# RISK ASSESSMENT ATTENDANCE SHEET

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|---|---|
| **OPERATION:** Russell Vale Colliery | **RA Document Control Number: WCL-HS-RA-002** |
| **Risk Assessment Title:** Extraction Plan PC27 to PC34 | |
| **AUTHOR/OWNER:** WCL<br>**Name:** Richard Sheehan | **Title:** Group Environmental Manager |

| Attendee | Employer | Aspect |
|---|---|---|
| Warwick Lidbury | Wollongong Coal Ltd | CEO |
| Devendra Vyas | Wollongong Coal Ltd | Technical Services |
| Richard Sheehan | Wollongong Coal Ltd | Group Environmental Manager |
| Trescinda Brown (Facilitator) | Umwelt | Facilitator |
| David Holmes | Umwelt | Extraction Plan Author |
| Luke Bettridge | Umwelt | Extraction Plan Author |
| Nicholas Robinson | Umwelt | Extraction Plan Preparation |
| Matthew Copeland | Umwelt | Extraction Plan Preparation |
| Kirsty Cooksey | Umwelt | Groundwater |
| Chris Bonomini | Umwelt | Surface Water |
| Stephen Wilson | SCT | Mine Subsidence, Built Features, Natural Features, Public Safety |
| Jane Raithby-Veall | Biosis | Heritage, Biodiversity and Swamps |
| Caragh Heenan | Biosis | Biodiversity and Swamps |
| Samantha Keats | Biosis | Heritage |

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# 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 | 15 | **Low 5** | Consider a visual inspection for erosion and add to SWMP if necessary. | Richard Sheehan | With completed Extraction Plan | Ongoing |
| 2 | 36 | **N/A** | SCT to provide relevant context within the subsidence assessment. | SCT | March 2022 | Complete |
| 3 | 38 | **Low 1** | SCT to produce a figure to show depth of cover vs distance to road. | SCT | February 2022 | Complete |

# 2. INTRODUCTION

A risk assessment was conducted on 01 February 2022 which analysed the hazards relating to the mining of PC27 to PC34 and assessed risk of manifestation of those hazards.

This risk assessment is required to support the Extraction Plan for mining PC27 to PC34 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 less than 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 small, isolated areas within and near the edges of Bulli Seam Goaf areas where remnant pillars not already collapsed become unstable. 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, CORPORTATE 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

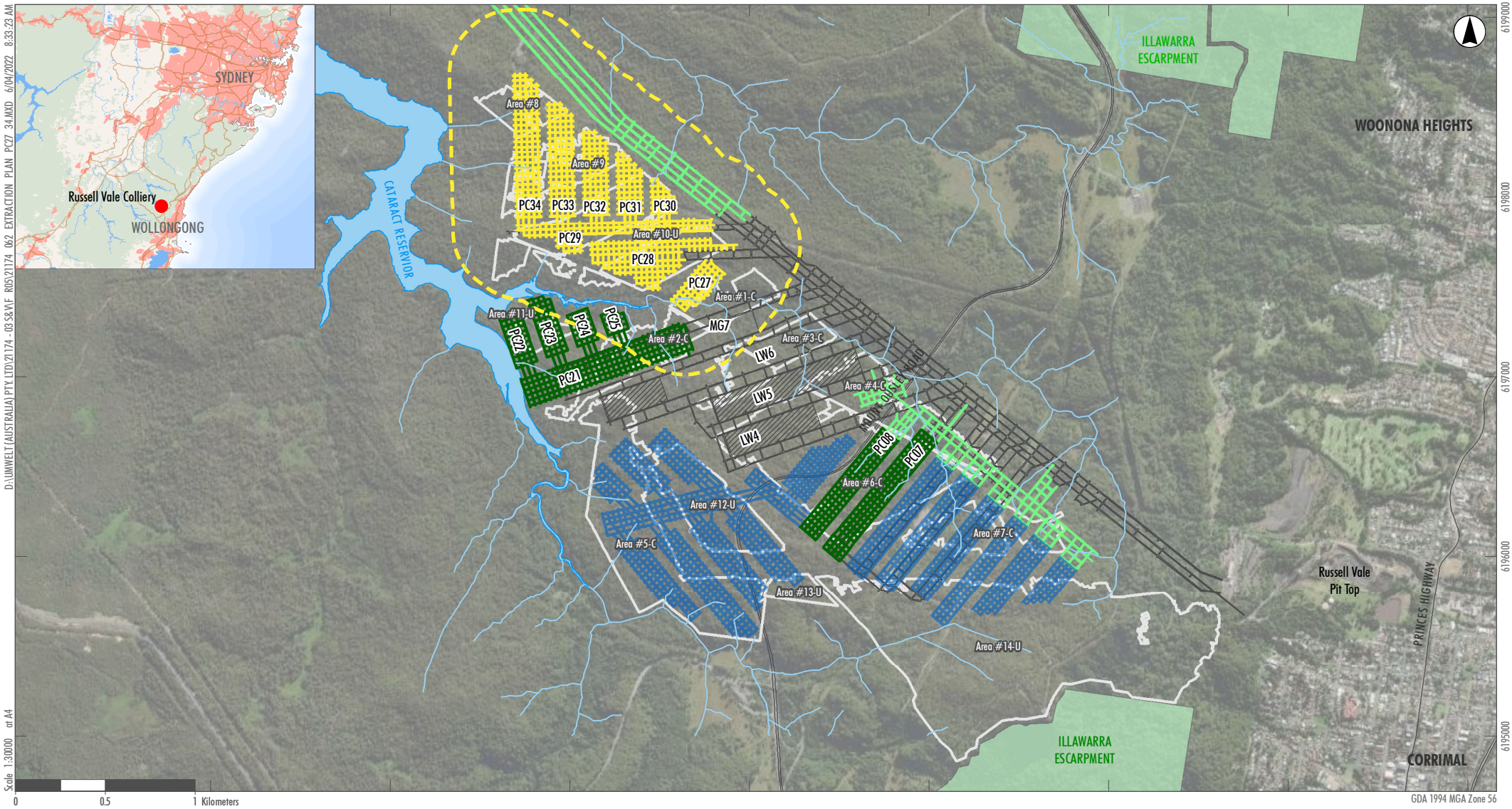
The objectives of the risk assessment process were as follows:

- 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 PC27 to PC34).

The EP Assessment Area is 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 (being, 350m to 390m).

The assessment team was assembled at WCL Russell Vale Colliery and undertook the assessment on 01 February 2022. The scope of the EP Area is shown on **Figure 1** below.




Legend

- Stage 2 Area PC27-34
- EP2 Layout PC27-34
- EP1 Layout PC07-08 and PC21-25
- Future Wongawilli Seam Workings (not subject to this EP)
- Existing Wongawilli Seam Workings
- Wongawilli Seam First Workings (Approved under MP09_0013)
- Bulli Seam Goaf Areas -
  - C - Confirmed as collapsed/subsided
  - U - Unconfirmed as collapsed/subsided
- State Conservation Area
- Drainage Line
- Road

FIGURE 1

Extraction Plan Area
PC27 to 34

Image Source: ESRI (2021) Data source: DFSI (2020)

## 4.1 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.

## 4.2 Assessment Team

**Facilitator: Trescinda Brown**

| Name | Role | Experience relevant to this risk assessment |
|---|---|---|
| **Warwick Lidbury** | CEO WCL | CEO WCL<br>GM Caledon Resource<br>Mine Manager North Goonyella, Crinom, Cook, Russell Vale, Clarence, Kestral Extension<br>Site Senior Executive Cook<br>Registered Survey<br>SEE Queensland<br>First Class Cert of Competency<br>Bachelor of Science (Safety) Newcastle Uni<br>Mines Rescue |
| **Devendra Vyas** | 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. |
| **Richard Sheehan** | 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. |
| **Luke Bettridge (Umwelt)** | 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. |

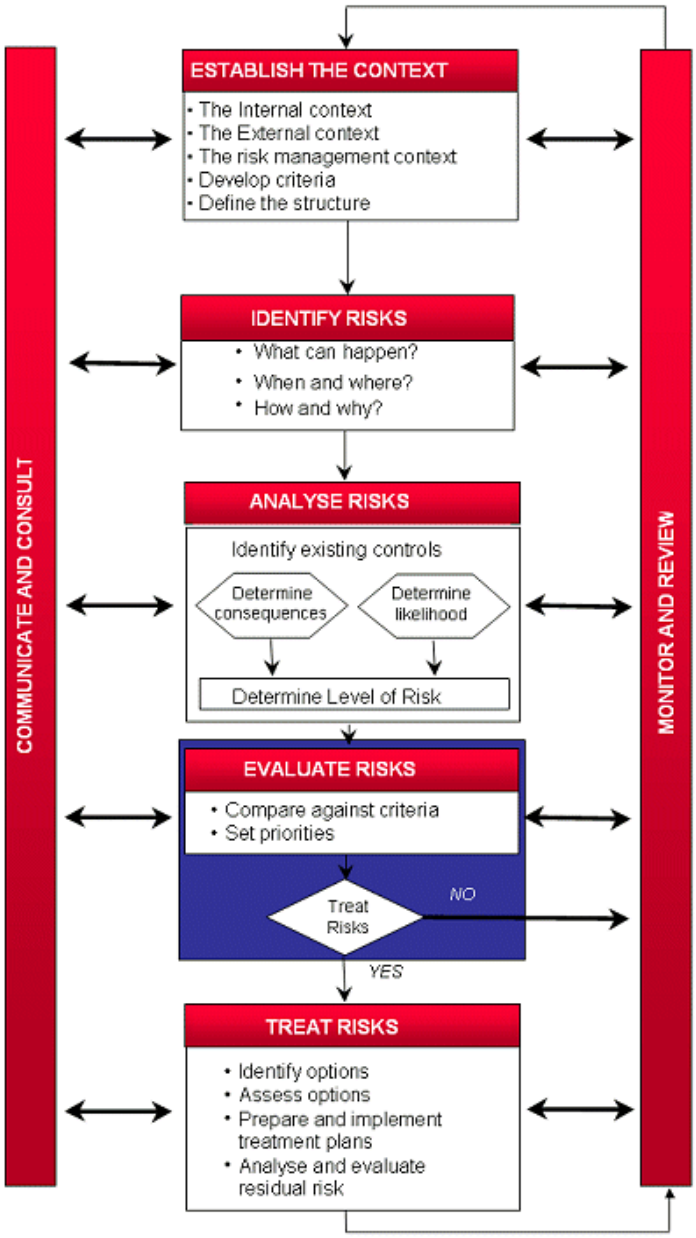
| Name | Role | Experience relevant to this risk assessment |
|---|---|---|
| **David Holmes (Umwelt)** | Principal Environmental Consultant | David is a Principal Environmental Consultant with particular expertise in environmental impact assessment (EIA), environmental policy and environmental and natural resource regulatory systems. David has also peer reviewed a number of technical assessments for the Russell Vale UEP Project. |
| **Trescinda Brown (Umwelt)** | Senior Environmental Scientist | Trescinda has over 15 years' experience as an Environmental Scientist, and has extensive experience in the environmental management sector, with particular focus in the 'on the ground' environmental management of coal mining projects in the NSW Hunter Valley. Trescinda has acted in site-based environment and community positions at various coal mining operations. Trescinda has been responsible for environmental management of underground coal mining operations, open cut coal mines as well as a being an Environment and Community Coordinator for construction projects in the Hunter Valley. Trescinda has previously been involved with the Russell Vale Colliery Stage 1 Extraction Plan.<br>Trescinda has a Statement of Attainment for Facilitation of Risk Assessments. |
| **Nick Robinson (Umwelt)** | Senior Environmental Engineer/Consultant | Nick is an Environmental Consultant with over 15 years experience in the field of environmental consulting. His experience includes environmental management for construction and coal mining. Nick has previously been involved with the Russell Vale Colliery Stage 1 Extraction Plan. |
| **Stephen Wilson (SCT)** | 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. |
| **Kirsty Cooksey** | Senior Hydrogeologist | Kirsty has over 10 years' experience in groundwater consulting across Australia and New Zealand, along with experience as an engineering geologist in hard-rock mining.<br>Kirsty has practical experience in mining, infrastructure and farming sites throughout New Zealand and Australia. She has developed diversified skills and experience, including field investigation programs and fieldwork involving bore installation for water supply and monitoring, surface water and groundwater sampling, and hydraulic testing, groundwater management plans, water supply studies, compliance reporting (annual reviews and trigger reviews), planning and approvals (groundwater impact assessments) to address Local Government, State and Commonwealth regulatory requirements. |

| Name | Role | Experience relevant to this risk assessment |
|---|---|---|
| **Chris Bonomini (Umwelt)** | Principal Engineer - Water Resources | Chris is a water and process engineer who has worked in industry for 24 years, gaining a wide range of hands on experience and practical knowledge. For the last 14 years Chris has worked as a consulting engineer. Chris has extensive experience with surface water and soil management, water balance modelling, water quality, process engineering, qualitative and quantitative risk analysis, and resource efficiency. He has strong practical experience in plant installation and commissioning. These skills enable Chris to offer a comprehensive range of practical water, process and risk engineering services to a diverse client base. |
| **Jane Raithby-Veall** | Associate Director | Jane has over eighteen years' ecological experience on various rail, road, mining and power projects in metropolitan and western Sydney and regional NSW. Her ecological knowledge has been endorsed by the industry as a Certified Environmental Practitioner (Ecology), an Independent Auditor for Rehabilitation and Ecology and an accredited Biodiversity Assessment Method Assessor. |
| **Caragh Heenan** | Project Zoologist | Dr Caragh Heenan has an education culminating in a PhD in the Comparative Animal Physiology laboratory at the University of Adelaide, where her research looked at the structural and thermal properties of avian cup-shaped nests. Caragh has been working in the Natural Resource Management space since 2014, working largely on community engagement and education. Her work has involved engaging with a diverse range of visitors to Uluru-Kata Tjuta National Park in the Northern Territory, to landholders in Alice Springs while coordinating the Land for Wildlife program throughout central Australia, and most recently, working with members of the public regarding threatened species in the Northern Rivers NSW. |
| **Samantha Keats (Biosis)** | 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

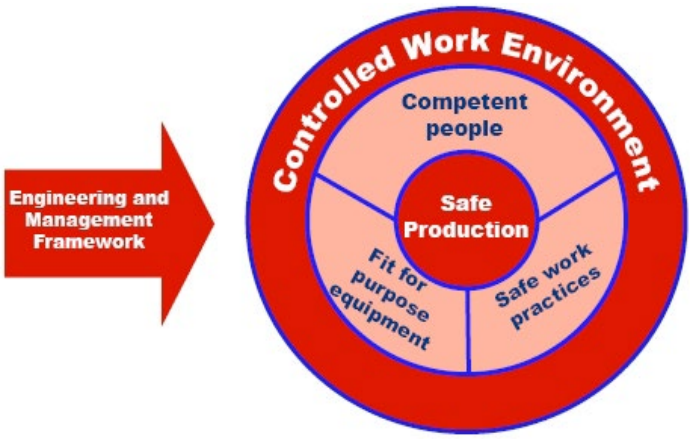
Frequency is defined as the number of times something (e.g.an activity, the hazard or incident) may occur within a specified timeframe, such as daily, weekly or annually. Within this guideline the frequency term is used in quantitative risk assessments.

## 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.

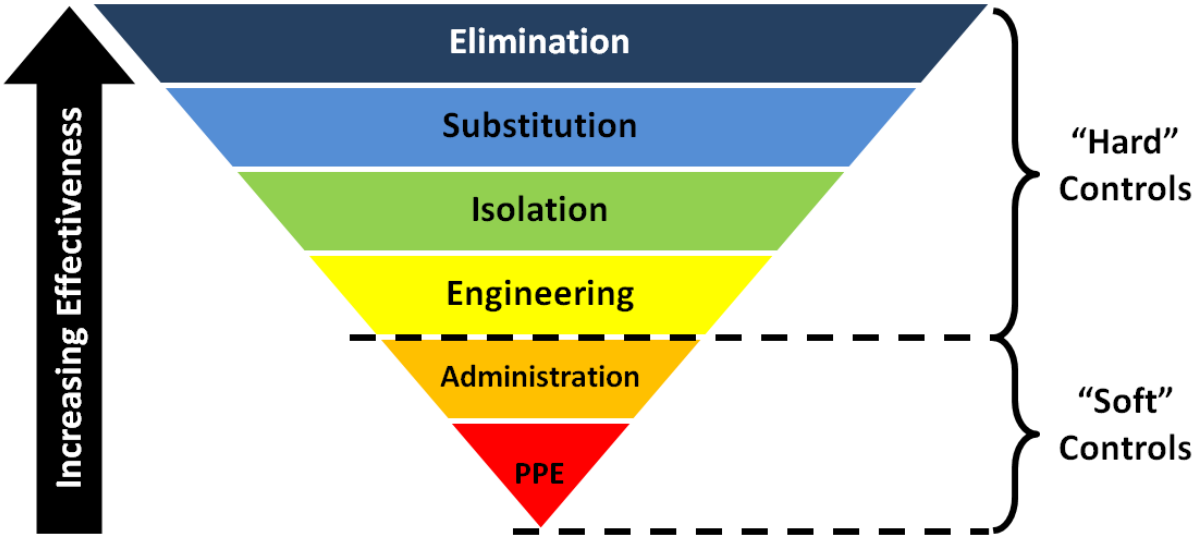
## 7.10 Common Mining Energies

| | |
|---|---|
| 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 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 always considered 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).

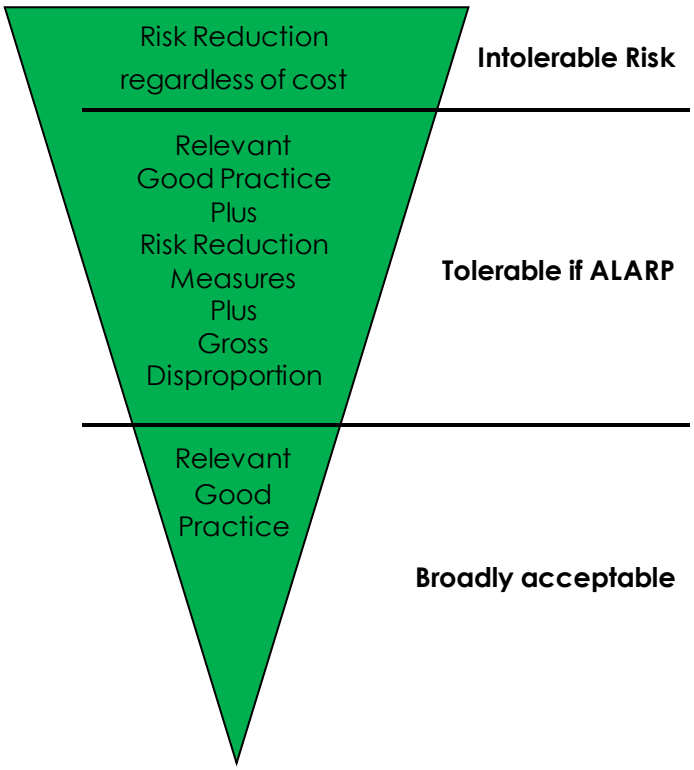



**Diagram – Risk Acceptability**

# 8. RISK METHODOLOGY

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

Consequence Severity

| | 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** |
| **Harm to People Safety & Health (S/H)** | 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 |
| **Environmental Impact (EI)** | 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 |
| **Business Interruption/ Damage and Other Losses (BI/MD)** | 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 |

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

## 8.2 Risk Matrix

| | CONSEQUENCE | | | | |
|---|---|---|---|---|---|
| | Insignificant | Minor | Moderate | High | Major |
| PROBABILITY | 1 | 2 | 3 | 4 | 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 |

**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** | Natural Features | Mining induced subsidence | Visual amenity impact of subsidence | Land Management Plan.<br>Rehabilitation Management Plan (as contingency).<br>Subsidence Monitoring Program. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | No further actions | Not applicable |
| **2** | Natural Features | Mining induced subsidence | Subsidence of cliff lines | No cliff lines in Extraction Plan area that align to MSEC definition of Cliffs.<br>Land Management Plan.<br>Rehabilitation Management Plan.<br>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 steep slopes | No steep slopes within the Stage 2 area.<br>Proposed non-caving mining method is not expected to result in mining induced instability.<br>Land Management Plan.<br>Rehabilitation Management Plan.<br>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 rock faces | No rock faces within the Stage 2 area. (Proposed mining is not expected to result in perceptible surface subsidence.<br>Land Management Plan.<br>Rehabilitation Management Plan.<br>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 adversely impacts the Illawarra Escarpment | EP area located over 2km from Escarpment.<br>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 |
| **6** | Groundwater | Mining induced subsidence | Groundwater inflows exceed Water Access License Capacity (615ML) | Groundwater Management Plan.<br>Groundwater monitoring program.<br>Subsidence Monitoring Program.<br>Site Water Balance.<br>Monitoring quality of water pumped from the mining areas.<br>Correlation of rainfall records with mining area seepage records/model estimates.<br>Management and monitoring of adit outflows.<br>Predicted to be very unlikely to exceed 543ML per year.<br>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 |

| 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** | Groundwater | Mining induced subsidence | Groundwater drawdown in Hawkesbury sandstone extent greater than predicted - loss of water to swamps | Groundwater Management Plan.<br>Groundwater monitoring program.<br>Subsidence Monitoring Program.<br>Site Water Balance.<br>Monitoring quality of water pumped from the mining areas.<br>Correlation of rainfall records with mining area seepage records/model estimates.<br>Management and monitoring of adit outflows.<br>Triggers for vertical groundwater head and site monitoring bores.<br>Ongoing monitoring of VWPs and open standpipes.<br>Regional proposed network for long-term monitoring of depressurisation.<br>Model updates based on 3 years of data.<br>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 |
| **8** | Groundwater | Mining induced subsidence | Groundwater depressurisation beyond predictions within the Permian Coal Measures and Narrabeen Group | Groundwater Management Plan.<br>Groundwater monitoring program.<br>Subsidence Monitoring Program.<br>Site Water Balance.<br>Monitoring quality of water pumped from the mining areas.<br>Correlation of rainfall records with mining area seepage records/model estimates.<br>Management and monitoring of adit outflows.<br>Triggers for vertical groundwater head and site monitoring bores.<br>Ongoing monitoring of VWPs and open standpipes.<br>Regional proposed network for long term monitoring of depressurisation.<br>Model updates based on 3 years of data.<br>Non-caving Mining Method. | D -Unlikely | 1 - Insignificant | **Low 2** | Ongoing monitoring in accordance with GWMP | D -Unlikely | 1 - Insignificant | **Low 2** | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9** | Groundwater | Mining induced subsidence | Groundwater depressurisation beyond predictions within the Hawkesbury Measures | Groundwater Management Plan.<br>Groundwater monitoring program.<br>Subsidence Monitoring Program.<br>Site Water Balance.<br>Monitoring quality of water pumped from the mining areas.<br>Correlation of rainfall records with mining area seepage records/model estimates.<br>Management and monitoring of adit outflows.<br>Triggers for vertical groundwater head and site monitoring bores.<br>Ongoing monitoring of VWPs and open standpipes.<br>Regional proposed network for long term monitoring of depressurisation.<br>Model updates based on 3 years of data.<br>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 |
| **10** | 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.<br>Groundwater Management Plan.<br>Groundwater monitoring program.<br>Subsidence monitoring program.<br>Surface water monitoring program. | D -Unlikely | 1 - Insignificant | **Low 2** | No further controls required | D -Unlikely | 1 - Insignificant | **Low 2** | No further actions | Not applicable |
| **11** | Groundwater | Mining induced subsidence | Subsurface cracking leads to groundwater quality changes beyond predictions | Cracking from 100mm not expected but could occur in areas of higher (up to 500mm) subsidence impact.<br>Due to the very low level of predicted subsidence, and by association, the minimal overburden fracturing that could develop because of the proposed bord and pillar workings, no observable pH or iron hydroxide changes are anticipated in the shallow strata during active mining.<br>Groundwater Management Plan.<br>Groundwater monitoring program.<br>Monitoring quality of water pumped from the mining areas (including field analysis, discrete and full suite).<br>Management and monitoring of adit outflows. | E - Rare | 2 - Minor | **Low 3** | Maintain existing water quality monitoring. | E - Rare | 2 - Minor | **Low 3** | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **12** | Surface Water | Mining induced subsidence | Surface cracking of first order watercourses requiring remediation (e.g. Cataract and Bellambi Creeks) | Surface Water Management Plan.<br>Rehabilitation Management Plan.<br>Existing monitoring and flow monitoring. | E - Rare | 2 - Minor | **Low 3** | No additional monitoring required – refer to Swamp monitoring. | E - Rare | 2 - Minor | **Low 3** | No further actions | Not applicable |
| **13** | Surface Water | Mining induced subsidence | Surface cracking of fourth order watercourses requiring remediation (Cataract Creek) | Surface Water Management Plan.<br>Rehabilitation Management Plan.<br>Existing monitoring and flow monitoring. | D -Unlikely | 2 - Minor | **Low 5** | Potential for monitoring including flow monitoring to be included in monitoring program. | D -Unlikely | 2 - Minor | **Low 5** | No further actions | Not applicable |
| **14** | Surface Water | Mining induced subsidence | Surface cracking of watercourses causing redirection of surface water | Surface Water Management Plan.<br>Rehabilitation Management Plan.<br>Existing monitoring and flow monitoring. | D -Unlikely | 2 - Minor | **Low 5** | No further controls required | D -Unlikely | 2 - Minor | **Low 5** | No further actions | Not applicable |
| **15** | Surface Water | Mining induced subsidence | Increased sedimentation/ erosion of creeks | Surface Water Management Plan.<br>Rehabilitation Management Plan.<br>Existing monitoring and flow monitoring.<br>Aquatic monitoring within BMP. | D - Unlikely | 2 - Minor | **Low 5** | Additional visual inspection monitoring point to be considered / determined downstream of PC27. | D - Unlikely | 2 - Minor | **Low 5** | Consider a visual inspection for erosion and add to SWMP if necessary. | As part of EP |
| **16** | Surface Water | Mining induced subsidence | Interconnective cracking of watercourses into lower strata causing loss of water resources from creeks | Surface Water Management Plan.<br>Rehabilitation Management Plan.<br>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 |
| **17** | Surface Water | Mining induced subsidence | Loss of water storage within Cataract Dam | Water Management Plan.<br>Surface Water Management Plan.<br>Rehabilitation Management Plan.<br>Dam Safety NSW Approval/Notification.<br>Mining method - no undermining of Dam. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 2 - Insignificant | **Low 1** | No further actions | Not applicable |
| **18** | 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 | D - Unlikely | 2 - Minor | **Low 5** | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **19** | Swamps | Mining induced subsidence | Subsidence impacts the water holding capacity within the swamps | Swamp water monitoring program.<br>Swamp water level and soil moisture monitoring network.<br>Swamp subsidence monitoring program.<br>Ecological monitoring program.<br>Surface water monitoring program.<br>Biodiversity Management Plan.<br>Water level monitoring.<br>Non-caving mining method can be adapted if required. | E - Rare | 4 - High | **Medium 10** | Offsets in the event of irreversible impacts | E - Rare | 4 - High | **Medium 10** | No further actions | Not applicable |
| **20** | Swamps | Mining induced subsidence | Change to the composition or distribution of flora and fauna species (Giant Dragonfly and *Puttenea aristata*) within Swamp in EP area | Low potential for vertical subsidence up to 300mm in very small areas.<br>Proposed mining is not expected to result in perceptible surface subsidence.<br>Upland Swamp Monitoring Plan.<br>Biodiversity Management Plan.<br>Terrestrial Biodiversity Monitoring Program.<br>Baseline monitoring.<br>Swamp floristic monitoring and Giant Dragonfly targeted surveys.<br>Monitoring of the soil moisture.<br>Water level monitoring.<br>Field monitoring.<br>Ongoing monitoring to be implemented if required based on pre-data. | E - Rare | 3 - Moderate | **Medium 6** | Offsets in the event of impacts | E - Rare | 3 - Moderate | **Medium 6** | No further actions | Not applicable |
| **21** | Swamps | Mining induced subsidence | Change to the composition or distribution of flora and fauna species (Giant Dragonfly) within Swamp | Proposed mining is not expected to result in perceptible surface subsidence.<br>Pre-data to be gathered for 1 year with monitoring. | E - Rare | 2 - Minor | **Low 3** | Offsets in the event of impacts | E - Rare | 2 - Minor | **Low 3** | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **22** | Swamps | Mining induced subsidence | Change to the composition or distribution of flora and fauna species (Giant Dragonfly) within Swamp | Low potential for vertical subsidence up to 300mm in very small areas.<br>Proposed mining is not expected to result in perceptible surface subsidence.<br>Upland Swamp Monitoring Plan.<br>Biodiversity Management Plan.<br>Terrestrial Biodiversity Monitoring Program .<br>Baseline monitoring.<br>Swamp floristic monitoring and Giant Dragonfly targeted surveys.<br>Monitoring of the soil moisture.<br>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 |
| **23** | 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.<br>Biodiversity Management Plan.<br>UEP Aquatic Ecological Monitoring Program.<br>Rehabilitation Management Plan.<br>Water Management Plan. | E - Rare | 2 - Minor | **Low 3** | Refer to visual monitoring for erosion and sedimentation | E - Rare | 2 - Minor | **Low 3** | No further actions | Not applicable |
| **24** | 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.<br>Biodiversity Management Plan.<br>UEP Aquatic Ecological Monitoring Program.<br>Rehabilitation Management Plan. | D -Unlikely | 3 - Moderate | **Medium 9** | No further controls required | D -Unlikely | 3 - Moderate | **Medium 9** | No further actions | Not applicable |
| **25** | 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.<br>Biodiversity Management Plan.<br>UEP Aquatic Ecological Monitoring Program.<br>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 |
| **26** | 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.<br>Biodiversity Management Plan<br>UEP Aquatic Ecological Monitoring Program.<br>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 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **27** | Flora and Fauna | Mining induced subsidence | Change to the composition or distribution of flora (*Crypstylus huntariana*) or Fauna species (Broad-headed snakes) | Proposed mining is not expected to result in perceptible surface subsidence.<br>Biodiversity Management Plan.<br>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 |
| **28** | Flora and Fauna | Mining induced subsidence | Change to the composition or distribution of cave-dwelling bats | Potential habitat within EP Area.<br>Water Management Plan.<br>Biodiversity Management Plan.<br>Mine Plan – Roadway TARP – Monitoring. | D – Unlikely | 2 - Minor | **Low 5** | No further controls required | D – Unlikely | 2 - Minor | **Low 5** | No further actions | Not applicable |
| **29** | Flora and Fauna | Mining induced subsidence | Change to the composition or distribution of Giant Burrowing Frog and Little Johns Tree Frog | Potential habitat within EP Area.<br>Water management plan.<br>Biodiversity management plan. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | No further actions | Not applicable |
| **30** | 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.<br>Biodiversity Management Plan.<br>Aquatic Biodiversity Monitoring Program.<br>Water quality monitoring as described in the Water Management Plan. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | No further actions | Not applicable |
| **31** | Heritage | Mining induced subsidence | Change in historic heritage site condition is observed, and the heritage values of a site are impacted.<br>Cataract Reservoir | Proposed mining is not expected to result in perceptible surface subsidence.<br>Existing TARP - subsidence monitoring.<br>Mine plan design - >100m. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | No further actions | No further actions |
| **32** | Heritage | Mining induced subsidence | Impact on previously identified Aboriginal heritage sites from subsidence<br>Two grinding groove sites are unable to be located in the Stage 2 area | Non-caving mining method, no significant impacts predicted.<br>Predicted subsidence of 100mm, unlikely to be greater than 300mm.<br>Heritage Management Plan.<br>Baseline inspections have been undertaken across the area.<br>Subsidence Assessment. | C - Possible | 2 - Minor | **Medium 8** | Monitor the location in an attempt to find 2 x grinding groove locations | C - Possible | 2 - Minor | **Medium 8** | No further actions | No further actions |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **33** | Built Features | Mining induced subsidence | Damage to walking/access tracks – land owned by WaterNSW | Rehabilitation Management Plan.<br>Built Features Management Plan.<br>Subsidence Monitoring Program.<br>Land Management Plan.<br>Water NSW agreement.<br>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 |
| **34** | Built Features | Mining induced subsidence | Damage to electrical transmission lines<br>Decommissioned WCL line – 2 x poles over the area remain<br>No other features (public) within the area | Non located directly above mining.<br>Built Features Management Plan.<br>Public Safety Management Plan.<br>Subsidence Monitoring Program. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | No further actions | Not applicable |
| **35** | Built Features | Mining induced subsidence | Damage to Telecommunication lines/Telstra assets | N/A - remote from the EP Area – not assessed further. | | | **#N/A** | | | | **#N/A** | | |
| **36** | Built Features | Mining induced subsidence | Damage to the integrity of Cataract Dam Wall | N/A - remote from the EP Area – not assessed further. | | | **#N/A** | | | | **#N/A** | SCT to provide relevant context within the subsidence assessment. | Mar 2022 (Complete) |
| **37** | Built Features | Mining induced subsidence | Interaction with adjacent non-Russell Vale workings (Goaf for Corrimal alongside western boundary to EP area) | Subsidence Assessment. | D - Unlikely | 1 - Insignificant | **Low 2** | No further controls required | D - Unlikely | 1 - Insignificant | **Low 2** | No further actions | Not applicable |
| **38** | Built Features | Mining induced subsidence | Damage to Mount Ousley Road (pavement, culverts, cuttings and embankments) | Remote from mining - no perceptible impacts expected.<br>Public roads are not expected to be significantly impacted by mining.<br>Subsidence Monitoring Program.<br>Current risk control measures e.g. closure slot. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | SCT to produce a figure to show depth of cover vs distance to road. | Feb 2022 (Complete) |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **39** | 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.<br>Public Safety Management Plan.<br>Landowner Signage noting restricted access.<br>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 |
| **40** | Public Safety | Mining induced subsidence | Damage to Mount Ousley Road causing road accidents | Remote from mining – no perceptible impacts expected.<br>Subsidence Monitoring Program.<br>Current risk control measures e.g. closure slot. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | No further actions | Not applicable |
| **41** | Public Safety | Mining induced subsidence | Damage to Electrical transmission lines leading to loss of power to key service users or bushfire | Remote from mining – no perceptible impacts expected.<br>Subsidence Monitoring Program. | E - Rare | 1 - Insignificant | **Low 1** | No further controls required | E - Rare | 1 - Insignificant | **Low 1** | No further actions | Not applicable |

# 9. ACTION PLAN

| Issue Hazard/Risk | Action | Safety/ Production/ Compliance | Responsibility | Department/ Area | Due Date | Action status |
|---|---|---|---|---|---|---|
| Increased sedimentation/ erosion of creeks | Consider a visual inspection for erosion and add to SWMP if necessary. | Compliance | Richard Sheehan | Environment | With completed Extraction Plan | Ongoing |
| Damage to the integrity of Cataract Dam Wall | SCT to provide relevant context within the subsidence assessment. | Compliance | Richard Sheehan | Environment | March 2022 | Complete |
| Damage to Mount Ousley Road (pavement, culverts, cuttings and embankments) | SCT to produce a figure to show depth of cover vs distance to road. | Compliance | Richard Sheehan | Environment | February 2022 | Complete |

# 10. CONTROL AND REVISION HISTORY

| PROPERTY | VALUE |
|---|---|
| Approved by | Mining Engineering Manager |
| Document Owner | Warwick Lidbury |
| Effective Date | |

**Revisions**

| VERSION | DATE REVIEWED | REVIEW TEAM (CONSULTATION) | NATURE OF THE AMENDMENT |
|---|---|---|---|
| 1 | March 2022 | All attendees | Draft risk assessment |
| F1 | March 2022 | All attendees | Finalisation for submission to DPE |