



LWB4 to LWB7

Subsidence Monitoring Program

January 2019



DOCUMENT CONTROL

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27/6/2017	0	Original document	D Lee G Mulhearn	Tony Sutherland
21/9/2017	1	Updated frequency of inspections on Sandy Creek Road and subsidence impact monitoring for BFMPs. Update to water monitoring summary in Appendix A.	D. Lee G. Mulhearn	Tony Sutherland
5/2/2018	2	Update of marks to be removed in Plan No.1707 – Plan 7	M. Wright	W. Farnworth
1/2/2019	3	Updated following shortening of LWB4	D. Lee	W. Farnworth

TABLE OF CONTENTS

Page

1 INTRODUCTION	1
1.1 SCOPE & OBJECTIVE	1
1.2 BUILT FEATURES SUBSIDENCE MONITORING	2
2 SUBSIDENCE MONITORING PROGRAM.....	3
2.1 LAND OWNERSHIP AND LAND ACCESS	3
2.2 SUBSIDENCE PARAMETERS OVER LONGWALLS – SURVEY PROGRAM	3
2.3 GENERAL LANDFORM CONDITION INSPECTIONS	4
3 ADAPTIVE MANAGEMENT	5
3.1 INCREASE IN MONITORING FREQUENCY	5
3.2 REVIEW.....	5
4 SM PROGRAM ROLES AND ACCOUNTABILITIES	6

APPENDICES

Appendix A Subsidence Monitoring Survey Program

Appendix B Subsidence Inspection Visual Checklist

1 INTRODUCTION

Austar Coal Mine Pty Ltd (Austar), a subsidiary of Yancoal Australia Limited (Yancoal), owns Austar Coal Mine, an underground coal mine located approximately 10 kilometres south of Cessnock in the Lower Hunter Valley in NSW. The mine is an aggregate of the former Ellalong, Pelton, Cessnock No.1 and Bellbird South Collieries and is located in the South Maitland Coalfields. These operations, including coal extraction, handling, processing and transport, collectively form the Austar Mining Complex.

A modification to the Bellbird South development consent (DA29/95 MOD7) was submitted for approval under delegated authority of the Minister for Planning on 22 May 2017. The modification extends the Bellbird South consent area and permits the transfer of coal from three conventional longwall panels (Longwalls B4 to B7) within the Ellalong Colliery and Bellbird South Colliery areas to existing infrastructure for processing and transport of coal.

On the 18 September 2018, the Department of Planning and Environment approved the shortening of Longwall B4 by 279m due to geological factors and the occurrence of coal burst incidents in the LWB4 panel. This Subsidence Monitoring Program (the **SM Program**) has been prepared as part of the Extraction Plan for Longwalls LWB4 to LWB7.

1.1 SCOPE & OBJECTIVE

The scope of the SM Program includes the Extraction Plan Area for LWB4 to LWB7 (the **Extraction Plan Area**).

The objective of the SM Program is to provide a formal program for monitoring of subsidence parameters and subsidence effect observations on land within the Extraction Plan Area.

To achieve the objective the SM Program will:

- Describe subsidence monitoring procedures to measure actual subsidence parameters for the Extraction Plan Area; and
- Describe observations/inspections of the general landform and environmental condition in the Extraction Plan area.

The monitoring results from the SM Program will allow review against subsidence predictions, and to allow a trigger for any required remediation and/or review management measures based on measurements of observations.

The process for collecting subsidence monitoring data, review against the relevant TARP, and trigger of actions from relevant Extraction Plan sub-plans is provided in the main Extraction Plan document.

1.2 BUILT FEATURES SUBSIDENCE MONITORING

Monitoring specific to individual built features (e.g. powerlines, telecommunications, and private property improvements) will be detailed in individual Built Features Management Plans prepared in consultation with the relevant owner.

2 SUBSIDENCE MONITORING PROGRAM

2.1 LAND OWNERSHIP AND LAND ACCESS

Surface land in the Extraction Plan Area comprises Austar owned land, privately owned rural properties, public roads and Crown land. Placement and monitoring of subsidence marks and general condition monitoring can only be conducted with agreement with the relevant landowners.

2.2 SUBSIDENCE PARAMETERS OVER LONGWALLS – SURVEY PROGRAM

The proposed layout and monitoring details of the subsidence lines are outlined in **Appendix A**.

The proposed subsidence monitoring strategy consists of:

1. A continuation of the LWB1 – LWB3 cross line, with survey marks at 25m centres, located as centrally as possible over Longwalls LWB4 – LWB7 but positioned to cause minimum disturbance to land owners.
2. A continuation of the Sandy Creek Road monitoring line, with road spikes at 25m centres positioned along the edge of the bitumen. Additional monitoring points on culverts to measure potential changes in drainage patterns will also be included.
3. The installation of monitoring marks will be progressively installed.
4. Sandy Creek Road monitoring line will be installed prior to LWB4 impacting.
5. The cross line will be completed prior to LWB4 impacting.

Survey particulars include:

- The subsidence lines will be established using a combination of “Feno” survey marks, concrete nails and road spikes at nominal 25m intervals.
- Lines will be progressively installed prior to the influence of subsidence. The lines will be monitored using Total Station traversing techniques to measure full three dimensional movements.
- Expected survey accuracy will be within:
 - i. $\pm 15\text{mm}$ for horizontal movements
 - ii. $\pm 15\text{mm}$ for vertical movements
- Data will be kept in an excel spreadsheet and will be accompanied by an updated subsidence plan (which will show the longwall face positions at the time of each survey).
- Survey data will be provided to the DRG via the Subsidence Data Portal within 1 week of completing data acquisition.
- Monitoring frequency as per attached table in **Appendix A**.

2.3 GENERAL LANDFORM CONDITION INSPECTIONS

Mine personnel will also conduct surface inspections of the area during routine subsidence surveys as outlined in **Table A1**. Regular inspections will be conducted in the zone defined as being 300 metres behind and 100 metres in front of the current face position will include inspection of:

- Surface cracking particularly around edges of extraction void, travelling abutments and steep slopes
- Surface humps near centre of extracted panels, travelling abutments and topographic lows of adjacent steep slopes
- Step changes in land surface
- Serviceability of access tracks
- Slope, boulder and tree instability
- General vegetation condition observations
- Sandy Creek Road including culvert observations
- Condition of tributaries/drainage lines observations
- Condition of power poles observations.

Additional visual monitoring of Sandy Creek Road will occur as per the following protocols:

Action	Timing	Person Responsible
Routine visual inspection of road condition to inspect for possible subsidence damage	Fortnightly within 100m of the road	Austar Mine Surveyor or delegate
Increased visual inspections of the road for cracking and humps or drainage issues.	Twice weekly within 50m of the road	Austar Mine Surveyor or delegate
Daily visual inspection of the road for cracking and humps or drainage issues.	<p>Once subsidence monitoring indicates subsidence parameters have exceeded:</p> <ul style="list-style-type: none"> • Strain >2mm/m • Or irregularity observed in routine visual inspections <p>Until stable or remediation undertaken.</p>	Austar Mine Surveyor or delegate

The proposed surface condition monitoring form to be completed during each inspection is included in **Appendix B**. Natural landform features within the Extraction Plan Area (including steep slopes and drainage lines) are included with the monitoring form in **Appendix B**.

3 ADAPTIVE MANAGEMENT

3.1 INCREASE IN MONITORING FREQUENCY

The Extraction Plan TARP indicates scenarios where the frequency of subsidence monitoring may be increased to more frequent intervals than that presented in **Appendix A**. This may occur where greater than predicted subsidence parameters are measured, or abnormal surface conditions are observed.

3.2 REVIEW

This SM Program shall be reviewed after the completion of each longwall. The plan will also be reviewed as a result of an incident, if subsidence levels are significantly higher than predicted, if any changes to the mine plan occur, or after submission of an Annual Review or Independent Environmental Audit.

Significant changes to the SM Program (such as alteration of proposed monitoring lines, or a reduction in monitoring frequency based on monitoring results) will be undertaken with the approval of the Division of Resources and Geosciences (DRG).

4 SM PROGRAM ROLES AND ACCOUNTABILITIES

Detailed below are key personnel involved with implementing this SM Program, their roles and responsibilities.

Role	Responsibilities
Technical Services Manager (TSM)	<ul style="list-style-type: none"> • Owner of the SM Program • Coordinate Mine Surveyor to ensure subsidence monitoring is undertaken in accordance with the SM Program • Review subsidence monitoring data against predictions and TARPs in order to trigger any actions required on the basis of subsidence results • Review and update the SM Program as required • Ensure visual monitoring requirements are completed by a trained and competent person
Environment and Community Superintendent (ECS)	<ul style="list-style-type: none"> • Liaise with Landholders in relation to gaining access for monitoring of the SM Program • Notify and liaise with neighbours and community in relation to mining timing and monitoring performance;
Mine Surveyor	<ul style="list-style-type: none"> • Ensure that all subsidence monitoring is completed to the requirements of the Subsidence Monitoring Program and provided to the TSM for review. • Ensure appropriate road controls are in place for monitoring along Sandy Creek Road.

Appendix A

Subsidence Monitoring Survey Program

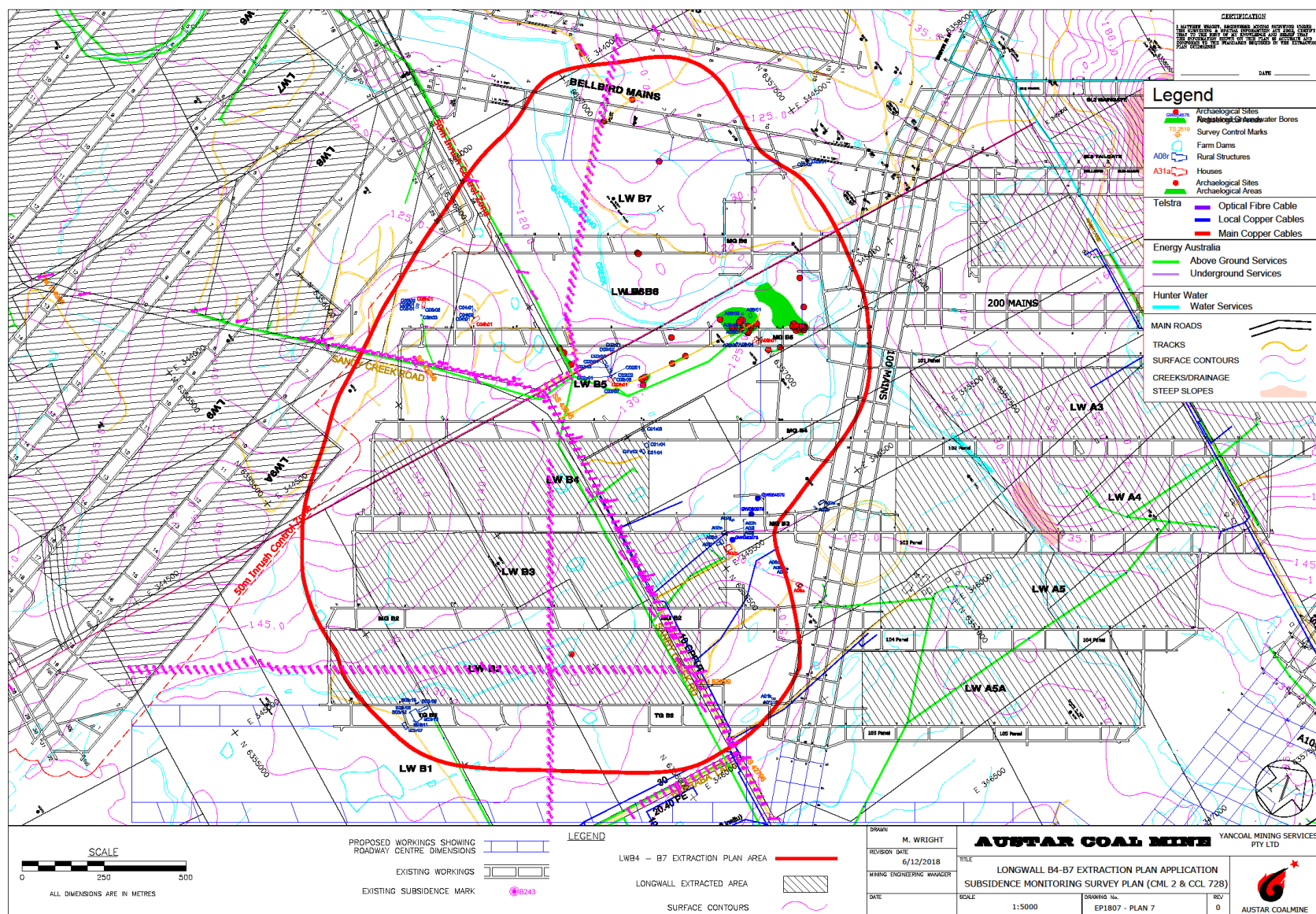
Table A1: Subsidence Monitoring Survey Program

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Cross Line	With due regard to minimum disturbance to surface features. A Cross line for Longwalls B4 to B7.	To capture the subsidence profile across the combined extraction area.	Feno marks with 600mm spike if no rock.	25 metres	Pre-mining and at the completion of each longwall and 6 month post mining.
Sandy Creek Road	Monitoring line running parallel to the road within the area affected by B4 to B7	To measure the onset of movement on the road and trigger requirements as per the Cessnock City Council BFMP and Public Safety MP.	Road spikes in edge of bitumen and concrete nails or drill holes on converts	25m and either end of culverts	Pre-mining and fortnightly when the Longwall has approached within 100m of the road and at the completion of each longwall (visual inspections to continue with each routine subsidence monitoring occurrence)

Table A2: Subsidence Impacts Monitoring

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
Public Safety Management Plan Monitoring (Summary of monitoring actions only – full details provided in actual management plan)			
Public Safety Management Plan	Surface Cracking including steep slopes	Pre and post mining plus monthly around active mining area	Visual inspection of the area immediately behind the longwall faces passage to identify/map subsidence cracking that may require remediation.
	Dams	Pre and post mining plus monthly around active mining area	Monitoring of dams within the Extraction Plan Area to detect any subsidence impacts that may require management. Monitor water level using markers.
	Flooding and Access	Pre and post mining plus monthly around active mining area	Visual inspection to identify any ponding impacts that could affect the safety and access of vehicles.
Built Features Management Plan (Summary of monitoring actions only – full details provided in actual management plan)			
Ausgrid BFMP	Power Poles	Pre and post mining surveys plus fortnightly inspections around active mining area	Survey monitoring of power poles for subsidence impacts and visual damage to poles Management plan under construction in conjunction with asset owner
	Transmission Lines	Fortnightly inspections around active mining area	Visual inspections of transmission lines for increase/decrease in tension and ground clearance Management plan under construction in conjunction with asset owner
Telstra BFMP	Telstra Copper Cables and Pits	Pre and post mining surveys plus	Survey monitoring of road adjacent to cable for subsidence impacts and visual

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
		fortnightly inspections around active mining area	damage to pits Management plan under construction in conjunction with asset owner
WaterNSW – Water Bores BFMP	WaterNSW – Water owned water bores	Fortnightly inspections around active mining area if access to property granted	Visual inspections of bores for subsidence impacts/damage Management plan under construction in conjunction with asset owner
Individual Property BFMP	House/Fences/Sheds/Tanks/Farm dams etc	Pre and post mining inspections if access to property granted	Visual inspections of built features for subsidence impacts/damage Management plan under construction in conjunction with land owners
Environmental Management Plans (Summary of monitoring action only – full details provided in actual management plan. Monitoring programs are subject to changes should the approved management plan be varied during the course of the Extraction Plan)			
Land Management Plan	General Land Surface	During and post mining	Visual inspection of cracking and subsidence to manage erosion, impacts to flora and fauna and drainage.
Biodiversity Management Plan	Flora and Fauna	Annually	Monitoring flora and fauna for any possible mining related impacts
Water Management Plan	Quorrobolong Creek, Alluvial Aquifer	Monthly, Quarterly	Monitoring in Quorrobolong and Coney Creeks in accordance with Austar's Site Water Management Plan for pH, electrical conductivity (EC), and total suspended solids (TSS) to detect any possible mining related impacts Channel stability monitoring by visual inspection within Quorrobolong Creek (supported by photographic monitoring in one area). Monitoring of water level and quality in alluvial and porous rock aquifers.



Appendix B

Subsidence Inspection Visual Checklist

FORM: Subsidence Inspection Visual Checklist

SUBSIDENCE INSPECTION CHECKLIST		
Date		
Name of Inspection		
Longwall Number		
Face Position (chainage)		
Inspection Zone Start (Face chainage -300m)		
Inspection Zone End (Face chainage +100m)		
INSPECTION ITEM	CHECKED	COMMENTS
Surface cracking		
Surface humps (compression)		
Step change in land surface		
Unstable slopes, boulders or trees		
Surface slumping, erosion		
Changes to streams, ponding, sediment load		
General vegetation condition (in particular, dieback of vegetation)		
Sandy Creek Road / Barraba Lane and surrounding road verges for cracking and humps. Also inspection of the culverts for headwall or pipe join alignment and drainage issues. Road cuttings for signs of cracking, toe movement or general instability.		
Damage to poles, crossarms, insulators and conductors. Eg leaning poles, increased sag in conductors, reduced ground clearance		

SUBSIDENCE INSPECTION CHECKLIST

Where to Inspect

300 metres behind and 100 metres in front of the current face position.

Cover the full subsidence bowl out to the 26.5° angle of draw.

What to look for

- Surface cracking - edges of extraction void and start and travelling abutments particularly in rock outcrop areas and topographic high;
- Surface humps (compression) - near centre of extracted panels, the travelling abutment and topographic lows if adjacent to steep terrain;
- Step change in land surface - associated with cracking;
- Slope, boulder and tree instability;
- Surface slumping, erosion;
- Serviceability of access tracks;
- Changes to streams, ponding, sediment load; and
- General vegetation condition (in particular dieback of vegetation)
- Change in conditions of Sandy Creek road and Barraba Lane or surrounding verges including drainage culverts and water flows as well as road cutting stability.
- Damage to poles, conductors, powerlines
- Low hanging conductors
- Any effect that may cause a safety risk

Actions if there is a public safety risk

- Implement the **Public Safety Management Plan**; including
- Immediately notify the Landholder or Stakeholder (or responsible person) of the issue (Stakeholder list contained in Appendix A of the Public Safety Management Plan);
- take actions to remediate the issue (if possible);
- erect 'NO ACCESS' tape and warning signs (e.g. traffic control signs, traffic controllers as appropriate) if remediation is not possible; and
- notify the Mine Operations Manager and/or Environmental Manager of the findings
- The Manager of Mining Engineering shall immediately notify the Department of Planning & Environment – Resources & Geosciences, landholder and any infrastructure owner.

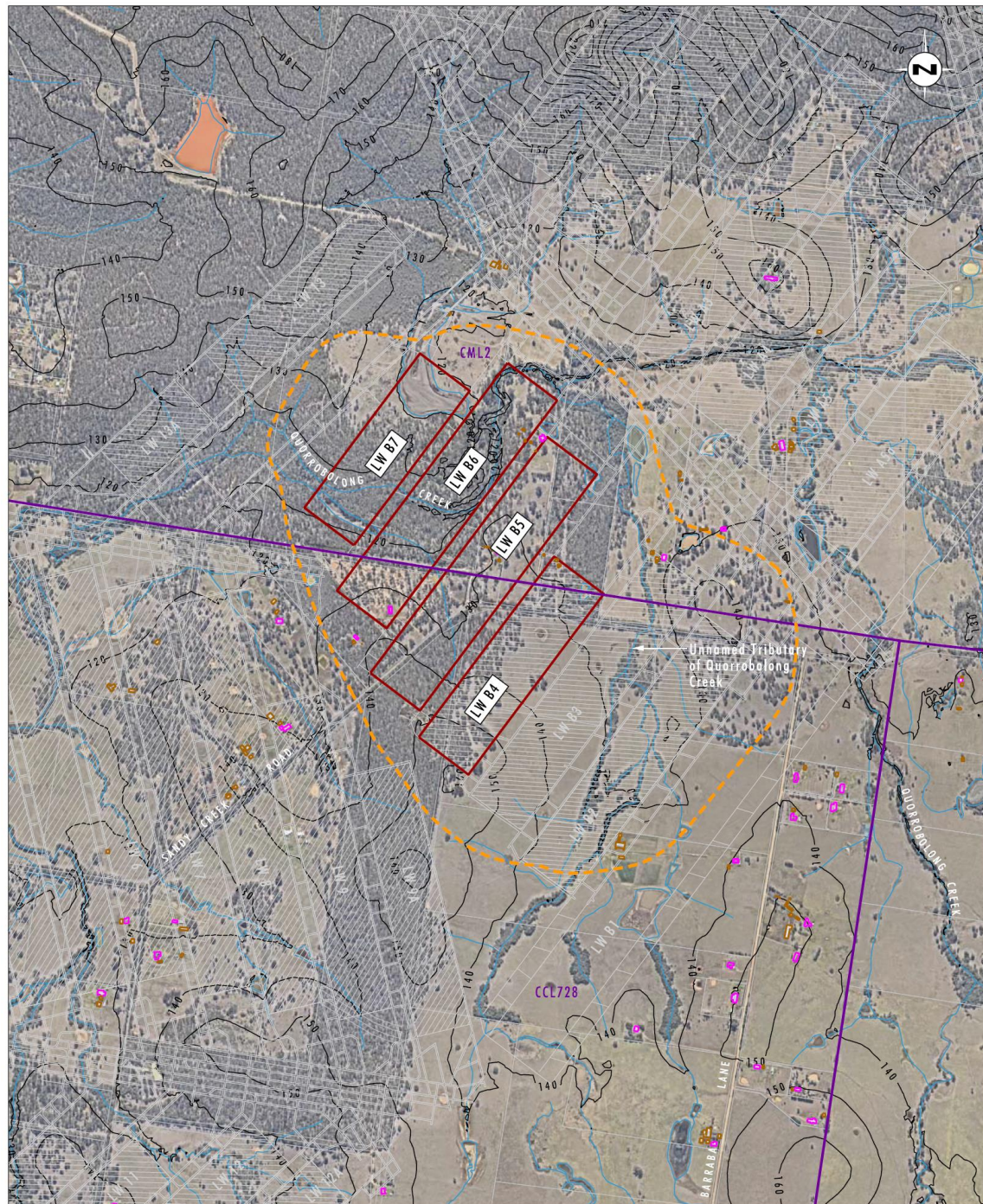


Image Source: Nearmap (Sep 2018)
Data Source: Austar Coal Mine (2017)
Note: Contour Interval 10m

Legend

- LWB4-B7 Extraction Plan Longwall Panels
- LWB4-B7 Extraction Plan Area
- Mining Lease Boundary
- Completed Underground Workings
- Drainage Line
- Contour
- Dwelling
- Other Structure

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FIGURE 1.2

LWB4-B7 Extraction Plan Area