YANCOAL
兖煤澳大利亚有限公司

AUSTAR COAL MINE
PART OF THE YANCOAL AUSTRALIA GROUP

SITE: Middle Road, Paxton NSW 2325 Australia
POSTAL: PO Box 806 Cessnock NSW 2325 Australia
PHONE: +61 2 4993 7200
FAX: +61 2 4993 7326
EMAIL: info@austarcoalmine.com.au
WEBSITE: www.austarcoalmine.com.au
ABN 67 111 910 822

19 August 2014

Director General
Department of Trade and Investment- Division of Resources and Energy
PO Box 344
Hunter Regional Mail Centre NSW 2310

Attention: Mr Paul Langley

Dear Paul,

END OF PANEL REPORT- STAGE 3 LONGWALL A7

Austar Coal Mine Pty Ltd (Austar) completed extraction of Longwall A7 on 19 April 2014. Austar submits this End of Panel report for Longwall A7 in accordance with Condition 18 of Subsidence Management Plan (SMP) Approval for Austar Coal Mine Longwalls A7 to A10 (File No. 13/1867, approved on 3 June 2013).

This report encompasses the monitoring undertaken during the extraction of Longwall A7. The report consists of the analysis from:

- Appendix 1: Surface subsidence monitoring program;
- Appendix 2: Public safety monitoring and management plan;
- Appendix 3: Vibration monitoring plan
- Appendix 4: Biodiversity Management Plan

In summary, surface subsidence was of the order of 200mm, less than predictions. No perceptible impacts to the environment or increase in public safety risk have occurred. There has been no abnormal behavior that has required particular review.

Please contact myself on (02) 4993 7293 if you require further information regarding any of the data or interpretations summarised in this report.

Yours faithfully,

Adrian Moodie
Technical Services Manager
Austar Coal Mine

Appendix 1: Surface Subsidence Monitoring

1.1 Monitoring Results Summary

Subsidence monitoring has been undertaken in accordance with the Subsidence Monitoring Program. Summary results are displayed below and compared against maximum predicted subsidence from MSEC Report MSEC484 (2011) which supported the original Extraction Plan/SMP application; and MSEC Report MSEC650 (2013) which supported a modification to the Longwall A7 geometry (shortened started position and lengthened finish position) and associated Extraction Plan/SMP Revision 3. Included in **Table 1.1** are the Maximum Predicted subsidence parameters and actual observed subsidence parameters. The subsidence parameters are taken as the largest at any time from either Line A7 (centerline) or Line XL3 (cross line). The Maximum Predicted case was determined using the calibrated Incremental Profile Method.

Panel A7 is the first longwall panel in the Stage 3 area.

Table 1.1: Actual vs Maximum Predicted Subsidence Parameters

LW	Maximum Predicted Cumulative Subsidence (mm)	Actual Cumulative Subsidence (mm)	Maximum Predicted Cumulative Tilt (mm/m)	Actual Cumulative Tilt (mm/m)	Maximum Predicted Cumulative Tensile Strain (mm/m)	Actual Cumulative Tensile Strain (mm/m)	Maximum Predicted Cumulative Compressive Strain (mm/m)	Actual Cumulative Compressive Strain (mm/m)
After A7	450	232	2.5	1.5	0.6	0.9	0.9	0.8

Note: Predictions for strain after A7 have been converted from curvature predictions from the MSEC650 using the relationship strain = 15 x curvature. The factor of 15 was adopted (rather than 10 which is typically used in the Newcastle Coalfield) due to the higher depths of cover and better correlation with the local monitoring at Austar and Ellalong.

Further detailed analysis of the individual monitoring lines can be found in the attached report '*MSEC719 Longwall A7 End of Panel Subsidence Review Report*' as attached.

1.2 Analysis of Monitoring Results

See attached report *MSEC719 Longwall A7 End of Panel Subsidence Review Report*.

1.2.1 Comparison to Impact Assessment Criteria

Chapter 3 of the subsidence prediction report (MSEC650) details the anticipated impacts on natural features and surface infrastructure. **Table 1.2** summarises these impacts and makes comment as to the level of impact created by A7 subsidence as compared to maximum predicted subsidence parameters.

Table 1.2- Impact Assessment Criteria Post Longwall A7 Mining

Item	Subsidence Impact Assessment	Actual Observation / Occurrence	Action
Cracking of alluvial creek beds	None within SMP area	NA	Nil
Drainage lines	Potential for minor shallow isolated cracking around tensile zones of perimeter of longwalls	None observed.	Nil
Steep slopes (southern side A7 near start and southern side 0f A7 along chain pillar last half of panel)	Tilts 5.5mm/m, Strains ≤1.35mm/m after LWA10. Potential for minor cracking and unlikely to cause any long term impact	Tilt 1.5mm/m, Tensile Strain 0.9mm/m potentially as a result of downward slope movement near top of hill.	Continue to monitor.
Quorrobolong Rd	150mm after LWA7 and 0.7mm/m Tilt. After LWA10 1250mm, Tilt 5.0mm/m, Strains 0.3-1.1mm/m. Minor surface cracking to 25mm	Subsidence 66mm. Tilt 1.9mm/m Strains to 4.0mm/m. Tilts and strains higher but appear disturbed. No visual sings of impact	Nil
Electrical Infrastructure	Unlikely for any adverse impact	No impact observed.	Re-contact Ausgrid regarding line roller installation as per M.Plan
Telecommunications Cables	After LWA10 1600mm, Tilt ≤4mm/m, Strains 0.3-0.45mm/m. Moderate likelihood of damage.	OTDR testing completed. No loss of transmission.	Continue to monitor as per M.Plan
Rural building structures	No expected impacts	None reported.	Nil
Other structures/dams	Minimal impact	None reported	Nil
Archaeological Sites	Minor cracking with no adverse impact	None reported	Nil

1.2.2 Comparison to Previous Panels

This is the first panel of the Stage 3 mining area. Compared to A3 which was a similar geometry and first panel in the Stage 2 sequence of longwalls, the following is noted:

- The maximum observed subsidence due to Longwall A7 was around 1.5 times that observed due to Longwall A3. The higher subsidence is consistent with prediction (also 1.5 times higher), which is due to Longwall A7 having a greater overall void width than Longwall A3 (237m versus 227m) and due to the slightly shallower depth of cover and slightly thicker seam in the locations of the transverse monitoring lines.
- The maximum observed subsidence was around half of the maximum predicted subsidence for both Longwalls A3 and A7. The Incremental Profile Method tends to be more conservative (i.e. over-predict) the subsidence for first panels, due to the lower magnitudes of subsidence when compared with subsequent longwalls in the series.

- The maximum observed tilt due to Longwall A7 was around 2 times that observed due to Longwall A3. This ratio is higher than that for subsidence (1.5 times), as observed tilt profiles with lower magnitudes tend to be slightly irregular, due to the larger influence of survey tolerance and disturbed survey marks.

- The maximum observed strains for Longwall A7 were 2 to 3 times greater than those for Longwall A3. It is noted, however, that the maximum strains for Longwall A7 were localised and appear to be associated the surface topography (top of hill effects) not associated with A3, and likely disturbed survey marks. Away from these locations, the observed strains due to Longwall A7 were less than those predicted based on conventional movements.

  Consequently variations to A3 are either predicted or understood and the prediction method still appears to be robust not requiring re-calibration.

Table 1.3- Subsidence parameters after Stage 2 (A3) and Stage 3 (A7) first Longwalls

LW	Maximum Predicted Incremental Subsidence (mm)	Actual Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Actual Incremental Tilt (mm/m)	Maximum Predicted Incremental Tensile Strain (mm/m)	Actual Incremental Tensile Strain (mm/m)	Maximum Predicted Incremental Compressive Strain (mm/m)	Actual Incremental Compressive Strain (mm/m)
A3	295	157	1.5	0.7	0.2	0.2	0.4	0.4
A7	450	232	2.5	1.5	0.6	0.9	0.9	0.8

1.2.3 Comparisons to Predictions in SMP

See sections 1.2 and 1.2.1 above.

1.3 Trends in Monitoring Results

Monitoring data is revealing trends that match predicted profiles, with subsidence parameters around maximum predicted and subsidence being controlled by compression of the strata surrounding the chain pillars. The most recent survey conducted for A7 was approximately 2 months after the completion of mining. The trends in the monitoring data and overall levels of subsidence indicate that final subsidence parameters due to A7 will equivalent to or be less than maximum predicted with minor variation in strain attributed to a localised movement near the top of a steep slope that has not resulted in any visible impact.

1.4 Subsidence Management Actions

Nil actions required. Continue following management plans.

Appendix 2: Public Safety Monitoring and Management Plan

2.0 Summary

During routine subsidence monitoring and on occasions the area was being accessed for other purposes the following items were inspected as per the Public Safety Management Plan:

- Surface cracking;
- Surface humps;
- Step changes in landform;
- Serviceability of roads and access tracks;
- Slope or boulder instability;
- Other sign of subsidence.

Of all the inspection occasions no evidence of any of the above could be observed (Also refer to **Table 1.2**). Inspections also confirmed that no safety issues manifested and no physical signs of subsidence were observed.

Appendix 3: Vibration Monitoring

3.1 Monitoring Results Summary

Vibration monitoring has been undertaken in accordance with the Noise and Vibration Management Plan.

Monitoring was undertaken at locations V7 and V8 during extraction of LWA7 (refer to **Figure 3.1**).

Monitors were set to monitor vibration continuously, and also to record a waveform when vibration exceeded 1mm/sec in any axis. Results of vibration monitoring greater than 1mm/sec are shown in **Figures 3.2** and **3.3**. Periods which recorded vibration less than 1mm/sec are not shown on the graphs.

Guideline values for annoyance (*Assessing Vibration: a technical guideline, DECC February 2006*), and for minimal risk of cosmetic damage (*BS7385:1993*) are included with the graphed results.

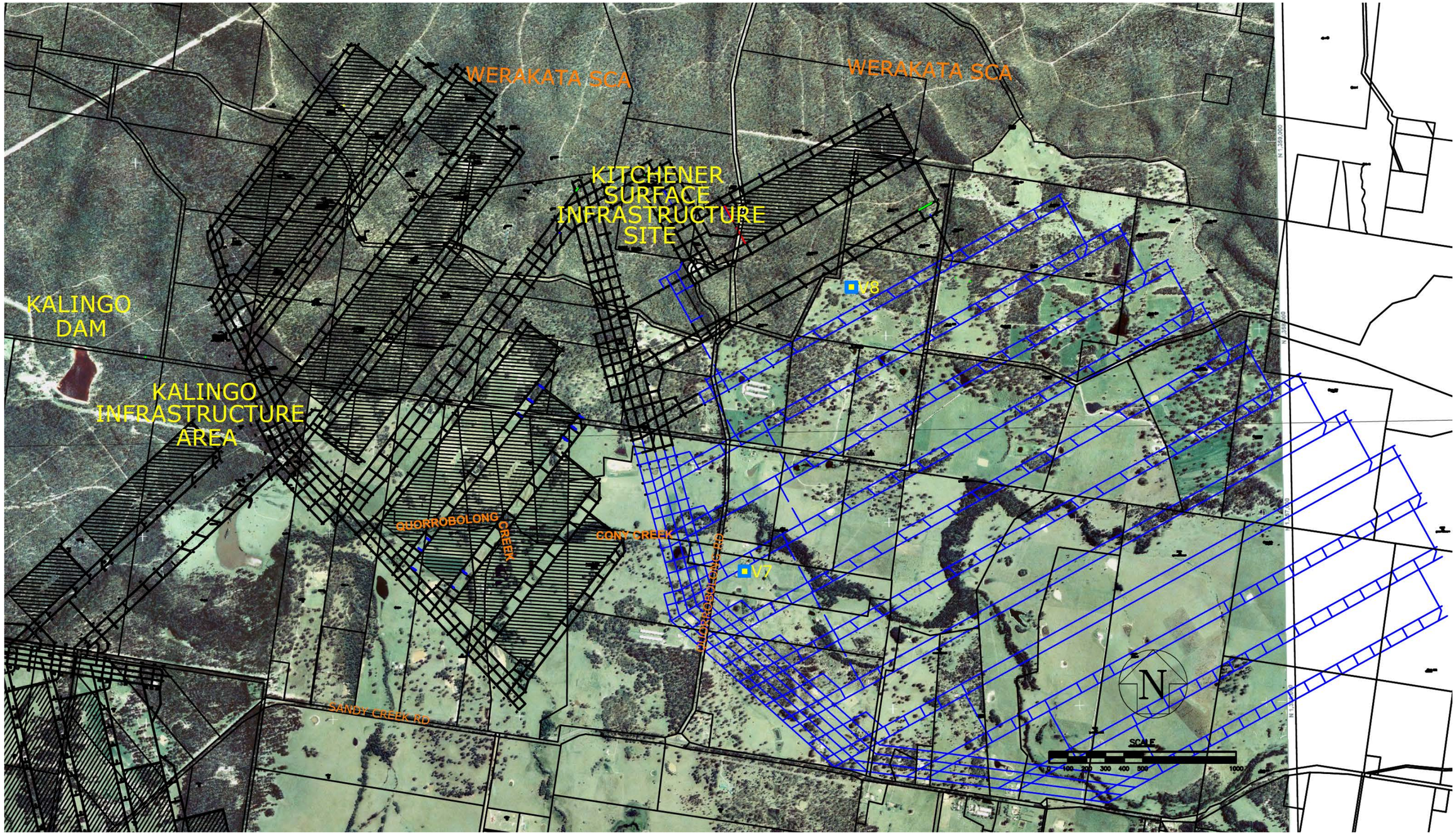


Figure 3.1 Austar Vibration Monitoring Network (V7 and V8)

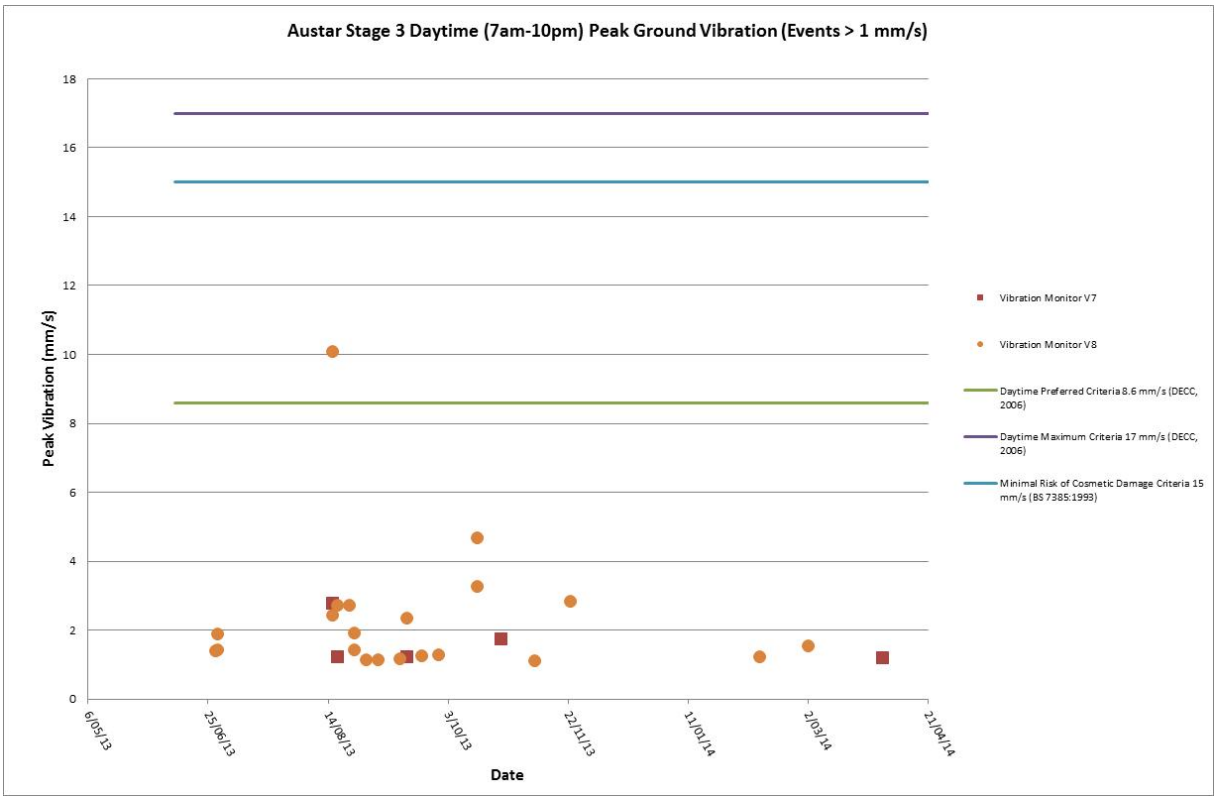


Figure 3.2 Vibration Monitoring Results – Daytime

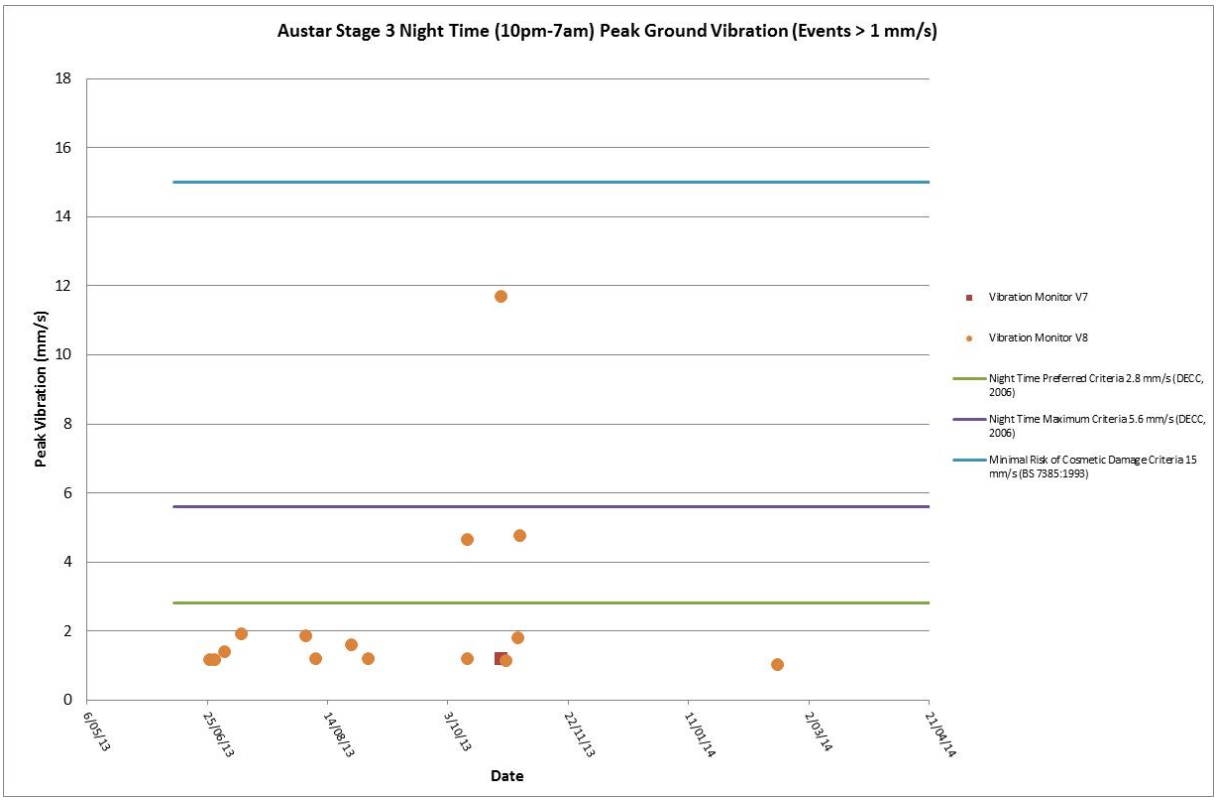


Figure 3.3 Vibration Monitoring Results – Night

3.2 Analysis of Monitoring Results

Results indicate that vibration from the extraction of Longwall A7 has been event based in nature, typically generated by strata failures from material overlying the mining area. The majority of vibration events are less than 4 mm/sec, with only 2 events greater than 6 mm/sec over the period of extraction of A7. There were no events greater than 11.7 mm/sec.

Over the period of monitoring (June 2013 to April 2014), one event exceeded the maximum criteria for human response to vibration during the night period. One exceedance of the maximum criteria over the extraction of Longwall A7 is not considered to be significant. It is important to note that the vibration criteria are non-mandatory (*DECC 2006*) so are used as a monitoring tool to assess possible annoyance. Also, due to the vibration being strata generated, the timing of vibration events cannot be controlled, as would be the case in say pile driving, so operational controls are not feasible in this case.

No events exceeded the guideline value where a minimal risk of cosmetic damage to building structures may occur (15mm/sec).

Ditton Geotechnical Services (DGS) previously conducted a review of adequacy of the Stage 2 Vibration Monitoring Program as part of the Independent Environmental Audit Austar Coal Mine November 2011 (Trevor Brown and Associates, April 2012). DGS noted:

"The only issue of concern from this audit period is whether the frequency of vibration events is becoming a significant issue with local residents. It is noted that the magnitude of the vibrations do not exceed minimum limits for cosmetic damage and it is not practical to impose operational constraints on the mine to reduce the frequency of the vibration events from occurring."

As noted in the DGS comment, it is not practical to impose operational constraints on the mine to reduce vibration events. To manage vibration, Austar has continued to provide adequate community access to vibration monitoring information in regular underground mine status reports to landholders over the active Stage 3 mining area. These status reports include vibration monitoring and mining status information to affected residents.

3.3 Trends in Monitoring Results

This is the first longwall panel in the Stage 3 mining area. There were more vibration events between the start of the longwall in June 2013 and November 2013, than there were after November 2013. Mining in Longwall A7 was completed on 19 April 2014. Vibration results are similar in magnitude to those from the previous Stage 2 mining area.

3.4 Management Actions

No management actions relating to vibration have been necessary. Vibration monitoring should continue for Stage 3 as per the Stage 3 Noise and Vibration Management Plan.

Appendix 4: Biodiversity Monitoring

6.1 Monitoring Results Summary

A Biodiversity Management Plan (BMP) is being implemented as part of the Extraction Plan for LWA7 to LWA10. The purpose of the BMP is to describe the ecological management strategies, procedures, controls and monitoring programs that are to be implemented for the management of flora and fauna as a result of subsidence related biodiversity impacts described in the Austar Stage 3 Modification Environmental Assessment (Umwelt 2011) and within the Austar Coal Mine LWA7-A10 Modification - Stage 3 Area Environmental Assessment (Umwelt 2013).

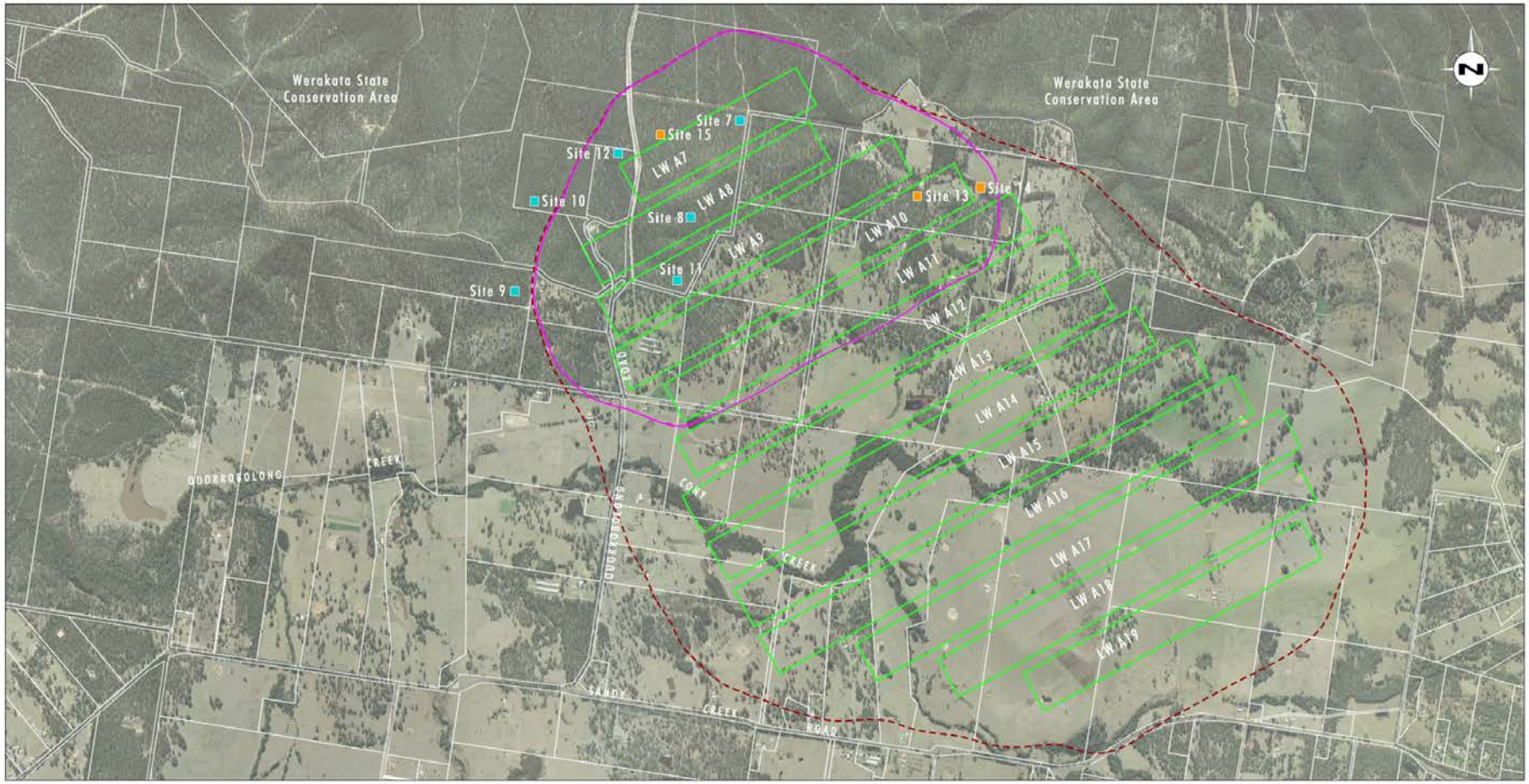
Secondary workings undertaken as part of Stage 3 mining are not anticipated to have a significant impact on biodiversity. However, in order to assess any potential impacts, a detailed Monitoring Program has been developed for the Extraction Plan area. The monitoring specifically focuses on the Lower Hunter Spotted Gum – Ironbark Forest EEC and River Flat Eucalypt Forest EEC which occur on the drier slopes and ridges of the Extraction Plan area and on the drainage flats/lower slopes respectively, and threatened species identified within the subsidence zone of LWA7 to LWA10.

Monitoring is undertaken using a mixture of bi-annual monitoring (one survey in autumn and one in spring), and annual monitoring (for threatened species monitoring to coincide with flowering events). Monitoring locations are shown in **Figure 6.1**.

There are eight routine monitoring locations above the mining area and two reference sites. The program is arranged so that monitoring sites will be added to and removed from the program progressively as mining proceeds. For example, sites influenced by mining of LWA8 will be monitored for baseline data 12 months prior to the mining of that longwall, and will continue after the mining of that longwall. Additional sites for future longwall panels (i.e. LW A11 onwards) will be commenced prior to mining of these panels.

For the current stage of the Stage 3 program the following key methods are utilised:

- permanent vegetation sampling quadrats;
- ecological condition assessment;
- photographic monitoring; and
- targeted threatened species monitoring.



Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

Legend

- Layout for Stage 3 Longwall Panels, incorporating LW A7-A10 Modification
- Extraction Plan Area
- 20mm Subsidence Contour for Stage 3 Longwall Panels
- Current Monitoring Location
- Proposed Monitoring Location

FIGURE 8.1

Monitoring Locations

File Name (A4): R06/3264_057.dgn
20131023 10.10

Figure 6.1 – Ecological Monitoring Locations

6.2 Analysis of Monitoring Results

Monitoring undertaken prior to and up to the completion of LWA7 has included baseline monitoring in 2012, and monitoring in 2013, up to the Autumn 2014 survey. The results arising from the data obtained from the monitoring surveys undertaken to date are detailed below.

- Longwall mining has now passed under monitoring Site 7 and in close proximity to Site 12 and 15. Ongoing monitoring will consequently be tracking potential impacts resulting from longwall mining.
- No discernible change was observed in the vegetation or condition of the Stage 3 monitoring sites during the autumn 2014 monitoring from the spring 2013 monitoring event.
- No changes have been observed at any of the monitoring sites occurring over longwalls that would be attributable to the impacts of longwall mining.
- As the vegetation of these sites is currently considered stable and there are no impacts as a result of longwall mining, no management recommendations are considered necessary at this point in time.
- The targeted threatened species monitoring locations revealed these species in a good state of health.
- There was no myrtle rust identified at any of the locations.
- No weed infestation was identified at any of the sites with only five introduced species recorded across five sites. Lantana was observed at two sites at a low density.
- One of the Stage 3 reference sites (Site 10) has been subject to bushfire since the spring 2013 monitoring event. Shrubs and groundcover were largely absent in the autumn 2014 monitoring event, however the canopy was largely un-impacted. It is likely that this vegetation will recover over time and will provide an opportunity to monitor how this vegetation community responds following a bushfire event.

6.3 Trends in Monitoring Results

To date there is no evidence of any impacts on ecological features as a result of longwall mining.

6.4 Management Actions

Nil management actions required to date in relation to biodiversity.

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Austar Coal Mine:

Stage 3 – Longwall A7

Longwall A7 End of Panel Subsidence Monitoring Review Report

DOCUMENT REGISTER

Revision	Description	Author	Checker	Date
01	Draft Issue	JB	-	12th Aug 14
A	Final Issue	JB	PD	19th Aug 14

Report produced to:- Support the End of Panel Report for Longwall A7 which will be issued to the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS).

Associated reports:-

MSEC309 (Revision D) – The Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Natural Features and Surface Infrastructure Resulting from the Extraction of Proposed Austar Longwalls A6 to A17 in Support of a Part 3A Application (September 2008).

MSEC484 (Revision A) – Stage 3 – Longwalls A7 to A19 – Subsidence Predictions and Impact Assessments for Natural Features and Surface Infrastructure in Support of a Modification to the Development Consent (May 2011).

MSEC650 (Revision A) – Stage 3 – Longwalls A7 to A10 - The Effects of the Proposed Modified Commencing End of LWA8 and Modified Finishing Ends of LWA7 to LWA10 in Stage 3 at Austar Coal Mine on the Subsidence Predictions and Impact Assessments (October 2013).

Background reports available at *www.minesubsidence.com*:-

Introduction to Longwall Mining and Subsidence (Revision A)

General Discussion of Mine Subsidence Ground Movements (Revision A)

Mine Subsidence Damage to Building Structures (Revision A)

CONTENTS

Tables

Tables are prefixed by the number of the chapter in which they are presented.

Figures

Figures are prefixed by the letter of the appendix in which they are presented.

Drawings

Drawings referred to in this report are included in Appendix B at the end of this report.

1.1. Background

Austar Coal Mine Pty Limited (Austar) has completed the extraction of Longwall A7 in Stage 3 at Austar Coal Mine (the Mine), which is located in the Newcastle Coalfield in New South Wales. The layout of the longwalls in Stage 3 is shown in Drawing No. MSEC719-01, in Appendix B. The extraction of Longwall A7 commenced on the 14th June 2013 and was completed on the 19th April 2014.

Mine Subsidence Engineering Consultants (MSEC) was previously commissioned by Austar to prepare subsidence predictions and impact assessments for the proposed longwalls in Stage 3 at the Mine. Report No. MSEC309 (Revision D) was issued on the 18th September 2008 in support of the Part 3A Application for these longwalls. The Minister for Planning granted Austar project approval for mining in Stage 3 in September 2009 (PA 08_0111).

Austar then proposed a modification to the layout of the longwalls in Stage 3 at the Mine. Report No. MSEC484 (Revision A) was issued on the 13th May 2011 in support of the S75W Modification of the Project Approval and included impact assessment of the natural and built features. The modification of the Stage 3 longwalls was approved under delegation from the Minister for Planning and Infrastructure in March 2012.

Austar then proposed to shorten the commencing (i.e. north-eastern) end of LWA7 by 70 metres by varying the approved first workings. A letter was issued by Austar to the Department of Planning & Infrastructure (DP&I) on the 21st February 2013 in support of this variation to first workings. Austar received approval for the modified commencing end of LWA7 on the 21st February 2013.

Austar then proposed to lengthen the finishing (i.e. south-western) end of LWA7 by 101 metres from the approved position. Report No. MSEC650 (Rev. A) was issued on the 15th October 2013 in support of this modification application. Austar received approval for the modified finishing end of LWA7 on the 17th December 2013.

In accordance with Condition 18 of the Subsidence Management Plan Approval for Longwall A7, this report provides comparisons between the observed and predicted subsidence movements for the monitoring lines in Stage 3 resulting from the extraction of this longwall.

1.2. Mining Geometry

The layout of the longwalls in Stage 3 is shown in Drawing No. MSEC719-01, in Appendix B. The overall length of Longwall A7 is 1,032 metres and the overall void width, including first workings, is 237 metres. This longwall is the first in the series in Stage 3 of the Mine.

The depth of cover to the Greta Seam, directly above Longwall A7, varies between a minimum of 455 metres towards the northern most corner of the longwall and a maximum of 520 metres above the maingate towards the middle of the longwall.

The thickness of the Greta Seam within the extent of Longwall A7 varies between 6.0 metres and 6.5 metres. The Longwall Top Coal Caving equipment extracted the bottom 3.3 metres of the seam and partially recovered (no caving between chocks 40 through to 70) on average 65 % of the top coal from the commencing end up to longwall chainage 660 metres, then recovered (full face width) on average 70 % of the top coal up to chainage 300 metres, and then recovered no top coal (rear AFC removed) through to the longwall finishing end.

2.1. Introduction

The mine subsidence movements resulting from the extraction of Longwall A7 were monitored using the following:-

- Line A7,
- Line XL3, and
- Quorrobolong Road Line.

The locations of these monitoring lines are shown in Drawing No. MSEC719-01, in Appendix B.

The following sections provide comparisons between the observed and predicted subsidence movements for the monitoring lines which were measured during and after the extraction of Longwall A7. The predicted movements are based on the predicted subsidence contours provided in Report No. MSEC650 (Rev. A), which includes the modified commencing and finishing ends of Longwall A7.

The predicted incremental conventional subsidence contours, resulting from the extraction of Longwall A7, have been reproduced in Drawing No. MSEC719-05, in Appendix B. The predicted subsidence contours are based on extracting 3.0 metres of bottom coal and achieving an 85 % recovery of the top coal. It is noted, that the as-extracted seam thickness (bottom plus top coal) is around 10 % less than that assumed for the subsidence predictions.

2.2. Line A7

Line A7 is a longitudinal monitoring line which follows the centreline of Longwall A7. The monitoring line was measured five times during and one time after the extraction of Longwall A7. The latest survey was carried out on the 17th June 2014, around two months after the completion of the longwall. The base survey was carried out on the 25th May 2013, around three weeks prior to the commencement of Longwall A7.

The observed profiles of incremental subsidence, tilt and strain along Line A7, resulting from the extraction of Longwall A7, are shown in Fig. A.01, in Appendix A. The predicted profiles of incremental subsidence and tilt along this monitoring line, after the completion of the longwall, are also shown in this figure for comparison.

A summary of the maximum observed and maximum predicted incremental subsidence parameters along Line A7, resulting from the extraction of Longwall A7, is provided in Table 2.1. The observed values are the maxima at any time during or after the completion of Longwall A7.

Table 2.1 Maximum Observed and Predicted Incremental Subsidence Parameters along Line A7 Resulting from the Extraction of Longwall A7

Type	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Tensile Strain (mm/m)	Maximum Total Comp. Strain (mm/m)
Observed	232	1.3	0.6	0.8
Predicted	450	2.5	*- Refer to discussions below -*	

The maximum observed incremental subsidence along Line A7 was 232 mm, which represents 52 % of the maximum predicted subsidence of 450 mm. Similarly, the maximum observed tilt of 1.3 mm/m represented 52 % of the maximum predicted tilt.

The observed subsidence and tilt profiles were reasonably symmetrical, but the subsidence profile was slightly flatter (i.e. lower tilt) at the longwall finishing end (i.e. left side of Fig. A.01). A localised bump (i.e. uplift) developed in the subsidence profile at Mark A733, however, it was not associated with any elevated strains and was not considered anomalous.

The maximum observed incremental strains along Line A7 were 0.6 mm/m tensile and 0.8 mm/m compressive. The maximum predicted conventional strains, based on applying a factor of 15 to the maximum predicted conventional curvatures anywhere above Longwall A7, are 0.6 mm/m tensile and 0.9 mm/m compressive.

The maximum observed strains occurred in adjacent survey bays (i.e. as a tensile-compressive pair) and were located outside of the extents of the longwall and, therefore, could be the result of a disturbed survey mark. Elsewhere, the observed strains were typically in the order of survey tolerance (i.e. 0.3 mm/m), with localised strains up to 0.5 mm/m tensile and compressive.

There were no irregular (i.e. anomalous) strains identified along Line A7.

2.3. Line XL3

Line XL3 is a cross-line located between the middle and commencing end Longwall A7. The monitoring line was measured five times during and one time after the extraction of Longwall A7. The latest survey was carried out on the 16th June 2014, around two months after the completion of the longwall. The base survey was carried out on the 4th June 2013, which was 10 days prior to the commencement of Longwall A7

The observed profiles of incremental subsidence, tilt and strain along Line XL3, resulting from the extraction of Longwall A7, are shown in Fig. A.02, in Appendix A. The predicted profiles of incremental subsidence and tilt along this monitoring line, at the completion of Longwall A7, are also shown in this figure for comparison.

A summary of the maximum observed and maximum predicted incremental subsidence parameters along Line XL3, resulting from the extraction of Longwall A7, are provided in Table 2.2. The observed values are the maxima at any time during or after the completion of Longwall A7.

Table 2.2 Maximum Observed and Predicted Incremental Subsidence Parameters along Line XL3 Resulting from the Extraction of Longwall A7

Type	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Tensile Strain (mm/m)	Maximum Total Comp. Strain (mm/m)
Observed	232	1.5	0.9	0.8
Predicted	450	1.5	*- Refer to discussions below -*	

The maximum observed incremental subsidence along Line XL3 was 232 mm, which represents 52 % of the maximum predicted subsidence of 450 mm (as per Line A7). The shape of the observed subsidence profile reasonably matched the predicted subsidence profile, but with a reduced magnitude. There is a slight lateral shift in the observed subsidence profile, towards the longwall maingate (i.e. right side in Fig. A.02), which could be the result of the natural surface slope.

The maximum observed incremental tilt was 1.5 mm/m which was the same as the maximum predicted tilt. The observed tilt profile also reasonably matched the predicted tilt profile. The observed tilt locally exceeded the predicted tilt between Marks XL326 and XL327, due to the localised bump (i.e. uplift) in the subsidence profile at Mark XL326. The localised bump was not associated with any elevated strains and, therefore, was not considered anomalous.

The maximum observed incremental strains were 0.9 mm/m tensile and 0.8 mm/m compressive. The maximum predicted conventional strains, based on applying a factor of 15 to the maximum predicted conventional curvatures anywhere above Longwall A7, are 0.6 mm/m tensile and 0.9 mm/m compressive

The maximum observed tensile strain occurs between Marks XL339 and XL340, which were located at the top of the hill and, therefore, this localised strain could have been influenced by the surface topography. The maximum observed compressive strain occurs between Marks XL328 and XL329, which were located directly above the longwall, and was less than the maxima predicted due to conventional movements.

There was a tensile-compressive strain pair (both 0.7 mm/m) located between Marks XL311 to XL313, which were located well outside the longwall and, therefore, could be the result of a disturbed survey mark. Elsewhere, the observed strains were typically in the order of survey tolerance, with some localised strains up to around 0.5 mm/m.

There were no non-conventional (i.e. anomalous) strains identified along the Line XL3.

2.4. Quorrobolong Road

The Quorrobolong Road monitoring line follows the alignment of Quorrobolong Road which crosses the north-western corner Longwall A7. The monitoring line was measured five times during and three times after the extraction of Longwall A7. The latest survey was carried out on the 20th May 2014, around one month after the completion of the longwall. The base survey was carried out on the 28th January 2014, when the longwall chainage was 230 metres and the extraction face was around 100 metres from the road.

The observed profiles of incremental subsidence, tilt and strain along the Quorrobolong Road Line, resulting from the extraction of Longwall A7, are shown in Fig. A.03, in Appendix A. The predicted profiles of incremental subsidence and tilt along this monitoring line, at the completion of Longwall A7, are also shown in this figure for comparison.

A summary of the maximum observed and maximum predicted incremental subsidence parameters along the Quorrobolong Road Line, resulting from the extraction of Longwall A7, are provided in Table 2.3. The observed values are the maxima at any time during or after the completion of Longwall A7.

Table 2.3 Maximum Observed and Predicted Incremental Subsidence Parameters along the Quorrobolong Road Line Resulting from the Extraction of Longwall A7

Type	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Tensile Strain (mm/m)	Maximum Total Comp. Strain (mm/m)
Observed	66	1.9	4.0	3.0
Predicted	150	0.7	*- Refer to discussions below -*	

The maximum observed incremental subsidence along the Quorrobolong Road Line was 66 mm, which is less than half of the maximum predicted subsidence of 150 mm. Only low level subsidence developed along this monitoring line as it crosses the corner of the longwall.

It can be seen from Fig. A.03, that the profiles of observed tilt and strain were very irregular. The localised tilts and strains along the monitoring line exceed those predicted based on conventional movements and are greater than those which would be expected based on the low level of vertical subsidence.

The survey marks have been established in the verge adjacent to Quorrobolong Road and, therefore, it is likely that these localised tilts and strains were the result of disturbed survey marks. This is supported by the fact that the visual monitoring did not identify any visual impacts in road pavement as a result of mining.

It is expected, based on the low levels of vertical subsidence, that the actual tilts and strains (i.e. excluding the disturbed marks) would be in the order of survey tolerance.

2.5. Summary

The ground movements measured along Lines A7 and XL3 indicate that the observed subsidence and tilt, resulting from the extraction of Longwall A7, were generally similar to or less than the maxima predicted. The profiles of observed subsidence and tilt also reasonably matched those predicted, but with reduced magnitudes.

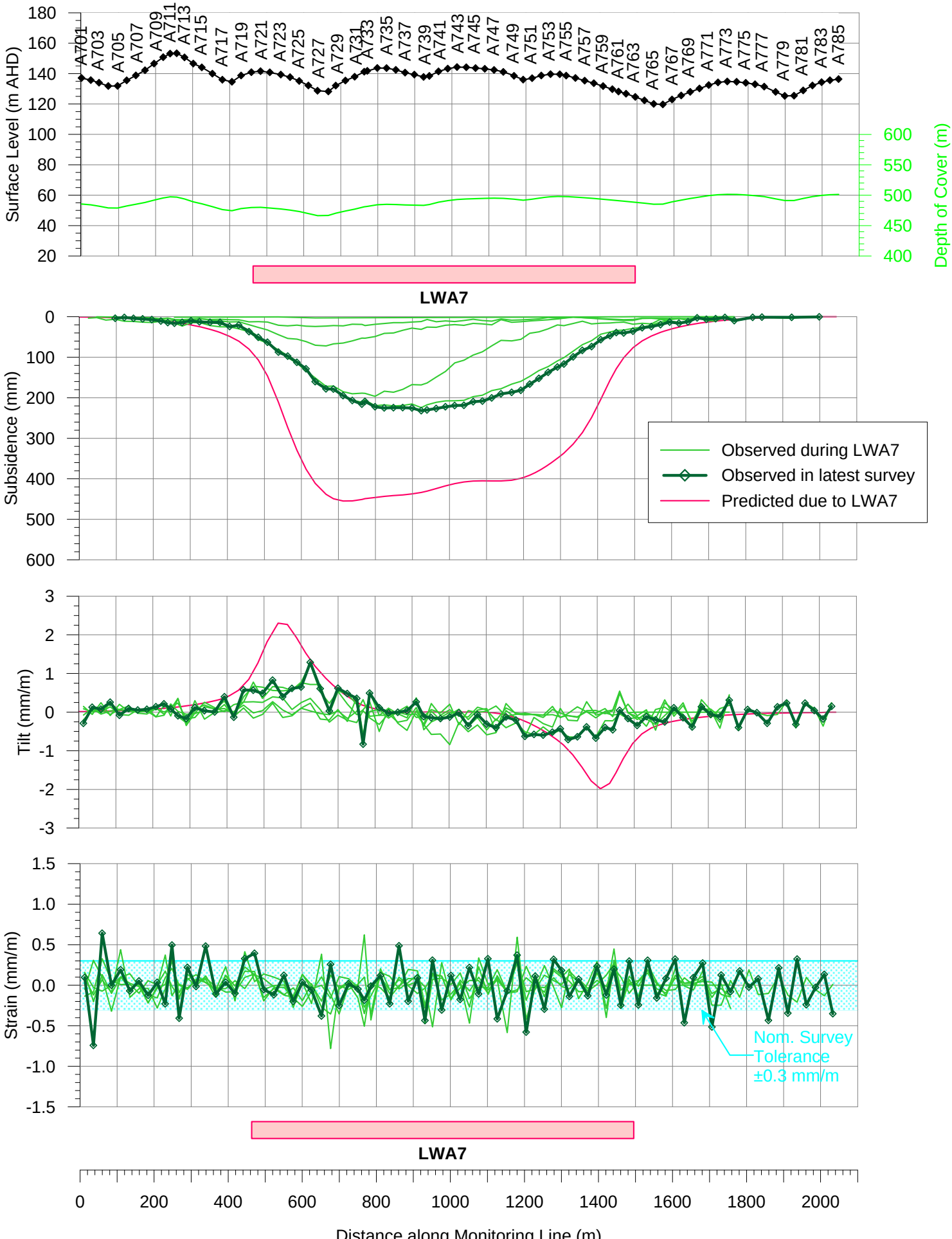
Only low level subsidence was measured along the Quorrobolong Road Line as this monitoring line crosses the corner of the longwall. The observed tilt and strain profiles along this monitoring line were very irregular and the localised movements appear to be the result of disturbed survey marks.

The observed strains along Lines A7 and XL3 were typically less than the predicted conventional strains. The maximum observed tensile strain along the XL3 Line, of 0.9 mm/m, occurred at the top of a hill and could have been influenced by the surface topography. Tensile-compressive strain pairs also occurred along each of the Lines A7 and XL3, at locations outside of the longwall and, therefore, could have resulted from disturbed survey marks. Otherwise, the strains were similar to the order of survey tolerance.

It has been considered, therefore, that the Incremental Profile Method has provided adequate predictions of the mine subsidence movements for Austar Stage 3 Longwall A7. It has also been considered that it is not necessary to undertake any further calibration of the prediction model, based on the monitoring data, or to update the impact assessments which have been provided in Reports Nos. MSEC309, MSEC484 and MSEC650.

APPENDIX A. FIGURES

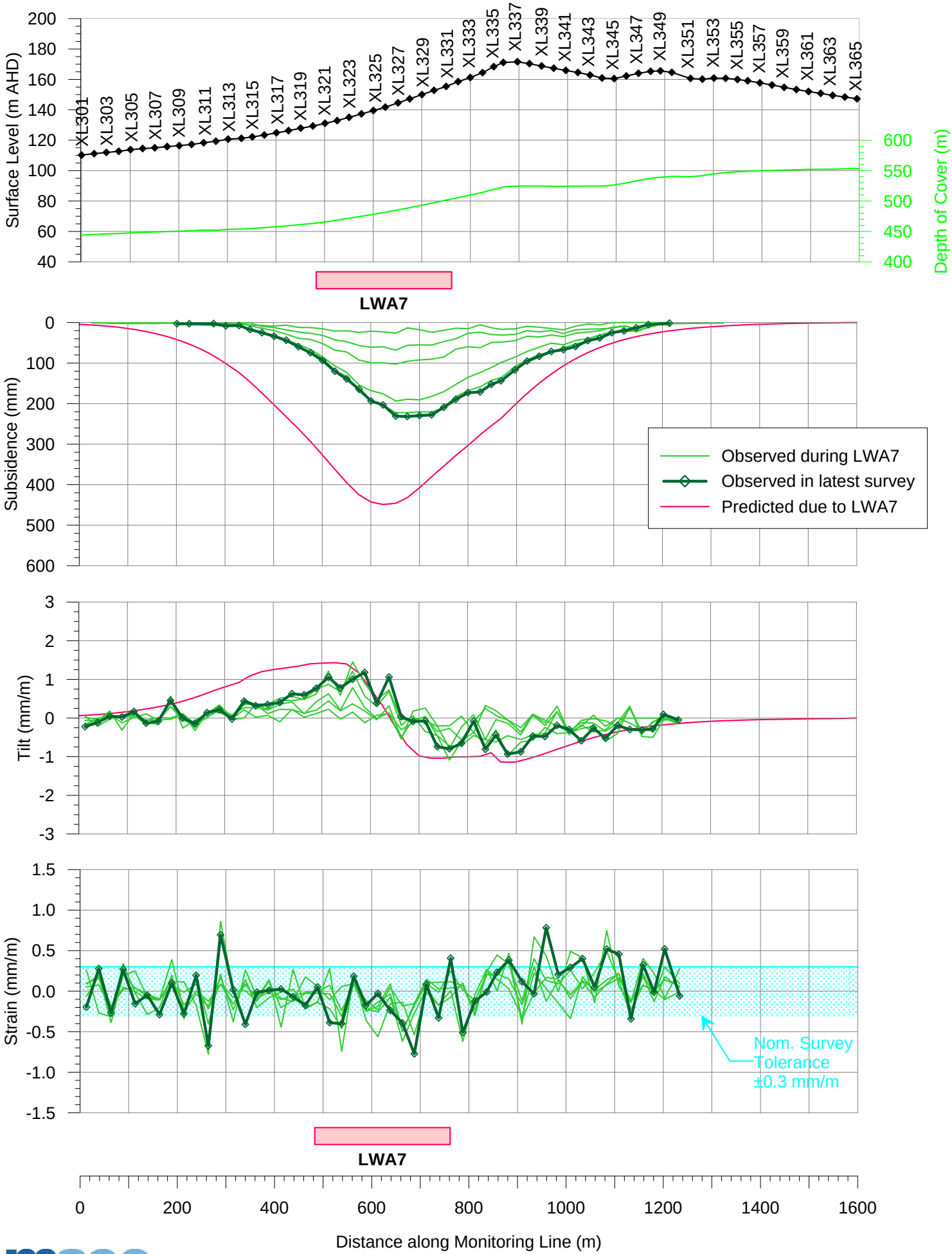
Observed and Predicted Profiles of Incremental Subsidence, Tilt and Strain along the A7-Line during Austar Stage 3 LWA7



msec

Fig. A.01

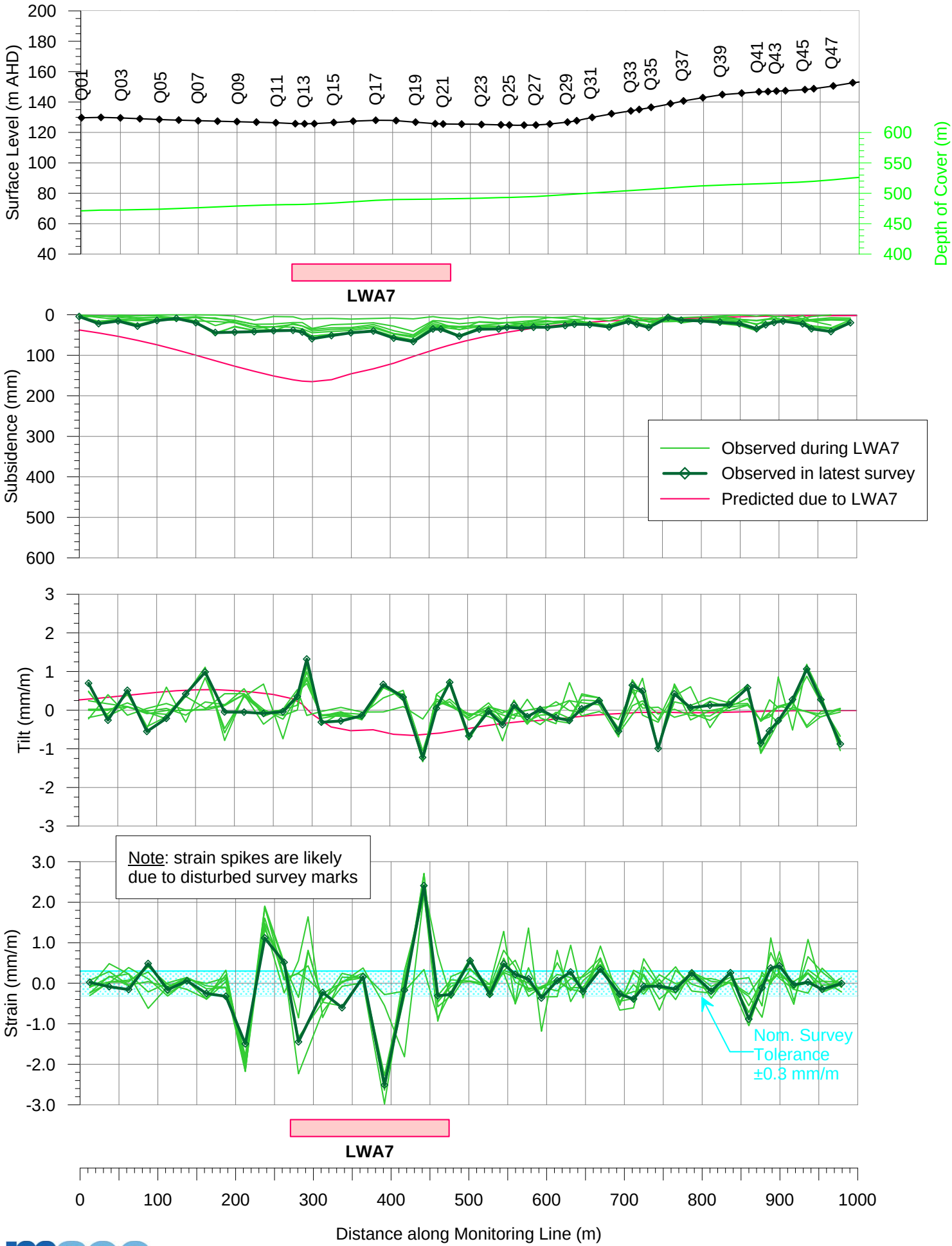
Observed and Predicted Profiles of Incremental Subsidence, Tilt and Strain along the XL3-Line during Austar Stage 3 LWA7



msec

Fig. A.02

Observed and Predicted Profiles of Incremental Subsidence, Tilt and Strain along Quorrobolong Road during Austar Stage 3 LWA7



msec

Fig. A.03

APPENDIX B. DRAWINGS

I:\Projects\Austar\Stage 3\MSEC719 - LWA7 End of Panel Report\AcadData\MSEC719-01.dwg

msec mine subsidence ENGINEERING CONSULTANTS
Level 1, 228 Victoria Ave, Chatswood NSW 2067
PO Box 3047, Willoughby North NSW 2068
Tel +61 2 9413 3777 Fax +61 2 9413 3822
www.minesubsidence.com

AUSTAR COAL MINE

STAGE 3 MODIFICATION
LONGWALL A7 END OF PANEL
GENERAL LAYOUT

DATE:	SCALE:	DRAWING No:	Rev No
19-Aug-2014	1:12500	MSEC719-01	A

Aberdare Central

6 360 000

6 359 000

347 000

348 000

349 000

LEGEND

EXISTING MONITORING LINES

LINE XL3

LINE A7

QUORROBOLONG RD

START LWA7
14-JUN-2013

FINISH LWA7
19-APR-2014

LW A7

LW A8

LW A9

LW A10

LW A11

Grid to MGA co-ordinates

I:\Projects\Austar\Stage 3\MSEC719 - LWA7 End of Panel Report\AcadData\MSEC719-02.dwg

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Level 1, 228 Victoria Ave, Chatswood NSW 2067
PO Box 3047, Willoughby North NSW 2068
Tel +61 2 9413 3777 Fax +61 2 9413 3822
www.minesubsidence.com

AUSTAR COAL MINE

STAGE 3 MODIFICATION
LONGWALL A7 END OF PANEL
SURFACE LEVEL CONTOURS

DATE:	SCALE:	DRAWING No:	Rev No
19-Aug-2014	1:12500	MSEC719-02	A

SURFACE LEVEL CONTOURS ARE IN m AHD

Grid to MGA co-ordinates

6 360 000
6 359 000
347 000
348 000
349 000

LW A7
LW A8
LW A9
LW A10
LW A11

I:\Projects\Austar\Stage 3\MSEC719 - LWA7 End of Panel Report\AcadData\MSEC719-03.dwg

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Level 1, 228 Victoria Ave, Chatswood NSW 2067
PO Box 3047, Willoughby North NSW 2068
Tel +61 2 9413 3777 Fax +61 2 9413 3822
www.minesubsidence.com

AUSTAR COAL MINE

STAGE 3 MODIFICATION
LONGWALL A7 END OF PANEL
DEPTH OF COVER CONTOURS

DATE:	SCALE:	DRAWING No:	Rev No
19-Aug-2014	1:12500	MSEC719-03	A

DEPTH OF COVER CONTOURS ARE IN METRES

6 360 000
6 359 000
347 000
348 000
349 000

LW A7
LW A8
LW A9
LW A10
LW A11

Abernethy Fault Zone
Quorrobolong Fault Zone

Grid to MGA co-ordinates

I:\Projects\Austar\Stage 3\MSEC719 - LWA7 End of Panel Report\AcadData\MSEC719-04.dwg

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Level 1, 228 Victoria Ave, Chatswood NSW 2067
PO Box 3047, Willoughby North NSW 2068
Tel +61 2 9413 3777 Fax +61 2 9413 3822
www.minesubsidence.com

AUSTAR COAL MINE

STAGE 3 MODIFICATION
LONGWALL A7 END OF PANEL
SEAM THICKNESS CONTOURS

DATE:	SCALE:	DRAWING No:	Rev No
19-Aug-2014	1:12500	MSEC719-04	A

SEAM THICKNESS CONTOURS ARE IN METRES

6 360 000
6 359 000
347 000
348 000
349 000

LW A7
LW A8
LW A9
LW A10
LW A11

6.5
6.5
0.7
0.9

Abernethy Fault Zone
Quorrobolong Fault Zone
10m

Grid to MGA co-ordinates

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Level 1, 228 Victoria Ave, Chatswood NSW 2067
PO Box 3047, Willoughby North NSW 2068
Tel +61 2 9413 3777 Fax +61 2 9413 3822
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AUSTAR COAL MINE

STAGE 3 MODIFICATION

LONGWALL A7 END OF PANEL

PREDICTED INCREMENTAL SUBSIDENCE CONTOURS DUE TO LWA7

DATE:	SCALE:	DRAWING No:	Rev No
19-Aug-2014	1:12500	MSEC719-05	A

PREDICTED SUBSIDENCE CONTOURS ARE IN MILLIMETRES (mm)