Chapter 32

Hazard and Risk

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32. HAZARD AND RISK

32.1 Introduction

This chapter describes the potential hazards and risks to people and property that may be associated with the Byerwen Project and provides a preliminary risk assessment of these hazards. This chapter is based on the Hazard and Risk Assessment Report provided in **Appendix 34**. A draft risk management plan is included in **Appendix 33**.

32.2 Methodology

32.2.1 Overview

Assessment of hazards and risk to people and property from the construction, operation and decommissioning of the project was undertaken via a preliminary risk assessment in accordance with AS/*NZS ISO 31000: 2009. Risk Management – Principles and Guidelines* and *IEC/ISO 31010 Risk Management: 2009. – Risk Assessment Techniques.* The hazard and risk assessment also considers the potential impact on surrounding land use.

The study applies to abnormal hazardous events and conditions, rather than conditions considered to be routine. Hazard identification takes into account compliance with regulatory requirements and therefore deliberately licensed release of pollutants such as air emissions and waste disposal is not included in the assessment.

The assessment involved:

- Determination of the existing values including sensitive receptors.
- Identification of any potential hazards to people and property, documented in a hazard identification word diagram.
- Review of relevant statistics and information to obtain probability data for hazardous events.
- Evaluation of the risks associated with each hazard.
- Proposal of mitigation measures.
- Preparation of a draft risk management plan.

The scope of this risk assessment did not include assessment of environmental risks or economic risks associated with project delays. Environmental risks and potential economic impacts are addressed in other chapters of the EIS.

32.2.2 Risk Analysis Criteria

ISO 31000 states that risk analysis consists of determining the causes and sources of risk, their consequences and likelihood taking into account the effectiveness and efficiency of controls. Criteria for likelihood and consequence are detailed in **Table 32-1** and **Table 32-2**.

Table 32-1 Likelihood Scale

Likelihood	Descriptor	Description	Indicative frequency
A	Almost Certain	Is expected to occur in most circumstances	More frequently than monthly
B	Likely	Will probably occur in most circumstances	Monthly - yearly
C	Possible	Could occur	Every one year to 25 years
D	Unlikely	Could occur but is not expected	Every 25-50 years
E	Rare	Could occur only in exceptional circumstances	Once every 50 years or more, unlikely to occur during life of mine

Source: Adapted from ISO 31010: 2009 and Coal Services Health and Safety Trust (2007)

Table 32-2 Consequence Scale

Consequence	Descriptor	Health and safety - public and site workers	Community amenity	Environment	Property damage – cost to repair or replace infrastructure, including lost revenue
1	Negligible	First aid treatment, no lost time injury.	Minor impact to amenity for up to a few days affecting local residents.	Negligible reversal environmental impact on site requiring no or minor remediation.	<$10,000
2	Minor	Minor injury or illness – reversible, requiring medical treatment.	Short term localised impact e.g. weeks to months.	Minor environmental impact, on or off site, able to be promptly contained and cleaned up.	$10,000 - $100,000
3	Moderate	Serious injury or illness requiring medical/hospital treatment. Will recover.	Medium term e.g. 1-5 years on the local community. Region wide concern.	Environmental impact with short term effect off site requiring significant remediation.	$100,000-$1 million
4	Severe	Severe irreversible permanent disabling injuries or illnesses.	Significant and long term impact to the region e.g. > 5 years.	Prolonged environmental impact requiring significant remediation, with recovery expected in the medium term – years.	$1 million – $100 million
5	Catastrophic	Fatality. Multiple severe irreversible permanent disabling injuries or illnesses to tens of people.	Permanent, significant and ongoing impact on a wide scale e.g. state-wide.	Significant environmental impact with long term effect requiring major and ongoing remediation.	> $100 million

Source: Adapted from DRET (2008) and ISO 31010: 2009.

32.2.3 Risk Level

The likelihood and consequence scales are combined to evaluate the overall level of risk, as outlined in **Table 32-3**.

Table 32-3 Risk Levels

Likelihood Level	Consequence Level				
	Negligible (1)	Minor (2)	Moderate (3)	Severe (4)	Catastrophic (5)
Almost Certain (A)	Medium	High	Extreme	Extreme	Extreme
Likely (B)	Medium	Medium	High	Extreme	Extreme
Possible (C)	Low	Medium	High	High	Extreme
Unlikely (D)	Low	Low	Medium	High	High
Rare (E)	Low	Low	Medium	Medium	High

Compliance with regulatory requirements is mandatory and therefore the hazard identification processes has assumed compliance with regulatory requirements and relevant Australian Guidelines and Codes applicable to the management and mitigation of hazards and risks at a Queensland coal mining operation such as the Byerwen project. Hazard identification and recommended risk treatment measures have been identified based on the premise that legislation and relevant, widely accepted, Australian Guidelines and Codes are implemented whilst undertaking the activity. These include:

- *Work Health and Safety Act 2011 and Work Health and Safety Regulation 2011* – aims to secure the health and safety of workers and workplaces. Workers and others are to be given the highest level of protection from hazards and risks as is reasonably practicable
- *Coal Mining Safety and Health Act 1999* - aims to protect the safety and health of personnel at coal mines as well as people that may be affected by coal mining operations. There is a requirement to ensure that the risk of injury or illness to any person resulting from coal mining operations be at an acceptable level and requires a means of monitoring the effectiveness and management of health and safety.
- *Coal Mining Health and Safety Regulation 2001* - requires Queensland coal mines to have systems in place to undertake risk identification and assessment, hazard analysis, hazard management and control as well as reporting and recording health and safety data.
- *Explosives Act 1999* - includes requirements for the safe handling, storage, transport and manufacturing of explosives.
- *Explosives Regulation 2003* - includes specific limits and requirements for the safe handling, storage, transport and manufacturing of explosives.
- AS/NZS ISO 31000:2009 Risk Management Principles and Guidelines - provides a framework for managing risk and specifies the elements of the risk management process.
- *AS 1940:2004. The Storage and Handling of Flammable and Combustible Liquids* – includes the requirements and recommendations for the safe storage handling of flammable liquids and dangerous goods Class 3 (as classified in the United Nations (UN) Recommendations for the Transport of Dangerous Goods). AS1940:2004 also includes requirements and recommendations for

the storage and handling of combustible liquids and provides minimum acceptable safety requirements for storage facilities, operating procedures, emergency planning and fire protection. It provides technical guidance that may assist in the storage and handling of flammable and combustible liquids.

- *AS 2187.1/1-2000 Explosives– Storage, Transport and Use – Storage* –details the requirements and precautions for the storage of explosives and for the location, design, construction and maintenance of magazines.
- *AS 2187.2:2006 Explosives – Storage and Use – Use of Explosives* – details the requirements and precautions for the use of factory-made, commercially available explosives and certain explosives mixed or assembled at sites.
- Department Mines and Energy (now DNRM) (2008). Guidance Note QGN10. Handling Explosives in Surface Mines and Quarries.
- ADG 7. Australian Goods Code - provides technical requirements for the land transport of dangerous goods across Australia.
- Queensland Health (2002). Guidelines to minimise mosquito and biting midge problems in development areas.
- State Planning Policy 1/03 (2003). Mitigating the Adverse Impacts of Floods, Bushfire and Landslide.

The focus of the hazard identification is on abnormal hazardous events and conditions. Routine emissions and operations are detailed in other sections of this EIS and are addressed via pollution control mechanisms and legislation.

Potential health and safety hazards that may affect site workers in normal on site day-to day activities during the construction and operation of the project are listed in **Table 32-4**. These hazards are well addressed in workplace health and safety legislation and relevant Australian standards and are not included in the hazard identification process for this EIS.

For each hazardous incident (e.g. fire, spill, leak, collision) the potential initiating events have been defined in order to represent the range of possible incidents. This enables a more accurate assessment of the conceivable scenarios that could lead to the hazard and therefore appropriate risk treatment measures can be recommended.

32.3 Hazard Identification – Health and Safety

32.3.1 Site Workers Health and Safety

Table 32-4 details the health and safety hazards that are likely to be present in normal on-site day-to-day activities during construction and operation of the project. These hazards are well addressed in workplace health and safety legislation and relevant standards and will be complied with at all times during the construction, operation and decommissioning of the project.

Table 32-4 Hazard Identification - Site Workers Health and Safety

Hazard	Description	Consequence	Risk treatment measures
Manual Handling	Incorrect handling	Injury likely to recover from	Use approved safe work method, training and competency assessment, provide equipment fit for purpose and suitable allocation of resources.
Slips and trips	Water, oil on ground	Injury likely to recover from	Use approved safe work method, training and competency assessment.
Interaction with mobile equipment	Worker hit by mobile equipment	Injury / fatality	Training, competency assessment, systems of authorisations, inspections, signage, traffic management plan, "no go" zones, dedicated pedestrian walkways.
Working at heights	Fall	Injury / fatality	Training, competency, appropriate scaffolding and/or PPE, inspections, safe work methods.
Working with electrical equipment	Electric shock / Electrocution	Injury / fatality	Qualified electricians, training, competency, approved safe work methods, equipment maintenance, testing and tagging procedures, inspections, separate / barricade work areas, isolation permit system.
Equipment with moving parts	Failure to isolate correctly	Injury / fatality	Isolation procedures, tag protection system, maintenance of guarding, inspections, training, competency.
Falling objects	Object falls from height	Injury	PPE, barricading, approved safe work methods.
Fatigue	Operating plant and equipment whilst tired	Injury / fatality	Fit for work program, fatigue management plan, traffic plan.
Confined space	Suffocation	Fatality	Confined space permits, training, competency, approved safe work method statement, equipment serviced regularly.
Pinch points	Crush	Fatality	Safe work methods, training, competency, guarding, barricading, signage
Lightning	Struck by lightning	Fatality	Storm procedures, approved safe work methods, lightning masts.

Hazard	Description	Consequence	Risk treatment measures
Wildlife hazards	Snake bites	Fatality	PPE e.g. long trousers, high sided safety boots, first aid training, emergency management plan.
Disease vectors	Mosquito bites	Illness	PPE e.g. long trousers, long shirts, insect repellant where required. Water bodies, including dams, managed to avoid stagnation hence minimizing potential for mosquito breeding sites.
Dust	Clearing, excavation, unsealed roads, blasting	Respiratory issues	Watering roads, dust suppression, PPE.
Noise	Excessive noise from plant and equipment	Hearing loss	PPE, noise barriers, equipment location.
Sun burn	Working in sun without protection	Skin damage, no treatment	PPE, provision of sunscreen.
Dehydration /Heat Stress	Working in hot conditions without sufficient water	Hospitalisation	PPE, safe work method statement, provide water, training.
Welding and cutting	Fumes, hot metal, sparks	Poisoning, skin burn, foreign object in eye	PPE, safe work method statement, qualifications.
Exposure to hazardous substances	Oils, diesel, chemicals	Skin, eye irritation	PPE, training, MSDS, standards and procedures for transporting, handling, using and disposing of hazardous substances.
Fire	Buildings, vehicles, conveyors, CHPP	Smoke inhalation	Emergency exits, training, Emergency Management Plan, fire extinguishers, fire alarms.

32.3.2 Hazardous Substances

The project will use a number of hazardous substances during construction and operations.

Table 32-5 provides an indicative list of hazardous substances to be used during the project and the likely quantities stored on site. Material Safety Data Sheets (MSDS) will be available on site where these substances are to be stored or used.

Table 32-5 Indicative List of Hazardous Substances

Chemical name	Storage location	Highest likely total storage quantity	Rate of usage	Comments
Explosives •Primers •Detonators •Ammonium nitrate with not more than 0.2% total combustible material	Explosives magazine located in an isolated area on site separated from other mining infrastructure on the project area. Nearest residence to the magazine will be at least 3km away.	No bulk explosives stored on site – mixed on site	50,000 tpa	Storage facility designed and constructed to AS 2187 Explosives – Storage, Transport and Use.
Methyl Isobutyl Carbinol (MIBC)	MIA	550t	8,000 – 13,000 tpa	
Diesel	MIA fuel facility comprising of a number of interconnected self-bunded bulk diesel storage tanks.	800kL	20,000 kLpa	Diesel will be reticulated to heavy vehicle service bays and heavy and light vehicle bowsers. Access to the fuel facility will be via internal MIA access roads. The fuel facility will be located at a safe operating distance from other MIA and surrounding facilities in accordance with AS1940 The storage and handling of flammable and combustible liquids. There will be no in-field fuel storage. Fuel trucks will transfer from the fuel storage tanks to mine vehicles.
Oils •Transmission oil • Hydraulic oil •Diesel Engine oil • Final drive oil • Waste oil	MIA lube and oil facility	30,000L 15,000L 10,000L 10,000L 25,000L	2,250,000 Lpa	Self bunded lube and oil storage tanks

Chemical name	Storage location	Highest likely total storage quantity	Rate of usage	Comments
Lubricants and coolants •Engine coolant • Gear oil • Other lubricants	MIA lube and oil facility	2,500L 2,500L 2,500L	187,500 Lpa	Self bunded lube and oil storage tanks
Petrol	MIA	Minor	Minor	
Paint	MIA	Minor	Minor	
Solvents	MIA	Minor	Minor	
Thinners	MIA	Minor	Minor	

32.4 Hazard Identification - Natural Hazards

32.4.1 Flood

The project is located in the headwaters of the Suttor River catchment which is a tributary of the Burdekin River. The Suttor River catchment covers an area of approximately 65,000 km^2 although the catchment area upstream of the proposed mine site is around 900 km^2 on the Suttor River and 750 km^2 on Suttor Creek. No data was available on the flood history of the project area.

The flooding impact assessment concludes that flood protection measures can be designed to protect pit and final void from 1 in 1,000 year flood events.

32.4.2 Bushfire

Bushfire risk analysis maps for Isaac Regional Council and Whitsunday Regional Council have been prepared (June 2008) and cover the project area. The project area is classified as low and medium risk. There does not appear to be any available information on the actual frequency of bushfires that may affect the project location.

32.4.3 Wildlife

A search of the Department of Environment and Heritage Protection (EHP) wildlife online database for Isaac Regional Council and Whitsunday Regional Council RC identified a number of wildlife species that are potentially dangerous to humans. These included mammals such as red fox, dingoes, rats, pigs; and reptiles such king brown snake, eastern brown snake, western brown snake, common death adder and red-bellied black snake.

32.4.4 Vector-borne Disease

Increasing potential freshwater breeding sites such as receding flood waters and pooling water can result in larger numbers of mosquitoes, which in turn increases the potential for outbreaks of mosquito-borne diseases (Queensland Health 2011). Notifiable diseases reported in Queensland include Barmah Forest Virus, Ross River Virus, Dengue Fever and Malaria.

32.4.5 Climate Change

The impacts of climate change on the project area show projections of temperature increases and either declining or increasing rainfall depending on the climate model. It is expected that the frequency and intensity of storms and cyclones will not change significantly in the area of the project.

32.5 Preliminary Hazard Identification – Construction, Operation and Decommissioning

Table 32-6 identifies the non-routine hazards associated with the construction, operation and decommissioning (abbreviated as C,O,D) of the mine and associated infrastructure taking into account the project description, natural hazards and estimated hazardous substances being stored and used on site. Transport risks and interaction with external projects are also identified. Potential health and safety hazards to the site workers for routine operations are not included as these have been previously identified and can be addressed by compliance with relevant standards and regulations.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
Interaction with Third Party Elements					
Goonyella to Abbot Point rail line. Alpha Coal Project rail line	O	Fly rock from blasting	• Misfire • Failure to comply with explosive management plan	• Injury to public / site worker • Fatality to public / site worker • Property damage	Blast design plan and monitoring program. Management of blasting and handling of explosives in accordance with Australian Standards and Regulations. Explosives management plan including maintenance of a blasting exclusion zone and appropriate signage. Licensed, trainer, experienced and competent personnel.
	C,O,D	Vehicle accident	• Vehicle and train collision	• Injury to public / site worker • Fatality to public / site worker • Property damage	Traffic control measures, Traffic management plan, Bridge or conveyor for hauling waste rock over rail lines.
Access road / heavy vehicle road intersects Collinsville-Elphinstone Road	C,O	Vehicle accident	• Vehicle collision	• Injury to public / site worker • Fatality to public / site worker • Property damage	Traffic control measures for crossings. Traffic management plan.
Xstrata mine vehicles along the transport route from mines south of the project to the Xstrata Newlands Mine that bisects Byerwen tenements	C,O	Vehicle accident	• Vehicle collision	• Injury to public / site worker • Fatality to public / site worker • Property damage	Traffic control measures. Traffic management plan. Liaison with Xstrata.

Table 32-6 Hazard Identification Word Diagram

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
Transport					
Transporting personnel, equipment and materials to and from the site and within site	C,O,D	Vehicle accident	• Driver error • Fatigue • Vehicle collision • Adjacent landholder on access routes	• Injury to public / site worker • Fatality to public / site worker • Property damage	The project will be accessed via the Suttor Developmental Road, Bowen Developmental Road and Collinsville-Elphinstone Road.
	C,O,D	Spill, leak of liquid or fumes	• Incorrect loading • Tank failure • Collision	• Property damage • Fire • Health impacts from contamination (soil, water, groundwater)	Secure loading of materials, procedures, training, spill management, Emergency Management Plan.
	C,O,D	Excessive dust	• High winds • Unsealed roads	• Vehicle accident / collision	Speed limits, paving, watering roads, wind breaks.
Transport of explosives to and within site	O	Fire, explosion	• Driver error • Vehicle collision • Failure of equipment • Failure to comply with procedures	• Property damage • Injury / fatality site worker • Injury / fatality public • Health impacts from contamination (soil, water, groundwater)	Speed limits, traffic management plan, transport in accordance with relevant standards, training, Emergency Management Plan.
Transport of fuel to and within site	C,O,D	Fire Spill, leak	• Driver error • Vehicle collision • Failure of equipment • Failure to comply with procedures	• Property damage • Injury / fatality site worker • Injury / fatality public • Health impacts from contamination (soil, water, groundwater)	Speed limits, traffic management plan, transport in accordance with relevant standards, training, Emergency Management Plan.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
Storage					
Storage of fuel	C,O,D	Spill, leak	• Failure of equipment • Failure to comply with procedures	• Property damage • Health impacts from contamination (soil, water, groundwater)	Fuel storage designed and operated in accordance with AS1940. Bunds, signage, spill procedures, emergency response planning, training, inspection and maintenance program.
	C,O,D	Fire, explosion	• Ignition source or fire • Failure of equipment • Failure to comply with procedures	• Injury to public / site worker • Fatality to public / site worker • Property damage	Fuel storage designed and operated in accordance with AS1940. Signage, emergency response planning, training, inspection and maintenance program.
Storage of explosives	O	Fire, explosion	• Ignition source or fire • Failure of equipment • Failure to comply with procedures	• Injury to public / site worker • Fatality to public / site worker • Property damage	Management of blasting and handling of explosives in accordance with Australian Standards and Regulations. Explosives management plan including maintenance of a blasting exclusion zone and appropriate signage. Licensed, trained, experienced competent personnel, Emergency Management Plan.
Construction and Installation					
Clearing and earthworks	C	Excessive dust	• High winds • Unsealed roads	• Vehicle accident / collision	Speed limits, paving, watering roads, wind breaks.
	C	Landslide	• Heavy rainfall	• Property damage	Erosion and sediment control plan include diversion and management of water runoff and progressive stabilisation.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
	C	Wildlife (e.g. snakes)	• Disturbance / clearance of habitat	• Injury to site worker • Injury to public • Fatality to site worker / public	Awareness of site personnel regarding hazards, Emergency Response Plan.
Construction and installation of Infrastructure including: • CHPP, MIA, administration and service facilities • dams • rail • power • fencing • access roads • yards and laydown areas • water diversion system	C	Fire	• Works such as welding, grinding in combination with high winds	• Injury to site worker • Injury to public • Property damage	Staff training, procedures relating to controlling sources of ignition, Emergency Response Plan.
	C	Excessive dust	• High winds • Unsealed roads	• Vehicle accident / collision	Speed limits, paving, watering roads, wind breaks.
	C	Erosion	• Heavy rainfall • Failure to comply with erosion and sediment control plan	• Property damage	Erosion and sediment control plan including diversion and management of water runoff and progressive stabilisation.
	C	Vehicle accident	• Collision of construction vehicles / workers crossing Collinsville-Elphinstone Road • Collision of construction vehicles / workers crossing Goonyella Abbot Point Rail line • Collision of vehicles / workers crossing the Xstrata haul road	• Injury to public / site worker • Fatality to public / site worker • Property damage	Traffic management plan.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
Coal Mining Operations					
Topsoil stripping and storage	O	Excessive dust	• High winds • Unsealed roads	• Vehicle accident / collision	Speed limits, paving, watering roads, wind breaks.
	O	Landslide	• Heavy rainfall	• Property damage	Erosion and sediment control plan include diversion and management of water runoff and progressive stabilisation.
	O	Wildlife (e.g. snakes)	• Disturbance • Clearance of habitat	• Injury to site worker • Injury to public	Awareness of site personnel regarding hazards, Emergency Response Plan.
Blasting	O	Fly rock projected outside blast zone	• Misfire • Failure to comply with explosive management plan	• Injury to public / site worker • Fatality to public / site worker • Property damage	Management of blasting and handling of explosives in accordance with Australian Standards and Regulations. Explosives management plan including maintenance of a blasting exclusion zone and appropriate signage. Licensed, trained, experienced competent personnel. Dust control measures and monitoring, explosives management plan, training.
	O	Vibration exceeding design criteria	• Misfire • Failure to comply with explosive management plan	• Property damage	
	O	Excessive dust	• High winds • Failure to comply with procedures	• Property damage • Public amenity	
	O	Uncontrolled blast	• Ignition source such as mobile phone, static electricity, lightning	• Injury to public / site worker • Fatality to public / site worker • Property damage	
Removal of waste rock	O	Excessive dust	• High winds • Unsealed roads	• Vehicle accident / collision	Dust controls procedures, monitoring.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
	O	Pit slope failure	• Incorrect design, failure to excavate in accordance with mine plan, geological anomaly	• Injury • Fatality to site worker	Mine plan, surveys, inspections.
Waste Rock Dump Operation	O	Excessive dust	• High winds	• Vehicle accident / collision	Speed limits, paving, watering roads, wind breaks.
	O	Dump slope failure	• Dump batters slope failure	• Injury to worker • Fatality to worker • Property damage	Mine plan, waste rock management plan, surveys, inspections.
Hauling ROM Coal	O	Vehicle accident, Fire	• Driver error • Vehicle collision • Vehicle roll over	• Injury to site worker • Fatality to site worker • Property damage	Road design, signage, speed limits, vehicle maintenance, roll over bars, fitness for work, training, traffic management.
	O	Dust	• High winds • Unsealed roads	• Vehicle accident/collision • Property damage	Dust control measures and monitoring.
CHPP facilities including crushing, screening, processing, blending, washing	O	Coal dust	• High wind • Failure to comply with procedures	• Property damage	Dust control procedures and monitoring.
	O	Fire Explosion	• Ignition source or fire • Spontaneous combustion	• Injury to site worker • Fatality to site worker • Property damage	Fire breaks maintained, control of ignition sources via procedures and training, watering, equipment available to rapidly manage stockpiles, Emergency Management Plan, training.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
	O	Leak, spill	• Equipment failure • Failure to comply with procedures	• Health impacts from contamination (soil, water, groundwater) • Property damage	Bunding equipment and material, location of CHPP away from potential to enter watercourses, spills procedure, Emergency Management Plan, training, inspection and maintenance programs.
Coal stockpiling and handling at train loading facility	O	Dust	• High winds • Failure to comply with procedures	• Property damage • Public amenity	Dust control measures, monitoring.
	O	Fire	• Ignition source or fire • Spontaneous combustion	• Injury to public / site worker • Fatality to public / site worker • Property damage	Fire breaks maintained, control of ignition sources via procedures and training, watering, equipment available to rapidly manage stockpiles, Emergency Management Plan, training.
Product coal transport – rail loop and rail spur	O	Fire	• Ignition source or fire • Spontaneous combustion	• Injury to public / site worker • Fatality to public / site worker • Property damage	Fire breaks maintained around the activity area including the conveyor to the train loading bin, control of ignition sources via procedures and training, Emergency Management Plan, training, exclusion of public, dedicated crossing points for landholders, cattle grids.
	O	Coal dust	• High winds • Failure to comply with procedures	• Property damage • Public health	Dust control measures, cover conveyor, spill trays, monitoring.
	O	Vehicle accident	• Vehicle and train collision	• Injury to public / site worker • Fatality to public / site worker • Property damage	Traffic control measures Traffic management plan.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
Earthworks and re-contouring of excavated surfaces and spoil dumps	O	Land instability, water hazard	• Failure to comply with Final Void Plan	• Injury to public / site worker • Fatality to public / site worker	Final Void Plan to be developed and implemented progressively through the life of the mine to ensure geotechnical stability, void stability, management of water quality, rehabilitation taking into account native flora and fauna.
Waste Management					
Management of mine-affected waters – collection, storage and disposal	C,O	• Uncontrolled release • Storage facility failure • Overtopping of storage facility	• Equipment failure • Failure to comply with procedures • Overfilling or heavy rainfall resulting in exceeding design capacity	• Property damage • Injury to public /site worker • Fatality to public / site worker	Appropriate design, procedures, training, inspection and maintenance. Emergency procedures for unplanned releases. Design and construction of dam in accordance with required standards, routine inspections and monitoring.
Waste management (solid) – storage, transfer and disposal	C,O	Vermin	• Failure to comply with procedures	• Health impacts	Appropriate design and distance from ML boundary, procedures, training, inspection and maintenance.
Management of rejects, including co-disposal dams, reject water	O,D	Leak, spill	• Equipment failure • Failure to comply with procedures	• Health impacts from contamination (soil, water, groundwater) • Property damage	Bunding equipment and material, location of CHPP away from potential to enter watercourses, spills procedure, Emergency Management Plan, training, inspection and maintenance programs.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
	O,D	Release of tailings	• Dam failure	• Health impacts from contamination (soil, water, groundwater) • Property damage	Design and construction of dam in accordance with required standards, routine inspections, Emergency Management Plan, training.
	O,D	Stagnant water	• Failure to comply with procedures	• Disease vector - mosquitoes	Mosquito control plan Inspections and monitoring.
	O,D	Storage facility failure. Overtopping of storage facility.	• Overfilling or heavy rainfall exceeding design capacity	• Property damage • Injury to public / worker • Fatality to public / site worker	Design and construction of dam in accordance with required standards, routine inspections and monitoring, Emergency Management Plan, training.
Maintain Infrastructure					
Road maintenance – internal and external	C,O	Dust	• High winds • Unsealed roads	• Vehicle accident/collision	Dust control measures and monitoring.
Water infrastructure	C,O	Subsidence	• Pipeline leak or failure	• Property damage	Appropriate design, inspection and maintenance.
Decommissioning					
Remediation of contaminated land	D	Release (leaching)	• Failure to comply with remediation plan	• Health impacts from contamination (soil, water, groundwater)	All contaminated land will be remediated prior to mine closure and surrender of land (e.g. soil quality investigation and remediation will be undertaken in accordance with EHP Guidelines for Contaminated Land).

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
Demolition, remediation of co-disposal dam	D	Leaching	• Failure to adequately rehabilitate co-disposal dam.	• Health impacts from contamination (soil, water, groundwater)	Rehabilitate dam area. Cap surface with benign overburden material to prevent water ingress. Vegetate in accordance with the rehabilitation plan. Register the site on the Environmental Management Register and the Contaminated Land Register with EHP. Implement Site Management Plan.
Final Void	D	Final void landform	• Fall	• Injury to public • Fatality to public • Injury / fatality to livestock	Maintenance of bunding and fencing and signage to prevent trespassing.
External Factors					
External factors	C,O,D	Sabotage Protest	• Security breach	• Injury to public / site worker • Fatality to public / site worker • Property damage	Security management plan, fencing.
	C,O,D	Disease outbreak	• Epidemic	• Illness to public / site worker • Fatality to public / site worker • Property damage	Site hygiene standards, Emergency Management Plan.

Activity / (Phase)	Phase (C,O,D)	Hazard	Cause / initiating event	Potential consequences	Risk treatment measures
SunWater Pipeline (Burdekin to Moranbah)	C,O	Vehicle accident	• SunWater operator failing to comply with procedures	• Injury to public / site worker • Fatality to public / site worker • Property damage	Demarcation of easement. Traffic controls.
Gas Pipeline	C,O,D	Gas release – fire or explosion	• Accidental disturbance	• Injury to public / site worker • Fatality to public / site worker • Property damage	Site procedures, site map, signage, contractor management.
	O	Pipeline failure	• Vibration from blasting	• Injury to public / site worker • Fatality to public / site worker • Property damage	Blast design plan and monitoring program. Management of blasting and handling of explosives in accordance with Australian Standards and Regulations. Explosives management plan including maintenance of a blasting exclusion zone and appropriate signage. Licensed, trainer, experienced and competent personnel.
Interaction with cattle / livestock, wildlife	C,O,D	Cattle, livestock, wildlife	• Vehicle accident	• Injury to public / site worker • Fatality to public / site worker • Property damage • Livestock damage	Fencing. Equipment barricaded.

32.6 Hazard Analysis and Risk Assessment

Risks were evaluated using the hazard identification word diagram in combination with the qualitative risk assessment of likelihood and consequence takes into account available quantitative data relating to probability of initiating events and consideration of the frequency factors, project design and available operational details, as well as the local environment.

The risk analysis takes into account the risk treatment measures included in the hazard identification word diagram on the basis that it is expected that all legal requirements, relevant standards, guidelines and codes of practice will be implemented in the design, construction, operation and decommissioning of the project. The objective of the risk analysis is to determine whether the residual risks are tolerable and if they are not then to propose new risk treatment measures.

Where the residual risk was determined as high or extreme, these activities are included in the draft risk management plan (refer **Appendix 33**).

Tables are prepared for the following:

- Transportation (**Table 32-7**)
- Bulk storage (**Table 32-8**)
- Construction and Installation (**Table 32-9**)
- Coal Mining Operations (**Table 32-10**)
- Waste Management (**Table 32-11**)
- Maintenance (**Table 32-12**)
- Decommissioning (**Table 32-13**)
- Interaction with External Factors and Third Parties (**Table 32-14**)

32.6.1 Risk Evaluation - Transportation

The risk levels associated with the transportation activities are summarised in **Table 32-7**. High risks were associated with transporting personnel, equipment and materials to and from the site and within the site; transporting explosives to and within the site; and transporting fuel to and within the site. It should be noted that the risk ratings are determined as high when there is a possibility of the consequence resulting in a severe injury or fatality, even though the likelihood of the event is “unlikely” (rating of D). No extreme risks were identified.

The draft risk management plan will include mitigation measures to address these transport risks.

Table 32-7 Hazard Analysis for Transportation

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
Transporting personnel, equipment and materials to and from the site and within site	C,O,D	Vehicle accident	Injury to public / site worker	3	C	High
			Fatality to public / site worker	5	D	High
			Property damage	3	B	High
	C,O,D	Spill, leak of liquid or fumes	Property damage	2	C	Low
			Fire	2	C	Low
			Health impacts from contamination (soil, water, groundwater)	2	D	Low
	C,O,D	Excessive dust	Vehicle accident / collision	3	D	Medium
Transport of explosives to and within site	O	Fire, explosion	Injury to public / site worker	3	C	High
			Fatality public / site worker	5	D	High
			Health impacts from contamination (soil, water, groundwater)	2	D	Low
			Property damage	3	D	Medium
Transport of fuel to and within site	O	Fire Spill, leak	Injury to public / site worker	3	C	High
			Fatality public / site worker	5	D	High
			Health impacts from contamination (soil, water, groundwater)	2	D	Low
			Property damage	3	D	Medium

32.6.2 Risk Evaluation - Bulk Storage

The risk levels associated with the bulk storage activities are summarised in **Table 32-8**. High risks were associated with fire / explosion storing fuel and explosive. It should be noted that the risk ratings are determined as high when there is a possibility of the consequence resulting in a severe injury or fatality, even though the likelihood of the event is “unlikely” or “rare” (rating of D or E). No extreme risks were identified.

The draft risk management plan will include mitigation measures to address these bulk storage risks.

Table 32-8 Hazard Analysis for Bulk Storage

Activity	Phase	Spill, leak	Potential consequences	Consequence	Likelihood	Risk level
Storage of fuel	C,O	Spill, leak	Property damage	2	C	Medium
			Health impacts from contamination (soil, water, groundwater)	2	D	Low
	C,O	Fire, explosion	Injury to public / site worker	4	D	High
			Fatality public / site worker	5	D	High
			Health impacts from contamination (soil, water, groundwater)	2	D	Low
Storage of explosives	O	Fire, explosion	Injury to public / site worker	4	E	Medium
			Fatality public / site worker	5	E	High
			Property damage	2	E	Low

32.6.3 Risk Evaluation - Construction and Installation

The risk levels associated with the construction and installation activities are summarised in **Table 32-9**. High and extreme risks were associated with the potential for a vehicle accident and a high risk was determined for the potential of a fatal snake bite during clearing. It should be noted that the risk ratings are determined as high or extreme when there is a possibility of the consequence resulting in a severe injury or fatality, even though the likelihood of the event is "unlikely" (rating of D). No extreme risks were identified.

The draft risk management plan will include mitigation measures to address these transport risks and snake bite risk.

Table 32-9 Hazard Analysis for Construction and Installation

Activity	Phase	Spill, leak	Potential consequences	Consequence	Likelihood	Risk level
Clearing and earthworks	C	Excessive dust	Vehicle accident / collision	3	D	Medium
	C,O	Landslide	Property damage	2	D	Low
	O	Wildlife (e.g. snakes)	Injury to site worker	3	D	Medium
			Injury to public	3	D	Medium
			Fatality site worker / public	5	E	High
Construction and installation of Infrastructure including: • CHPP, MIA, administration and service facilities • Dams • Rail • Power • Fencing • Access roads • Yards and Laydown areas • Water diversion system	C	Fire	Injury to site worker	3	D	Medium
			Injury to public	3	D	Medium
			Property damage	3	D	Medium
		Excessive dust	Vehicle accident / collision	3	D	Medium
		Erosion	Property damage	2	E	Low
		Vehicle accident	Injury to public / site worker	3	C	High
			Fatality to public / site worker	5	D	High
			Property damage	3	B	High

32.6.4 Risk Evaluation - Coal Mining Operations

The risk levels associated with coal mining operations are summarised in **Table 32-10**. High risks were associated with the potential for:

- fly rock projected outside the blast zone
- an uncontrolled blast
- pit slope failure in the removal of waste rock
- wall / slope failure operating the waste rock dump
- fire / explosion at the CHPP
- fire at the coal stockpiling and train loading facility
- dam failure or overtopping of storage facility
- land instability during earthworks

The above risks were rated as high as there was the possibility of the consequence resulting in a severe injury or fatality. It should be noted that in all cases, the likelihood was assessed as 'unlikely' or 'rare' (D or E).

High risks were associated with the potential for vehicle accident while hauling ROM coal due to the possibility of the consequence resulting in a severe injury or fatality.

No extreme risks were identified.

The draft risk management plan will include mitigation measures to address these operational risks.

Table 32-10 Hazard Analysis for Coal Mining Operations

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
Topsoil stripping and storage	O	Excessive dust	Vehicle accident / collision	3	D	Medium
		Landslide	Property damage	2	D	Low
		Wildlife (e.g. snakes)	Injury to site worker	3	D	Medium
			Injury to public	3	D	Medium
			Fatality site worker / public	5	E	High
Blasting	O	Fly rock projected outside blast zone	Injury to public / site worker	3	E	Medium
			Fatality to public / site worker	5	E	High
			Property damage	2	D	Low
		Vibration exceeding design criteria	Property damage	3	E	Medium
		Excessive dust	Property damage	1	C	Low
			Public amenity	1	D	Low
		Uncontrolled blast	Injury to public / site worker	3	E	Medium
			Fatality to public / site worker	5	E	High
			Property damage	2	E	Low
Removal of waste rock	O	Excessive dust	Vehicle accident / collision	3	D	Medium
	O	Pit slope failure	Injury to site worker	4	D	High
			Fatality to site worker	5	D	High

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
Waste rock dump operation	O	Excessive dust	Vehicle accident / collision	3	D	Medium
	O	Wall / slope failure	Injury to site worker	4	D	High
			Fatality to site worker	5	D	High
			Property damage	2	D	Low
Hauling ROM coal	O	Vehicle accident Fire	Injury to site worker	3	C	High
			Fatality to site worker	5	D	High
			Property damage	2	B	Medium
	O	Excessive dust	Vehicle accident / collision	3	D	Medium
			Property damage	1	D	Low
CHPP facilities including crushing, screening, processing, blending, washing	O	Coal dust	Property damage	1	D	Low
	O	Fire / explosion	Injury to site worker	3	D	Medium
			Fatality to site worker	5	E	High
			Property damage	2	C	Medium
	O	Leak, spill	Health impacts from contamination (soil, water, groundwater)	2	E	Low
			Property damage	1	E	Low
Coal stockpiling and handling at train loading facility	O	Excessive dust	Property damage	1	D	Low
			Public amenity	1	D	Low
	O	Fire	Injury to public / site worker	3	D	Medium
			Fatality to public / site worker	5	E	High

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
			Property damage	2	C	Medium
Product coal transport – rail loop and rail spur	O	Fire	Injury to public / site worker	3	D	Medium
			Fatality to public / site worker	5	E	High
			Property damage	2	C	Medium
	O	Excessive dust	Property damage	1	E	Low
			Public amenity	1	D	Low
	O	Vehicle accident	Injury to public / site worker	3	C	High
			Fatality to public / site worker	5	D	High
			Property damage	2	B	Medium
Earthworks and re-contouring of excavated surfaces and spoil dumps	O	Land instability Water hazard	Injury to public / site worker	3	D	Medium
			Fatality to public / site worker	5	E	High

32.6.5 Risk Evaluation - Waste Management

The risk levels associated with waste management activities are summarised in **Table 32-11**. High risks were associated with the potential for water storage facility overtopping or failure. The high risk was attributed to the possibility of the consequence resulting in a fatality, even though the likelihood was very low (rating E). No extreme risks were identified.

The draft risk management plan will include mitigation measures to address the potential for overtopping.

The risk of spread of mosquito-borne disease was evaluated as low. Therefore a mosquito management plan is not required as the proposed controls appear to be adequate.

Table 32-11 Hazard Analysis for Waste Management

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
Management of mine-affected waters – collection, storage and disposal	C,O	Uncontrolled release, Storage facility failure, Overtopping of storage facility	Injury to public / site worker	3	E	Medium
			Fatality to public / site worker	5	E	High
			Property damage	4	C	High
Waste management (solid) – storage, transfer and disposal	C,O	Vermin	Health impacts	1	E	Low
Management of rejects, including co-disposal dams, reject water	O,D	Leak, spill	Health impacts from contamination (soil, water, groundwater)	2	E	Low
			Property damage	1	E	Low
	O,D	Release of tailings	Health impacts from contamination (soil, water, groundwater)	2	D	Low
			Property damage	2	D	Low
	O,D	Stagnant water	Disease vector - mosquitoes	1	D	Low
		Storage facility failure, Overtopping of storage facility	Injury to public / site worker	3	E	Medium
			Fatality to public / site worker	5	E	High
			Property damage	4	C	High

32.6.6 Risk Evaluation - Maintenance

The risk levels associated with the maintenance activities are summarised in **Table 32-12**. No high or extreme risks were identified.

Table 32-12 Hazard Analysis for Maintenance

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
Road maintenance – internal and external	C,O	Excessive dust	Vehicle accident / collision	3	D	Medium
			Property damage	1	E	Low
Water infrastructure	C,O	Subsidence	Property damage	2	D	Low

32.6.7 Risk Evaluation - Decommissioning

The risk levels associated with decommissioning activities are summarised in **Table 32-13**. High risks were associated with the potential for the final land form creating a risk to the public. The high risk was attributed to the possibility of the consequence resulting in a fatality, even though the likelihood was low (rating D). No extreme risks were identified.

The draft risk management plan will include mitigation measures to address the management of the final void.

Table 32-13 Hazard Analysis for Decommissioning

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
Remediation of contaminated land	D	Release (leaching)	Health impacts from contamination (soil, water, groundwater)	2	E	Low
Demolition, remediation of co-disposal dam	D	Leaching	Health impacts from contamination (soil, water, groundwater)	2	E	Low
Final Void	D	Final land form	Injury to public	3	D	Medium
			Fatality to public	5	D	High
			Injury / fatality to livestock	2	C	Medium

32.6.8 Risk Evaluation - Interaction with External Factors and Third Party Elements

The risk levels associated with external factors and third party elements are summarised in **Table 32-14**. High risks were associated with sabotage / protest and disease outbreak attributed to the possibility of the consequence resulting in a fatality, even though the likelihood was 'rare' (rating E).

The draft risk management plan will include mitigation measures to address the management of the sabotage / protest and disease outbreak.

High risks were identified resulting from the interaction with third parties, namely:

- Goonyella to Abbot Point rail line
- Alpha Coal Project rail line
- Access road / heavy vehicle road intersects Collinsville-Elphinstone Road
- Xstrata mine vehicles along the transport route from mines south of the project to the Xstrata Newlands Mine that bisects Byerwen tenements
- SunWater Pipeline (Burdekin to Moranbah)
- Gas pipeline
- Interaction with cattle / livestock, wildlife

These risks related to the potential for vehicle accidents, fly rock from blasting and explosion from the gas pipeline. The risk has been assessed as high as the consequence could result in a fatality, however likelihood of the event was 'unlikely' or 'rare' (D or E in most cases).

32.6.9 Cumulative Risk

Potential interactions with third parties are identified in **Table 32-14**, with associated hazards and risks identified.

Upon review of the projects considered in cumulative impact assessment (refer **Chapter 34**), it was determined that it is unlikely that there is an increased risk on the hazards identified as a result of the other projects identified.

There is no data available to quantitatively determine the level of change that may result on the risk contours of other relevant existing or proposed industrial facilities in the area as a result of the proposed project, however, it is unlikely that the hazards and risks associated with the Byerwen project will present additional or increased hazards and risks to other existing or proposed facilities in the vicinity of the project area.

Table 32-14 Hazard Analysis for Interaction with External Factors and Third Party Elements

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
External factors	C,OD	Sabotage Protest	Injury to public / site worker	3	E	Medium
			Property damage	3	E	Medium
	C,O,D	Disease outbreak	Illness to public / site worker	3	E	Medium
			Fatality to public / site worker	5	E	High
Goonyella to Abbot Point rail line. Alpha Coal project rail line	O	Fly rock from blasting	Injury to public / site worker	3	E	Medium
			Fatality to public / site worker	5	E	High
			Property damage	2	D	Low
	C,O,D	Vehicle accident (collision with train)	Injury to public / site worker	4	D	High
			Fatality to public / site worker	5	E	High
			Property damage	3	D	Medium
Access road / heavy vehicle road intersects Collinsville-Elphinstone Road	C,O	Vehicle accident	Injury to public / site worker	3	C	High
			Fatality to public / site worker	5	D	High
			Property damage	3	D	Medium
Xstrata mine vehicles along the transport route from mines south of the project to the Xstrata Newlands Mine that bisects Byerwen tenements	C,O	Vehicle accident	Injury to public / site worker	3	C	High
			Fatality to public / site worker	5	D	High
			Property damage	3	B	High

Activity	Phase	Hazard	Potential consequences	Consequence	Likelihood	Risk level
SunWater Pipeline (Burdekin to Moranbah)	C,O	Vehicle accident	Injury to public / site worker	3	D	Medium
			Fatality to public / site worker	5	E	High
			Property damage	3	C	High
Gas pipeline	C,O,D	Gas release – fire or explosion	Injury to public / site worker	4	D	High
			Fatality to public / site worker	5	E	High
			Property damage	3	D	Medium
	O	Pipeline failure	Injury to public / site worker	3	D	Medium
			Fatality to public / site worker	5	E	High
			Property damage	3	D	Medium
Interaction with cattle / livestock, wildlife	C,O,D	Cattle, livestock, wildlife	Injury to public / site worker	3	D	Low
			Fatality to public / site worker	5	D	High
			Property damage	1	D	Low
			Livestock damage	1	D	Low

32.7 Conclusion

The risks of hazards to people and property associated with the project were identified and evaluated. The risks associated with each identified hazard were determined based on the likelihood and consequences of the hazard and risk, taking into account standard risk treatment measures.

The risk assessment resulted in the following:

- The majority of hazards associated with the activities have a low or medium risk level based on the potential consequences and likelihood of the hazard occurring assuming standard risk treatment measures are implemented and working effectively.
- Those risks that were determined as “high” on the relative scale were due to the potential for a severe injury or fatality, even though the likelihood of an event was assessed as rare or unlikely
- No “extreme” risks were identified.
- With respect to cumulative risk, the project activities undertaken may interact with other project activities in the region however this interaction is unlikely to increase risk level, assuming the treatment measures recommended are implemented and working effectively.

The preliminary risk assessment undertaken for the project indicates that the greatest risks to people and property relate to:

- vehicle collisions and accidents
- fire
- explosion
- snake bite
- fly rock projecting outside blast zone
- pit slope failure in the removal of waste rock
- wall failure operating the waste rock dump
- dam failure or overtopping of storage facility
- land instability during earthworks
- final land form
- sabotage
- disease outbreak.

This assessment is a preliminary hazard and risk assessment for the project. A framework for the ongoing assessment and management of risks is detailed in the draft risk management plan provided in **Appendix 33**. It is reiterated that the risk assessment did not consider environmental impacts as they are assessed in other sections of the EIS. Routine operational health and safety risks have been identified and will be managed in accordance with legislation, standards and codes of practice.

A more specific evaluation of hazards will be undertaken when final detailed design and mine operating plans have been developed prior to the construction phase and then prior to the operational phase. The risk assessment process will be undertaken in detail prior to construction and operation and be maintained as operations and conditions may change. In line with standard industry practice, job safety and environmental analyses will take place prior to the commencement of any activity.