Jellinbah Group

LAKE VERMONT RESOURCES ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 16 HAZARDS AND SAFETY

arc ENVIRONMENTAL SOLUTIONS

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16.1 Introduction

This chapter identifies and describes the potential hazards and risks of the Project posed to people, property and environmental values. Identifying and managing hazards is an essential component of Project planning that will continue throughout the life of the Project. A risk assessment has been undertaken, and the possible consequences and likelihoods of hazards have been rated to determine a ranking for each identified risk. When required, control measures have been nominated to manage risks to an acceptable level. Relevant management plans and procedures for the Project are referenced where applicable.

16.2 Scope

This chapter addresses the ToR requirements relating to hazards and safety. The assessment targets potential risks to public safety, employees, property and key environmental values, taking into consideration:

- statutory requirements;
- community consultation;
- advice and resources provided by government agencies;
- Queensland government guidelines; and
- information collected from the Project area.

16.3 Objectives and performance outcomes

This chapter has been prepared to assist the DES in carrying out the environmental objective assessment in respect of the following environmental objectives as stated in the Project ToR:

> *The construction and operation of the Project should aim to ensure:*
>
> - *The risk of, and the adverse impacts from, natural and man-made hazards are avoided, minimised or mitigated to protect people and property.*
> - *The community's resilience to natural hazards is maintained or enhanced.*
> - *The storage and handling of hazardous materials are appropriately located, designed and constructed to minimise health and safety risks to communities and individuals and adverse effects on the environment.*
> - *That any risk associated with explosives use, transportation, storage or manufacturer is within an acceptable level, in accordance with the Explosives Act 1999 and codes and standards, including the Australian Standard AS2187 Explosives Storage, transport and use.*
> - *The proposed Project prevents or minimises the production of hazardous contaminants and waste.*
> - *If the production of hazardous contaminants and waste is unavoidable, the proposed project treats and/or contains hazardous contaminants until their disposal at an approved facility.*

16.4 Risk assessment methodology

This section describes the potential hazards and risks to people, property, environmental values and the community that may result from the Project's construction, operation and decommissioning rehabilitation phases. A risk assessment has been prepared to identify the potential risks and considered stakeholders, Project processes and assets, environmental and external factors, relevant legislation, standards and guidelines and the following references:

- 'AS/NZS ISO 31000:2018 Risk Management–Guidelines' (Standards Australia 2018);
- 'HB203:2012 Managing environment-related risk' (Standards Australia, 2012b);
- 'Recognised Standard 02 Control of risk management practices *Coal Mining Safety and Health Act 1999'* (CMSH Act) (DNRME 2018); and
- The Queensland Emergency Risk Management Framework (Queensland Government 2020).

Any risk assessment needs to be undertaken in consideration of the scope, context and criteria relevant to the assessment. For this risk assessment, the following scope and purpose have been agreed to:

> *The purpose of this risk assessment is to identify and analyse any risks arising as a result of the Project that may impact on environmental aspects, including socio-economic aspects, at the local, regional and state levels and across the construction, operational and closure stages of the Project.*

The following assumptions have also been identified:

- Occupational health and safety hazards are assumed to be assessed and managed at an operational level in accordance with strict legislated requirements, recognised standards made under the CMSH Act and contemporary mining industry practice.
- The risk assessment is a preliminary and high-level assessment set at the overall Project level. Therefore, while some risk scenarios may be considered generic, the assessment workshop process interrogates the risk scenarios to focus on Project and site-specific aspects in assessing hazards and risks.
- Risks have been assessed on the basis that the existing, contemporary operational controls will apply to the Project.

In accordance with the process outlined in 'AS ISO 31000:2018 Risk Management–Guidelines' (Standards Australia 2018), risks have been identified to take into account sensitive receptors and the broad set of potential hazards and risks associated with the Project. The sensitive receptors, potential hazards and risks considered for the risk assessment are outlined in sections 16.4.2, 16.5 and 16.6.

Potential hazards that could pose risks to people, property and the environment from non-routine or abnormal scenarios have been identified by considering:

- historical industry experience;
- Project context;
- hazardous substances;
- natural hazards;
- regulatory triggers; and
- external factors.

16.4.1 Risk assessment scheme

The most likely and highest impact consequences posed by identified hazards have been assessed according to consequence and likelihood criteria matrices shown in Table 16.1 and Table 16.2. The maximum reasonable consequence from the occurrence of each hazard event has been determined assuming the effective application of standard and expected controls. The likelihood categories have been applied based on either a frequency or probability scale.

A risk severity ranking was determined from the risk analysis matrix, as shown in

Table 16.3. The risk severity rankings have been reviewed against

Table 16.4 to determine the requirement for additional controls that might be considered necessary depending on the final risk ranking.

More detailed qualitative descriptors to assist in classifying the consequence(s) specific to the identified impact type are shown in Table 16.5.

Table 16.1: Consequence of impacts

Consequence rating	Impact on health and safety	Impact on infrastructure or property	Impact on natural environment	Impact on community
1 (Insignificant)	Minor injury with temporary impact on individual health	Damage that can be easily rectified	Negligible/minor effects on biological or physical environment	Minor medium-term social impacts on local population—mostly repairable
2 (Minor)	Significant reportable injury with major impact	Superficial damage to infrastructure	Moderate, short-term effects but not affecting ecosystem functions	• Ongoing social issues • Permanent damage to items of cultural significance
3 (Moderate)	Major injury with severe impacts on one or more people	Moderate damage to infrastructure	Serious medium-term environmental effects	• Ongoing serious social issues • Significant damage to structures/items of cultural significance
4 (Major)	Single fatality or severe permanent impairment	Major damage to infrastructure	Very serious, long-term environmental impairment of ecosystem functions	• Ongoing severe social issues • Severe damage to structures/items of cultural significance
5 (Severe)	Multiple fatalities or permanent impacts on the health of a large number of people	Infrastructure severely affected	Extremely serious, long-term, potentially irreversible, environmental impairment of ecosystem functions	Irreparable damage to community

Table 16.2: Likelihood criteria

Score	A (Almost certain)	B (Likely)	C (Possible)	D (Unlikely)	E (Rare)
Description	The event will occur often.	The event could easily happen.	The event could happen and has happened elsewhere.	The event has not happened but could.	Conceivable but only in extreme circumstances.
Frequency	Occurs more than once every year.	Occurs about once every year.	Occurs at least once every three years.	Occurs at least once every 10 years.	Occurs less than once every 30 years.
Probability	>95%	60–95%	30–60%	5–30%	<5%

Table 16.3: Risk analysis matrix

	Consequence				
Likelihood	**1 (Insignificant)**	**2 (Minor)**	**3 (Moderate)**	**4 (Major)**	**5 (Severe)**
A (Almost certain)	Medium (II)	Medium (II)	High (III)	Extreme (IV)	Extreme (IV)
B (Likely)	Medium (II)	Medium (II)	High (III)	High (III)	Extreme (IV)
C (Possible)	Low (I)	Medium (II)	Medium (II)	High (III)	High (III)
D (Unlikely)	Low (I)	Low (I)	Medium (II)	Medium (II)	High (III)
E (Rare)	Low (I)	Low (I)	Low (I)	Medium (II)	High (III)

Table 16.4: Risk level actions

Risk ranking	Risk level actions
Very high risk	Board and/or board-level committee attention required; action plans and management responsibility specified
High risk	Senior executive management attention required; action plans and management responsibility specified
Medium risk	Manage by specific monitoring or response procedures, with management responsibility specified
Low risk	Manage by routine procedures—unlikely to need specific application of resources

Table 16.5: Consequence classification

Consequence type	Consequences				
	Very low	**Low**	**Moderate**	**High**	**Very high**
Greenhouse	<0.6%	0.6–2.5%	2.5–7.5%	7.5%–15%	>15%
Health	• Reversible health effects of little concern • First aid treatment	• Reversible health effects of concern • Medical treatment	• Severe reversible health effects of concern • Lost time illness	Single fatality or irreversible health effects or disabling illness	Multiple fatalities or serious disabling illness to multiple people
Safety	• Low-level, short-term subjective inconvenience or symptoms • First aid treatment	• Reversible injury requiring treatment but does not lead to restricted duties • Medical treatment	• Reversible injury or moderate irreversible damage or impairment to one or more persons • Lost time injury	Single fatality and/or severe irreversible damage or severe impairment to one or more persons	Multiple fatalities or permanent damage to multiple people
On-site Environment	Near-source confined and promptly reversible impact (typically, a shift)	Near-source confined and short-term reversible impact (typically, one week)	Near-source confined and medium-term recovery impact (typically, one month)	Impact that is unconfined and requiring long-term recovery, leaving residual damage (typically, years)	Impact that is widespread, unconfined and requiring long-term recovery, leaving major residual damage (typically, years)
Off-site Environment	Not applicable	Near-source confined and promptly reversible impact (typically, a shift)	Near-source confined and short-term reversible impact (typically, one week)	Near-source confined and medium-term recovery impact (typically, one month)	Impact that is unconfined and requiring long-term recovery, leaving residual damage (typically, years)
Community trust	Tangible expressions of trust/mistrust among a handful of community members, with no influence on public opinion or decision-makers	Tangible expressions of trust/mistrust among a few community members, with some influence on public opinion and decision-makers	Tangible expressions of trust/ mistrust among some community members, with moderate influence on public opinion and decision-makers	Tangible expressions of trust/ mistrust among most community members, with significant influence on decision-makers	Widespread loss/gain of trust across the community setting the agenda for decision-makers and key stakeholders

Consequence type	Consequences				
	Very low	**Low**	**Moderate**	**High**	**Very high**
Compliance	• Non-conformance with internal requirements and very low potential for impact • Non-compliance with community commitment and goes unnoticed by external party/parties • Minimal effort to correct	• Non-compliance with external or internal requirements and low potential for impact • Formal censure • Non-compliance with community commitment • Limited effort to correct	• Non-compliance with internal or external requirements and moderate impact • Moderate penalties for breach of legislation, contract, permit or licence • Non-compliance with community commitment requiring reporting formally • Significant effort to correct	• Breach of licence(s), legislation, regulation—high potential for prosecution • Contract breach—significant penalty • Systemic internal standards breach—high impact • Community commitment breach—high potential business impact • Significant effort to fix	• Suspended or severely reduced operations imposed by regulators • Breach of community commitment resulting in direct loss of established consents with widespread secondary effects
Stakeholders	Key civil/political stakeholder(s) express support/dissatisfaction informally	Key civil/ political stakeholder(s) express support/dissatisfaction formally	Key civil/political stakeholder(s) threaten to oppose or disengage/ strengthen offers to support or engage	Key civil/political stakeholder(s) actively oppose or actively refuse to engage/actively support and engage	Key civil/political stakeholder(s) actively get others to oppose/engage
Cultural Heritage	Reparable damage to site or item of low cultural significance	Irreparable damage to site or item of low cultural significance	Repairable damage to site or item of cultural significance	Irreparable damage to site or item of cultural significance	Irreparable damage to site or item of international cultural significance

16.4.2 Sensitive receptors

The Project location and proposed activities are described in Chapter 3, Project Description. The Project is in a district predominantly used for beef cattle grazing, cropping and coal extraction. The receptors of risk from hazards associated with the Project include the workers of the Project, adjacent land users, the Dysart community and environmental values identified in:

- Chapter 7, Groundwater;
- Chapter 8, Surface Water;
- Chapter 10, Terrestrial Ecology; and
- Chapter 11, Aquatic Ecology.

Site workers who reside locally, as well as those who reside at the worker accommodation village at Dysart, travel to the site in buses or vehicles daily.

16.5 Anthropogenic risks

16.5.1 Site worker health and safety

On-site incidents have the potential to cause injury to personnel and harm to the environment. The management of health and safety incidents will be undertaken in accordance with the requirements of the CMSH Act and will include the development and implementation of a mandatory Safety and Health Management System (SHMS)—see also section 16.9.1. Potential health and safety hazards associated with normal activities during planning and design of the Project and the proposed risk control measures are detailed in Table 16.6.

Table 16.6: Hazard identification for site workers' health and safety

Hazard	Risk factors	Consequence	Risk treatment measures
Mobile equipment	Driving or maintaining vehicles, fatigue, weather conditions	Serious injury or fatality	• Training • Authorisation systems • Vehicle inspections • Traffic management systems
Manual handling tasks	Incorrect handling	Injury	• Use approved safe work methods • Training and competency assessment • Provide equipment fit-for-purpose • Suitable allocation of resources.
Slips and trips	Water or oil on ground, uneven surfaces, access and egress from equipment	Injury	• Safe work approval measures • PPE
Interactions with external property users	Property usage and activities (mustering, gunfire, vehicles)	Injury	• Landowner contact protocols • Communication with neighbouring landowners/users
Working at heights	Appropriateness of work area, staff competence	Serious injury or fatality	• Barricading • Safe work approval measures • PPE

Hazard	Risk factors	Consequence	Risk treatment measures
Working with electrical equipment	• Standards of equipment • Staff competence	Serious injury or fatality	• Qualified staff • Safe work approval measures • Equipment standards • Maintenance and inspection of equipment • Test tagging procedures, isolation protocols
Equipment with moving parts	• Unguarded areas near moving equipment • Staff competence	Serious injury or fatality	• Equipment guarding • Maintenance and inspection of equipment • Isolation protocols
Falling objects	Guarding exposed areas	Injury	• Barricading • Approved safe work methods • PPE
Confined spaces	Unbreathable atmosphere	Fatality	• Staff competency and training • Safe work approval measures • Equipment servicing
Pinch points	• Unguarded areas • Staff competence	Serious injury or fatality	• Barricades and guards • Approved safe work methods • Signage • PPE
Heavy rain, storms, lightning	Work in exposed locations during inclement weather	Fatality	Safe work approval measures
Wildlife hazards	Interactions with fauna	Fatality	• Staff competency when interacting with fauna • PPE
Infectious disease	• Staff travel • Disease vector breeding • COVID-19 outbreaks	Serious injury or fatality	• Water bodies managed to avoid mosquito breeding • Adherence to health department guidelines
Dust	Works disturbing fine particles	Chronic health consequence	• Active dust suppression • Vehicle dust exclusion • PPE
Noise	Heavy equipment usage	Chronic health consequence	• Noise barriers • Equipment maintenance • PPE
Dehydration, heat stress and sunburn	Working in hot conditions	Injury	• Safe work approval measures • Training • PPE
Welding and cutting	Fumes, hot materials, sparks	Injury	• Staff competency and training • Safe work approval measures • PPE
Exposure to hazardous substances	• Spill events • Insufficient storage measures • Insufficient handling methods	Injury	• Standards and procedures for storing, transporting and handling hazardous substances • Safety data sheet register maintenance • PPE

Hazard	Risk factors	Consequence	Risk treatment measures
Fire	• Exposure to smoke • Fires in underground areas	Serious injury or fatality	• Emergency exits • Fire alarms and extinguishers • Gas and monitoring systems • Staff training • Emergency Response Plan
Geotechnical structure collapse	• Weather conditions • Underground roadway and face conditions	Serious injury or fatality	• Staff competency and training • Safe work approval measures

16.5.2 Hazardous and dangerous substances

Project construction, mining activities and coal handling require the storage and use of several dangerous goods and hazardous substances. These materials may pose a risk to human and wildlife health and safety and the environment through characteristics such as:

- flammability;
- explosive or corrosive potential;
- toxicity;
- contamination; and
- radioactivity.

The principal hazardous substances that may be present during the lifecycle of the Project will include:

- explosives;
- fuels;
- lubricants;
- minor quantities of various construction and maintenance-related chemicals (e.g. solvents, degreasers and paints);
- welding and cutting materials;
- water treatment chemicals;
- mining and processing wastes; and
- wastes from ancillary activities.

The Project has been assessed against the major hazard facility criteria ('Work Health and Safety Regulation 2011' [Qld]), and it is expected that the Project will not meet the definition of a major hazard facility. At appropriate intervals, an assessment will be made to determine whether more than 10% of the threshold for any Schedule 15 chemical is likely to be present for the remaining life of the Project and, should this occur, undertake the required notification.

The hazardous substances to be stored, used, transported, processed or produced on-site are presented in Table 16.7.

Table 16.7: Anticipated hazardous materials and dangerous goods

Hazardous substance	DG Class[1]	UN Number[2]	Packing group[3]	Maximum quantity stored	Annual rate of use	Purpose/use
Acetone	3	1090	II	500 L	1000 L	Degreasing agent and paint thinner
Ammonium nitrate	1.1D	0241	N/A	250 kg	100 kg	Explosive
Acetylene	2.1	1001	N/A	75 kg	300 kg	Welding and cutting
Chlorine	2.3 (5.1, 8)	1017	N/A	150 L	15,000 L	Water treatment
Diesel	3	1202	III	1,500 kL	100,000 kL	Fuel for vehicles and equipment and explosives use
Liquid petroleum gas	2.1	1075	N/A	300 kg	1,500 kg	Fuel for forklifts
Lubricant oils, grease and waste oil	9	3082	III	130 kL	1,100 kL	Transmission oils, hydraulic oils, engine oils, drive oils
Oily rags	4.2	1856	N/A	<5 t	<10 t	Waste product
Methyl isobutyl carbinol	3	2.53	III	< 100,000 L	<1,000 t	CHPP
Sodium hydroxide (caustic soda)	8	1823	II	1,000 kg	1,500 kg	Degreasing agent and sewage treatment
Paint	3	1263	I	500 L	1,000 L	Painting

[1] DG Class: Dangerous Goods class means the hazard class of the dangerous goods as stated in the Australian Code for the Transport of Dangerous Goods by Road and Rail Edition 7.7, 2020.

[2] UN numbers: A number that identifies hazardous substances and articles (such as explosives, flammable liquids, toxic substances, etc.) in the framework of international transport. UN numbers are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods.

[3] Packaging Group: Assigned to dangerous goods (other than Classes 1, 2 and 7) according to the degree of risk the goods present (I = great danger, II = medium danger and III = minor danger)

16.5.2.1 Explosives

The Project will use bulk explosives during the operational phase, and related explosives material, such as detonators and detonation cords, will be used in blasting activities. Explosive materials will be transported to the Project site as required for operations. Explosives will be stored, used and transported within the acceptable standards of Australian Standard AS2187.1 'Explosives–storage transport and use'.

Specialist explosive contractors and personnel licensed and trained in the transport, handling, mixing and firing of explosives will conduct all use of explosives and blasting. Specialist blasting personnel will be used to ensure blasting design meets the vibration requirements outlined in Chapter 14, Noise and Vibration.

16.5.2.2 Fuel

Diesel will be the primary fuel used throughout the Project lifecycle, and it will be stored on-site in bulk at the MIA. The diesel will be sourced from Moranbah or Mackay and transported to the site *via* road. The fuel storage facility will have a maximum capacity of 1,500 kL and be constructed with appropriate aprons and

hardstands, spill clean-up equipment and fire extinguishers. Staff involved in fuel storage and handling activities will be trained in the operation of the refuelling equipment, spill clean-up equipment and response in the event of an emergency incident. The fuel storage facility will undergo regular inspections to monitor structural integrity. All fuel storage facilities will be constructed and operated in accordance with Australian Standard (AS) 1940 'The Storage and Handling of Flammable and Combustible Liquids'.

16.5.2.3 Lubricants

Large quantities of lubricating and hydraulic oils will be required during the Project. The maximum quantity to be held on-site will be 130 kL, including lubricating oil, hydraulic oil and waste oil. Bulk storage of oil will occur in the workshop area of the MIA, where appropriate aprons and hardstands for lubricant transfer will be constructed. Storage of these materials will utilise secondary collection and storage measures, such as bunded pallets or self-bunded shipping containers. Other lubricants (and liquids, such as engine coolant and detergents) will be stored in containers up to 1000 L within the workshop area. Spill clean-up equipment and fire extinguishers will be maintained throughout the workshop. The MIA and workshop stormwater system will include oil separation systems to remove oil prior to stormwater entering runoff sediment basins.

16.5.2.4 CHPP reagents

ROM coal will be processed at the existing CHPP. The coal preparation process uses reagents (floatation agents, flocculants and coagulants) to separate the coal product from waste materials (coal rejects). Based on coal quality and feasibility analyses, reagents will include methyl isobutyl carbinol, diesel-based floatation agents and flocculants.

The reagents are bulk stored at the CHPP where secondary collection and storage facilities, such as bunded pallets or self-bunded shipping containers, are constructed and used in accordance with Australian Standard (AS) 1940 'The Storage and Handling of Flammable and Combustible Liquids'. Appropriate aprons and hardstands for reagent transfer are provided and include spill clean-up equipment and fire extinguishers.

16.5.2.5 Other hazardous materials

Small quantities of other hazardous materials will be used and stored within the Project, including:

- welding and cutting gases;
- cleaning solvents;
- radioactive sources (used in testing instruments and equipment); and
- corrosives (e.g. acids).

Very small quantities of radioactive isotopes will be used in some instruments in the CHPP plant, as is typical for coal processing systems. The radiation sources will be enclosed in sealed units and are not expected to present a significant hazard or safety risk. The material safety data sheets will be kept accordingly, and the equipment will only be manipulated by licenced, adequately trained professionals.

Gas obtained from the surface or underground gas drainage will be flared to reduce greenhouse gas emissions. Gas flares will be operated by trained and competent staff and will be set away from the gas drainage equipment and in a location which will prevent the escape of fire or release of sparks. Gas flares are not expected to present a significant hazard or safety risk.

All other hazardous substances will be stored and handled in accordance with relevant standards, label instructions and material safety data sheets. It is therefore, not expected that hazardous chemicals will present a significant risk to the workforce, surrounding community or receiving environment.

16.5.2.6 Mine products and waste material

Coal

ROM coal produced and stockpiled by the Project will be transported to the Lake Vermont CHPP. Coal products have the potential to spontaneously combust, causing environmental impacts. Coal materials may also cause hazards to the environment through contaminated leachate. Impacts resulting from coal leachate are assessed in Chapter 15, Waste Management.

Mine wastes

The management of overburden and spoil material is presented in Chapter 3, Project Description. Waste rock emplacements are potentially hazardous due to instability and may adversely impact water quality and cause erosion. Mine wastes are discussed in Chapter 6, Rehabilitation and Chapter 15, Waste Management.

Waste from consumables

Construction, operation and decommissioning activities will generate relatively small amounts of wastes, including general, recyclable and potentially some small quantities of hazardous waste. These waste streams will be segregated for removal and treatment off-site in accordance with a Waste Management Plan that will be developed for the Project. Refer to Chapter 15, Waste Management, for further details on wastes from consumables.

Emissions to air

Potential air quality impacts that may be associated with the Project, including potential impacts on sensitive receptors, are discussed in Chapter 13, Air Quality.

Noise and vibration

Project noise and vibration mitigation and management is described in Chapter 14, Noise and Vibration.

16.6 Project risk from natural hazards

16.6.1 Geophysical risk

The Project area has an annual 0.14% probability of experiencing a magnitude 5.35 earthquake and a 0.02% probability of experiencing a magnitude 6.05 earthquake (with the Project area noted to be located within a zone encompassing the Isaac, Mackay, Whitsunday, Burdekin, Livingstone, south of Charters Towers and north of Central Highlands local government areas) (QFES 2019b). The 30-year probability for the same zone is 4.23% for a magnitude 5.35 earthquake and a 0.59% probability for a magnitude 6.05 earthquake (QFES 2019b).

A magnitude 5.0 earthquake has the intensity to generate general alarm, damage masonry, dislodge tiles, burst domestic water tanks, damage concrete irrigation ditches and cause small slips of sand or gravel banks (QFES 2019b). A magnitude 6.0 earthquake has the intensity to create alarm approaching panic, affect steering of motor cars, damage and partially collapse masonry, twist or topple chimneys, factory stacks, towers, and elevated tanks, cause cracks in steep slopes and wet ground, cause landslips in roadside cuttings and unsupported excavations (QFES 2019b). Although these risks are very low, the potential consequence of a 6.0 magnitude earthquake could include a structural failure of underground mining areas or the open cut pit.

The earthquake risk will be managed through the consideration of structural geology, ground control, geotechnical stability in the mine design and the maintenance of the safety and emergency response systems, as described in section 16.9. Given the likelihood, potential consequence and proposed Project design, the geophysical risk of the Project is considered to be low.

16.6.2 Cyclone and severe wind hazard risk

The Project is located within the non-cyclonic wind region A4 (greater than 100 km from the coastline) as defined by the Australian/New Zealand Standard 'Structural design actions Part 2: Wind actions' (ANZS 2011). This region may experience indirect impacts from cyclones and significant rainfall and flooding from ex-tropical cyclones and tropical lows.

Severe weather events with damaging winds, heavy rain, very large hail and tornados occur throughout Queensland and could occur in the locality of the Project (QFES 2017). Severe weather events can cause localised power outages, communication disruptions, disruptions to transport and damage to property or personnel health and safety.

16.6.3 Flood risk

Tropical cyclones or severe weather events may deliver significant amounts of rainfall, with rainfall runoff potentially leading to flooding impacts, including within the region where the Project is located (QFES 2017). Floods are likely to cause short-term disruptions to various local and regional infrastructure, including power supply and communication structures and road and rail infrastructure. Modelling of flood risk for the Project and flood mitigation and management measures are presented in Chapter 9, Flooding and Regulated Structures.

16.6.4 Heat and heatwave risk

The Project is within an area that periodically experiences heatwave conditions. Currently, the region experiences heatwave frequencies of 2.7% annually, with an expected increase by 2030 (3.0%) and 2050 (8.1%) under the business-as-usual greenhouse gas emissions pathway (using RCP8.5, QFES 2019a). Heatwaves will potentially disrupt the Project through direct health and safety impacts on staff and additional stress on Project infrastructure.

16.6.5 Bushfire risk

The Project is in an area mapped by the 'State Planning Policy Integrated Mapping Systems' (DILGP 2016c) as having:

- medium potential bushfire intensity;
- potential impact buffers; and
- low bushfire hazard areas.

Bushfire risk in the medium potential bushfire intensity areas is expected to exceed a 1 in 100-year ARI frequency. The potential impact buffer areas are locations that could be subject to significant bushfire attack from embers, flames or radiant heat. The low hazard areas are unlikely to support a significant bushfire.

The MIA, including the ROM stockpile and hazardous materials storage areas, are to be located within areas which will be cleared of vegetation as a bushfire risk mitigation measure. Buffers between vegetation and infrastructure will be maintained to ensure that all facilities are protected from radiant bushfire heat. The on-site availability of firefighting equipment, water trucks and earth moving machinery will contribute to bushfire control on-site. Bushfire management will be addressed in the Emergency Response Plan (ERP) for the Project.

16.6.6 Climate change risk

The Project area is likely to experience changes in climatic conditions over the life of the Project. The climate of the region is predicted to become warmer and drier as a consequence of climate change. Climate change projections for the Project area under different scenarios are presented in Section 4.3 of Chapter 4, Climate.

16.6.7 Dangerous wildlife and disease vectors

The construction and operational workforce may encounter potentially dangerous wildlife, particularly snakes. Sufficient suitably trained personnel will be available to ensure that any incidents concerning dangerous wildlife can be appropriately managed—in most cases through removal or containment. Any associated injuries or health consequences for personnel will be managed in accordance with established first aid, medical and emergency response procedures.

Potential disease vectors at the Project will include vermin and mosquitoes. Mosquitoes have the potential to transmit a variety of diseases to humans, such as Ross River Virus, Barmah Forest Virus and Dengue Fever (Queensland Health 2019a). The construction and operation of the Project is not expected to lead to an increase in the risk of disease vectors. Site management planning will incorporate measures targeting vermin and mosquito control to aid in the prevention of the spread of diseases on-site and throughout the surrounding community. Key strategies will include:

- materials storage protocols;
- housekeeping standards;
- water management protocols;
- waste management protocols;
- inspections and monitoring; and
- eradication programs (when necessary).

Based on the operational experience of the Lake Vermont Mine (over approximately the past 12 years) issues with mosquito outbreaks have never been observed. While it is acknowledged that the Project will result in surface subsidence which may create areas of additional water ponding, the existing landscape already provides sufficient potential mosquito habitat, in the form of numerous natural ponding areas (gilgai formations), wetlands and farm dams. It is therefore considered unlikely that the Project will result in increases of mosquito populations and a mosquito management plan is not currently proposed or considered to be required. In the unexpected event that substantial mosquito populations were to develop on site, a mosquito management plan would be prepared and implemented in accordance with Queensland Health guidelines, to prevent the spread of mosquito-borne disease on-site.

Further details on disease vector management strategies are included in Chapter 12, Biosecurity.

16.7 Project siting and layout

The Project siting and layout is presented in Chapter 3, Project Description, Section 3.1.4. The underground mining layout is designed considering:

- structural geology;
- geotechnical aspects;
- key mining parameters;
- predicted subsidence; and
- potential impacts on environmental values.

The underground mine access will be sited to avoid the floodplain and associated risks during natural hazard events. The open-pit mine design is based on the constraints of the floodplain conditions of the site. The infrastructure corridor is designed to mitigate the risk of natural hazard events, particularly regarding the floodplain and watercourse crossings.

16.8 Risk analysis, evaluation and controls

The risk analysis workshop undertaken to analyse and evaluate potential risks and hazards of the Project used the following process steps:

- The basis and purpose of the risk identification was discussed and agreed on, as well as the process used to develop the risk scenarios, causes and impacts proposed in the risk assessment template.
- The risk assessment scheme, including the consequence descriptors for each consequence type, the likelihood classifications and the control effectiveness rankings, were evaluated and agreed upon.
- Each of the identified risk scenarios or descriptions was then considered in turn. In most cases, one or more of the 'risk/hazard title', 'causes' and 'impacts' proposed were refined as a result of the discussion.
- The risk controls expected to be in place were nominated and a 'control effectiveness' ranking was agreed upon for each control.
- The likelihood of each risk/hazard (subject to the expected control level) was considered, and a ranking was provided in accordance with the consensus view of the panel.
- The consequence category for the relevant impact or impacts was similarly assessed and ranked.
- The risk class was determined based on the risk matrix in use.
- For risks and hazards determined as being Classes III and IV, additional control measures were identified and assessed and, when effective and appropriate, proposed.

Unacceptably high risks were then subjected to further assessment to identify control measures likely to be effective in reducing risk levels. The generally accepted hierarchy of control was applied to minimise risks and was adopted in the following preferential order:

1) Eliminate the hazard or threat.
2) Minimise or replace the hazard or threat.
3) Control the risk using engineered devices that do not require human actuation.
4) Control the risk using devices that require human actuation.
5) Control the risk using appropriate procedures.
6) Control the risk using personal protective equipment (PPE).
7) Control the risk through administrative means (such as job rotation to limit exposures).
8) Control the risk with warnings and by raising awareness.

16.9 Mitigation and management measures

Of the 60 unique risks identified and assessed, no class IV risks were identified while six Class III risks were identified. The identified Class III risks are summarised in Table 16.8, along with additional control measures able to be utilised to further minimise these risks. It should be noted that a number of Class II risk are so ranked by virtue of the potential for a fatality to an employee or as a consequence of necessary disturbance which would be authorised by an EA if approval is granted. The full list of hazards associated with the Project, their causes, consequences and final risk ranking is provided in Appendix N, Hazards and Safety Risk Assessment (section 5).

16.9.1 Safety and health management system (SHMS)

The Project will adopt an SHMS in accordance with the requirements of the CMSH Act. The SHMS will be based on AS/NZS 4801 'Occupational Health and Safety Management Systems' (Standards Australia/Standards New Zealand Committee, 2001) and incorporate risk management elements and practices with clearly defined and measurable objectives.

The SHMS will document the standards, methods and procedures necessary to mitigate risks relevant to the stages of the Project and ensure legislative compliance. Strict adherence to the SHMS will be required by all personnel who enter the site (i.e. Project workforce, contractors and visitors).

A detailed hazard and opportunities assessment will be undertaken as part of the final planning process for the various components of the development and construction phases. The assessment will build on the above preliminary hazard and risk assessment and identify the principal hazards for management focus during each phase of the Project.

The objectives of the SHMS will include (but not be limited to):

- compliance with regulatory requirements;
- leadership accountability at all levels;
- commitment to effectively communicate expectations and requirements;
- commitment to provide adequate resources, support and training;
- initiatives to actively involve and consult employees, contractors and other stakeholders;
- commitment to keep personnel informed and provide open communication;
- commitment to investigate all incidents and take necessary corrective actions to prevent recurrence;
- occupational rehabilitation programs;
- commitment to monitor, measure, review and audit SHMS adequacy and compliance with objectives;
- initiatives to implement changes to the SHMS based on monitoring and review outcomes; and
- commitment to foster continuous improvement.

Table 16.8: Identified Class III risks

Risk or hazard title	Causes (triggers &/or indicators)	Potential impacts (consequences)	Inherent risk with assumed expected or standard controls	Risk ranking			Risk mitigation approach
				Health & safety	Environment	Community trust	
Safety: Increased risk of motor vehicle incidents	Increased light and heavy vehicle movements associated with the Project	Ranges from inconvenience to fatality	Road access design (subject to regulatory controls) and public road controls	III			• Fatigue management/fitness for work • Alcohol and drug testing • Road safety awareness training
Operational OHS hazards	Construction, mining and industrial activities	• Health and safety • Operational costs	• Staff awareness and training • Safety management system	III			• OHS performance to be closely monitored and assessed and, when required, individual, issue-specific risk assessments to be undertaken to identify fit-for-purpose safety initiatives
Hazardous materials: Storage and use of explosives	• Incorrect storage • Accidental incidents	• Noise/vibration • Fly rock • Unplanned explosion	• Appropriate storage and handling of explosives • Saff training	III			• Employee training • Supervision • Critical controls relating to blast management
Land disturbance: Direct clearing, topsoil removal and earthworks	• Soil characteristics • Weather • Unexpected flora/fauna impacts	• Erosion • Damage to environmental values • Dust	• ESC practices followed • Spotter catchers employed when necessary		III		• Sediment dams • ESC controls • Rapid revegetation
Air quality: Dust impacts to sensitive receptors	• Equipment, processes and vehicle movements on unsealed roads • Increased bare areas (waste rock dumps, TSF)	• Annoyance • Amenity (sensitive receptors) • Harm to wildlife • Crop impact • Contamination of water tanks	• Distance from source • Routine haul road watering • Progressive rehabilitation • Speed limits			III	• Chemical treatment of haul roads • Rescheduling of blasting operations • Reactive dust control measures

Risk or hazard title	Causes (triggers &/or indicators)	Potential impacts (consequences)	Inherent risk with assumed expected or standard controls	Risk ranking			Risk mitigation approach
				Health & safety	Environment	Community trust	
Impacts on fauna (wildlife interactions)	• Driving conditions • Workers interacting with wildlife	• Vehicular accident • Site work injury	• Staff training to operate vehicles defensively • Staff awareness		III		• Monitor fauna interactions via incident reporting; • if required, introduce additional controls (e.g. fencing, ultrasonic deterrent devices etc.

16.9.2 Emergency response plan (ERP)

The existing Lake Vermont Mine ERP outlines the responsibilities and processes for providing adequate emergency response at the Lake Vermont Mine. As a result of the emergency planning existing Lake Vermont Mine operation has maintained a good safety record and the operation has achieved avoiding incurring the following throughout its operation:

- non-compliance environmental incidents;
- transitional environmental programs;
- environmental evaluations;
- environmental protection orders;
- direction notices;
- clean-up notice;
- prosecutions

The Lake Vermont Mine safety record is driven by site personnel, a culture of proactive engagement with safety management systems and an efficient functioning ERP. The ERP follows the following structure:

- emergency response requirements;
- communications;
- secure team records and logs;
- trigger action response plans;
- emergency response scenarios and guidelines;
- duty cards;
- emergency response roles;
- emergency response responsibilities;
- external emergency assistance;
- emergency provisions;
- emergency activation;
- emergency response strategy;
- return to normal duties;
- post incident review and assessment;
- testing and training;
- emergency equipment and storage;
- monitor, audit and review; and
- emergency response handbook.

The ERP will be updated to provide risk mitigation measures and emergency response protocols for the proposed Project and will be applicable to all Project phases. The updated ERP will achieve the following:

- provide current contact details relevant to emergency management;
- outline the roles and responsibilities of site personnel, including, but not limited to, the:
    - Incident Commander (Project Manager/Site Senior Executive [SSE]);
    - Incident Controller;
    - Emergency Response Team;

  - Supervisors; and
  - mine workers;
- address the range of feasible emergency situations that could occur, including situations specific to underground mining operations including, but not limited to;
  - search and rescue scenarios;
  - underground firefighting scenarios;
  - excess fumes scenario;
  - ground movement response scenarios;
  - geotechnical concern response scenarios;
  - personal protective equipment;
  - breathing apparatus use conditions; and
  - rope rescue scenarios;
- underground mine emergency exits;
- withdrawal from mine under unsafe conditions;
- detail the equipment available to emergency responders;
- provide emergency response training;
- provide regular testing of the site's emergency response capability;
- outline the emergency response procedure to be followed, including raising the alarm and summoning emergency assistance and the termination of emergency response;
- identify emergency communications protocols, including requests for assistance from external emergency services (e.g. Queensland Mines Rescue Service, Queensland Fire and Emergency Services, Queensland Police);
- outline fire response procedures;
- detail evacuation procedures and muster points including for various emergency types as follows:
  - general emergency situations – evacuation of the building/work area/mine area and assembly at the relevant muster points;
  - tyre fires – evacuation areas of distance not less than 300m radius of the fire;
  - mobile equipment fire – evacuation of the mobile equipment on the side of the machine opposite the fire if possible;
  - explosives fire or unintentional detonation – evacuation area for a distance of no less than 1 km;
  - major gas/chemical fire/floatation agent/fuel spill or fire – evacuation to up wind of emergency area;
  - malicious threat – evacuation to a relevant exclusion zone;
  - vehicle contacts powerlines – evacuation the immediate vicinity;
  - flash flood – evacuation from at risk areas;
  - confined space – evacuation confined area;
  - severe weather event or bushfire – revise evacuation arrangements or evacuate to storm or bushfire evacuation point.
- include maps and relevant GPS information; and
- include duty cards detailing the roles and responsibilities of the Incident Commander, Incident Controller, Emergency Response Team, supervisors and mine workers.

The updated ERP will be maintained in consultation with key external bodies involved in emergency responses relating to site activities, including:

- Queensland Fire and Emergency Services;
- Queensland Mines Rescue Service
- Queensland Ambulance Service;
- Queensland Police Service;
- Rural Fire Service;
- RACQ CQ Rescue Service; and
- Isaac Regional Council (relative to regional emergency plans).

An outline of key events addressed by the ERP is provided in Table 16.9.

Table 16.9: Emergency Response Plan key elements

Event	Location	Potential response and resources	Coordination of response
Severe injury or illness	On-site	On-site: Emergency response and rescue External: Ambulance from Queensland Ambulance Service, rescue helicopter from CQ Rescue service	Site delegate
Vehicle/ machinery collision	On-site	On-site: Emergency response and rescue External: Recovery equipment from Queensland Fire and Emergency Services, ambulance from Queensland Ambulance Service, rescue helicopter from CQ Rescue service	Site delegate
Vehicle collision	Off-site in the area of the Project	On-site: Emergency response, if required, as first respondent. External: Queensland Police Service, recovery equipment from Queensland Fire and Emergency Services, ambulance from Queensland Ambulance Service, rescue helicopter from CQ Rescue service	Queensland Police Service, Queensland Fire and Emergency Services, Queensland Ambulance Service
Chemical/fuel spill	On-site	On-site: Emergency response and rescue, firefighting equipment, spill clean-up equipment	Site delegate
Fire	On-site	On-site: Emergency response and rescue, water truck, firefighting equipment, spill clean-up equipment External: Firefighting equipment from Queensland Fire and Emergency Services (if required)	Site delegate
Bushfire	On-site and off-site	On-site: Water truck, grader, dozer, firefighting equipment External: Mine site water truck, grader, dozer, firefighting equipment from Queensland Fire and Emergency Services	• Site delegate for on-site response • Queensland Fire and Emergency Services for off-site response
Spontaneous combustion	On-site	On-site: Water truck, excavator, dozer, firefighting equipment	Site delegate

16.9.3 Bushfire management plan (BMP)

The existing ERP includes a section to address the emergency response to fires. This will be updated prior to Project commencement and will identify specific bushfire hazards for the Project area, as well as outline the response and resourcing required for bushfire emergencies. The BMP component of the ERP will be updated in consultation with the Queensland Fire and Emergency Services and reviewed by the responsible site representative (Mine Manager) prior to each bushfire season. The BMP section of the ERP will include:

- a bushfire hazard analysis and risk assessment for the approaching season;
- fire regimes for vegetation communities;
- detailed bushfire mitigation strategies;
- identification of fire management zones;

- identification of existing and proposed firebreaks and fire management lines;
- assessment of any proposed vegetation clearings for fire control;
- fire protection controls and maintenance of controls;
- specification of firefighting equipment;
- strategies to achieve development outcomes of the State Planning Policy to;
    - avoid activities in bushfire hazard areas of the Project when practicable;
    - support the Queensland Fire and Emergency Services;
    - avoid an increase in the severity of bushfire hazard;
    - avoid risk to public safety from hazardous materials; and
    - maintain natural bushfire processes as applicable;
- proposed monitoring and auditing of the ERP; and
- detailing emergency contact information and site wardens.

16.9.4 Monitoring and improvement

To ensure the effectiveness of the ERP, the plan will be periodically tested, audited and reviewed. An investigation will take place after any emergency. Regular training and testing of the emergency response workers will take place.

Monitoring of the SHMS and ERP and audits of the implementation of management plans will be conducted periodically. Inspections will take place regularly to ensure all emergency equipment is working and has been maintained. Monitoring information will be provided for management team review, and corrective actions will be implemented as required. Corrective actions will include reviews of relevant policies, plans and procedures.