APPENDIX M

Environmental Risk Assessment

Illawarra Coal Holdings Pty Ltd

Dendrobium Mine
Plan for the Future: Coal for Steelmaking

Risk Assessment Report

AR2254

Revision 2

09 April 2019

Assessment and report completed by;
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1. Revisions

Rev No	Date	Description
1	18 January 2018	Final Release
2	09 April 2019	Addition of hazard identified in the LW17 SMP Risk Assessment included into this assessment

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2. Participants

Name	Position	Relevant Years' Experience
Matthew Richardson	Niche Environment and Heritage Director	20 Years
Renee Regal	Niche Environment and Heritage Heritage Team Leader	12 Years
Lindsay Gilbert	HEC Principal Water Resources Engineer	30 Years
Josh Hunt	Resource Strategies Principal	20 Years
Luke Baker	Niche Environment and Heritage Ecology Team Leader	10 Years
Stuart Brown	HGEO Principal Hydrogeologist	20 Years
James Barbato	MSEC Subsidence Engineer	13 Years
Gary Brassington	South32 Manager Approvals	25 Years
Joanna Hinks	Resource Strategies Senior Environmental Manager	10 Years
Will Minchin	Watershed HydroGeo Hydrogeologist	15 Years

3. Introduction

The Dendrobium Mine is an existing underground coal mine situated in the Southern Coalfield of New South Wales (NSW), approximately 8 kilometres west of Wollongong.

Illawarra Coal Holdings Pty Ltd (Illawarra Coal), a wholly owned subsidiary of South32 Limited, is the owner and operator of the Dendrobium Mine.

The existing mining operations are undertaken in accordance with Development Consent DA 60 03 2001 (as modified), as well as the Approval Decision (EPBC 2001/214) under the Environment Protection and Biodiversity Conservation Act, 1999.

This Environmental Risk Assessment (ERA) has been prepared in support of an Environmental Impact Statement (EIS) for the Dendrobium Mine – Plan for the Future: Coal for Steelmaking (the Project).

The Project includes new underground mining areas at the Dendrobium Mine to gain access to additional coal within CCL 768 in two proposed future mining areas; namely Area 5 and Area 6. This extension would be supported by the development of supporting infrastructure, including ventilation and gas drainage infrastructure. The Project would also involve the use of the existing, approved surface facilities at the Dendrobium Mine and the use of the Cordeaux Pit Top until the end of the Project life in 2048.

Key surface facilities at the Dendrobium Mine include the Dendrobium Pit Top, Kemira Valley Coal Loading Facility, Kemira Valley Rail Line, Dendrobium Coal Preparation Plant (CPP) and Dendrobium Nos 1, 2 and 3 Shafts.

4. System Description

The key steps in the process involved conducting:

1. Background analyses on environmental aspects for the Dendrobium Mine;

2. A scoping session with decision making personnel to discuss the topic, and to confirm the risk analysis process and key outcomes sought;

3. A team-based analysis with technical experts to evaluate and treat the risks, including:
   a. An open discussion with the team on “what do we want to achieve” in relation to the analysis as identified within the assessment scope;
   b. Presentation on the Project and associated environmental aspects, including experiences, at the Dendrobium Mine;
   c. Comprehensive assessment of all relevant environmental aspects, including utilising a list of environmental aspects (steps) as a guide;
      (The previous "Guideline For Applications For Subsidence Management Approvals" (EDG17) was used as a guide to identify the subsidence impacts to identified surface features. Those items that were not applicable to the Project were removed from the assessment list.)
   d. Risk Ranking of the identified hazards;
   e. Identification of risk mitigation measures to reduce risk levels to a tolerable state; and
   f. Generation of an action plan of identified treatments options.

5. Context Summary

5.1 Strategic Context

South32 (S32) Illawarra Coal is committed to comprehensive and effective management of environmental aspects related to its operations.

When changes to mining or new mining processes are implemented, Illawarra Coal implements Risk Assessment techniques to reduce the risks to the environment.

5.2 Corporate Context

As Illawarra Coal is committed to comprehensive and effective management of environmental aspects related to its operations, Risk Assessment techniques are used to identify any hazards and to minimise exposure to its people, the environment, and operations.

5.3 Risk Management Context

The primary objective of this ERA is to identify hazards associated with the Project that relate to the environment and the public, and to determine what further controls, if any, are required to reduce or eliminate any identified hazards to tolerable levels as far as practicable.

This assessment has been prepared in support of an EIS for the Project. The Secretary's Environmental Assessment Requirements (SEARs) for the project state: "a risk assessment of the potential environmental impacts of the development, identifying key assessment issues".

6. Objectives and Scope

A scoping session was held prior to the assessment (Section 4) and the detail was agreed and confirmed.

The objective of this ERA is to identify hazards associated with the Project that relate to the environment and the public, and to determine what additional controls, if any, are required to reduce or eliminate any identified hazards to tolerable levels as far as practicable.

The ERA was conducted to satisfy the requirements of the Project SEARs.

7. Assumptions and Constraints

The following assumptions and limitations were applied to this risk assessment:

- This assessment relates to the Project, including extraction, transport and processing of additional coal within CCL 768 in two proposed future mining areas; namely Area 5 and Area 6.
- All commitments, including monitoring and management programs, will proceed as identified in the EIS.

The team noted that safety and business-related issues (i.e. non-environmental risks) identified are intended to be addressed by other South32 risk management systems and are not explored in any depth in this ERA.

Documents related to this ERA include:

- AS NZS ISO 31000-2009
  Risk management - Principles and guidelines

- MDG1010 - Minerals Industry Safety and Health Risk Management Guideline
  Dated. January 2011

- EDG17
  Guideline for Applications for Subsidence Management Approvals

- The Project SEARs

- HB 203:2012 - Managing environment-related risk

8. Risk Treatment

The team was introduced to the Risk Assessment Process at the commencement of the session by the facilitator. The various steps were explained and the group reviewed the Likelihood, Consequence and Risk Ranking Matrix.

The risk ranking was done with consideration to existing controls being in place, and controls that were already planned to be implemented. Controls were developed using the following forms:

1. Avoidance – avoid the risk by deciding not to proceed with the activity likely to generate the risk (where this is practicable).
2. Reduction – reduce the likelihood of the event.
3. Reduction – reduce the consequences of the event.
4. Transfer – transfer the risk – involve another party to bear or share some part of the risk.
5. Accept – accept the risk within the organisation and establish an appropriate plan to manage the consequences of these risks if they are to occur.

The above risk control options were applied by reference to the following control methodologies in a hierarchical sequence:

1. Design – to the extent reasonable and practicable, ensure that hazards are designed out of the Project.
2. Remove the hazard or substitute less hazardous aspects of the Project.
3. Adopt a safer process – alter aspects of the Project to make them safer.
4. Enclose or isolate the hazard – provide guards or boundaries around the Project.
5. Establish appropriate administrative procedures. Set up, document and implement new procedures that provide for:
   - Scheduling of the Project to reduce exposure.
   - Routine procedures to reduce hazards from the Project.
   - Training on hazards and correct work procedures.
   - Monitoring to identify unanticipated trends or outcomes.

An audit system will be in place to confirm that all recommendations from this assessment are implemented.

9. Facilitator Qualifications and Experience

Shane Chiddy holds an Associate Diploma in Engineering (Electrical), is an Officer of the Institution of Engineers (Australia) and is a member of the Maintenance Engineering Society of Australia (MESA) and the Mining Electrical and Mining Mechanical Engineering Society (MEMMES). He has also completed Conveyancing Law through Macquarie University and Establish the Risk Management Systems (Mine 7033 - G3) through Queensland University and is certified as a Functional Safety Engineer by TÜV Rheinland for both Safety Instrumented Systems and Machine Safety.

Prior to commencing his consulting career, Shane Chiddy qualified as an electrician and worked underground for 15 years. He then occupied a number of engineering roles within Rio Tinto, including such roles as electrical supervisor, Development Engineer and Senior Production Engineer. This latest role was responsible for the Longwall, underground diesel equipment and conveyors.

Additionally Shane Chiddy has been trained and accredited by John Moubray in the UK as a certified RCM II practitioner, and has conducted a number of extensive Reliability-centred Maintenance II analyses including underground and surface equipment such as Longwalls, Continuous Miners and conveying systems. He has facilitated RCM II analysis and delivered training in the mining, defence and telecommunications industries.

His consulting experience includes the application of Reliability-centred Maintenance II and extensive Risk Management and Project Management assignments.

10. Sub-Systems Considered in the Assessment

Sub-System		STEP IN PROCESS	
1	Underground Mine – Areas 5 and 6	A	Catchment Areas or Declared Special Areas (Yield / Supply Capacity)
		B	Surface Water Quantity
		C	Surface Water Quality
		D	Aquifers or Known Groundwater Resources
		E	Cliffs, minor cliffs, rock outcrops and steep slopes
		F	Swamps, Wetlands or Water Related Ecosystems (inc. Aquatic Flora and Fauna)
		G	Threatened or Protected Species
		H	State Conservation Areas
		I	Terrestrial Flora and Fauna
		J	Disused Railway Corridor
		K	Roads (All Types including Culverts) (inc. Road Safety)
		L	Gas infrastructure
		M	Electricity transmission lines, powerlines or associated plants
		N	Dams, Reservoirs or Associated Works
		O	Areas of Archaeological and/or Heritage Significance
		P	Buildings and other structures
		Q	Groundwater and Surface Water
2	Use of Existing Dendrobium Mine Surface Facilities	A	Surface Water Quantity or Quality
		B	Flora and Fauna including Threatened or Protected Species
		C	Roads (All Types) (inc. Road Safety)
		D	Acoustic Amenity
		E	Air Quality
		F	Visual Amenity
		G	Contamination of Land
3	Continued Use of Kemira Valley Rail Line	A	Acoustic Amenity
		B	Air Quality
		C	Visual Amenity
		D	Contamination of Land
4	Construction and Use of Ventilation and gas drainage infrastructure	A	Catchment Areas or Declared Special Areas
		B	Flora and Fauna including Threatened or Protected Species
		C	Areas of Archaeological and/or Heritage Significance
		D	Acoustic Amenity
		E	Air Quality
		F	Visual Amenity
		G	Contamination of Land
5	Use of Cordeaux pit top	A	Catchment Areas or Declared Special Areas
		B	Roads (All Types) (inc. Road Safety)
		C	Acoustic Amenity
		D	Air Quality
		E	Visual Amenity
		F	Contamination of Land

11. Risk Assessment Methodology

11.1 Qualitative Risk Analysis

This Risk Assessment has been performed using Qualitative Risk Analysis techniques and has been performed to align with the principles of the Australian Standard AS31000 - Risk Management Principles and Guidelines and the Department of Mineral Resource Guideline MDG1010.

The Risk Assessment has followed the WRAC (Workplace Risk Assessment and Control) principles as outlined in the guideline.

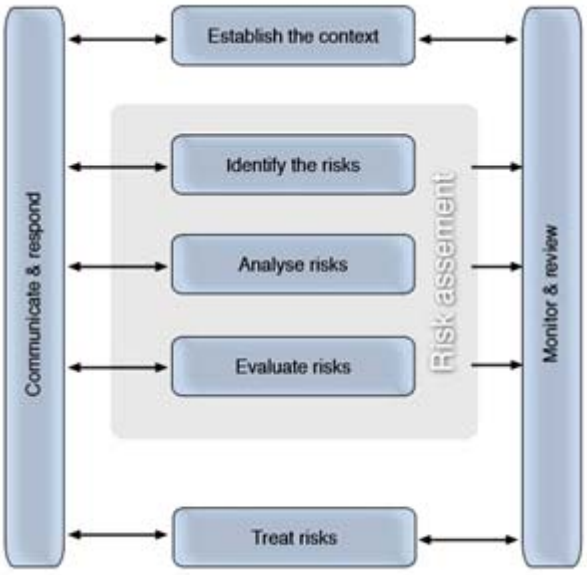
The qualitative approach succeeds by using local expert knowledge and relevant historical data.

This system of analysis uses a participative approach which is very powerful for identifying potential hazard scenarios.

The following steps outline the systematic identification of hazards, ranking of risks, and identification of new and/or improved controls that were used in the Risk Assessment session:

1. Introduce team to the Risk Assessment process and the context of the Risk Assessment. This includes the scope and method of the Risk Assessment.
2. Identify discrete components, or elements, of the Project.
3. Identify and add potential deviation steps.
4. Review each sub-system and identify loss scenarios, (Potential Incidents and Accidents).
5. For those hazards evaluate the risk using the risk rank method by determining the probability, consequence, and risk rank of each loss scenario.
6. Identify existing controls for each hazard.
7. Specify additional controls required to control the hazard(s).
8. Close the Risk Assessment.
9. Document and distribute to the team for proof reading.
10. Undertake verification of the assessment by a nominated person.

The available Standards on Risk Management (including MDG1010) define the Risk Management process as that shown below.



11.2 Establish the Context

This risk analysis has been performed using Qualitative Risk Analysis techniques and is performed in compliance with the Department of Mineral Resources (now the Resources Regulator) Guideline MDG1010.

11.3 Identify Hazards

This step involves identification of all the hazards to be managed. To correctly apply this step a well structured systematic process must be used, because controls may not be able to be implemented to reduce or eliminate any hazards missed at this point in the analysis.

For each hazard, the team identifies:

1. What Can Happen; and
2. How and Why it Can Happen.

Checklists, Flowcharts and Brainstorming are used to identify hazards.

11.4 Analyse Risks

The main objectives of an analysis is to separate minor risks from major risks and to provide data to assist in the evaluation and treatment of hazards.

Risk Analysis involves considering the following:

1. Likelihood of the Hazard occurring (identifed as 'L' within the worksheets).
2. Consequences if the Hazard does occur (identified as 'C' in the worksheets).
3. Determining any existing controls.

The combination of the Likelihood and the Consequence determines the level of the risk involved. The likelihood and consequence categories used are outlined in Section 13.

During the assessment the consequences are categorised as either hazards to personnel, the environment or to the site operations. Additional categories such as reputation and community may also be considered where deemed appropriate.

The consequence category is identified on the Analysis Worksheets in the Column labelled 'T' for Type.

11.5 Evaluate Risks

Evaluation involves comparing the level of risk found during the analysis with previously established risk criteria.

The output of this part of the process is a list of prioritised hazards for further action.

If the resulting hazards fall into the low or tolerable risk categories they may be accepted with minimal further treatment. Although, low and tolerable hazards should be monitored and periodically reviewed to ensure that they remain tolerable.

If hazards do not fall into the low or tolerable risk category then they should be treated using other options.

11.6 Treat Risks

Risk treatment involves identifying the range of options for treating risks, assessing the options and preparing risk treatment plans and implementing them.

Risk treatment may be in one of the following forms:

1. Risk Avoidance. Decide not to proceed with the activity.
2. Reduce Likelihood. Reduce the chance of the risk occurring.
3. Reduce the Risk Consequences. Reduce the consequence if the risk occurs.
4. Transfer the Risk. Involve other parties to bear or share the risks. This may reduce the hazard to the organisation, however, the risk may not be managed effectively as it still exists.
5. Retain (or accept) the Risk. Plans should be put in place to mitigate the consequences of these risks in the event that they occur.

Risk treatment options should be assessed on the extent of any additional benefits or opportunities created. A number of options may be considered and applied either individually or in a combination.

Risk treatment plans should be developed to identify responsibilities, schedules, budgets and performance measures and the review process that is to be established.

11.7 Monitor and Review

It is essential to monitor the effectiveness of the risk management system and the risk treatment implementation.

Risks and the effectiveness of control measures need to be monitored to ensure that the changing environments do not alter risk priorities. Few risks remain static.

Factors affecting Likelihood and/or Consequence change as do factors regarding suitability of controls.

11.8 Communications and Consultations

Communication and consultation are important during the entire risk management process. It is important to develop a communication plan for both internal and external stakeholders.

This should be a two-way consultation not a one-way flow of information.

Effectiveness of internal and external communications is important to ensure that those responsible for implementing risk management understand the basis on which all decisions have been made, and why particular actions are required.

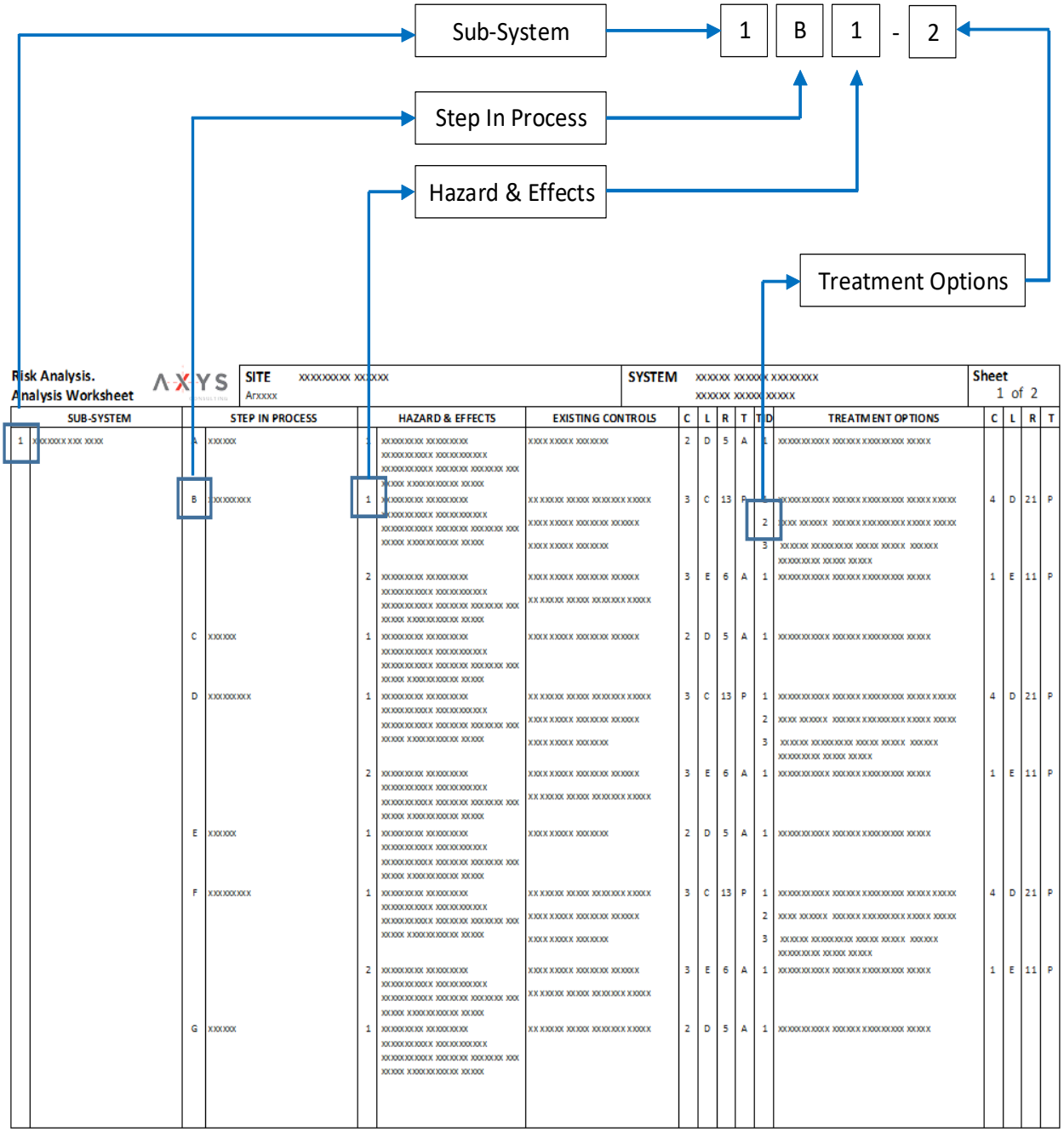
12. Risk Assessment Numbering

The assessment uses an alphanumeric numbering system to differentiate each Component, the Step in the Process, the Hazard and the Treatment Options.

The Sub System Number is found in the first column of the worksheets, the Step Letter is found in the third column, the Hazard number in the fifth column and the treatment options in the TID (Treatment ID) column.

Using this method each hazard and treatment option throughout the analysis has a distinct identifier. This identifier then flows through all of the worksheets and can be referenced back to the Analysis Worksheets.

The example below shows the Distinct Identifier for the hazard is 1B1, the treatment option identified below would be identified as 1B1-2.



13. Risk Rank Method

For each event, the Likelihood and Consequence is determined and selected. If an event affects more than one area of consequence (e.g. affects people and operations), the highest rank number is always selected.

Risk Matrix							
Likelihood		**Consequence**					
		Low 1	**Minor 3**	**Moderate 10**	**Significant 30**	**Major 100**	**Catastrophic 300**
10 Almost Certain	Could be expected to occur more than once during the study or project. Could occur once per year.	**10**	**30**	**100**	**300**	**1000**	**3000**
3 Likely	Could easily be incurred and has generally occurred in similar studies or projects Could be incurred 1 - 2 Years	**3**	**9**	**30**	**90**	**300**	**900**
1 Possible	Incurred in a minority of similar studies or projects. Could be incurred within a 5 year strategic budget period	**1**	**3**	**10**	**30**	**100**	**300**
0.3 Unlikely	Known to happen, but only rarely. Could be incurred within a 5 -20 year time frame	**0.3**	**0.9**	**3**	**9**	**30**	**90**
0.1 Rare	Has not occurred in similar studies or projects, but could Could be incurred 20 – 50 years	**0.1**	**0.3**	**1**	**3**	**10**	**30**
0,03 Very Rare	Conceivable, but only in extreme circumstances. Has not happened in industry in the last 50 years	**0.03**	**0.09**	**0.3**	**0.9**	**3**	**9**

Area of Effect	Estimated Level of Consequence					
	1	3	10	30	100	300
Harm to People (P)	Low level short term subjective symptoms or inconvenience. No medical treatment	Objective but reversible impairment. Medical treatment injury or illness	Permanent impairment <30% of body to one or more persons	Single fatality. Permanent impairment >30% of body to one or more persons	2-20 fatalities Permanent impairment >3-% of body more than 10 persons	>20 fatalities. Permanent impairment >30% of body to more than 100 persons
Environmental (E)	Low level impact to land, biodiversity, ecosystem services, water resources or air	Minor Impacts (<3 months) to land, biodiversity, ecosystem services, water resources or air	Moderate impacts. (<1 year) to land, biodiversity, ecosystem services, water resources or air	Major impacts (<5 years) to land, biodiversity, ecosystem services, water resources or air	Serious or extensive impacts (<20 years) to land, biodiversity, ecosystem services, water resources or air	Severe impacts (>20 years) to land, biodiversity, ecosystem services, water resources or air
Community (C)	Single low level community health, safety or security impact, low level inconvenience <2 weeks, minor, low level disturbance to a single house or structure.	Minor community health, safety or security impacts (<10 households) or human rights infringements, inconvenience to livelihoods <6 months, moderate damage to <50 houses or community infrastructure	Moderate community health, safety or security impacts (<50 households). Single allegation of human rights violations, moderate disruption to people's lives (<50 households)	Serious community health, safety or security impacts (<50 households). Multiple allegations of human rights violations, extended disruption to people's lives (>50 households)	Serious community health, safety or security impacts (>50 households) or human rights violation, extended disruption to people's lives (>200 households)	Extensive community health, safety or security impacts (>200 households) or human rights violations, extended serious disruption to people's lives (>1000 hosueholds)
Reputation (R)	Public concern restricted to local complaints. Low level interest from local media and/or regulator	Adverse local public or media attention and complaints. Heightened scrutiny from regulator. Asset reputation is adversely affected with a small number of people	Attention from regional media and/or heightened concern by local community. Criticism by community, NGOs or activists. Asset reputation adversely affected.	Adverse national media attention. General public and NGO adverse reaction with interest from regulators with no material outcome. Structured campaigning from employees.	Serious national and international negative media attention. General public and NGO adverse reaction with interest from regulators (<3 months). Structured campaigning from employees.	Crisis event or publication of confidential material information resulting in international media, government, regulator, NGO campaigning and employee condemnation of the company (<6 months)
Legal (L)	Low level legal issue	Minor legal issues and non-compliance with commitments	Breach of regulation. Lack of valid exploration title	Significant civil litigation	Prosecutions for criminal breaches resulting in gaol terms for employees or agents or defendant to major civil litigation	Lack of valid operating title, forced closure of an operation, competition, anti-corruption, international trade law or tax breach
Financial (F)	<US$500,000	US$5,000,000 to >US$500,000	US$25,000,000 to >US$5,000,000	US$100,000,000 to >US$25,000,000	US$250,000,000 to >US$100,000,000	>$250,000,000

Attachment 1

Analysis Worksheets

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	A	Catchment Areas or Declared Special Areas (Yield / Supply Capacity)	1	Mine subsidence causes an effect to water yield and quality (surface and groundwater) including sediment load within the catchment and/or the supply capacity. Reduction in water supply to WaterNSW.	Set back of mining areas from Lake Avon and Lake Cordeaux provides a physical buffer (reduced subsidence movements) between the mining impacts and the storage Set back of mining areas from large permanently flowing streams provides a physical buffer (reduced subsidence movements) between the mining impacts and the streams Dams Safety Committee Approval for mining within notification areas, identifies monitoring and management of subsidence impacts Mine geometry including longwall width and extraction height limit subsidence movements and fracturing in the strata Previous experience with the mining in Areas 1, 2 and 3 Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Research and technical investigations (e.g. hydrogeology, geology, geotechnical) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Numerical and empirical modelling of mining impacts (e.g. surface water, groundwater, subsidence) Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation Licensing of groundwater and incidental surface water take	1	10	10	E	1	Implement water quality offsets to satisfy NorBE Test				

SUB-SYSTEM	STEP IN PROCESS	HAZARD & EFFECTS	EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
			Consultation with WaterNSW regarding additional storages on Cordeaux River										

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	A	Catchment Areas or Declared Special Areas (Yield / Supply Capacity)	2	Community anxiety arising from concerns about mine subsidence effects to water yield and quality and/or the supply capacity.	Set back of mining areas from Lake Avon and Lake Cordeaux provides a physical buffer (reduced subsidence movements) between the mining impacts and the storage Set back of mining areas from large permanently flowing streams provides a physical buffer (reduced subsidence movements) between the mining impacts and the streams Dams Safety Committee Approval for mining within notification areas, identifies monitoring and management of subsidence impacts Mine geometry including longwall width and extraction height limit subsidence movements and fracturing in the strata Previous experience with the mining in Areas 1, 2 and 3 Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Research and technical investigations (e.g. hydrogeology, geology, geotechnical) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Numerical and empirical modelling of mining impacts (e.g. surface water, groundwater, subsidence) Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation	10	10	100	C	1	Identify key stakeholders with concerns regarding water supply and develop a communications strategy to inform them of controls in place to protect the security of the drinking water supply	10	3	30	C

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	B	Surface Water Quantity	1	Mine subsidence and reduced groundwater pressures reduces water quantity within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Mine geometry including longwall width and extraction height limit subsidence movements and fracturing in the strata Numerical and empirical modelling of mining impacts (e.g. surface water, groundwater, subsidence) Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation Previous experience with the mining in Areas 1, 2 and 3 Research and technical investigations (e.g. hydrogeology, geology, geotechnical, ecological) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Set back of mining areas from Lake Avon and Lake Cordeaux provides a physical buffer (reduced subsidence movements) between the mining impacts and the storage Set back of mining areas from large permanently flowing streams provides a physical buffer (reduced subsidence movements) between the mining impacts and the streams Remediation and mitigation of mining impacts to rivers, streams, creeks and other water features are proposed as part of the project	3	10	30	E	1	No additional controls identified				

SUB-SYSTEM	STEP IN PROCESS	HAZARD & EFFECTS	EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
			Biodiversity offsets in accordance with State and Commonwealth legislation Licensing of water take										

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	C	Surface Water Quality	1	Mine subsidence affects water quality within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Numerical and empirical modelling of mining impacts (e.g. surface water, groundwater, subsidence) Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation Previous experience with the mining in Areas 1, 2 and 3 Research and technical investigations (e.g. hydrogeology, geology, geotechnical, ecological) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Set back of mining areas from Lake Avon and Lake Cordeaux provides a physical buffer (reduced subsidence movements) between the mining impacts and the storage Set back of mining areas from large permanently flowing streams provides a physical buffer (reduced subsidence movements) between the mining impacts and the streams Remediation and mitigation of mining impacts to rivers, streams, creeks and other water features are proposed as part of the project Biodiversity and water quality offsets in accordance with State and Commonwealth legislation	3	10	30	E	1	Implement water quality offsets to satisfy NorBE Test				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	D	Aquifers or Known Groundwater Resources	1	The group considered that Aquifers or Known Groundwater Resources were considered in the other items (e.g. Step F) and that further assessment was not required.											
		E	Cliffs, minor cliffs, rock outcrops and steep slopes	1	Mine subsidence causes rock falls or surface deformation having adverse impacts to safety and environmental aspects. e.g. biodiversity, water quality, cultural heritage, aesthetics.	Set back of mining areas from streams and lakes provides a physical buffer (reduced subsidence movements) for many of the mapped cliffs Previous experience with the mining in Areas 1, 2 and 3 Monitoring and reporting of steep slope impacts including access protocols to exclude personnel from potential unstable areas	1	10	10	E	1	No additional controls identified				
		F	Swamps, Wetlands or Water Related Ecosystems (inc. Aquatic Flora and Fauna)	1	Mine subsidence, including far field effects, causes surface deformation or changes to groundwater resulting in changes to erosion potential, swamp size and swamp vegetation.	Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Biodiversity offsets in accordance with State and Commonwealth legislation Remediation and mitigation of mining impacts to rivers, streams, creeks and other water features are proposed as part of the project Research and technical investigations (e.g. hydrogeology, geology, geotechnical, ecological) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Set back of mining areas from streams and lakes provides a physical buffer (reduced subsidence movements) for some of the mapped swamps Geological and Hydrogeological assessment of the mining area and surrounds has and will continue to be undertaken	3	10	30	E	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	G	Threatened or Protected Species	1	Loss or degradation of threatened flora and fauna habitat from mine subsidence (e.g. changes in surface water flows, rock falls).	Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Mine geometry including longwall width and extraction height limit subsidence movements and fracturing in the strata Numerical and empirical modelling of mining impacts e.g. surface water, groundwater, subsidence, ecology Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation Previous experience with the mining in Areas 1, 2 and 3 Research and technical investigations (e.g. hydrogeology, geology, geotechnical, ecological) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Set back of mining areas from Lake Avon and Lake Cordeaux provides a physical buffer (reduced subsidence movements) between the mining impacts and the storage Set back of mining areas from large permanently flowing streams provides a physical buffer (reduced subsidence movements) between the mining impacts and the streams Remediation and mitigation of mining impacts to rivers, streams, creeks and other water features are proposed as part of the project	10	3	30	E	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
						Biodiversity offsets in accordance with State and Commonwealth legislation										
		H	State Conservation Areas	1	Conservation area affected by downstream and far-field effects causing impacts to conservation value.	Set back of mining areas from conservation area provides a physical buffer (reduced subsidence movements) between the mining impacts and the state conservation area Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Numerical and empirical modelling of mining impacts e.g. surface water, groundwater, subsidence, ecology Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation Previous experience with the mining in Areas 1, 2 and 3 Research and technical investigations (e.g. hydrogeology, geology, geotechnical, ecological) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Set back of mining areas from large permanently flowing streams provides a physical buffer (reduced subsidence movements) between the mining impacts and the streams Remediation and mitigation of mining impacts to rivers, streams, creeks and other water features are proposed as part of the project upstream of the state conservation area Biodiversity offsets in accordance with State and Commonwealth legislation	1	1	1	E	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	I	Terrestrial Flora and Fauna	1	Loss or degradation of terrestrial flora and fauna habitat from mine subsidence (e.g. surface water flows, rock falls, cracks)	Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Numerical and empirical modelling of mining impacts e.g. surface water, groundwater, subsidence, ecology Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation Previous experience with the mining in Areas 1, 2 and 3 Research and technical investigations (e.g. hydrogeology, geology, geotechnical, ecological) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Set back of mining areas from large permanently flowing streams provides a physical buffer (reduced subsidence movements) between the mining impacts and the streams Remediation and mitigation of mining impacts to rivers, streams, creeks and other water features are proposed as part of the project Biodiversity offsets in accordance with State and Commonwealth legislation	1	3	3	E	1	No additional controls identified				
		J	Disused Railway Corridor	1	Mine subsidence results in impacts to the railway corridor and associated infrastructure. (Culverts, cuttings and embankments)	Previous experience with the mining in Area 3 Numerical and empirical modelling of mining impacts e.g. subsidence Continuation of existing monitoring and reporting of progressive mining	1	0.3	0.3	F	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	K	Roads (All Types including Culverts) (inc. Road Safety)	1	Mine subsidence results in impacts to Picton Road and associated infrastructure, leading to road closure or public safety issues.	Set back of mining areas from Picton Road provides a physical buffer (reduced subsidence movements) between the mining impacts and the road Previous experience with mining near roads in the NSW coalfields Built features management plan developed in consultation with Roads and Maritime Services includes Picton Road Monitoring and reporting of subsidence impacts on Picton Road, including implementation of a TARP	3	0.1	0.3	C	1	No additional controls identified				
		K		2	Mine subsidence results in impacts to Cordeaux Dam Road and Fire Trails and associated infrastructure, leading to road closure or public safety issues.	Previous experience with the mining at Dendrobium Mine and NSW coalfields Built features management plan developed for WaterNSW assets includes Cordeaux Dam Road and Fire Trails Ground and visual monitoring and reporting Monitoring and reporting of subsidence impacts on Picton Road, including implementation of a TARP	1	0.3	0.3	C	1	No additional controls identified				
		L	Gas infrastructure	1	Mine subsidence results in impacts to gas pipelines and associated infrastructure, leading to impacts to the gas supply.	Previous experience with the mining in the NSW coalfields under gas pipelines Well established methods for management of potential subsidence impacts of gas pipelines Built features management plan developed for gas pipeline in consultation with infrastructure owners Monitoring and reporting of subsidence impacts on the gas pipeline, including implementation of a TARP	3	0.1	0.3	F	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	M	Electricity transmission lines, powerlines or associated plants	1	Mine subsidence results in impacts to 330kV transmission and 33kV power line and associated infrastructure, leading to impacts to the electrical supply.	Previous experience with the mining in the NSW coalfields under electricity transmission and power lines Well established methods for management of potential subsidence impacts of electricity transmission and power lines e.g. Cruciform Footings Built features management plan developed for electricity transmission and power lines in consultation with infrastructure owners Monitoring and reporting of subsidence impacts on the electricity transmission and power lines including implementation of a TARP	3	0.1	0.3	F	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	N	Dams, Reservoirs or Associated Works	1	Mine subsidence results in impacts to Avon and Cordeaux Dams and associated infrastructure, leading to impacts to water storage and public safety issues.	Set back of mining areas from Avon Dam and Cordeaux Dam provides a physical buffer (reduced subsidence movements) between the mining impacts and the Avon Dam and Cordeaux Dam walls Previous experience with mining near water storage structures in the NSW coalfields Built features management plan developed for Avon Dam and Cordeaux Dam in consultation with Dams Safety Committee and WaterNSW Dams Safety Committee Approval for mining within notification areas, identifies monitoring and management of subsidence impacts Monitoring and reporting of the Avon Dam and Cordeaux Dam including implementation of a TARP Geological assessment of the mining area and surrounds has and will continue to be undertaken Consultation with WaterNSW regarding additional storages on Cordeaux River Heritage Management Plan developed in consultation with Office of Environment and Heritage and other stakeholders, including mitigation measures for heritage items	30	0.1	3	F	1	No additional controls identified				

Risk Analysis. Analysis Worksheet	SITE Illawarra Coal Holdings Pty Ltd AR2254	SYSTEM Dendrobium Mine Plan for the Future: Coal for Steelmaking	Sheet Page 33

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	O	Areas of Archaeological and/or Heritage Significance	1	Mine subsidence results in impacts to Archaeological and/or Heritage Significance.	Continued consultation with Aboriginal community Continuation of existing monitoring and reporting of progressive mining including adaptive management of the mining effects Numerical and empirical modelling of mining impacts e.g. subsidence. Ongoing contribution to subsidence science and understanding of impacts through 3rd party monitoring and investigation Previous experience with the mining in Areas 1, 2 and 3 Research and technical investigations (e.g. archaeological) into understanding of impacts to the catchment to reduce uncertainty around levels of impact Set back of mining areas from streams and lakes provides a physical buffer (reduced subsidence movements) for many of the mapped cliffs Set back of mining areas from Avon Dam and Cordeaux Dam provides a physical buffer (reduced subsidence movements) between the mining impacts and the archaeological and heritage sites located near the dams Heritage Management Plan developed in consultation with Office of Environment and Heritage and other stakeholders, including mitigation measures for heritage items	10	1	10	C	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	P	Buildings and other structures	1	Mine subsidence results in impacts to buildings and structures and associated infrastructure. (e.g. picnic areas).	Previous experience with the mining near and under built features in the NSW coalfields Built features management plan developed for WaterNSW assets Engineering assessment of existing structures Monitoring and reporting of the structures including TARP	1	1	1	C	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
1	Underground Mine – Areas 5 and 6	Q	Groundwater and Surface Water	1	Lineaments, bedding shear planes, faults and dykes result in impacts in excess of predictions.	Lineaments are mapped and recorded in Appendices A, B and P Lineaments are assessed for correlation with known geological conditions Surface Mapping around lineaments to understand if there is an associated geological feature Drilling on both surface and underground targeting known and inferred geology completed IEMPC Review Report Faults and Dykes are mapped and recorded in Appendices A and P of the EIS Surface geological mapping around Faults and Dykes Drilling on both surface and underground targeting known and inferred geology completed Elouera Fault Investigation Investigation and Reporting of Geological Features Review of Permeability of Geological Structures in the Dendrobium Area J DOYLE 2007 Tonkin, C., & Timms, W. (2015). Geological Structures and Fault-infill in the Southern Coalfields and Implications for Groundwater Flow. Journal of Research Projects Review, 4, 49 - 58. Mine Headings through Dyke under reservoir do not produce groundwater Extensive exploration program undertaken to identify location of Faults and Dykes Longwall panels setback at least 300m from Reservoir full supply level	10	0.3	3	L	1	Specify monitoring locations, methods, trigger levels and contingencies in Extraction Plans, including consideration of any correlation between groundwater fingerprinting (chemistry) and lineaments during mining, any correlation between piezometers response and lineaments and any impact of surface subsidence associated with lineaments				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
						Subsidence Modelling and Monitoring Ground and Surface Water Monitoring Mine Design avoids major geological structures Groundwater Modelling at multiple scales (regional and local) Targeted Avon Dam Bedding Plain Shear Investigation - TDR, Pre and Post Mining Packer Testing, Groundwater Pressure Monitoring, Water Chemistry Dams Safety Committee Management Plan (Including Contingency Planning) Flank inseam drilling program in advance of development panels (between reservoirs and panels)										
2	Use of Existing Dendrobium Mine Surface Facilities	A	Surface Water Quantity or Quality	1	Extension of the use and volume of water discharge due to the continued use of the surface facilities results in South32 being unable to meet EPA discharge licence requirements.	Existing licensed discharge point on Allans Creek is in tidal zone Existing licensed discharge point in American Creek Erosion and sediment controls Site water balance will be conducted for EIS	1	3	3	E	1	No additional controls identified				
		B	Flora and Fauna including Threatened or Protected Species	1	Impacts to flora and fauna habitat from the continued use of the surface facilities. e.g. removal of vegetation and habitat for car park extension	Biodiversity offsets in accordance with State and Commonwealth legislation Site layout and location designed to minimise impacts Vegetation clearing and operational protocols Rehabilitation of site after construction	1	3	3	E	1	No additional controls identified				
		C	Roads (All Types) (inc. Road Safety)	1	Additional vehicle movements along local roads including Cordeaux Road affects the serviceability and increased risk of accidents.	Vehicle movement predictions undertaken Existing intersection and safety infrastructure Delivery curfew (deliveries can only occur in nominated hours)	30	0.1	3	P	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
2	Use of Existing Dendrobium Mine Surface Facilities	D	Acoustic Amenity	1	Continued use of the surface facilities results in impacts to the acoustic amenity of local residents.	Existing noise monitoring programs Equipment design includes consideration of noise mitigation	3	3	9	C	1	No additional controls identified				
		E	Air Quality	1	Continued use of the surface facilities results in impacts on air quality of local residents	Existing Air Quality monitoring programs Dust suppression at the site	3	1	3	C	1	No additional controls identified				
		F	Visual Amenity	1	No changes to existing hazards. No further assessment required.											
		G	Contamination of Land	1	Contamination of the land due to upgrades and continued operations at the Dendrobium Mine surface facilities	Clean and dirty water separation Spill clean-up equipment and emergency response Major maintenance activities are not undertaken at the site Pollution Incident Response Management Plan	1	0.3	0.3	E	1	No additional controls identified				
3	Continued Use of Kemira Valley Rail Line	A	Acoustic Amenity	1	Continued use of Kemira Valley Rail Line impacts acoustic amenity of local residents.	Existing noise monitoring programs Equipment design includes consideration of noise mitigation Rail operations curfew (only operates in nominated hours) Pollution reduction programs and other studies to reduce wheel squeal and other noise impacts to the local residents	3	10	30	C	1	No additional controls identified				
		B	Air Quality	1	Continued use of Kemira Valley Rail Line impacts air quality of local residence.	Existing Air Quality monitoring programs Dust suppression through moisture content of the coal Dust suppression sprays at the stockpile Slow train speeds and short haul	1	3	3	P	1	No additional controls identified				
		C	Visual Amenity	1	No changes to existing hazards. No further assessment required.											
		D	Contamination of Land	1	No changes to existing hazards. No further assessment required.											

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
4	Construction and Use of Ventilation and gas drainage infrastructure	A	Catchment Areas or Declared Special Areas	1	Effect to water quality as a result of construction and operations of ventilation and gas drainage infrastructure.	Previous experience with construction and operations of ventilation and gas drainage infrastructure in the Metropolitan Special Area Continuation of existing monitoring and reporting of water quality Site layout and location designed to minimise impacts Water quality offsets in accordance with State legislation	10	0.3	3	L	1	Implement water quality offsets to satisfy NorBE Test				
		B	Flora and Fauna including Threatened or Protected Species	1	Impacts to flora and fauna habitat from the construction and operations of the ventilation and gas drainage infrastructure. e.g. removal of vegetation and habitat, accidental bushfire from flaring.	Biodiversity offsets in accordance with State and Commonwealth legislation Site layout and location designed to minimise impacts Koala Management Plan Vegetation clearing and operational protocols Rehabilitation of site after construction Bushfire Management Plan including hazard reduction zone and enclosed flaring	1	1	1	E	1	No additional controls identified				
		C	Areas of Archaeological and/or Heritage Significance	1	Impacts to Archaeological and/or Heritage Significance as a result of construction of ventilation and gas drainage infrastructure.	Continued consultation with Aboriginal community Heritage Management Plan developed in consultation with Office of Environment and Heritage and other stakeholders, including mitigation measure for heritage items	1	1	1	C	1	No additional controls identified				
		D	Acoustic Amenity	1	No hazards identified due to location of the ventilation and gas drainage infrastructure											
		E	Air Quality	1	No hazards identified due to location of the ventilation and gas drainage infrastructure											
		F	Visual Amenity	1	Visual Impacts to users of the Cordeaux Dam picnic area as a result of construction and operations of ventilation and gas drainage infrastructure.	Three of the four shaft sites are not visible from the Cordeaux Dam picnic area Structure colouring selected to match environment	1	1	1	C	1	No additional controls identified				

SUB-SYSTEM		STEP IN PROCESS		HAZARD & EFFECTS		EXISTING CONTROLS	C	L	R	T	TID	TREATMENT OPTIONS	C	L	R	T
4	Construction and Use of Ventilation and gas drainage infrastructure	G	Contamination of Land	1	Contamination of the land due to construction and operations of the ventilation and gas drainage infrastructure.	Clean and dirty water separation Spill clean-up equipment and emergency response Major maintenance activities are not undertaken at the site	1	0.3	0.3	E	1	No additional controls identified				
5	Use of Cordeaux pit top	A	Catchment Areas or Declared Special Areas	1	Effect to water quality or flora and fauna as a result of upgrades, dewatering and use of Cordeaux pit top.	Previous experience with construction and operations of infrastructure in catchment area Continuing of existing monitoring and reporting of water quality Site layout and location designed to minimise impacts Water quality offsets in accordance with State legislation Monitoring and assessment prior to any disturbances at site	1	1	1	E	1 2	Implement water quality offsets to satisfy NorBE Test Develop strategy for de-watering of the Cordeaux Mine and the management of the water	1	1	1	E
		B	Roads (All Types) (inc. Road Safety)	1	Additional vehicle movements along Picton road affects serviceability and increased risk of accidents.	Vehicle movement predictions undertaken Road transport review prior to relocation of main mine access (and associated personnel) to the Cordeaux pit top Existing intersection and safety infrastructure	30	0.1	3	P	1	No additional controls identified				
		C	Acoustic Amenity	1	No hazards identified due to location of the Cordeaux pit top											
		D	Air Quality	1	No hazards identified due to location of the Cordeaux pit top											
		E	Visual Amenity	1	No hazards identified due to location of the Cordeaux pit top and nature of the proposed works											
		F	Contamination of Land	1	Contamination of the land due to upgrades and operations at the Cordeaux pit top	Clean and dirty water separation Spill clean-up equipment and emergency response Major maintenance activities are not undertaken at the site	1	0.3	0.3	E	1	No additional controls identified				

Attachment 2

Assessment Worksheets
(Risk Rank Order)

REF	Risk	HAZARD	TID	TREATMENT OPTIONS
1A2	100	Community anxiety arising from concerns about mine subsidence effects to water yield and quality and/or the supply capacity.	1	Identify key stakeholders with concerns regarding water supply and develop a communications strategy to inform them of controls in place to protect the security of the drinking water supply
1B1	30	Mine subsidence and reduced groundwater pressures reduces water quantity within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	1	No additional controls identified
1C1	30	Mine subsidence affects water quality within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	1	Implement water quality offsets to satisfy NorBE Test
1F1	30	Mine subsidence, including far field effects, causes surface deformation or changes to groundwater resulting in changes to erosion potential, swamp size and swamp vegetation.	1	No additional controls identified
1G1	30	Loss or degradation of threatened flora and fauna habitat from mine subsidence (e.g. changes in surface water flows, rock falls).	1	No additional controls identified
3A1	30	Continued use of Kemira Valley Rail Line impacts acoustic amenity of local residents.	1	No additional controls identified
1A1	10	Mine subsidence causes an effect to water yield and quality (surface and groundwater) including sediment load within the catchment and/or the supply capacity. Reduction in water supply to WaterNSW.	1	Implement water quality offsets to satisfy NorBE Test
1E1	10	Mine subsidence causes rock falls or surface deformation having adverse impacts to safety and environmental aspects. e.g. biodiversity, water quality, cultural heritage, aesthetics.	1	No additional controls identified
1O1	10	Mine subsidence results in impacts to Archaeological and/or Heritage Significance.	1	No additional controls identified
2D1	9	Continued use of the surface facilities results in impacts to the acoustic amenity of local residents.	1	No additional controls identified
1I1	3	Loss or degradation of terrestrial flora and fauna habitat from mine subsidence (e.g. surface water flows, rock falls, cracks)	1	No additional controls identified
1N1	3	Mine subsidence results in impacts to Avon and Cordeaux Dams and associated infrastructure, leading to impacts to water storage and public safety issues.	1	No additional controls identified
1Q1	3	Lineaments, bedding shear planes, faults and dykes result in impacts in excess of predictions.	1	Specify monitoring locations, methods, trigger levels and contingencies in Extraction Plans, including consideration of any correlation between groundwater fingerprinting (chemistry) and lineaments during mining, any correlation between piezometers response and lineaments and any impact of surface subsidence associated with lineaments
2A1	3	Extension of the use and volume of water discharge due to the continued use of the surface facilities results in South32 being unable to meet EPA discharge licence requirements.	1	No additional controls identified
2B1	3	Impacts to flora and fauna habitat from the continued use of the surface facilities. e.g. removal of vegetation and habitat for car park extension	1	No additional controls identified
2C1	3	Additional vehicle movements along local roads including Cordeaux Road affects the serviceability and increased risk of accidents.	1	No additional controls identified
2E1	3	Continued use of the surface facilities results in impacts on air quality of local residents	1	No additional controls identified
3B1	3	Continued use of Kemira Valley Rail Line impacts air quality of local residence.	1	No additional controls identified
4A1	3	Effect to water quality as a result of construction and operations of ventilation and gas drainage infrastructure.	1	Implement water quality offsets to satisfy NorBE Test
5B1	3	Additional vehicle movements along Picton road affects serviceability and increased risk of accidents.	1	No additional controls identified

REF	Risk	HAZARD	TID	TREATMENT OPTIONS
1H1	1	Conservation area affected by downstream and far-field effects causing impacts to conservation value.	1	No additional controls identified
1P1	1	Mine subsidence results in impacts to buildings and structures and associated infrastructure. (e.g. picnic areas).	1	No additional controls identified
4B1	1	Impacts to flora and fauna habitat from the construction and operations of the ventilation and gas drainage infrastructure. e.g. removal of vegetation and habitat, accidental bushfire from flaring.	1	No additional controls identified
4C1	1	Impacts to Archaeological and/or Heritage Significance as a result of construction of ventilation and gas drainage infrastructure.	1	No additional controls identified
4F1	1	Visual Impacts to users of the Cordeaux Dam picnic area as a result of construction and operations of ventilation and gas drainage infrastructure.	1	No additional controls identified
5A1	1	Effect to water quality or flora and fauna as a result of upgrades, dewatering and use of Cordeaux pit top.	1	Implement water quality offsets to satisfy NorBE Test
			2	Develop strategy for de-watering of the Cordeaux Mine and the management of the water
1J1	0.3	Mine subsidence results in impacts to the railway corridor and associated infrastructure. (Culverts, cuttings and embankments)	1	No additional controls identified
1K1	0.3	Mine subsidence results in impacts to Picton Road and associated infrastructure, leading to road closure or public safety issues.	1	No additional controls identified
1K2	0.3	Mine subsidence results in impacts to Cordeaux Dam Road and Fire Trails and associated infrastructure, leading to road closure or public safety issues.	1	No additional controls identified
1L1	0.3	Mine subsidence results in impacts to gas pipelines and associated infrastructure, leading to impacts to the gas supply.	1	No additional controls identified
1M1	0.3	Mine subsidence results in impacts to 330kV transmission and 33kV power line and associated infrastructure, leading to impacts to the electrical supply.	1	No additional controls identified
2G1	0.3	Contamination of the land due to upgrades and continued operations at the Dendrobium Mine surface facilities	1	No additional controls identified
4G1	0.3	Contamination of the land due to construction and operations of the ventilation and gas drainage infrastructure.	1	No additional controls identified
5F1	0.3	Contamination of the land due to upgrades and operations at the Cordeaux pit top	1	No additional controls identified

Attachment 3

Assessment Worksheets
(Consequence Order)

REF	Cons	HAZARD	TID	TREATMENT OPTIONS
1N1	30	Mine subsidence results in impacts to Avon and Cordeaux Dams and associated infrastructure, leading to impacts to water storage and public safety issues.	1	No additional controls identified
2C1	30	Additional vehicle movements along local roads including Cordeaux Road affects the serviceability and increased risk of accidents.	1	No additional controls identified
5B1	30	Additional vehicle movements along Picton road affects serviceability and increased risk of accidents.	1	No additional controls identified
1A2	10	Community anxiety arising from concerns about mine subsidence effects to water yield and quality and/or the supply capacity.	1	Identify key stakeholders with concerns regarding water supply and develop a communications strategy to inform them of controls in place to protect the security of the drinking water supply
1G1	10	Loss or degradation of threatened flora and fauna habitat from mine subsidence (e.g. changes in surface water flows, rock falls).	1	No additional controls identified
1O1	10	Mine subsidence results in impacts to Archaeological and/or Heritage Significance.	1	No additional controls identified
1Q1	10	Lineaments, bedding shear planes, faults and dykes result in impacts in excess of predictions.	1	Specify monitoring locations, methods, trigger levels and contingencies in Extraction Plans, including consideration of any correlation between groundwater fingerprinting (chemistry) and lineaments during mining, any correlation between piezometers response and lineaments and any impact of surface subsidence associated with lineaments
4A1	10	Effect to water quality as a result of construction and operations of ventilation and gas drainage infrastructure.	1	Implement water quality offsets to satisfy NorBE Test
1B1	3	Mine subsidence and reduced groundwater pressures reduces water quantity within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	1	No additional controls identified
1C1	3	Mine subsidence affects water quality within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	1	Implement water quality offsets to satisfy NorBE Test
1F1	3	Mine subsidence, including far field effects, causes surface deformation or changes to groundwater resulting in changes to erosion potential, swamp size and swamp vegetation.	1	No additional controls identified
1K1	3	Mine subsidence results in impacts to Picton Road and associated infrastructure, leading to road closure or public safety issues.	1	No additional controls identified
1L1	3	Mine subsidence results in impacts to gas pipelines and associated infrastructure, leading to impacts to the gas supply.	1	No additional controls identified
1M1	3	Mine subsidence results in impacts to 330kV transmission and 33kV power line and associated infrastructure, leading to impacts to the electrical supply.	1	No additional controls identified
2D1	3	Continued use of the surface facilities results in impacts to the acoustic amenity of local residents.	1	No additional controls identified
2E1	3	Continued use of the surface facilities results in impacts on air quality of local residents	1	No additional controls identified
3A1	3	Continued use of Kemira Valley Rail Line impacts acoustic amenity of local residents.	1	No additional controls identified
1A1	1	Mine subsidence causes an effect to water yield and quality (surface and groundwater) including sediment load within the catchment and/or the supply capacity. Reduction in water supply to WaterNSW.	1	Implement water quality offsets to satisfy NorBE Test
1E1	1	Mine subsidence causes rock falls or surface deformation having adverse impacts to safety and environmental aspects. e.g. biodiversity, water quality, cultural heritage, aesthetics.	1	No additional controls identified
1H1	1	Conservation area affected by downstream and far-field effects causing impacts to conservation value.	1	No additional controls identified
1I1	1	Loss or degradation of terrestrial flora and fauna habitat from mine subsidence (e.g. surface water flows, rock falls, cracks)	1	No additional controls identified

REF	Cons	HAZARD	TID	TREATMENT OPTIONS
1J1	1	Mine subsidence results in impacts to the railway corridor and associated infrastructure. (Culverts, cuttings and embankments)	1	No additional controls identified
1K2	1	Mine subsidence results in impacts to Cordeaux Dam Road and Fire Trails and associated infrastructure, leading to road closure or public safety issues.	1	No additional controls identified
1P1	1	Mine subsidence results in impacts to buildings and structures and associated infrastructure. (e.g. picnic areas).	1	No additional controls identified
2A1	1	Extension of the use and volume of water discharge due to the continued use of the surface facilities results in South32 being unable to meet EPA discharge licence requirements.	1	No additional controls identified
2B1	1	Impacts to flora and fauna habitat from the continued use of the surface facilities. e.g. removal of vegetation and habitat for car park extension	1	No additional controls identified
2G1	1	Contamination of the land due to upgrades and continued operations at the Dendrobium Mine surface facilities	1	No additional controls identified
3B1	1	Continued use of Kemira Valley Rail Line impacts air quality of local residence.	1	No additional controls identified
4B1	1	Impacts to flora and fauna habitat from the construction and operations of the ventilation and gas drainage infrastructure. e.g. removal of vegetation and habitat, accidental bushfire from flaring.	1	No additional controls identified
4C1	1	Impacts to Archaeological and/or Heritage Significance as a result of construction of ventilation and gas drainage infrastructure.	1	No additional controls identified
4F1	1	Visual Impacts to users of the Cordeaux Dam picnic area as a result of construction and operations of ventilation and gas drainage infrastructure.	1	No additional controls identified
4G1	1	Contamination of the land due to construction and operations of the ventilation and gas drainage infrastructure.	1	No additional controls identified
5A1	1	Effect to water quality or flora and fauna as a result of upgrades, dewatering and use of Cordeaux pit top.	1	Implement water quality offsets to satisfy NorBE Test
			2	Develop strategy for de-watering of the Cordeaux Mine and the management of the water
5F1	1	Contamination of the land due to upgrades and operations at the Cordeaux pit top	1	No additional controls identified

Attachment 4

Risk Treatment Schedule Action Plan

ID	HAZARD	TID	TREATMENT OPTIONS	RESPONSIBILITY	IMPLEMENTATION	COMMENTS	COMPLETED (Sign Off)
1A1	Mine subsidence causes an effect to water yield and quality (surface and groundwater) including sediment load within the catchment and/or the supply capacity. Reduction in water supply to WaterNSW.	1	Implement water quality offsets to satisfy NorBE Test	South32 - Principal Approvals	Tuesday, 29 June 2021		
1A2	Community anxiety arising from concerns about mine subsidence effects to water yield and quality and/or the supply capacity.	1	Identify key stakeholders with concerns regarding water supply and develop a communications strategy to inform them of controls in place to protect the security of the drinking water supply	Principal Community Engagement	Tuesday, 29 June 2021		
1B1	Mine subsidence and reduced groundwater pressures reduces water quantity within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	1	No additional controls identified				
1C1	Mine subsidence affects water quality within rivers, streams, creeks and other water features. Loss or degradation of aquatic habitat and riparian vegetation.	1	Implement water quality offsets to satisfy NorBE Test	South32 - Principal Approvals	Tuesday, 29 June 2021		
1D1	The group considered that Aquifers or Known Groundwater Resources were considered in the other items (e.g. Step F) and that further assessment was not required.						
1E1	Mine subsidence causes rock falls or surface deformation having adverse impacts to safety and environmental aspects. e.g. biodiversity, water quality, cultural heritage, aesthetics.	1	No additional controls identified				
1F1	Mine subsidence, including far field effects, causes surface deformation or changes to groundwater resulting in changes to erosion potential, swamp size and swamp vegetation.	1	No additional controls identified				
1G1	Loss or degradation of threatened flora and fauna habitat from mine subsidence (e.g. changes in surface water flows, rock falls).	1	No additional controls identified				
1H1	Conservation area affected by downstream and far-field effects causing impacts to conservation value.	1	No additional controls identified				

ID	HAZARD	TID	TREATMENT OPTIONS	RESPONSIBILITY	IMPLEMENTATION	COMMENTS	COMPLETED (Sign Off)
1I1	Loss or degradation of terrestrial flora and fauna habitat from mine subsidence (e.g. surface water flows, rock falls, cracks)	1	No additional controls identified				
1J1	Mine subsidence results in impacts to the railway corridor and associated infrastructure. (Culverts, cuttings and embankments)	1	No additional controls identified				
1K1	Mine subsidence results in impacts to Picton Road and associated infrastructure, leading to road closure or public safety issues.	1	No additional controls identified				
1K2	Mine subsidence results in impacts to Cordeaux Dam Road and Fire Trails and associated infrastructure, leading to road closure or public safety issues.	1	No additional controls identified				
1L1	Mine subsidence results in impacts to gas pipelines and associated infrastructure, leading to impacts to the gas supply.	1	No additional controls identified				
1M1	Mine subsidence results in impacts to 330kV transmission and 33kV power line and associated infrastructure, leading to impacts to the electrical supply.	1	No additional controls identified				
1N1	Mine subsidence results in impacts to Avon and Cordeaux Dams and associated infrastructure, leading to impacts to water storage and public safety issues.	1	No additional controls identified				
1O1	Mine subsidence results in impacts to Archaeological and/or Heritage Significance.	1	No additional controls identified				
1P1	Mine subsidence results in impacts to buildings and structures and associated infrastructure. (e.g. picnic areas).	1	No additional controls identified				

ID	HAZARD	TID	TREATMENT OPTIONS	RESPONSIBILITY	IMPLEMENTATION	COMMENTS	COMPLETED (Sign Off)
1Q1	Lineaments, bedding shear planes, faults and dykes result in impacts in excess of predictions.	1	Specify monitoring locations, methods, trigger levels and contingencies in Extraction Plans, including consideration of any correlation between groundwater fingerprinting (chemistry) and lineaments during mining, any correlation between piezometers response and lineaments and any impact of surface subsidence associated with lineaments	South32 - Principal Approvals	Tuesday, 29 June 2021		
2A1	Extension of the use and volume of water discharge due to the continued use of the surface facilities results in South32 being unable to meet EPA discharge licence requirements.	1	No additional controls identified				
2B1	Impacts to flora and fauna habitat from the continued use of the surface facilities. e.g. removal of vegetation and habitat for car park extension	1	No additional controls identified				
2C1	Additional vehicle movements along local roads including Cordeaux Road affects the serviceability and increased risk of accidents.	1	No additional controls identified				
2D1	Continued use of the surface facilities results in impacts to the acoustic amenity of local residents.	1	No additional controls identified				
2E1	Continued use of the surface facilities results in impacts on air quality of local residents	1	No additional controls identified				
2F1	No changes to existing hazards. No further assessment required.						
2G1	Contamination of the land due to upgrades and continued operations at the Dendrobium Mine surface facilities	1	No additional controls identified				
3A1	Continued use of Kemira Valley Rail Line impacts acoustic amenity of local residents.	1	No additional controls identified				
3B1	Continued use of Kemira Valley Rail Line impacts air quality of local residence.	1	No additional controls identified				
3C1	No changes to existing hazards. No further assessment required.						
3D1	No changes to existing hazards. No further assessment required.						

ID	HAZARD	TID	TREATMENT OPTIONS	RESPONSIBILITY	IMPLEMENTATION	COMMENTS	COMPLETED (Sign Off)
4A1	Effect to water quality as a result of construction and operations of ventilation and gas drainage infrastructure.	1	Implement water quality offsets to satisfy NorBE Test	South32 - Principal Approvals	Tuesday, 29 June 2021		
4B1	Impacts to flora and fauna habitat from the construction and operations of the ventilation and gas drainage infrastructure. e.g. removal of vegetation and habitat, accidental bushfire from flaring.	1	No additional controls identified				
4C1	Impacts to Archaeological and/or Heritage Significance as a result of construction of ventilation and gas drainage infrastructure.	1	No additional controls identified				
4D1	No hazards identified due to location of the ventilation and gas drainage infrastructure						
4E1	No hazards identified due to location of the ventilation and gas drainage infrastructure						
4F1	Visual Impacts to users of the Cordeaux Dam picnic area as a result of construction and operations of ventilation and gas drainage infrastructure.	1	No additional controls identified				
4G1	Contamination of the land due to construction and operations of the ventilation and gas drainage infrastructure.	1	No additional controls identified				
5A1	Effect to water quality or flora and fauna as a result of upgrades, dewatering and use of Cordeaux pit top.	1	Implement water quality offsets to satisfy NorBE Test	South32 - Principal Approvals	Tuesday, 29 June 2021		
		2	Develop strategy for de-watering of the Cordeaux Mine and the management of the water	South32 - Principal Approvals	Tuesday, 29 June 2021		
5B1	Additional vehicle movements along Picton road affects serviceability and increased risk of accidents.	1	No additional controls identified				
5C1	No hazards identified due to location of the Cordeaux pit top						
5D1	No hazards identified due to location of the Cordeaux pit top						

ID	HAZARD	TID	TREATMENT OPTIONS	RESPONSIBILITY	IMPLEMENTATION	COMMENTS	COMPLETED (Sign Off)
5E1	No hazards identified due to location of the Cordeaux pit top and nature of the proposed works						
5F1	Contamination of the land due to upgrades and operations at the Cordeaux pit top	1	No additional controls identified				