

WAMBO COAL PTY LIMITED



SOUTH BATES EXTENSION UNDERGROUND MINE

EXTRACTION PLAN LONGWALLS 24 TO 26

REPORT 4 SUBSIDENCE RISK ASSESSMENT

Peabody



For Peabody Energy – Wambo Coal Pty Ltd (WCPL)

Wambo U/G South Bates Extension Underground Mine – Longwalls 24-26 – Extraction Plan Risk Assessment Report

Report Title: South Bates Extension Underground Mine –
Longwalls 24-26 Extraction Plan Risk Assessment
Report

Client: Peabody Energy, Wambo Coal Operations

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Key Supporting Documentation	AS/NZS ISO 31000: 2018 Risk Management – Principles and Guidelines. MDG1010 – Minerals Industry Safety and Health Risk Management Guideline. STANDISH, Peter – South Bates Extension Underground Mine – Longwalls 17 to 20 Subsidence Risk Assessment Report. 1/2/2018 Ref ORMJ1801 STANDISH, Peter – South Bates Extension Underground Mine – Longwalls 21 to 24, Extraction Plan Risk Assessment Report, 25/2/2020. Ref RM19042 NSW Government Dept of Trade & Investment – EDG17 Guideline for Applications for Subsidence Management Approvals. Dec 2003

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1 EXECUTIVE SUMMARY

Wambo Coal Mine is an underground coal mining operation located approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW). The Wambo Coal Mine is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited. The South Bates Extension Underground Mine is a component of the approved Wambo Coal Mine and comprises extraction of Longwalls 17 to 26 in the Whybrow Seam. Longwall extraction in the Whybrow Seam commenced in 2018.

An Extraction Plan for Longwalls 21 to 24 at the South Bates Underground Mine was approved by the Department of Planning and Environment on 1st April 2021.

This Risk Assessment has been prepared to support an Extraction Plan for Longwalls 24 to 26 in the Whybrow Seam.

This work follows on from earlier team-based risk assessments. The earlier team-based risk assessments have highlighted:

- Groundwater – with issues such as failure of the monitoring program to detect and respond to an impact on the groundwater system;
- Surface water – with issues related to the North Wambo Creek diversion and the open cut void;
- Flora and fauna – with potential undermining of Remnant Woodland Enhancement Program (RWEPP) areas;
- Land impacts due to subsidence of major or minor cliff lines;
- Public safety – with potential for step cracking due to subsidence impacts on access tracks;
- Subsidence effects due to Longwalls 17 to 23 appear to be consistent with predictions made by Mine Subsidence Engineering Consultants (MSEC);
- Experience of subsidence impacts as a result of mining Longwalls 17 to 23 indicates that the likelihood of some risks may not be as high as previously anticipated; and
- The change of location and orientation of Longwalls 24 to 26 since the previous risk assessment workshop results in reduced risks associated with some surface features (particularly North Wambo Creek) in the vicinity of these longwalls.

All identified risks have a Risk Treatment Plan (Appendices). These risks have been assessed by the team to be as low as reasonably practicable (ALARP) or tolerable after the effective implementation of the identified controls and actions.

Recommendations for follow up made by the team in the risk assessment workshops are included in Table 1 below. The team understood that WCPL will track and review these actions, updating this Risk Assessment Report as required, and confirm the adequacy of the identified controls.

With the application of the identified controls, the team consensus was that subsidence related impacts over Longwalls 24 to 26 could be managed at a tolerable level of risk.

1.1 Action Plan

Table 1 – Action Plan

ID	Process/Issue/Activity	Action	Responsible	Next Due
SBRA52	Impacts on trees (that access weathered Permian water sources).	Add to visual inspection requirements during longwall operations/subsidence.	WCPL Environment and Community Manager	Q2 2023
SBRA17	North Wambo Creek damaged by subsidence (surface cracking along diversion directly above LW 24) resulting in inflow to workings and delay to operations.	Revise relevant assessment for under clause 33 of the <i>Work Health and Safety (Mines and Petroleum Sites) Regulation 2014</i> notification process for LWs 24 to 26 as part of the ongoing review process.	WCPL Technical Services Manager	Q2 2023
SBRA30	High wall or end wall instability or collapse of the Montrose pit due to insufficient protection from subsidence impacts.	Include a second check on Slope Stability Management Plan – inspection frequency and Trigger Action Response Plan for United Wambo Joint Venture (UWJV) and WCPL	WCPL Technical Services Manager	Q2 2023
SBRA34	Impact on statutory inspections and service provision to open cut (e.g. low voltage and high voltage maintenance activities, access for other operational activities etc.).	Follow up on the items related to the Open Cut (O/C) with the UWJV team members (covers all the identified points).	WCPL Environment and Community Manager	Q2 2023
SBRA16	Environmental consequences associated with water flow and quality changes in unnamed minor drainage lines resulting from subsidence impacts associated with the extraction of LWs 24 to 26.	Review and confirm ranking aligns with creek appearance (although noted to be a 3rd order stream). Confirm if 1 st , 2 nd and 3 rd order streams need to be separated. Also review the potential for tension cracking in the clays and alluviums.	WCPL Environment and Community Manager	Q2 2023
SBRA57	Potential for a change in the alignment of North Wambo Creek - due to a change in surface topography over LW 24 to 26	Complete sequential modelling works to confirm issues related to avulsion threat to North Wambo Creek.	WCPL Environment and Community Manager	Q2 2023
IS2303	Adjustment of lease and refencing and UWJV Statutory area (O/C) - will need to have specific Access Controls in place and configured.	Confirm the refencing of UWJV Statutory area is included in Security Plan and confirm in conjunction with UWJV	WCPL Environment and Community Manager	Q2 2023

2 DEFINITIONS

The following table provides guidance on terms used throughout this report.

Table 2 – Definition of Terms

Term	Explanation
ALARP	“As Low As Reasonably Practicable”. The level of risk between tolerable and intolerable levels that can be achieved without disproportionate expenditure in relation to the benefit gained.
Aspect	A classification of risk normally applied to environmental matters. “Aspects” are best thought of as mechanisms of harm – or causes of loss. Typical aspects are: surface water contamination or loss; land changes; or fauna/flora changes. Each of these aspects produces a subsequent environmental “impact”.
Causal Pathway	A term used to describe the “flow” of events beginning from a root cause and leading to an unwanted outcome. The flow is typically causes prevented from becoming incidents by preventative controls and incidents reduced in severity by mitigating controls which lead to different severity outcomes. A causal pathway is a cause <i>to</i> failed preventative controls <i>to</i> incident <i>to</i> successful mitigating controls <i>to</i> outcome.
GWMP	Abbreviation – Groundwater Monitoring Program – a document defining an approach to monitoring groundwater conditions and potential changes due to potential subsidence impacts.
Hazard	A thing or a situation with potential to cause loss.
HAZOP	Method of analysing mining operations, plant or processes to identify potential causes of incidents and prompt for required controls. Guidance on the method is available in AS/IEC 61882-2003 Hazard and operability studies (HAZOP).
Impact	A result of risk normally used when considering environmental matters. Impacts are the end result of the realisation of an “aspect”. For example – surface water changes have an impact that includes loss of habitat for water dwelling fauna and flora.
Incident	A step in the causal pathway which describes the point at which control of pathway is lost. System required preventative controls have failed or been circumvented when an incident occurs. An incident is NOT a risk as it should not be described as a consequence.
Inspection	A regular check of workplace equipment, working environment and practices, to identify hazards and deficiencies.
Instrument	Term used to describe either statute, standards, policies or other legal or corporate document which imposes obligations on the site and the personnel filling roles in the organisation.
Issue	Is used in the document to describe any point raised by the team or in the risk review process generally. An issue can be any of cause, hazard, incident, control, outcome (risk), requirement, background information or general point related to the subject area.
LMP	Abbreviation – Land Management Plan – A document outlining the management of potential environmental consequences due to potential subsidence impacts within the Project area and surrounds.
LW	Abbreviation – Longwall – the key method of secondary extraction considered.
Personnel	Includes all people working in and around the site (e.g. all contractors, sub-contractors, visitors, consultants, project managers, etc.).

Term	Explanation
Practicable	The extent to which actions are technically feasible, in view of cost, current knowledge and best practices in existence and under operating circumstances of the time.
Residual Risk	The risk associated with an unwanted event <i>after</i> the existing control measures are considered.
Review	An examination of the effectiveness, suitability and efficiency of a system and its components.
Risk	The combination of the potential consequences arising from a specified hazard together with the likelihood of the hazard resulting in an unwanted event.
Risk Management	The systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring risk.
SBX	Abbreviation – South Bates Extension Underground Mine.
RWEP	Abbreviation – Remnant Woodland Enhancement Program. Areas being managed by WCPL to help to conserve regional biodiversity, whilst enhancing the habitat available to flora and fauna.
SGWRP	Abbreviation – Surface and Groundwater Response Plan.
SWMP	Abbreviation – Surface Water Monitoring Program.
UWJV	Abbreviation – United Wambo Joint Venture
WCPL	Abbreviation – Wambo Coal Pty Limited.
WMP	Abbreviation – Water Management Plan.

3 INTRODUCTION

3.1 Objectives and Deliverables

The primary objectives of this risk assessment were to:

- Use the risk assessment to identify items to be addressed in the Extraction Plan (and related plans);
- Use the risk assessment as input into the preparation of the Extraction Plan for Longwalls (LWs) 24 to 26 at the South Bates Extension Underground Mine;
- Develop parameters for inclusion in other management plans;
- Involve a cross section of Wambo Coal Pty Ltd (WCPL), subject matter experts, decision makers and key stakeholders in the issue (hazard) identification process;
- Prioritise identified issues;
- Determine the criticality of controls;
- Identify recommended actions for follow up; and
- Document the process and the results.

3.2 Client

The client for the risk assessment is the WCPL Environment and Community Manager.

3.3 Scope

On the 6th of March 2023, a team consisting of WCPL technical and environmental staff and specialist consultants participated in a facilitated risk assessment workshop on the extraction related issues at the site. The goals for the workshop were:

Aim

- To review the risk assessment previously completed for LWs 21 to 24¹ of the South Bates Extension (SBX) Underground Mine, with an emphasis on identifying those subsidence impacts with high-risk levels and/or potentially severe consequences for the planned LWs 24 to 26.
- To confirm that adequate risk treatment measures are applied such that the residual risk ranking is tolerable.
- To rigorously identify and address all risks that are relevant to the SBX Underground Mine.

Proponent

- WCPL, a subsidiary of Peabody Energy Australia Pty Limited.

Mandate

- The team is to focus on the identification of key subsidence issues to be addressed in the Extraction Plan for LWs 24 to 26.

The risk assessment workshop included:

- Establishing the context including review of supporting information and objectives;
- Identifying risks via a number of risk management techniques, including:
 - Brain writing;
 - Modified hazard and operability analysis; and

¹ Note that an approval was given for a change of DA 305-7-2003 for the LW 24 first workings as MOD 18 in November 2021 – which requires a review of the extraction of LW24 as it was not covered in the earlier application for Extraction approval.

- Gap analysis against the subsidence impact performance measures in the Development Consent (DA 305-7-2003) and the features that may be affected by underground coal mining listed in Appendix B of EDG17 – Guideline for Applications for Subsidence Management Approvals (Department of Mineral Resources, 2003)²;
- Analysis of identified risks and nomination of key potential environmental issues; and
- Ranking of the risks, including consideration of identified preventative and mitigation measures.

3.4 External Facilitation

The team sessions were facilitated by Dr Peter Standish of Risk Mentor – a company specialising in risk assessment and risk management processes.

3.5 The Team

The team met on 6th March 2023 via a Microsoft Teams call. A team-based approach was utilised to incorporate an appropriate mix of skills and experience to identify the potential loss scenarios/issues relating to LWs 24 to 26. Details of the team members and their relevant qualifications and experience are shown in Table 3.

Table 3 – Team Members

Name	Role / Affiliation	Experience, Training and Skills I bring to the team session
Rohan Lucas	Alluvium - Surface Water Specialist	Formal qualifications and over 15 years research and design
Timothy Chisholm	Wambo - Tech Services Superintendent	Formal engineering and operational qualifications and over 10 years industrial experience
Peter Jaeger	Manager Environment and Community - WCPL	B Env Sc, Grad Cert Agri Business, over 10 years in energy sector
Patric Illingworth	Project Manager - Resource Strategies	B Eng (Chemical and Environmental); over 2 years' experience in environmental management and project approvals for resource industry.
Lucas Burns	Senior Project Manager - Resource Strategies	B Eng (Environmental), B Business Mgmt; nearly 20 years' experience in environmental management and project approvals for resource industry.
Brian Rask	SLR Consulting – Technical Director Hydrogeologist	Formal geological and hydrological qualifications and over 30 years technical experience
James Barbato	MSEC - Associate Director	B Eng (Civil). PhD and over 18 years' experience in the mining industry.
Nicole Dobbins	Environmental Adviser WCPL	B Sc (Environment Biology) and over 20 years' experience in environmental management and project approvals in the resource industry
Peter Standish	Facilitator / RM	Formal mining qualifications (PhD, B.Eng), statutory manager qualifications and over 30 years industrial experience. Facilitator for over 20 environmental risk analyses

Team member “goals” were gathered at the start of the process and were used to confirm that initial expectations of the team session were met – with the team members reflecting on these goals towards the end of the session. No additional points were raised during the goal review process.

² It is noted that although this Guideline no longer applies, it still provides a list of features that aid in hazard identification.

4 ESTABLISH THE CONTEXT

4.1 Project Context

The Wambo Coal Mine is an underground coal mining operation located approximately 15 km west of Singleton, near the village of Warkworth, NSW. The Wambo Coal Mine is owned and operated by WCPL, a subsidiary of Peabody Energy Australia Pty Limited.

A range of open cut and underground mine operations have been conducted at the Wambo Coal Mine since mining operations commenced in 1969. Mining under the Development Consent (DA 305-7-2003) commenced in 2004 and currently underground operations are conducted.

The SBX Underground Mine is a component of the approved Wambo Coal Mine, located north-west of the South Bates Underground Mine (see **Figure 1**). The SBX Underground Mine is approved for extraction in the Whybrow Seam (LWs 17 to 25) (**Figure 2**).

At the time of the February 2023 workshop, extraction of LW 22 had been completed, and extraction in LW 23 was ongoing. Extraction from LWs 24 to 26 is anticipated to commence in late 2023.

This risk assessment report has been prepared to support an updated Extraction Plan for LWs 24 to 26 in the Whybrow Seam at the SBX Underground Mine.

More information on the mine and its operation can be found on the company's website: www.peabodyenergy.com.au.

4.2 Risk Management and Organisational Context

The Development Consent (DA 305-7-2003) outlines a range of performance measures regarding the potential consequences of subsidence risks posed by mining. These subsidence impact performance measures are shown in Table 4.

Table 4 – Performance Measures

Feature	Subsidence Impact Performance Measure
Wollombi Brook	Negligible subsidence impacts and environmental consequences. Release of water from the site only in accordance with EPL requirements.
Low level cliffs within the South Bates Extension Area	Minor environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing that in total do not impact more than 5% of the total face area of such features).
Wollemi National Park	Negligible subsidence impacts and environmental consequences.
Warkworth Sands Woodland Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
White Box, Yellow Box, Blakely's Red Gum, Woodland/Grassy White Box Woodland Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Central Hunter Valley Eucalypt Forest and Woodland Ecological Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Conservation Area (including the proposed Wambo offset area under SSD 7142)	Negligible reduction to previously identified biodiversity credits.

Feature	Subsidence Impact Performance Measure
Threatened Species and Communities	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Wambo Homestead Complex	Negligible impact on heritage values, unless approval has been granted by the Heritage NSW and/or the Minister.
All built features (including public infrastructure and all structure on privately-owned land)	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.
Public Safety	Negligible additional risk.

Figure 1 – Wambo Mine Collective General Arrangement

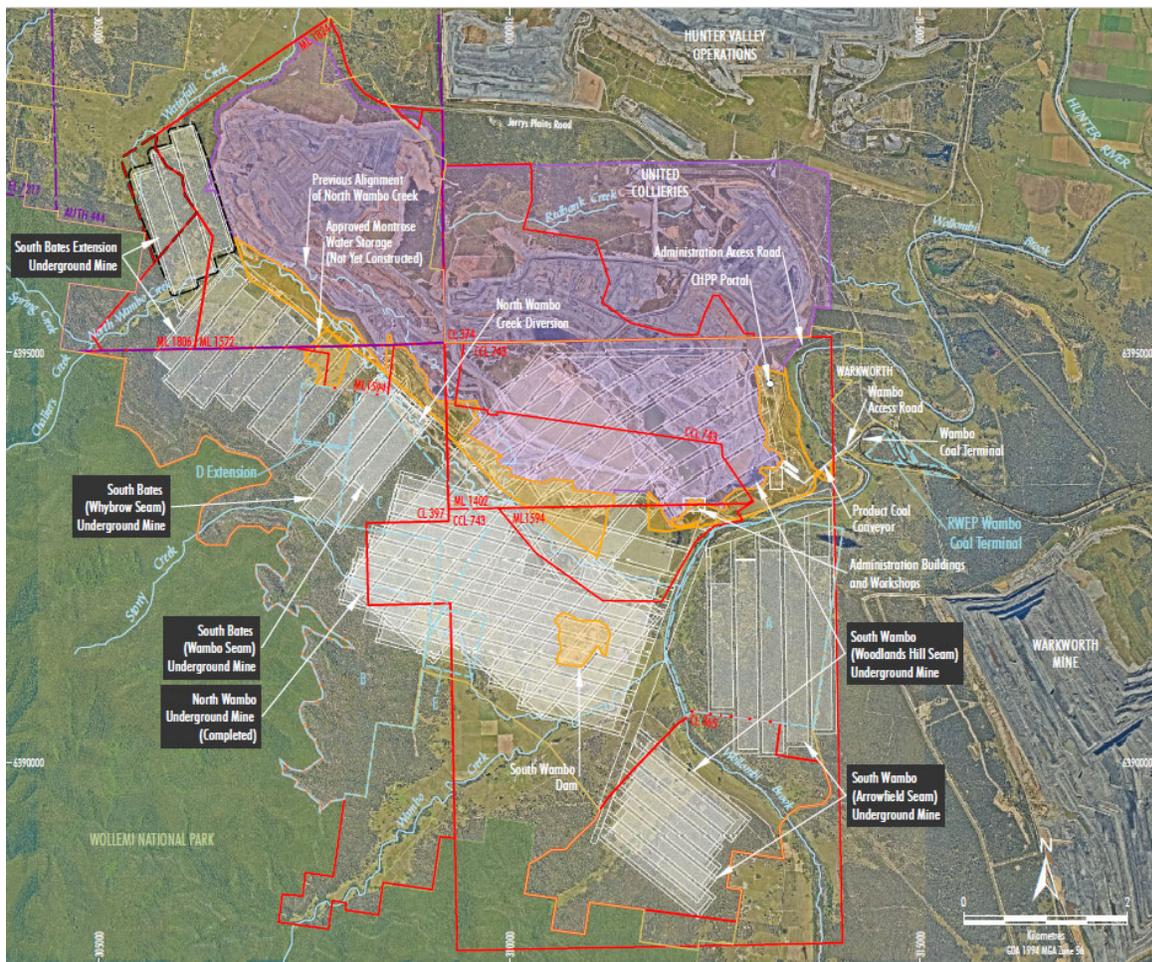
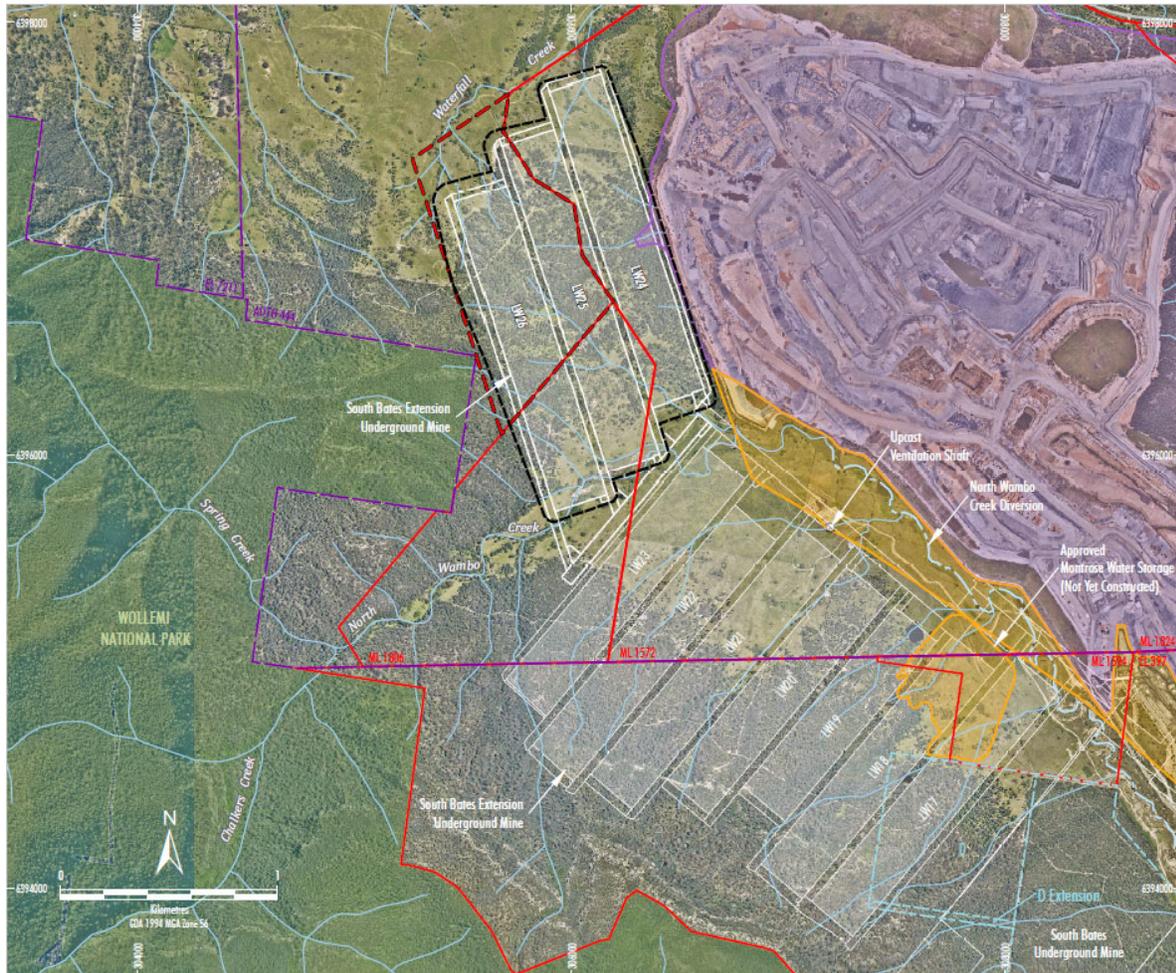


Figure 2 – Aerial Photograph of South Bates Extension Underground Mine



The Extraction Plan review process involved the following key steps:

1. Earlier studies from 2014 to 2020;
2. Latest extraction plan approved for LWs 21 to 24 approved in April 2021; and
3. Prepare Extraction Plan for LWs 24 to 26 for lodgement in the second quarter of calendar year 2023.

The assessment of risks has also referred to:

- Relevant criteria defined by statutory requirements;
- Community consultation findings;
- Requirements by local and state government agencies with responsibilities in the area;
- Structural tolerances of built surface structures;
- Operational licenses of public utilities which may be affected by subsidence in the proposed mining area;
- Relevant guidelines published by the NSW Government;
- Previous observations/information collected in the area; and
- Other relevant information made available to the team.

4.3 Key Assumptions for Client Review and Confirmation

The identification of key assumptions is a critical part of the risk assessment process – forming the basis for many engineering/project decisions. It is important that these assumptions are validated and reviewed as part of the risk management process. Key assumptions applied during the risk assessment process were:

- The risk assessment relates to the extraction of LWs 24 to 26 inclusive in the Whybrow Seam only;
- All commitments made in approval documentation (e.g. the *Wambo Development Project Environmental Impact Statement* and *South Bates Extension Modification Environmental Assessment*) or controls currently allocated to a work stream were taken to be “planned controls”;
- Injury to third parties is no longer a credible threat (SBRA42 and 39) with the lack of any requirement for access and implementation of the Security Management Plan, including fencing to isolate the subsidence area from people and stock;
- Longwall subsidence impact on the levee bank is not a credible threat due to distance and presence of the open cut void (SBRA36);
- Impact on the ventilation shaft is no longer credible due to the separation distance between LWs 24 to 26 and the shaft (SBRA59); and
- Risk ranking was undertaken on the basis of consequences being in excess of approved levels and in consideration of remediation.

5 METHOD

5.1 Key Steps

The key steps in the risk assessment process were:

1. Background analysis on the subsidence issues and experiences of underground mining at the Wambo Coal Mine;
2. Facilitation of a scoping session (developed by Resource Strategies and communicated to Risk Mentor) with decision making personnel to discuss scope material, and to confirm the risk analysis process and key outcomes sought;
3. Facilitation of a team-based analysis to evaluate and treat risks, comprising:
 - a. an open discussion with the team on “what do we want to achieve” in relation to the analysis;
 - b. presentation by subject matter experts on the project and the status of detailed studies;
 - c. review of earlier relevant Risk Assessment studies (for Longwalls 17 to 20 and 21 to 24);
 - d. brain writing process to identify general issues related to the extraction of Longwalls 24 to 26;
 - e. modified HAZOP - reviewing an aerial photo view of the mine to identify potential surface features which could contribute to/be affected by subsidence;
 - f. cross mapping to the applicable subsidence impact performance measures in the Development Consent (DA 305-7-2003) and surface and sub-surface features that may be affected by underground coal mining in Appendix B of EDG17 to confirm all items have been addressed;
 - g. risk ranking of the outcomes shown in the confirmed risk and control chart;
 - h. identification of planned (existing) and additional controls to mitigate risk levels to a tolerable state; and
 - i. generation of an action plan to complete the identified additional controls;
4. Complete draft report to AS/NZS ISO 31000:2018 standard for review by personnel; and
5. Finalise the report and issue as a controlled copy for ongoing use.

6 IDENTIFYING HAZARDS AND ISSUES

6.1 *Background Analysis of Documents*

The various documents listed in Section 11 were reviewed to determine the nature of specific threats and controls identified for the operation.

6.2 *Brain Writing*

Brain writing is a technique based on the work of de Bono (who built on the work of Alex Faickney Osborne) and is intended to promote creative thought amongst a group of people. As applied by Risk Mentor, the process involves:

1. Quiet reflection – individuals write their thoughts on the subject onto paper or card(s);
2. Group discussion – in turns, each person in the team reads out one of their issues. Each issue is then refined based on input from other team members who had similar items on their list; and
3. Key word association (where relevant) to identify additional issues for the register based on connection with the subject.

6.3 *Modified HAZOP*

An aerial photograph of the mine was used to identify potential subsidence impacts – with key word prompts connected with the various aspects of potential harm (**Figure 3**). The output from this process was added to the over-arching risk register and issues listing from the team session (shown in Table 5 and Table 6 respectively).

7 ANALYSE RISK

Analysis of identified issues requires the stakeholders to determine the risk that the identified threat poses to the organisation or the importance of the potential control. Risk is the product of the consequence and the likelihood of the event occurring with and without controls in place.

Risk analysis involves determining the consequences or impact of a potential event occurring in combination with the likelihood of that event occurring. The result is a “level of risk” defined by the following.

$$\text{Level of Risk} = \text{Consequence} \times \text{Likelihood}$$

The elements of risk level determination are as follows:

1. Consider the causal pathway – the balance between the intensity and frequency of the cause(s) and the preventative controls in place to prevent them from becoming incidents;
2. Identify existing mitigating control strategies and tactics that act to minimise negative outcomes from an incident;
3. Determine the consequences of the outcome reached by the causal pathway – with a negative impact or an opportunity. Where appropriate, the causal pathway considered should identify the facet that is impacted (e.g. outcome is related to harming people, natural environment, property, process continuity, etc.);
4. Determine the likelihood of the outcome being reached – giving balance to the cause, preventative and mitigating controls for a negative consequence or positive opportunity occurring. Likelihood is defined as the product of the probability of the event occurring and the overall exposure to the event;
5. Estimate the level of risk of an outcome by combining the consequence and likelihood rankings using the risk matrix (**Figure 5**); and
6. Identify and consider any uncertainties in the estimates; validate these where appropriate.

This technique was applied to reach the risk scores shown in Table 5 later in this report. Note that in some instances the risk levels were not scored – which flows from guidance including:

- Uncertainty – if the causal pathway cannot be clearly described, any estimation of risk levels would be misleading, and the matter should be referred as an action to the Client to determine the level of risk more clearly;
- Being Control Related – an issue such as failing to follow a procedure or a detection system not functioning are identified. In this case it is impossible to generate a meaningful risk score, as it requires the combination of the probability of the control failing AND the causal pathway being “traversed” at the same instant in time, which is not assessable; and
- Being Undefined – a causal pathway has no clear outcome and so no meaningful risk score can be assigned.

8 ASSESS RISK

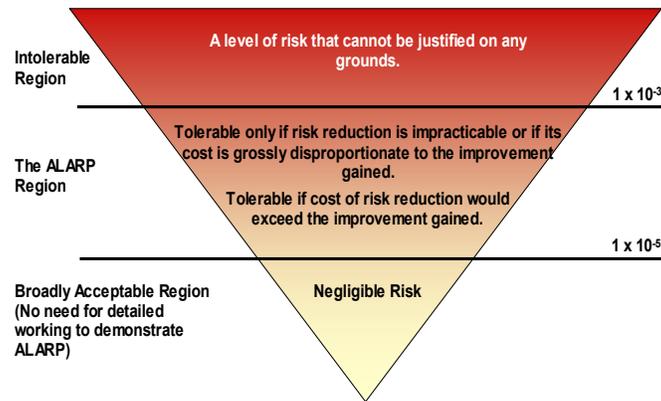
8.1 Risk Acceptability and Risk Criteria

The ‘tolerability’ of a risk is the willingness to live with a risk to secure benefits, on the understanding that the risk is being properly controlled (HB 203:2006 – *Environmental Risk Management – Principles and Process*). Legislation and good practice is targeted to reduce risk to “As Low as Reasonably Practicable” (ALARP). ALARP is often interchanged with “As Low as Reasonably Achievable” (ALARA).

The purpose of risk criteria is to allow the organisation to clearly define unacceptable levels of risk, or conversely the level of risk which is acceptable or tolerable. In essence the risk criterion enables the organisation to prioritise actions proposed to control the risk during the risk assessment – leading to the development of the Risk Treatment Plan (Appendices).

The ALARP principle, as represented in the diagram below, was developed to assist in the definition of the acceptability of risk and to demonstrate that an organisation has done all that is considered to be practical in reducing the level of exposure to a risk. More often this is done qualitatively rather than as a quantitative probability as shown on the right-hand side of the diagram presented in Figure 4. A risk may be tolerable in the ALARP zone if the cost of removing the risk is disproportionate to the benefits gained.

Figure 4 – Risk Criteria “ALARP”



8.2 Risk Ranking

The risk ranking likelihood, consequences and risk matrix considered by the team during the ranking process are outlined in **Figure 5**. The Risk Treatment Plan given in the Appendices shows the risk ranking results. The teams took into account cumulative impacts throughout all loss scenarios.



Figure 5 – Risk Assessment Matrix

Likelihood	Likelihood description	Probability	Consequence					
			Low (1)	Minor (2)	Moderate (5)	Significant (10)	Major (25)	Catastrophic (50)
5 - Very Likely	Likely to occur repeatedly – Expected in the work team	10% - 100%	5	10	25	50	125	250
4 - Likely	Probably will occur several times - Expected at this location	1% - 10%	4	8	20	40	100	200
3 - Possible	Could occur intermittently - Expected within Peabody	0.1% - 1%	3	6	15	30	75	150
2 - Unlikely	Could occur but hardly ever - Expected within the mining industry	0.01% - 0.1%	2	4	10	20	50	100
1 - Rare	Improbable or unrealistic - Not expected in the mining industry but seen in other industries	< 0.01%	1	2	5	10	25	50

Note – Figure 5 continues over the next 2 pages



Consequence Category		Consequence descriptions					
		Low	Minor	Moderate	Significant	Major	Catastrophic
Harm to People	P	Near miss, near hit, no medical treatment, report only (RO)	Slightly injured, first aid treatment (FAI)	Medical treatment (MTI), disabling reversible impairment, restricted work (RWI) or lost time (LTI)	Serious bodily injury or disabling irreversible impairment, permanent partial disability (PPD)	Single fatality incident. Total and permanent disability (TPD). Major irreversible health effects	Multiple fatality incident. Major injury / disease among multiple employees
Environmental	E	Negligible or reversible environmental impact Nil to minor remediation (typically a shift) No breach of regulations or requirement to report to regulators	Minor reversible environmental impact, minor remediation (typically < 5 days) Non-compliances and breaches of regulation that may result in a citation (NOV) May require reporting to the regulators	Incident resulting in moderate reversible onsite and/or off-site impact causing short term effect. Moderate remediation required (typically a month) Non-compliances and breaches of regulation that may result in prosecution or citation or punitive fine. Requirement or obligation to report to the regulators	Incident resulting in significant onsite or off-site environmental impact causing medium to long term environmental harm Significant remediation required (typically less than 12 months) Significant legal issues, non-compliances and breaches of regulation that results in a prosecution or citation or fine Moderate litigation issues involving many weeks of senior management time	A major incident resulting in regional environmental impact causing long term environmental harm Major long term remediation required (greater than 12 months) Major litigation or prosecution resulting in long term interruption to operations or loss of licence at a site	Incident resulting in catastrophic widespread regional environmental harm causing disastrous effect Major long term remediation required (over multiple years) Major litigation or prosecution, Loss of License to operate at Multiple sites
Finance (higher of cost or NPV)	F	<\$10,000	\$10,000 - \$100,000	\$100,000 - \$1 mil	\$1 mil - \$20 mil	\$ 20 mil-\$100 mil	>\$100 mil
Impact on reputation	R	Minor impact, no public concern; Market cap impact < \$20 M (< \$0.07 per share)	Local media or public concern; Market cap impact \$20 M - \$30 M (\$0.07 - \$0.12 per share)	Regional media or public concern. Local criticism; Market cap impact \$30 M - \$100 M (\$0.12 - \$0.40 per share)	National adverse media or public criticism; Market cap impact \$100 M - \$250 M (\$0.40 - \$1.00 per share)	International adverse media or public criticism. International public concern; Market cap impact \$250 M - \$500 M (\$1.00 - \$1.85 per share)	Significant international public or media criticism or condemnation; Market cap impact > \$500 M (> \$1.85 per share)
Law / Compliance / regulatory	C	Minor, one-off violations of law, regulation, permit or policy; minimal fines, penalties or costs	Recurring or systemic minor violations of law, regulation, permit or policy	Violations of law, regulation, permit or policy with moderate fines or penalties. Moderate Litigation, MSHA imminent danger order or similar	Significant violation of law or permit with material fines, penalties or costs. Serious dispute with strategic customer. Major Litigation	Material Litigation. Serious investigation by SEC, DOJ or foreign equivalent. Code of Conduct violations	Criminal investigation or proceedings involving officers or directors. Litigation with allegations of executive fraud or misappropriation
Strategic risk	SR	Event does not have a meaningful impact to Strategic Outlook	Event does not have meaningful impact to Strategic Outlook, but may require further monitoring	Event may have a material impact on near-term outlook for a region or mine	Event has a material impact on strategic outlook for a region or basin that may require a change to operations to mitigate risk	Event causes mines in a region or basin to cease current operations	Event or threat such that BTU would cease to exist as an ongoing concern in coal operations



Risk Score	Notification	Level	Action (H&S)
<11	Crew / team	Same level	Develop a plan (formal or informal) with crew or continue with and established plan (SOP etc.) that ensures the task can be completed safely. Team should remain aware for changing conditions.
11 to 30	Supervisor	.+1	Develop a formal safe action plan with supervisor and others within the crew (SOP) that identifies all known hazards and details what controls need to be in place and how the task should be performed to ensure it can be completed safely.
31 to 50	Area manager or site GM	.+2	Conduct a formalized risk review of existing work process and controls. Explore additional control options that eliminate, substitute or reduce the risk. Monitor controls for effectiveness during the task.
51 - 100	BU Mgt	.+3	Controls should be reviewed to ensure risk is as low as reasonably practicable (ALARP), critical controls must be identified and monitored for effectiveness. If risk is not at ALARP, additional controls must be identified and a plan developed for implementation.
101 to 199	ELT	.+4	Controls should be added / improved and an additional risk assessment completed for activity to proceed.
200 or greater	CEO	.+5	Controls should be added / improved and an additional risk assessment completed for activity to proceed.

9 TREAT RISKS

A systems approach to the treatment of risks involves consideration of three aspects:

1. Areas of Intervention (Prevention, Monitoring, Mitigation, Response/Recovery);
2. Wheel of Safe Production (Nertney Wheel); and
3. Sequence of Barriers (Hierarchy of Controls).

Additional information is provided in the Appendices.

A selection of controls to reduce the likelihood of the risks associated with the topic under review were made with due regard to their prospective reliability. That is, installing engineering modifications is a superior control to relying on operator training efforts. As part of the process, existing controls are analysed and recommendations for amendments or additions made where these existing controls were deemed unacceptable or inadequate.

Further, the prospective reliability of the controls identified was also reviewed. These controls were qualitatively reviewed by considering their position on the hierarchy of controls, the ability to detect any deterioration in the control and the ability to mitigate this deterioration.

9.1 Risk Treatment Plan

The Risk Treatment Plan given in the Appendices (at Table 5) shows the risk evaluation results.

10 MONITOR AND REVIEW

10.1 *Nominated Coordinator*

The nominated coordinator and client is the WCPL Environment and Community Manager. The coordinator should encourage all parties who attended the risk assessment team session to review this report and the identified hazards/issues – commenting as needed.

The nominated coordinator should also:

1. Review the report to confirm the accuracy of the material recorded from the team session;
2. Provide feedback to the parties who attended the risk assessment on any decisions which may be different from team expectations/recommendations raised on the day; and
3. Monitor the completion of the additional actions to confirm there is close out of each action.

10.2 *Implementation Review Plan*

It is important to confirm the controls and actions identified are appropriately managed. The expectation of the team was that:

1. Appropriate personnel would be allocated for implementation of recommended actions in a timely manner for completion;
2. Assumptions are validated; and
3. Action items would be appropriately resourced and implemented.

WCPL can make modifications to the recommended actions, but these should be done considering the risk management framework. Where a change is required, the basis for the change and a desktop review to assess if the risk of the underlying hazard remains tolerable is required. Where the change is significant then implementation of formal analysis and communication process should be triggered by the site's Change Management protocols.

10.3 *Communication and Consultation*

Communication and consultation form an integral part of the risk management process. It is the Client's responsibility to confirm that this report is shared with all participants involved in the process and other stakeholders as appropriate throughout the life cycle of the study subject area.

10.4 *Concluding Remarks*

A significant goal of the risk assessment process was to identify and analyse the subsidence related hazards with rigour. The desired outcome was to prevent losses to people, equipment, the environment and consequential business by evaluating the causal pathways and developing recommended controls for inclusion into an action plan.

This outcome was achieved by following the risk assessment process described within this document.

Ongoing review will be needed to manage the additional controls identified, and to ensure that subsequent risk management activities are conducted as required.

Dr Peter Standish would like to thank all personnel – particularly Patric Illingworth, Lucas Burns and Nicole Dobbins who arranged the sessions and resources provided – and other team members who contributed to the risk assessment.

11 REFERENCES

NSW Department of Mineral Resources (2003) EDG17. *Guideline for Applications for Subsidence Management Approvals*. December 2003.

NSW Department of Industry and Investment (2011) MDG1010. *Minerals Industry Safety and Health Risk Management Guideline*. January 2011.

12 APPENDICES

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12.1 Risk Treatment Plan

The following Risk Treatment Plan was developed by the team during the session on the 6th of March 2023.

Table 5 – Risk Treatment Plan

Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA06	SB068	Potential impacts on open artefact scatters.	Pre-work	Archaeological	Heritage management plan. AHIP pending. Ranking based on the experience of mining previous longwalls and the consequence would be covered under an approved condition so only minor in nature. Assumption was that rehabilitation would be properly managed.	Env	2	2	4	
SBRA32	SB028	Mine subsidence impacts on known items/open sites of Aboriginal heritage.	Pre-work	Archaeological	Implementation of Heritage Management Plan. AHIP in place for the majority of the Application Area. Due diligence process for surface disturbance (Surface Disturbance Permit process).	Env	2	2	4	
SBRA33	SB029	Mine subsidence impacts on items of unknown Aboriginal heritage.	Pre-work	Archaeological	Implementation of Heritage Management Plan. Due diligence process for surface disturbance (Surface Disturbance Permit process).	Env	2	2	4	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA02	SB071	Controls and remediation that were committed to be implemented were not executed to a standard which meets regulators expectations and significant later works are required.	Team Review	Business	SLR Process (third party specialist doing a risk based inspection process and providing a register of works required). Ranking basis - Considered a legal compliance issue. Likelihood is possible as even though its planned there are complications from changing regulator requirements / expectations and organisational changes on site. There are also access challenges with some of the locations that might be disturbed. Consequence level is moderate. Note that for LWs 24-26 Wambo is the owner of all properties affected - there are no credible impacts on non-owned properties. Ranking Basis - Based on the expenditures required for remediating neighbouring landowners properties and the current community perceptions of any harm caused by mining operations.	Leg	3	5	15	
SBRA10	SB064	Ingress of oxygen into mine workings as a result of subsidence cracking and subsequent spontaneous combustion events.	Modified HAZOP	Business	Implementation of Ventilation and Gas Management Plan, Mines Inspection System and Spontaneous Combustion Management Plan. Subsidence modelling and monitoring. Highwall stability assessment for extraction of LW24-26 indicating negligible impacts. Ranked as for earlier studies.	Fin/SR	2	10	20	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA58	SB080	Management plan delays cause delays to extraction plan approval		Business	Environment Planning Process. Direct consultation with DPE to resolve approval timeframe issues/complexities. Control failure related so not ranked.					
SBRA05	SB016	Subsidence impacts on UWJV Offset areas reducing biodiversity values.	Pre-work	Flora/Fauna	Implementation of the Extraction Plan, Biodiversity Management Plan, bed and bank stability monitoring, flora and fauna monitoring program, visual inspections, and remediation. Ranking considered to be slightly more likely - but with limited impact on biodiversity values (based on site observations of earlier longwalls).	Env	3	2	6	
SBRA12	SB046	Creation of subsidence repairs, monitoring or other tracks affects the conservation values of UWJV Offset areas.	Brainstorming	Flora/Fauna	Adherence to Surface Disturbance Permit as per Biodiversity Management Plan. Consultation with regulator. Remediation database. Ranking would indicate a requirement for additional offsets and an unlikely potential for it to occur.	SR	2	5	10	
SBRA20	SB019	Mine subsidence impacts resulting in impacts on vegetation along the North Wambo Creek Diversion.	Pre-work	Flora/Fauna	Implementation of the Extraction Plan, Biodiversity Management Plan, bed and bank stability monitoring, flora and fauna monitoring program, visual inspections, and remediation. IDSC annual monitoring program. Ranked considering observed impacts from LW17 to 23. LWs 24 to 26 are stepping away from the diversion - so the threats should be lower - anything that further detracts from flow will impact the vegetation and required adaptive management to achieve revegetation goals.	Env	4	1	4	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA21	SB021	Subsidence impacts and surface disturbance due to extraction of LWs 24 to 26 resulting in long-term loss of native vegetation.	Pre-work	Flora/Fauna	Implementation of the Extraction Plan, Biodiversity Management Plan, bed and bank stability monitoring, flora and fauna monitoring program, visual inspections and remediation. Ranking - considered rare and with minor consequences (10-15 years of historical mining would suggest this event is very rare (not sighted) so considered as rare).	Env	1	2	2	
SBRA25	SB020	Subsidence impacts and surface disturbance due to the extraction of Longwalls 24 to 26 resulting in loss of habitat for threatened species.	Pre-work	Flora/Fauna	Implementation of the Extraction Plan, Biodiversity Management Plan, bed and bank stability monitoring, flora and fauna monitoring program, visual inspections and remediation.	Env	1	5	5	
SBRA51	SB073	Impacts on vegetation and Groundwater Dependent Ecosystems (GDE) (tying in with SB072)		Flora/Fauna	GDE Monitoring program (commenced 2019). Controls as for SB072. Ranking basis would be as for SB072	Env	4	1	4	
SBRA52	SB074	Impacts on trees (that access weathered permian water sources).		Flora/Fauna	Water Management Plan - with groundwater modelling and monitoring. GDE Monitoring program (commenced 2019). Ranking basis would be as for SB072	Env	4	1	4	See Table 1



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA07	SB008	Failure of the monitoring program to detect and respond to an impact on the groundwater system.	Pre-work	Groundwater	Documentation and execution of the Water Management Plan (including the Surface Water Management Plan, Groundwater Management Plan, Surface and Groundwater Response Plan and North Wambo Creek Subsidence Response Strategy). Assessment of impacts during development of the Extraction Plan. Clear allocation of roles and responsibilities in the management plans. Ranking basis - considered to be unlikely to occur and if it does occur will be reversible over time as the aquifers recharge. Noted that in 2020 and 2023 there is a more extensive network of bores (and is likely to expand) - and this may lead to greater financial impacts if any damage occurs.	Env	2	5	10	
SBRA38	SB050	Presence of a geological structure mid block for LW's 24 to 26. Change in orientation will move closer to the mapped fault - which might lead to differences between modelled and observed groundwater drawdown (possibly conservative at a distance, but inaccurate locally).	Team Review	Groundwater	Documentation and execution of the Water Management Plan (including the Surface Water Management Plan, Groundwater Management Plan and Surface and Groundwater Response Plan). Assessment of impacts during development of the Extraction Plan. Confidence increase in prediction with LW17 to 20 acting as predicted.	Env	2	5	10	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA50	SB072	Position of LW 24 to 26 - fracturing and subsidence issues of North Wambo Creek interception of alluvial groundwater and interception of groundwater within weathered coal measures		Groundwater	Water Management Plan, Groundwater modelling and monitoring. Ranking basis - considered hydraulic property changes being added and increased frequency of monitoring (and feedback to models). Take is largely from the Permian (not the alluvial) - Environmental impacts would be on GDE's / stygofauna . Water is deep and wouldn't have impacts on GDE's (ecologists report as basis).	Env	4	1	4	
SBRA55	SB077	Licensing requirements for base flow water loss and confidence in modelled number to address licensing requirements for the whole complex		Groundwater	Existing licenses based on modelled requirements. Water Management Plan. Groundwater Modelling (confirming consistency with predictions). Ranked considering it is possible and the impacts would also be moderate and potential increased focus on water - and gathering of ongoing records.	Fin	3	5	15	
SBRA14	SB056	Subsidence impacts to WCPL power and communication lines.	Historic Review	Infrastructure	Implementation of Extraction Plan and Built Features Management Plan (WCPL Asset Management Plan), Subsidence Monitoring. All lines are run over the mains (not over the main areas of subsidence). Ranked on the basis of lines being present - but controls having proved effective in other operating areas.	Bus	1	2	2	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA17	SB010	North Wambo Creek damaged by subsidence (surface cracking along diversion directly above Longwall 24) resulting in inflow to workings and delay to operations.	Pre-work	Infrastructure	Inrush Management Plan. Implementation of the Extraction Plan. Installation of adequate mine dewatering capacity. Weekly inspections of areas over subsidence. Ranked reflecting the experience of earlier longwalls. (Re-ranked in line with Inrush MP analysis).	Bus	2	10	20	
SBRA19	SB017	Subsidence impacts to unsealed gravel access roads or fire trails.	Pre-work	Infrastructure	Implementation of Extraction Plan and Built Features Management Plan, including monitoring and remediation. Ranked on the basis of accessing pumps, vent shaft and generators etc.	Bus	3	2	6	
SBRA23	SB009	Structural damage to wells and bores close to the mine footprint, in particular monitoring bores and other gas drainage infrastructure.	Pre-work	Infrastructure	Implementation of Extraction Plan and Built Features Management Plan. Noted an increase in likelihood with the increased amount of monitoring sites.	Bus	3	5	15	
SBRA26	SB022	Mine subsidence impacts to fences on WCPL owned land.	Pre-work	Infrastructure	Implementation of Extraction Plan and Built Features Management Plan, including monitoring and remediation. Ranked considering the cost of the damage.	Bus	3	2	6	
SBRA29	SB025	Exploration activities affected by subsidence.	Pre-work	Infrastructure	Ground Disturbance Permit and Surface Disturbance Permit processes.	Bus	1	2	2	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA30	SB026/ SB038	High wall or end wall instability or collapse of the Montrose pit due to insufficient protection from subsidence impacts.	Pre-work	Infrastructure	Implementation of Built Features Management Plan, Slope Stability Management Plan, high wall inspection program. Execution of geotechnical assessment processes. Ranking comment - Geotech assessments undertaken with negligible assessed impact.	Bus	1	1	1	
SBRA34	SB034	Impact on statutory inspections and service provision to open cut (e.g. low voltage and high voltage maintenance activities, access for other operational activities etc.).	Brainstorming	Infrastructure	Implementation of Extraction Plan, Built Features Management Plan, Slope Stability Management Plan and high wall inspection program. Ranking Basis - Considered as interactions with Joint Venture doing stat inspections	Bus	1	2	2	See Table 1
SBRA37	SB042	Subsidence impacts on access tracks restrict access for monitoring/remediation.	Brainstorming	Infrastructure	Implementation of Extraction Plan and Built Features Management Plan, including monitoring and remediation. Ranked considering consistent failure monitor due to loss of access - with controls in place would be unlikely.	Leg	2	2	4	
SBRA49	SB070	Subsidence impacts on farm dams leads to exposure to potential health and safety impacts	Modified HAZOP	Infrastructure	Subsidence monitoring. Inrush Control management plan (potential for dewatering). Ranking discussion - Discussed around health and safety and earlier ranking was around inrush.	Per	1	1	1	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA01	SB012/ SB044	Unintended subsidence impacts resulting in rock instability of the Wollemi National Park escarpment and associated environmental consequences.	Brainstorming	Land	<p>Implementation of Extraction Plan, Land Management Plan and Public Safety Management Plan.</p> <p>Identification of cliff lines that are associated with the Wollemi National Park with appropriate mine design offsets applied.</p> <p>Ranking basis - Considered the implications of a serious non-compliance should the event occur. All the subsidence models and site experience suggest that this event is improbable and not expected to occur - but the consequence would be significant for both legal and reputation.</p> <p>Note - the LW24-26 are much further from the escarpment - and there is an argument to suggest there is no longer any credible impact. Drone flights made - and no visible mining related impacts on the cliff lines.</p> <p>Note - there were 2 rock falls related to a heavy rainfall event.</p>	Leg/Rep	1	10	10	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA04	SB013A	Exceedance of subsidence impact performance measure above longwalls.	Team Review	Land	Implementation of Extraction Plan, Land Management Plan and Public Safety Management Plan. Monitoring program against performance criteria (before and after subsidence). Contingency plan. Verified monitoring results from LW's 17 to 21 - which indicate that predictions are consistent with measured movements. Ranking basis drew on the performance of the subsidence models - which indicate that it would be less likely (i.e. Rare) as the cliffs are small and conglomerate rock. Consequences is related to legal compliance.	Leg	1	5	5	
SBRA11	SB015	Subsidence impacts resulting in significant cracking and downslope movement of steep slopes and associated environmental consequences.	Pre-work	Land	Implementation of Extraction Plan, Land Management Plan and Public Safety Management Plan. Ranked on the basis of being possible from the subsidence modelling and unlikely if drawing on past experience and a potential for moderate impacts.	Env	3	5	15	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA18	SB013	Subsidence impacts resulting in instability or rock fall of cliff lines on the escarpment resulting in environmental consequence.	Pre-work	Land	Implementation of Extraction Plan, Land Management Plan and Public Safety Management Plan. Ranking basis is that the cliffs are not over the longwalls and subsidence prediction is to about 30 mm so likelihood is rare and implications are environmental (minor reversible). Noted that the consideration now are only for cliffs of the escarpment. Consequence increased for a mining related incident (LW's 24 to 26) - and impact on reputation from a reputational/legal basis.	Env	1	5	5	
SBRA24	SB014	Subsidence impacts resulting in instability of rock pagodas or other rock features and associated environmental consequences.	Pre-work	Land	Implementation of Extraction Plan, Land Management Plan and Public Safety Management Plan. (Probability reduced as no pagodas known in the study area). Ranking basis was that it was rare for an event to occur but a moderate consequence could result	Env	1	5	5	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA08	SB051	Impacts on access for fire fighting or fire management purposes over Longwalls 24 to 26.	Brainstorming	Public Safety	Implementation of Public Safety Management Plan. Subsidence monitoring and remediation. Bush Fire Management Plan (which includes monthly inspections of fire trails during fire season). Ranking discussion indicated that cracks are repaired following identification. Monthly inspections on perimeter tracks as part of the Subsidence Monitoring programs. With repairs conducted it would be unlikely that a minor impact would occur with injury to a person. Also discussed access to the levee and secondary access road are not over the LW24-26 area.	Per	2	2	4	
SBRA03	SB011	Impacts to downstream water quality.	Pre-work	Surface Water	Implementation of Extraction Plan and Water Management Plan, including bed and bank stability monitoring and remediation. Ranked on the experience with earlier longwalls which showed no ingress of water into the underground. Even with this the likelihood will still remain unlikely (2) and the consequence environmentally would be moderate but the likely financial impacts of remediation would be more significant (10). Ranking Basis - subsidence of LW's 24-26 will be to reduce flow and thus damage to the diversion - and subsequently impacting the measurements at downstream sites.	Fin	2	10	20	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA09	SB045	Induced leakage from North Wambo Creek (natural and diverted) due to subsidence resulting in adverse impact on environmental flow.	Brainstorming	Surface Water	Implementation of Water Management Plan and subsidence remediation. Ranking basis - Noted that there will be ongoing work to identify and manage any losses. Expected around 60,000 m3 of subsidence of North Wambo Creek (previously was a larger amount).	Leg/Fin	3	5	15	
SBRA15	SB003	Reduced base flow to North Wambo Creek / diversion resulting from a lowering of the water table associated with the extraction of Longwalls 24 to 26.	Pre-work	Surface Water	Implementation of Extraction Plan and Water Management Plan, including monitoring and remediation. Ranked on an environmental basis with medium term reversible impacts on aquatic fauna (noted ongoing cumulative impact that is still being understood).	Env	2	5	10	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA16	SB004	Environmental consequences associated with water flow and quality changes in unnamed minor drainage lines resulting from subsidence impacts associated with the extraction of Longwalls 24 to 26.	Pre-work	Surface Water	Implementation of Extraction Plan and Water Management Plan, including monitoring and remediation. As for SB003. Note that a contribution from the Escarpment to the Western tributaries will need to be considered - rainfall recharge/infiltration in fractured sandstone reports to base of slope. No fracturing of the Narrabeen group (in groundwater assessment). Waterfall creek is being undermined for the first time - concern over potential for gully erosion (stepping and exposed bedrock). Unlikely to have changes in surface flows - but could see cracking in bedrock. Waterfall creek is quite a bit steeper - but ranked treating all the same.	Env	2	5	10	See Table 1
SBRA22	SB007	A change in land surface slope and preferential pathways for rainfall infiltration resulting from fracturing to the land surface caused by the extraction of Longwalls 24 to 26	Pre-work	Surface Water	Implementation of Extraction Plan and Water Management Plan, including bed and bank stability monitoring and remediation. Alluvium management structures (rock chutes). Annual IDAS monitoring.	Env	2	5	10	
SBRA35	SB035	Increased ponding along North Wambo Creek and tributaries as a result of subsidence.	Brainstorming	Surface Water	Implementation of Extraction Plan and Water Management Plan, including bed and bank stability monitoring and remediation. Ranked considering ponding in isolation.	Env	1	3	3	



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA40	SB054	A change in flood regimes or extent of potential inundation due to subsidence resulting from the extraction of Longwall 24 to 26.	Historic Review	Surface Water	Implementation of Extraction Plan and Water Management Plan, including monitoring and remediation. Alluvium management structures (rock chutes). Ranked considering flooding of vegetation and localised impact - so it could happen but with minor consequence.	Env	3	2	6	
SBRA53	SB075	Impacts on diversion arising from changes in bed-load impact (similar to a weir effect - that takes up the bed-flow transport - leading to erosion in downstream areas).		Surface Water	Water Management Plan. Erosion and Sediment Control Plan. Subsidence Monitoring Program. Surface Crack Remediation. North Wambo Creek Diversion Management Plan (with potential to add additional items as needed). Ranked considering predicted impact and with moderate level of consequence - now minor with reoriented longwalls	Env	3	2	6	
SBRA56	SB078	Potential for cracking enlargement in dispersive subsoils (where there are surface slopes)		Surface Water	Water Management Plan. Erosion and Sediment Control Plan. Subsidence Monitoring Program. Surface Crack Remediation. Ranked considering predicted impact and with moderate level of consequence (considered environmental issues as well - but was ranked higher in Financial so this is shown). (Confirm as for minor mapped drainage)	Fin	3	5	15	
SBRA57	SB079	Potential for a change in the alignment of North Wambo Creek - due to a change in surface topography over LW 24 to 26		Surface Water	Not same potential change as previously considered. Not possible to rank due to additional analysis required.					See Table 1



Ref	Was	Process/Issue/Activity	Source	Aspect Type	Planned Controls	Cat	L	C	R	Actions
SBRA42 and SBRA39		Potential for injury to third parties was noted to be significantly lower for the planned LW24 to 26 layout - with no requirement for any access by third parties and implementation of the Security Management Plan with fencing to isolate the area from people and stock.		Assumption	To note with client					See Key Assumptions for Client Review and Confirmation
SBRA36		LW Subsidence impact on the Levee bank is not a credible threat due to distance and presence of the O/C void.		Assumption	To note with client					See Key Assumptions for Client Review and Confirmation
SBRA59	N/A	Potential for impact on the Ventilation shaft is no longer credible due to the separation distance between LWs 24 to 26 and the shaft.		Assumption	To note with client					See Key Assumptions for Client Review and Confirmation

Table 6 – Issues Register (General Points Raised at the Workshops)

Ref	Issue	Source	Comment on Current Controls	Action Item(s)
IS2002	Base flow loss of North Wambo Creek to subsidence effects.	2020 Study	Addressed in Table 5	
IS2003	Impact on ventilation shaft	2020 Study	Addressed in Table 5 and Section 4.3	
IS2005	Ponding and impacts on vegetation along North Wambo Creek alignment	2020 Study	Likely that any increased water loss will lead to an absence of ponding (although if cracks infill then there will be a potential for ponding). Current experience is that this has not presented as a significant problem.	
IS2006	Impacts on vegetation and GDEs (tying in with IS2007)	2020 Study	Addressed in Table 5	
IS2007	Greater than predicted subsidence leading to greater than predicted impacts on groundwater - particularly if there is greater fracturing/surface fracturing (potential increase in connectivity)	2020 Study	Addressed in Table 5	
IS2008	Subsidence cracking coinciding with environmental features - EEC	2020 Study	Mapping cracking in the area - with commitments to rehabilitate if required	
IS2009	Point in time effect arising because of the drought - loss of base flow	2020 Study	Addressed in Table 5	
IS2010	Impacts on diversion arising from changes in bed-flow impact (similar to a weir effect - that takes up the bed-flow transport - leading to erosion in downstream areas).	2020 Study	Addressed in Table 5	
IS2011	Groundwater take - how that impacts overall groundwater performance	2020 Study	Addressed in Table 5	
IS2014	Geological Structures present but not adequately modelled	2020 Study	Ground/Strata Management Plan in place and implemented - with ongoing exploration and monitoring intended.	

Ref	Issue	Source	Comment on Current Controls	Action Item(s)
IS2015	RMP commitment to return vegetation in creek diversion to riparian - impacted by draw downs and losses	2020 Study	Action - review changing the commitment in the next RMP review	Addressed in Table 1
IS2016	Subsidence cracking coinciding with steep slopes/cliffs and impacts	2020 Study	Addressed in Table 5	
IS2017	Subsidence cracking impacts Wollemi escarpment	2020 Study	Addressed in Table 5	
IS2018	Offset vegetation impacted by subsidence repairs.	2020 Study	Addressed in Table 5	
IS2019	Licensing requirements for base flow water loss and confidence in modelled number to address licensing requirements for the whole complex	2020 Study	Addressed in Table 5	
IS2020	Potential for cracking enlargement in dispersive subsoils (where there is surface slopes)	2020 Study	Addressed in Table 5	
IS2021	Direct risks around erosion of the pillar zones over the subject area	2020 Study	Addressed in Table 5	
IS2022	Impacts on land-holder bores in the area	2020 Study	No bores in the area	
IS2023	Changes post closure with the pit length in Montrose - cumulative post closure - how to remediate along North Wambo Creek	2020 Study	Referred to closure risks. Spoil against the pit wall could lead to contamination downstream - and not calculable for LW24-26 impacts.	
IS2025	Management plan delays cause delays to extraction plan approval	2020 Study	Confirmed covered in discussions	
IS2027	Potential for a change in the alignment of North Wambo Creek - due to a change in surface topography over LW 24 to 26 (noted that this was a lower order risk than for the previous layout where LW24 was in the same alignment as the North Wambo Creek)	2020 Study	Subsidence MP, Erosion and Sediment Control Plan. Ranked - very low number of trees in area - dominantly ground cover (so no/few GDE's). $3 / 5 = 15$	

Ref	Issue	Source	Comment on Current Controls	Action Item(s)
IS2301	Secondary extraction risks should consider subsidence of the High Wall area - noted that this will be covered in a High Risk Activity application and is outside the scope of the Subsidence RA	Discussions	Addressed in Table 5	
IS2303	Adjustment of lease and refencing and UWJV Statutory area (O/C) - will need to have specific Access Controls in place and configured.	Discussions	Addressed in Table 5	Addressed in Table 1
IS2304	New UWJV offset area at the Southern end of LW26	Discussions	Addressed in Table 5	
IS2305	Monitoring network (particularly bores) - will potentially damage existing monitoring sites - will they need replacing at the same location or elsewhere? Decommissioning of bores	Discussions	Addressed in Table 5	
IS2307	North Wambo Creek	Modified HAZOP	Addressed in Table 5	
IS2308	Proximity to Highwall	Modified HAZOP	Technical analysis noted and confirmed as addressed in Table 5	
IS2309	Escarpment	Modified HAZOP	Addressed in Table 5	
IS2310	Structures and dams	Modified HAZOP	Addressed in Table 5	
IS2311	North Wambo Creek	Modified HAZOP	Addressed in Table 5	
IS2312	Incision management in gully	Modified HAZOP	Addressed in Table 5	
IS2313	Aboriginal heritage sites	Modified HAZOP	Addressed in Table 5	
IS2314	Montrose Highwall / Licence considerations	Modified HAZOP	Addressed in Table 5	
IS2315	Upper reaches of Waterfall Creek	Modified HAZOP	Addressed in Table 5	
IS2316	Avulsion of tributary to North Wambo Creek	Modified HAZOP	Addressed in Table 5	Addressed in Table 1 (see SBRA057)
IS2317	Montrose Property Agistment	Modified HAZOP	Addressed in Table 5	

Ref	Issue	Source	Comment on Current Controls	Action Item(s)
IS2318	Boundary of National Park	Modified HAZOP	Addressed in Table 5	
IS2319	UWJV / Wambo Interactions	Modified HAZOP	Addressed in Table 5	
IS2320	Waterfall Creek	Modified HAZOP	Addressed in Table 5	
IS2321	Flows in North Wambo Creek	Modified HAZOP	Addressed in Table 5	
IS2322	Landowner bores	Modified HAZOP	Addressed in Table 6 (see comments for IS2022)	
IS2323	Limited Surface (topography) Access for inspections / monitoring	Modified HAZOP	Addressed in Table 5	
IS2324	Drainage parallel to tension cracks initiating gully erosion	Modified HAZOP	Addressed in Table 5	
IS2325	Conservation area	Modified HAZOP	Addressed in Table 5	
IS2326	Incision upstream of LW's	Modified HAZOP	Addressed in Table 5	
IS2327	Wambo Biodiversity Conservation Area	Modified HAZOP	Addressed in Table 5	

12.2 Modified HAZOP – Detailed Information

The following figures provide more legible views of the annotated aerial photograph.

Figure 6 – Northern Part of Aerial Photograph

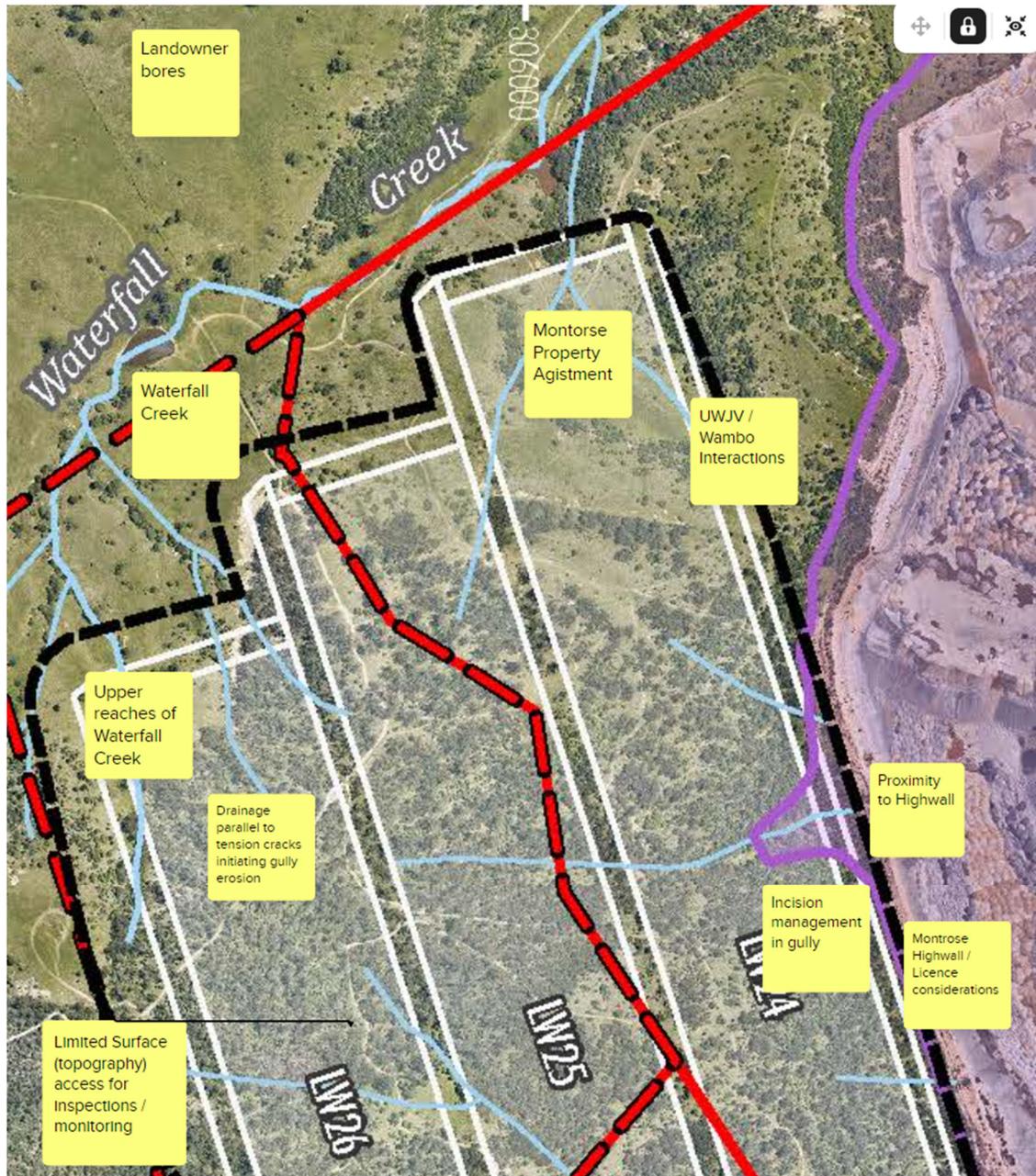


Figure 7 – Southern Part of Aerial Photograph

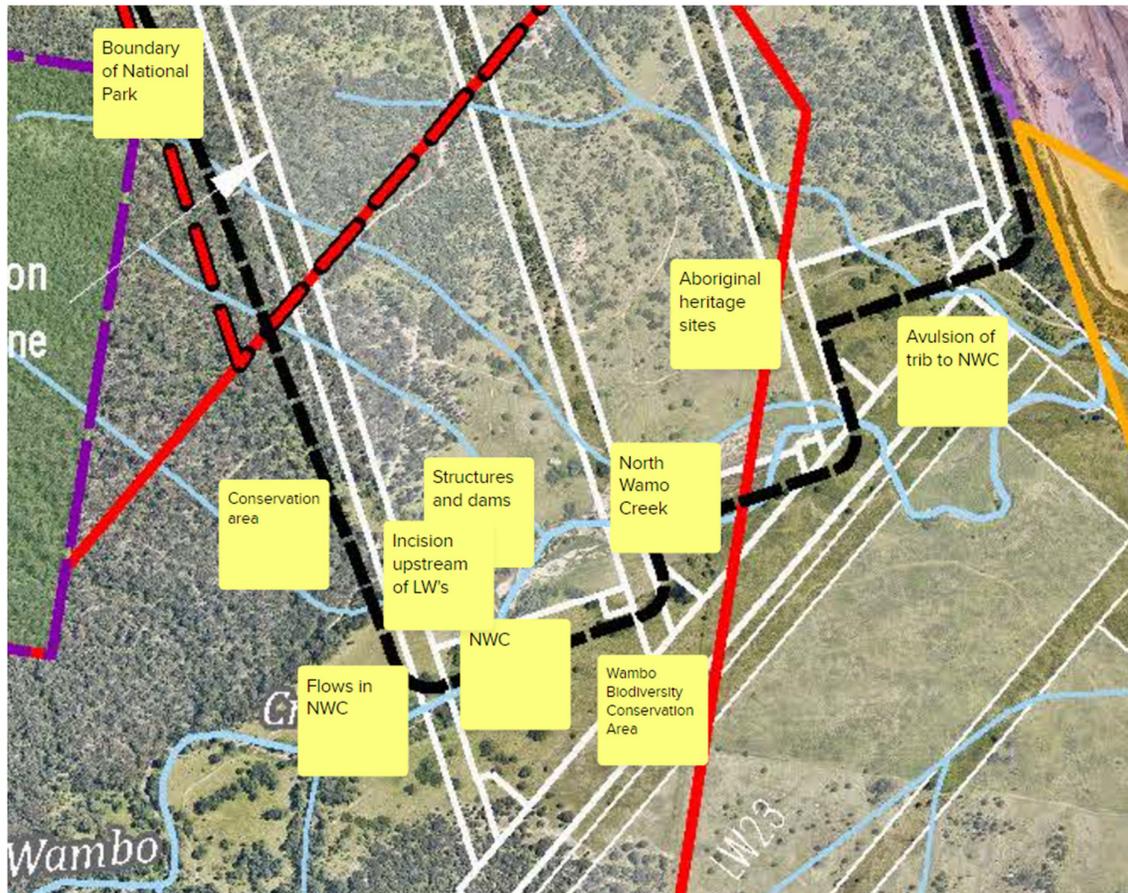
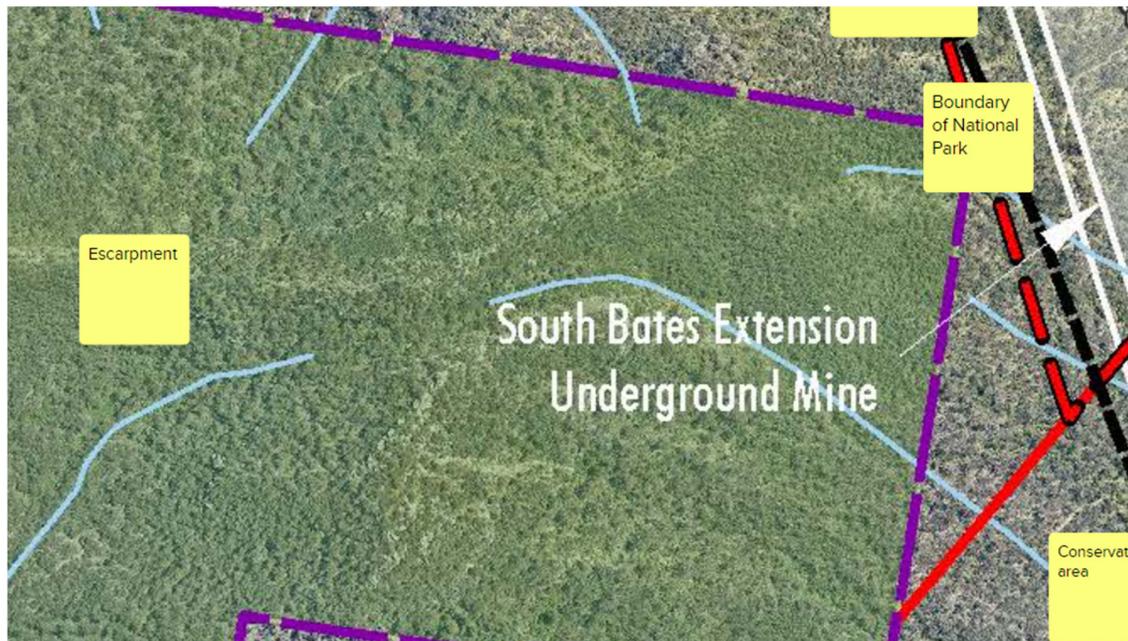


Figure 8 – Western Part of Aerial Photograph



12.3 About Your Report

Your report has been developed on the basis of your unique and specific requirements as understood by Risk Mentor and only applies to the subject matter investigated.

We have endeavoured to accurately gather information from observations, document reviews and from site personnel. Analysis has been conducted using the best methods of risk engineering science known to the author(s) and should represent a useful suite of information on which the site can base subsequent actions.

Even with all these efforts made it is possible that due to information reviewed being erroneous or incomplete errors may exist in the document or that the recommendations may not be fully effective in avoiding unwanted risks.

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