



# LWB1 to LWB3 Subsidence Monitoring Program

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**TABLE OF CONTENTS**

**Page**

<b>1 INTRODUCTION .....</b>	<b>1</b>
1.1 SCOPE & OBJECTIVE .....	1
1.2 BUILT FEATURES SUBSIDENCE MONITORING .....	2
<b>2 SUBSIDENCE MONITORING PROGRAM.....</b>	<b>3</b>
2.1 LAND OWNERSHIP AND LAND ACCESS .....	3
2.2 SUBSIDENCE PARAMETERS OVER LONGWALLS – SURVEY PROGRAM .....	3
2.3 GENERAL LANDFORM CONDITION INSPECTIONS .....	5
<b>3 ADAPTIVE MANAGEMENT .....</b>	<b>6</b>
3.1 INCREASE IN MONITORING FREQUENCY .....	6
3.2 REVIEW.....	6
<b>4 SM PROGRAM ROLES AND ACCOUNTABILITIES .....</b>	<b>7</b>

**APPENDICES**

Appendix A Subsidence Monitoring Survey Program

Appendix B General Landform Condition 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 MOD6) was approved under delegated authority of the Minister for Planning on 29 January 2016. The modification extends the Bellbird South consent area and permits the transfer of coal from three conventional longwall panels (Longwalls B1 to B3) within the Ellalong Colliery and Bellbird South Colliery areas to existing infrastructure for processing and transport of coal. The modification also extends the development consent expiry for five years to allow the longwall panels to be extracted.

Since the modification was approved, Austar obtained further information on the location and nature of geological structures near the commencing and finishing positions of Longwalls B2 and B3. Austar was approved by the nominee for the Secretary of the Department of Planning and Environment on 29 April 2016 to shorten Longwall B2 and Longwall B3, and the extent of those shortened panels has been used in all diagrams and subsidence predictions in the preparation of this Extraction Plan.

This Subsidence Monitoring Program (the **SM Program**) has been prepared as part of the Extraction Plan for Longwalls LWB1 to LWB3.

### 1.1 SCOPE & OBJECTIVE

The scope of the SM Program includes the Extraction Plan Area for LWB1 to LWB3 (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 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.

Austar has secured access for monitoring purposes over several of the private landholdings in the Extraction Plan Area and will continue to seek access for monitoring.

### 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. Longitudinal subsidence monitoring line to be established along the central part of LWB2, with survey mark spacing at nominal 25m intervals but positioned to cause minimum disturbance to land owners .
2. A cross line, with survey marks at 25m centres, located as centrally as possible over Longwalls LWB1 – LWB3 but positioned to cause minimum disturbance to land owners.
3. 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.
4. Barraba Lane monitoring line, with survey marks at 25m centres positioned adjacent to the lane. Additional monitoring points on culverts to measure potential changes in drainage patterns will also be included.
5. The installation of monitoring marks will be progressively installed. Prior to the commencement of extraction (LWB2) B2 centreline will be established.
6. Sandy Creek road monitoring line will be installed prior to LWB2 impacting.
7. Barraba Lane monitoring line will be installed prior to LWB2 impacting.
8. Cross line 1 will be completed prior to LWB2 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.  $\pm 10\text{mm}$  for horizontal movements
  - ii.  $\pm 10\text{mm}$  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 DRE 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 and Barraba Lane including culvert observations
- Condition of tributaries/drainage lines 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	As per Survey Subsidence Monitoring program (Table A.1)-ie Fortnightly within 100m of the road	Austar Mine Surveyor or delegate
Increased visual inspections of the road for cracking and humps or drainage issues.	Every 35m ( $\pm 5$ m) of retreat when the Longwall is within 30m of the nearest point of the road	Austar Mine Surveyor or delegate
Daily visual inspection of the road for cracking and humps or drainage issues.	Once subsidence monitoring indicates subsidence parameters have exceeded: <ul style="list-style-type: none"> <li>• Strain <math>&gt;2\text{mm/m}</math></li> <li>• Or irregularity observed in routine visual inspections</li> </ul> Until stable or remediation undertaken.	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 Energy (DRE).

## 4 SM PROGRAM ROLES AND ACCOUNTABILITIES

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

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

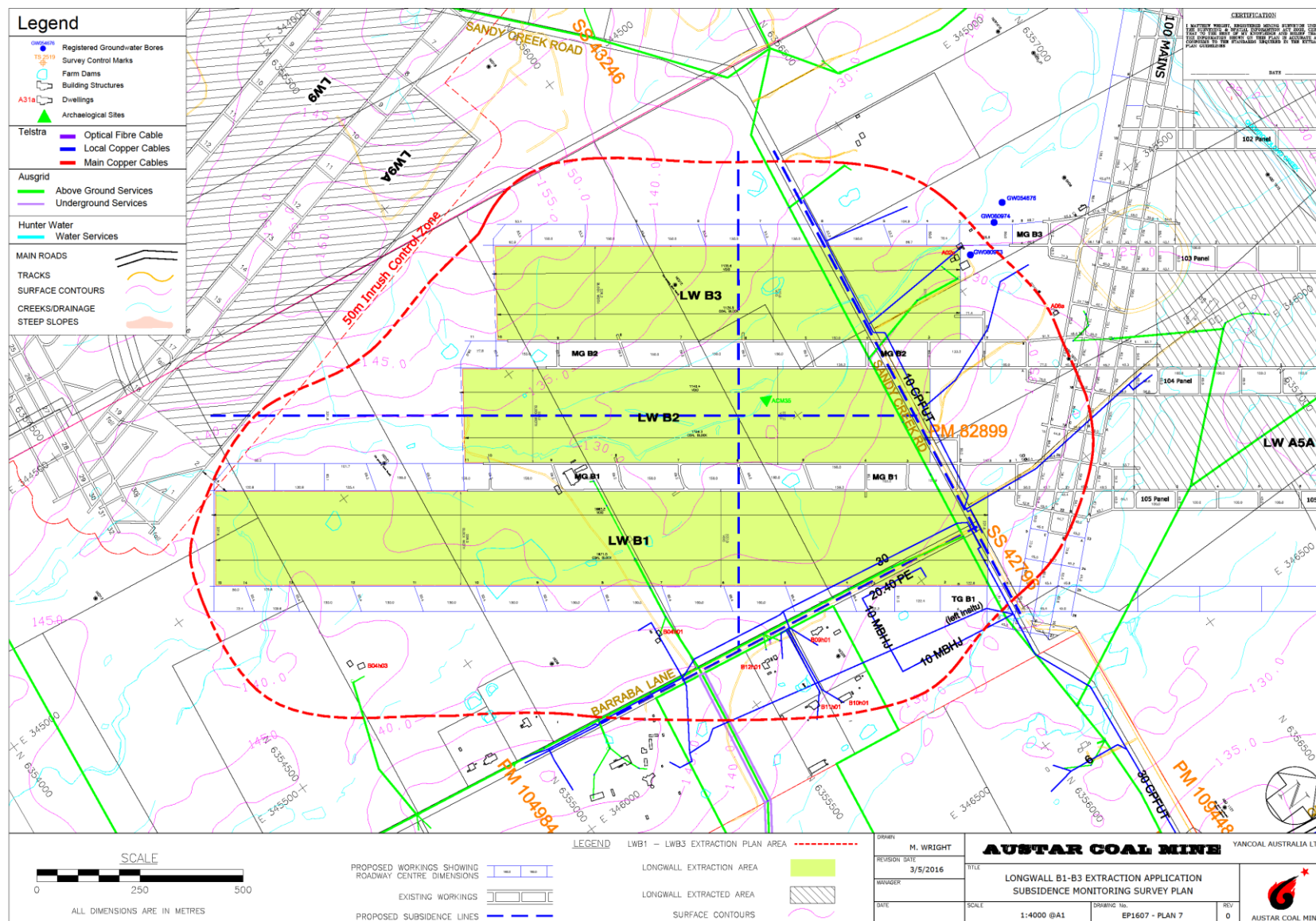
# **Appendix A**

# **Subsidence Monitoring Survey Program**

**Table A1: Subsidence Monitoring Survey Program**

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Line B2	Longitudinal line located as centrally over B2 Longwall as the surface features will allow.	Measure the development of the B2 subsidence then capture the combined subsidence effect of the adjacent longwall blocks.	Feno marks with 600mm spike if no rock.	25 metres	Pre mining and every 100m of retreat for the first 400m retreat of Longwall B2. Reduction to Quarterly for the remainder of extraction.  At the completion of each longwall and 6 month post mining after completion of B1.  Additional monitoring as requested by DRE Principal Subsidence Engineer (PSE).
Cross Line	With due regard to minimum disturbance to surface features. A Cross line for Longwalls B1 to B3	To capture the subsidence profile across the combined extraction area.	Feno marks with 600mm spike if no rock.	25 metres	Pre mining and when LW is at -100m, 0m, +100m, +200m from the cross line (-ve = inbye of, +ve = outbye of)  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 B1 to B3	To measure the onset of movement on the road and trigger requirements as per the Cessnock City Council Built Features and Public Safety MP.	Road spikes in edge of bitumen and concrete nails 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  Continued fortnightly monitoring for a month after the completion of the longwall panel (visual inspections to continue with each routine subsidence monitoring occurrence)

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Barraba Lane	Monitoring line running parallel to the road within the area affected by B1 & B2	To measure the onset of movement on the road and trigger requirements as per the Cessnock City Council Built Features and Public Safety MP.	Feno marks with 600mm spike in ground adjacent to road and positioned to minimise chance of disturbance	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 B1  Continued fortnightly monitoring for a month after the completion of the longwall panel (visual inspections to continue with each routine subsidence monitoring occurrence)



# **Appendix B**

## **Subsidence Inspection Checklist**

## FORM: Subsidence Inspection 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.		

## 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.

### 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 Environment & Community Manager to coordinate actions.

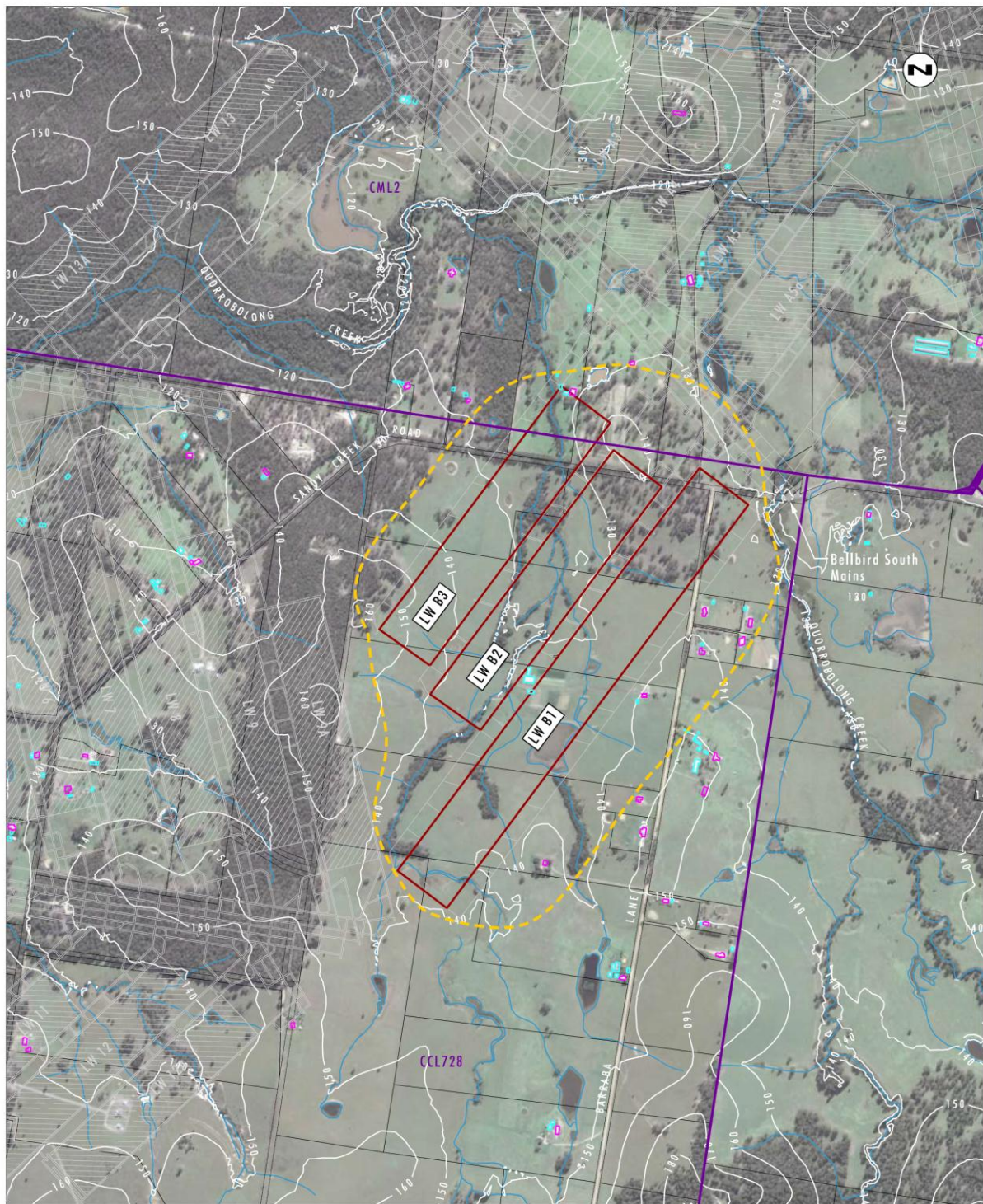


Image Source: Google Earth (2014)  
Data Source: Austar Coal Mine (2015)  
Note: Contour Interval 10m

#### Legend

- LW B3 LWB1-B3 Extraction Plan Longwall Panels
- LW B2 LWB1-B3 Extraction Plan Area
- CCL728 Completed Underground Workings
- CML2 Mining Lease Boundary
- SANDY CREEK ROAD Drainage Line
- 120 Contour
- 120 Dwelling
- 120 Other Structure

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FIGURE 1.2

LWB1-B3 Extraction Plan Area