimum tensile strain required to cause cracking.

Minor fracturing has only ever been observed outside the limits of longwalls at distances approximately equal to half of those now proposed. The cracks observed did not impact on water flows or quality of the rivers involved.

Further studies on valley uplift and closure and the stability of both sections of cliff lines have now been completed by Don Kay of Mine Subsidence Consultants Pty Ltd (MSEC), refer to **MSEC, 2006**. The outcomes of that study also suggest that the proposed set-back distance will probably not result in cracking or instability of the cliff lines and valley floor.

4.2 Cliff lines within the Angle of Draw of the Preferred Longwall Layout (CL1 - CL 4, CL6 to CL8)

The stability assessment for the cliffs above the No.4 UG area generally remains unchanged except for Cliff Line 3, which now will have a significant reduction in impact due to the preferred mining layout. It is assessed that 50% of the cliff line will now be located directly above first workings only, see **Figure 2**, and subject to subsidence of <0.1 m , tilts <2 mm/m and strains < 1 mm/m. It is assessed that the impact to this section of the cliff line will be 'low' based on the **ACARP, 2002** methodology.

The remaining north-west facing portion of the cliff line will be subject to subsidence of between 0.1 and 2.0 m, tilts between 2 and 26 mm/m and strains between 1 and 9 mm/m (tensile and compressive). These movements are likely to cause 'moderate' to 'high' impact, with rock falls affecting an estimated 30% to 50% of the cliff line above the end of LW13.

A summary of the empirical cliff line stability assessment for Cliff Line 3, due to the impacts of longwall extraction is presented in **Table 2**.

Table 2 - Summary of Stability Assessment Related to Mine Subsidence Impacts for Cliff Line 3

Cliff Line #	Cliff Face Height (m)	Maximum Subsidence at Cliff (m)	Mining Impact Category		Public Exposure/ Aesthetics Category		Natural Instability Category		Total Impact Rating
			Rating	Ranking	Rating	Ranking	Rating	Ranking	
CL3a *	10 - 30	0.1	0.28	L	0.18	VL	0.31	M	**Low**
CL3b *	10 - 30	2.0	0.89	EH	0.18	VL	0.31	M	**High**

Notes:
Mod = Moderate impact.
* - (a) refers to the section outside the limits of the proposed longwalls;
* - (b) refers to the section above the proposed longwalls.

The results indicate that the cliffs at CL 3 (see **Figure 2**) now have an overall impact rating ranging from ‘Low’ to ‘High’ after consideration of cliff line aesthetics and natural instability. The 'Low’ impact ratings refer to the portion of cliff beyond the limits of workings.

For The Drip and Corner Gorge, no damage or rock falls are predicted, particularly now that the set back distances have been increased by a further 250 m or more.

4.3 Aboriginal Heritage Sites

A re-assessment of the impact of the preferred project layout on the archaeological sites is summarised in **Table 3**.

The outcomes indicate that several of the previous sites assessed as having a ‘Moderate’ to ‘High’ likelihood of being damaged are now given a ‘Low’ damage likelihood rating, namely S1MC Site #’s 264 and 267. The S1MC Site # 280 is now considered to have ‘Moderate’ damage likelihood (previously a ‘High’ damage likelihood site).

Two shelters, S1MC Site #’s 256 and 261, that were previously given a ‘Low’ likelihood of damage rating, now have a ‘High’ and ‘Moderate’ damage likelihood rating respectively with the preferred layout. Both of these sites were noted as having ‘Low’ scientific significance however.

The damage likelihood ratings for the rest of the heritage sites listed in **Table 3** remain unchanged.

Table 3 – Damage Likelihood Outcomes for the Aboriginal Heritage Sites

S1MC # (SEA #)	Damage Likelihood Parameter Scores															
	IP1	Score	**IP2**	Score	**IP3**	Score	**IP4**	Score	**IP5**	Score	**IP6**	Score	**IP7**	Score	Total	
254 (AS1)	0-10°	**3**	2.0	**3**	8E	**1**	-4	**3**	NA	**0**	30-60	**0.5**	Soil	**0**	10.5	**Mod**
256 (AS2)	10-30°	**2**	1.13	**3**	31	**3**	2	**3**	3-4	**2**	30-60	**0.5**	Low	**1.5**	15	**High**
261 (AS3)	10-30°	**2**	0.35	**2**	9	**1**	2	**3**	3-4	**2**	30-60	**0.5**	Low	**1.5**	10	**Mod**
264 (AS4)	10-30°	**2**	< 0.02	**0**	<1	**0**	< 0.3	**0**	NA	**0**	0-10	**1.5**	Low	**1.5**	5	**Low**
267 (AS5)	0-10°	**3**	0.02	**0**	1E	**0**	< 0.3	**0**	2-3	**2**	0-10	**1.5**	Low	**1.5**	9	**Low**
271 (AS6)	10-30°	**2**	0.0	**0**	1W	**0**	< 0.3	**0**	2-3	**2**	30-60	**0.5**	Low	**1.5**	6	**Low**
280 (AS7)	0-10°	**3**	0.45	**1**	<1	**0**	1.4	**2**	5-6	**3**	0-10	**1.5**	Low	**1.5**	12	**Mod**
281 (AS8)	60-90°	**0**	0.0	**0**	NA	**0**	0.0	**0**	NA	**0**	30-60	**0.5**	Soil	**0**	05	**Very Low**
282 (AS9)	60-90°	**0**	0.0	**0**	NA	**0**	0.0	**0**	NA	**0**	30-60	**0.5**	Soil	**0**	0.5	**Very Low**
283 (AS10)	10-30°	**2**	0.0	**0**	0	**0**	0.0	**0**	2-3	**2**	30-60	**0.5**	Low	**1.5**	6	**Low**
284 (AS11)	10-30°	**2**	0.0	**0**	<1	**0**	< 0.3	**0**	4-7	**3**	0-10	**1.5**	Low	**1.5**	5	**Low**
285 (AS12)	0-10°	**3**	0.02	**0**	1.5	**0**	0.7	**1**	4-5	**3**	30-60	**0.5**	Low	**1.5**	10	**Mod**
286 (AS13)	0-10°	**3**	0.0	**0**	<1	**0**	< 0.3	**0**	2-3	**2**	30-60	**0.5**	Low	**1.5**	7	**Low**

Note:
* - where a parameter is considered to be non-applicable (i.e. NA) a score of 0 is assumed.
Mod = Moderate.
IP1 = Principal strain relative to cliff face rating; IP2 = Subsidence Rating; IP3=Tilt Rating; IP4 = Strain Rating; IP5 = Overhang Depth Rating; IP6 = Joint Set Factor Rating; IP7 = Degree of Weathering; see **Table 12.8** in **SEA, 2006**.

4.4 Farm Dam Impacts

There are five dam sites in the southern area of the site, regarding which the subsidence impact is likely to change due to the preferred project layout. The damage to these features will however, generally remain unchanged from the previous assessment, see **Table 4**.

Table 4 – Summary of Subidence Impact to the Farm Dams

Dam No	Location	Predicted Subsidence (m)	Predicted Tilt (mm/m)	Maximum Predicted Strain* (mm/m)	Likelihood of Repairs to Damage Required and Loss of Storage due to Mining
6	LW7	0.28	2	1	Possible
7	LW6	0.37	3	1	Possible
11	LW5	0.56	4	2	Likely
12	LW3	1.98	16	-9	Likely
13	LW3	1.92	15	-8	Likely

* - tensile strains are positive.

5.0 Conclusions

The conclusions in the original report have been brought up to-date to take into account the changes produced by the preferred mine plan.

The 'preferred project' mine plan for the No. 4 Underground area component of the Moolarben Coal Project has materially reduced the potential subsidence effects compared to the original proposed mine plan. The result is the protection from damage of:

- The Drip
- The Corner Gorge.
- The Goulburn River Creek Bed.
- Approximately 50% to 70% of Cliff line (CL3).

In addition, several of the Aboriginal archaeological sites that had been rated of 'Moderate' to 'High' scientific significance will now have a lower likelihood of damage occurring. Two sites of low scientific significance will now have a 'Moderate/High' likelihood of damage.

The outcomes previously provided in **SEA, 2006** for the other items mentioned generally remain unchanged. The proposed surface and sub-surface monitoring programs presented are still also considered necessary to gather appropriate impact management information to satisfy stakeholder concerns.

Kind Regards,

Steven Ditton
Principal Geotechnical Engineer - Subsidence
CP Eng MIE (Aust)

STRATA ENGINEERING (Australia) PTY LTD

Attachments:

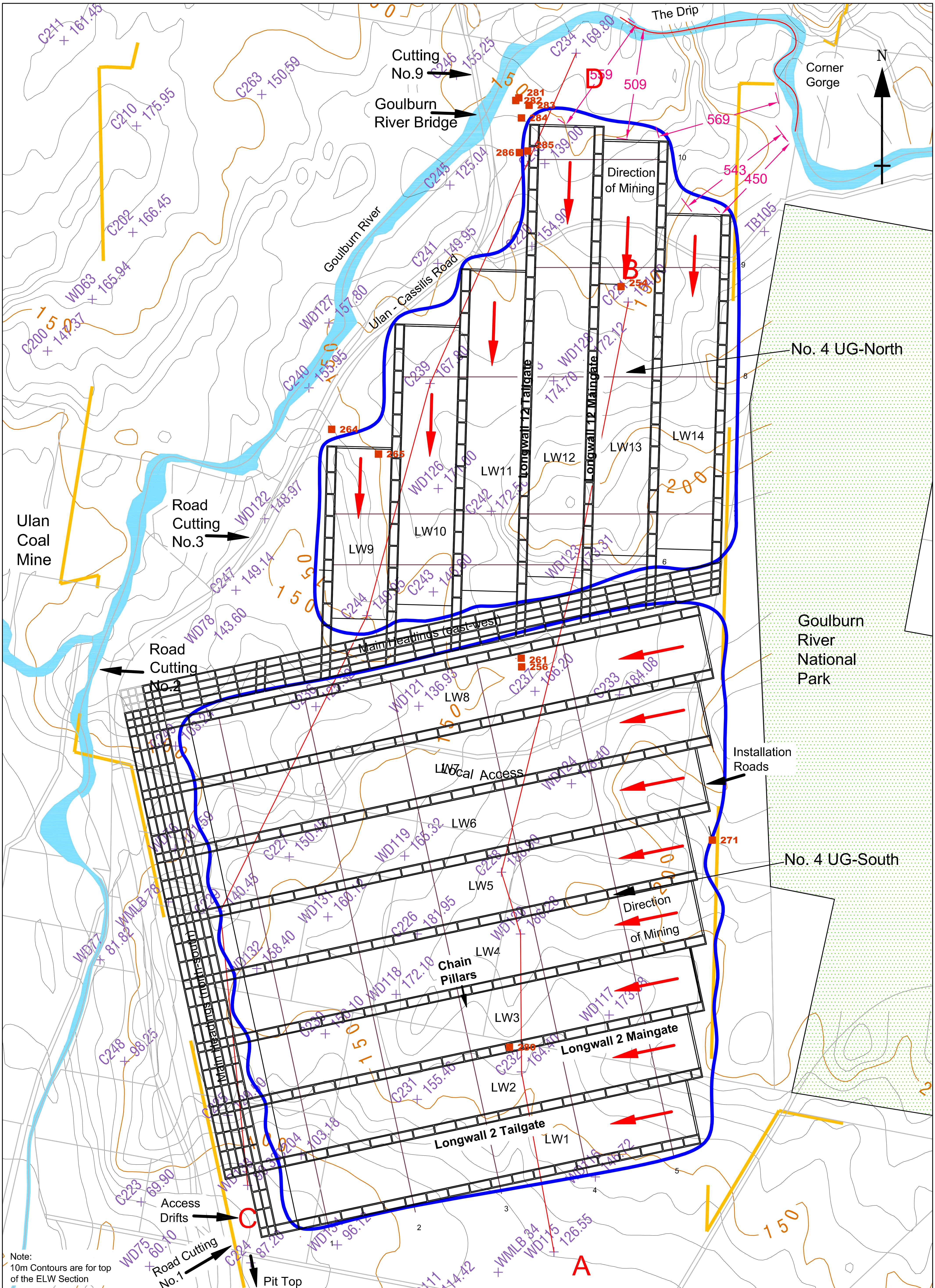
Figures 1 to 16

References:

SEA, 2006. **Mine Subsidence Impact Assessment for the Proposed Longwall Panels 1 to 14, No. 4 Underground Area, Moolarben Coal Project.** Report No. 04-001-WHT/1 (September).

ACARP, 2002. **Notes on Valley Upsidence and Closure, Cliff Lines Impacts and Subsidence Predictions due to Moolarben Coal Mines Layout**. Report No. MSEC 287 Rev A (November 2006).

Attachments - Figures 1 to 16



Key:

- Borehole Location
- Section Lines
- Aboriginal Heritage Sites (refer to text)
- Maximum Angle of Draw Limit to 20 mm Subsidence

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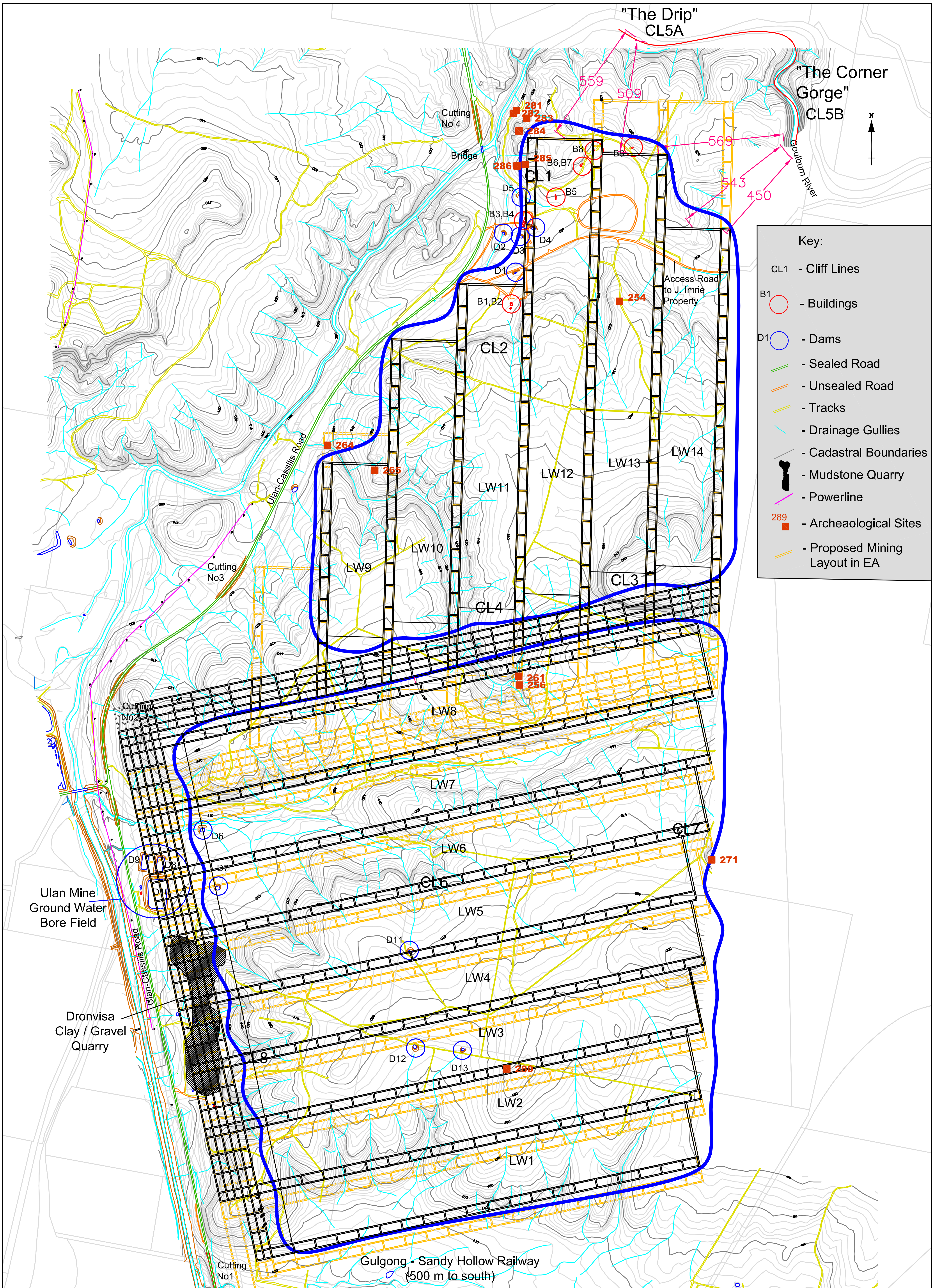
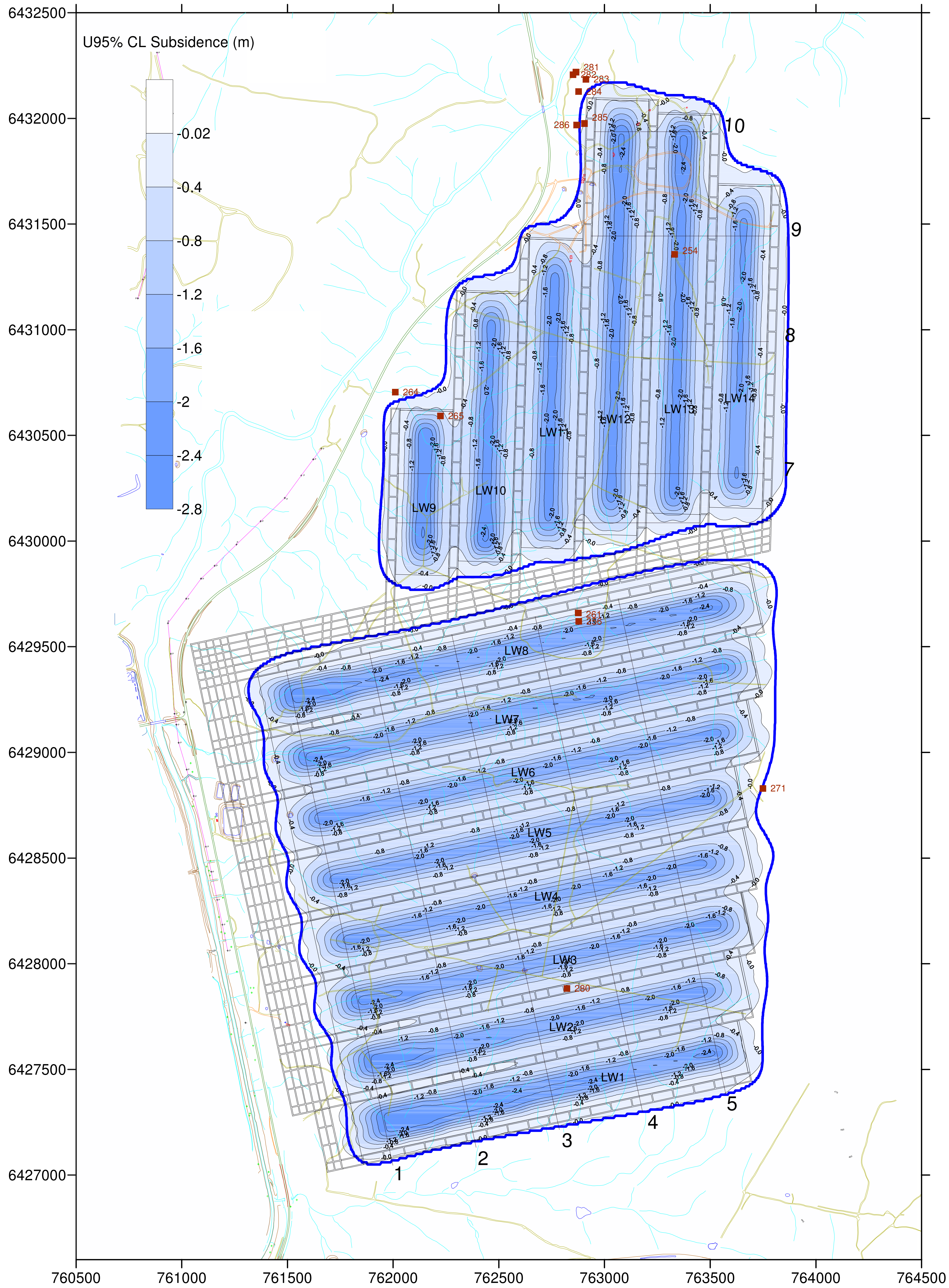
Engineer:	S.Ditton	CLIENT:	Moolarben Coal Mine	STRATA ENGINEERING (Australia) Pty Ltd
Drawn:	N. Paine		06-002(WHT)-1	
Date:	26.11.06	TITLE:	Moolarben Coal Project Stage 1 Preferred No. 4 Underground	FIGURE
Scale:	1:15,000		Layout and Cover Depth Contours	1



Engineer:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	STRATA ENGINEERING (Australia) Pty Ltd
Drawn:	S.Ditton		06-002-WHT/1	
Date:	20.11.06	TITLE:	Surface Level Contours and Features above the	FIGURE
Scale:	1:15,000		Proposed Moolarben UG4 LWs 1-14 (Preferred)	2

M:\Figures\Moolarben\06-002(WHT)-1



Key

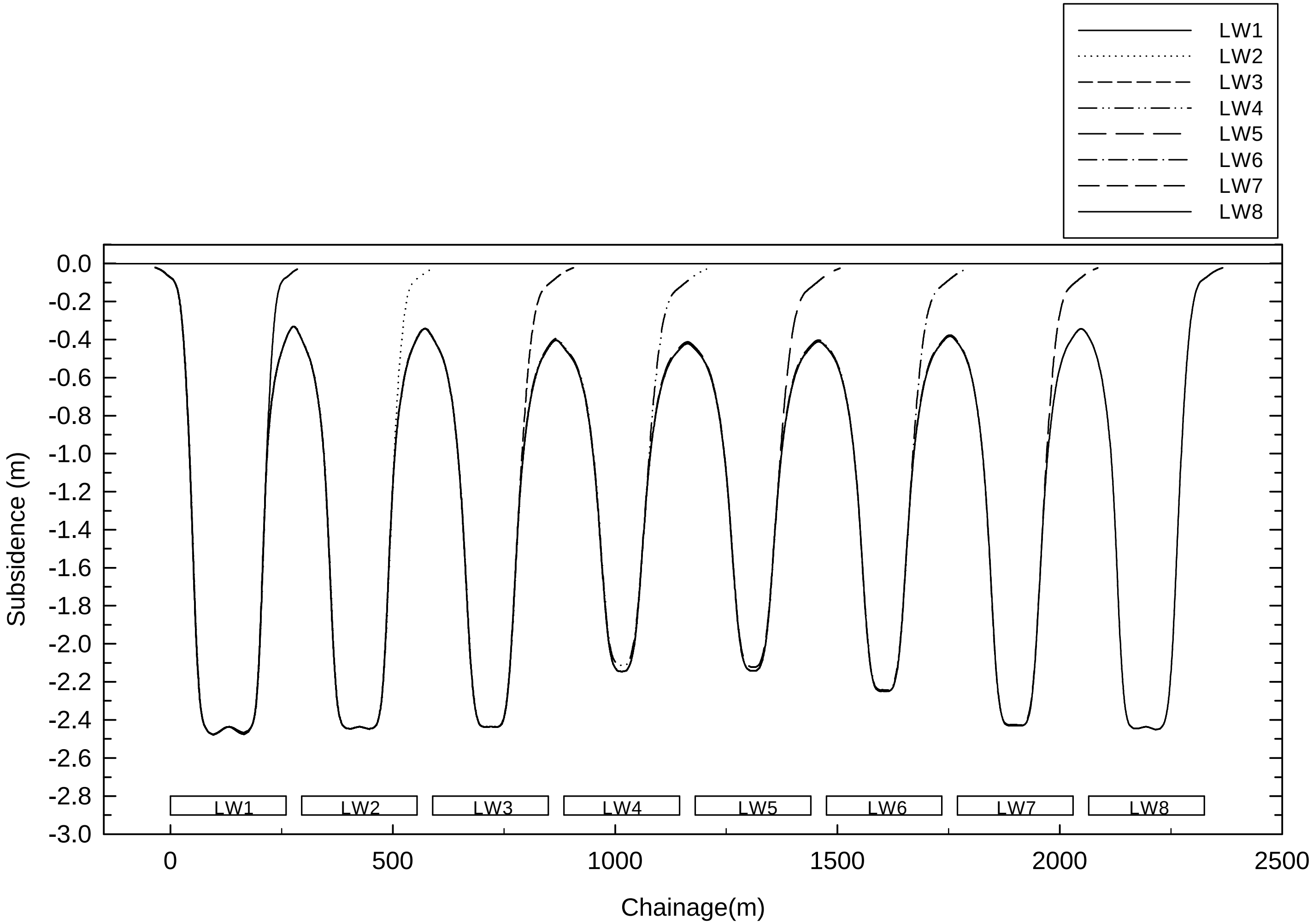
Preferred Project Layout

256 Aboriginal Heritage Sites

1 Main Subsidence Prediction Lines

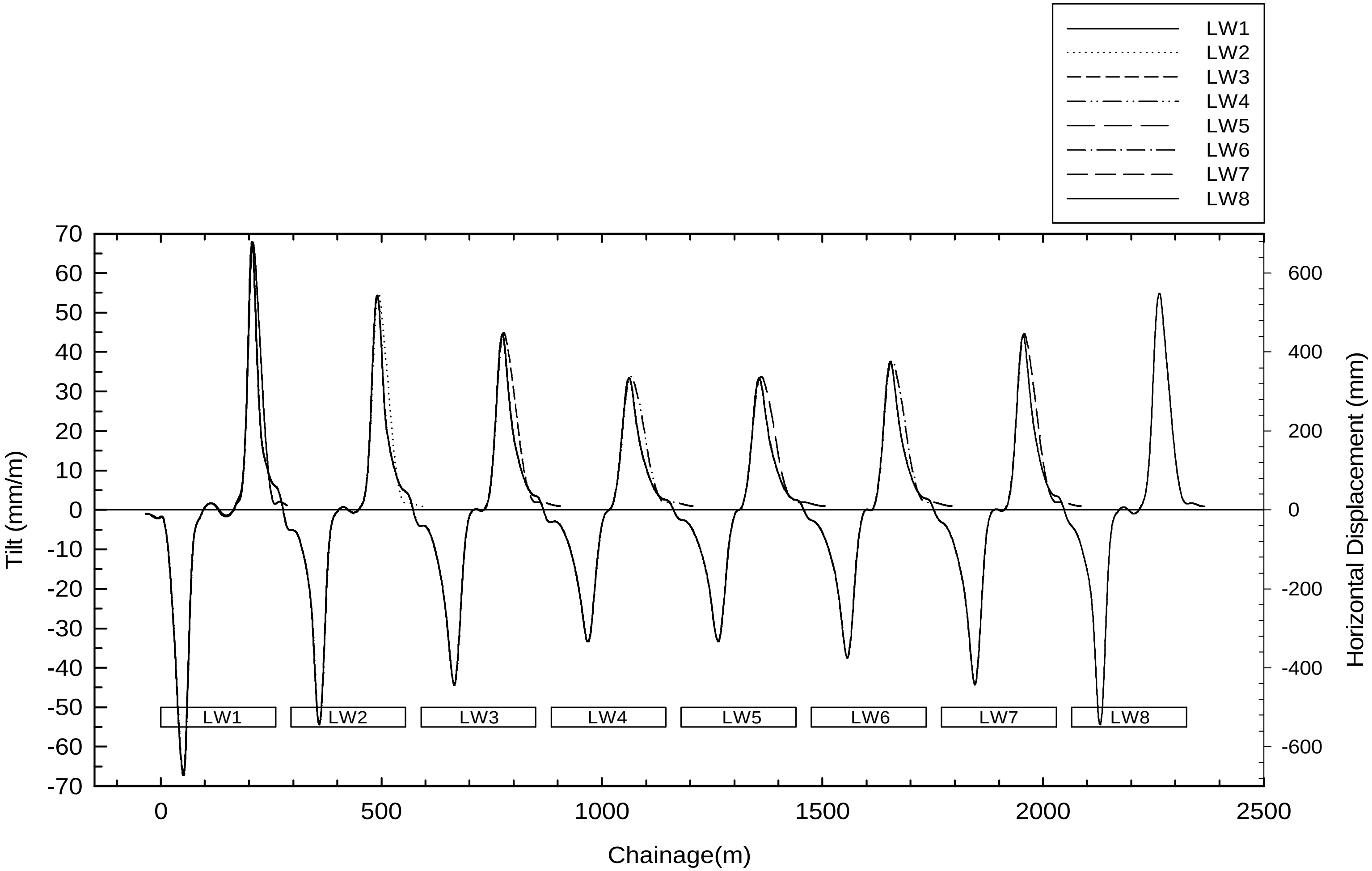
Predicted Maximum Angle of Draw to 20 mm Subsidence Limit

Engineer:	SD/JJ	CLIENT:	Moolarben Coal Mines Pty Limited R06-002-WHT/1	**STRATA ENGINEERING (Australia) Pty Ltd**
Drawn:	SD/JJ			
Date:	29.11.06	TITLE:	Predicted Upper 95% Confidence Limit Subsidence Contours for the Proposed Moolarben LWs 1-14 (Preferred Project Plan)	FIGURE 3
Scale:	1:20,000			



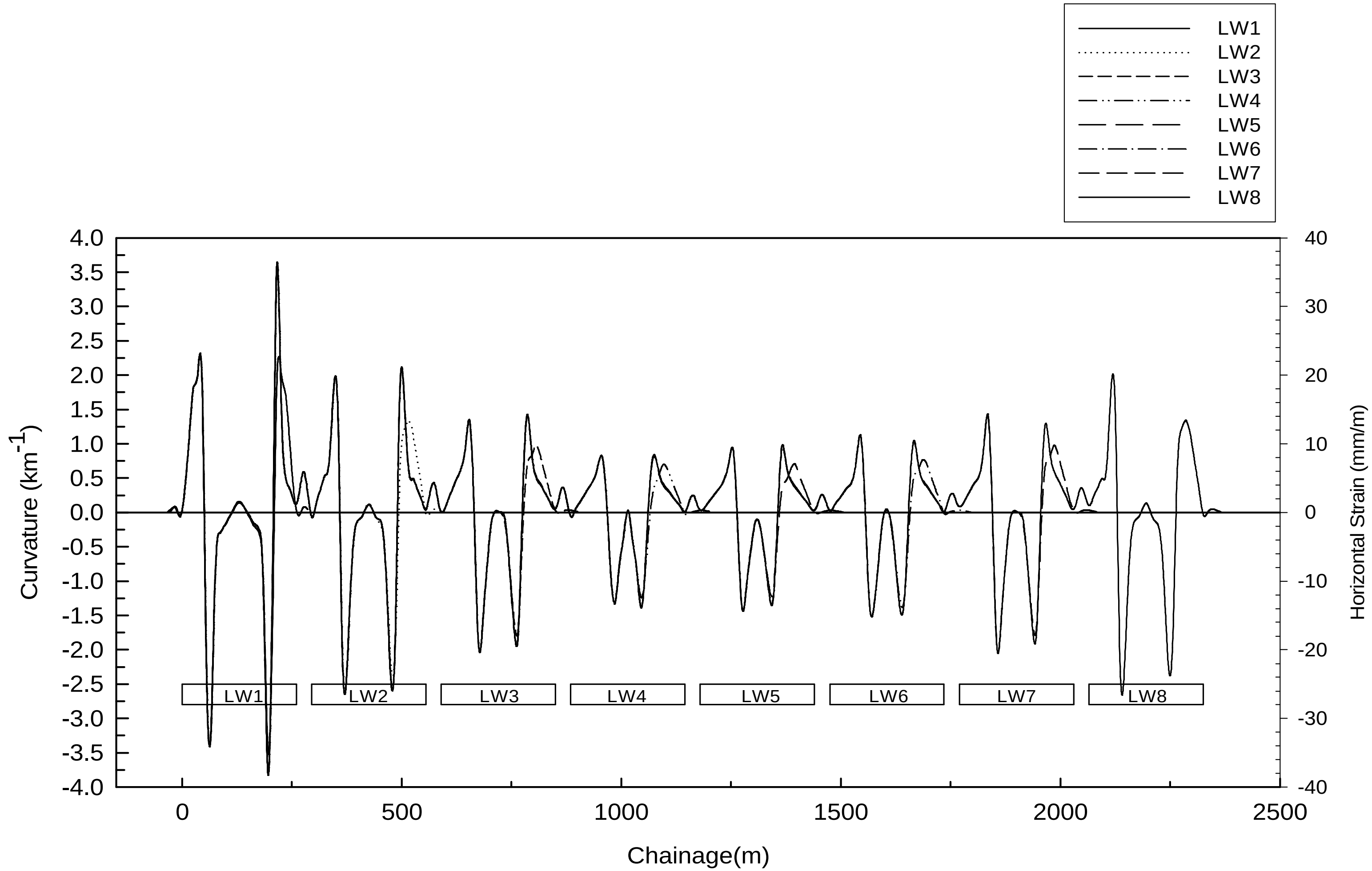
Note: The predicted profiles are for 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**
DRAWN:	S.Ditton		06-002-WHT/1	
DATE:	22.11.06	TITLE:	Predicted First and Final Subsidence Profiles (U95%CL) at XL1, LW1 to LW8	FIGURE: 4
SCALE:	As Shown			



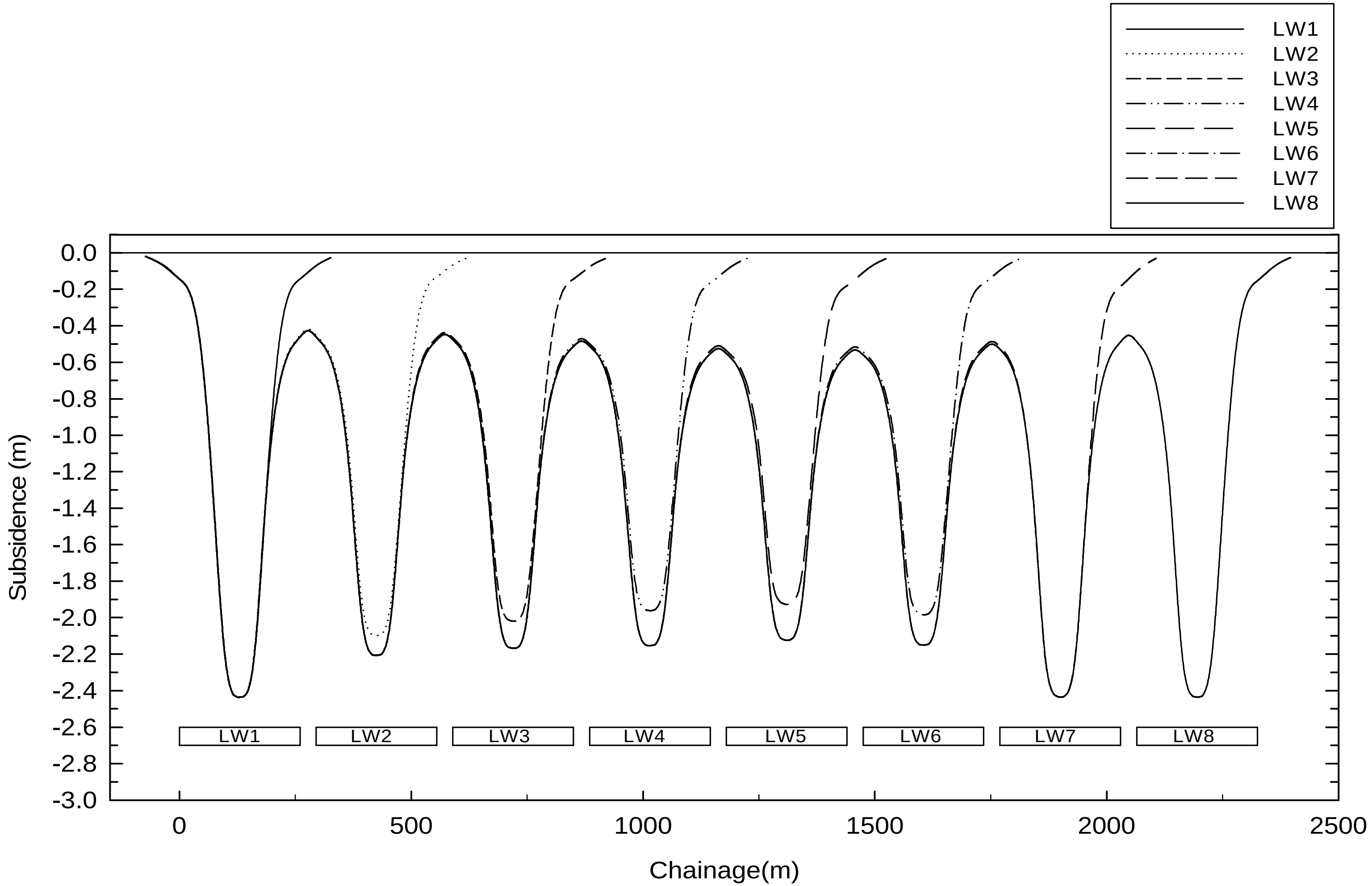
Note: The predicted profiles are for the CWC 'smooth' subsidence profiles (refer to text).

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**
DRAWN:	S.Ditton		06-002-WHT/1	
DATE:	24.11.06	TITLE:	Predicted First & Final Tilt & Horizontal Displacement Profiles at XL1 above LWs 1 to 8	FIGURE: 5
SCALE:	As Shown			



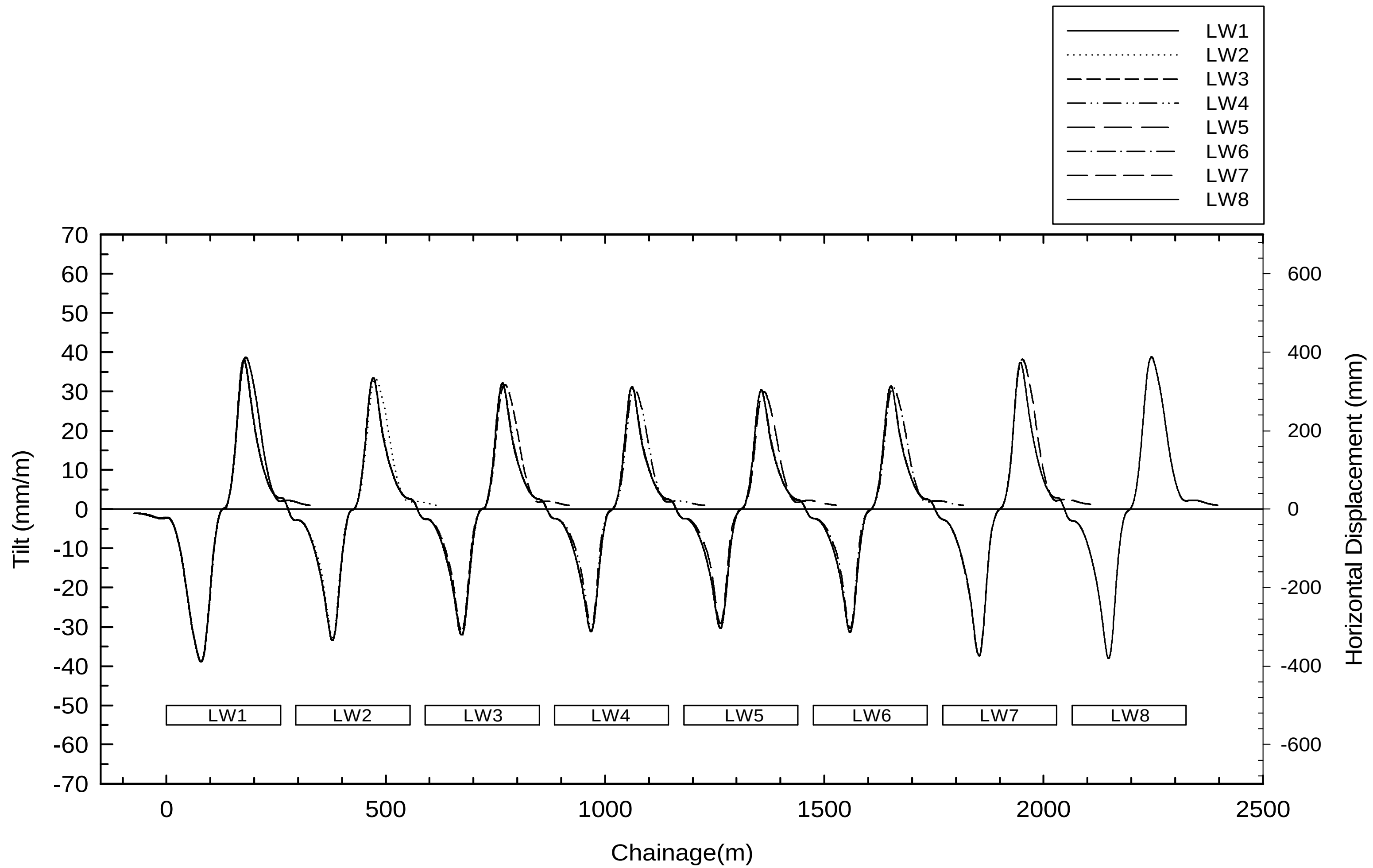
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**
DRAWN:	S.Ditton		06-002-WHT/1	
DATE:	25.11.06	TITLE:	Predicted First & Final Curvature & Strain Profiles at XL1 above LWs 1 to 8	FIGURE 6
SCALE:	As Shown			



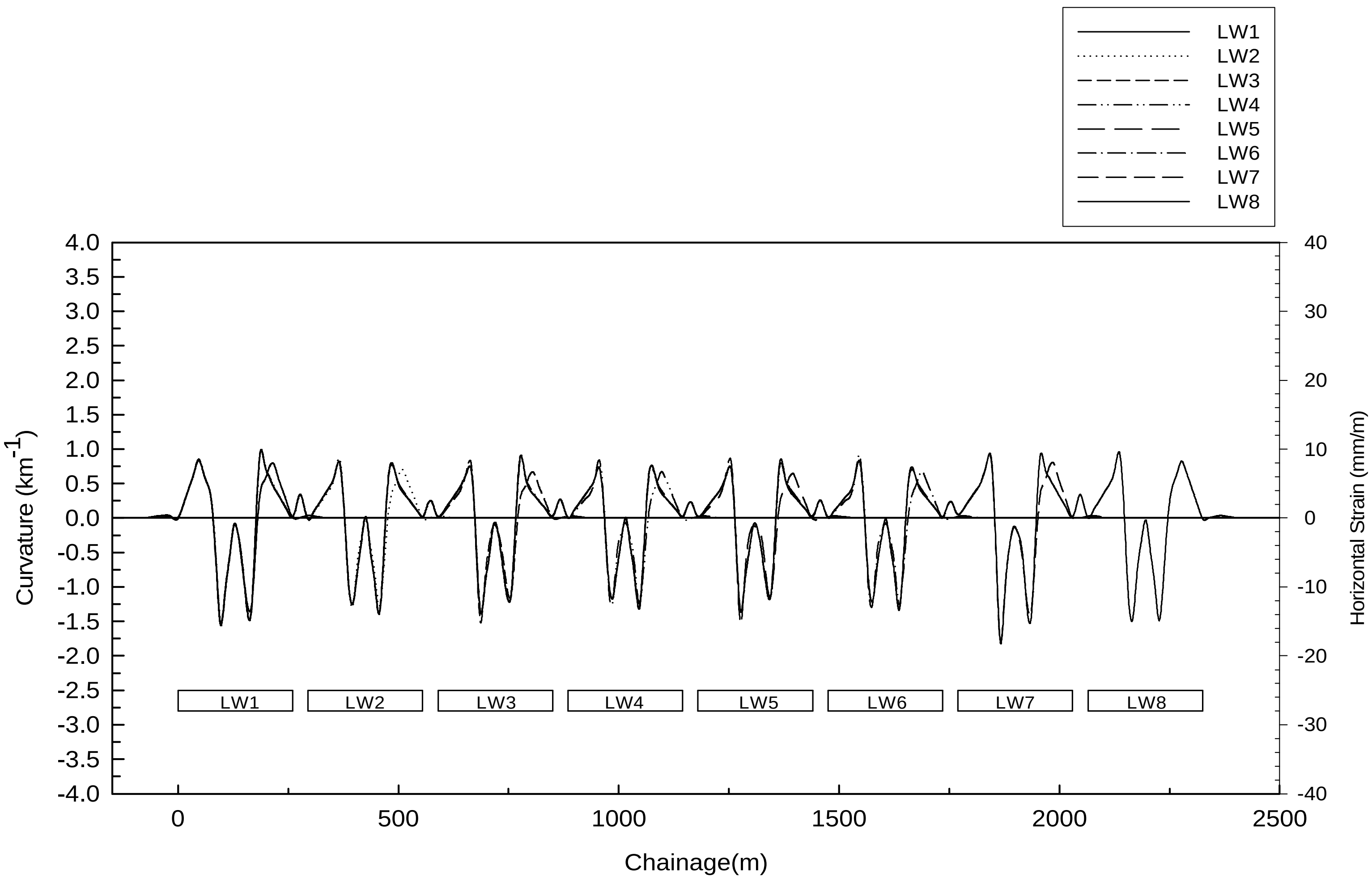
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING**
DRAWN:	S.Ditton		06-002-WHT/1	**(Australia) Pty Ltd**
DATE:	25.11.06	TITLE:	Predicted First and Final Subsidence Profiles	FIGURE
SCALE:	As Shown		at XL4, LW1 to LW8	7



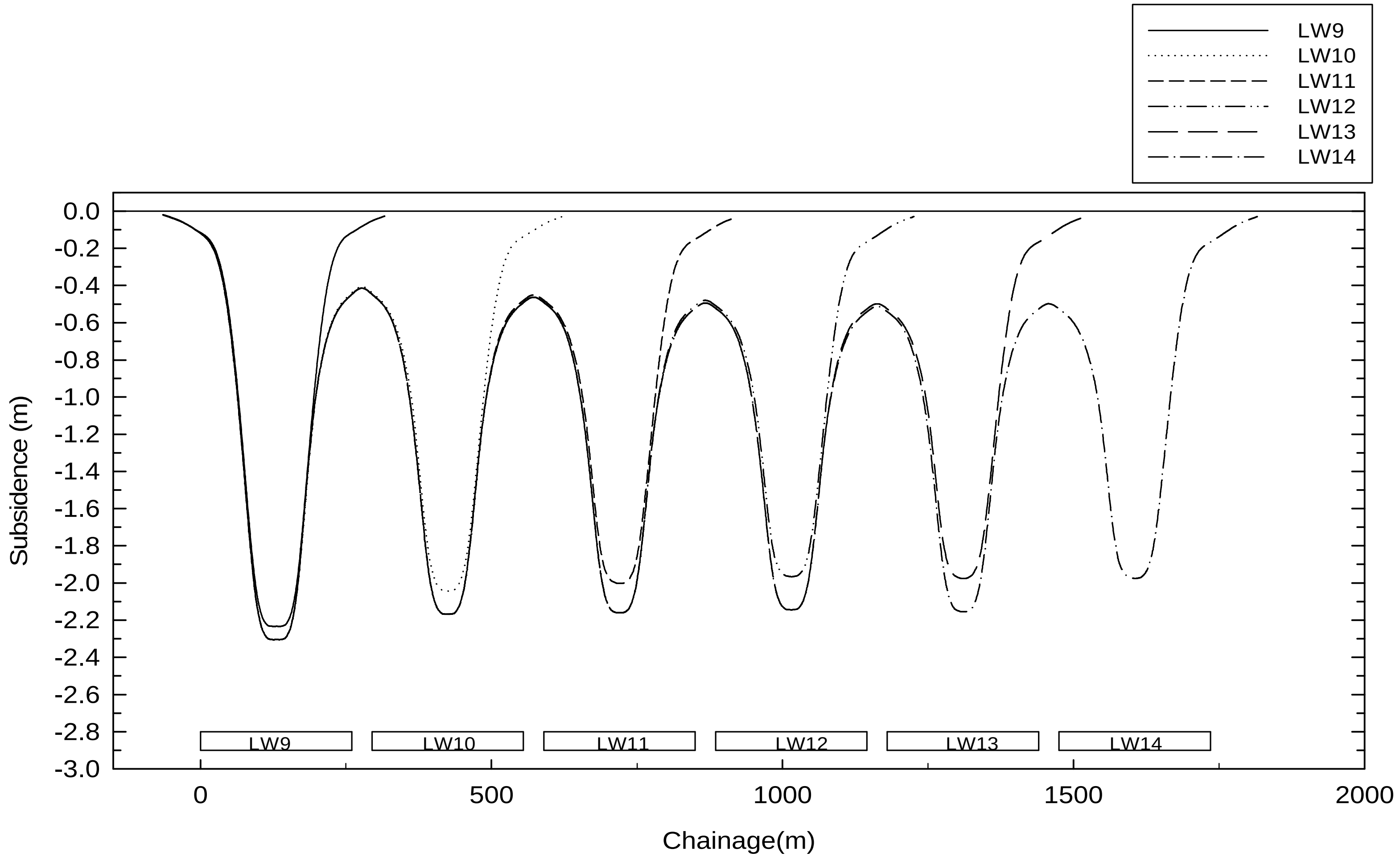
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**	
DRAWN:	S.Ditton		06-002-WHT/1		
DATE:	25.11.06	TITLE:	Predicted First & Final Tilt & Horizontal Displacement Profiles at XL4, LW1 to LW8		FIGURE 8
SCALE:	As Shown				



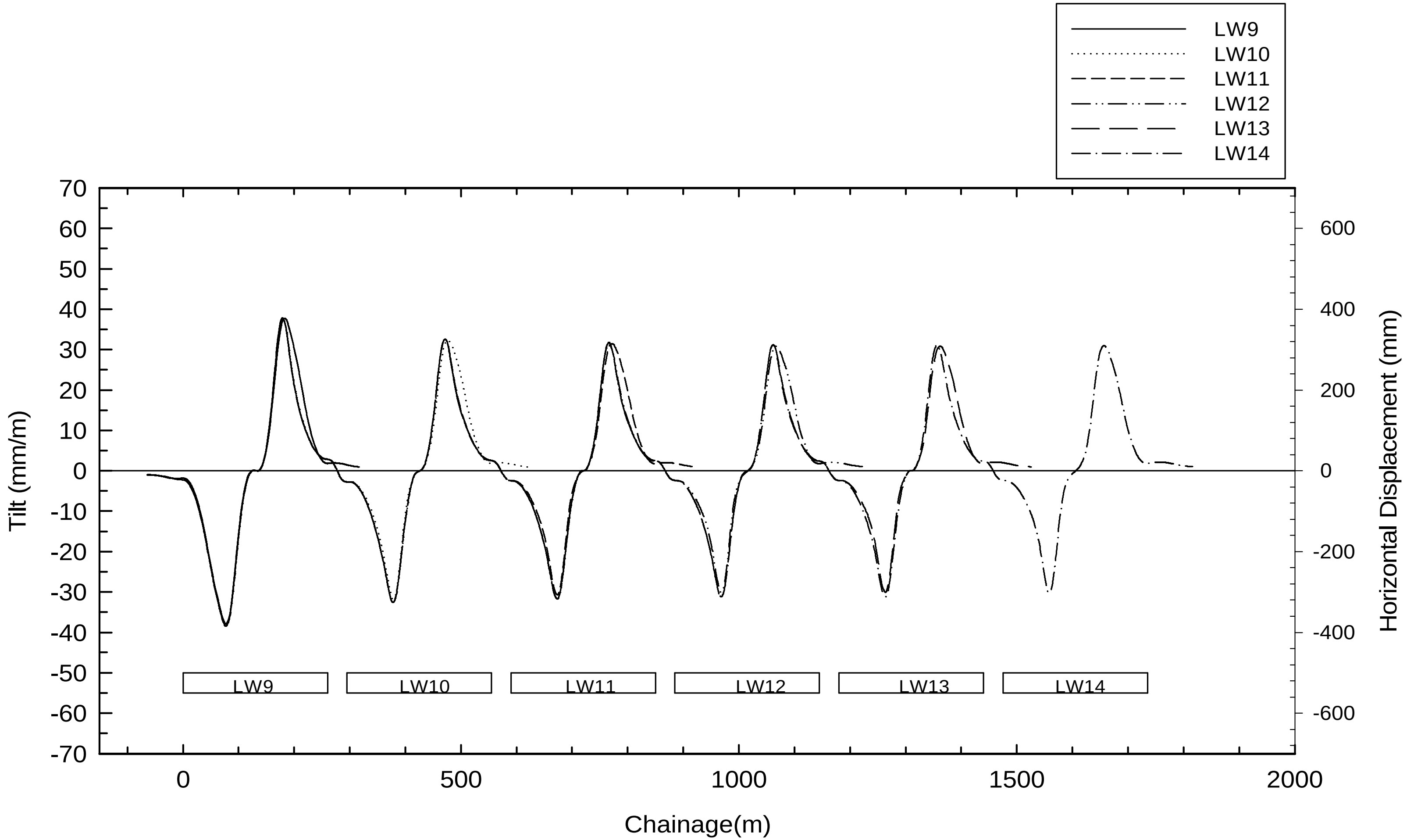
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**	
DRAWN:	S.Ditton		06-002-WHT/1		
DATE:	25.11.06	TITLE:	Predicted First & Final Curvature & Strain Profiles at XL4, LW1 to LW8		FIGURE 9
SCALE:	As Shown				



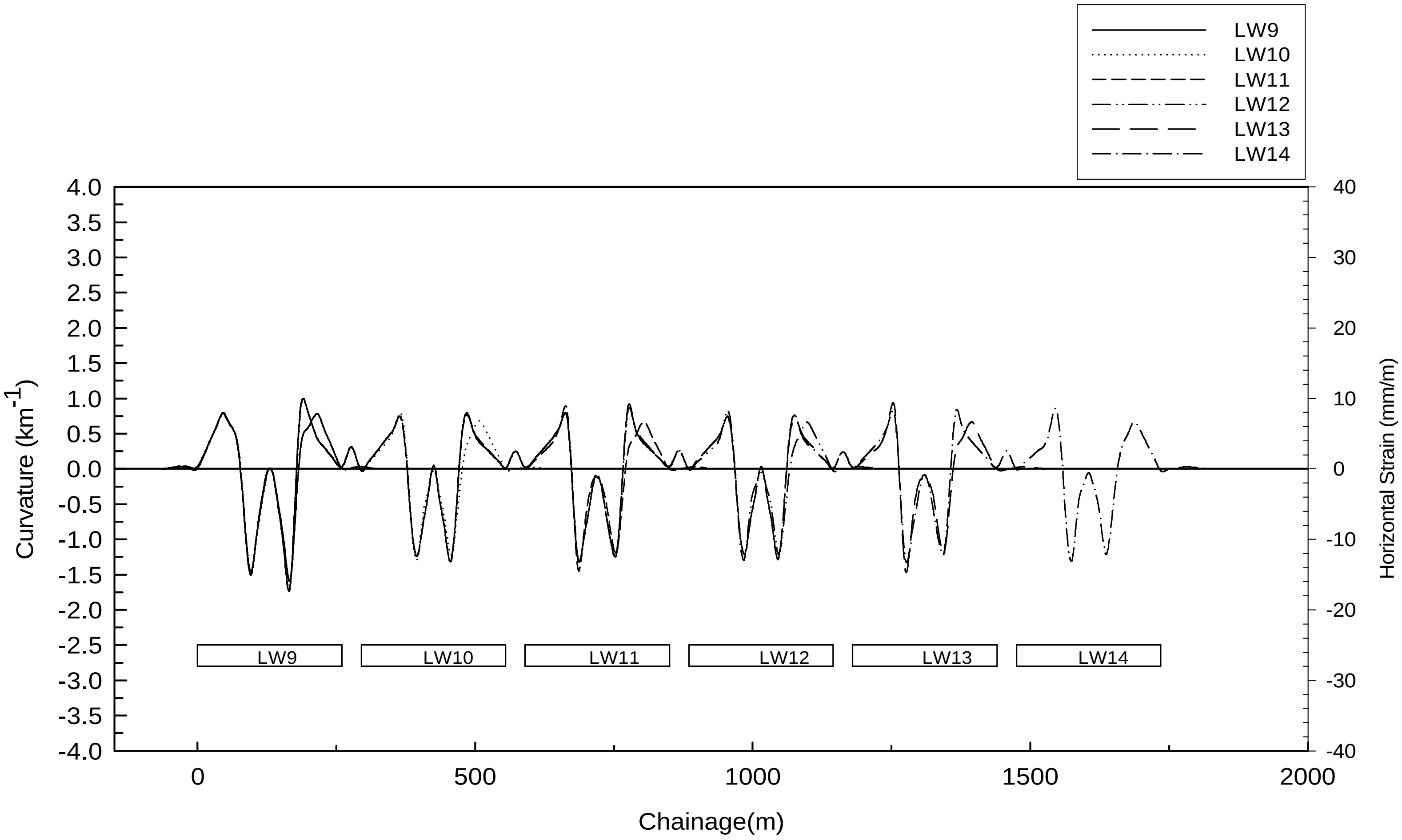
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING**	
DRAWN:	S.Ditton		06-002-WHT/1	**(Australia) Pty Ltd**	
DATE:	24.11.06	TITLE:	Predicted First and Final Subsidence Profiles		FIGURE:
SCALE:	As Shown		at XL7, LW9 to LW14		10



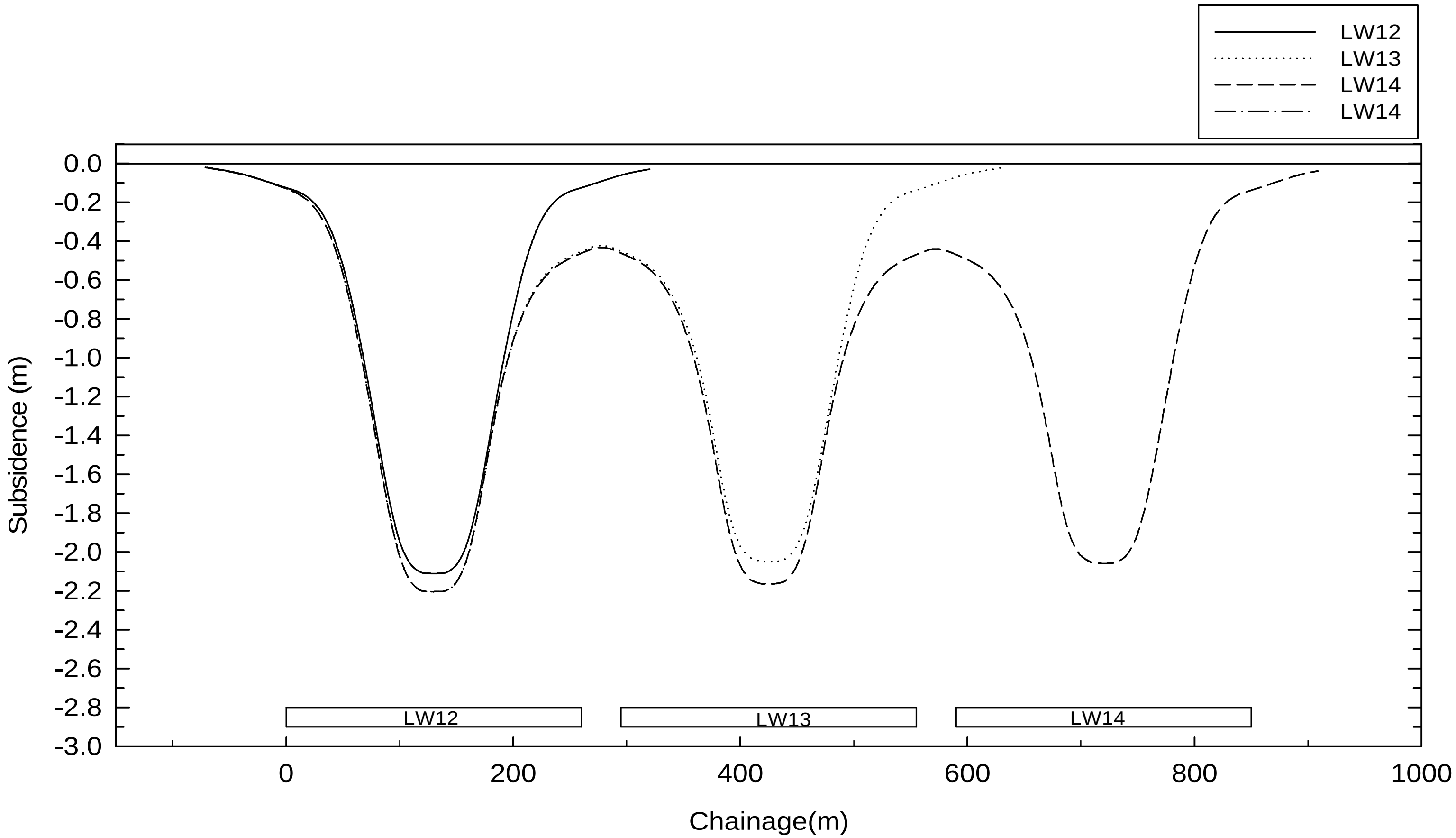
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**
DRAWN:	S.Ditton		06-002-WHT/1	
DATE:	25.11.06	TITLE:	Predicted First & Final Tilt & Horizontal Displacement Profiles at XL7, LW9 to LW14	FIGURE 11
SCALE:	As Shown			



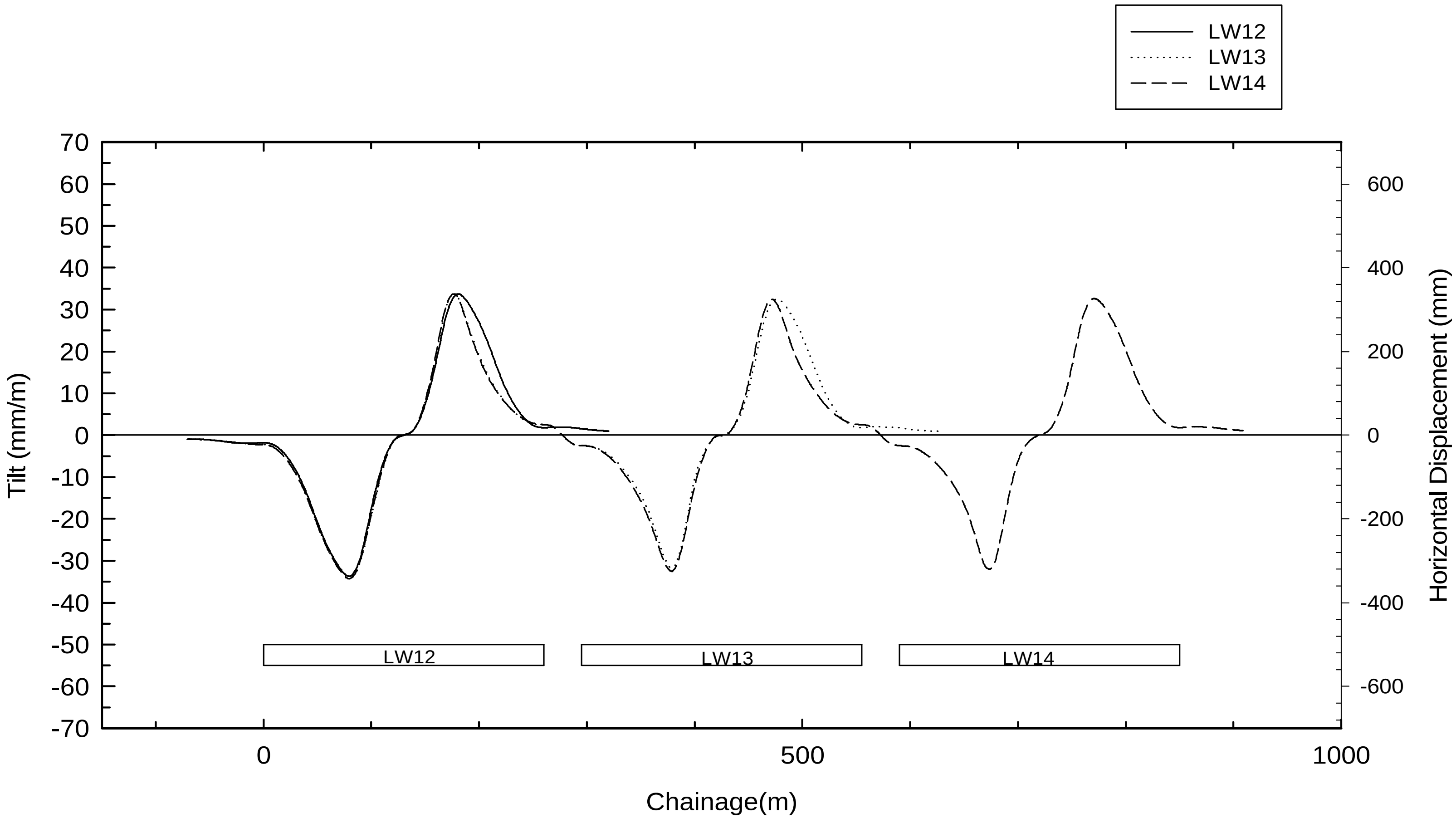
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**	
DRAWN:	S.Ditton		06-002-WHT/1		
DATE:	24.11.06	TITLE:	Predicted First & Final Curvature & Strain Profiles at XL7, LW9 to LW14		FIGURE 12
SCALE:	As Shown				



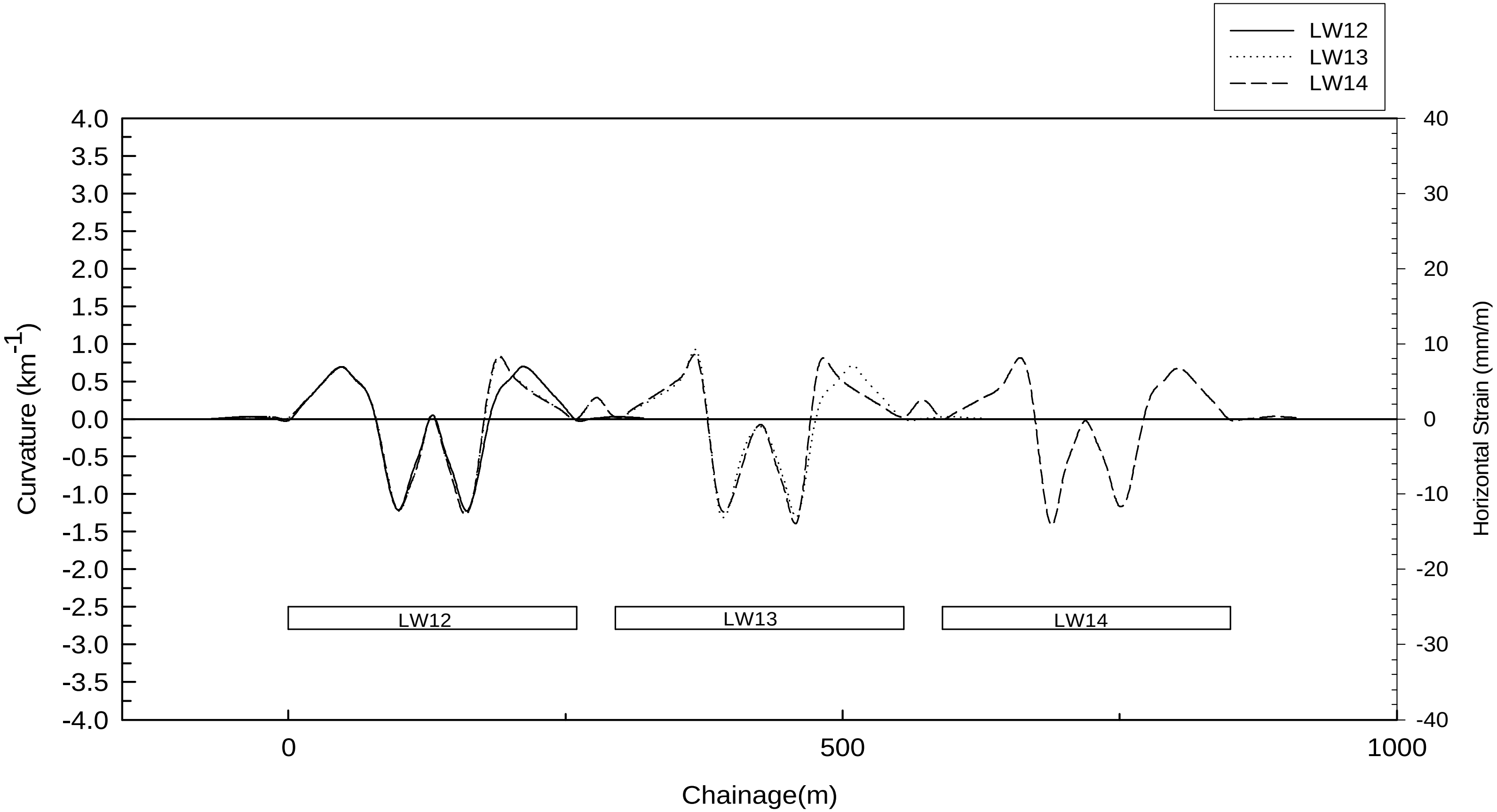
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**
DRAWN:	S.Ditton		06-002-WHT/1	
DATE:	24.11.06	TITLE:	Predicted First and Final Subsidence Profiles at XL9, LW12 to LW14	FIGURE: 13
SCALE:	As Shown			



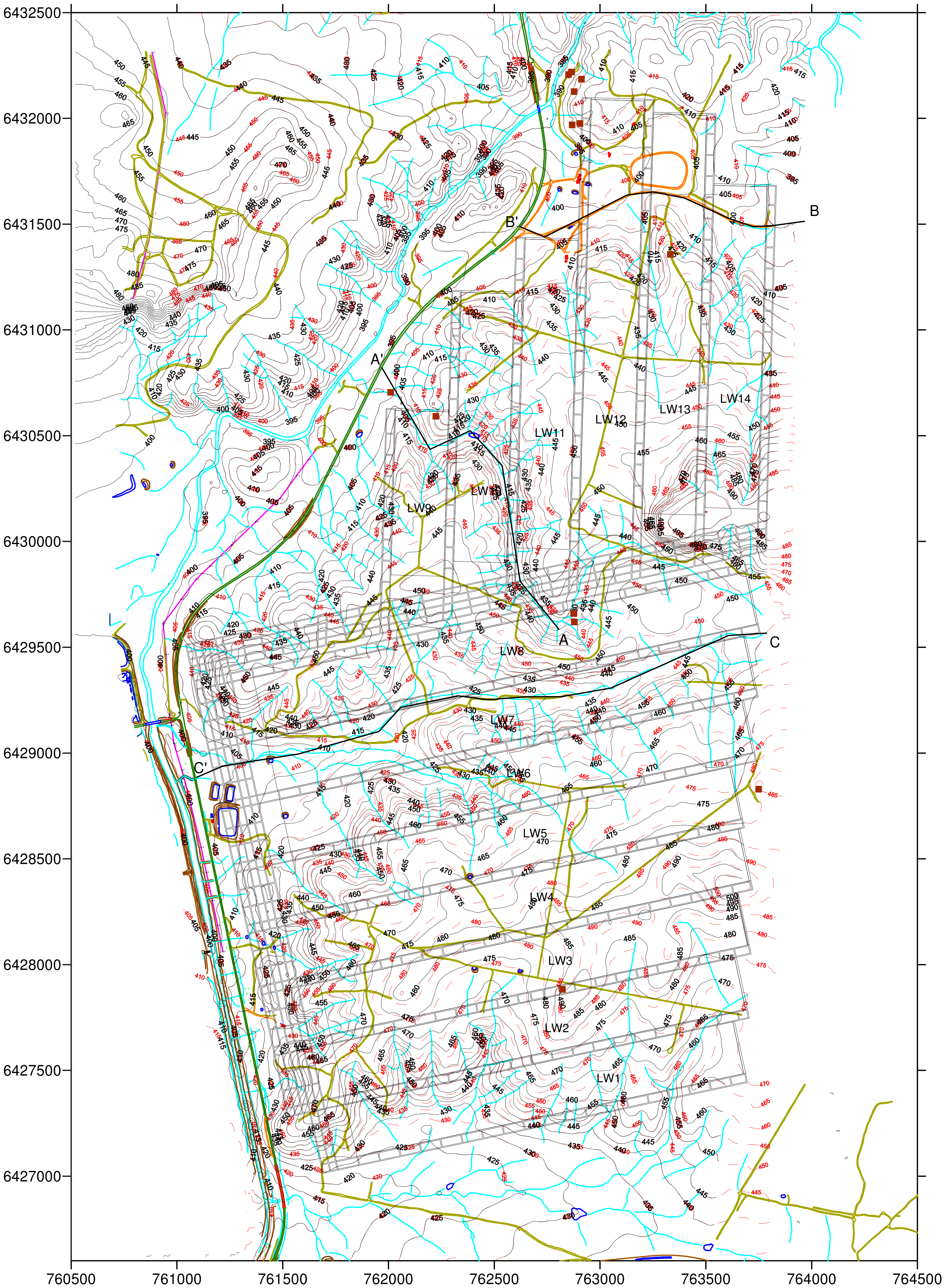
Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING (Australia) Pty Ltd**	
DRAWN:	S.Ditton		06-002-WHT/1		
DATE:	24.11.06	TITLE:	Predicted First & Final Tilt & Horizontal Displacement		FIGURE
SCALE:	As Shown		U95%CL Profiles at XL9, LW12 to LW14		14



Note: The predicted profiles are for CWC 'smooth' subsidence profiles (refer to text)

ENGINEER:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited	**STRATA ENGINEERING**	
DRAWN:	S.Ditton		06-002-WHT/1	**(Australia) Pty Ltd**	
DATE:	24.11.06	TITLE:	Predicted First & Final Curvature & Strain		FIGURE:
SCALE:	As Shown		Profiles at XL9, LW12 to LW14		15



Key

435 Pre-mining Surface Levels

435 Post-mining Surface Levels

A' A Section

Potential Ponding Affected Area

Engineer:	S.Ditton	CLIENT:	Moolarben Coal Mines Pty Limited R06-002-WHT/1	STRATA ENGINEERING (Australia) Pty Ltd
Drawn:	S. Ditton			
Date:	29.11.06	TITLE:	Pre-Mining and Predicted Post-Mining Surface Level Contours for No. 4 UG LWs1-14 (Preferred)	FIGURE 16
Scale:	1:2,000			

MOOLARBEN COAL PROJECT

Response to Submissions

APPENDIX A9

Upsidence and Valley Closure

Moolarben Coal Project

SUPPLEMENTARY NOTES ON

PREDICTIONS OF
SUBSIDENCE, VALLEY UPSIDENCE AND CLOSURE
AND
IMPACTS OF SUBSIDENCE, UPSIDENCE AND CLOSURE
ON THE GOULBURN RIVER AND CLIFF LINES

BASED ON THE

PREFERRED PROJECT MINE LAYOUT

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Report Number MSEC287 Rev D
November 2006

DOCUMENT REGISTER

Revision	Description	Author	Checker	Date
A	Draft Report	Don Kay		24-Nov-06
B	Minor modifications	Don Kay		25-Nov-06
C	Further Amendments provided	Don Kay	AAW	27-Nov-06
D	Mine plan amended for Southern Longwalls	Don Kay	AAW	30-Nov-06

EXECUTIVE SUMMARY

Moolarben Coal Mines Pty Ltd (MCM) has requested Mine Subsidence Engineering Consultants Pty Ltd (MSEC) to prepare this supplementary report to provide additional information on;

- the predictions of subsidence, valley upsidence and closure,
- the likely impacts of subsidence, upsidence and closure on the Goulburn River, and
- the likely impacts of ground movements on cliff lines at The Drip and The Corner Gorge,

as a result of increased set back distances from various surface features and a recent site inspection.

Drawing MSEC287-01, which is attached in Appendix A to this report, shows the previous and the preferred project mine plan, the surface level contours, and the increased set back distances from various surface features.

The proposed mining at Moolarben is predicted to cause rock falls along the cliff lines that are located immediately above the proposed longwalls. A review of an extensive database of rock fall data confirmed our advice in our previous report MSEC280 that the risk of rock falls from the previously proposed longwalls, where the set back distance was 250 metres, was extremely low to negligible. The assessed risk of a rock fall from the proposed longwalls in the preferred project mine plan, i.e. where the longwalls have been set back 450 metres from the cliffs, is therefore a lower risk that could be viewed as negligible. Hence, because of the increased setback distances no rock falls are anticipated in the area called the Drip or the Corner Gorge or within the immediate cliff lines of the Goulburn River valley from the preferred mine plan.

Fracturing of creek beds that are located directly above the longwall panels is likely to occur due to the predicted valley upsidence and closure movements. Whilst valley upsidence and closure movements of about 100 mm were predicted at The Drip and Corner Gorge due to the previously proposed mine layout, upsidence and closure movements of less than 10 mm and 30 mm respectively are predicted for the preferred project mine plan. Some minor fracturing of the bed of Goulburn River might occur, but, as the method to predict upsidence and closure is empirical and based on conservative upper bound prediction curves, it is more likely that no mining-induced fracturing will occur, since the predicted upsidence and closure movements and predicted ground strains for this preferred project mine plan are very small and may not be measureable.

If mining induced fractures occur in the base of the Goulburn River, they will only be localised in nature and relatively minor in size and they would only be visible in areas where the bedrock is exposed. However, the bed rocks in the base of the Goulburn River, where it was recently inspected, i.e. to the north and north-west of the proposed Longwalls 11, 12, 13 and 14, were not visible as they were covered with flowing water and alluvial deposits, predominantly sand, pebbles and occasional boulders. Hence, because of the increased setback distances and the condition of the river as inspected during the recent site meeting, it is unlikely that any fracturing of the bed rock will be observed and it is unlikely that any fracturing will result in any increased rate of diversion of surface water into near-surface substrata.

INTRODUCTION AND BACKGROUND TO THIS REPORT

Moolarben Coal Mines Pty Ltd (MCM) proposes to develop a new underground coal mine 50kms to the north west of Mudgee.

The underground workings will be in the Ulan Seam which has a thickness of 4.2m. The seam is to be extracted using longwall mining methods. The longwall panels will be approximately 260m wide and up to 2.5km long. The cover in the area varies from 85m to 215m.

The preferred project mine plan includes barriers of unmined coal that will provide protection for the Ulan/Cassilis Road in the west of the longwalls, for the Goulburn River in the west, north and north-east, for the cliff lines at The Drip and The Corner Gorge in the north and north-east, for the Goulburn River National Park in the east, for the Gulgong to Sandy Hollow rail-line to the south and for various archaeological sites that are located within the project site.

The land above the proposed longwalls is largely undeveloped bush with several ephemeral drainage gullies or watercourses and 5 metres to 30 metres high sheer to rounded sandstone cliff faces. Surface developments consist of gravel access roads, fire trails, small stock watering dams and residential dwellings on one private land holding.

Mine Subsidence Engineering Consultants Pty Ltd (MSEC) was commissioned by MCM on Friday 27th October 2006 to study the mining proposals and a Mine Subsidence Impact Assessment Report that was prepared in September 2006 by Steve Ditton of Strata Engineering (Australia) Pty Ltd (SEAPL), and to provide a supplementary report. MSEC provided a brief report on 5th November 2006 that was numbered MSEC280 and titled "*Notes on Valley Upsidence and Closure, Cliff Lines Impacts and Subsidence Predictions Due to the Proposed Mining of Longwalls 1 to 14 At Moolarben Coal Project For an Independent Hearing and Assessment Panel For Moolarben Coal Project Public meeting on 7th to 9th November 2006*"

A site inspection was undertaken along the Goulburn River valley, including the areas known as The Drip and the Corner Gorge, on 13th November 2006 with Alan Wells of Wells Environmental Services. This site inspection was undertaken after submitting the MSEC280 report.

PREFERRED PROJECT MINE PLAN

After hearing the submissions during the IHAP public meeting, MCM amended the proposed mine layout to provide additional set backs from various archaeological sites, cliff lines and the Goulburn River. The revised mine plan is referred to as the Preferred Project Mine Plan.

Drawing MSEC287-01, which is attached in Appendix A to this report, shows the previous and the preferred project mine plan, the surface level contours, and the set back distances from various surface features. The setback distances from the cliff lines at The Drip and Corner Gorge to the nearest edges of the previously proposed mine plan was 250 metres and the setback distances from the cliff lines at The Drip and Corner Gorge to the nearest edges of the preferred project mine plan is 450 metres. The depth of cover at these features is approximately 150 metres and hence these setback distances are now 3 times the local depths of cover.

MSEC has been asked to provide this update report which refers to both the previous mine plan and the preferred project mine layout. This report has been prepared based only on the data provided in the previous SEAPL report and preferred new mine plan that has been issued to us.

It is understood that SEAPL is revising its mine subsidence impact assessment report to also refer to the preferred project mine plan.

The subsidence predictions provided in the SEAPL report have been prepared using an empirical method called Geosub which provides reduced subsidence predictions for the Newcastle Coalfield based on the influence of strong strata beams. The Geosub model appears to be useful in shallow mining conditions with supercritical panels, where intensive geological knowledge is available. MSEC has not predicted subsidence for this Moolarben Coal Project using the Incremental Profile Method (IPM) model, which was developed by MSEC.

However, as the proposed longwall panel widths at the Moolarben Coal Project are 260 metres and the depths of cover vary between 85 metres and 215 metres, almost all of the subsidence profiles will be supercritical. This means that there should not be a large difference between the subsidence predictions using the Geosub or the IPM model. The only differences will be associated with Geosub assuming a 60% rather than a 65% maximum subsidence factor and with small differences in the shapes of the profiles, which will lead to differences in the resulting predictions of tilts and strains. Because the panels are supercritical, it is reasonable to assume that the subsidence profile will be centred over the longwall panel.

PREDICTIONS AND IMPACTS OF VALLEY UPSIDENCE AND CLOSURE MOVEMENTS

Report MSEC280 provided an introduction to the observed upsidence and closure movements in valleys. Valley upsidence and closure movements have been monitored at other mines in the Western Coalfield and predictions of valley upsidence and closure have been provided at various creek locations above the proposed longwall panels and for some locations along the Goulburn River.

The calculations indicate that the proposed mining will cause high valley upsidence and closure ground movements within the creeks above the longwalls but much lower predictions of valley upsidence and closure ground movements within the bed of the Goulburn River.

Whilst valley upsidence and closure movements of about 100 mm were predicted at The Drip and Corner Gorge for the previous mine layout, upsidence and closure movements of less than 10 mm and 30 mm respectively are predicted for the preferred project mine plan. As the predicted subsidence in the bed of the Goulburn River at The Drip and Corner Gorge is zero, the river bed may experience a nett uplift of up to 10 mm.

Fracturing of creek beds that are located directly above the longwall panels is likely to occur due to the predicted valley upsidence and closure movements. Some minor fracturing of the bed of Goulburn River might also occur, but, as the method to predict upsidence and closure is empirical and based on conservative upper bound prediction curves, it is also possible that no mining-induced fracturing will occur, since the predicted upsidence and closure movements and predicted ground strains for this preferred project mine plan are very small.

If mining induced fractures occur in the base of the Goulburn River they will only be visible in areas where the bedrock is exposed. If fracturing does occur, it is likely that the fractures will be localised in nature and relatively minor in size. However, the bed rocks in the base of the Goulburn River, where it was recently inspected, i.e. to the north and north-west of the proposed Longwalls 11, 12, 13 and 14, were not visible as they were covered with flowing water and alluvial deposits, predominantly sand, pebbles and occasional boulders. Whilst there were rock boulders within the valley gorge, no natural rock bars were observed, during the recent site inspection, within these reaches of the river.

The river falls at a gentle gradient of about one metre vertical per 250 metres horizontally through these gorges with no pools or rock bars. Hence, because of the increased setback distances and the condition of the river as inspected during the recent site meeting, it is unlikely therefore that any fracturing of the bed rock will be observed and it is unlikely that any fracturing will result in any increased rate of diversion of surface water into near-surface substrata.

Natural erosion and valley formation processes have already cracked the existing creek and river beds and baseline studies can be undertaken to assess the existing surface and substrata flow rates through the river system before any longwalls are extracted. Studies of the condition of the creeks and rivers over and near the northern series of longwalls can be continued during the proposed extraction of the southern series of longwalls.

This baseline data can then be used to measure the extent to which the actual ground movements might differ from those that have been predicted, to periodically review the predictions and impact assessments in the light of this measured data, to confirm that the proposed mining will not affect the existing conditions in the Goulburn River and to assist in managing the commencing end positions of those longwalls that are planned to be located near the Goulburn River, the Goulburn River Bridge, The Drip and the Corner Gorge.

EFFECTS OF MINE SUBSIDENCE ON CLIFF LINES

An extensive database has been accumulated of known rock falls that have been caused by mining. This database was initially developed following a large study into the effects of coal mining-induced subsidence on steep slopes and cliff lines. For that study a new monitoring technique, using Electronic Distance Meters and acrylic reflectors attached to the cliff face, valley and plateau areas, provided safety for the surveyors and extensive and accurate three dimensional displacement data as longwalls approached, mined under and past many cliff lines. The cliff lines, which were monitored at Baal Bone Colliery, were predominantly orientated across the longwall panels. Many rock falls occurred during this ground movement monitoring study and additional data was added to the database as mining induced rock fall data became available. Detailed analysis of this extensive empirical database has provided an understanding of the major factors that influence rock falls.

Numerical data was gathered for each factor thought to influence the likelihood of rock falls and these were entered into a computerised database. Graphs were then prepared to show trends in this data and to assess which of these factors most influenced the rock fall occurrences. Factors considered included the;

- shapes and heights of the cliffs,
- existence of natural jointing,
- location of cliff face with respect to mining geometry,
- direction and rate of mining,
- extent of mining and magnitude of mining-induced subsidence movements, and the
- propagation of mining induced surface cracks in the cliff plateau rocks near the cliff lines.

After analysing and reviewing the data, it was concluded that many factors influenced the likelihood of rock falls but to varying extents. It was concluded that no one factor dominated as the major cause of rock falls and, often, many factors combined to cause cliff face instability

The study noted that the incidence of rock falls increased with increasing cliff height and cliff width and the incidence of rock falls increased when cliffs were located over the current or previously mined panel. The study also noted that where low levels of subsidence movements were experienced along cliff lines, lower levels of cliff damage occurred. When the depth of cover was shallow, a greater proportion of a cliff line experienced rock falls than when the cover was deep.

It was once assumed that if a longwall face commenced under the plateau area and behind a cliff face, and if this longwall retreated away from the cliff face, then the cliff would be tilted back slightly and, hence, they would be left in a more stable position than before mining. It was also assumed that more rock falls would occur if longwalls undermined the valley side of a cliff before passing under the cliff, than if the longwalls approached from the plateau side before undermining the cliff. However, these assumptions were not proven as this field monitoring study concluded that similar numbers of rock falls occurred whether the face approached from the valley side or from the plateau side of the cliff.

Fifty eight cliffs or rock faces were observed to fall during the field monitoring study. The 607 lineal metres of rock faces, which fell in the areas monitored during this project, represents 16% of the 3820m of rock faces undermined in the monitoring areas

Ninety six percent of the falls occurred over the mined or previously mined panels and only six falls were observed to occur or extend beyond the mined panel. These six falls were observed mainly over development headings and the furthest rock fall observed beyond the edge of a mined panel was a part of a rock fall that extended out to 0.5 times the depth of cover from the goaf edge.

The field monitoring study observed that no rock falls occurred until after the longwall face passed underneath or immediately beside a cliff face. Most of the rock falls occurred when the longwall had travelled between 0.2 to 1.0 times the depths of cover past the cliff face. The average cliff face subsidence, at the time of the observed rock falls, was 421 mm and the earliest that a rock fall was observed happened when subsidence of 63 mm was measured at the cliff face. This rock fall occurred in the centre of the panel and when the longwall approached from the valley side of the cliff line.

Analyses showed that most of these rock falls occurred within a distance of between 0 to 0.5 times the depth of cover inside the mined panel, with the most common fall position being 0.25 to 0.35 times the depth of cover inside the panel.

It was often noticed by the surveyors that the highest cliff or the most undercut cliff of a cliff line was not necessarily the portion of the cliff line where rock falls occurred. In 86% of the rock falls in this database a surface crack was observed running across the exposed plateau rock above the cliff line and through the rock fall. The locations and extents of the surface cracks were noted and the most common location where rock falls occurred was where these surface cracks outcropped at the cliff line.

The proposed mining at Moolarben is therefore predicted to cause rock falls along the cliff lines that are located immediately above the proposed longwalls. Based on experience over previous mined longwalls at similar depths of cover, approximately 15 to 20% of these cliff lines are likely to experience some instability after they are undermined. A further review and assessment of the database of rock fall data confirmed our previous advice in our report MSEC280 that the risk of a rock fall from the previously proposed longwalls is extremely low to negligible. The previously proposed set back distance of 250 metres, i.e. 1.6 times the depth of cover, was considered to provide a safe set back distance for The Gorge area.

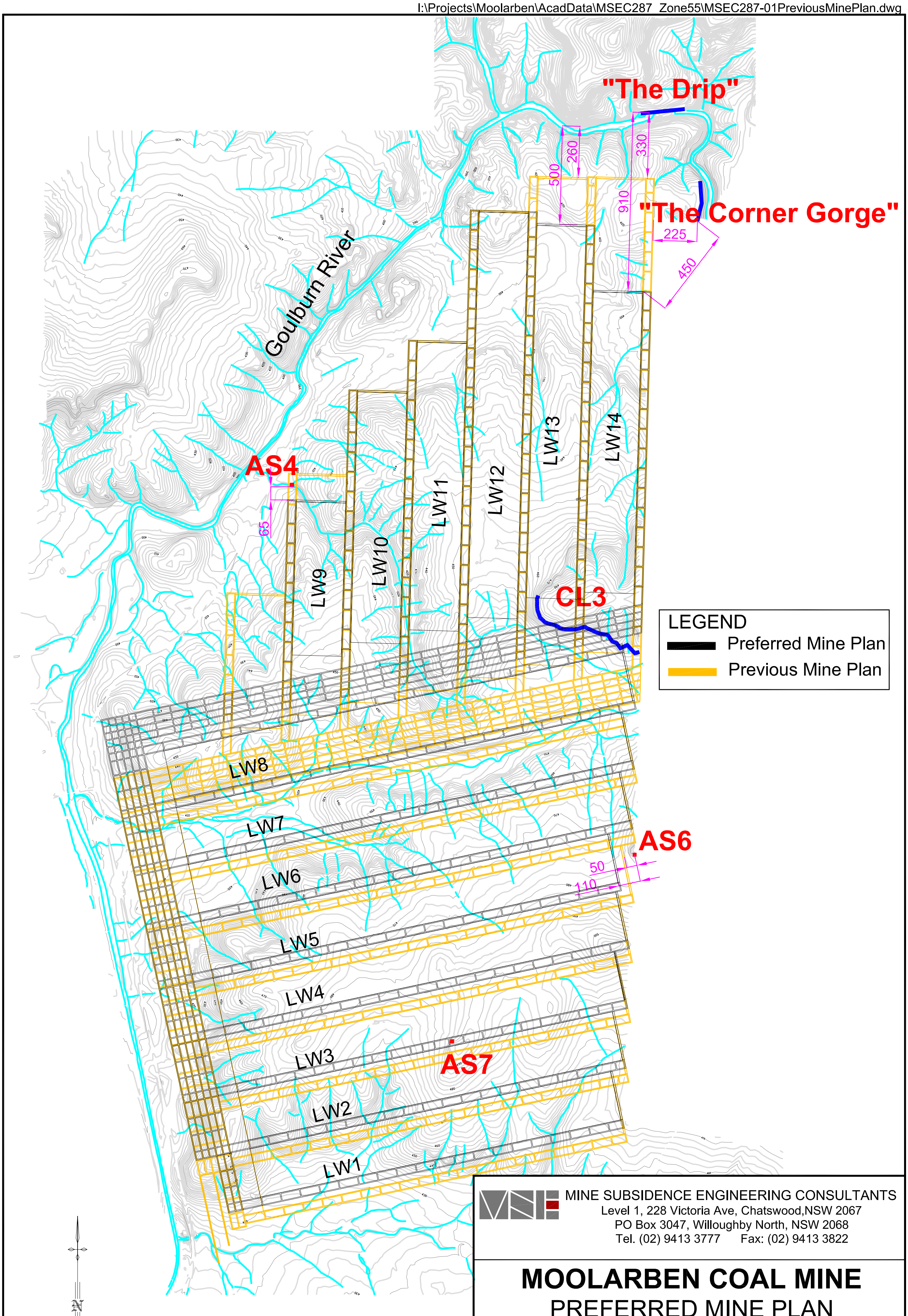
The new set back distance of 450 metres, i.e. three times the depth of cover, is considered to provide an extremely safe set back distance for both The Gorge area and the Corner Gorge area compared to all the recorded cliff falls in the database of rock falls that have been observed due to mining. The assessed risk of a rock fall from the preferred proposed longwalls, i.e. where the longwalls have been set back 450 metres from the cliffs, is therefore a lower risk that must be viewed to be close to negligible. No rock falls are therefore anticipated in the area called the Drip or within the immediate cliff lines of the Goulburn River valley from the preferred mine plan.

Studies of the existing condition of various cliff lines and the detailed monitoring of the ground movements at various cliff lines before and during mining are recommended. The information gathered during the baseline and monitoring studies will permit greater confidence in positioning and managing the commencing end positions of those longwalls that are planned to be located near the Goulburn River, the Goulburn River Bridge, The Drip and the Corner Gorge.

APPENDIX A

Drawings

I:\Projects\Moolarben\AcadData\MSEC287_Zone55\MSEC287-01PreviousMinePlan.dwg



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MOOLARBEN COAL MINE
PREFERRED MINE PLAN
GENERAL LAYOUT

DATE:	SCALE:	DRAWING No:	Rev No
30 Nov 2006	1:25 000	MSEC287-01	A