



Site	Wollongong Coal	DOC ID	WCL HS RA 001
Type	Risk Assessment	Date Published	21/07/2022
Doc Title	Extraction Plan PC07, PC08 and PC21 to PC25		

## RISK ASSESSMENT SIGN OFF/APPROVAL SHEET

<b>OPERATION:</b> Russell Vale Colliery	<b>RA Document Control Number:</b>
<b>Risk Assessment Title:</b> Extraction Plan PC07, PC08 and PC21 to PC25.	
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## PC07, PC08 and PC21 to PC25 Extraction Plan Risk Assessment

### 1. EXECUTIVE SUMMARY OF ACTIONS

The below includes a summary of the additional improvement action required to be completed during the development of the Extraction Plan and associated sub-plans.

No.	Item No.	Risk Rating	Improvements/Actions (12 month)	Who	When	Action status
1	37	Low 1	Two previously recorded sites 52-3-0323 and 52-3-0325 could not be located during a field survey undertaken. Further site survey to locate the sites to be undertaken.	Richard Sheehan	During development of heritage management plan – May 2021	Completed during revision of heritage management plan, September 2021

### 2. INTRODUCTION

A risk assessment was conducted which analysed the hazards relating to the mining of PC07, PC08 and PC21 to PC25 and assessed risk of manifestation of those hazards.

This risk assessment is required to support the Extraction Plan for mining PC07, PC08 and PC21 to PC25 and to satisfy condition C10 of the Development Consent (MP09\_0013).

This risk assessment will identify the potential for any required actions and mitigation measures if any of the controls are inadequately applied.

#### 2.1 Key controls

The following existing controls are in place to ensure that the management of any potential impacts from mining is effective:

- Proposed non-caving mining method is not expected to result in perceptible surface subsidence.
- Non-caving mining method is adaptable if required.
- TARPs established for each management plan and contingency plans implemented for any exceedances.
- Risk analysis undertaken by (SCT, 2020a) quantifies the risk of such a pillar failure occurring as less than 1 in 100,000 (0.001 % over the life of the project and therefore less than 0.01 % per year). The likelihood of initiating event occurring is considered to be remote.

## 2.2 Assumptions

The following assumptions were made during the risk assessment:

- Subsidence assumed to be 30-100 mm.
- Health and safety management related to the underground mining operations are excluded from this risk assessment.
- Additional vertical subsidence (up to 500mm) is possible but unlikely in one small isolated area over the Bulli Seam Goaf Area #Area 11 where the full collapse of all pillars cannot be confirmed. This area is located over panels PC23, 24 and 25. There are no swamps located over this area. Subsidence associated with the failure of any remnant standing pillars in these areas are cumulative impacts from previous mining impacts, which are likely to occur irrespective of the approved mining within the UEP area. Cumulative existing subsidence predictions used in the risk assessment have assumed these areas have fully collapsed. Groundwater modelling has also assumed these areas have fully collapsed.
- Risk analysis undertaken by (SCT, 2020) quantifies the risk of such a pillar failure occurring as less than 1 in 100,000 (0.001 % over the life of the project and therefore less than 0.01 % per year). The likelihood of initiating event occurring is considered to be remote.

## 3. CONTEXT STRATEGY, CORPORATE AND RISK MANAGEMENT

The process followed in this review was based on the Wollongong Coal Risk Management Procedure. This procedure is consistent with the requirements of the NSW Trades and Investment Mine Safety MDG1010 Guidelines for Risk Management and Risk Assessment and as well as the Australian/NZ Standard for Risk Management AS/NZ/ISO:31000:2009.

The results from the risk assessment will be used to ensure all controls including practices and procedures, are adequate for the identified risks. Additionally, it defines the controls and conditions necessary to ensure the safe handling application and management of the materials, process at any 'generic' location.

## 4. OBJECTIVES AND SCOPE

The objectives of the risk assessment process were as follows:

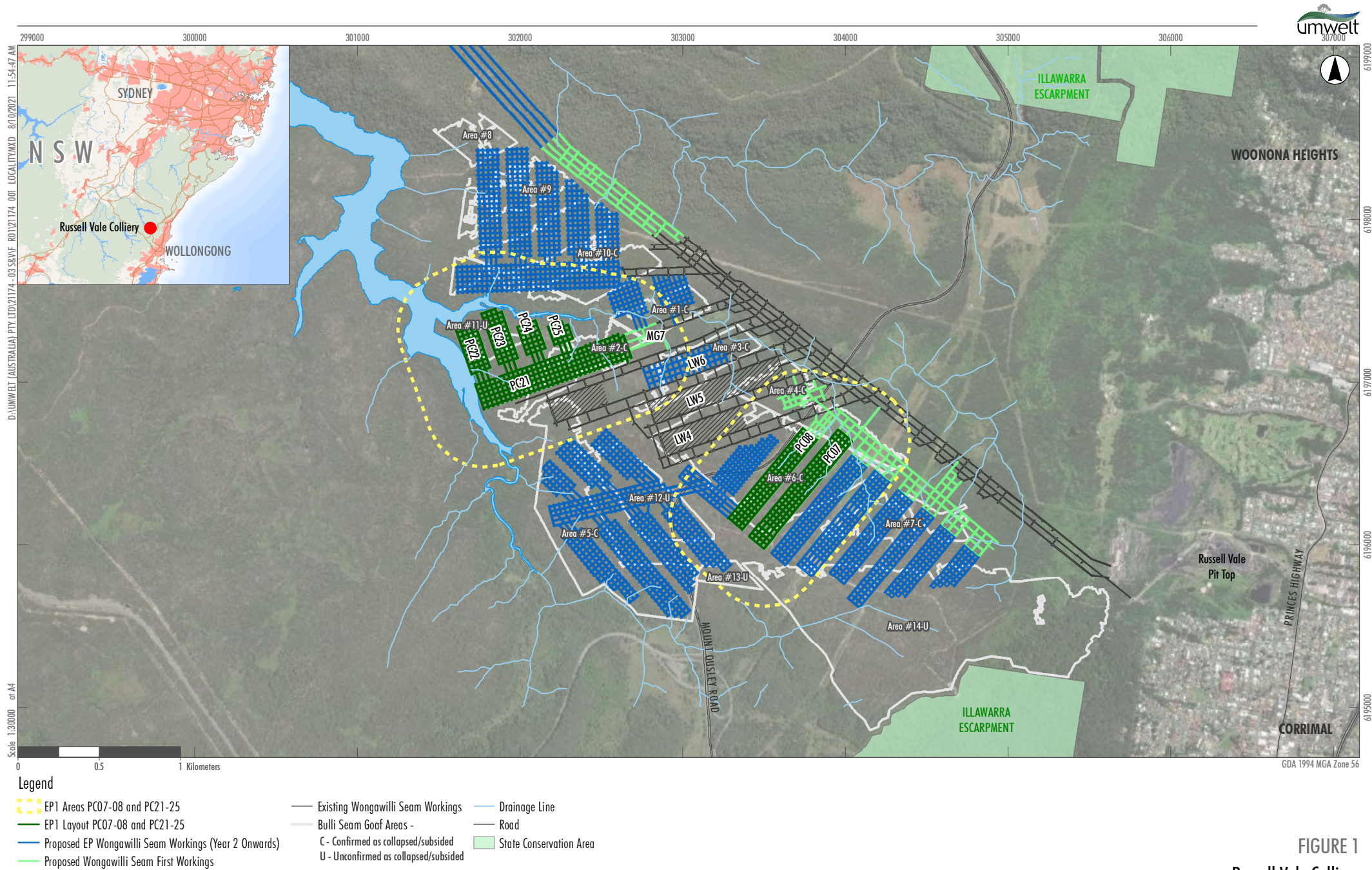
- Demonstration that critical risks have been identified and risk reduction strategies and systems have been adopted which will manage those.
- Verification that the risk reduction strategies will be effective in managing those risks to a level acceptable to WCL Wongawilli/Russell Vale Colliery.

The risk assessment scope was restricted to WCL Russell Vale Colliery Extraction Plan Area, specifically for the environmental management of subsidence and public safety management relating to the EP Area (mining of PC07, PC08 and PC21 to PC25).

EP Assessment Area defined based on distance equal to 1x overburden depth and consideration of coal barriers remaining in Bulli seam workings. This was considered conservative for impact assessment purposes.

The assessment team was assembled at WCL Russell Vale Colliery and undertook the assessment on 10 March 2021. The scope of the EP Area is shown on **Figure 1** below.





**FIGURE 1**  
**Russell Vale Colliery**  
**Locality Plan**

#### 4.11 The Work of the Risk Assessment Team

A key factor in the effectiveness of an exercise is the availability of relevant information and expertise. This is addressed mainly through the group workshop. Group workshops recruit the knowledge and experience of a group of people who are familiar with a particular work situation.

The role of team members is to provide their expertise, experience and technical knowledge, and to respect that provided by others. Outcomes are critically dependent on the team as a whole providing a balanced view at a level of expertise appropriate to the nature of the subject under Assessment. The experience and expertise of the team, together with the quality of facilitation, are crucial factors in the quality of the results derived.

#### 4.12 Assessment Team

**Facilitator: Luke Bettridge**

Name	Role	Experience relevant to this risk assessment
<b>Warwick Lidbury</b>	CEO WCL	CEO WCL GM Caledon Resource Mine Manager North Goongella, Crinom, Cook, Russell Vale, Clarence, Kestral Extension Site Senior Executive Cook Registered Survey SEE Queensland First Class Cert of Competency Bachelor of Science (Safety) Newcastle Uni Mines Rescue
<b>Devendra Vyas</b>	Tech Service Manager	30+ years in mining in various roles. Associated with Russel Vale and Wollongong Coal approvals throughout the process. Mine planning, scheduling, financial evaluation, HSC etc.
<b>Richard Sheehan</b>	Group Environmental and Approvals Manager	Richard has over 15 years industry experience, with skills and experience in the complimentary fields of environmental impact assessment, environmental management.
<b>Robert Faddy-Vrouwe</b>	Environmental Coordinator	5 years mining industry experience Degree Environmental Chemistry (Hon)
<b>Sasa Cugalj</b>	Environmental Monitoring Coordinator	4.5 Years Environmental/Mining Experience. BSC Physical Geography/Human Geography
<b>Luke Bettridge (Umwelt)</b>	Manager Operational Environmental Support NSW / principal Consultant	Luke has extensive experience in environmental assessment and management, particularly in the mining and extractive industry sector. Luke has a Bachelor of Environmental Science with a major in Environmental Management and has accredited qualifications regarding risk management. Luke has 17 years experience and has spent approximately 8 years in on site coal mining environmental management roles.



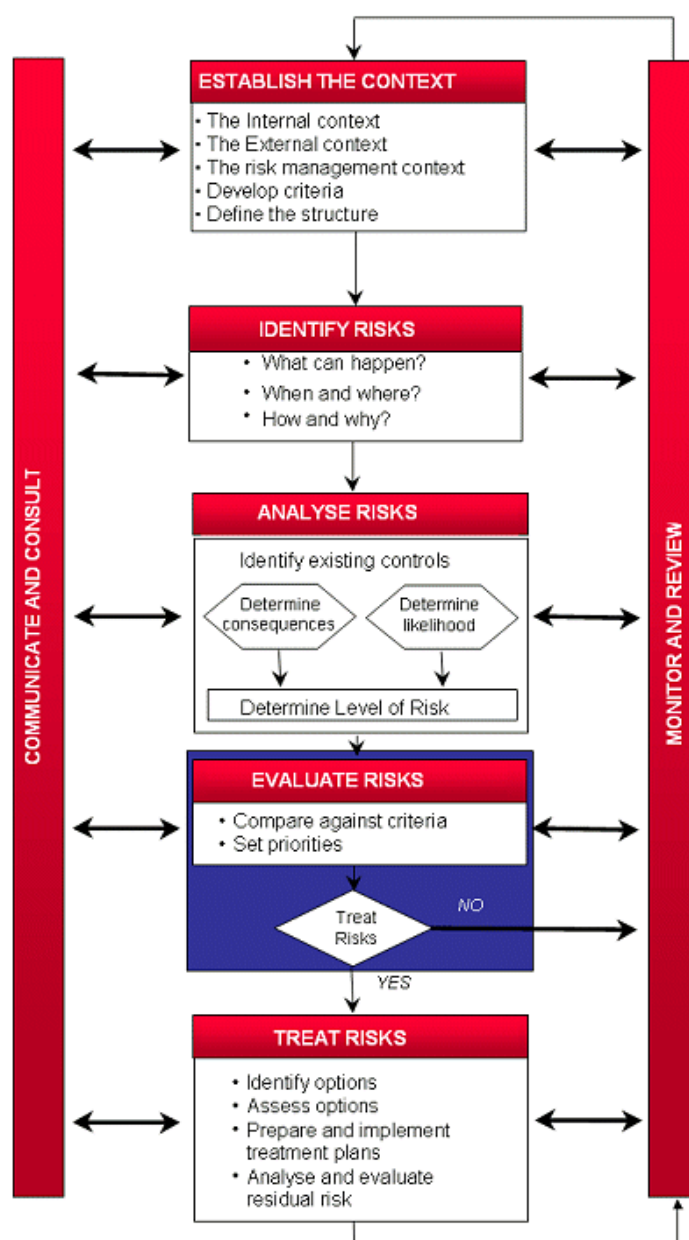
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Name	Role	Experience relevant to this risk assessment
<b>David Holmes (Umwelt)</b>	Principal Environmental Consultant	David is a Principal Environmental Consultant with particular expertise in environmental impact assessment (EIA), environmental policy and environmental and natural resource regulatory systems. David has also peer reviewed a number of technical assessments for the Russell Vale UEP Project.
<b>Michelle Grierson (Umwelt)</b>	Senior Environmental Scientist	An experienced Environmental Specialist with a demonstrated history of working in the mining & metals industry for over 10 years. Highly skilled in maintaining environmental compliance, managing and monitoring environmental issues.
<b>Claire Stephenson (Umwelt)</b>	Leader, Hydrogeology Services	Claire has over 13 years' experience in groundwater consulting across Australia, with prior experience working in agriculture and forestry. Claire has extensive experience managing complex groundwater projects to meet Local Government, State and Commonwealth regulatory requirements.
<b>Rebecca Dwyer (Biosis)</b>	Team Leader - Ecology (NSW)	Rebecca has 14 years on-ground experience in ecology and has been involved in a large number of ecological studies of varying scales throughout Australia.
<b>Stephen Wilson (SCT)</b>	Consultant / Mine Planner	Steve has over 40 years experience at various underground mine sites, mainly in the NSW Southern Coalfield. Steve has been involved in broad range of consulting tasks including mining approval applications, pillar and mining layout design, as well as projects associated with monitoring ground movements and ground water behaviour.
<b>Adam Wyatt (Engeny)</b>	Principal Engineer - Water Resources	Adam has 10 years experience modelling and assessing natural and man-made systems, incorporating disciplines of hydrology, hydraulics, terrain modelling and infrastructure design for projects ranging in scale from flood plains to residential subdivisions.
<b>Luke Stone (Biosis)</b>	Consultant Aquatic Ecologist	Luke's broad range of experience includes AusRivAs field survey methodology and model analysis, fish community surveys including electrofishing techniques, aquatic habitat surveys, water quality sampling, waterway classification and geomorphic river assessment. Luke has considerable experience managing and improving long term ecological monitoring programs.
<b>Samantha Keats (Biosis)</b>	Team Leader - Heritage (NSW)	Samantha has worked as an Archaeologist in the Wollongong region for over 4 years and has extensive experience in working with Aboriginal Representative Bodies and mining and exploration companies.

## 5. METHODOLOGY

The assessment was conducted in line with the requirements of the Australian Standard for Risk Management (AS/NZS ISO 31000:2009) and MDG 1010 Minerals industry safety & health risk management guideline (January 2011) while utilising the colliery's methodology in the identification, assessment and effective control of each of the recognised hazards and, included rating of likelihood and consequence of occurrence based on a combination of aspects including health and safety.

The resulting documented assessment of hazards, their rating, proposed controls and residual assessment were then included in this document. An action plan with specific responsibilities was then developed to ensure implementation of the identified controls.





## 6. ASSUMPTIONS AND REFERENCES

Compliance with the requirements of the:

- Development Consent (MP09\_0013).
- Work Health and Safety Act 2011,
- Work Health and Safety Regulation 2011,
- Work Health and Safety (Mines & Petroleum Sites) Act 2013,
- Work Health and Safety (Mines & Petroleum Sites) Regulation 2014,
- MDG 1010 Minerals industry safety & health risk management guideline (January 2011),
- MDG 1014 Guide to reviewing a risk assessment of mine equipment & operations (July 1997),
- Safe Work Australia Code of Practice - How to Manage Work Health & Safety Risks,
- WCL Mine Safety Management System,
- WCL SHECQ Management System.

## 7. DEFINITIONS

### 7.1 Hazard

The term "hazard" is defined as "a source of potential harm". The minerals industry has many large and sometimes complex hazards. Using this definition, electricity, large mobile equipment, ground and objects at height all have a potential for harm. This guideline, in conjunction with the NMIHSRAG, suggests that good risk management involves the identification and understanding of hazards, the establishment of potential unwanted events related to those hazards and, subsequently, the analysis of risk related to the unwanted event. Using this approach risk is a measure of concern; used to increase awareness, set priority or determine acceptability of an unwanted event risk.

**Environment note:** The term 'hazard' is essentially equivalent to 'environmental aspect'.

Establishing the context within the risk management process involves the overall direction setting and rationale for the entire process. AS/NZS ISO 31000:2009 includes consideration of external and internal factors in establishing context as well as the resultant goals, objectives and strategies including definition of risk acceptability criteria.

### 7.2 Incident (or ongoing condition)

An incident (or ongoing condition) is any occurrence that has the potential to result in adverse consequences to people, the environment, property/plant, or a combination of these.

### 7.3 Consequence

Consequences can result from the development of an incident over time (immediately after or over an extended period). The concept of consequence includes, within its scope, the potential adverse impacts/effects on people, the environment, plant or property, or a combination of these. By definition, consequence must be expressed as a quantitative between 1 and 5.

### 7.4 Impact/Effect

Impacts are specific adverse effects resulting from an incident and may be related to people, the environment, plant or property, or a combination of these.

### 7.5 Probability

Probability is an expression of the chance of a particular outcome. By definition, probability must be expressed as an alphabetical reference between A and E. Within this guideline the term probability is the qualitative description of likelihood and/or frequency in relation to the chance that something will occur & will be referenced as such in this risk assessment.

### 7.6 Frequency

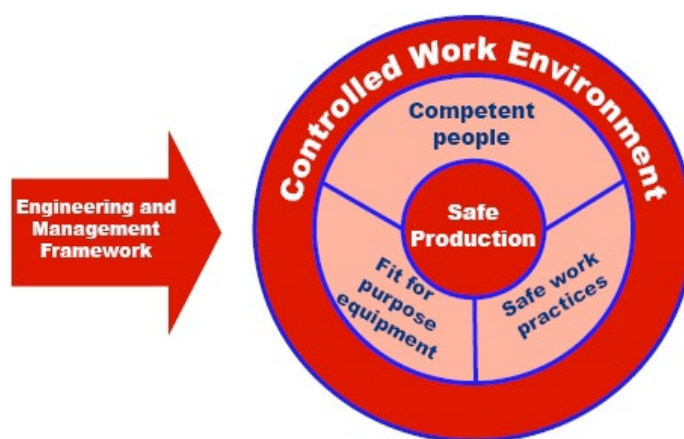
Frequency is defined as the number of times something (e.g. an activity, the hazard or incident) may occur within a specified timeframe, such as daily, weekly or annually. Within this guideline the frequency term is used in quantitative risk assessments.

### 7.7 Risk

Risk is defined as the likelihood of an impact on people, the environment, property, or a combination of these.

### 7.8 "Nertney Wheel"

The "Nertney Wheel" (Bullock, 1979), illustrated below, offers a model of an ideal work process for achieving safe production - the intended outcome of most site decisions. The wheel identifies four components of a safe and productive work process, competent people, safe work practices, fit for purpose equipment and a controlled environment.



**Process Model or the Nertney Wheel**

The term competent people is intended to not only refer to competency related to training and skills but also appropriate motivation and "fitness for duty".

## 7.9 The basic risk management process

The first step in understanding risk management involves becoming comfortable with the terminology and the intention of risk management. Obviously correct use of the word “risk”, considering its definition, is important to successful risk management. Risk is defined as “effect of uncertainty on objectives” (AS/NZS ISO 31000:2009). This definition has evolved over the last 10 years, improving its clarity. AS/NZS ISO 31000:2009 also notes that “Risk is often characterized by reference to potential events and consequences or a combination of these”. For the purposes of this guideline, the identification of an unwanted event will be separated from the term “risk”. The term “risk” will be used to describe MDG 1010 – Risk Management Guideline Page 14 of 117 only the measure of event consequences and likelihood. Note that a risk is usually thought of in terms of negative impact but similar approaches can be used to identify positive events or opportunities. It is important to note that there is no “zero risk”. A source may suggest that risks must be eliminated but unless the hazard is totally removed and no related hazard put in its place, elimination cannot be achieved. Risk is managed to a level of acceptability or practicality.

Risk analysis is defined as a “process to comprehend the nature of risk and to determine the level of risk” (AS/NZS ISO 31000:2009). In other words, this is the step where likelihood and consequence are somehow estimated. Risk analysis is usually done considering the impact of existing controls though there are circumstances where estimating inherent risk, or risk without controls, is desirable.

AS/NZS ISO 31000:2009 defines risk assessment as the “overall process of risk identification, risk analysis and risk evaluation” as outlined above. In practice, most risk assessment involves the application of a variety of informal and formal, qualitative and quantitative methods to assist with the management of risk.

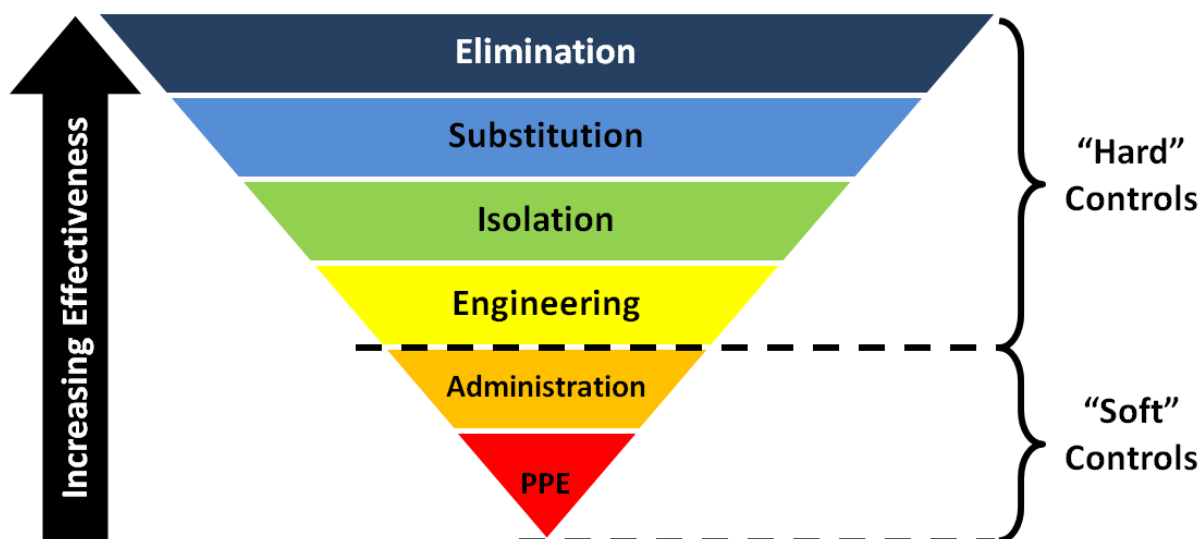
## 7.10 Common Mining Energies

Biological	bacteria, viruses, contagious diseases, natural poisons, etc.
Chemical	coal, gases, fuels, lubes, degreasers, solvents, paints, etc.
Electrical	high voltage, low voltage, batteries, etc.
Gravitational (objects)	falling coal, rock, tools, components, structures, etc.
Gravitational (people)	falling from or into equipment, structures, ladders, sumps, etc.
Machine (Fixed)	powered by electrical, hydraulic, pneumatic, combustion, etc.
Machine (Mobile)	haulage trucks, LHDs, service vehicles, gen sets, tools, etc.
Magnetic	handling metal objects in strong magnetic fields
Noise	from machines and other sources
Object	pressurised systems, cylinders, springs, chains, flying bits, etc.
People	slip, trip, lift strain, push/pull sprain, repetitive /postural strain
Thermal	conducted (contact), convected (airstreams), radiation
Vibration	from vehicles, equipment, tools, etc.
Other	friction, wind, animal, bio-chemical.

## 7.11 Hierarchy of Controls

In occupational health and safety risk management there is a hierarchy of controls referred to as the Safety Precedence Sequence for Barriers/Controls. This lists the types of control and their effectiveness in descending order.

The most effective controls are those that eliminate the hazard. If a hazard cannot be eliminated it should be minimised to an acceptable level. This may be achieved through a system of engineering controls, often referred to as 'hard' barriers down to administrative controls usually referred to as 'soft' barriers. Hard barriers actually prevent or minimise the risk of contact with the hazard whereas soft barriers may rely on policies and procedures and their enforcement, training, skills and experience, work organisation and the wearing of personal protective equipment (PPE). These controls are primarily based on controlling human behaviour and are subject to human error. Therefore they may be less effective in preventing exposure to hazards. Nevertheless, there is a place for both hard and soft barriers in any risk management plan.

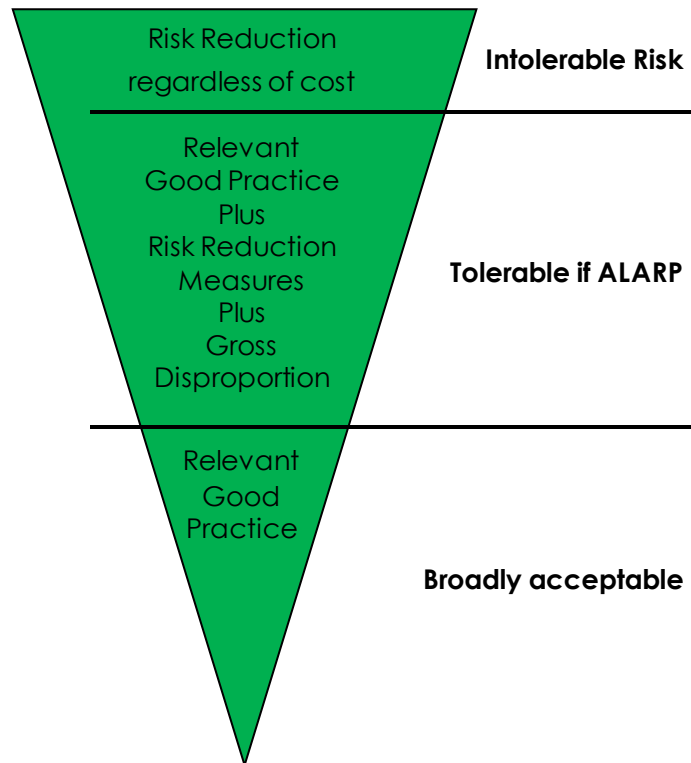


The effectiveness and place of each control on the 'hierarchy' is considered at all times when identifying and suggesting controls for hazards. Existing controls are considered and where necessary, additional controls are recommended



## 7.12 Risk acceptability

Risk acceptability and risk management is one of the most challenging concepts in risk management concerns the establishment of risk acceptability. There is no zero risk if a hazard is truly or potentially present. Risk must be managed to a level that is as low as reasonably practicable (ALARP).



**Diagram – Risk Acceptability**

## 8. RISK METHODOLOGY

### Wollongong Coal Ltd Risk Methodology - (as reference).

#### Consequence Severity

Loss Type <small>(Additional 'Loss Types' may exist for an event; identify and rate accordingly)</small>	Consequence Definitions <small>(Where a scenario has more than one 'Loss Type', choose the one with the maximum credible rating)</small>				
	1 Insignificant	2 Minor	3 Moderate	4 High	5 Major
<b>Harm to People Safety &amp; Health (S/H)</b>	First aid case/exposure to minor health risk	Medical treatment case / Exposure to major health risk	Lost time injury/reversible impact on health	Loss of quality of life/ Irreversible impact on health	Single or multiple fatalities/Impact on health ultimately fatal
<b>Environmental Impact (EI)</b>	Negligible impacts such as small spill or leak immediately contained or recovered. One adverse local public complaint	Minor environmental harm such as large release of contaminant to land that is contained and readily recoverable using pumps or mobile plant. Recovery and clean up costs less than \$5,000. Minor complaint from local resident/s likely easily rectified	Moderate, environmental harm e.g. release of contaminant into storm drain or soil causing deep or moderate contamination. Possible cumulative impact event such as nutrient/sediment runoff. Recovery/clean up and or legal costs up to \$50,000. Numerous public complaints from community moderately difficulty address	Significant off-site release of contaminant to land/water/air. Difficult to recover and major environmental harm or potential harm expected e.g. fish kill, human health with recovery/clean up/ legal costs up to \$250,000. Numerous ongoing public complaints/government lobbying difficult and costly to address	Uncontrolled release of toxic contaminant to land/water/air off-site with significant and long-term environmental harm. Clean up costs over \$250,000. Widespread and serious public outcry/ government lobbying difficult and costly to address
<b>Business Interruption/ Damage and Other Losses (BI/MD)</b>	No disruption to operation/ < \$150k (effect NPBT)	Brief disruption to operation / \$150k to \$750k	Partial shutdown / \$750k to \$3m	Partial loss of operation / \$3m to \$5m	Substantial or total loss of operation / > \$5m

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Consequence Definitions					
(Where a scenario has more than one 'Loss Type', choose the one with the maximum credible rating)					
Loss Type (Additional 'Loss Types' may exist for an event; identify and rate accordingly)	1 Insignificant	2 Minor	3 Moderate	4 High	5 Major
Legal and Regulatory (L&R)	Low level legal issue	Minor legal issue; non-compliance and breaches of the law	Serious breach of law; investigation/report to authority, prosecution and/or moderate penalty possible	Major breach of the law; considerable prosecution and penalties	Very considerable penalties and prosecutions. Multiple law suits and jail terms
Impact on Reputation/Social/Community (R/S/C)	Slight impact - public awareness may exist but no public concern	Limited impact - local public concern	Considerable impact - regional public concern	State impact - state public concern	National impact - national public concern

## 8.1 Probability Chart

The probability that the consequence will occur or re occur.

Level	Descriptor	Description
A	<b>Almost Certain</b>	Expected to occur in most circumstances multiple/12 months (> 80% probability)
B	<b>Likely</b>	Will probably occur in most circumstances once/12 months (61-80% probability)
C	<b>Possible</b>	Might occur within 1-2 year time period once/12 months – 2 years (41-60% probability)
D	<b>Unlikely</b>	Could occur during specified time period once/12 months – 5 years (21-40% probability)
E	<b>Rare</b>	May only occur in exceptional circumstances once > 5 years (20% probability)

## 8.2 Risk Matrix

PROBABILITY	CONSEQUENCE				
	Insignificant 1	Minor 2	Moderate 3	High 4	Major 5
A Almost Certain	M11	S16	S20	E23	E25
B Likely	M7	M12	S17	E21	E24
C Possible	L4	M8	S13	S18	E22
D Unlikely	L2	L5	M9	S14	S19
E Rare	L1	L3	M6	M10	S15

### Risk Ranking Legend

## 8.3 Safety Standard to be Achieved

Selection of controls to reduce risks are made with due regard to their reliability. That is, installing engineering modifications is a superior control to operator training, education or warning signs. Removing the hazard altogether is the most effective control of all.

In every case the effectiveness of the controls in place was considered and assessed by the team for adequacy. In this manner the Risk Control Effectiveness (RCE) was assessed by the team using the risk rank and potential consequences of each hazard to ensure that the controls bring the risk to an acceptable level as low as reasonably practicable (ALARP).

Risk Rating	Risk Level	Guidelines for Risk Rating Matrix
E21 to E25	(E) – Extreme	Eliminate, avoid, implement specific action plans/procedures to manage and monitor – elevate to Senior Management Team for consideration prior to activity – must include improvements to decrease level of risk
S13 to S20	(S) – Significant	Proactively manage with systems and approval of same by Senior Management Team – must include improvements to decrease level of risk
M6 to M12	(M) – Medium	Actively manage
L1 to L5	(L) – Low	Monitor and manage as appropriate



**8.31 Table 1: Risk Assessment**

Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
1	Approvals	Administrative - Non-compliance with reporting, licencing or related timeline, failure to follow due diligence	Extraction Plan area monitoring and management measures fail leading to non-compliance with approval conditions.	Extraction Plan and key component management plans. Monitoring plans	C - Possible	1 - Insignificant	Low 4	No further controls required	C - Possible	1 - Insignificant	Low 4	No further actions	Not applicable
2	Natural Features	Mining induced subsidence	Visual amenity impact of subsidence	Land Management Plan Rehabilitation Management Plan Subsidence Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
3	Natural Features	Mining induced subsidence	Subsidence of cliff lines	No cliff lines in Extraction Plan area that align to MSEC definition of Cliffs. Land Management Plan Rehabilitation Management Plan Subsidence Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
4	Natural Features	Mining induced subsidence	Subsidence of steep slopes	Proposed non-caving mining method is not expected to result in perceptible surface subsidence. Land Management Plan Rehabilitation Management Plan Subsidence Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
5	Natural Features	Mining induced subsidence	Subsidence of rock face features	Proposed mining is not expected to result in perceptible surface subsidence. Land Management Plan Rehabilitation Management Plan Subsidence Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
6	Natural Features	Mining induced subsidence	Subsidence adversely impacts the Illawarra Escarpment	EP area located over 1km from Escarpment Proposed mining is not expected to result in perceptible surface subsidence or impacts.	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable

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Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
7	Public Safety	Mining induced subsidence	Unauthorised access into subsidence zone leads to injury to persons	EP area is wholly within the Sydney Drinking Water Catchment Area which does not allow general public access. Public Safety Management Plan Landowner Signage noting restricted access PPE requirements for staff/authorised persons	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
8	Public Safety	Mining induced subsidence	Damage to Mount Ousley Road causing road accidents	Public roads are not expected to be significantly impacted by mining. Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program Current risk control measures e.g. closure slot.	D -Unlikely	2 - Minor	Low 5	No further controls required	D -Unlikely	2 - Minor	Low 5	No further actions	Not applicable
9	Public Safety	Mining induced subsidence	Damage to Electrical transmission lines leading to loss of power to key service users or bushfire	Public Safety Management Plan Built Features Management Plan Subsidence Assessment Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
10	Public Safety	Mining induced subsidence	Subsidence causes damage to fencing allowing livestock or wildlife to readily access roadways, causing injury to people	<i>Not located in EP Area - not assessed further.</i>			#N/A				#N/A		
11	Groundwater	Mining induced subsidence	Groundwater inflows exceed Water Access License Capacity (615ML)	Groundwater Management Plan Groundwater monitoring program Subsidence Monitoring Program Site Water Balance Monitoring quality of water pumped from the mining areas Correlation of rainfall records with mining area seepage records/model estimates Management and monitoring of adit outflows Predicted to be very unlikely to exceed 543ML per year Non-caving Mining Method	D -Unlikely	2 - Minor	Low 5	No further controls required	D -Unlikely	2 - Minor	Low 5	No further actions	Not applicable

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Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
12	Groundwater	Mining induced subsidence	Groundwater drawdown in Hawkesbury sandstone extent greater than predicted - loss of water to swamps	Groundwater Management Plan Groundwater monitoring program Subsidence Monitoring Program Site Water Balance Monitoring quality of water pumped from the mining areas Correlation of rainfall records with mining area seepage records/model estimates Management and monitoring of adit outflows Triggers for vertical groundwater head and site monitoring bores Ongoing monitoring of BWP's and open standpipes Regional proposed network for longterm monitoring of depressurisation Model updates based on 3 years of data Non-caving Mining Method	D -Unlikely	2 - Minor	<b>Low 5</b>	Proposed new monitoring bores Conceptual Swamp Water Balance (measure within the TARPs)	D -Unlikely	2 - Minor	<b>Low 5</b>	No further actions	Not applicable
13	Groundwater	Mining induced subsidence	Groundwater depressuration beyond predictions within the Permian Coal Measures and Narrabeen Group	Groundwater Management Plan Groundwater monitoring program Subsidence Monitoring Program Site Water Balance Monitoring quality of water pumped from the mining areas Correlation of rainfall records with mining area seepage records/model estimates Management and monitoring of adit outflows Triggers for vertical groundwater head and site monitoring bores Ongoing monitoring of BWP's and open standpipes Regional proposed network for longterm monitoring of depressurisation Model updates based on 3 years of data Non-caving Mining Method	D -Unlikely	1 - Insignificant	<b>Low 2</b>	Ongoing monitoring in accordance with GWMP	D -Unlikely	1 - Insignificant	<b>Low 2</b>	No further actions	Not applicable

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Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
14	Groundwater	Mining induced subsidence	Groundwater depressuration beyond predictions within the Hawkesbury Measures	Groundwater Management Plan Groundwater monitoring program Subsidence Monitoring Program Site Water Balance Monitoring quality of water pumped from the mining areas Correlation of rainfall records with mining area seepage records/model estimates Management and monitoring of adit outflows Triggers for vertical groundwater head and site monitoring bores Ongoing monitoring of BWP's and open standpipes Regional proposed network for long term monitoring of depressurisation Model updates based on 3 years of data Non-caving Mining Method	D -Unlikely	2 - Minor	Low 5	No further controls required	D -Unlikely	2 - Minor	Low 5	No further actions	Not applicable
15	Groundwater	Mining induced subsidence	Groundwater baseflow losses beyond predictions	Reduction in baseflow for Cataract River, Cataract Creek and Bellambi Creek combined is predicted to be very small. Groundwater Management Plan Groundwater monitoring program Subsidence monitoring program Surface water monitoring program	D -Unlikely	1 - Insignificant	Low 2	No further controls required	D -Unlikely	2 - Minor	Low 5	No further actions	Not applicable



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Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
16	Groundwater	Mining induced subsidence	Subsurface cracking leads to groundwater quality changes beyond predictions	Due to the very low level of predicted subsidence, and by association, the minimal overburden fracturing that could develop as a result of the proposed bord and pillar workings, no observable pH or iron hydroxide changes are anticipated in the shallow strata during active mining. Groundwater Management Plan Groundwater monitoring program Monitoring quality of water pumped from the mining areas (including field analysis, discrete and full suite) Management and monitoring of adit outflows	E - Rare	2 - Minor	<b>Low 3</b>	No further controls required	E - Rare	2 - Minor	<b>Low 3</b>	No further actions	Not applicable
17	Groundwater	Mining induced subsidence	Underground mine rejects cause groundwater quality changes to the Permian Coal Measures	Groundwater Management Plan Ongoing representative monitoring of reject material will be undertaken prior to disposal and on a 6-monthly ongoing basis during active operations, if underground storage of tailings is undertaken. No wet washing to be undertaken on site. Waste Management Plan Adit Management Plan	E - Rare	1 - Insignificant	<b>Low 1</b>	No further controls required	E - Rare	1 - Insignificant	<b>Low 1</b>	No further actions	Not applicable
18	Surface Water	Mining induced subsidence	Surface cracking of first order watercourses requiring remediation	Surface Water Management Plan Rehabilitation Management Plan Existing monitoring and flow monitoring	D -Unlikely	2 - Minor	<b>Low 5</b>	No further controls required	D -Unlikely	2 - Minor	<b>Low 5</b>	No further actions	Not applicable
19	Surface Water	Mining induced subsidence	Surface cracking of second order watercourses requiring remediation	Surface Water Management Plan Rehabilitation Management Plan Existing monitoring and flow monitoring	D -Unlikely	2 - Minor	<b>Low 5</b>	No further controls required	D -Unlikely	2 - Minor	<b>Low 5</b>	No further actions	Not applicable

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Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
20	Surface Water	Mining induced subsidence	Increased sedimentation/erosion of creeks	Surface Water Management Plan Rehabilitation Management Plan Existing monitoring and flow monitoring Aquatic monitoring within BMP	D -Unlikely	2 - Minor	Low 5	No further controls required	D -Unlikely	2 - Minor	Low 5	No further actions	Not applicable
21	Surface Water	Mining induced subsidence	Interconnective cracking of watercourses into lower strata causing loss of water resources from creeks	Surface Water Management Plan Rehabilitation Management Plan Existing monitoring and flow monitoring	E - Rare	3 - Moderate	Medium 6	No further controls required	E - Rare	3 - Moderate	Medium 6	No further actions	Not applicable
22	Surface Water	Mining induced subsidence	Loss of water storage within Cataract Dam	Water Management Plan Surface Water Management Plan Rehabilitation Management Plan Dam Safety NSW Approval/Notification Mining method - no undermining of Dam	E - Rare	2 - Minor	Low 3	No further controls required	E - Rare	2 - Minor	Low 3	No further actions	Not applicable
23	Surface Water	Mining induced subsidence	Increased flooding or inundation of land	Water Management Plan Surface Water Management Plan	C - Possible	1 - Insignificant	Low 4	No further controls required	C -Possible	1 - Insignificant	Low 4	No further actions	Not applicable
24	Surface Water	Mining induced subsidence	Groundwater impacts - Surface water quality changes/interactions/seepage.	Water monitoring program, TARPs, Mitigation measures where practical	D -Unlikely	2 - Minor	Low 5	No further controls required	B - Likely	1 - Insignificant	Medium 7	No further actions	Not applicable
25	Swamps	Mining induced subsidence	Subsidence impacts the water holding capacity within the swamps	Low potential for vertical subsidence Swamp water monitoring program Swamp water level and soil moisture monitoring network Swamp subsidence monitoring program Ecological monitoring program Surface water monitoring program Biodiversity Management Plan Water level monitoring Non-Caving mining method can be adapted if required	E - Rare	4 - High	Medium 10	Offsets in the event of impacts	E - Rare	4 - High	Medium 10	No further actions	Not applicable

Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
26	Swamps	Mining induced subsidence	Change to the composition or distribution of flora and fauna species (Giant Dragonfly) within Swamp CCUS5	Proposed mining is not expected to result in perceptible surface subsidence. Upland Swamp Monitoring Plan Biodiversity Management Plan Terrestrial Biodiversity Monitoring Program Baseline monitoring Swamp floristic monitoring and Giant Dragonfly targeted surveys Monitoring of the soil moisture Water level monitoring	E - Rare	3 - Moderate	Medium 6	Offsets in the event of impacts	E - Rare	3 - Moderate	Medium 6	No further actions	Not applicable
27	Swamps	Mining induced subsidence	Change to the composition or distribution of flora and fauna species (Giant Dragonfly) within Swamp CCUS20	Proposed mining is not expected to result in perceptible surface subsidence. Pre-data to be gathered for 1 year with monitoring. Field monitoring. Ongoing monitoring to be implemented if required based on pre-data.	E - Rare	2 - Minor	Low 3	Offsets in the event of impacts	E - Rare	2 - Minor	Low 3	No further actions	Not applicable
28	Swamps	Mining induced subsidence	Change to the composition or distribution of flora and fauna species (Giant Dragonfly) within Swamp CCUS1	Low potential for vertical subsidence Proposed mining is not expected to result in perceptible surface subsidence. Upland Swamp Monitoring Plan Biodiversity Management Plan Terrestrial Biodiversity Monitoring Program Baseline monitoring Swamp floristic monitoring and Giant Dragonfly targeted surveys Monitoring of the soil moisture Water level monitoring	E - Rare	3 - Moderate	Medium 6	Offsets in the event of impacts	E - Rare	3 - Moderate	Medium 6	No further actions	Not applicable

Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
29	Flora and Fauna	Mining induced subsidence	Changes in flow or natural drainage behaviour of pools leads to negative impact to fauna habitat	Proposed mining is not expected to result in perceptible surface subsidence. Biodiversity Management Plan UEP Aquatic Ecological Monitoring Program Rehabilitation Management Plan	E - Rare	2 - Minor	Low 3	No further controls required	E - Rare	2 - Minor	Low 3	No further actions	Not applicable
30	Flora and Fauna	Mining induced subsidence	Changes in flow or natural drainage behaviour of pools leads to negative impact to fauna habitat	Proposed mining is not expected to result in perceptible surface subsidence. Biodiversity Management Plan UEP Aquatic Ecological Monitoring Program Rehabilitation Management Plan	D -Unlikely	3 - Moderate	Medium 9	No further controls required	D -Unlikely	3 - Moderate	Medium 9	No further actions	Not applicable
31	Flora and Fauna	Mining induced subsidence	Water quality data within upper or lower limits of baseline monitoring, OR, Change in Taxa Score; OR, Change in AUSRIVAS Band.	Proposed mining is not expected to result in perceptible surface subsidence. Biodiversity Management Plan UEP Aquatic Ecological Monitoring Program AUSRIVAS monitoring surveys of impact monitoring sites and necessary control sites.	E - Rare	2 - Minor	Low 3	No further controls required	E - Rare	2 - Minor	Low 3	No further actions	Not applicable
32	Flora and Fauna	Mining induced subsidence	Water quality data exceeding upper or lower limits of baseline monitoring, OR, Change in Taxa Score; OR, Change in AUSRIVAS Band.	Proposed mining is not expected to result in perceptible surface subsidence. Biodiversity Management Plan UEP Aquatic Ecological Monitoring Program AUSRIVAS monitoring surveys of impact monitoring sites and necessary control sites.	E - Rare	2 - Minor	Low 3	No further controls required	E - Rare	2 - Minor	Low 3	No further actions	Not applicable
33	Flora and Fauna	Mining induced subsidence	Change to the composition or distribution of flora ( <i>Pultenea aristata</i> , <i>Crypstylus huntariana</i> ) or Fauna species (Cave dwelling bats, Broad-headed snakes)	Proposed mining is not expected to result in perceptible surface subsidence. Biodiversity Management Plan Terrestrial Biodiversity Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable



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Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
34	Flora and Fauna	Mining induced subsidence	Change to the composition or distribution of Giant Burrowing Frog and Little Johns Tree Frog	Not within EP Area (potential habitat within EP Area) Water management plan Biodiversity management plan	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
35	Flora and Fauna	Mining induced subsidence	Changes in water quality or flows impact fish species such as Macquarie Perch etc.	Proposed mining is not expected to result in perceptible surface subsidence. Biodiversity Management Plan Aquatic Biodiversity Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
36	Heritage	Mining induced subsidence	Change in historic heritage site condition is observed, and the heritage values of a site are impacted.	Not located in EP Area - not assessed further.			#N/A				#N/A		
37	Heritage	Mining induced subsidence	Impact on previously identified heritage sites from subsidence	Proposed mining is not expected to result in perceptible surface subsidence. Heritage Management Plan Two previously recorded sites 52-3-0323 and 52-3-0325 could not be located during inspection. Monitoring to re-find locations to occur.	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	Richard Sheehan  Two previously recorded sites 52-3-0323 and 52-3-0325 could not be located during a field survey inspection. Further site survey to locate the sites to be undertaken.	During development of Heritage Management Plan
38	Built Features	Mining induced subsidence	Damage to walking/access tracks	Rehabilitation Management Plan Built Features Management Plan Subsidence Monitoring Program Restricted access to land which forms the EP Area	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
39	Built Features	Mining induced subsidence	Damage to fences causing unauthorised access to Catchment Land	Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable

Step	Aspect	Failure mechanism	Identified hazards	Existing risk reductions	Prob.	Cons.	Risk Rating	Proposed strategies/ Additional Controls	Prob.	Cons.	Residual Risk Rating	Action/ Responsibility	Timing
40	Built Features	Mining induced subsidence	Damage to fire trails impeding access/use	Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
41	Built Features	Mining induced subsidence	Damage to electrical transmission lines	Non located directly above mining Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program Monitoring of the 330kV, 132kV and 33kV transmission lines	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
42	Built Features	Mining induced subsidence	Damage to Telecommunication lines/Telstra assets	Not located in EP Area - not assessed further.			#N/A				#N/A		
43	Built Features	Mining induced subsidence	Damage to the integrity of Cataract Dam Wall	Remote from EP area Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
44	Built Features	Mining induced subsidence	Interaction with adjacent non Russell Vale workings (Corrimal etc.)	Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program Groundwater Management Plan	E - Rare	1 - Insignificant	Low 1	No further controls required	E - Rare	1 - Insignificant	Low 1	No further actions	Not applicable
45	Built Features	Mining induced subsidence	Damage to Mount Ousley Road (pavement, culverts, cuttings and embankments)	Public roads are not expected to be significantly impacted by mining. Built Features Management Plan Public Safety Management Plan Subsidence Monitoring Program Current risk control measures e.g. closure slot.	D -Unlikely	2 - Minor	Low 5	No further controls required	D -Unlikely	2 - Minor	Low 5	No further actions	Not applicable

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## 9. ACTION PLAN

Issue Hazard/Risk	Action	Safety/ Production/ Compliance	Responsibility	Department/ Area	Due Date	Action status
Impact on previously identified heritage sites from subsidence	Two previously recorded sites 52-3-0323 and 52-3-0325 could not be located during a field survey undertaken. Further site survey to locate the sites to be undertaken.	Compliance	Richard Sheehan	Environment	During development of Heritage Management Plan - May 2021	Completed during revision of heritage management plan, September 2021

## 10. RISK REDUCTION VERIFICATION DETAILS

**To be completed prior to activity taking place.**

Process Step	Risk Reduction Measure	Responsible Person	Date Completed

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## 11. REFERENCES

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## 12. CONTROL AND REVISION HISTORY

PROPERTY	VALUE
Approved by	Mining Engineering Manager
Document Owner	Warwick Lidbury
Effective Date	21/07/2022

### Revisions

VERSION	DATE REVIEWED	REVIEW TEAM (CONSULTATION)	NATURE OF THE AMENDMENT
1	08/10/2021	WCL	Draft risk assessment
F1	08/10/2021	WCL	Finalisation for DPE Submission
3			