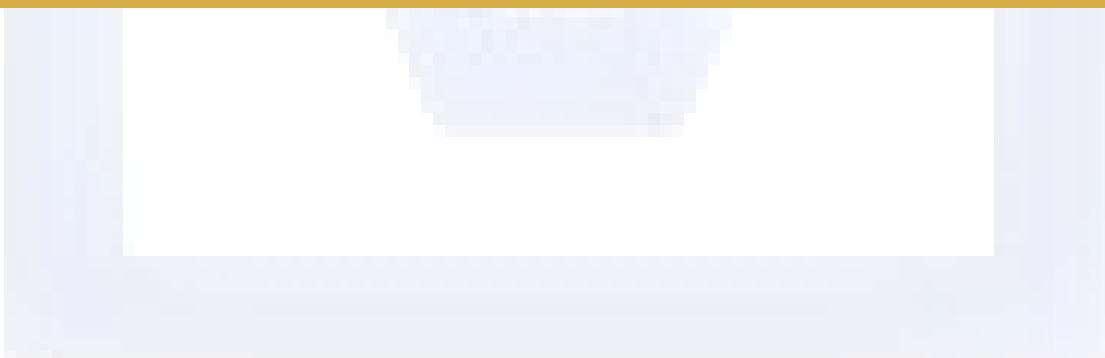




VULCAN MINE



Highwall Mining Safety Management Plan





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1. PURPOSE

The purpose is to describe the safety management system for Highwall Mining at Vulcan Mine.

2. SCOPE

This procedure is applicable to all persons at the Vulcan Mine including employees, contractors and visitors involved with the highwall mining operation.

3. DEFINITIONS

Abnormal Circumstances Declaration	As defined by Coal Mining Safety and Health Legislation and Section 1.15 of this document.
ALARA	As low as reasonably achievable
CHM	Cutter Head Module
CMSHA	Coal Mining Safety and Health Act
CMSHR	Coal Mining Safety and Health Regulation
ERZ	Explosion Risk Zone
FOPS	Falling Objects Protection System
Guidance System	Equipment and software used by the highwall mining system to guide and record the direction and dimension of highwall mining plunges. It includes an inertial navigation system and encoder on the cable reel and an operator interface.
OCE	Open Cut Examiner
Pillar	Is the coal left between Highwall Mining plunges
Shall	Indicates that a statement is mandatory
Should	Indicates a recommendation
SSE	Site Senior Executive
TARP	Trigger Action Response Plan
Push Beam Loading Area	Immediate vicinity loading side for push beams onto HWM
Fundamentally Stable	A condition where a vehicle will not move from its parked position in the absence of brakes.
Heavy Equipment	A vehicle or equipment over 13.9 tonnes GVM
Light Vehicle	Vehicle up to 4.5 tonnes GVM
Loader	Front end loader (does not include IT loader)
Loader Work Area	From stacker stockpile to the in-pit coal stockpile and surrounding areas within HWM Operational Area (identified by call signage)
HWM	Highwall Miner
Medium Vehicle	4.5 – 13.9 tonnes GVM
RDT	Rear Dump Truck
WI	Work Instruction

4. OPERATIONS AREA LAYOUT

The highwall mining operations area is setup following the guideline below any variations to this design are assessed using a Job Hazard Analysis (JHA) to identify additional controls. Only when additional controls have been implemented shall highwall mining operations commence.

Areas defined within the highwall mining operations are

- Coal haulage access road
- Coal stockpile area
- Light vehicle access road
- Highwall stand-off (10m or as otherwise described and delineated)



- Push Beam storage area
- Emergency muster area
- Heavy mobile equipment parking
- Crib hut
- Restricted zone
- Service corridor from Water tank, power farm to HWM
- Light vehicle parking area
- Power & Nitrogen plant
- Water storage
- Restricted area boundaries
- Maintenance area
- Diesel tank

5. MOBILE PLANT INTERACTIONS

Interaction within the Highwall Mining area can occur in the following areas:-

5.1. Segregation

All traffic management will be in accordance with the VUL-SOP-076-Using Mobile Plant and the Highwall Mining Operational Area Traffic Management Plan.

The Highwall mining operation shall be segregated into 2 areas with the construction of safety berm to define a restricted area requiring authorisation to enter the area.

The safety berm will allow light vehicles to travel to the vehicle parking bay and crib hut without any interaction with the highwall mining operation.

5.2. Vehicle and pedestrian access

Vehicle and pedestrian access to the highwall mining operation is detailed in VUL-SOP-125(2)(a) Highwall mining operations entry and evacuation.

5.3. Light vehicle parking

Bunded designated light vehicle parking area shall be established close to the Highwall Miner in and area outside the restricted zone, and construction will complying with **VUL-SOP-076-Using Mobile Plant**.

5.4. Travelling behind Highwall miner

Before travelling behind the Highwall Miner with a loader or heavy mobile equipment the operator shall:

- Make “positive communications” with the Highwall miner operator;
- Sound the horn;
- Have the implement/s or item being carried as low to the ground as possible;
- Travel at walking pace.
- Ensure no personnel are on the rear deck of the Highwall miner

Where the access road behind the Highwall Miner is less than 1.5 times the largest vehicle utilising the road, a spotter shall be in place with a handheld radio to guide the vehicle through Push beams may only be transported behind the Highwall miner:

- on the loader WA600 forks



- where there is a minimum of 10m between the low wall rill and outside of the highwall miner rear walkway
- Carry the load lower than the Highwall mine rear walkway handrail.

All obstacles should be removed prior to transporting push beams behind HWM if the load cannot be kept below the HWM rear walkway.

Adequate lighting behind the HWM should be in place.

5.5. Maintenance activities

The maintenance area shall be segregated using safety berms and have a defined entry point. Maintenance activities in the highwall operations area will be highlighted at prestart meetings.

Prior to entering the maintenance bay area all vehicles and equipment operator must obtain positive communication with maintenance personnel working in the area. And the following Standard operating procedures must be followed **VUL-SOP-072c-Assembling & Maintaining Plant** and **VUL-SOP-072h-Servicing, Lubricating & Refueling**.

6. HIGHWALL STABILITY

6.1. Standoff distance

A 10-meter exclusions zones from the highwall must be in place for pedestrians and equipment without FOPS installed as detailed in **VUL-MOP-003b-Ground Control Monitoring**. No person shall proceed forward with the HWM front cross beam when the HWM is in operation.

6.2. Execution of plan

During highwall mining operations the **VUL-FRM-19-20 Permit to Mine (PTW)** shall be adhered to with regards to highwall mining plunge alignment and dimensions. These parameters shall be monitored regularly by the HWM Operator and Highwall Mining Supervisor by using the guidance system.

Highwall mining operations shall cease if the CHM gyroscope guidance system is not in operation.

The relevant parameters and configuration of the guidance system shall be maintained for accuracy. The launch vehicle positioning shall be directed by the on-board Trimble system. Any variances to plan shall be escalated to the Highwall Mining Supervisor as soon as possible and controls implemented as detailed in **VUL-TAR-010-Highwall Mining Geotechnical**.

6.3. Highwall monitoring

The highwall face and immediate highwall crest shall be subject to routine inspections by the OCE before the start of mining activities and periodically as required. in accordance with the **VUL-SOP-094-Check, Examine and Restrict Work Areas**.

The Highwall Mining Supervisor is to conduct inspections at the start of every shift and continually conduct throughout their shift and record on **VUL-FRM-Highwall mining supervisor inspection**.



Highwall and low wall conditions shall be monitored and controlled as per **VUL-PHMP-03-Geotechnical** and **VUL-TAR-003-Geotechnical Failure**.

Highwall Mining pre-start communications shall include information regarding geotechnical hazards within area.

6.4. Pillar Instability

At the first indication of pillar or highwall instability from either visual indicators or extensometer alarms, the following steps shall be implemented immediately.

1. Notify the Highwall Mining supervisor who shall advise all personnel of the current situation.
2. All personnel to withdraw away from the unstable area until conditions have been evaluated and an action plan has been discussed.
3. Highwall Mining supervisor to notify OCE of the situation and advise of the planned actions.
4. If it is considered safe to do so, commence withdrawal of equipment from the plunge.
5. Relocate HWM away from the mined section of the highwall.
6. Remove all equipment and material away from in front of the pillar activity area.
7. Cordon off the pit floor area in front of the affected area of highwall and post barriers to prevent unauthorised entry to the area.
8. Inspect top of the highwall for signs of cracking and prevent access to the affected areas.
9. During the above activity the pillars will be monitored with particular emphasis on highwall instability. Where the strata continue to indicate movement and highwall face activity is increasing, all personnel will be removed from the general area and will not return to the area until the following occurs:
 - a. The Highwall Mining Supervisor will inform the Senior Site Executive, of the current situation.
 - b. When the Highwall Mining Manager and Senior Site Executive are satisfied that it is safe to continue mining and where there is no evidence of highwall activity, a barrier pillar will be established, and mining activities resumed.

6.5. Intersecting a Completed Plunge

At the first indication of the active plunge intersecting a completed plunge, the following steps are taken:

- Cease underground mining operations immediately and notify the Highwall Mining Supervisor.
- Record the following data on shift production report
 - Plunge number
 - Plunge distance
 - Pitch and roll of CHM
- Distance from completed drive relative to active drive from PLC screen; and
- Record all guidance data
- Commence system withdrawal immediately.
- Withdraw all equipment from the plunge

Highwall mining Supervisor to notify the OCE & Highwall Mining Manager.



Upon completion of equipment withdrawal, check and record the HWM survey alignment and compliance.

Commence incident investigation following **VUL-MOP-015-Incident Reporting & Investigating**.

7. GAS MANAGEMENT

Areas of potential explosive areas are identified and marked as detailed on **VUL-SOP-125(2)(c)(i)(ii)(d)-HWM explosive atmospheres**.

The potential for an explosive atmosphere will be monitored during the highwall mining plunges at the following location, cutting head, HWM deck. Gas encountered from the plunge shall be managed in accordance with **VUL-TAR-010-Highwall Mining Gas Management**.

During mining operations, the water flow system, sprays, nitrogen system must be operational, or the operation must be stopped until repairs have been carried out.

Gas monitoring shall be conducted as per the **VUL-SOP-142-Flammable and Toxic Gas in Work Environment**.

Open plunges with potential explosive and/or oxygen deficient or otherwise toxic atmospheres must be signed to warn personnel of the potential presence of gas as per the **VUL-SOP-125(2)(c)(i)(ii)(d) explosive atmospheres**.

7.1. Establishing an Inert Atmosphere

The nitrogen plant is located within the Highwall mining operational area. This unit will generate and supply nitrogen to the cutting head providing an inert gas to the cutting face to assist in the prevention of an explosive atmosphere at the cutting face and out-bye of the Cutter head module.

The nitrogen generator provides a continuous nitrogen supply at 97% purity to the Highwall miner cutter heads to make the underground atmosphere inert. Purity of the nitrogen mixture is controlled by a failsafe oxygen analyser set to limit the oxygen content at no greater than 3%. Nitrogen is supplied to the miner and cutting face along a supply hose that is directly attached to the miner. As the mining system advances, the hose is fed out via a manually activated, hydraulically plunge hose reel located adjacent to the LHF track assembly and is retracted as the mining system is withdrawn.

To verify the inert atmosphere oxygen levels are also monitored.

A light vehicle service corridor from the nitrogen plant to the launch vehicle will be established and maintained adjacent to the access road and safety berms will be established to protect the nitrogen delivery lines from damage.

A nitrogen flow alarm in the operator's cabin if the flow of nitrogen is too low or stops.



7.2. Maintaining an inert atmosphere

7.2.1. Plunge sequence

Prior to the commencement of each plunge the following must be checked:

- nitrogen flow to the cutter head shall be checked
- gas monitoring system
- Cutter head module oxygen and methane sensors.
- The Cutter Head Module oxygen and methane sensors are challenged tested.

A gas monitoring system failure will cause the power to the miner to be tripped.

The Highwall miner operator shall continuously monitor gas levels and where gas trip levels area being approached the operator may slow the cutting rate to reduce methane levels (CH₄) to avoid reaching trip levels.

Gas levels and alarms will be recorded in the shift log along with actions taken along with trips and managed in accordance with **VUL-SOP-125(2)(c)(i)(ii)(d)-HWM explosive atmospheres.**

Upon re-entry the nitrogen supply is to be turned on prior to the cutter head module entering the underground drive plunge Monitor nitrogen flow as the Cutter Head Module is advanced back to the coal face.

7.3. Withdrawal sequence

At the commencement of withdrawal operations, the inert gas flow is to remain turned on until the cutter head module is fully out of the plunge. This applies to completion of an entry plunge and temporary withdrawals.

7.4. Re-entry

If there is a requirement to re-enter the plunge, the gas monitoring and response process will be the same as for mining as per the **VUL-TAR-010-Highwall Mining Gas Management.**

Upon re-entry the nitrogen supply is to be turned on prior to the cutter head module entering the underground plunge.

Nitrogen flow is monitored as the Cutter Head Module is trammed back to the face to ensure integrity of hoses and flow.

Re-entry is conducted under Methane Control Mode.



7.5. Plunge completion

The Highwall plunge will be considered complete if one or more of the following conditions are met:

- Withdrawn due to roof falls, push beam conveyor failure caused by mining conditions. If actual depth is 95% of the target depth as follows:

TARGET DEPTH (M)	135	180	225	300
COMPLETION (M)	130	170	210	285

- Where roof falls are occurring at approximately the same location in each entry and where all reasonable strategies have been employed to penetrate beyond this particular zone, then entry target depths will be reviewed after due consultation with the technical services team.
- Rib spalling observed/cracking/dribbling is observed during daily inspection of completed drive entries.
- Methane levels exceeded 2.5% at the cutting face.
- Adjacent plunge fills with water during mining of the current entry;
- Highwall or low wall stability in the immediate operating are; or
- Geotechnical anomalies leading to a decision to not proceed with entry.

The Highwall Mining Manager or his delegate may vary these criteria in the interest of personnel safety or asset protection in consultation with the senior site executive.

8. GAS MONITORING

8.1. Monitoring Strategy

The gas monitoring strategy is established to fulfil the obligations under the CSMHR 2017 section 223.

The monitoring is carried out remotely by GasGuard Sensors. The information transmits to the launch vehicle cab for the operator to observe and trend this data.

Multi-gas handheld monitoring devices are also used by appointed persons for the purpose of checking and examining their work areas for flammable or noxious gases.

	Level 1 Response	Level 2 Response	Level 3 Response
Methan – Gasguard	Warning alarm only launch vehicle cabin @ 1.0 %	Power tripped to minder cutter head motors @1.8%	All power tripped underground @ 2.0%
Methane – PGD (CMW on launch vehicle)	Ensure operating diesel equipment is 10m away		
Carbon Monoxide - Gasguard	30ppm		
Carbon Monoxide – PGD (on launch vehicle)	15ppm		



Oxygen - Gasguard			
Oxygen – PGD (on launch vehicle)			All affected persons withdraw to fresh air <19.0%

VUL-TAR-010-Highwall Mining Gas Management covers the action to be taken.

9. GAS MONITORS – SERVICING & INSPECTION

9.1. Weekly Calibration

All gas monitors will be inspected and calibrated and trip levels verified weekly or if a fault is detected using Span test gas. Results of these inspections and calibrations recorded in the maintenance management system.

9.2. Set up and Commissioning

During the set up and commissioning of gas monitors, the commissioning sheets shall be completed and filed for future reference.

Oxygen monitors to be installed in the following locations:

- On the CHM
- On the HWM Transfer point

9.3. Sensor Failure

A gas sensor fault can be identified as:

- Sensor fault recorded on Gas Guard unit.
- Sensor readings become erratic; and
- Sensor reading under-range or over range.

If a single sensor fault occurs on the CHM during mining, the sensor can be disabled allowing the entry to be completed.

This fault shall be recorded on the Highwall Mining Supervisor Production Report and Electrical Trade Report.

If more than one sensor fault occurs, on the continuous miner the system must be withdrawn from the plunge and the faults corrected.

It is not permissible to commence a new plunge unless all gas sensors are operational.



10. FIRE PREVENTION AND FIRE FIGHTING

Detailed in **VUL-SOP-125(2)(b) Highwall Mining Fire Prevention and Fire Fighting**.

11. FLOODING

Flooding is covered in **VUL-SOP-125(2)(e) Highwall operations flooding (inrush outrush)**.

12. ALUMINIUM ALLOYS – EQUIPMENT EXPLOSION & PROTECTION

Please refer to **VUL-SOP-125(2)(c)(i)(ii)(d)- Explosive atmospheres**.

13. DUST SUPPRESSION

Dust generation shall be monitored by the Highwall Mining Supervisor and managed accordingly with water sprays and water carts.

14. SPONTANEOUS COMBUSTION

Spontaneous combustion shall be managed in accordance with the **VUL-SOP-138(a)(b)-Work on or Near Stockpiles**.

15. ROLES AND RESPONSIBILITIES

SSE	Shall review and approve this procedure.
HST Manager	Shall ensure that all provisions of this procedure are implemented, and that compliance is achieved.
Superintendents	Shall be responsible for their area of operations and the implementation and application of this procedure; Provide adequate training, information, structure and supervision to ensure that this procedure is implemented; Carry-out a periodic review of activities to ensure the appropriate application and understanding of this procedure; and Ensure immediate and appropriate steps are taken to investigate and rectify any risks to health and safety arising from these activities.
Supervisors	Ensure all CMWs are familiar with, have access to and comply with the requirements set out in this procedure.
All CMWs (including visitors and contactor)	Shall comply with the requirements of this procedure.



16. REFERENCES

- AS/NZS 60079 Explosive Atmospheres
- AS/NZS ISO 31000 Risk Management
- Coal Mining Safety and Health Act 1999
- Coal Mining Safety and Health Regulation 2017
- Mining Industry Hazard Database
- PHMP Geotechnical and Geotechnical TARP
- Recognised Standard 02 – Control of Risk Management Practices
- VUL-PHMP-02-Vehicle Interaction
- VUL-PHMP-03-Geotechnical
- VUL-MOP-003b-Ground Control Monitoring
- VUL-MOP-003c - Highwall Ground Control Monitoring
- VUL-SOP-076-Using Mobile Plant
- VUL-SOP-138(a)(b)-Work on or Near Stockpiles
- VUL-SOP-072c-Assembling & Maintaining Plant
- VUL-SOP-072h-Servicing, Lubricating & Refueling
- VUL-FRM-19-20- Permit to mine
- VUL-SOP-094-Check, Examine and Restrict Work Areas
- VUL-FRM-19-20-Highwall Mining Supervisor Inspection
- VUL-TAR-003-Geotechnical Failure
- VUL-SOP-125(2)(c)(i)(ii)(d) explosive atmospheres
- VUL-TAR-010-Highwall Mining Gas Management
- VUL-SOP-142-Flammable and Toxic Gas in Work Environment.
- VUL-SOP-125(2)(c)(i)(ii)(d)- Explosive atmospheres

17. REVIEW

This document shall be reviewed as follows:

- when there is a change of method and/or technology and/or legal or other requirement that may affect the accuracy of this document.
- when operational changes occur that effect the currency of the document.
- when there has been a significant event to which this document was relevant; and
- as a result of relevant audit findings

18. DOCUMENT CONTROL

Version	Date	Description	Document Controller
01	04/03/2025	Review & Formatting	Kelly Jensen