WRAC Risk Assessment

Workplace Risk Assessment & Control

RA00290 – Miniwall S4 Extraction Plan Subsidence Management Risk Assessment

Site: Chain Valley Colliery

Date: 04/07/2019

No:	RA 00290 - Miniwall S4 Extraction Plan Subsidence Management		
Topic	Miniwall S4 Extraction Plan Subsidence Management		
Venue	Chain Valley Colliery		
Requested by:	Chris Armit Environment and Community Coordinator	**Date:** 04/07/2019	**Time allowed:** 1.5 hours
Facilitator	Chris Armit Environment and Community Coordinator		

Relevant Risk Assessment Documents/Procedures/Safety Alerts/Safety Bulletins

- S4 Subsidence Predictions report
- S2/S3 Extraction Plan Risk Assessment

Persons participating in Risk Assessment

Name	Position	Years' Experience in Industry	Signature
Chris Armit	Environment and Comm Co-ord	19	
DAVID HILL	GEOTECH/SUBS. CONSULT	40	
Tim Chisholm	Registered Mine Surveyor	13	
Chris Nicholas	Tech Services Manager	14	

Purpose

This risk assessment has been conducted to assess and document potential surface and sub-surface subsidence risks associated with mining of Northern Mining Domains (NMD) Miniwall S4.

Objectives and Scope

The objectives of this risk assessment are to:

- Identify hazards and assess the risk associated with environmental, public safety and surface built feature impacts from extraction.
- Ensure compliance with the WHS (Mines) Regulation 2014 Clause 67 Subsidence:

  (1) In complying with clause 9, the mine operator of an underground coal mine must manage risks to health and safety associated with subsidence at the mine.

  (2) Without limiting subclause (1), the mine operator must ensure that:

  (a) So far as is reasonably practicable, the rate, method, layout, schedule and sequence of mining operations do not put the health and safety of any person at risk from subsidence, and

  (b) Monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features, and

  (c) Any investigation of subsidence and any interpretation of subsidence information is carried out only by a competent person, and

  (d) All subsidence monitoring data is provided to the regulator in the form and at the times required by the regulator, and

  (e) So far as reasonably practicable, procedures are implemented for the effective consultation, co-operation and co-ordination of action with respect to subsidence between the mine operator and relevant persons conducting any business or undertaking that is, or is likely to be, affected by subsidence.
- Meet (where applicable) the standards for assessing and managing risks of subsidence as outlined in the "Managing Risks of Subsidence Guideline", February 2017.
- Place a particular focus on recently updated subsidence predictions and recommendations for the area including a review of factors behind the exceedance of subsidence predictions over the MW 1 to 12 area.
- Identify the existing and potential controls to reduce the risk to a reasonable practicable level.

The scope of the risk assessment focuses on the extraction area defined by a 35 degree angle of draw or to the predicted 20mm subsidence contour of S4 (see **Figure 1**). The level of monitoring strategy required will be commensurate with the assessed level of risk (i.e. after controls are put in place) or potential consequence. The corresponding residual risk will determine if these controls are sufficiently acceptable.

The list of surface and sub-surface features outlined in Appendix B of the 2003 NSW Department of Mineral Resources Guidelines for Application for Subsidence Management Approvals, along with items outlined in the 2017 Managing Risks of Subsidence Guideline, have been used as a starting reference list of features for assessment. All features on the list were assessed as to whether they exist within the defined extraction plan area. Where a feature is not noted in the WRAC assessment, it has not been identified within the area of interest.

Figure 1- NMD S2 to S4 Extraction Impact area due to Fassifern Miniwall Mining

Risk Assessment Process

1. Hazard identification
2. Identified hazards were evaluated with regard to consequence and then the Likelihood of that consequence outcome was assessed, assuming existing controls to be effectively implemented.
3. Risk rankings were derived.
4. Additional controls were proposed where possible for medium and high risks and the hazards were re-evaluated to arrive at the residual risk.
5. Likelihood and consequence were assessed in accordance AS/NZS ISO 31000:2009 Risk Management – Principles and guidelines.
6. This risk assessment was conducted in general compliance with MDG1010 and MDG1014.
7. As low as reasonably practicable (ALARP) is determined from WHS Act 2011, Section 18.

8. Hazardous Manual Tasks should be identified and controlled to a reasonable practicable level of risk using the Risk Assessment Worksheet for Hazardous Manual Tasks Form and actions recorded in this risk assessment.

9. Actions and outcomes from the risk assessment are recorded with a due date of action completion and responsible person.

10. Risk Assessments are monitored and reviewed as detailed by the Delta Coal Site Work Health and Safety Management System.

Risk Assessment Checklist based on Hazard / Energy Types

Energy Type	POTENTIAL HAZARDS			
	To People	To Equipment	To Production	To The Environment
Electrical	• Electric Shock • Burns • Smoke Inhalation	• Unplanned movement • Fire • Circuit Damage	• Supply fails causing shutdown • Inadequate supply causing process slowdown	• Fire
Mechanical	• Crushed • Struck by Moving or Flying Objects • Caught Between Moving Objects	• Collision • Breakdown • Unplanned Movement • Breakages • Vibration	• Fails & Causes Shutdown • Slows Down Production	• Physical Damage • Fire
Chemical	• Burns • Skin Irritation • Ingestion • Inhalation (Toxic atmospheres) • Explosion (Mixing incompatible)	• Fire • Internal Damage • Corrosion	• Causes Delays or Shutdowns (Not enough, wrong type to much)	• Spillage (Water contamination, soil contamination, air pollution, vegetation destroyed)
Pressure (Fluids/Gases)	• Fluid Injection • Crush • Respiratory Problems	• Unplanned Movement • Poor Performance • Breakdown	• Equipment Failure Shutdown (No fluids or to much fluids, no gases or to much gases)	• Contamination (Dust, fuel/oil, dirty water0
Radiation	• Burns • Eye Damage (welding flash) • Internal problems		• Source fails (Causing delays or shutdown)	• Contamination
Thermal	• Burns • Heat Exhaustion • Frostbite	• Overheating • Freezing	• Shutdown (Overheating or freezing)	
Biochemical	• Sprains • Strains		• Slowdown due to loss of staff	
Noise/Vibration	• Hearing damage	• Mechanical damage	• Slowdown due to people not accessing area	• Community complaints
Biological	• Illness • Disease		• Shutdown due to lack of people	
Gravitational	• Falling from Heights • Objects falling on Personnel	• Rollover • Collapse • Failure • Damage from fall • Damage from objects falling	• Objects falling causing slowdown or shutdown	• Contamination

Risk Matrix

HIERARCHY OF CONTROL		LIKELIHOOD			
Elimination	Do we still have to do this?	A	Almost certain to happen	FREQUENCY	1 per week to 1 per month
Substitution	Is there another way or product?	B	Likely to happen at some point		1 per month to 1 per year
Redesign/Engineer	Can the equipment or process be modified?	C	Moderate, possible; heard of so it might happen		1 per year to 1 per 10 years
Isolation/Guarding	Will guarding or some type of barrier help?	D	Unlikely, not likely to happen		1 per 10 years to 1 per 100 years
Administration	Will a written procedure and/or training help?	E	Rare, practically impossible		Less than 1 per 100 years
PPE	Is personal protective equipment adequate?				

MAXIMUM REASONABLE CONSEQUENCE

CONSEQUENCE	INJURY (I)	ENVIRONMENTAL (E)	LOSS (L)
1 - CRITICAL	Could kill, permanently disable	Regional environmental impact/ecosystem damage. Impact causing mine or business closure. E.g. Major release off site with long term detrimental effect	Could cause very major damage > $3M
2 - HIGH	Could cause serious injury (major LTI)	Substantial environmental damage which could result in major financial loss and/or prosecution. E.g Off-site release resulting in local ecosystem damage	Could cause major damage $500K - $3M
3 - MEDIUM	Could cause typical MTC/LTI	Substantial temporary or minor long term damage, release immediately contained with outside assistance eg. A minor water discharge or large hydrocarbon spill. Legal non-compliance.	Could cause moderate damage $100K - $500K
4 - LOW	Could cause first aid injury	Temporary or minor damage, non-compliance with internal environmental target, no legal breach, eg. Minor spill	Could cause damage $20K - $100K
5 - INSIGNIFICANT	Couldn't cause injury	No detrimental effect, low financial loss, negligible environmental impact	Couldn't cause damage, or <$20K damage

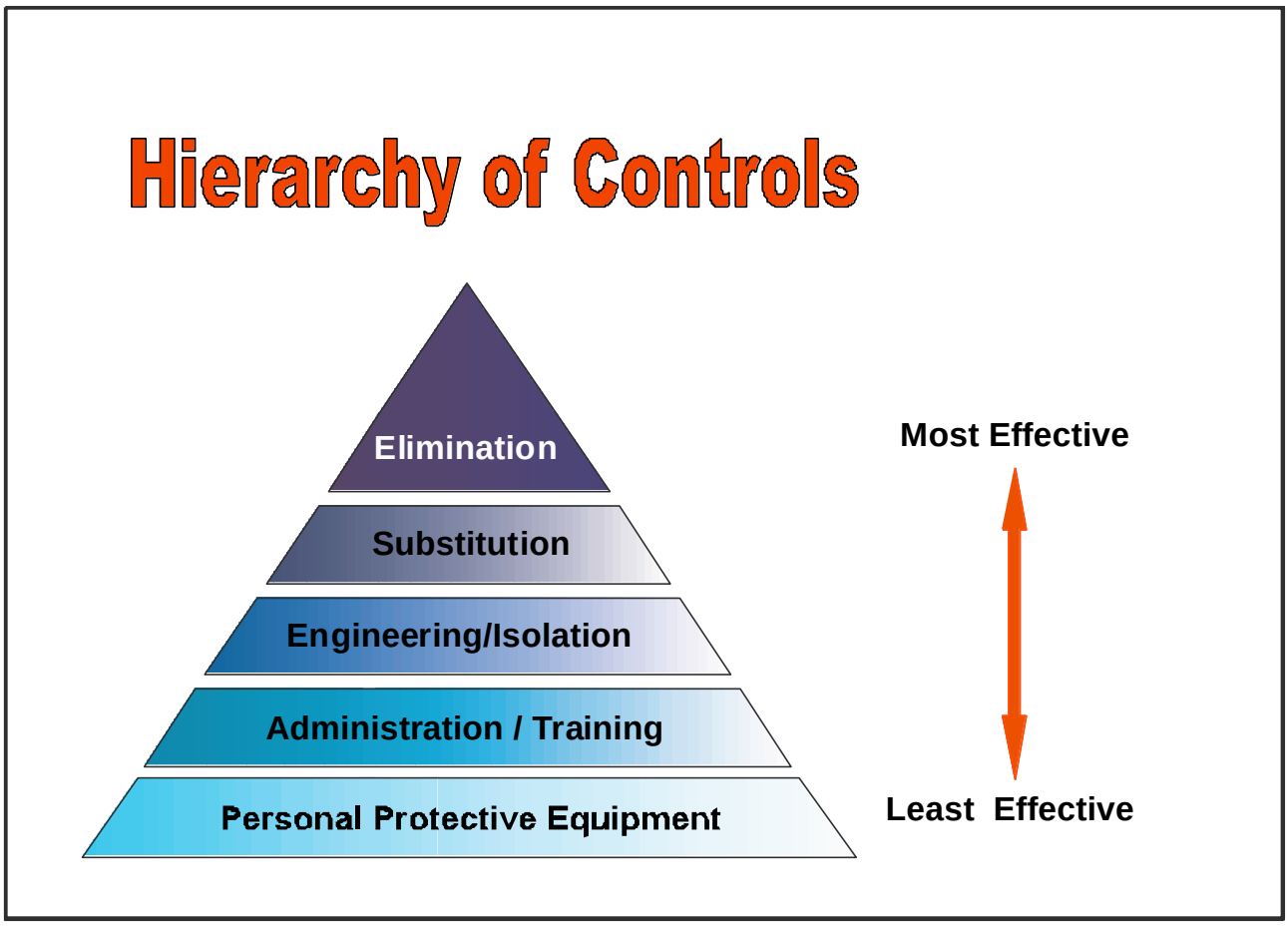
Risk Score Matrix

RISK SCORE	RISK	WHAT SHOULD I DO?
1 to 3	Critical	STOP WORK Immediate action required, inform senior management
4 to 10	High	Risk Assessment required. Action plan required, senior management attention needed
11 to 15	Medium	Specific monitoring of procedures required management responsibility must be specified
16 to 25	Low	Manage through routine procedures

CONSEQUENCE	LIKELIHOOD: A- Certain	B - Likely	C - Moderate	D - Unlikely	E - Rare
1 - Critical	1	2	4	7	11
2 - High	3	5	8	12	16
3 - Medium	6	9	13	17	20
4 - Low	10	14	18	21	23
5 - Insignificant	15	19	22	24	25

Least Effective ↕ Most Effective

Hierarchy of Controls (as per WHS Regulations 2011 Clause 36)



HIERARCHY OF CONTROLS 1-6 Descending Order (as per WHS Regulations 2011 Clause 36)	
Elimination	Remove the hazard from the workplace (Re-Design)
Substitution	Substituting (wholly or partly) the hazard giving rise to the risk with something that gives rise to a lesser risk. (Alternative product / plant)
Isolation	Isolating the hazard from any person exposed to it. Use barriers to shield or isolate the hazard (Guards on machines, enclosures for noises)
Engineering controls	Design & install equipment to counteract or lessen the hazard
Administrative controls	change to a system of work, a process or a procedure to lessen the hazard

Personal Protective Equipment	ensuring the provision and use of suitable personal protective equipment

Hazard Analysis and Risk Assessment

The risk management methodology as described in WHS Act 2011, WHS Regulations 2011, WHS Code of Practice WHS Act 2011, Section 274, Code of Practice –How to Manage Work, Health and Safety Risks 2011, MDG1010 and AS/NZS ISO 31000:2009 is used to identify the various processes and activities at Delta Coal sites.

Risk analyses shall be completed for each activity based on the following matrix. The subsequent risk ranking shall then determine the frequency of re-assessments.

Likelihood	Consequences
A. Almost certain to happen	1. Permanently disable.
B. Like to happen at some point	2. Could cause serious injury (Major LTI)
C. Moderate, possible, heard of so it might happen	3. Could cause Medical Treatment Case/ LTI
D. Unlikely, not likely to happen	4. Could cause First Aid Treatment
E. Rare, practically Impossible	5. Could not cause injury

Likelihood and Consequences are applicable to Table 1 below.

		LIKELIHOOD				
CONSEQUENCE		A – Certain	B – Likely	C – Moderate	D – Unlikely	E - Rare
	1 - Critical	1	2	4	7	11
	2 - High	3	5	8	12	16
	3 - Medium	6	9	13	17	20
	4 - Low	10	14	18	21	23
	5 - Insignificant	15	19	22	24	25

Facts

- Extraction is to occur in the Fassifern seam utilising miniwall extraction methods and solely beneath Lake Macquarie (ie outside the High Water Mark Subsidence Barrier and Seagrass Protection Barrier).
- S4 extraction depth of cover ranges between an effective depth of 160 to 171m. The panels are at >35^0 angle of draw to the foreshore.
- The S4 miniwall has a void width of 97m and an inter panel pillar width of 40m.
- No extraction is planned within the High Water Mark Subsidence Barrier (HWMSB) and Seagrass Protection Barrier (SPB)
- Updated predictions for subsidence over the MW1 to 12 area of 720mm were exceeded in the MW7 to 10 area with up to 1100mm recorded (a further 150mm of creep movement could be expected). The subsidence model has since been reviewed and amended to align with this increase, and to gain an understanding of the potential mechanisms behind the increase. This model and information has been utilised to develop a mine plan and updated predictions for the NMD such that predicted subsidence is planned to remain within the approved 780mm for the domain allowing for anticipated longer term creep.
- A detailed subsidence assessment has been undertaken for miniwalls S2 and S3 by Mine Subsidence Engineering Consultants (MSEC). The assessment has indicated that the subsidence results over the miniwalls will result in approximately 290mm of vertical subsidence and 6mm/m tilt. Predicted vertical subsidence at the sea grass beds/moorings and jetties are predicted to be less than 20mm. The expected subsidence at Pelican rock is expected to be in the order of 90mm.
- Strata2 Consulting has undertaken a detailed subsidence assessment for miniwall S4. The assessment has indicated that the subsidence result over the miniwall S4 will result in approximately 296mm of vertical subsidence and 4 mm/m tilt. Predicted vertical subsidence at the sea grass beds/moorings and jetties are predicted to be less than 20mm. The expected subsidence at Pelican Rock is expected to be in the order of 130mm.
- Strata2 Consulting has undertaken a detailed geotechnical design report for the miniwall layout which has formed the basis for the mine design used in the subsidence assessment.
- Delta Coal has successfully mined Miniwall S1 in the NMD with subsidence monitoring results at the foreshore well within predictions.
- Delta Coal has completed a rock head survey of the NMD which has formed the basis for the key assumptions used in the technical reports.
- The location of the maximum predicted subsidence is located beneath Lake Macquarie within the FAS working footprint (ie outside the foreshore and mapped seagrass areas) **Figure 1**.

Assumptions

- Employees are trained and assessed in relevant contents of the Delta Coal site WHSMS as a minimum.
- Compliance with the Environmental Protection Act 1994, Environmental Planning and Assessment Act 1979, Work Health and Safety Act 2011 and Work Health and Safety Regulations 2011, Code of Practice –How to Manage Work, Health and Safety Risks 2011, AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines.
- Compliance with the Delta Coal Environmental Management System
- Compliance with the Work Health and Safety Act 2011 and Work Health and Safety Regulations 2011, Code of Practice –How to Manage Work, Health and Safety Risks 2011, AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines.

Monitoring and Review

Delta Coal site monitoring and review processes should encompass all aspects of the risk management process for the purposes of:

- ensuring that controls are effective and efficient in both design and operation;
- obtaining further information to improve risk assessment;
- analyzing and learning lessons from events (including near-misses), changes, trends, successes and failures;
- Identifying emerging risks.

References

- AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines
- MDG1010 – Risk Management Handbook for the Mining Industry
- MDG1014 - Guideline to reviewing a risk assessment of mine equipment and operations
- Work Health and Safety Act 2011
- Work Health and Safety Regulations 2011
- Codes of Practice –WHS Act 2011, Section 274.
- Work Health and Safety Mines Act 2013
- Work Health and Safety Mines Regulations 2014

- AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines
- MDG1010 – Risk Management Handbook for the Mining Industry
- MDG1014 - Guideline to reviewing a risk assessment of mine equipment and operations
- Environmental Protection Act 1994
- Environmental Planning and Assessment Act 1979
- DGS, 2017. Multi-Seam Mining Feasibility Study for the Proposed Miniwalls CVB to CVB4 at Chain Valley Colliery
- EMM, 2015. Chain Valley Colliery- Modification 2- SoEE
- EMM, 2019. Chain Valley Colliery- Modification 3 - SoEE
- EMM, 2013. Chain Valley Colliery Mining Extension project 1- EIS
- Lake Coal, 2013. Chain Valley Colliery Extraction Plan MW7 to MW12
- NSW DMR, 2003. Guideline for Applications for Subsidence Management Approvals
- NSW DRE Mine Safety, 2017. Guideline Managing Risk of Subsidence
- PHMP 00021- Mannering and Chain Valley Collieries Principal Hazard Management Plans
- Subsidence PHMP Risk Assessment Dated 15/12/16
- Miniwall S1/N1 Extraction Plan and associated Risk Assessment

Definitions

Hazard

Means a situation or thing that has the potential to harm a person. Hazards at work may include: noisy machinery, a moving forklift, chemicals, electricity, working at heights, a repetitive job, bullying and violence at the workplace.(reference Code of Practice –How to Manage Work, Health and Safety Risks 2011)

Hazardous Manual Task

Defined in the WHS Regulations 2011, means a task that requires a person to lift, lower, push, pull, carry or otherwise move, hold or restrain any person, animal or thing involving one or more of the following:

- repetitive or sustained force
- high or sudden force
- repetitive movement

- sustained or awkward posture
- exposure to vibration.

Musculoskeletal disorder

Defined in the WHS Regulations 2011, means an injury to, or a disease of, the musculoskeletal system, whether occurring suddenly or over time. It does not include an injury caused by crushing, entrapment (such as fractures and dislocations) or cutting resulting from the mechanical operation of plant.

Risk Assessment
Risk management process applied to a scope of work, overall activities, equipment and machinery to determine how often specified events may occur and the magnitude of their consequence. When applied to a specific and sequential set of job steps/activities this may be referred to as a Job Safety Analysis.

Risk

Is the possibility that harm (death, injury or illness) might occur when exposed to a hazard. (Reference Code of Practice –How to Manage Work, Health and Safety Risks 2011)

Risk control

Means taking action to eliminate health and safety risks so far as is reasonably practicable, and if that is not possible, minimising the risks so far as is reasonably practicable. Eliminating a hazard will also eliminate any risks associated with that hazard. .(reference Code of Practice –How to Manage Work, Health and Safety Risks 2011)

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Subsidence
Movement of the ground surface as a result of readjustments of the overburden due to collapse or failure of underground mine workings and/or compression of remnant pillars

Subsidence Effects
The term used to define the subsidence and differential subsidence parameters (i.e. subsidence, tilt, strain and horizontal displacement) that may or may not have an impact on natural or man-made surface and sub-surface features above a mining area

Subsidence Impacts
The impact that a subsidence effect has on natural or man-made surface and sub-surface features above a mining area

Tilt
The rate of change of subsidence between two points (A and B), measured at set distances apart (usually 10 m).

Strain

The change in horizontal distance between two points at the surface after mining, divided by the pre-mining distance between the points, may be tensile, compressive or shear.

Rock Head
The geological boundary in the overburden between competent rock and unconsolidated sediments and weathered rock

Abbreviations

ALARP	As low as reasonably practicable (ALARP) - determined from WHS Act 2011, Section 18.
CVC	Chain Valley Colliery
DISRD	Department of Industry, Skills and Regional Development
EMP	Environmental Management Plan
FOS	Factor of Safety
JSA	Job Safety Analysis
LTA	less than adequate
LAK	Delta Coal
MC	Mannering Colliery
MSD	Musculoskeletal Disorder
MSMFI	Multi-seam Mining Feasibility Investigation
PCP	Principle Control Plans
PMHMP	Principle Mining Hazard Management Plans
PPE	Personal protective Equipment
STD	Standard
STF	Slip/Trips/Falls
SMP	Safety Management Plan
SWP	Standard Work Procedure

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- Identifying emerging risks.

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WRAC

Workplace Risk Assessment & Control

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ALARP	As low as reasonably practicable (ALARP) - determined from WHS Act 2011, Section 18.
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PMHMP	Principle Mining Hazard Management Plans
PPE	Personal protective Equipment
STD	Standard
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SMP	Safety Management Plan
SWP	Standard Work Procedure

Risk Table

The hazards were analysed and risks derived. The existing control mechanisms were identified prior to establishment of risk. Proposed risk reductions were discussed and agreed and a residual risk determined based on implementation of existing and propose d risk reductions. Consequences assessed through this risk assessment were taken as the reasonable practicable level of risk considering Injury to Personnel as a primary consideration and Environmental Impact and Financial Loss as a secondary consideration as defined in the Risk Assessment Matrix.

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.	**Natural Features**													
1.1a	Groundwater	Loss of groundwater from aquifers due to subsidence induced fracturing impacts users or dependant ecosystems	• Sub-critical Mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing) • Strata 2 Mine Design Report • Existing extraction has already influenced groundwater levels (minimal further impact predicted) • Avg dewatering volume is within predictions. • Ground water assessment (SEE) • GWMP • Operational water management TARP and underground water make monitoring.	E	D	3	17	Update the GWMP for S4 Extraction Plan application Implement recommendations				ALARP	E&C Coordinator	30/09/19

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.1b		Abnormal groundwater loss due to extraction of miniwall panel	• Strata 2 Mine Design Report • Documented experience indicates that dykes and normal faults with throws of up to 3m have no appreciable impact on subsidence development or overburden hydraulic conductivity • Sub-critical Mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing) • Existing extraction has already influenced groundwater levels (minimal further impact predicted) • Avg dewatering volume is within predictions • Subsidence and Water Management TARP • Ground water assessment (SEE) • GWMP	E	D	3	17					ALARP		

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.1c		Impact on registered groundwater bores in proximity to extraction effects their ongoing use (GW24575)	• Minimal impact based on assessment and existing mining (SEE) • Sub-critical Mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing)	E	D	4	18	Monitor yields, saturated thickness and quality where access granted Check groundwater bores register Provide alternative water supply until impacted bore recovers where proven to be related to mining impact or as required by the secretary	D	5	22	LOW	E&C Coordinator	If triggered

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.2a	Sea/Lake	Increased lakebed cracking resulting in impacts outside predictions	• Sub-critical Mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing) • Geological mapping of known structures incorporated into the mine design and assessed. • Detailed subsidence assessment by Strata 2. Predictions are significantly less than the EA approved limits. • Thickening of Teralba Conglomerate reduces fracture heights • Extensive subsidence model including bathymetric survey • Subsidence monitoring program • No previous evidence of significant irregularities around geological structures in previous MW areas	E	D	3	17					ALARP		

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.3a	Shoreline	Increased flooding risk due to subsidence	• HWMSB/Mine Design Report • Subsidence assessment (<20mm predicted) • Subsidence monitoring program • Contingency Plan	E	E	2	16					ALARP		
1.3b		Foreshore ecology impacted by increased flooding or erosion	• HWMSB/Seagrass Protection Barrier Mine Design • Subsidence assessment (<20mm predicted) • Subsidence monitoring program including 6 monthly bathymetric surveys	E	E	3	20	Undertake remediation of any mining affected sections of foreshore in consultation with relevant authorities/landowners.				ALARP	E&C Coordinator	If triggered
1.3c		Changes in lakebed depth and wave climate result in increased erosion	• HWMSB/Mine Design • Low wave height environment (SEE) • Subsidence assessment (<300mm vertical subsidence predicted) • monitoring program	E	E	4	23					ALARP		

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.4	Ecosystems (Seagrass)	Increased depth from subsidence reduces presence/health of seagrass beds	• Sub-critical Mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing) • Seagrass mapping (no threatened species identified in extraction plan area) • Seagrass Management Plan and monitoring program • SPB/Mine design report • Subsidence assessment (<20mm predicted) • Subsidence monitoring program	E	D	4	21					ALARP		
1.5	Ecosystems (Benthic Communities)	Increased depth from subsidence reduces colony numbers/health	• Benthic surveys (6 monthly) • Benthic Communities Management Plan • Subsidence assessment (<300mm predicted) • Subsidence monitoring program • Predictive modelling and assessment	E	D	4	21					ALARP		

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.6	Threatened and Protected Species (Loggerhead and Green Turtles)	Increased depth from subsidence results in reduction in food source (seagrass)	• Annual Seagrass mapping • SPB/Mine Design Report • Subsidence Assessment (<20mm Predicted) • Mobile and no impact predicted to food source	E	E	5	25					ALARP		
1.7	Cliff/Steep Slope(Frying Pan Point)	Horizontal movements of cliff face results in rock failure	• Sub-critical Mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing) • Subsidence assessment (Strata2) • Subsidence monitoring program • HWMSB/Mine Design	E	E	5	25					ALARP		

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
1.8	Rock outcrops within lake (adjacent S2)	Change in depth results in public safety risk	• Subsidence assessment (<130mm predicted) • No direct undermining of the outcrop or marker • Subsidence monitoring program updated to include Pelican Rock Navigational Marker • Built Features Management and RMS Consultation	I	E	2	16					ALARP		
2.	**Public Utilities**													
2.1	Telecommunication line	Nil. Outside extraction area	•											
2.2	Services	Services not identified within impact area during original SEE impacted by subsidence	• Dial before you dig has confirmed no services located within subsidence affectation area (>20mm). All services located landward from high water mark.	L	E	3	20					ALARP		

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
3. Public Amenities														
	Nil		•											
4. Farm Land and Facilities														
	Nil		•											
5. Industrial, Commercial and Business Establishments														
	Nil													

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
6. Areas of Archaeological and/or Heritage Significance														
6.1	AHIMS sites (adjacent extraction plan area)	Arch sites near foreshore impacted by flooding or erosion increases due to subsidence	• Locations identified (approx.) via AHIMS register • No sites located adjacent to mining footprint on AHIMS register • Heritage Management Plan (EMP-D-16371) • HWMSB (no impact predicted) • Subsidence assessment (<20mm) • Subsidence monitoring program	E	E	4	23	• Review previous Archaeological surveys and requirement for further surveys for subsidence monitoring				ALARP	EC Coordinator	
7. Items of Architectural Significance														

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
	Nil													
8. Permanent Survey Control Marks														
8.1	State Survey Marks/Permanent Survey Marks	Survey marks near foreshore effected by horizontal/vertical movement	• HWMSB/Mine Design • Subsidence assessment • Subsidence monitoring program • Built Features Management Plan	E	D	4	21	Reviews subsidence monitoring program for horizontal and vertical monitoring of state survey marks.				ALARP	Mine Surveyor	31/12/19
9. Residential Establishments														

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
	Nil		•											
10. Other identified items requiring particular assessment														

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
10.1a	Public Safety	Shallow water buoy (or other markers including sailing markers) within extraction plan area impacted due to subsidence resulting public safety risk	• Subsidence assessment • Strata 2 Mine Design Report. • Marker locations visually assessed and mapped and within seagrass area. • RMS consulted as part of previous Extraction Plan. • Keep CCC informed of actions taken in relation to public safety risks	I	D	3	17					ALARP		
10.1b		Jetties within extraction plan area impacted due to subsidence	• Subsidence assessment (<20mm predicted) due to mine design principles • Consultation program / community notifications • Visual assessment undertaken • Subsidence monitoring program	E	D	4	21	Consultation with affected landholders - send out notification letters Keep CCC informed of actions taken and progress.				ALARP	Mine Surveyor E&C Coordinator	31/12/19 Quarterly

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
		Moorings within extraction plan area impacted due to subsidence	• Limited moorings adjacent the EP area • Strata 2 S4 Subsidence assessment • Majority of moorings within seagrass boundary (<20mm subsidence).Negligible change • Subsidence monitoring program	E	D	4	21					ALARP		
10.2	Consultation	LTA community, stakeholder or agency consultation results in concerns over impact	• CCC • Website • Newsletter • Regular meetings with relevant authorities • Extraction Plan Guidelines • Landowner notifications to be sent out.	E	C	4	18	Review notification requirements for secondary extraction for affected stakeholders				ALARP	Mine Surveyor/EC Coordinator	31/12/19

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
10.3a	Subsidence Impact (general)	Subsidence predictions exceeded results in increased impact/community concern/ breach of conditions	• Sub-critical Mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing) • Strata 2 Subsidence Assessment • Extensive subsidence model including bathymetric survey • Subsidence monitoring program	E	D	3	17	Extend foreshore monitoring where access is granted Organise appropriate land access to conduct monitoring Investigate potential for additional floor and roof cores to be undertaken in the NMD to improve understanding of geological conditions Review mine design and contingency plans/adaptive management measures in each management plan/TARP are adequate	E	3	20	Low	Mine Surveyor Mine Surveyor Technical Services Manager Technical Services Manager	31/03/20 31/12/19 31/3/20

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
10.3b	Subsidence Impact (general)	Known or unknown geological structures in the workings increases subsidence impact	• Geological database and mapping from old and existing workings • Strata 2 Mine Design Report • Known major structures incorporated into the updated geological and subsidence model • Strata Failure Management Plan • All pillars squat pillars thus confinement not reduced by structures • Subsidence monitoring to date has not indicated significant variation in areas of geological structure • Subsidence monitoring program	E	D	3	17					ALARP		

10.3c	Subsidence Impacts (Height of Fracturing)	Height of fracturing exceeds predictions leading to impacts on groundwater/ingress into mine workings due to direct hydraulic connectivity with the Lake.	• Sub-critical mine design (panel width, chain pillar width and extraction height to limit height of hydraulic fracturing) • Lake Bed rock head survey undertaken and used to inform Mine Design and Subsidence Assessment report. • Constrained zone thickness is greater than or equal to 12T • Strata 2 Mine Design Report • Experience from inbye end of Miniwall 12 at Chain Valley at similar rock head thickness did not result in increased water make or signs of direct connectivity at higher levels of subsidence • Strata 2 Subsidence Assessment Report • No overlying workings in the NMD • Geological mapping and site model • Subsidence monitoring program • Avg dewatering volume is within predictions • Ground water assessment (SEE)	E	D	3	17	Bathymetric survey to be undertaken at the end of S2 and end of S3 panel.				ALARP	Mine Surveyor	28/02/20

No	Activity	Potential Hazard	Existing Controls	Cons I,E,L	Likelihood	Consequence	Risk Rank	Proposed Controls	Likelihood	Consequence	Risk Rank	Risk Level	Responsible Person	Due Date
			• GWMP • Operational water management TARP											
10.3d	Overall S2 to S4 Subsidence Risk (consideration of all risks and required controls)	Irregular subsidence due to Failure/yield of pillars or floor resulting in subsidence exceedance /impacts	• Mine design Report (panel width, pillar width and extraction height results in limited subsidence of <300mm) • Panels designed to exclude direct extraction and indirect interconnection with major fault plane/dip • Only three extraction panels separated by 40m wide (solid) pillars. • Subsidence assessment • Subsidence monitoring program • Subsidence management TARP • No previous evidence of significant subsidence irregularities around geological structures in previous MW areas	E L I	D D D	3 3 3	17 17 17	Consider taking floor cores along the north mains to determine claystone thickness/properties to confirm consistency with design assumptions. Review Subsidence Management TARP after S2 panel, if greater than normal triggered. Revise predictions and management strategies as required Bathymetric survey to be undertaken at the end of S2 and end of S3 panel.				ALARP	Technical Services Manager Technical Services Manager Mine Surveyor	28/02/20 Post S2 (indicative 28/2/20) 28/02/20

Actions

No	Clause(s) No from RA Tables	Action	Person responsible for Action	Action timeframe	Comments	Database Action No	Responsible Person signature
1.	1.1.a	Update the GWMP for S4 Extraction Plan application	C Armit	30.09.2019	Has been completed.		
2	1.1.c	Monitor yields, saturated thickness and quality where access granted Check groundwater bores register Provide alternative water supply until impacted bore recovers where proven to be related to mining impact or as required by the secretary	C Armit	31.03.2020			
3	1.3.b	Undertake remediation of any mining affected sections of foreshore in consultation with relevant authorities/landowners.	C Armit	If triggered			
4	6.1	Review previous Archaeological surveys and requirement for further surveys for subsidence monitoring	C Armit	30.09.2019	Has been completed. CRA approved by NPWS for MWS4 subsidence line.		
5	8.1	Review subsidence monitoring program for horizontal and vertical monitoring of state survey marks.	T Chisholm	31.03.2020			
6	10.1.b	Consultation with affected landholders - send out notification letters	T Chisholm	31.03.2020			
7	10.1.b	Keep CCC informed of actions taken and progress.	C Armit	31.12.2019	Has been completed. CCC was notified in Nov 2019.		

8	10.2	Review notification requirements for secondary extraction for affected stakeholders	C Armit	31.03.2020			
9	10.3.a	Extend foreshore monitoring where access is granted Organise appropriate land access to conduct monitoring	T Chisholm	30.04.2020			
10	10.3.a 10.3.d	Investigate potential for additional floor and roof cores to be undertaken in the NMD to improve understanding of geological conditions Consider taking floor cores along the north mains to determine claystone thickness/properties to confirm consistency with design assumptions.	C Nicholas	31.03.2020			
11	10.3.a	Review mine design and contingency plans/adaptive management measures in each management plan/TARP are adequate	C Nicholas	31.03.2020			
12	10.3.c and 10.3d	Bathymetric survey to be undertaken at the end of S2 and end of S3 panel.	T Chisholm	28.02.2020			
13	10.3.d	Review Subsidence Management TARP after S2 panel, if greater than normal triggered. Revise predictions and management strategies as required	C Nicholas	31.03.2020			

[Chris Armit] **[Signature]** **[17/12/19]**

(Dave McLean)	**[Signature]**	**[Date]**

MDG 1014 Review Checklist

RISK ASSESSMENT REVIEW CHECKLIST

Risk Assessment Title: MINIWALL S4 EXTRACTION PLAN SUBSIDENCE MGMT ***Date:*** 17/7/19

Site: CHAIN VALLEY COLLIERY

1. Report

[Circle or Highlight Yes or No for the following]

1.1	Is there a description of the operation or equipment being assessed?	Yes / No
1.2	Is there a summary of the strategic, corporate and risk management context?	Yes / No
1.3	Is there a list of the people involved in the risk identification step, together with their organizational roles and experience relevant to the risk assessment topic?	Yes / No
1.4	Is there an adequately detailed outline of the approach used to identify the risks?	Yes / No
1.5	Is there an outline of the method used for assessing the likelihood and consequences of the risks?	Yes / No
1.6	Is there, discussion of the basis for defining either the safety standard to be achieved, or the level of risk management expenditure?	Yes / No
1.7	Is there a list of the main actions to be taken to reduce risks and to manage risks?	Yes / No
1.8	Is there a timetable for implementing the main actions?	Yes / No
1.9	Does the report specify a requirement for a working audit requirement after completion of all stages?	Yes / No

2. Process

	How do you rate the following? [Circle or Highlight Poor to Very Good]	Poor/Very Good
2.1	The range of expertise of team which did the study.	**1 2 3 4 5**
2.2	The appropriateness of the degree of detail of the study.	**1 2 3 4 5**
2.3	The comprehensiveness of the systematic approach.	**1 2 3 4 5**
2.4	The identification of the key risk scenarios to be addressed.	**1 2 3 4 5**
2.5	The basis for deciding the required safety level or effort.	**1 2 3 4 5**
2.6	The method for assessing likelihood and consequences.	**1 2 3 4 5**
2.7	The thoroughness of consideration of planned risk reduction actions.	**1 2 3 4 5**
2.8	The thoroughness of consideration of existing or planned risk controls.	**1 2 3 4 5**
2.9	The objectivity and balance of the study (ie not unduly optimistic or pessimistic)	**1 2 3 4 5**

Signed: 

Position: Environment and Community Coordinator Date: 17/07/19