



AUSTAR COAL MINE



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LWB4 to LWB7 Extraction Plan / Subsidence Risk Assessment

Final Report

June 2017

HMS1379



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This Report was prepared on the basis of information recorded by HMS Consultants Australia Pty Ltd during the risk assessment workshop held on the 6th June 2017, being group consensus opinion of the subsidence risk issues associated with the planned longwall mining.

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TABLE OF CONTENTS

1	EXECUTIVE SUMMARY	1
2	INTRODUCTION	2
3	CONTEXT.....	2
3.1	OWNERSHIP	2
3.2	PURPOSE	2
3.3	SCOPE	2
3.4	OBJECTIVES	3
3.5	EXTRACTION PLAN CHARACTERISTICS AND ASSUMPTIONS	4
3.6	EXISTING AUSTAR ENVIRONMENTAL MANAGEMENT SYSTEM ELEMENTS	4
3.7	EXCLUSIONS & LIMITATIONS	5
3.8	REFERENCES.....	5
4	DEFINITIONS AND ABBREVIATIONS	7
4.1	DEFINITIONS	7
4.2	ABBREVIATIONS.....	8
5	WORKSHOP PARTICIPANTS	9
6	METHOD OF APPROACH	10
6.1	HMS RISK MANAGEMENT MODEL	10
6.2	PRELIMINARIES	11
6.3	ASPECTS AND CONSIDERATIONS	11
6.4	RISK ISSUES IDENTIFIED.....	12
6.5	RISK EVALUATION	12
6.6	RISK REDUCTION STRATEGY	12
6.7	RISK ASSESSMENT FOLLOW-UP	12
7	RESULTS.....	13
7.1	RISK DISTRIBUTION.....	13
7.2	CONSEQUENCE DISTRIBUTION.....	13
8	ACTION PLAN	13
APPENDIX A – Austar Coal Mine EP/SMP LWB4 to LWB7 – Action Plans, June 2017		
APPENDIX B – Austar Coal Mine EP/SMP LWB4 to LWB7 Risk Assessment – Risk Table, June 2017, (Assessment Order)		
APPENDIX C – Austar Coal Mine EP/SMP LWB4 to LWB7 Risk Assessment – Risk Table, June 2017, (Risk Rank Order)		
APPENDIX D – Austar Coal Mine EP/SMP LWB4 to LWB7 Risk Assessment – Risk Table, June 2017, (Consequence Order)		
APPENDIX E – Austar Coal Mine EP/SMP LWB4 to LWB7 Risk Assessment – Yancoal Coal Risk Matrix		
APPENDIX F – NSW Department of Mineral Resources Guideline for Subsidence Management Approvals – Appendix B		
APPENDIX G – Austar Coal Mine EP/SMP LWB4 to LWB7 Risk Assessment - MDG1014 Checklist		

1 EXECUTIVE SUMMARY

HMS Consultants Australia Pty Ltd (HMS) was engaged by Austar Coal Mine (Austar), for the provision of consultancy services in accordance with the scope to facilitate a risk assessment on the extraction of longwall panels - LWB4 to LWB7 at Austar in the Greta Seam utilising traditional longwall methods and associated subsidence risks.

The Extraction Plan covering an area of 288ha is situated just 8 km south west of Cessnock in the Newcastle Coalfields, located in the Lower Hunter Valley in New South Wales.

The top coal caving longwall mining method which has been utilised at Austar in recent times will not be utilised for extracting longwall panels LWB4 to LWB7. These panels will be mined by conventional longwall mining methods.

The risk assessment workshop was conducted at the Austar CHPP Offices on the 6th June 2017. This report incorporates the findings from the workshop which was facilitated on a consultative basis.

The reader should refer to Section 3 for details of the context of the risk assessment, including the scope, assumptions and limitations. Section 7 should be referred to for a summary of results. Risk ranking was undertaken in accordance with the Yancoal Coal Risk Matrix, provided in Appendix E.

Twenty six (26) risk issues were identified in the risk assessment and subsequently assessed by the workshop team.

There were nil (0) “**extreme**” risk issues identified.

One (1) “**High**” risk was identified by the risk assessment team. The “**High**” risk is summarised in *Table 1 – Summary of High Risk*, following:

#	Risk Issue	Existing Controls	Further Actions
2.01.01	<p>Injury to road user due to impact of mine subsidence on sandy Creek Road.</p> <p>Note; speed limit on this road is 100kph</p>	<p>1. Subsidence impact assessment predicts minor and manageable impacts to road surface, even if the strains exceed predictions by a factor of 2.</p> <p>2. Flooding and drainage assessment indicates road is already subject to flooding, and there will be no change in flood hazard category.</p> <p>3. Past experience mining in area shows no impact to Nash Lane or Quorrobolong Road with mining conducted to date.</p> <p>4. Sandy Creek Road has been previously managed during longwall mining by Ellalong Colliery.</p> <p>5. Extensive mining has occurred in the Southern Coalfields at similar depths of cover which have been manageable in a safe and serviceable condition during mining.</p>	<p>1. Pre-mining condition inspection of road</p> <p>2. Subsidence monitoring program to include visual inspection of road surface and survey monitoring</p> <p>3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately.</p> <p>4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.</p>

Table 1 – Summary of High Risk

There were nil (0) risks identified having a potentially “**Catastrophic**” consequence.

Based on the information analysed during this risk assessment and provided the existing controls and further actions are implemented effectively the author concludes that the resultant risk profile for the mining of LWB4 to LWB7 should be acceptable to all relevant stakeholders.

Appendix A presents the further actions in an Action Plan in risk rank order with responsibilities and completion dates assigned.

A full list of risks in assessment order, risk rank order and consequence order respectively are shown in Appendices B-D.

2 INTRODUCTION

HMS Consultants Australia Pty Ltd (HMS) was engaged by Austar for the provision of consultancy services in accordance with the scope to facilitate a risk assessment on the extraction and subsidence risk issues associated with the mining of longwall panels LWB4 to LWB7 at Austar.

Austar management submitted the LWB4 to LWB7 modification application to DPE in May 2017, to:

- Extend the development consent area to cover the four longwall panels
- Include a new Extraction Plan condition to cover the longwall panels LWB4 to LWB7

Approval for the LWB4 to LWB7 modification had not been determined at the time of undertaking this risk assessment.

The risk assessment workshop was conducted at the Austar CHPP Offices on the 6th June 2017.

This report incorporates the findings from the workshop which was facilitated on a consultative basis.

3 CONTEXT

3.1 OWNERSHIP

Austar is owned by Yancoal Australia Ltd. The mine is a deep underground longwall coal mine situated just 8 km south west of Cessnock in the Newcastle Coalfields, located in the lower Hunter Valley in New South Wales, producing coking coal for overseas customers.

3.2 PURPOSE

The purpose of this risk assessment was to identify and assess the surface and subsurface subsidence risks associated with the longwall mining of coal from LWB4 to LWB7 using traditional longwall methods as well as identify and document management strategies and priorities for action to reduce identified risk to an acceptable level. The outcomes are intended to inform development of an Extraction Plan for LWB4 to LWB7.

3.3 SCOPE

The physical scope of this extraction and subsidence risk assessment is delineated by a red outline in *Figure 1 – Austar Extraction Plan Area LWB4 to LWB7*, an area of 288ha, located in Quorrobolong, approximately 3kms east of the township of Ellalong, in the lower Hunter Valley, NSW.

The Austar Extraction Plan Area for longwall panels LWB4 to LWB7 is shown below in *Figure 1 – Austar Extraction Plan Area LWB4 to LWB7*. The study area is bounded by the predicted 20mm subsidence contour that may occur after extraction of longwall panels LWB4 to LWB7 as is delineated by the red line on Figure 1.

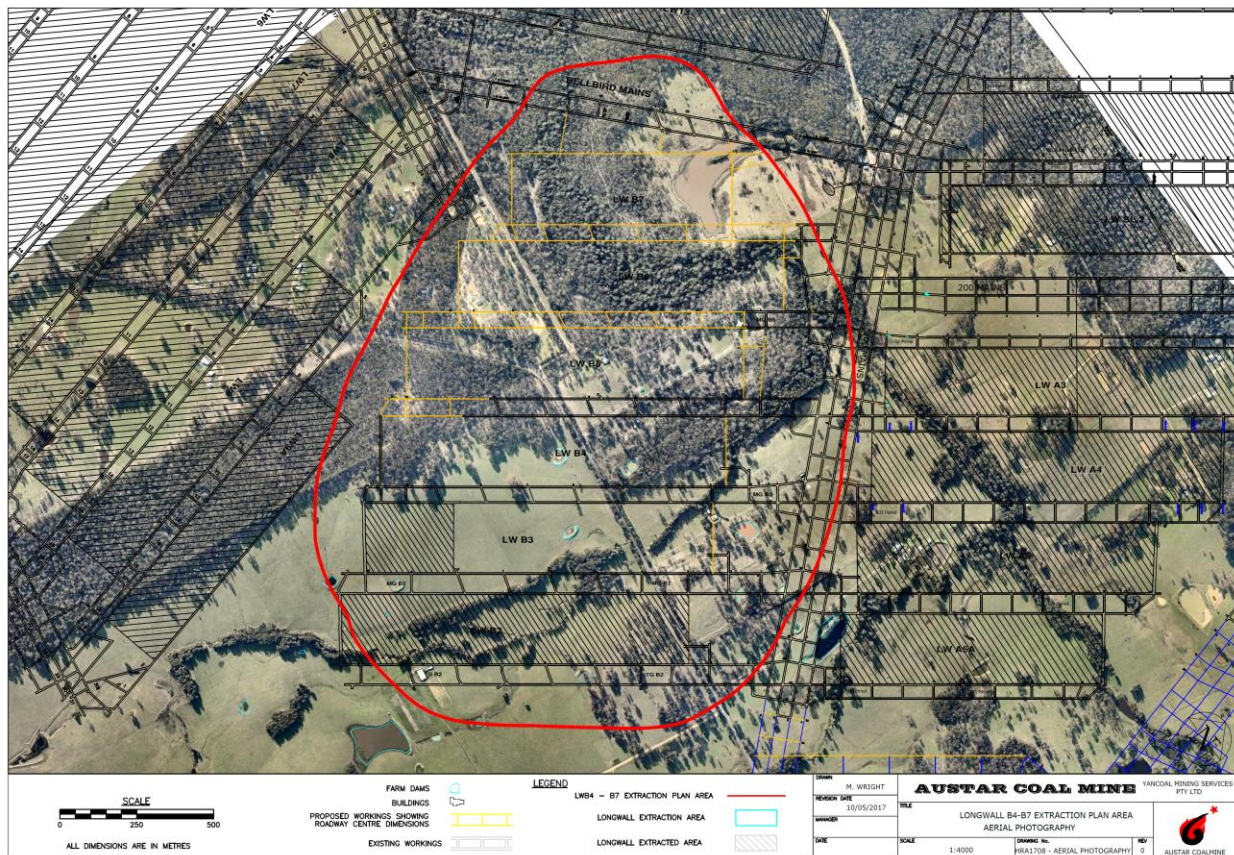


Figure 1 – Austar Extraction Plan Area LWB4 to LWB7.

The risk assessment team considered the subsidence impacts based on the extraction of all four (4) panels. The assessment includes the following considerations as a minimum:

- Identify subsidence risks from all potential sources for the subject area, including:
 - Surface:
 - Surface improvements / structures including private, public and mine assets, roads, tracks, power lines, utilities, etc.
 - Natural features, e.g. watercourses, catchment areas, flora and fauna, drainage patterns and hydrology
 - Features of cultural and heritage significance
 - Sub-surface, geo-hydrology, water table, etc.
 - Other

A detailed scope of the risk issues examined is provided in *Section 6.3 Aspects and Considerations*.

3.4 OBJECTIVES

The objective of the risk assessment was to facilitate a structured process to enable critical and objective challenge of the subject area to assist Austar fulfil its obligations:

- Protecting the health and safety of persons in accordance with the requirements of:
 - Work Health and Safety Act (2011) and Regulations (2011)
 - Work Health and Safety (Mines & Petroleum) Act 2013

- Work Health and Safety (Mines & Petroleum) Regulation 2014
- Relevant Planning, Environmental, and other Legislation
- Welfare of live stock
- By involving relevant key stakeholders, operational personnel, mine management and a qualified and experienced facilitator
- The risk assessment was undertaken in accordance with the Australian & New Zealand Standard for Risk Management AS/NZS ISO 31000:2009 and MDG1010 – Risk Management Handbook for the Mining Industry.

3.5 EXTRACTION PLAN CHARACTERISTICS AND ASSUMPTIONS

The following assumptions apply to this risk assessment:

- Extraction Plan Area is located in the suburbs of Ellalong and Quorrobolong approximately 3kms east of the township of Ellalong
- Extraction is to occur in the Greta Seam
- Extraction Plan Area is 288ha
- The landform within the Extraction Plan Area is situated in the Quorrobolong Creek catchment (a sub catchment to the large Wollombi Brook and ultimately the Hunter River)
- The topography of the Extraction Plan Area is generally characterised by low undulating hills and creek flats associated with Quorrobolong Creek and its unnamed tributaries
- Elevations within the area range from approximately 115 metres to 160 metres Australian Height Datum (AHD)
- Depth of cover over the longwall panel varies between 400m and 505m
- Longwall extraction will be by conventional longwall mining method with an extraction height of approximately 3.4m
- Land use overlying the Extraction Plan Area is primarily rural and agricultural grazing including cattle and goat grazing on private landholdings in the south and east. Land within the north and west of the area is owned by the Crown and Austar and is currently vacant supporting remnant and regrowth vegetation.
- Dominant land use within and surrounding is grazing however includes rural residential, vegetated land and underground mining and coal processing associated with Austar.
- The villages of Kitchener, Abernathy, Ellalong and Paxton are located within 4km north and west of the Extraction Plan Area.
- Watagans National Park is located approx. 4km south and the Werakata State Conservation Area is located approx. 2km north.
- The Extraction Plan Area is located beneath Sandy Creek Road, Crown land, Austar owned land and private landholdings.
- The Extraction Plan Area is located within Consolidated Coal Lease 728 (CCL728), and Consolidated Mining Lease 2 (CML2).

3.6 EXISTING AUSTAR ENVIRONMENTAL MANAGEMENT SYSTEM ELEMENTS

- Environmental Management Strategy
- Environmental Monitoring Program
- Subsidence Management Plans (SMP) for Stage 1 and Stage 2
- Extraction Plan/SMP for Stage 3 LWA7 to LWA10 (including sub plans)

- Extraction Plan for LWB1 to LWB3 (including sub plans)
- Noise and Vibration MP
- Air Quality and Greenhouse Gas MP
- Site Water MP
- Bushfire MP
- Pollution Incident Response MP
- Aboriginal Cultural Heritage MP
- Historic Heritage MP
- Landscape MP – Kitchener SIS
- Mining Operations Plan

3.7 EXCLUSIONS & LIMITATIONS

This risk assessment was limited to the Extraction Plan Area as defined in *Figure 1 – Austar Coal Mine Extraction Plan Area for longwalls LWB4 to LWB7*.

3.8 REFERENCES

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4 DEFINITIONS AND ABBREVIATIONS

4.1 DEFINITIONS

Business/ Project Risk Management

The structured and consistent approach that aligns strategy, process, people, technology and knowledge, with the purpose of evaluating and managing the uncertainties that the entity faces in achieving its values and objectives

Cause

The direct and indirect factors that must be present for a risk, loss or gain to occur

Consequence

The outcome or impact of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. There may be a range of possible outcomes associated with a particular risk issue

Likelihood

The chance of something happening and can be expressed as a qualitative descriptor or probability where sufficient valid data exists

MFL

Maximum Foreseeable Loss (MFL) of a risk issue, generally when all existing controls fail or no controls have been implemented

Project

A temporary process or endeavour which has a clearly defined start and end time, a structured set of activities and tasks, a budget and a specified business case.

Risk Controls

A process, practice or other action that acts to minimise negative risk or enhance positive opportunities

Risk Control Effectiveness

The control effectiveness is a measure of the effectiveness of a particular control in its application for controlling the risk. Engineering or hard controls are more effective than procedural or soft controls

Reasonably Practical (Safe Work Australia – Interpretive Guideline)

In this context, reasonably practicable means that which is, or was at a particular time, reasonably able to be done to ensure health and safety, taking into account and weighing up all relevant matters including: (a) the likelihood of the hazard or the risk concerned occurring (b) the degree of harm that might result from the hazard or the risk (c) what the person concerned knows, or ought reasonably to know, about the hazard or risk, and ways of eliminating or minimising the risk (d) the availability and suitability of ways to eliminate or minimise the risk, and (e) after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

Risk

Risk is the chance of something happening that will have an impact on objectives. (AS/NZS 4360:2004). This may have a positive or negative impact. Risk is measured by the combination of likelihood and consequence and its perceived importance to the organisation.

4.2 ABBREVIATIONS

SMP	Subsidence Management Plan
EP	Extraction Plan
MP	Management Plan
DPE	Department of Planning and Environment
EMP	Environmental Management Plan
BFMP	Built Features Management Plan
PSMP	Public Safety Management Plan
DMMS	Dam Monitoring Management Strategy
GWMP	Ground Water Management Plan
RMP	Road Management Plan
EC	Environment and Community
TARP	Trigger Action Response Plan
SA-NSW	Subsidence Advisory - New South Wales

5 WORKSHOP PARTICIPANTS

A key factor in the effectiveness of the exercise is the availability of quality information and expertise. A workshop team made up of relevant personnel representing Austar, together with an independent specialist and an independent facilitator achieved this.

The role of team members was to provide their expertise, experience and technical knowledge, and to respect that provided by others. Outcomes were dependent upon group consensus.

The facilitator's role was to understand the Client's requirements and offer advice as to the best approach to meet the workshop objectives. He assisted the team by providing a systematic process and maintaining focus on the Scope and Objectives. HMS documented the workshop process and outcomes, and offered post-workshop feedback to the Client and team.

The team members are listed in *Table 2 – Risk Assessment Participants*, following:

Name	Position/ Title	Organisation	6/06/2017
Gary Mulhearn	Environment & Community Manager	Austar Coal Mine	X
Daniel Lee	Regional Registered Surveyor	Yancoal	X
Bill Farnworth	Technical Services Manager	Austar Coal Mine	X
James Barbato	Subsidence Engineer	MSEC	X
David Swan	Managing Director - Facilitator	HMS Consultants Australia	X
Peter Foster	Senior Consultant - Facilitator	HMS Consultants Australia	X

Table 2 – Risk Assessment Participants

6 METHOD OF APPROACH

6.1 HMS RISK MANAGEMENT MODEL

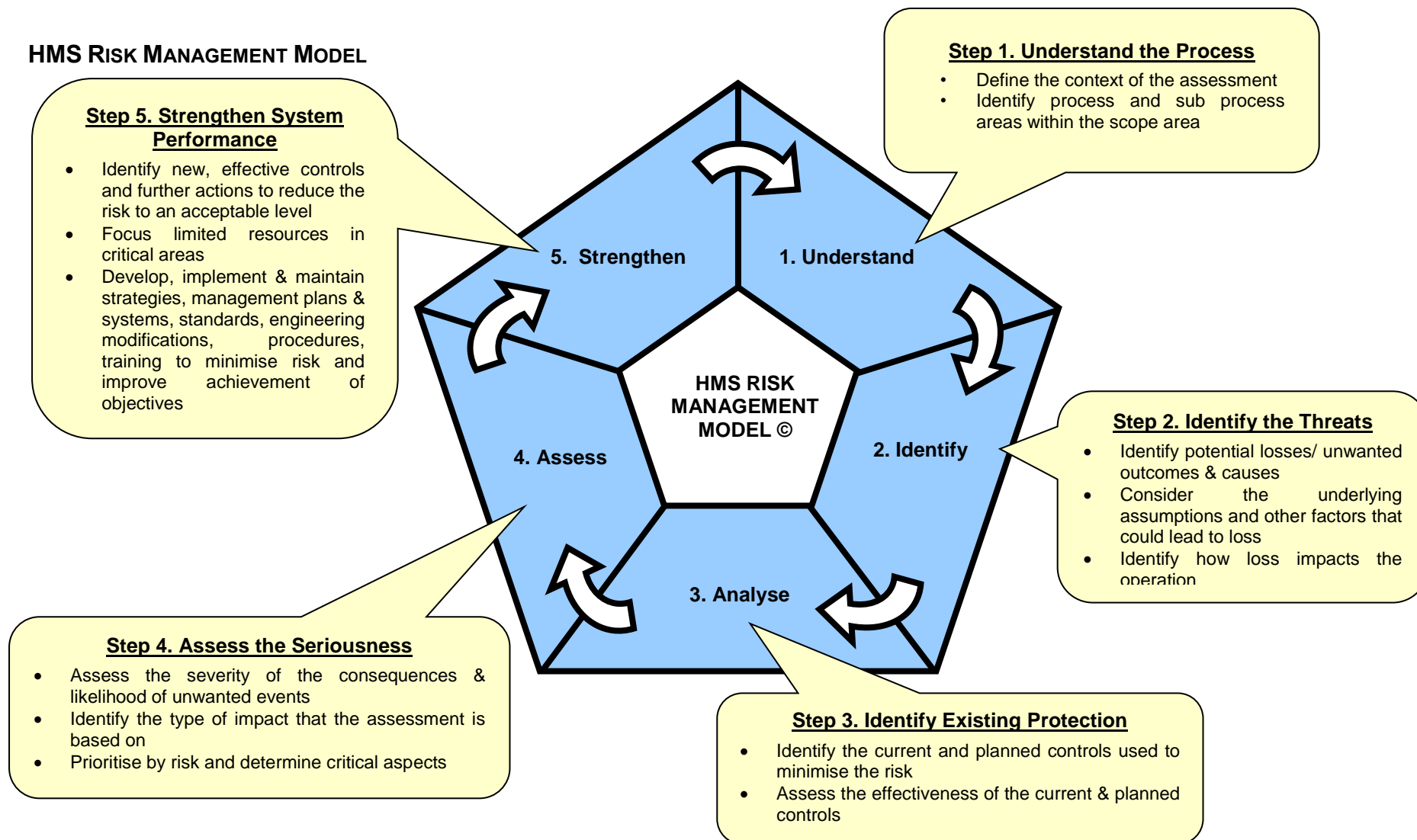


Figure 2 – HMS Risk Management Model

6.2 PRELIMINARIES

At the commencement of the workshop:

- The names, position / title and experience of the workshop team were recorded
- The workshop scope was discussed and agreed upon
- Technical presentations and detailed plans were provided to the workshop team

6.3 ASPECTS AND CONSIDERATIONS

The risk assessment process followed the structure presented in *Table 3 – Aspects and Considerations*, below, being those identified by the team as relevant for this assessment.

Note: The NSW Department of Mineral Resources Guideline for Application for Subsidence Management Approvals – Appendix B listing was utilised as a basis of identification of Aspects and Considerations for consideration for the risk assessment. The list in its entirety is shown in Appendix F – NSW Department of Mineral Resources Guideline for Subsidence Management Approvals – Appendix B.

Aspects	#	Considerations
Natural Features	1.01	Catchment areas – drinking water
	1.02	Creeks
	1.03	Aquifers
	1.04	Steep slopes
	1.05	Land prone to flooding or inundation
	1.06	Water related ecosystems
	1.07	Threatened and protected species
	1.08	Natural vegetation
Public Utilities	2.01	Roads
	2.02	Bridges
	2.03	Culverts
	2.04	Electricity power lines (overhead only in EP area)
	2.05	Telecommunication lines (overhead / underground) and associated plants
Public Amenities	3.01	Nil identified
Farm Land and Facilities	4.01	Agricultural utilisation or agricultural suitability of farm land
	4.02	Farm buildings / sheds
	4.03	Private gas and / or fuel storage
	4.04	Fences
	4.05	Farm dams
	4.06	Wells, bores
	4.07	Any other feature considered significant
Areas of Archaeological and/or Heritage Significance	5.01	Areas of Archaeological and/or Heritage
Permanent Survey Control Marks	6.01	General
Residential Establishment	7.01	Houses
	7.02	Associated structures such as workshops, garages, on-site waste systems, water or gas tanks, swimming pools and tennis courts

Table 3 – Aspects and Considerations

6.4 RISK ISSUES IDENTIFIED

The risk assessment workshop team systematically discussed each consideration to identify potential subsidence risks that may arise from the extraction of longwalls LWB4 to LWB7. Each risk was assessed for its potential impact.

Each potential risk was assessed for subsidence risk that could be caused from traditional longwall mining within the subject area. The underlying causes were then identified and recorded for each identified risk issue.

The risk assessment team identified the existing and planned controls to address the causes and control the risk issue.

6.5 RISK EVALUATION

Risk was determined on a residual risk basis, i.e. in consideration of the effectiveness of the existing controls. Whilst worst case scenarios were discussed by the risk assessment team, the worst case consequence scenario was not necessarily the consequence severity chosen for risk ranking. The risk assessment team used their industry and site experience, as well as their knowledge of the effectiveness of the actual controls, to choose the most appropriate consequence severity for risk ranking. Likelihood was chosen relative to the agreed consequence severity.

The facilitator played a key role in challenging the risk assessment team's perception and tolerance to risk at this stage.

The risk ranking and risk level were chosen using the Yancoal Coal Risk Matrix (see *Appendix E*).

6.6 RISK REDUCTION STRATEGY

The risk ranking and risk level were primary drivers for identifying risk issues where better risk control is required. Following evaluation of the residual risk, the team then identified additional risk controls that should be implemented to reduce each risk to a level as low as reasonably practicable.

6.7 RISK ASSESSMENT FOLLOW-UP

Following completion of this risk assessment, it is recommended that an audit or review of existing controls and additional actions is carried out at an appropriate time to ensure they have been properly implemented to control the identified subsidence risks to an acceptable level.

Appendix A presents a summary of additional controls from this risk assessment in the form of an Action Plan.

7 RESULTS

There were twenty six (26) risk issues identified in the risk assessment workshop.

7.1 RISK DISTRIBUTION

The following *Table 4 – Risk Distribution by Risk Ranking* summarises the risk distribution of all risks by risk rank.

RISK RANKING	No.	%
Extreme	0	0
High	1	4
Moderate	4	15
Low	21	81
TOTAL	26	100

Table 4 – Risk Distribution by Risk Rank

Nil (0) “**Extreme**” risk and one (1) “**High**” risk was identified by the risk assessment team. The “**High**” risk is summarised as:

- Risk Issue - 2.01 Roads – Injury to road user on Sandy Creek Road, due to impact of mine subsidence on road

7.2 CONSEQUENCE DISTRIBUTION

The following *Table 5 – Risk Distribution by Consequence* summarises the risk distribution of all risks by consequence.

CONSEQUENCE	No.	%
Catastrophic	0	0
Major	1	4
Moderate	1	4
Minor	8	31
Insignificant	16	61
TOTAL	26	100

Table 5 – Risk Distribution by Consequence

Nil (0) risk was assessed as having a potentially “**Catastrophic**” consequence. One (1) risk was assessed as having a potentially “**Major**” consequence, it is the same as the risk issue listed in Section 7.1 – Risk Distribution, above.

8 ACTION PLAN

An action plan has been prepared (see Appendix A), listing the status of all additional controls (Actions) from the risk assessment. Actions required are listed in risk ranking priority order, with timing and responsible person indicated for each.

A full listing of all results is shown in Appendices B to D, being the risk registers in assessment, risk rank and consequence order respectively.

APPENDIX A

Austar Coal Mine - Extraction Plan - Subsidence LWB4 - LWB7 Risk Assessment

Action Plans

June 2017

H# Process Sub-process	Risk Issue	Further Actions	Who	When
2.01.01 Public Utilities Roads – Sandy Creek Road	Injury to road user due to impact of mine subsidence on Sandy Creek Road Note; Speed limit is 100kph	1. Pre-mining condition inspection of road 2. Subsidence monitoring program to include visual inspection of road surface and survey monitoring 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
6.01.01 Permanent Survey Control Marks	Use of disturbed State Survey Marks	1. Notify Land and Property Information 2. Requirement to re-establish marks following subsidence 3. Identify Survey Marks in Built Features Management Plan.	WF	
7.01.01 Residential Establishments Houses	Damage to Residences requiring repair	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
7.01.02 Residential Establishments Associated structures such as workshops, garages, on-site waste water systems, water or gas tanks, swimming pools and tennis courts	Damage to sensitive structures	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
2.03.02 Public Utilities Culverts	Sedimentation / potential flooding across road results in injury to road user	1. Pre-mining condition inspection of culverts. 2. Subsidence monitoring program to include visual inspection of culverts and survey monitoring. 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
1.06.01 Natural Features Water related ecosystems	Damage/ loss of riparian vegetation within EP area	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels.	GM	
2.01.02 Public Utilities Roads – Barraba Lane	Injury to road user due to impact of mine subsidence on Barraba Lane	1. Subsidence monitoring program to include visual inspection of road surface and survey monitoring 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
2.03.01 Public Utilities Culverts	Cracking resulting in structural impacts	1. Subsidence monitoring program to include visual inspection and survey monitoring. 2. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
4.05.01 Farm Land and Facilities Private farm dams	Damage to dams and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4.05.02 Farm Land and Facilities Austar CO3d01 dam	Damage to dam and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Land Management Plan and Water Management Plan to include the potential subsidence impacts on the Austar CO3d01 dam.	GM	

H# Process Sub-process	Risk Issue	Further Actions	Who	When
5.01.01 Areas of Archaeological and/or Heritage Significance	Damage to Aboriginal artefacts e.g. artefact scatters	1. Update existing ACHMP for EP area. 2. Include Archaeological considerations in the Land Management Plan	GM	
1.03.01 Natural Features Aquifers	Loss of groundwater resource	1. Water Management Plan to include monitoring of existing licenced bore (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted)	GM	
1.05.01 Natural Features Land prone to flooding or inundation	Increased area of ponding or flooding as a result of subsidence and rainfall event	1. Water Management Plan and Land Management Plan to consider a program to complete drainage remediation works, if required.	GM	
4.06.01 Farm Land and Facilities Wells, bores	Loss of utility of monitoring bore	1. Water Management Plan to include monitoring of existing licenced bores (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted) 4. Built Features Management Plan – to be prepared in consultation with bore owner and SA-NSW.	WF	
1.02.01 Natural Features Creeks and ephemeral drainage lines	Loss of surface water flow in existing creeks	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	
1.02.02 Natural Features Creeks	Increased erosion	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	
1.07.01 Natural Features Threatened and protected species	Damage/ loss of threatened species within EP area	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
1.08.01 Natural Features Natural vegetation	Change in habitat / fauna	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
1.08.02 Natural Features Natural vegetation	Visual impact	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
2.04.01 Public Utilities Electricity power lines (overhead only in EP area)	Damage and / or loss of clearance to 11kV Ausgrid Power line	1. Built Features Management Plan – Ausgrid to be prepared in consultation with Ausgrid and SA-NSW.	WF	

H# Process Sub-process	Risk Issue	Further Actions	Who	When
2.05.01 Public Utilities Telecommunication lines (overhead/ underground) and associated plants	Damage to Telstra Local Copper Cables	1. Built Features Management Plan – Telstra to be prepared in consultation with Telstra and SA-NSW.	WF	
4.01.01 Farm Land and Facilities Agricultural utilisation or agricultural suitability of farm land	Stock safety Temporary loss of utilisation	1. Land Management Plan to address subsidence remediation works. 2. Built Features Management Plan – to be prepared for each landholder and include Land Management Plan remediation methods in consultation with the landholder.	WF	
4.02.01 Farm Land and Facilities Farm buildings / sheds (pig sheds, general rural sheds)	Damage to farm structures	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and the SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access..	WF	
4.03.01 Farm Land and Facilities Private gas and / or fuel storage	Damage and / or loss of gas fuel	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4.04.01 Farm Land and Facilities Fences	Damage to fences and / or gates including resulting loss of livestock	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	

APPENDIX B

Austar Coal Mine - Extraction Plan - Subsidence LWB4 - LWB7 Risk Assessment

Risk Table (Assessment Order)

June 2017

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.01	Catchment areas – drinking water	1.01.01	Nil drinking water catchment identified.										
1	Natural Features	1.02	Creeks and ephemeral drainage lines	1.02.01	Loss of surface water flow in existing creeks	1. Surface cracking 2. Cracking in creek 3. Ponding in creek	1. Quorrobolong Creek and ephemeral drainage lines experience low levels of movement based on subsidence predictions. 2. Predicted landform following subsidence based on maximum predicted subsidence will remain free draining, but locally increased ponding areas along existing drainage lines. 3. Experience from previous mining including beneath Quorrobolong Creek, depth of cracking is relatively minor. Austar has mined by longwall methods beneath approx. 3 km of creeks. No significant cracking or loss of surface flows identified. 4. All streams are ephemeral and have natural soil beds (not rock based).	E	1	D	2	L	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	
1	Natural Features	1.02	Creeks	1.02.02	Increased erosion	1. Changes in grade 2. Localised ground movements	1. Experience from previous mining including beneath Quorrobolong Creek. Austar has mined by longwall methods beneath 3 km of creeks. No increased erosion identified. 2. Changes to flow velocities unlikely to be significant based on modelling. Not expected to result in scouring or erosion.	E	1	D	2	L	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.03	Aquifers	1.03.01	Loss of groundwater resource	1. Connective cracking 2. Depressurisation of aquifers due to mining activities greater than predicted 3. Intersection with geological structures	1. Existing groundwater assessment has been reviewed during EA. 2. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 3. Limited resource not utilised. 4. Past experience mining in area shows no impact to shallow aquifers above mining area. However there has been some drawdown on the Branxton Formation aquifer (which is not being utilised in the LWB4-B7 area). 5. Austar is licenced to extract water from the porous rock aquifer that includes the Branxton Formation.	O	1	C	4	L	1. Water Management Plan to include monitoring of existing licenced bore (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted).	GM	
1	Natural Features	1.04	Steep slopes (1 in 3)	1.04.01	No steep slopes within EP area (apart from very localised areas along creeks and roads)										
1	Natural Features	1.05	Land prone to flooding or inundation	1.05.01	Increased area of ponding or flooding as a result of subsidence and rainfall event	1. Change in landform alters drainage patterns	1. Ephemeral streams 2. Flood and drainage assessment indicates changes to flood regime and remnant ponding are negligible. 3. Existing farm dams on ephemeral drainage line alignments 4. Locally increased ponding areas along existing drainage lines or near some of the farm dams.	O	1	C	4	L	1. Water Management Plan and Land Management Plan to consider a program to complete drainage remediation works, if required.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.06	Water related ecosystems	1.06.01	Damage/ loss of riparian vegetation within EP area	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects riparian vegetation	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or Alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area. 5. Ecological assessment over increased ponding area LWB6-B7 includes assessment of ecological communities over ponding area (riparian Cabbage Gum open forest may be periodically inundated without loss of vegetation).	E	2	D	5	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels.	GM	
1	Natural Features	1.07	Threatened and protected species	1.07.01	Damage/ loss of threatened species within EP area	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects riparian vegetation 3. Subsidence remediation works (surface cracking, erosion, drainage)	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required. 5. Ecological assessment has identified locations of threatened species.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.08	Natural vegetation	1.08.01	Change in habitat / fauna	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects vegetation available for habitat 3. Subsidence remediation works (surface cracking, erosion, drainage) 4. Ecological assessment has identified potential for fauna species to occur within the area.	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required. 5. Significant areas of existing vegetation in surrounding land.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
1	Natural Features	1.08	Natural vegetation	1.08.02	Visual impact	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects vegetation available for habitat 3. Subsidence remediation works (surface cracking, erosion, drainage)	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
2	Public Utilities	2.01	Roads – Sandy Creek Road	2.01.01	Injury to road user due to impact of mine subsidence	1. Cracking 2. Compression heaving of road surface 3. Change in drainage / damage to culverts 4. Flood Inundation increase due to subsidence	1. Subsidence impact assessment predicts minor and manageable impacts to road surface, even if the strains exceed predictions by a factor of 2. 2. Flooding and drainage assessment indicates road is already subject to flooding, and there will be no change in flood hazard category. 3. Past experience mining in area shows no impact to Nash Lane or Quorrobolong Road with mining conducted to date. 4. Sandy Creek Road has been previously managed during longwall mining by Ellalong Colliery. 5. Extensive mining has occurred in the Southern Coalfields at similar depths of cover which have been manageable in a safe and serviceable condition during mining.	P	4	D	14	H	1. Pre-mining condition inspection of road 2. Subsidence monitoring program to include visual inspection of road surface and survey monitoring 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
2	Public Utilities	2.01	Roads – Barraba Lane	2.01.02	Injury to road user due to impact of mine subsidence	1. Cracking 2. Compression heaving of road surface 3. Change in drainage	1. Subsidence impact assessment predicts minor and manageable impacts to road surface (less than 20mm additional vertical subsidence). 2. Past experience mining in area shows no impact to Nash Lane or Quorrobolong Road with mining conducted to date. 3. Extensive mining has occurred in the Southern Coalfields at similar depths of cover which have been manageable in a safe and serviceable condition during mining. 4. Local road (mainly local traffic).	P	2	D	5	L	1. Subsidence monitoring program to include visual inspection of road surface and survey monitoring 2. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 3. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
2	Public Utilities	2.02	Bridges	2.02.01	Impacts on bridge from subsidence (Forbes Bridge, Sandy Creek Road)	Mining induced ground movements	1. Subsidence Impact Assessment completed - Bridge is predicted to receive low levels of subsidence (less than 20mm additional vertical subsidence).	O	1	E	1	L	Nil additional Actions required.		
2	Public Utilities	2.03	Culverts	2.03.01	Cracking resulting in structural impacts	1. Subsidence induced curvatures and strains	1. Subsidence Predictions & Impact Assessment completed 2. Extensive experience in mining beneath culverts in the mining industry and impacts can be managed.	O	2	D	5	L	1. Subsidence monitoring program to include visual inspection and survey monitoring. 2. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
2	Public Utilities	2.03	Culverts	2.03.02	Sedimentation / potential flooding across road results in injury to road user	1. Temporary change of drainage flow due to subsidence induced tilt during extraction	1. Subsidence Predictions & Impact Assessment completed. 2. Extensive experience in mining beneath culverts in the mining industry and impacts can be managed. 3. Flooding and drainage assessments have been conducted.	P	3	E	6	M	1. Pre-mining condition inspection of culverts. 2. Subsidence monitoring program to include visual inspection of culverts and survey monitoring. 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
2	Public Utilities	2.04	Electricity power lines (overhead only in EP area)	2.04.01	Damage and / or loss of clearance to 11kV Ausgrid Power line	1. Subsidence 2. Tilt	1. Timber poles more resilient to subsidence impacts. 2. Industry and Austar experience mining under power lines at similar depth. 3. Site specific subsidence predictions.	O	1	D	2	L	1. Built Features Management Plan – Ausgrid to be prepared in consultation with Ausgrid and SA-NSW.	WF	
2	Public Utilities	2.05	Telecommunication lines (overhead/ underground) and associated plants	2.05.01	Damage to Telstra Local Copper Cables	1. Strains 2. Tilt	1. Industry and Austar experience mining under copper cables at similar depth. 2. Site specific subsidence predictions.	O	1	D	2	L	1. Built Features Management Plan – Telstra to be prepared in consultation with Telstra and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
3	Public Amenities	3.01	Nil Identified	3.01.01											
4	Farm Land and Facilities	4.01	Agricultural utilisation or agricultural suitability of farm land	4.01.01	Stock safety Temporary loss of utilisation	1. Surface cracking and remediation thereof 2. Increase in surface ponding	1. Industry and Austar experience mining at similar depth. 2. Site specific subsidence predictions 3. Gently undulating topography 4. Negligible cracking observed to date in Stages 1-3.	O	1	D	2	L	1. Land Management Plan to address subsidence remediation works. 2. Built Features Management Plan – to be prepared for each landholder and include Land Management Plan remediation methods in consultation with the landholder.	WF	
4	Farm Land and Facilities	4.02	Farm buildings / sheds (pig sheds, general rural sheds)	4.02.01	Damage to farm structures	1. Strains 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths. 2. Site specific subsidence predictions. 3. Farm structures inherently more flexible than brick structures.	O	1	D	2	L	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and the SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
4	Farm Land and Facilities	4.03	Private gas and / or fuel storage	4.03.01	Damage and / or loss of gas fuel	1. Subsidence 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths.	O	1	D	2	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4	Farm Land and Facilities	4.04	Fences	4.04.01	Damage to fences and / or gates including resulting loss of livestock	1. Strain	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions – indicates significant impacts unlikely to fences.	O	1	D	2	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4	Farm Land and Facilities	4.05	Private farm dams	4.05.01	Damage to dams and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Cracking 2. Strains 3. Tilt causes dam overflow to be bypassed	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions.	O	2	D	5	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
4	Farm Land and Facilities	4.05	Austar CO3d01 dam	4.05.02	Damage to dam and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Cracking 2. Strains 3. Tilt causes dam overflow to be bypassed	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions.	E	2	D	5	L	1. Land Management Plan and Water Management Plan to include the potential subsidence impacts on the Austar CO3d01 dam.	GM	
4	Farm Land and Facilities	4.06	Wells, bores	4.06.01	Loss of utility of monitoring bore	1. Connective cracking 2. Depressurisation of aquifers due to mining activities greater than predicted 3. Shearing causes damage to bore	1. Existing groundwater assessment has been reviewed during EA. 2. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 3. There are no operating productive bores in the extraction plan area. 4. Have mined beneath alluvium monitoring bores in Stage 2 to date with nil impacts.	O	1	C	4	L	1. Water Management Plan to include monitoring of existing licenced bores (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted). 4. Built Features Management Plan – to be prepared in consultation with bore owner and SA-NSW.	WF	
4	Farm Land and Facilities	4.07	Any other feature considered significant	4.08.01	None identified										
5	Areas of Archaeological and/or Heritage Significance	5.01	Areas of Archaeological and/or Heritage	5.01.01	Damage to Aboriginal artefacts e.g. artefact scatters	1. Subsidence remediation works 2. Change to drainage causes erosion at archaeological site	1. Aboriginal Cultural Heritage Assessment has been completed including walkover of EP area with Aboriginal Parties and archaeologists. 2. Artefact locations have been identified and mapped. 3. Subsidence assessment indicates artefact scatters are unlikely to be impacted. 4. Consultation with Aboriginal community. 5. Existing approved Aboriginal Cultural Heritage Management Plan (ACHMP) has been prepared in consultation with Registered Aboriginal Parties.	E	2	D	5	L	1. Update existing ACHMP for EP area. 2. Include Archaeological considerations in the Land Management Plan.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
6	Permanent Survey Control Marks	6.01	Permanent Survey Control Marks	6.01.01	Use of disturbed State Survey Marks	1. Disturbance of State Survey Marks due to subsidence	1. Location of marks known	O	1	A	11	M	1. Notify Land and Property Information. 2. Requirement to re-establish marks following subsidence. 3. Identify Survey Marks in Built Features Management Plan.	WF	
7	Residential Establishments	7.01	Houses	7.01.01	Damage to Residences requiring repair	1. Subsidence impacts	1. Subsidence assessment indicates houses are predicted to stay within safe and repairable criteria even if the strains are exceeded by a factor of 2.	O	2	C	8	M	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
7	Residential Establishments	7.02	Associated structures such as workshops, garages, on-site waste water systems, water or gas tanks, swimming pools and tennis courts	7.02.01	Damage to sensitive structures	1. Strains 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths 2. Subsidence assessment indicates all structures within the EP area are predicted to stay within safe and repairable criteria even if the strains are exceeded by a factor of 2.	O	2	C	8	M	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and the SA-NSW. 2. Pre mining inspection by competent building inspector .subject to landholder access.	WF	

APPENDIX C

Austar Coal Mine - Extraction Plan - Subsidence LWB4 - LWB7 Risk Assessment

Risk Table (Risk Rank Order)

June 2017

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
2	Public Utilities	2.01	Roads – Sandy Creek Road	2.01.01	Injury to road user due to impact of mine subsidence	1. Cracking 2. Compression heaving of road surface 3. Change in drainage / damage to culverts 4. Flood Inundation increase due to subsidence	1. Subsidence impact assessment predicts minor and manageable impacts to road surface, even if the strains exceed predictions by a factor of 2. 2. Flooding and drainage assessment indicates road is already subject to flooding, and there will be no change in flood hazard category. 3. Past experience mining in area shows no impact to Nash Lane or Quorrobolong Road with mining conducted to date. 4. Sandy Creek Road has been previously managed during longwall mining by Ellalong Colliery. 5. Extensive mining has occurred in the Southern Coalfields at similar depths of cover which have been manageable in a safe and serviceable condition during mining.	P	4	D	14	H	1. Pre-mining condition inspection of road 2. Subsidence monitoring program to include visual inspection of road surface and survey monitoring 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
6	Permanent Survey Control Marks	6.01	Permanent Survey Control Marks	6.01.01	Use of disturbed State Survey Marks	1. Disturbance of State Survey Marks due to subsidence	1. Location of marks known	O	1	A	11	M	1. Notify Land and Property Information. 2. Requirement to re-establish marks following subsidence. 3. Identify Survey Marks in Built Features Management Plan.	WF	
7	Residential Establishments	7.01	Houses	7.01.01	Damage to Residences requiring repair	1. Subsidence impacts	1. Subsidence assessment indicates houses are predicted to stay within safe and repairable criteria even if the strains are exceeded by a factor of 2.	O	2	C	8	M	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
7	Residential Establishments	7.02	Associated structures such as workshops, garages, on-site waste water systems, water or gas tanks, swimming pools and tennis courts	7.02.01	Damage to sensitive structures	1. Strains 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths 2. Subsidence assessment indicates all structures within the EP area are predicted to stay within safe and repairable criteria even if the strains are exceeded by a factor of 2.	O	2	C	8	M	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and the SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
2	Public Utilities	2.03	Culverts	2.03.02	Sedimentation / potential flooding across road results in injury to road user	1. Temporary change of drainage flow due to subsidence induced tilt during extraction	1. Subsidence Predictions & Impact Assessment completed. 2. Extensive experience in mining beneath culverts in the mining industry and impacts can be managed. 3. Flooding and drainage assessments have been conducted.	P	3	E	6	M	1. Pre-mining condition inspection of culverts. 2. Subsidence monitoring program to include visual inspection of culverts and survey monitoring. 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.06	Water related ecosystems	1.06.01	Damage/ loss of riparian vegetation within EP area	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects riparian vegetation	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or Alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area. 5. Ecological assessment over increased ponding area LWB6-B7 includes assessment of ecological communities over ponding area (riparian Cabbage Gum open forest may be periodically inundated without loss of vegetation).	E	2	D	5	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels.	GM	
2	Public Utilities	2.01	Roads – Barraba Lane	2.01.02	Injury to road user due to impact of mine subsidence	1. Cracking 2. Compression heaving of road surface 3. Change in drainage	1. Subsidence impact assessment predicts minor and manageable impacts to road surface (less than 20mm additional vertical subsidence). 2. Past experience mining in area shows no impact to Nash Lane or Quorrobolong Road with mining conducted to date. 3. Extensive mining has occurred in the Southern Coalfields at similar depths of cover which have been manageable in a safe and serviceable condition during mining. 4. Local road (mainly local traffic).	P	2	D	5	L	1. Subsidence monitoring program to include visual inspection of road surface and survey monitoring. 2. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 3. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
2	Public Utilities	2.03	Culverts	2.03.01	Cracking resulting in structural impacts	1. Subsidence induced curvatures and strains	1. Subsidence Predictions & Impact Assessment completed 2. Extensive experience in mining beneath culverts in the mining industry and impacts can be managed.	O	2	D	5	L	1. Subsidence monitoring program to include visual inspection and survey monitoring. 2. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
4	Farm Land and Facilities	4.05	Private farm dams	4.05.01	Damage to dams and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Cracking 2. Strains 3. Tilt causes dam overflow to be bypassed	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions.	O	2	D	5	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4	Farm Land and Facilities	4.05	Austar CO3d01 dam	4.05.02	Damage to dam and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Cracking 2. Strains 3. Tilt causes dam overflow to be bypassed	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions.	E	2	D	5	L	1. Land Management Plan and Water Management Plan to include the potential subsidence impacts on the Austar CO3d01 dam.	GM	
5	Areas of Archaeological and/or Heritage Significance	5.01	Areas of Archaeological and/or Heritage	5.01.01	Damage to Aboriginal artefacts e.g. artefact scatters	1. Subsidence remediation works 2. Change to drainage causes erosion at archaeological site	1. Aboriginal Cultural Heritage Assessment has been completed including walkover of EP area with Aboriginal Parties and archaeologists. 2. Artefact locations have been identified and mapped. 3. Subsidence assessment indicates artefact scatters are unlikely to be impacted. 4. Consultation with Aboriginal community. 5. Existing approved Aboriginal Cultural Heritage Management Plan (ACHMP) has been prepared in consultation with Registered Aboriginal Parties.	E	2	D	5	L	1. Update existing ACHMP for EP area. 2. Include Archaeological considerations in the Land Management Plan.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.03	Aquifers	1.03.01	Loss of groundwater resource	1. Connective cracking 2. Depressurisation of aquifers due to mining activities greater than predicted 3. Intersection with geological structures	1. Existing groundwater assessment has been reviewed during EA. 2. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 3. Limited resource not utilised. 4. Past experience mining in area shows no impact to shallow aquifers above mining area. However there has been some drawdown on the Branxton Formation aquifer (which is not being utilised in the LWB4-B7 area). 5. Austar is licenced to extract water from the porous rock aquifer that includes the Branxton Formation.	O	1	C	4	L	1. Water Management Plan to include monitoring of existing licenced bore (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted).	GM	
1	Natural Features	1.05	Land prone to flooding or inundation	1.05.01	Increased area of ponding or flooding as a result of subsidence and rainfall event	1. Change in landform alters drainage patterns	1. Ephemeral streams 2. Flood and drainage assessment indicates changes to flood regime and remnant ponding are negligible. 3. Existing farm dams on ephemeral drainage line alignments 4. Locally increased ponding areas along existing drainage lines or near some of the farm dams.	O	1	C	4	L	1. Water Management Plan to consider a program to complete drainage remediation works, if required.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
4	Farm Land and Facilities	4.06	Wells, bores	4.06.01	Loss of utility of monitoring bore	1. Connective cracking 2. Depressurisation of aquifers due to mining activities greater than predicted 3. Shearing causes damage to bore	1. Existing groundwater assessment has been reviewed during EA. 2. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 3. There are no operating productive bores in the extraction plan area. 4. Have mined beneath alluvium monitoring bores in Stage 2 to date with nil impacts.	O	1	C	4	L	1. Water Management Plan to include monitoring of existing licenced bores (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted). 4. Built Features Management Plan – to be prepared in consultation with bore owner and SA-NSW.	WF	
1	Natural Features	1.02	Creeks and ephemeral drainage lines	1.02.01	Loss of surface water flow in existing creeks	1. Surface cracking 2. Cracking in creek 3. Ponding in creek	1. Quorrobolong Creek and ephemeral drainage lines experience low levels of movement based on subsidence predictions. 2. Predicted landform following subsidence based on maximum predicted subsidence will remain free draining, but locally increased ponding areas along existing drainage lines. 3. Experience from previous mining including beneath Quorrobolong Creek, depth of cracking is relatively minor. Austar has mined by longwall methods beneath approx. 3 km of creeks. No significant cracking or loss of surface flows identified. 4. All streams are ephemeral and have natural soil beds (not rock based).	E	1	D	2	L	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.02	Creeks	1.02.02	Increased erosion	1. Changes in grade 2. Localised ground movements	1. Experience from previous mining including beneath Quorrobolong Creek. Austar has mined by longwall methods beneath 3 km of creeks. No increased erosion identified. 2. Changes to flow velocities unlikely to be significant based on modelling. Not expected to result in scouring or erosion.	E	1	D	2	L	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	
1	Natural Features	1.07	Threatened and protected species	1.07.01	Damage/ loss of threatened species within EP area	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects riparian vegetation 3. Subsidence remediation works (surface cracking, erosion, drainage)	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required. 5. Ecological assessment has identified locations of threatened species.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.08	Natural vegetation	1.08.01	Change in habitat / fauna	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects vegetation available for habitat 3. Subsidence remediation works (surface cracking, erosion, drainage) 4. Ecological assessment has identified potential for fauna species to occur within the area.	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required. 5. Significant areas of existing vegetation in surrounding land.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
1	Natural Features	1.08	Natural vegetation	1.08.02	Visual impact	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects vegetation available for habitat 3. Subsidence remediation works (surface cracking, erosion, drainage)	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
2	Public Utilities	2.04	Electricity power lines (overhead only in EP area)	2.04.01	Damage and / or loss of clearance to 11kV Ausgrid Power line	1. Subsidence 2. Tilt	1. Timber poles more resilient to subsidence impacts. 2. Industry and Austar experience mining under power lines at similar depth. 3. Site specific subsidence predictions.	O	1	D	2	L	1. Built Features Management Plan – Ausgrid to be prepared in consultation with Ausgrid and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
2	Public Utilities	2.05	Telecommunication lines (overhead/ underground) and associated plants	2.05.01	Damage to Telstra Local Copper Cables	1. Strains 2. Tilt	1. Industry and Austar experience mining under copper cables at similar depth. 2. Site specific subsidence predictions.	O	1	D	2	L	1. Built Features Management Plan – Telstra to be prepared in consultation with Telstra and SA-NSW.	WF	
4	Farm Land and Facilities	4.01	Agricultural utilisation or agricultural suitability of farm land	4.01.01	Stock safety Temporary loss of utilisation	1. Surface cracking and remediation thereof 2. Increase in surface ponding	1. Industry and Austar experience mining at similar depth. 2. Site specific subsidence predictions 3. Gently undulating topography 4. Negligible cracking observed to date in Stages 1-3.	O	1	D	2	L	1. Land Management Plan to address subsidence remediation works. 2. Built Features Management Plan – to be prepared for each landholder and include Land Management Plan remediation methods in consultation with the landholder.	WF	
4	Farm Land and Facilities	4.02	Farm buildings / sheds (pig sheds, general rural sheds)	4.02.01	Damage to farm structures	1. Strains 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths. 2. Site specific subsidence predictions. 3. Farm structures inherently more flexible than brick structures.	O	1	D	2	L	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and the SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
4	Farm Land and Facilities	4.03	Private gas and / or fuel storage	4.03.01	Damage and / or loss of gas fuel	1. Subsidence 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths.	O	1	D	2	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4	Farm Land and Facilities	4.04	Fences	4.04.01	Damage to fences and / or gates including resulting loss of livestock	1. Strain	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions – indicates significant impacts unlikely to fences.	O	1	D	2	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
2	Public Utilities	2.02	Bridges	2.02.01	Impacts on bridge from subsidence (Forbes Bridge, Sandy Creek Road)	Mining induced ground movements	1. Subsidence Impact Assessment completed - Bridge is predicted to receive low levels of subsidence (less than 20mm additional vertical subsidence).	O	1	E	1	L	Nil additional Actions required.		

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.01	Catchment areas – drinking water	1.01.01	Nil drinking water catchment identified.										
1	Natural Features	1.04	Steep slopes (1 in 3)	1.04.01	No steep slopes within EP area (apart from very localised areas along creeks and roads)										
3	Public Amenities	3.01	Nil Identified	3.01.01											
4	Farm Land and Facilities	4.07	Any other feature considered significant	4.07.01	None identified										

APPENDIX D

Austar Coal Mine - Extraction Plan - Subsidence LWB4 - LWB7 Risk Assessment

Risk Table (Consequence Order)

June 2017

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
2	Public Utilities	2.01	Roads – Sandy Creek Road	2.01.01	Injury to road user due to impact of mine subsidence	1. Cracking 2. Compression heaving of road surface 3. Change in drainage / damage to culverts 4. Flood Inundation increase due to subsidence	1. Subsidence impact assessment predicts minor and manageable impacts to road surface, even if the strains exceed predictions by a factor of 2. 2. Flooding and drainage assessment indicates road is already subject to flooding, and there will be no change in flood hazard category. 3. Past experience mining in area shows no impact to Nash Lane or Quorrobolong Road with mining conducted to date. 4. Sandy Creek Road has been previously managed during longwall mining by Ellalong Colliery. 5. Extensive mining has occurred in the Southern Coalfields at similar depths of cover which have been manageable in a safe and serviceable condition during mining.	P	4	D	14	H	1. Pre-mining condition inspection of road 2. Subsidence monitoring program to include visual inspection of road surface and survey monitoring 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
2	Public Utilities	2.03	Culverts	2.03.02	Sedimentation / potential flooding across road results in injury to road user	1. Temporary change of drainage flow due to subsidence induced tilt during extraction	1. Subsidence Predictions & Impact Assessment completed. 2. Extensive experience in mining beneath culverts in the mining industry and impacts can be managed. 3. Flooding and drainage assessments have been conducted.	P	3	E	6	M	1. Pre-mining condition inspection of culverts. 2. Subsidence monitoring program to include visual inspection of culverts and survey monitoring. 3. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 4. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.06	Water related ecosystems	1.06.01	Damage/ loss of riparian vegetation within EP area	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects riparian vegetation	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or Alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area. 5. Ecological assessment over increased ponding area LWB6-B7 includes assessment of ecological communities over ponding area (riparian Cabbage Gum open forest may be periodically inundated without loss of vegetation).	E	2	D	5	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels.	GM	
2	Public Utilities	2.01	Roads – Barraba Lane	2.01.02	Injury to road user due to impact of mine subsidence	1. Cracking 2. Compression heaving of road surface 3. Change in drainage	1. Subsidence impact assessment predicts minor and manageable impacts to road surface (less than 20mm additional vertical subsidence). 2. Past experience mining in area shows no impact to Nash Lane or Quorrobolong Road with mining conducted to date. 3. Extensive mining has occurred in the Southern Coalfields at similar depths of cover which have been manageable in a safe and serviceable condition during mining. 4. Local road (mainly local traffic).	P	2	D	5	L	1. Subsidence monitoring program to include visual inspection of road surface and survey monitoring 2. Public Safety Management Plan to include mitigation of identified public safety hazards immediately. 3. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
2	Public Utilities	2.03	Culverts	2.03.01	Cracking resulting in structural impacts	1. Subsidence induced curvatures and strains	1. Subsidence Predictions & Impact Assessment completed 2. Extensive experience in mining beneath culverts in the mining industry and impacts can be managed.	O	2	D	5	L	1. Subsidence monitoring program to include visual inspection and survey monitoring. 2. Built Features Management Plan – Council to be prepared in consultation with Cessnock City Council and SA-NSW.	WF	
4	Farm Land and Facilities	4.05	Private farm dams	4.05.01	Damage to dams and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Cracking 2. Strains 3. Tilt causes dam overflow to be bypassed	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions.	O	2	D	5	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4	Farm Land and Facilities	4.05	Austar CO3d01 dam	4.05.02	Damage to dam and water reticulation systems resulting in loss of serviceability / integrity of dam wall	1. Cracking 2. Strains 3. Tilt causes dam overflow to be bypassed	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions.	E	2	D	5	L	1. Land Management Plan and Water Management Plan to include the potential subsidence impacts on the Austar CO3d01 dam.	GM	
5	Areas of Archaeological and/or Heritage Significance	5.01	Areas of Archaeological and/or Heritage	5.01.01	Damage to Aboriginal artefacts e.g. artefact scatters	1. Subsidence remediation works 2. Change to drainage causes erosion at archaeological site	1. Aboriginal Cultural Heritage Assessment has been completed including walkover of EP area with Aboriginal Parties and archaeologists. 2. Artefact locations have been identified and mapped. 3. Subsidence assessment indicates artefact scatters are unlikely to be impacted. 4. Consultation with Aboriginal community. 5. Existing approved Aboriginal Cultural Heritage Management Plan (ACHMP) has been prepared in consultation with Registered Aboriginal Parties.	E	2	D	5	L	1. Update existing ACHMP for EP area. 2. Include Archaeological considerations in the Land Management Plan.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
7	Residential Establishments	7.01	Houses	7.01.01	Damage to Residences requiring repair	1. Subsidence impacts	1. Subsidence assessment indicates houses are predicted to stay within safe and repairable criteria even if the strains are exceeded by a factor of 2.	O	2	C	8	M	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
7	Residential Establishments	7.02	Associated structures such as workshops, garages, on-site waste water systems, water or gas tanks, swimming pools and tennis courts	7.02.01	Damage to sensitive structures	1. Strains 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths 2. Subsidence assessment indicates all structures within the EP area are predicted to stay within safe and repairable criteria even if the strains are exceeded by a factor of 2.	O	2	C	8	M	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and the SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
1	Natural Features	1.02	Creeks and ephemeral drainage lines	1.02.01	Loss of surface water flow in existing creeks	1. Surface cracking 2. Cracking in creek 3. Ponding in creek	1. Quorrobolong Creek and ephemeral drainage lines experience low levels of movement based on subsidence predictions. 2. Predicted landform following subsidence based on maximum predicted subsidence will remain free draining, but locally increased ponding areas along existing drainage lines. 3. Experience from previous mining including beneath Quorrobolong Creek, depth of cracking is relatively minor. Austar has mined by longwall methods beneath approx. 3 km of creeks. No significant cracking or loss of surface flows identified. 4. All streams are ephemeral and have natural soil beds (not rock based).	E	1	D	2	L	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.02	Creeks	1.02.02	Increased erosion	1. Changes in grade 2. Localised ground movements	1. Experience from previous mining including beneath Quorrobolong Creek. Austar has mined by longwall methods beneath 3 km of creeks. No increased erosion identified. 2. Changes to flow velocities unlikely to be significant based on modelling. Not expected to result in scouring or erosion.	E	1	D	2	L	1. Visual inspections, remediation as per the Land Management Plan and Water Management Plan.	GM	
1	Natural Features	1.03	Aquifers	1.03.01	Loss of groundwater resource	1. Connective cracking 2. Depressurisation of aquifers due to mining activities greater than predicted 3. Intersection with geological structures	1. Existing groundwater assessment has been reviewed during EA. 2. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 3. Limited resource not utilised. 4. Past experience mining in area shows no impact to shallow aquifers above mining area. However there has been some drawdown on the Branxton Formation aquifer (which is not being utilised in the LWB4-B7 area). 5. Austar is licenced to extract water from the porous rock aquifer that includes the Branxton Formation.	O	1	C	4	L	1. Water Management Plan to include monitoring of existing licenced bore (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted).	GM	
1	Natural Features	1.05	Land prone to flooding or inundation	1.05.01	Increased area of ponding or flooding as a result of subsidence and rainfall event	1. Change in landform alters drainage patterns	1. Ephemeral streams 2. Flood and drainage assessment indicates changes to flood regime and remnant ponding are negligible. 3. Existing farm dams on ephemeral drainage line alignments 4. Locally increased ponding areas along existing drainage lines or near some of the farm dams.	O	1	C	4	L	1. Water Management Plan to consider a program to complete drainage remediation works, if required.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.07	Threatened and protected species	1.07.01	Damage/ loss of threatened species within EP area	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects riparian vegetation 3. Subsidence remediation works (surface cracking, erosion, drainage)	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required. 5. Ecological assessment has identified locations of threatened species.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
1	Natural Features	1.08	Natural vegetation	1.08.01	Change in habitat / fauna	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects vegetation available for habitat 3. Subsidence remediation works (surface cracking, erosion, drainage) 4. Ecological assessment has identified potential for fauna species to occur within the area.	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required. 5. Significant areas of existing vegetation in surrounding land.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
1	Natural Features	1.08	Natural vegetation	1.08.02	Visual impact	1. Loss of available groundwater / surface water 2. Increase in surface water ponding affects vegetation available for habitat 3. Subsidence remediation works (surface cracking, erosion, drainage)	1. Flood and drainage assessment indicates changes to flood regime are negligible 2. Existing groundwater assessment has been reviewed during EA. 3. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 4. Past experience mining in area shows no impact to alluvial aquifers above mining area, and no subsidence remediation works have been required.	E	1	D	2	L	1. Biodiversity Management Plan including monitoring of riparian vegetation in possible ponding area, and remediation strategy if impact due to mining is identified. 2. Water Management Plan to include monitoring of alluvial groundwater levels. 3. Land Management Plan to address subsidence remediation works if required.	GM	
2	Public Utilities	2.02	Bridges	2.02.01	Impacts on bridge from subsidence (Forbes Bridge, Sandy Creek Road)	Mining induced ground movements	1. Subsidence Impact Assessment completed - Bridge is predicted to receive low levels of subsidence (less than 20mm additional vertical subsidence).	O	1	E	1	L	Nil additional Actions required.		
2	Public Utilities	2.04	Electricity power lines (overhead only in EP area)	2.04.01	Damage and / or loss of clearance to 11kV Ausgrid Power line	1. Subsidence 2. Tilt	1. Timber poles more resilient to subsidence impacts. 2. Industry and Austar experience mining under power lines at similar depth. 3. Site specific subsidence predictions.	O	1	D	2	L	1. Built Features Management Plan – Ausgrid to be prepared in consultation with Ausgrid and SA-NSW.	WF	
2	Public Utilities	2.05	Telecommunication lines (overhead/ underground) and associated plants	2.05.01	Damage to Telstra Local Copper Cables	1. Strains 2. Tilt	1. Industry and Austar experience mining under copper cables at similar depth. 2. Site specific subsidence predictions.	O	1	D	2	L	1. Built Features Management Plan – Telstra to be prepared in consultation with Telstra and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
4	Farm Land and Facilities	4.01	Agricultural utilisation or agricultural suitability of farm land	4.01.01	Stock safety Temporary loss of utilisation	1. Surface cracking and remediation thereof 2. Increase in surface ponding	1. Industry and Austar experience mining at similar depth. 2. Site specific subsidence predictions 3. Gently undulating topography 4. Negligible cracking observed to date in Stages 1-3.	O	1	D	2	L	1. Land Management Plan to address subsidence remediation works. 2. Built Features Management Plan – to be prepared for each landholder and include Land Management Plan remediation methods in consultation with the landholder.	WF	
4	Farm Land and Facilities	4.02	Farm buildings / sheds (pig sheds, general rural sheds)	4.02.01	Damage to farm structures	1. Strains 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths. 2. Site specific subsidence predictions. 3. Farm structures inherently more flexible than brick structures.	O	1	D	2	L	1. Built Features Management Plan – to be prepared for each landholder in consultation with the landholder and the SA-NSW. 2. Pre mining inspection by competent building inspector subject to landholder access.	WF	
4	Farm Land and Facilities	4.03	Private gas and / or fuel storage	4.03.01	Damage and / or loss of gas fuel	1. Subsidence 2. Tilt	1. Previous industry and Austar experience with mining under similar structures at similar depths.	O	1	D	2	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	
4	Farm Land and Facilities	4.04	Fences	4.04.01	Damage to fences and / or gates including resulting loss of livestock	1. Strain	1. Industry and Austar experience mining under fences at similar depth. 2. Site specific subsidence predictions – indicates significant impacts unlikely to fences.	O	1	D	2	L	1. Built Features Management Plan – to be prepared in consultation with landowner and SA-NSW.	WF	

P#	Process	S#	Sub-process	H#	Risk Issue	Causes	Existing Controls	Loss Type	Consequence	Likelihood	Risk Rank	Risk Level	Further Actions	Who	When
4	Farm Land and Facilities	4.06	Wells, bores	4.06.01	Loss of utility of monitoring bore	1. Connective cracking 2. Depressurisation of aquifers due to mining activities greater than predicted 3. Shearing causes damage to bore	1. Existing groundwater assessment has been reviewed during EA. 2. High depths of cover and narrow longwalls (width to height ratio) reduce potential for cracking to aquifers within Branxton Formation or alluvium. 3. There are no operating productive bores in the extraction plan area. 4. Have mined beneath alluvium monitoring bores in Stage 2 to date with nil impacts.	O	1	C	4	L	1. Water Management Plan to include monitoring of existing licenced bores (where access is granted). 2. Continued monitoring of existing groundwater monitoring bores over Stage 2 area and LWB1-B3 area. 3. Establishment of one additional groundwater monitoring bore in alluvium over the extraction area (where access is granted). 4. Built Features Management Plan – to be prepared in consultation with bore owner and SA-NSW.	WF	
6	Permanent Survey Control Marks	6.01	Permanent Survey Control Marks	6.01.01	Use of disturbed State Survey Marks	1. Disturbance of State Survey Marks due to subsidence	1. Location of marks known	O	1	A	11	M	1. Notify Land and Property Information. 2. Requirement to re-establish marks following subsidence. 3. Identify Survey Marks in Built Features Management Plan.	WF	
1	Natural Features	1.01	Catchment areas – drinking water	1.01.01	Nil drinking water catchment identified.										
1	Natural Features	1.04	Steep slopes (1 in 3)	1.04.01	No steep slopes within EP area (apart from very localised areas along creeks and roads)										
3	Public Amenities	3.01	Nil Identified	3.01.01											
4	Farm Land and Facilities	4.07	Any other feature considered significant	4.08.01	None identified										

APPENDIX E

Austar Coal Mine - Extraction Plan - Subsidence LWB4 - LWB7 Risk Assessment

Yancoal Coal Risk Matrix

June 2017



Yancoal Risk Matrix

		Effect / Consequence				
Loss Type		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
(P) Harm to People		Slight injury or health effects – first aid / minor or no medical treatment level	Minor injury or health effects – restricted work or minor lost time injury	Serious bodily injury or health effects – major lost time injury / permanent disability	Single fatality, permanent total disabilities	Multiple fatalities
(E) Environmental Impact		Environmental nuisance – trivial or negligible, short term impact to area of low significance, minimal or no physical remediation required No regulation. Cost < \$1,000	Minor environmental harm – short term impact to area of limited local significance, limited physical remediation Reportable Breach / Minor Non Compliance, potential warning notice, other notices (infringement / prosecution) unlikely. Costs \$1,000 - \$5,000	Serious environmental harm – medium term impact to area of local conservation value, medium term physical remediation, actual community health impacts or significance or pollution or contamination Infringement Notice but Prosecution unlikely Costs \$5k - \$50k	Major environmental harm – long term reversible impacts to area of regional conservation significance, health statistics in community alter as a result of this incident or pollution or contamination Prosecution Costs \$50k - \$500k	Extreme environmental harm – irreversible impacts on environmental values of extreme & widespread areas, or those of national conservation significance, community fatalities or pollution or contamination Prosecution, License revoked Costs > \$500k
(O) Asset Damage and Other Consequential Losses		Slight damage < \$0.1M or < 1 shift disruption to operation	Minor damage \$0.1M - \$1.0M or 1 Shift – 1 day disruption to operation	Local damage \$1.0M - \$5.0M or 1 day - 1 week disruption to operation	Major damage \$5.0M - \$25.0M or 1 week – 1 month Partial loss of operation	Extreme damage > \$25.0M or > 1 month Substantial or total loss of operation
(R) Impact on Reputation		Slight impact – Public awareness may exist but no public concern Isolated compliance failure – no brand damage	Limited impact – Some local public concern Intervention of regulating authority – minimal brand damage	Considerable impact – Regional public concern Major compliance failure involving fines – medium brand damage	National impact – National public concern Temporary withdrawal of license to operate – significant brand damage	International impact – International public attention Loss of shareholder confidence – irreparable brand damage
Likelihood	Likelihood Examples (Guide)		Level of Risk = (Likelihood X Effect/Consequence)			
A (Almost Certain)	Likely that the unwanted event could occur several times per year at this location		11 (M)	16 (H)	20 (H)	23 (E)
B (Likely)	Likely that the unwanted event could occur several times per year in the Australian mining industry; or could happen annually		7 (M)	12 (M)	17 (H)	21 (E)
C (Possible)	The unwanted event could well have occurred in the Australian mining industry at some time in the past 10 years		4 (L)	8 (M)	13 (H)	18 (H)
D (Unlikely)	The unwanted event has happened in the Australian mining industry at some time; or could happen in 50 years		2 (L)	5 (L)	9 (M)	14 (H)
E (Rare)	The unwanted event has never been known to occur in the Australian mining industry; or is highly unlikely that it could ever occur		1 (L)	3 (L)	6 (M)	10 (M)
Risk Rating	Risk Level	Risk Management	Reporting Timeframe – if incident		Investigation if Incident Occurs	Action Development Timeframe
21 - 25	(E) Extreme	Stop operations or don't proceed with activity (Make Safe). Immediate intervention required from Regional/or General/or Operations Manager.	Site to operations manager - immediately Operations Manager to Regional General Manager - immediately Regional General Manager to CEO - immediately CEO to Chairman/s Board & HSEC – immediately		External facilitated investigation	Within 24 hrs w/ copy "entered" for CEO/Regional/General Manager monitoring of status.
13 - 20	(H) High	Imperative to eliminate or reduce risk by introduction of controls. Do not proceed with activity until reviewed by Regional/or General/or Operations Manager.	CEO – within 48 hrs. Regional/General Manager - within 24 hrs. Operations Manager – within 12 hrs		Internal / external facilitator	Within 7 days w/ copy "entered" for Regional/General manager monitoring of status
6 - 12	(M) Moderate	Corrective action to be determined. Do not proceed without authorisation from Supervisor.	Operations Manager - within 24 hrs. Department Manager – within 12 hrs.		Detailed investigation including hard controls	Within 14 days
1 - 5	(L) Low	Safe to continue activity once risk is minimised.	Department Manager - within 48 hrs.		Consider further actions	Within 30 days

APPENDIX F

Austar Coal Mine - Extraction Plan – Subsidence LWB4 - LWB7 Risk Assessment

June 2017

NSW Department of Mineral Resources Guideline for Subsidence Management Approvals – Appendix B

Aspect	#	Consideration
Natural Features	1.01	Catchment areas and declared Special Areas
	1.02	Rivers and creeks
	1.03	Aquifers, known groundwater resources
	1.04	Springs
	1.05	Sea/lake
	1.06	Shorelines
	1.07	Natural dams
	1.08	Cliffs / pagodas
	1.09	Steep slopes
	1.10	Escarpments
	1.11	Land prone to flooding or inundation
	1.12	Swamps, wetlands, water related ecosystems
	1.13	Threatened and protected species
	1.14	National parks
	1.15	State recreation areas
	1.16	State forests particularly areas zoned FMZ 1, 2 and 3
	1.17	Natural vegetation
	1.18	Areas of significant geological interest, and
	1.19	Any other feature considered significant
Public Utilities	2.01	Railways
	2.02	Roads (all types)
	2.03	Bridges
	2.04	Tunnels
	2.05	Culverts
	2.06	Water/gas/sewerage pipelines
	2.07	Liquid fuel pipelines
	2.08	Electricity transmission lines (overhead/underground) and associated plants
	2.09	Telecommunication lines (overhead/underground) and associated plants
	2.10	Water tanks, water and sewage treatment works
	2.11	Dams, reservoirs and associated works
	2.12	Air strips
	2.13	Any other infrastructure items
Public Amenities	3.01	Hospitals
	3.02	Places of worship
	3.03	Schools
	3.04	Shopping centres
	3.05	Community centres
	3.06	Office buildings
	3.07	Swimming pools
	3.08	Bowling greens

Aspect	#	Consideration
	3.09	Ovals and cricket grounds
	3.10	Race courses
	3.11	Golf courses
	3.12	Tennis courts
	3.13	Any other amenities considered significant
Farm Land and Facilities	4.01	Agricultural utilisation or agricultural suitability of farm land
	4.02	Farm buildings / sheds
	4.03	Gas and / or fuel storages
	4.04	Poultry sheds
	4.05	Glass houses
	4.06	Hydroponic systems
	4.07	Irrigation systems
	4.08	Fences
	4.09	Farm dams
	4.10	Wells, bores
	4.11	Any other feature considered significant
Industrial, Commercial and Business Establishments	5.01	Factories
	5.02	Workshops
	5.03	Business or commercial establishments
	5.04	Gas and / or fuel storages and associated plants
	5.05	Waste storages and associated plants
	5.06	Buildings, equipment and operations that are sensitive to surface movements
	5.07	Surface mining (open cut) voids and rehabilitated areas
	5.08	Mine infrastructure including tailings dams and emplacement areas
	5.09	Any other feature considered significant
Areas of Archaeological and/or Heritage Significance	6.01	Areas of Archaeological and/or Heritage Significance
Items of Architectural Significance	7.01	Items of Architectural Significance
Permanent Survey Control Marks	8.01	Permanent Survey Control Marks
Residential Establishments	9.01	Houses
	9.02	Flats / Units
	9.03	Caravan parks
	9.04	Retirement/aged care villages
	9.05	Associated structures such as workshops, garages, on-site waste water systems, water or gas tanks, swimming pools and tennis courts
	9.06	Any other feature considered significant

APPENDIX G

Austar Coal Mine - Extraction Plan – Subsidence LWB4 - LWB7 Risk Assessment

June 2017

MDG1014 Checklist

1. Mineral Resources MDG 1014 Check List

To ensure this risk assessment complies with the Minerals Resources MDG 1010 Risk Management Handbook, the following checklist/ sign-off (MDG 1014) has been included.

Sub-sections 1.1, 1.2 and 1.3 have been completed by Austar Coal Mine Management.

1.1 Report Checklist

1.	Is there a description of the operation or equipment being assessed?	Yes / No
2.	Is there a summary of the strategic, corporate and risk management context?	Yes / No
3.	Is there a list of the people involved in the risk identification step, together with their organisational roles and experience relevant to the risk assessment topic?	Yes / No
4.	Is there an adequately detailed outline of the approach used to identify the risks?	Yes / No
5.	Is there an outline of the method used for assessing the likelihood and consequences of the risks?	Yes / No
6.	Are there two lists of identified risks, ranked by: a) risk magnitude , and b) consequence magnitude	Yes / No
7.	Is there discussion of the basis for defining either the safety standard to be achieved, or the level of risk management expenditure?	Yes / No
8.	Is there a list of the main actions to be taken to reduce risks and to manage risks?	Yes / No
9.	Have responsibilities for implementing additional controls / further actions been allocated?	Yes / No
10.	Is there a timetable for implementing main actions?	Yes / No
11.	Does the report specify a requirement for a working audit required after completion of all implementation stages?	Yes / No

1.2 Risk Assessment Process Evaluation

How do you rate the following:		<div style="display: flex; justify-content: space-between; width: 100%;"> Poor Good </div> <div style="text-align: center; font-size: small;">(Please Highlight)</div>				
1.	The range of expertise of team which did the study	1	2	3	4	5
2.	The appropriateness of the degree of detail of the study	1	2	3	4	5
3.	The comprehensiveness of the systematic approach	1	2	3	4	5
4.	The identification of the key risk scenarios to be addressed	1	2	3	4	5
5.	The bases for deciding the required safety level or effort	1	2	3	4	5
6.	The method for assessing likelihood and consequences	1	2	3	4	5
7.	The thoroughness of consideration of planned risk reduction actions	1	2	3	4	5
8.	The thoroughness of consideration of existing or planned risk controls	1	2	3	4	5
9.	The objectivity and balance of the study (i.e. not unduly optimistic or pessimistic	1	2	3	4	5

1.3 Risk Assessment Process Signoff

Name: Gary Mulhearn

Position: Environment and Community Manager

Signature:

Date: