

Jervois Base Metal Project

Risk Assessment Update

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1 INTRODUCTION

A risk assessment was undertaken to assist in identifying the key environmental, social, economic and human health and safety issues associated with the Jervois Project (the Project) as part of the project Environmental Impact Statement (EIS). A preliminary risk assessment based on *AS/NZS ISO 31000:2009, Risk management - Principles and guidelines* was conducted by Eco Urban Pty Ltd via a desktop study, a brainstorming session and followed by a workshop with representatives from Eco Urban, Nitro Solutions, KGL Resources and a group of specialist consultants. The initial findings were used to guide the project specific baseline studies. Following completion of the relevant baseline studies, the understanding of issues related to the project development, operation and closure were improved. The risk assessment was then updated by Nitro Solutions to incorporate the findings of the technical studies. This assessment also incorporated the risk assessment which was completed in 2014 as part of the Project Prefeasibility Study.

2 METHODOLOGY

The risk assessment process is outlined below in Figure 1 as based on *AS/NZS ISO 31000:2009, Risk management - Principles and guidelines*.

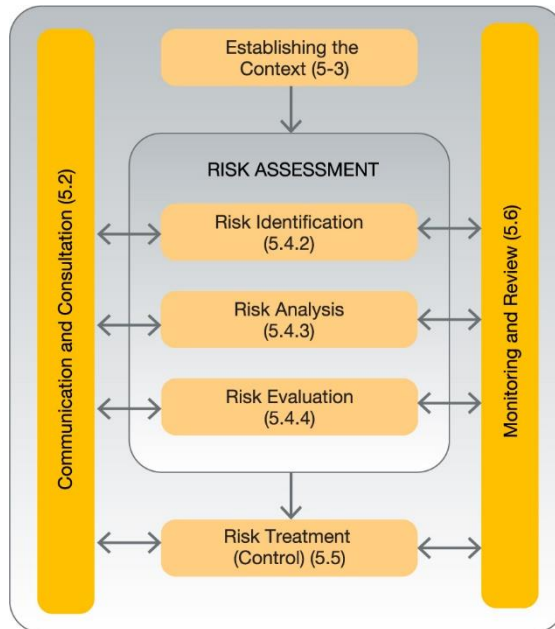


Figure 1: Risk Assessment Process

Initially the potential events of the Jervois Project development, operation and closure were identified. The risks and impacts of these potential events were then analysed and evaluated using the qualitative risk assessment matrix (Table 1, Table 2). The likelihood of occurrence (Table 3) and the consequence (Table 4) of the risks were assessed to determine the initial risk rating. Mitigation measures were developed to remove or reduce the risks to be as low as practicably possible and to an acceptable level. The residual risks were determined based on the same matrix. For ease of reference, risks were categorised into social and economic, environmental or human health and safety areas.

Specific risk assessments such as social impact, bush fire risk assessments were carried out as part of the technical impact assessments. The risk matrix used by different technical specialist for the specific risk assessments were different. The risk matrix adopted for the Project has incorporated the different risk matrix used in the technical impact assessment.

Table 1: Qualitative Risk Matrix

Likelihood of the Consequence Occurring	Maximum Reasonable Consequence				
	1. Insignificant	2. Minor	3. Moderate	4. Major	5. Catastrophic
A. Almost Certain	11 Low	16 Medium	20 High	23 Extreme	25 Extreme
B. Likely	7 Low	12 Medium	17 High	21 High	24 Extreme
C. Occasionally	4 Very Low	8 Low	13 Medium	18 High	22 High
D. Unlikely	2 Very Low	5 Very Low	9 Low	14 Medium	19 High
E. Rarely	1 Very Low	3 Very Low	6 Very Low	10 Low	15 Medium

Table 2: Risk Level

Risk Level	
Very Low	Such risks are below the risk acceptance threshold, no significant action or further assessments required, can be managed under existing operational controls
Low	Such risks are below the risk acceptance threshold, some mitigation may be required - no detailed assessment of factors and aspects required but addressed in the Environmental Management Plan as routine controls
Medium	Such risks are above the risk acceptance threshold, active monitoring and substantial mitigation required - assessment required of factors and aspects
High	Such risks are above the risk acceptance threshold, monitoring program and major mitigation action required - assessment required of factors and aspects
Extreme	Such risks are significantly above the risk acceptance threshold, potentially unacceptable, urgent management and comprehensive mitigation action required

Table 3: Qualitative Measure of Likelihood

Level	Descriptor	Description	Guideline Frequency
A	Almost Certain	Consequences are expected to occur in most circumstances	Occurs more than once a month
B	Likely	Consequences will probably occur in most circumstances	Occurs once every month to once every year
C	Occasionally	Consequence SHOULD occur at some time	Occurs once every 1 year to once every 10 years
D	Unlikely	Consequence COULD occur at some time	Occurs once every 10 to 100 years
E	Rarely	Consequence may only occur in exceptional circumstances	Occurs less than once every 100 years

Table 4: Qualitative Measure of Consequence

Risk Rating	Consequence type			
	Financial	Environmental	Personal, Commercial, Community, Reputation/Media	Legal
Catastrophic	> \$10M	An event or incident that causes substantial permanent damage requiring significant resources to control. Permanent damage expected.	Definite serious negative personal and or commercial effect; attention from regulators, workforce, contractors, public or national media outcry.	Highest level damage prosecution and fines. Major litigation including class action up to and including potential revocation of operating licenses and permits and fines.
Major	\$1M - \$10M	An event or incident that causes substantial long-term adverse effects requiring significant resources to control. Long-term damage expected.	Serious negative personal and or commercial effect; attention from regulators, workforce, contractors, public or national media outcry.	Major damage, breach of regulation, litigation, up to and including potential revocation of operating licenses and permits and fines.
Moderate	\$100K - \$1M	An event or incident that causes widespread temporary damage requiring extended resources to remedy. Full recovery expected.	Significant negative personal and or commercial effect; attention from regulators, workforce, contractors, public or national media outcry.	Serious damage, breach of regulation with investigation or report to authority including potential suspension of operating licenses and permits and fines.
Minor	\$10K - \$100K	An event or incident that causes localised low-level damage requiring minimal resources to remedy. Full recovery expected.	Medium negative personal and or commercial effect; attention from regulators, and potential media and/or heightened concern by workforce, contractors and local community. Criticism by non-government organisations.	Serious damage; minor legal issues, non-compliances and breaches of regulations, potentially resulting in fines.
Insignificant	<\$10K	An event or incident that is contained within controls and/or does not cause long term measurable impact.	Medium negative personal and or commercial effect; attention from regulators, and potential minor adverse workforce, contractor, local public or media attention or complaints.	Damage, non-compliances and breaches of regulations, resulting in investigation and reparation.

3 RISK ASSESSMENT RESULTS

A total of one hundred and seventeen (117) risks in relation to environment, social and economic, human health and safety were identified (Table 5). The residual risks were determined based on the assumption that the proposed mitigation measures were implemented effectively. The resulting risk ratings provide a good understanding of the Project risks and identifies key risks which will require more focus. The detailed risk assessment is outlined in Table 6, Table 7 and Table 8.

Table 5: Summary of the Risk Assessment

Risk Levels	Environment		Social and Economic		Human Health and Safety	
	Initial Risk Rating	Residual Risk Rating	Initial Risk Rating	Residual Risk Rating	Initial Risk Rating	Residual Risk Rating
Very Low	5	29	3	17	1	6
Low	14	14	19	14	2	5
Medium	21	2	7	11	7	15
High	5	0	16	3	17	1
Extreme	0	0	0	0	0	0
Total	45		45		27	
	Total Risks Identified				117	

No environmental, social, economic or human health and safety risks with an extreme initial or residual risk rating were identified for the Project. Three (3) potential social and economic risks with a high residual risk rating were identified during the assessment process. These are the positive impacts for local businesses being awarded contracts from the project, opportunities for direct and indirect jobs and training for local Indigenous people and residents in Alice Springs and benefits to the local community through distribution of sponsorship funds and royalties.

One human health and safety impact provided a high rating was Project traffic and workers travelling by road to and from site being involved in accidents. The likelihood for this risk was ‘unlikely’ whilst the consequence can be ‘catastrophic’. The following mitigation measures will be implemented to reduce the chance of accidents involving mine workers driving on public roads:

- Worker Code of Behaviour
- Road safety initiatives
- Road safety public awareness campaign and training

- Traffic Management Plan including Journey Management Plan
- Provision of alternative transport arrangements to and from site
- Workplace health and safety procedures

As the Project develops, more hazards will be identified and the current risks identified will change. Ongoing monitoring and periodic review of the Project risk assessment will be undertaken at key phases of the Project and control strategies will be reviewed for their effectiveness and implemented to ensure risks are adequately managed. In addition to reducing the likelihood and/or the consequences of an event, the introduction of new controls may result in additional benefits such as improving process efficiency or providing direct financial benefits for the Project. The evaluation of new control measures will be considered in accordance with the processes of elimination, substitution, isolation, administration, training and personal protective equipment.

4 SOCIAL AND ECONOMIC RISKS

Table 6: Social and Economic Risk Assessment

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
1	Project traffic	Road	Increased road trauma on local roads	Likely	Moderate	High	<ul style="list-style-type: none"> Minimise required number of trips to and from site Codes of behaviour when driving on public road Consultation with locals whether restricting project traffic to certain times of day Implement Traffic Management Plan Community liaison to ensure good communication Communication with other road users Road maintenance in consultation with key stakeholders Working with NT government to seek approval for early sealing of the Plenty Highway between Jervois and the Stuart Highway 	Occasionally	Moderate	Medium
2	Project traffic	Third Party	Reduction in tourist activity in the region	Likely	Moderate	High	<ul style="list-style-type: none"> Communication with NT Government for early sealing of Plenty Highway from Jervois to Gemtree Caravan Park Traffic Management Plan – Journey Management Plan to include speed limits, road watering Good communication and engagement with key tourism stakeholders 	Occasionally	Minor	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> PR strategy around traffic/road safety around mining trucks 			
3	Dust and noise from project traffic	Third Party	Increased dust and noise level for nearby communities and residents	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Traffic Management Plan to include speed limits, road watering Community liaison to ensure good communication Stakeholder engagement 	Rarely	Minor	Very Low
4	Driving on single sealed land and gravel shoulders	Mine Worker Third Party	Increased road trauma	Likely	Moderate	High	<ul style="list-style-type: none"> Community engagement to educate the public on how to interact with road trains Traffic Management Plan to ensure loaded vehicle leaves the seal and stops to allow oncoming loaded vehicle to pass without leaving seal KGL to engage with NTG to review priorities and possible acceleration of widening program and review introduction of passing lanes at several locations 	Occasionally	Moderate	Medium
5	Site distance deficiencies	Mine Worker Third Party	Increased road trauma	Likely	Moderate	High	<ul style="list-style-type: none"> Provide additional signage Lower crest curves Journey Management Plan for all transportation contractors to restrict speed at these locations to 70km/h for 500m in each direction Modify intersection if possible 	Occasionally	Moderate	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
6	Increase to traffic volumes	Mine Worker Third Party	Increased road trauma	Likely	Moderate	High	<ul style="list-style-type: none"> KGL to engage with NTG to review priorities and possible acceleration of widening program and review introduction of passing lanes at several locations Staging vehicle operations to minimise number of vehicles on the road at any one time Increased maintenance grades from 4 to 5 per year Wet weather restrictions for transportation of product and consumables 	Occasionally	Moderate	Medium
7	Night time operations	Mine Worker Third Party	Incidents relating to poor visibility	Likely	Moderate	High	<ul style="list-style-type: none"> Installation of traffic control devices to aid visibility after dark Infra-red line of site system to be installed in vehicles to alert drivers to people or animals adjacent on the road 	Occasionally	Moderate	Medium
8	Poor road conditions	Mine Worker Third Party	Increased road trauma	Likely	Moderate	High	<ul style="list-style-type: none"> Reconstruct offlets where drains encroach into the road Re-profile sub-standard sections Lift the road where the wearing surface is lower than natural surface Re-sheet where gravel loss is excessive Remove objects where clear zone defects are present 	Occasionally	Moderate	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
9	Risk to cyclist	Third Party	Increased road trauma	Likely	Moderate	High	<ul style="list-style-type: none"> Education Program Infrared on-board system in vehicles to highlight cyclist in line of sight Slow down when passing or approaching oncoming cyclists Notify other drivers in the fleet of presence of cyclist 	Occasionally	Moderate	Medium
10	Dust and noise from borefield construction and operation	Third party	Increased dust and noise level for nearby communities and residents	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> Community liaison to ensure good communication Ensure noise emissions in accordance with manufacturer's specifications and Australian Standards 	Unlikely	Insignificant	Very Low
11	Influx of Indigenous people back to communities	Third Party	High expectation of benefits such as job opportunities from the community	Occasionally	Minor	Low	<ul style="list-style-type: none"> Community engagement and good communication to manage expectations about job availability and timelines 	Occasionally	Insignificant	Very Low
12	Fears of impacts to water resources	Mine Worker	Opposition to mine development by property owners and the community	Likely	Moderate	High	<ul style="list-style-type: none"> Open and transparent communication plan about hydrological studies and monitoring program, water source for the project and impacts of drawdown on pastoral bores, soaks and other beneficial users Implement Environmental Management Plan Continuous communication on monitoring results 	Occasionally	Minor	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
13	Aquifer Depressurisation due to mining activities	Third Parties	Reduced groundwater availability for related parties	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Groundwater modelling demonstrate that the reduction in groundwater availability for other parties are negligible Groundwater monitoring Implement Groundwater Management Plan 	Rarely	Moderate	Very Low
14	Mobilisation of workforce and paid work	Third Party	Reduced community or social cohesion, displacement of other economic sectors through crowding out.	Occasionally	Minor	Low	<ul style="list-style-type: none"> Community liaison to ensure good communication Communication with local police Recruitment strategy that seeks locals, then encourages FIFO workers to relocate to Alice Springs so they are living in the local economy, not short-term accommodate. Manage transport to reduce impacts, 	Occasionally	Minor	Low
15	Distribution of sponsorship funds and royalties to local community	Third Party	Local community benefit	Occasionally	Minor	Low	<ul style="list-style-type: none"> Sponsorship Plan Royalties distributed through community development projects could be invested in community facilities 	Occasionally	Major	High
16	Rumours and misinformation received by native title holders	Third Party	Anxiety of native title holder about potential impacts	Occasionally	Minor	Low	<ul style="list-style-type: none"> Work closely with the Central Land Council to ensure continuous and good communication to native title holders Good communication 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
17	Early sealing of Plenty Highway from Jervois to Stuart Highway and upgrade to the Bonya airstrip	Third Party	Benefit to communities, tourism and property owner	Occasionally	Minor	Low	<ul style="list-style-type: none"> Communication with NT government and Outback Way and provide case for early sealing of Plenty Highway (road safety audit completed, supplied and discussed with NT government) Good communication to manage expectations 	Occasionally	Minor	Low
18	Increased pressure on local services (health, police)	Third Parties	Drawing on local services and infrastructure, inadequate emergency response	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Implementation of an Emergency Response Plan in consultation with local Police and health service providers Health monitoring of workers first response medical facility on site Installing appropriate firebreaks and safety precautions 	Unlikely	Minor	Very Low
19	Direct and indirect jobs and training for local Indigenous people and residents in Alice Springs	Third Parties	Increased job and training opportunities	Occasionally	Minor	Low	<ul style="list-style-type: none"> Indigenous employment and training plan Work with local employment and training providers and advance planning Communication with other major resource projects in the region to employ Indigenous workers when their project is complete 	Likely	Moderate	High
20	Direct and indirect jobs and training for local Indigenous people and residents in Alice Springs	Third Parties	Expectation of local jobs not met, low take up of jobs by local Indigenous people due to lack of work readiness,	Occasionally	Minor	Low	<ul style="list-style-type: none"> Indigenous employment and training plan Work with local employment and training providers Good communication on reasons if expectations are not met 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
			structural or cultural issues				<ul style="list-style-type: none"> • Good communication that allows for advance planning • Workforce planning to address barriers to employment • Support structures for local staff • Good communication on jobs available, including site visits • Collaboration with the community, NT and Australian Governments, employment and training providers 			
21	Project activities	Pastoralists	Reduced productivity of pastoralists	Unlikely	Moderate	Low	<ul style="list-style-type: none"> • Ensure continuous and good communication with pastoralists • Compensation agreement for areas excluded from properties for mining and associated activities 	Rarely	Minor	Very Low
22	Local business awarded contracts from the project	Third Parties	Boost to local businesses	Occasionally	Minor	Low	<ul style="list-style-type: none"> • Local Industry Participation Plan which includes consideration of how contracts might be packaged to suit existing capacity • Good communication about opportunities with the project • Working closely with industry groups (ICNNT and Chamber of Commerce) and NT Government to prepare businesses 	Likely	Moderate	High

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
23	Local targets not met due to lack of capacity or skills	Third Parties	Loss of opportunity to local businesses	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Local Industry Participation Plan which includes consideration of how contracts might be packaged to suit existing capacity Good communication and understanding of the capacities of local businesses Working closely with industry groups (ICN NT and Chamber of Commerce) and NT Government to prepare businesses 	Unlikely	Moderate	Low
24	Expectations of boost to local and/or regional economy not met	Third Parties	Expectations of boost to local and/or regional economy not met	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Industry Participation Plan Work with ICN NT, NT Government, Chamber of Commerce, REDCs to package and promote tenders to suit local capacity, boost skills, prepare businesses for competitiveness and standards required by KGL Resources Good communication to manage expectations 	Occasionally	Minor	Low
25	Project activities affect other sectors	Third Parties	Reduced productivity of other sectors	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> Industry Participation Plan Forward planning and communication Schedule flights so that workers are met and taken straight to site A recruitment strategy focussing on locals and the encouragement of FIFO workers to relocate Traffic management plan to reduce impacts 	Rarely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
26	Skill shortage	Mine Owner	Difficulty employing skilled workers for the mine, loss of staff and difficulties backfilling, potential financial impact to mine owner	Occasionally	Minor	Low	<ul style="list-style-type: none"> A recruitment strategy focussing on locals and the encouragement of FIFO workers to relocate Continued work with ICN NT, NT Government departments, the Chamber of Commerce and the REDC to promote tenders which suit local capacity, boost skills, prepare businesses for an increase in competition and standards required by KGL Engage local training providers and develop local training programs Workforce planning to address employment barriers Local Industry Participation Plan Collaborate with other major resource projects on training and education programs 	Unlikely	Minor	Very Low
27	Drugs or alcohol brought to site by mine worker	Third Parties	Reduced sense of safety and wellbeing in nearby communities	Occasionally	Minor	Low	<ul style="list-style-type: none"> Drug and alcohol policy HR management Good communication with local police 	Unlikely	Minor	Very Low
28	Disturbance to Indigenous heritage items	Cultural Heritage	Damage to sacred sites, upsetting of local Indigenous community and the CLC, possible fines to mine owner and damage to reputation;	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Establish and maintain a heritage register Cultural heritage survey Implement permit system to require consideration of cultural heritage sites Community liaison and communication MOU with Bonya community 	Rarely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
			Reduced cultural and spiritual connections to country or cultural offence							
29	Cumulative impact of five major resource projects in Central Australia potentially at the same time (TNG, Verdant, Arafura Resources, Tellus and KGL).	Third Parties	Cumulative impacts create pressure on workforce availability, services, inflationary pressures, but they can also increase the opportunities – local jobs, economic benefits, Indigenous employment and education outcomes	Occasionally	Minor	Low	<ul style="list-style-type: none"> Working with other proponents to sequence work, if possible, and take account of cumulative impacts Stakeholder engagement Good communication 	Occasionally	Minor	Low
30	Flood from waterways located within mine area	Mine Owner	Damage to mine workings and facilities, financial loss to mine owner	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Surface water modelling concluded that the project will not have any significant impact on flooding Water diversions appropriately design according to Water Management Plan 	Rarely	catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
31	Little warning of impending floods to mine	Mine Owner	Damage to mine workings and facilities, financial loss to mine owner	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Surface water modelling concluded that the project will not have any significant impact on flooding The proposed Reward pit is the only infrastructure proposed would be affected by flooding, located on the floodplain of Unca Creek. A permanent diversion of Unca Creek around the Reward pit is proposed to manage the risk for events up to 1,000 years 	Rarely	Catastrophic	Medium
32	Disturbance to non-Indigenous heritage items during mining operations	Heritage Items	Damage to heritage Items	Occasionally	Minor	Low	<ul style="list-style-type: none"> Establish and maintain a heritage register Implement permit system to require consideration of heritage sites Fence off identified Heritage Sites 	Rarely	Insignificant	Very Low
33	Uncontrolled fire caused by third party or natural disaster	Mine Owner Property Owner	Damage to mine facilities, workings and property, financial loss to mine owner and property owner	Likely	Major	High	<ul style="list-style-type: none"> Establish and maintain fire breaks Conduct of hazard reduction burns Monitoring of fire tracking and alert systems 	Unlikely	Moderate	Low
34	Uncontrolled fire caused by third party or natural disaster	Cultural Heritage	Damage to sacred sites	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Establish and maintain a heritage register Implement permit system to require consideration of cultural heritage sites BFMP 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
35	Uncontrolled fire caused by mining operations	Mine Owner	Damage to mine facilities and workings, financial loss to mine owner	Likely	Major	High	<ul style="list-style-type: none"> Establishment and maintenance of fire breaks Conduct of hazard reduction burns Store hydrocarbon and flammable material according to the requirements of AS1940-2004 - The storage and handling of flammable and combustible liquids BFMP Implement Hot Work Permits System Provision of firefighting training for personnel conducting hot works 	Unlikely	Moderate	Low
36	Uncontrolled fire caused by mining operations	Property Owner	Damage to property, financial loss to property owner	Occasionally	Major	High	<ul style="list-style-type: none"> Implement Hot Work Permits System Provision of firefighting training for personnel conducting hot works Communication with neighbours upon detection of wild fire BFMP 	Unlikely	Moderate	Low
37	Uncontrolled fire caused by mining operations	Cultural Heritage	Damage to sacred sites	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Establish and maintain a heritage register Implement permit system to require consideration of cultural heritage sites 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
38	Water storage failure	Mine Owner	Loss of water resource, financial loss to mine owner, potential damage to ecosystem	Unlikely	Major	Medium	<ul style="list-style-type: none"> Develop and implement Standard Operating Procedures Develop and implement a Water Management Plan Appropriate planning and design standards for water storages 	Rarely	Major	Low
39	Insufficient water supply in periods of drought	Mine Owner	Shut down or reduce production, financial loss to mine owner	Occasionally	Major	High	<ul style="list-style-type: none"> Detail mine planning and scheduling Upgrade of existing Jervois Dam facility to increase water supply Groundwater study and construction of borefields to ensure sufficient water for operation Water recycling 	Rarely	Major	Low
40	Base metals price change	Mine Owner	Impact on financial factors to mine operation, project stalled, potential financial impact to mine owner	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Financial modelling and business planning Market Awareness – Offtake Agreements 	Unlikely	Moderate	Low
41	Activists disrupting mining operations	Mine Owner	Production disrupted, raised underserved public awareness, financial loss to mine owner, share price fall	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Preparing a Local Industry Participation Plan Regular community engagement, communicating openly with land owners, local community and government, such as water monitoring results, soil test results, etc to reduce fears and to manage perception 	Rarely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
42	Influx of predominantly male workforce	Third Parties	Health and social impacts arising from interaction between locals and a predominantly male workforce	Occasionally	Minor	Low	<ul style="list-style-type: none"> Reduce recreational interaction of FIFO workers with local towns on days off (straight to plane or bus) Worker code of behaviour Communication with local police 	Unlikely	Minor	Very Low
43	Site not rehabilitated, infrastructure not removed	Community, future generations	Residual liability for site rehabilitation or maintenance	Unlikely	Major	Medium	<ul style="list-style-type: none"> Lodgement of security bond to the Northern Territory government on an annual basis as per operation condition to cover rehabilitation cost Removal of site infrastructure as per MRCP 	Rarely	Minor	Very Low
44	Final waste rock dump at closure not appropriately designed	Visual amenity	Decrease in visual amenity compared to baseline	Rarely	Insignificant	Very Low	<ul style="list-style-type: none"> Waste rock dump will be similar to the topography in the area 	Rarely	Insignificant	Very Low
45	Unaware of mine closure concept and timing	Local community	Unexpected loss of financial support or unexpected population decline for the community	Unlikely	Major	Medium	<ul style="list-style-type: none"> Continuous community engagement and public awareness campaign 	Rarely	Major	Low

5 ENVIRONMENT RISKS

Table 7: Environmental Risk Assessment

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
1	Land Clearing during construction, mining operations and exploration	Ecosystem	Loss of Flora and Fauna including Stygofauna	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Obtain relevant regulatory approvals for land clearing related to mine development Implement Clearing Procedures to ensure clearing is minimised and within defined boundaries Ensure there is an appropriately qualified Environmental Officer on-site Vegetation clearing / excavation to be subject to internal permitting system Staging works to manage habitat loss Demarcate exclusion zones to protect areas of vegetation to be retained prior to clearing Measures to retain mature trees or habitat trees where possible Salvage hollow logs, rocks and large debris removed by construction for habitat enhancement in areas for rehabilitation Collection of native seed from the Project area for use in rehabilitation program Progressive rehabilitation of Project area Offset for clearing of regionally exceptional vegetation communities Ongoing implementation and monitoring of offsets 	Occasionally	Moderate	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
2	Land Clearing during construction, mining operations and exploration	Ecosystem	Loss of threatened flora	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> • New mine infrastructure design to avoid clearing of threatened species • Future repair works on Jervois Dam to avoid impacts to the threatened species • Speed restrictions on haul roads to lessen the impact of dust on threatened species near roads • Ensure there is an appropriately qualified Environmental Officer on-site • Pre-clearing surveys to be undertaken within three months of clearing activities • Flag any areas containing threatened flora species in or directly adjacent to the Project area as an exclusion area prior to works commencing • Collection of seed from mature individuals prior to clearing • Use of collected seed in revegetation • Progressive rehabilitation of site • Monitoring program to monitor health of retained vegetation and rehabilitated areas • Ongoing implementation and monitoring of offsets • Employees and contractors to participate in an environmental induction program 	Unlikely	Moderate	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
3	Introduction and spread of weeds during operations	Ecosystem	Habitat quality reduction, reduction in biodiversity value, reduction in food availability for native fauna	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Clearing of vegetation to be restricted to the minimum required to enable safe construction, operation and maintenance Weed surveys and implementation of control programs for weeds of significance Prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary) Appropriate disposal of weed material to prevent further spread Equipment hygiene program to minimise the risk of introduction or spread of weeds or soil borne diseases to the project area Rehabilitation will be undertaken progressively Employees and contractors to participate in an environmental induction program 	Unlikely	Moderate	Low
4	Introduction of exotic fauna	Ecosystem	Habitat quality reduction, reduction in biodiversity value, reduction in food availability for native fauna	Likely	Minor	Medium	<ul style="list-style-type: none"> Inspection of all machinery (including motor vehicles) and equipment prior to entering mine areas Ensure site waste management measures reduce the potential to attract vermin and other fauna Any waste storage facilities to be designed and located to restrict fauna access Fauna, including pest species, will not be fed Implement weed management protocol to prevent degradation of remaining habitat areas and spread of feral animals into degraded areas 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
5	Dust from construction, mining operations and exploration	Ecosystem	Loss of Flora and Fauna	Likely	Minor	Medium	<ul style="list-style-type: none"> Regular watering of haul roads Adopt speed limits on site for all vehicles Regular grading of onsite haul roads Apply gravel to surfaces of haul roads Stage clearing and construction activities to minimise area of exposed ground Visual inspection requirements Limit burning of cleared vegetation Wet dust suppression measures in the form of high pressure, low volume water sprays Milling and ore processing are to be completed using wet processes Rehabilitation and vegetation of excavated areas as soon as practicable Minimise drop heights into hoppers, onto stockpiles and into haul trucks Minimise doubling handling of materials Positioning of crushing and screening plant and stockpiles in areas shielded by terrain Covering of all haul vehicles entering and exiting the site Chassis and wheels of haul trucks to be cleaned prior to exiting the site 	Unlikely	Minor	Very Low
6	Project lighting	Fauna	Disruption Fauna	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> Limit Project lighting Where lighting is required, use directional lighting to reduce the spill over into surrounding areas Use lighting in buildings only as required, i.e. sensor lighting or switch off during non-operational hours 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
7	Erosion and sedimentation due to land clearing and surface disturbance	Ecosystem	Ongoing damage to ecosystems, contamination of surface water and groundwater	Likely	Moderate	High	<ul style="list-style-type: none"> Use sediment catchment dams to prevent any sedimentation from the Project site travelling to downstream areas Rehabilitation and vegetation of excavated areas as soon as practicable – establish erosion management controls 	Unlikely	Minor	Very Low
8	Change to streamflow in Unca Creek due to Jervois Dam upgrade	Ecosystem	Damage to flora and fauna	Likely	Insignificant	Low	<ul style="list-style-type: none"> Implement a water management plan to ensure retention of base environmental flows through Unca Creek to maintain the health of the riparian ecosystem 	Likely	Insignificant	Low
9	Water bores creating new pathway to aquifers	Ecosystem	Enhanced contamination pathways, damage to groundwater quality and dependent ecosystem	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Implement Water Abstraction Management Plan and Groundwater Management Plan Only licensed drillers to carry out borefield drilling and construction of borefield All bores to be registered – regular assessment of groundwater monitoring program 	Rarely	Moderate	Very Low
10	Failure of fuels storage	Surface and Groundwater	Fuels leak into surface drainage systems and groundwater, poisoning and death of fauna and flora	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Store hydrocarbon fuels according to the requirements of AS1940-2004 - The storage and handling of flammable and combustible liquids MSDS and Hazardous Substance Register Ensure SOP for use of hydrocarbons 	Rarely	Moderate	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
11	Spillage of fuels during operation and transportation	Ecosystem	Spillage of fuels causing contamination of ecosystem, surface waters and/or ground waters, knock on effects to flora and fauna	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Store hydrocarbon fuels according to the requirements of AS1940-2004 - The storage and handling of flammable and combustible liquids Appropriate spill kits to be kept adjacent to storage area Implement procedure for transport and storage of hazardous substances /dangerous goods MSDS and Hazardous Substance Register PPE and clean-up procedure Ensure SOP for use of hydrocarbons 	Occasionally	Minor	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
12	Spillage or release of hazardous substances during operation and transportation	Ecosystem	Contamination of surface and ground water, damage to dependent ecosystems	Unlikely	Major	Medium	<ul style="list-style-type: none"> Hazardous substances register and MSDS, all material to be stored according to the relevant MSDS Regular inspection and maintenance of all hazardous substance storages Signage and labelling Provide training to personnel for appropriate handling of hazardous materials Implement procedure for transport and storage of hazardous substances, all vehicles to be registered and fitted with spill kits and PPE for emergency response Notify the Environmental Officer in case of a spill and commence investigation into soil, surface and groundwater impacted First Aid, spill kits and Emergency Response Plan 	Unlikely	Minor	Very Low
13	Inadequate design, failure of TSF	Ecosystem	Long term damage to ecosystem, leaching into ground and surface waters	Unlikely	Major	Medium	<ul style="list-style-type: none"> Design TSF in accordance with the ANCOLD 'Guidelines on tailings dams' requirements, in particular regarding Extreme Storm Storage, Contingency Freeboard, Spillway Capacity, Design Earthquake Loading, Stability Minimum Factor of Safety, Dam Safety/Inspection Frequency 	Rarely	Major	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> Contingencies in the TSF design: Four cells have been designed in the PFS, only two cells will be used according to the current mine plan Low permeability compacted composite liner comprising HDPE and soil liner incorporating a basin underdrainage system in the basin area for seepage control Maintenance of TSF in accordance with specifications 			
14	Contaminated seepage from TSF	Ecosystem	Acidic pH, salinity and/or heavy metals causing ongoing damage to ecosystems, contamination of surface and ground water	Occasionally	Major	High	<ul style="list-style-type: none"> TSF to be covered to prevent ARD runoff Low permeability compacted composite liner comprising HDPE and soil liner incorporating a basin underdrainage system in the basin area for seepage control Ongoing monitoring program, including monitoring at the release points, upstream and downstream of release points Groundwater monitoring Monitoring of water quality in sediment dams Spills or exceedance of water quality parameters reported to the Environmental Officer Ongoing testing for contamination of soils surrounding TSF to detect seepage 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> Develop Emergency Overflow Procedures for contamination events Basic store and release cover system on closure to isolate the tailings from the environment Paste backfilling of tailings into underground workings, tailings backfilling into the final void will be the preferred option for TSF Rehabilitation. Detail studies will be carried out to investigate the feasibility in the detailed mine planning stage 			
15	Fauna drowning	Fauna	Deaths of Fauna	Occasionally	Minor	Low	<ul style="list-style-type: none"> Implementing appropriate bird-deterrent methods to keep waterbirds and birds of prey away (Fauna will preferentially use the neighbouring Jervois Fresh Water Dam) 	Unlikely	Minor	Very Low
16	Structural failure of the process water storage facility	Ecosystem	Process water report to the environment and ecosystems, long term damage to ecosystem, leaching into ground and surface water	Unlikely	Major	Medium	<ul style="list-style-type: none"> Design processing plant following the appropriate engineering standards Develop Emergency Overflow Procedures for contamination events Ongoing water quality monitoring program, monitoring at the release points, upstream and downstream of release points Monitoring of water quality in sediment dams Spills or exceedance of water quality parameters reported to the Environmental Officer 	Rarely	Major	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
17	Contaminated seepage from process water storage facility	Ecosystem	Pollution of surface and groundwater systems, ongoing damage to ecosystems, contamination of surface and ground water	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Design processing plant to suitable design standards Ongoing water quality monitoring program, monitoring at the release points, upstream and downstream of release points Monitoring of water quality in sediment dams Spills or exceedance of water quality parameters reported to the Environmental Officer Develop Emergency Overflow Procedures for contamination events 	Unlikely	Minor	Very Low
18	Insufficient capacity of the process water storage facility	Ecosystem	Overtopping of dam walls, ongoing damage to ecosystems, contamination of surface and ground water, financial costs to mine owner to enlarge the storage facility	Unlikely	Major	Medium	<ul style="list-style-type: none"> Appropriate design of process water storage facility Develop Emergency Overflow Procedures for contamination events Design processing plant to suitable design standards 	Rarely	Major	Low
19	Pumping/pipeline failure causing process water escapes to ecosystem	Ecosystem	Damage to ecosystems, contamination of surface and ground water	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Backup pump, maintenance schedule Routine pipeline inspections to identify potential failure points Ongoing water quality monitoring program, monitoring at the release points, upstream and downstream of release points 	Rarely	Moderate	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> Monitoring of water quality in sediment dams Spills or exceedance of water quality parameters reported to the Environmental Officer 			
20	ARD from waste dumps leading to contaminated seepage/runoff	Ecosystem	Contamination of surface and ground water, damage to dependent ecosystems	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Waste rock to be retained within underground voids and pits where possible to minimise the operational footprint requiring rehabilitation Ongoing review and update of S-block Model to identify future changes to predicted waste characterization Selective handling of PAF material to prevent ARD, placement of PAF underground if practical with cement backfill Scheduling of underground waste rock to utilise PAF material in back fill WRDs to be covered to prevent ARD runoff Construction of surface water management infrastructure according to the surface water model and water management plan, including the process water dam, underground dewatering dam and 	Rarely	Moderate	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							sediment dams to capture and manage runoff from waste rock dumps <ul style="list-style-type: none"> Ongoing water quality monitoring program, monitoring at the release points, upstream and downstream of release points Monitoring of water quality in sediment dams Spills or exceedance of water quality parameters reported to the Environmental Officer Ongoing testing for contamination of soils surrounding waste dump to detect seepage Develop Emergency Overflow Procedures for contamination events 			
21	Insufficient cover material for waste dumps	Ecosystem	Inability to meet rehabilitation requirements	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Design waste rock dump according to geochemical properties of waste rock Independent site survey completed to identify suitable materials Implement soil stockpiling for all clearance areas in suitable areas for rehabilitation uses Implement Environmental Management Plan, including Erosion and Sediment Control Plan, Water Management Plan and MRCP 	Rarely	Moderate	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
22	ARD from ore ROM leading to contaminated seepage/runoff	Ecosystem	Contamination of surface and ground water, damage to dependent ecosystems	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Design ROM according to geochemical properties of the ROM Ore, incorporate management strategies to ensure leachate during storage is managed Ongoing water quality monitoring program, monitoring at the release points, upstream and downstream of release points Monitoring of water quality in sediment dams Spills or exceedance of water quality parameters reported to the Environmental Officer Ongoing testing for contamination of soils surrounding to detect seepage Develop Emergency Overflow Procedures for contamination events Assess likelihood of eventual processing and include contingency for appropriate management if processing does not take place 	Rarely	Moderate	Very Low
23	Insufficient clean-up of ore ROM at mine closure causing contaminated seepage/runoff	Ecosystem	Contamination of surface waters and groundwater, damage to dependent ecosystems	Unlikely	Major	Medium	<ul style="list-style-type: none"> Implement a Mine Rehabilitation and Closure Plan, including measures if the mine is put into care and maintenance Ensure all ore mined is treated prior to closure 	Rarely	Major	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
24	Blasting	Fauna	Injury or death of Fauna	Occasionally	Minor	Low	<ul style="list-style-type: none"> Limit the requirement for blasting where possible, particularly around sensitive areas such as the Unca Creek Corridor Blasting to be undertaken during the middle of the day when fauna movement is generally at its slowest Fence operating areas 	Unlikely	Minor	Very Low
25	Uncontrolled fire caused by mining operations	Ecosystem	Loss of flora and fauna	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Conduct hazard reduction burns Provision of firefighting training for personnel conducting hot works Implement Hot Work Permits System Restrict vehicle access to burnt areas to minimise erosion Coordinate weed spraying activities for the period following burns to assist native plant regeneration 	Unlikely	Moderate	Low
26	Old ROM samples stored in barrels	Ecosystem	ARD from barrels, contamination of surface and groundwater, damage to dependent ecosystems	Likely	Moderate	High	<ul style="list-style-type: none"> Incorporate old ROM into new development 	Rarely	Insignificant	Very Low
27	ARD from old tailings dam/old waste piles/old ROM	Ecosystem	Contamination of surface and ground	Likely	Moderate	High	<ul style="list-style-type: none"> Incorporate old materials into new development to manage historical risks 	Unlikely	Moderate	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
			water, damage to dependent ecosystems							
28	Elevated noise levels	Fauna	Disturbance to Fauna	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> Minimise noise from mining and construction equipment and machinery, ensure noise emissions in accordance with manufacturer’s specifications and Australian Standards, and noise suppression equipment fitted consistent with the requirements of the activity Domestic fauna excluded from operational areas with site fencing 	Rarely	Minor	Very Low
29	General waste escapes to environment	Ecosystem	Contamination of ecosystem, potential injury or death to fauna	Occasionally	Minor	Low	<ul style="list-style-type: none"> Operate under the procedures included in the Waste Management Plan 	Unlikely	Minor	Very Low
30	Waste exposed at storage	Ecosystem	Inappropriate diets for fauna	Occasionally	Minor	Low	<ul style="list-style-type: none"> Operate under the procedures included in the Waste Management Plan Any waste storage facilities to be designed and located to restrict fauna access 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
31	Failure of waste water treatment system	Ecosystem	Waste water released to the environment, potential contamination to surface water and ground water	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> STP will be developed in accordance with the Northern Territory Code of practice for on-site wastewater management and the Guidelines for wastewater works design approval for recycled water systems Regular maintenance, monitoring and testing of the system to the manufacturer's specifications 	Unlikely	Moderate	Low
32	Accidents when driving on public road/mine road	Fauna	Injury or death of fauna	Likely	Minor	Medium	<ul style="list-style-type: none"> Develop and implement a Traffic Management Plan to reduce driving on public roads and impose speed limits on mine roads Minimise mine worker driving during dawn and dusk 	Occasionally	Minor	Low
33	Greenhouse gas emission from project activities	Air Quality	Contribution to Northern Territory and Australian emission levels	Likely	Insignificant	Low	<ul style="list-style-type: none"> Incorporate a hybrid diesel and solar power station Minimising the use of fuel by selecting fuel efficient plant and equipment Operation of vehicles in a fuel efficient manner Turning off idling equipment Selecting construction techniques that utilise lower amounts of fuel Reduction of fuel usage through adopting efficient haul routes over the shortest distances Maintenance plan for all fuel-powered equipment 	Occasionally	Insignificant	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
34	Groundwater drawdown due to mining activities and project water supply	Ecosystem	Impact on Flora, Fauna, Stygofauna, GDE, potential loss of habitat causing death of GDE	Likely	Moderate	High	<ul style="list-style-type: none"> Implement Biodiversity Management Plan and voluntary biodiversity offset strategy Implement Groundwater Management Plan Implement Mine Rehabilitation and Closure Plan 	Occasionally	Moderate	Medium
35	Increase in the area inundated by the upgraded Jervois Dam	Ecosystem	Loss of habitat	Likely	Insignificant	Low	<ul style="list-style-type: none"> Discussion with relevant stakeholders before closure to consider options of upgraded dam remaining, reduction in spillway level to pre-mining level or complete removal of the dam 	Likely	Insignificant	Low
36	Mine water not appropriately managed	Ecosystem	Contamination to surface water and groundwater, adverse impact on ecosystem	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Construction of surface water management infrastructure according to the surface water impact assessment and water management plan, including the process water dam, underground dewatering dam and sediment dams to capture and manage runoff from waste rock dumps, dewatering of pits and underground workings Ongoing water quality monitoring program, monitoring at the release points, upstream and downstream of release points Monitoring of water quality in sediment dams Spills or exceedance of water quality parameters reported to the Environmental Officer Ongoing testing for contamination of soils surrounding waste dump to detect seepage 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> Develop Emergency Overflow Procedures for contamination events 			
37	Site not appropriately rehabilitated after closure	Ecosystem	Landscape function and vegetation no resilient, self-sustaining and comparable to surrounds	Unlikely	Moderate	Low	<ul style="list-style-type: none"> The project area is located on pre-disturb mine site Progressive rehabilitation and active revegetation of site at closure as per MRCP Post rehabilitation monitoring to ensure objectives are achieved as per MRCP 	Unlikely	Minor	Very Low
38	Migration of historical contamination to the environment during construction and operation	Ecosystem	Contamination to surface water and/or groundwater, adverse impact on dependent flora and fauna	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Implement an Environmental Management Plan Implement a Water Management Plan, Groundwater Management Plan and Erosion and Sediment Control Plan Dust suppression and implement other dust mitigation measures to ensure compliance Implement procedure for transport and storage of hazardous substances 	Rarely	Moderate	Very Low
39	Long term contamination of land	Ecosystem	Contamination to surface water and/or groundwater, adverse impact on dependent flora and fauna	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Appropriate design of facility to minimise land contamination Standard operating procedure and Environmental Management Plan to minimise land contamination, spill response and remediation if contamination occurred 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> Monitoring program during operation and post rehabilitation Decommissioning and rehabilitation activities as per MRCP to minimise contamination and to ensure contaminated areas are remediated 			
40	Borefields not appropriately decommissioned, uncontrolled release of groundwater from borefields	Groundwater	Adverse change in ecological conditions	Rarely	Minor	Very Low	<ul style="list-style-type: none"> Decommissioning and capping of borefields to be undertaken in accordance with relevant Australian and Northern Territory guidelines/standards Consultation with post closure land users to determine post closure infrastructure uses Monitoring after closure to ensure standards are met 	Rarely	Insignificant	Very Low
41	Surface water structures not physically stable	Fauna	Injury or death of Fauna	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> Surface water structures remain as per MRCP will be shaped to allow safe ingress and egress of fauna Ensure stability according to relevant standards and guidelines Monitoring after closure to ensure objectives are met 	Rarely	Insignificant	Very Low
42	Waste rock dump not physically or chemically stable	Ecosystem	Adverse effect on ecosystem	Unlikely	Major	Medium	<ul style="list-style-type: none"> Ensure waste rock dump geotechnically and chemically stable as per MRCP Monitoring after closure to ensure objectives and standards are met 	Rarely	Major	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
43	Inadequate rehabilitation of exploration sites, including drill holes, pads, sumps, costeans, tracks, etc	Ecosystem	Potential injury of fauna, adverse effect on ecosystem	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> All drill holes, pads, costeans and sumps will be backfilled according to the relevant Northern Territory guidelines Tracks and gridlines rehabilitated as per MRCP and relevant Northern Territory guidelines Monitoring after rehabilitation to ensure objectives are met 	Rarely	Minor	Very Low
44	Premature Closure	Ecosystem	Site rehabilitation or maintenance not completed	Unlikely	Major	Medium	<ul style="list-style-type: none"> Premature Closure Plans to be carried out as per MRCP Lodgement of security bond with the Northern Territory government as per operation condition to cover rehabilitation cost 	Rarely	Minor	Very Low
45	Natural disaster: earthquakes, rainfall events, fire and flood after closure	Ecosystem	adverse effect on ecosystem	Unlikely	Major	Medium	<ul style="list-style-type: none"> Implement Environmental Management Plan, including Water Management Plan, BFMP and Sediment and Erosion Control Plan Rehabilitation to be carried out as per MCRP Monitoring after closure to ensure objectives and standards are met Lodgement of security bond with the Northern Territory government as per operation condition to cover rehabilitation cost The proposed Reward pit is the only infrastructure on site that would be affected by flooding, located 	Rarely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<p>on the floodplain of Unca Creek. A permanent diversion of Unca Creek is proposed to manage the risk for events up to 1,000 years. The final landform between the Reward pit and the creek diversion will ensure that the final void is protected from inundation for all flood events up to and including the Probable Maximum Flood event. The Unca Creek diversion will remain in place as part of the final landform</p> <ul style="list-style-type: none"> • Ensure stored water in the final voids cannot overflow to impact on surface water, as predicted from groundwater modelling • Seismic hazard assessment has been carried out as part of the Project PFS, seismic ground motion parameters for the project area were determined and will be used in the detail mine planning. • TSF will be constructed according to ANCOLD guidelines requirement, in particular: Extreme Storm Storage, Contingency Freeboard, Spillway Capacity, Design Earthquake Loading, Stability Minimum Factor of Safety, Dam Safety/Inspection Frequency 			

6 HUMAN HEALTH AND SAFETY RISKS

Table 8: Human Health and Safety Risk Assessment

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
1	Dust from construction, mining operations and exploration	Worker	Impact to human health	Likely	Minor	Medium	<ul style="list-style-type: none"> Regular watering of haul roads Adopt speed limits on site for all vehicles Regular grading of onsite haul roads Apply gravel to surfaces of haul roads Stage clearing and construction activities to minimise area of exposed ground Visual inspection requirements Limit burning of cleared vegetation Wet dust suppression measures in the form of high pressure, low volume water sprays Rehabilitation and vegetation of excavated areas as soon as practicable Minimise drop heights into hoppers, onto stockpiles and into haul trucks Minimise doubling handling of materials Positioning of crushing and screening plant and stockpiles in areas shielded by terrain Covering of all haul vehicles entering and exiting the site 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> Chassis and wheels of haul trucks to be cleaned prior to exiting the site Dust management and monitoring of TSF as recommended by TSF Design Recommendations 			
2	Serious animal bites	Worker	Impact to human health or death of workers	Unlikely	Major	Medium	<ul style="list-style-type: none"> Potential wildlife hazards to be included in staff inductions First aid facilities, snake bite kits to be available on site PPE including steel cap boots, long-sleeve shirts and trousers Implement Emergency Management Plan and Emergency Plan 	Rarely	Moderate	Very Low
3	Personnel drowning	Worker public	Deaths of people	Rarely	Catastrophic	Medium	<ul style="list-style-type: none"> Secure water storage area appropriately to ensure the public and unauthorised workers do not have access Signage Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Major	Low
4	Failure of upgraded Jervois Dam	Worker Public	Flood to Unca Creek downstream, deaths of people	Rarely	Catastrophic	Medium	<ul style="list-style-type: none"> Jervois Dam upgrade to be carried out according to relevant standards Regular Jervois Dam monitoring and inspections 	Rarely	Major	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
5	Failure of Unca Creek Diversion	Worker Public	Flood to Reward pit, deaths of people	Rarely	Catastrophic	Medium	<ul style="list-style-type: none"> Regular diversion monitoring and inspections Construction of the Eastern and Western flood protection bunds along the right bank of Unca Creek Diversion to protect the final void and TSF from flooding 	Rarely	Major	Low
6	Collapse of pit walls	Worker	Serious injury or death of workforce	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Detail mine design and planning based on mine geotechnical data Geotechnical and geological monitoring Hazard reporting Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium
7	Workers or people from the public fall from mine pits, mine shafts	Worker Public	Serious injury or death of people	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Secure the Project site appropriately to ensure the public or unauthorised workers do not have access to pits and shafts Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
8	Heavy machinery, plant and equipment accidents during operation	Worker	Serious injury or death of workers	Occasionally	Catastrophic	High	<ul style="list-style-type: none"> Guarding PPE Competency and standard operating procedures Isolation Procedure Provide safe work platforms Regular service of machinery and plants according to the manufacturer's recommendation Implementation of an Emergency Management Plan and Emergency Plan Implementation of a traffic management plan 	Rarely	Catastrophic	Medium
9	Accidents when driving on mine road	Worker	Serious injury or death of mine work	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Implement Site Emergency Management Plan and Emergency Plan Competency and standard operating procedures Implement a Traffic Management Plan to impose speed limit on mine roads 	Rarely	Catastrophic	Medium
10	Accidents when driving on public road involving mine worker	Worker Public	Serious injury or death of mine worker and personnel from the public	Occasionally	Catastrophic	High	<ul style="list-style-type: none"> Implement a Traffic Management Plan to reduce driving on public roads, all workers to stay onsite or to travel by bus/flights provided by KGL Public awareness campaign Implement Site Emergency Management Plan and Emergency Plan 	Unlikely	Catastrophic	High

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
11	Inadequate ventilation at underground mine	Worker	Impact to human health or death of workers	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Adequate ventilation system design according to detail mine plan and to ensure provision of adequate flow rate and maintain healthy and safe atmosphere at all times Implement a Ventilation Control Plan Temperature, humidity and air quality monitoring Ventilation system auditing and maintenance Reduction/suppression of dust deposition in intake roadways 	Rarely	Catastrophic	Medium
12	Blasting	Worker	Serious injury or death of workers	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Accurate survey and measurement Blasting and blasting design to be carried out by competently trained personnel only and follow the Blasting Standard Operating Procedure Restriction of access such as excursion distances Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
13	Collapse of underground roof or walls	Worker	Serious injury or death of workers	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Detail mine design and ground control mechanisms based on mine geotechnical data Geotechnical and geological monitoring Inspection after blasting and restoration of support Access restriction Inspection of roof and walls before starting and during work commencement Hazard reporting Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium
14	Falling material from underground roof	Worker	Serious injury or death of workers	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Detail mine design and planning based on mine geotechnical data Geotechnical and geological monitoring Inspection after blasting and restoration of support Access restriction Inspection of roof and walls before and during work commencement Hazard reporting Install barriers PPE Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
15	Sudden inrush of waters at underground mine	Worker	Serious injury or death of workers	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Accurate surveying of new workings and maintain register of plans of old workings Drainage of old workings Adherence to underground working design Groundwater modelling and monitoring, detail mine plan following Water Management Plan and Groundwater Management Plan Fault grouting Probe drilling where necessary Adequate pump capacity Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium
16	Uncontrolled fire caused by third party or natural disaster	Worker	Serious injury or death of people	Occasionally	Catastrophic	High	<ul style="list-style-type: none"> Provision of fire information at formal and informal site meetings, wildfires monitoring Maintenance of fire breaks and access tracks Establishment of Emergency Muster Points within safe areas Identification of safe egress routes in event of fire emergency Establishment of Refuge Chambers in Underground operations Develop and implement a BFMP 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
17	Uncontrolled fire caused by mining operations	Worker	Serious injury or death of people	Occasionally	Catastrophic	High	<ul style="list-style-type: none"> Provision of firefighting training for personnel conducting hot works Implement Hot Work Permits System Identification of safe egress routes in the event of fire emergency Establishment of Refuge Chambers in Underground operations Equipping all mobile and stationary equipment within the project area with appropriate fire extinguishers Store hydrocarbon fuels according to the requirements of AS1940-2004 - The storage and handling of flammable and combustible liquids All staff, contractors and visitors to comply with fire ban days and advice provided by Bushfires NT Develop and implement a BFMP, establishing Emergency Muster Points within safe areas, identifying safe egress routes in the event of fire emergency 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
18	Transport and handling of hazardous substances and dangerous goods	Worker	Potential serious injury or death from exposure	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Hazardous substances register and MSDS, all material to be stored according to the relevant MSDS Regular inspection and maintenance of all hazardous substance storages Signage and labelling PPE Provide training to personnel for appropriate handling of hazardous materials Implement procedure for transport and storage of hazardous substances, all vehicles to be registered and fitted with spill kits and PPE for emergency response Notify the Environmental Officer in case of a spill and commence investigation into soil, surface and groundwater impacted First Aid and spill kits Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
19	Noise	Worker	Damage to hearing	Occasionally	Moderate	Medium	<ul style="list-style-type: none"> Minimise noise from construction equipment and machineries, ensure noise emissions in accordance with manufacturer’s specifications and Australian Standards, and noise suppression equipment fitted consistent with the requirements of the activity Regular Noise Audit Surveys Provide training to mine worker regarding appropriate PPE 	Unlikely	Moderate	Low
20	Failure of communication systems	Worker	Incidents or accidents due to loss of communication, financial loss to mine owner	Likely	Moderate	High	<ul style="list-style-type: none"> Implement a Communication Management Plan, including use of communication equipment suitable for the area Back-up and redundancy within included in design of site and off-site communications systems Establish a site communication system Implement Site Emergency Management Plan and Emergency Plan Vehicles to be fitted with recovery equipment, first aid kits and water supply 	Unlikely	Moderate	Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
21	Working in remote location	Worker	Limited site medical facilities, emergency response time increase, long travel distances and potential communication failures	Likely	Moderate	High	<ul style="list-style-type: none"> Implementation of a Site Emergency Management Plan in consultation with local Police and health service providers Implement a Communication Management Plan, including use of communication equipment suitable for the area Implement an Adverse Weather Procedure Strick worker code of conduct, site safety inductions and pre-employment medical checklists Fitness for work procedure, fatigue management and drug & alcohol policy Vehicles to be fitted with recovery equipment, first aid kits and water supply Personnel only to work alone using Remote Work Procedures when working in remote or isolated locations Establish First Response Medical Facilities and personnel on site 	Unlikely	Minor	Very Low

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
22	Working in remote location	Worker	Mental health issues	Occasionally	Minor	Low	<ul style="list-style-type: none"> HR management to support workers living away from families Access during recreational time to communications off-site with family/friends Good mentoring of staff, particularly Indigenous workers Manageable FIFO rosters 	Unlikely	Minor	Very Low
23	Working in the field	Worker	Sunburn, dehydration and heat exhaustion	Likely	Major	High	<ul style="list-style-type: none"> Where reasonably practical, reschedule tasks to the cooler part of the day Install shade cloth to reduce radiant heat from the sun Provide cool drinking water near work site and encourage mine workers to drink a cup of water (about 200 ml) every 15 to 20 minutes during hot weather conditions PPE including long-sleeve UV protection/High-Vis shirts, trousers, hats, sunglasses and sunscreen Provide mine worker with information and supervision on heat related illness, symptoms, sunburn, dehydration, and first aid Fitness for work policy, drug & alcohol policy and fatigue management 	Unlikely	Major	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
24	Contact with an electrical source	Worker	Electric shock, potential serious injury or death	Unlikely	Catastrophic	High	<ul style="list-style-type: none"> Only licensed electricians to carry out electrical work Procedure to ensure electricity switched off before working on equipment Testing and tagging of electrical equipment Remove unsafe electrical equipment or cords from site Tag out and isolation procedures Implement Site Emergency Management Plan and Emergency Plan 	Rarely	Catastrophic	Medium
25	Manual handling	Worker	Potential injuries relate to lower back injuries, knee and ankle injuries and soft tissue strains.	Unlikely	Moderate	Low	<ul style="list-style-type: none"> Implement a Manual Handling Standard Operating Procedure Implement Site Emergency Management Plan and Emergency Plan 	Unlikely	Minor	Very Low
26	Site not appropriately rehabilitated post closure, sites not geotechnically stable, or ease of public access	Public	Injury or potential death on human health	Rarely	Catastrophic	Medium	<ul style="list-style-type: none"> All infrastructure to be removed from site as per MRCP Ensure stability of potentially dangerous structures such as waste rock dump A pit bund to be constructed around each pit according to relevant standards at closure to prevent public access 	Rarely	Catastrophic	Medium

Reference	Potential Event	Aspect	Potential Impact	Initial Risk rating			Method of Control	Residual Risk rating		
				Likelihood	Consequences	Risk Rating		Likelihood	Consequences	Risk Rating
							<ul style="list-style-type: none"> Secure site to restrict public access to site by obstructing or concealing the access road and constructing bunds around the pits 			
27	Inadequate rehabilitation of exploration sites, including drill holes, pads, sumps, costeans, tracks, etc	Public	Potential injury	Unlikely	Minor	Very Low	<ul style="list-style-type: none"> All drill holes, pads, costeans and sumps will be backfilled according to the relevant Northern Territory guidelines Tracks and gridlines rehabilitated as per MRCP and relevant Northern Territory guidelines Monitoring after rehabilitation to ensure objectives are met 	Rarely	Minor	Very Low

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