Coal Inspectorate

Final investigation report to the Chief Inspector

Fatal Incident at Middlemount Coal Mine on Wednesday 26 June 2019 – Sch4p4(6)

Date of report

20TH MARCH 2020

Lead investigator

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Other Investigators

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Report approval

Lead Investigator	Regional Inspector	Chief
Sign: sch4p4(6)	Sign: sch4p4(6)	Sign: Sch4p4(6) sch4p4(6)
Date: 20-3-2020	Date: 20-3-2020	Date: 20/3/2020

Contents

1. Jurisdiction and Scope

Investigations of serious accidents at coal mines is a function of the Mines Inspectorate as required under Section 128 of the Coal Mining Safety & Health Act 1999.

Section 199 of the Coal Mining Safety & Health Act 1999 states that as soon as practicable after receiving a report of a serious accident causing death at a coal mine, an inspector must inspect the place of the accident, investigate the accident to determine its nature and cause, and report the findings of the investigation to the Chief Inspector.

2. Abbreviations Used in Report

AM	Ante meridiem (before noon)
CIB	Criminal Investigation Branch
CMW	Coal Mine Worker
DNRME	Department of Natural Resources Mines & Energy
ERT	Emergency Response Team
EX	Excavator
HR	Human Resources
JSEA	Job Safety Environmental Assessment
m	Metre
mm	Millimetre
m3	Cubic Metre
°	Degree
ML	Mining Lease
OCE	Open Cut Examiner
NOK	Next of Kin
PIO	Principal Investigations Officer
PM	Post meridiem (after noon)
QAS	Queensland Ambulance Service
QFRA	Queensland Fire and Rescue Authority
QPS	Queensland Police Service
SLAM	Stop, Look, Assess, Manage
SSE	Site Senior Executive
TARP	Trigger Action Response Plan

3. List of Persons Named in Report

Name	Occupation	Company
Sch4p4(6)	Operator (deceased)	Middlemount Coal
sch4p4(6)	sch4p4(6)	
sch4p4(6)	sch4p4(6)	Middlemount Coal
sch4p4(6)	Site Senior Executive	Middlemount Coal
sch4p4(6)	Operator's representative	Middlemount Coal
sch4p4(6)	Health Safety & Training Superintendent	Middlemount Coal
sch4p4(6)	Human Resources Advisor	Middlemount Coal
Cres BULGER	Senior Inspector of Coal Mines	DNRME
Graham CALLINAN	Inspector of Coal Mines	DNRME
Pat HURLEY	Inspector of Coal Mines - Mechanical	DNRME
John TOLHURST	Principal Investigation Officer	DNRME
Andrew SMITH	Principal Investigation Officer	DNRME
Josh RICHARDS	Constable Middlemount Police	QPS
Peter CLARKE	Sergeant Middlemount Police	QPS
Eddie ROGERS	Detective Acting Sergeant, CIB Moranbah	QPS
Renee HOGAN	Scenes Of Crime Officer Emerald	QPS
sch4p4(6)	Operator	Middlemount Coal
sch4p4(6)	Operator	Middlemount Coal
sch4p4(6)	Supervisor	Middlemount Coal
sch4p4(6)	OCE	Middlemount Coal
Deon ESTERHUIZEN	Inspector of Mines - Geotechnical	DNRME
Jacqui VINNICOMBE	Inspector of Mines - Geotechnical	DNRME
Asok SUR	Inspector of Mines - Geotechnical	DNRME
Rod KEANE	Explosives Inspector	DNRME
Leigh DEUTSCHER	Vegetation Management Officer	DNRME
Brad MORGAN	Paramedic Middlemount QAS	QAS
Logan MCINTOSH	Paramedic Middlemount QAS	QAS
Mark KLIENHANS	Research Officer	Simtars
Glenn AITCHISON	Project Officer	Simtars
sch4p4(6)	Principal Mining Engineer	Middlemount Coal
sch4p4(6)	Geology Superintendent	Middlemount Coal
sch4p4(6)	Graduate Health & Safety Advisor	Middlemount Coal
sch4p4(6)	Ex Technical Services Supt	Middlemount Coal
sch4p4(6)	Geotechnical Consultant	Cartledge Mining and Geotechnics

4. Executive Summary

At approximately 12.21 PM on Wednesday 26 June 2019, Sch4p4(6) was operating a Hitachi EX3600-6 excavator in Southern Terrace Pit Strip 19 when an adjacent section of pit wall suddenly failed. The material that fell from this pit wall engulfed the excavator and partially crushed the operator's cabin. This resulted in Sch4p4(6) receiving fatal injuries.

sch4p4(6) and sch4p4(6) were operating machinery in the same pit and witnessed the eastern echelon section of the pit wall suddenly fail. The failure caused a significant amount of dust and when the dust cloud cleared, both could see EX0046 had been severely impacted by the fallen material. sch4p4(6) immediately notified sch4p4(6) via the mine two way radio system and called the emergency.

The first responders to arrive at the incident scene were sch4p4(6) and sch4p4 sch4p4(6) Due to a large volume of unstable material being around and above EX0046, the emergency rescue was an extremely complex undertaking that took just over twelve hours to complete.

Approximately 7,000 cubic metres of material had failed which engulfed the operator's side of the excavator and crushed the cabin. This failed material was hung-up in front of the presplit line, above the area that the excavator was operating and had not been removed during the mining process as required.

Evidence (emails, survey, 12 Hr Dig Plans) showed the presence of this hung-up material was known by the mine's Site Senior Executive, Mining Manager, Principal Mining Engineer, Senior Mining Engineer, and C&D Crew Mine Seven Supervisor. On day shift 20 June 2019 the C&D Crew Mine Seven Supervisor directed a CMW to use a small excavator to push down the hung-up material. When this CMW arrived at the work area he called the C Crew OCE over the mine two way radio, and asked him to come and inspect some ground cracks that the CMW was concerned about. On day shift 22 June 2019 an excavator operator called the C Crew OCE and the C&D Crew Mine Seven Supervisor over the mine two way radio, and asked them to look at the eastern echelon pit wall as he had concerns with its stability. Later during the same shift a dozer operator working in the area raised concerns about the hazard of the echelon wall with the C Crew OCE. The removal of this material had not been undertaken to provide an acceptable level of risk for operations to continue. This same dozer operator raised a further concern with eastern echelon pit wall with the C Crew OCE on day shift 23 June 2019. On day shift 25 June 2019 this same dozer operator again raised a concern with the eastern echelon pit wall with the C Crew OCE and A&B Crew day shift Mine Seven Supervisor.

No risk management process was applied in the design of the Southern Terrace Pit, Strip 19 or the associated drill and blast design.

The following contributing factors were identified during the investigation:

1. There was a significant change in the Southern Terrace Pit design which introduced new hazards for which controls were not implemented.
2. There were design, drilling and loading failings in the Drill and Blast process which resulted in a poor blasting results.

3. The risk management process for identification and control of the hazards caused by contributing factors 1) and 2) was not implemented.
4. There was a failure to dig to the pit design due to the additional hazards caused by contributing factors 1) and 2).
5. Persons in senior management and statutory positions had knowledge of the section of pit wall being hazardous prior to the incident occurring, but did not act on that knowledge.
6. CMW's raised concerns with the C&D Crew day shift Mine Seven Supervisor and C Crew OCE about the instability of the section of pit wall that failed prior to the incident occurring.
7. The C Crew OCE failed to comply with legislative statutory requirements.
8. There were failures of persons to comply with the mine's safety and health management system.

5. Details of the Deceased

Name	Sch4p4(6)
Date of Birth	sch4p4(6)
Age	sch4p4
Residential address	sch4p4(6)
Occupation	Operator
Employer	Middlemount Coal Mine
Cause of Death	Sch4p4(6)
Next of Kin	sch4p4(6)
Relationship to Deceased	sch4p4(6)
Address Next of Kin	sch4p4(6)

[1] Appendix 10 - 10. Autopsy and Toxicology\Form 30 Autopsy Certificate.pdf

6. Mine Details

Mine Name	Middlemount Coal Mine
Mining Leases	ML 70379 ML 70417 ML 700014 ML 700027 MDL 282
Location of accident	ML 70379, Southern Terrace Pit, Strip 19, Block 3
Mine Operator	Middlemount Coal
Operator's representative	sch4p4(6)
Site Senior Executive	sch4p4(6)
Contact details of Site Senior Executive	sch4p4(6) @middlemountcoal.com.au sch4p4(6)

6.1 Location of Middlemount Mine

Middlemount Coal mine is situated approximately 11 kilometres west south west of Middlemount township, and 90 kilometres north east of Emerald township. **(Figure 1)**

Figure 1. Map of Central Queensland

7. Incident Details

7.1 Location of Incident

The incident occurred in the Southern Terrace pit, Strip 19, Block 3 which is situated within the area circled green. (Figure 2)

Figure 2. Aerial view of Middlemount Mine

7.2 Equipment Involved

A Hitachi EX3600-6 excavator in a backhoe configuration, similar to the one shown below in (Figure 3). The mine's identification unit number for the involved excavator was EX0046.

Figure 3. A Hitachi 3600-6 Excavator similar to EX0046

Hitachi EX3600-6 Excavator - Technical Specifications			
Weight	360 t	**Transport length**	11 m
Transport width	9.42 m	**Transport height**	7.83 m
Bucket capacity	22 m^3	**Track width**	1270 mm
Undercarriage	HD	**Maximum reach horizontal**	17.6 m
Dredging depth	8.58 m	**Tear-out force**	951 kN
Engine manufacturer	Cummins	**Engine type**	QSKTA60CE
Engine power	1450 kW	**Displacement**	60 l

7.3 Incident

Sch4p4(6) [redacted]

At approximately 12.21 PM on Wednesday 26 June 2019, Sch4p4(6) [redacted] was operating a Hitachi EX3600-6 excavator (EX0046) when an adjacent section of pit wall suddenly failed. The material that fell from this pit wall engulfed the excavator and partially crushed the operator's cabin. (**Figure 4**)

The pit wall that failed was approximately 42m higher than the bench where EX0046 was positioned at the time of the incident occurring. The section of pit wall that failed was along the pit excavation's eastern echelon, next to where it intersected the pit excavation's southern highwall. (**Figure 5**)

sch4p4(6) [redacted] nd sch4p4(6) [redacted] who were operating machinery in the pit witnessed[2] [3] the eastern echelon section of the pit wall suddenly fail. The failure caused a significant amount of dust and when the dust cloud cleared, both could see EX0046 had been severely impacted by the fallen material. sch4p4(6) [redacted] immediately notified sch4p4(6) [redacted] and called the emergency. Communication with EX0046 was attempted via the mine's two way radio system, but no response was received.

In response to the emergency call the first persons to arrive at the incident scene were sch4p [redacted] sch4p4(6) [redacted] and sch4p4(6) [redacted]

[2] Appendix- 10. Statement - Sch4p4(6) [redacted]
[3] Appendix- Sch4p4(6) [redacted] Paragraph 74

Figure 4. The failed pit wall that partially engulfed EX0046

An overview of the Strip 19 excavation's pit walls in Southern Terrace Pit	
Blue line	The excavation's western endwall
Green line	The excavation's southern highwall
Black line	The excavation's eastern echelon wall
Red line	The section of pit wall that suddenly failed
⊗	Approximate position of Ex46

Figure 5. An overview of the Strip 19 excavation pit walls (not to scale)

7.4 Emergency Response

- The mine site's ERT attended the scene immediately upon the emergency being called.
- Four QPS personal attended the incident scene during the emergency rescue, and they included Josh RICHARDS, Eddie ROGERS, Peter CLARKE, and Renee HOGAN.
- QAS Paramedics from Middlemount that attended the scene and assisted in the emergency rescue were Brad MORGAN and Logan McINTOSH.
- Teams from QFRS also attended the scene and assisted in the emergency rescue.
- Representatives from the DNRME coal inspectorate that attended the scene during the emergency rescue were Cres BULGER, Graham CALLINAN, Pat HURLEY, John TOLHURST and Andrew SMITH.

The emergency rescue mission was an extremely complex and prolonged undertaking due to the large volume of unstable material being above and around EX0046. **Figures (6, 7, 8).** Initially another smaller excavator was bought in to try and clear some of the fallen material away from EX0046 so emergency workers could access the excavator's cabin. However this was stopped due to an adjacent section of the pit wall potentially being unstable.

Approximately one hour after the incident occurring, QAS paramedic Mr MORGAN was able to gain access to EX0046's cabin, which was still mostly surrounded by the fallen material. Sch4p4(6) [redacted]

Sch4p4(6) [redacted]

The emergency response workers then spent a number of hours clearing away fallen material from around EX0046's cabin and cutting the roof away from the cabin. This work was extremely laborious, especially cutting the roof from the excavator's cabin as the steel proved to be much harder than envisaged.

Sch4p4(6) [redacted] QAS Paramedic Mr McINTOSH was able to

Sch4p4(6) [redacted]

QPS were in control of the incident scene during the emergency rescue operations. At 2:00 AM Thursday 27 June 2019, Mr CLARKE handed control of the incident scene over to DNRME's Inspector CALLINAN.

Mr CALLINAN then ensured the incident scene and surrounding pit area were secured prior to leaving the mine site.

Figure 6. Emergency workers gaining access to [redacted]0046's cabin

Figure 7. Emergency rescue operation

Figure 8. The incident scene post emergency rescue being completed

7.5 Notification of Incident

At 12:51 PM Wednesday 26 June 2019, Sch4p4(6) notified Mr BULGER via telephone that a pit wall had come down in the Southern Terrace pit and that fallen material had partially engulfed a Hitachi EX3600-6 excavator that was operating in the pit at the time. Sch4p4(6) also advised that no contact was able to be made with the operator on the excavator and EMT were on the scene responding.

Sch4p4(6) provided further updates on the emergency response situation to Mr BULGER via telephone calls at 1:07 PM and 1:30 PM on Wednesday 26 June 2019.

7.6 Notification of next of kin

At 1:14 PM on Wednesday 26 June 201 Sch4p4(6) phoned both Sch4p4(6) Sch4p4(6) and Sch4p4(6) to notify them of the incident. At the time Sch4p Sch4p4(6) did not answer the phone call and a message was left on her phone. Later at 1:30 PM, Sch4p4(6) spoke with Sch4p4(6) via telephone and advised her of the incident.

7.7 Investigation Team

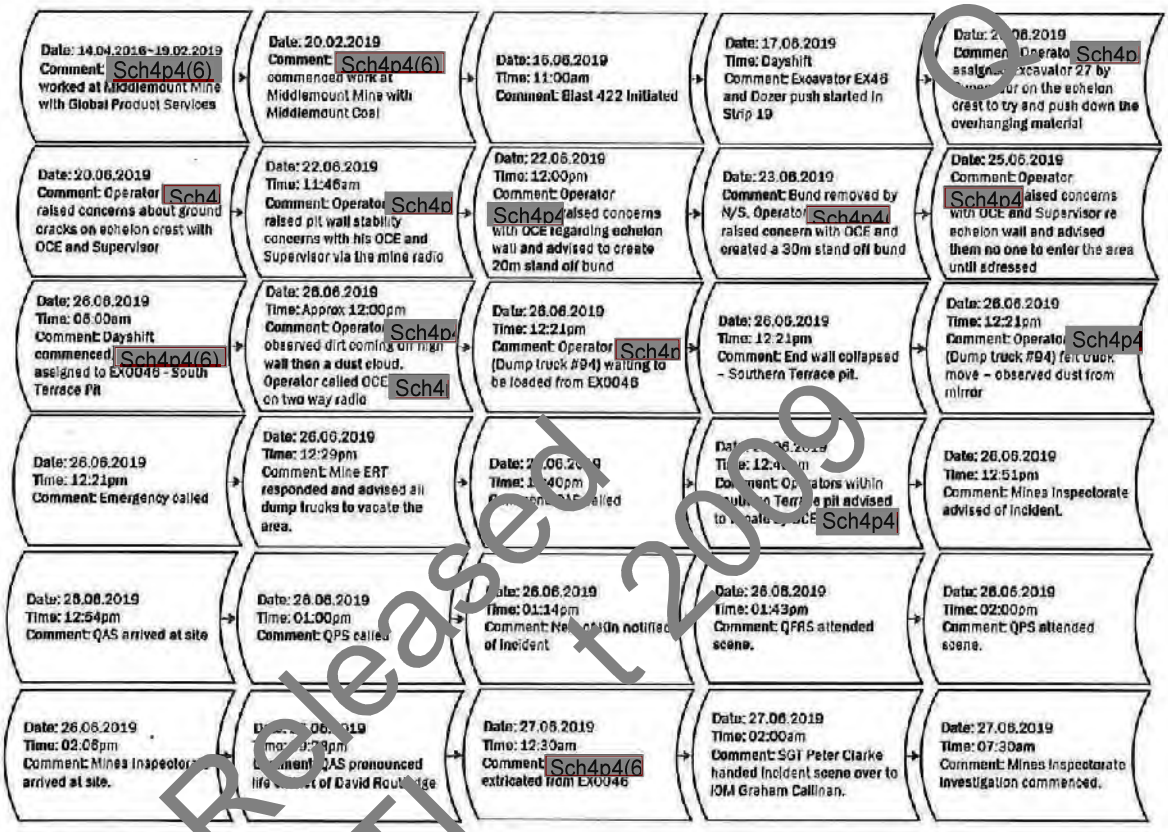
The initial DNRME investigation team consisting of Graham CALLINAN, Pat HURLEY, John TOLHURST, Andrew SMITH, Deon ESTERHUIZEN, Asok SUR and Cres BULGER commenced the investigation on Thursday morning 27 June 2019. A number of

inspections were made of the incident scene and surrounding pit areas and numerous photographs were taken.

On Monday 8 July 2019, Rod KEANE upon request attended Middlemount Mine to carry out an inspection of the incident scene and the surrounding pit area.

On Wednesday 10 July 2019, Simtars representatives Mark KLIENHANS and Glenn AITCHISON attended Middlemount Mine to carry out laser scanning of the incident scene and the surrounding pit area[4].

7.8 Timeline of events



8. Investigation Findings

8.1 Safety and Health Management System Documents

8.1.1 Principal Hazard Management Plan (PHMP) – Geotechnical

The copy of the PHMP – Geotechnical provided by the mine was approved by the Site Senior Executive on the 24 October 2018. The plan is also supported by a number of Trigger Action Response Plans (TARP's), with the most significant and relevant TARP being for Ground Control[5].

[4] Appendix- 13. SIMTARS 3D SCAN\MSTRC-303-0002-0002-RE0001 - Middlemount Mine.pdf
[5] Appendix- 6. Geotechnical\TPPH_001.5_Ground_Control.pdf

The PHMP[6] provides guidance in determining the primary standoff distances from the toe of a highwall. For a wall angle and height greater than 45 degrees and greater than 25m high, the required standoff distance is 15m.

The TARP for Ground Control identifies a number of triggers:

1. In the section for a Level Two or orange trigger, it references blasting. The trigger states, significant blast damage and no pre-split barrels visible.
2. Significant material left on wall creating non-compliance to design as a result of poor wall control.
3. The primary standoff distances from the toe of a highwall stated in the PHMP. It states that under TARP Level Two triggers, the standoff distance is to be determined by the Geotechnical Engineer. This had not been done prior to the incident.
4. The TARP for Ground Control also stipulates actions and responsibilities for a number of positions within the mine. The investigation identified that required actions were not implemented by key personnel across different levels of the mine management and statutory officials.

Following this TARP for ground control in Strip 19 South Terrace, it should have been managed under the requirements of a Level Two trigger in all respects.

8.1.2 Standard Operating Procedure 117 - Spoil Dumps and Excavated Faces.

The copy of Standard Operating Procedure 117 – Spoil Dumps and Excavated Faces provided by the mine did not identify the document owner or approval date. The procedure contains a section that is titled "Routine Inspections". Below is an extract from the procedure[7]:

The OCE and Shift Supervisor are required to conduct regular inspections of mining areas throughout the shift to identify hazards or unsafe work practices. If unsafe conditions are observed, they shall follow TARP's where applicable, notify appropriate personnel to rectify the problem, or conduct a JSEA / risk assessment to determine controls.

Where necessary, the OCE or Supervisor will withdraw personnel and equipment to a safe area until an area is deemed safe and increase frequency of inspections.

OCE's will enter details of their mine inspections, including any hazardous conditions, in the mine inspection record each shift. A copy of the OCE's inspection will be posted on crib hut notice boards where all mine workers have access to read the report and should do so prior to commencing their shift.

The investigation identified that all OCE's and Shift Supervisors did conduct regular inspections. However evidence shows that the C Crew OCE and C&D Crew Mine Seven Supervisor but did not comply with requirements listed in Standard Operating Procedure 117 – Spoil Dumps and Excavated Faces after becoming aware of unsafe conditions.

8.1.3 Mine Standard Operating Procedure 118 - Restricting Access to Hazardous Areas

On day shift 20 June 2019 the C&D Crew Mine Seven Supervisor directed a CMW[8] to use a small excavator to push down the hung-up material. When this CMW arrived at the work area he called the C Crew OCE over the mine two way radio, and asked him to come and inspect some ground cracks that the CMW was concerned about. The C Crew OCE then inspected the area, but failed to acknowledge the visual pre-split line with material hung-up

[6] Appendix- 6. Geotechnical\PHMP_1_Geotechnical.pdf
[7] Appendix- 12. SHMS Documents\SOP 117 Spoil Dumps and Excavated Faces.docx
[8] Appendix- 2 .ROI\ROI - sch4p4(6) doc Paragraph 108,110,214,233,243

in front of it. At the time the C Crew OCE told the CMW that the cracks were "mud cracks".

On day shift 22 June 2019 an excavator operator called the C Crew OCE and the C&D Crew Mine Seven Supervisor over the mine two way radio[9], and asked them to look at the eastern echelon pit wall as he had concerns with its stability. Later during the same shift a dozer operator working in the area raised concerns about the hazard of the echelon wall with the C Crew OCE10. The C Crew OCE then informed this dozer operator to erect a safety berm 20m from the toe of the eastern echelon pit wall to stop workers entering this area. The C Crew OCE then failed to enter this hazard in his statutory shift report, and there is no evidence of him communicating it to the oncoming shift. On day shift 23 June this same dozer operator notified the C Crew OCE that the safety berm installed the previous day had been removed during the proceeding night shift. The C Crew OCE then informed this dozer operator to reinstate the safety berm below the eastern echelon pit wall. Further evidence shows that this safety berm was removed for the second time during the following night shift. On day shift 25 June 2019 this same dozer operator again raised a concern with the eastern echelon pit wall with the C Crew OCE and A&B Crew day shift Mine Seven Supervisor, and on this occasion the dozer operator informed that he'd put a 30m standoff safety berm in place and that none of the operators are going into the area.

The area should have remained restricted until the hazard of the hung-up material was mitigated. These requirements are outlined in this procedure[11], but were not implemented.

8.1.4 Mine Standard Operating Procedure 99 - Restricting Access to parts of mine

The hung-up material on the echelon wall was identified as a hazard by Coal Mine Workers over a number of days. The Mine Standard Operating Procedure 99 - Restricting Access to parts of mine procedure required that the area around the echelon wall should have been closed or restricted. The area should have also been bunded and signposted as required by this procedure[12]. The procedure also states where an uncontrolled hazard creating an unacceptable level of risk exists, the affected area of the mine is considered to be at risk and the following actions must be taken:

1. Withdraw of all exposed personnel.
2. OCE and other competent people to assess the risk and develop a response plan.
3. On-duty OCE must report in the mine record the withdrawal of persons and any immediate action.

None of the above were actioned.

8.1.5 Reporting Highwall Compliance to Design – SWI 001.2

The purpose of this procedure is to provide instruction on generating compliance reporting for highwall post blast and during excavation. Data collection or a scan is taken immediately after a blast has occurred and before equipment starts excavating.

This process enables a comparison to be made between the design and the blast profile following the blast. This comparison enables the identification of hung-up material or back break. This was conducted and a report generated that identified a significant amount of hung-up material on the eastern echelon pit wall in Strip 19 Southern Terrace.

[9] Appendix-2 .ROI\ROI - sch4p4(6) doc Paragraph 108,110, 214,233 and 234
[10] Appendix-2 .ROI\ROI - sch4p4(6) doc Paragraph 258,302,310,330,360
[11] Appendix-11. SHMS Documents\MSOP 118 Restricting access to hazardous areas.docx
[12] Appendix- 12. SHMS Documents\MSOP 118 Restricting access to hazardous areas.docx

The procedure also stipulates that weekly scans are completed as part of a process that would ensure that the extraction of material was being conducted to design. The investigation found that the required scans were conducted. The mine provided evidence that five scans were conducted after the blast and during the days leading up to the incident. All of these scans clearly identified the hung-up material in front of the pre-split line[13].

8.2 Pit Design

The nominal pit strip width at Middlemount mine is 60m. Because of coal production requirements at the time[14], Strip 18 in the South Terrace Pit was designed with a width of 85m. Strip 19 was then designed with a strip width of 35m and the reason for this was to regain an overall alignment of 60m strip widths.

The consequence of the 35m strip width in Strip 19 is that the significantly narrower strip width meant the post-blast surface profile of the blasted material was much lower than created in the 60m width strips which was normal pit design practice, due to the resultant reduction in blasted volume of material. This lower surface profile of the blasted material in Strip 19 meant mining equipment was unable to effectively reach the newly created upper pit walls from below to scale down any hung-up material sitting inside the design lines[15].

The mine did not perform any change management processes on the significant changes to the pit design[16].

8.3 Drill and Blast

The blast conducted in Strip 19 South Terrace Pit was initiated at 11.00 AM on Sunday 16 June 2019. The blast identifier was BL 422. Design of the blast was developed by Middlemount Coal with the drill and blast conducted by Action Drill and Blast contractors.

8.3.1 Pre-blast risk assessment

There is evidence that a risk assessment checklist was completed for the BL422 drill design by the Drill and Blast Engineer on 5 June 2019. The document indicates that no unusual hazards were identified within the scope of BL422. This is the only evidence supplied of a risk assessment process for this blast. The design also included a pre-split line on the eastern echelon wall which was not a common practice at Middlemount Mine. The mine implemented this presplit in the eastern echelon to give a cleaner and straighter pit wall that would allow extraction of all the coal. The previous Strip 18 eastern echelon was not pre-split, and subsequently the coal recovery was reduced. No additional risk assessment or change management process was applied for the inclusion of the pre-split on the eastern echelon wall. Pre-split designs are often used in open cut mines as a means of providing a smooth highwall profile.

8.3.2 Drill and blast design

The blast design included a production/overburden blast comprising of 102 blast holes split over 4 rows. It also included a pre-split blast comprising of 110 holes running across the back of the production blast, as well as both ends of the loaded production/overburden holes. The pre-split is fired ahead of the production blast, followed by the two strings of

[13] Appendix- 6. Geotechnical\WI 001.2 Reporting HW Compliance to Design.docx
[14] Appendix- 2. ROI\ROI - sch4p4(6) doc Paragraph 117
[15] Appendix- 3. Photos\Photo of strip 19 after shot.docx
[16] Appendix- 2. ROI\ROI - sch4p4(6) doc Paragraph 125, 463

the production blast. The electronic initiation system ensures that all of the detonators receive the firing signal at the same time, minimising the potential for misfire[17].

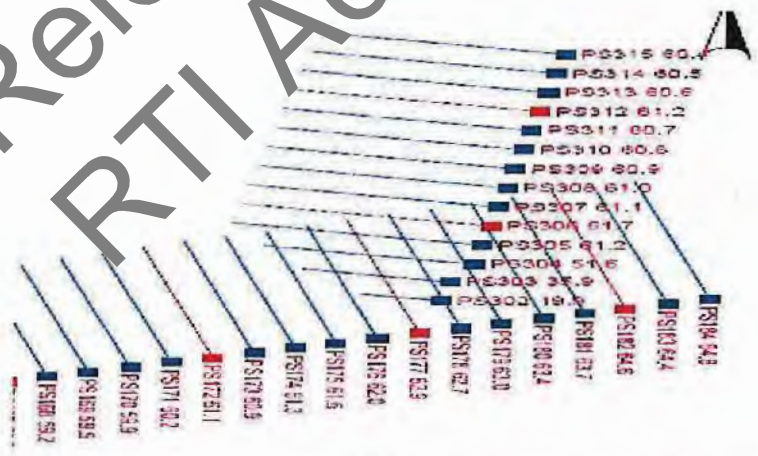
There were errors made in designing the optimal distance between the pre-split line and the last row of production holes. The distance between the pre-split line and the production holes was an estimated 4.5m to 5.0m across the length of the blast pattern. The optimal design distance should have been 2.5m as per the mine's drill and blast design principles. The pre-split holes drilled on the echelon wall were drilled outside the original design. This increased the burden distance between the pre-split line and the exposed face of the high wall.

8.2.4 Design Approval Process

The design approval process for BL422 consisted of a three stage process. The initial drill design is collated by the Middlemount Coal Drill and Blast Engineer. The proposed drill design is reviewed and approved by the Senior Mining Engineer. Once the drill design has been approved, it is then affirmed by the Action Drill and Blast Supervisor and drilling can commence[18] [19].

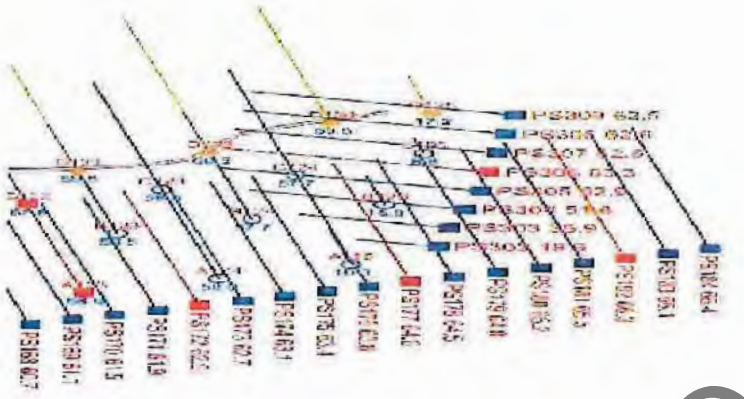
There were inconsistencies in the actual drill design when compared to the actual blast plan that was carried out. The original number of blast holes on the approved design was 206, yet 212 holes were drilled. On one of the blast hole rows, the design angle changed from 70 degrees to 65 degrees.

The initial drill design for BL422 shows there was to be 14 pre-split holes drilled across the eastern echelon wall. The approved drill design shows that there is 8 pre-split holes across the eastern echelon wall. The loading map used by the blast crew is an adjusted copy of the original drill design. It indicates that there were 15 holes drilled across the echelon wall. The loading map used by the blast crew also indicated that 4 pre-split holes across the echelon wall were not loaded with explosives. As a result this reduced the powder factor which in turn reduced the pre-split energy in the immediate area above the incident site. This contributed to the amount of hung up material left on the echelon wall.



Eastern End section - Blast 422 PS Design - 03.06.2019 - Initial Design

[17] Appendix- 5. Drill and Blast\BL422_Drill Design Checklist_v2.pdf
[18] Appendix- 5. Drill and Blast\BL422_BlastPack Distribution_05JUN19@1441.msg
[19] Appendix- 5. Drill and Blast\BL422_SHORT_TERM_PLAN_SIGNED.pdf



Eastern End section - Blast 422 V2 Design - 05.06.2019 - As Approved (Signed)

Eastern End section - Blast 422 V2 Design - As Loaded by Blast Crew

8.2.5 Post Blast Assessment

The Action Drill and Blast Shotfirers do not conduct a post blast report of the blast outcomes. The assessment of the blast outcomes are carried out by the mine's Technical Services Department. The assessment of the blast BL422 outcomes were extensive and included multiple personnel from both Middlemount Coal and the blasting contractor involved. All personnel who provided comment consider the blast to have produced an outcome that was less that desirable[20].

The Senior Mining Engineer stated that due to the blast being fired on the weekend, the commencement of mining started in Strip 19 Southern Terrace Pit prior to an assessment of the blasted ground being conducted by the relevant site personnel who did not work over weekends. This potentially contributed to the failure to identify the post blast hazard of unstable ground, not only along the high wall, but also at the eastern echelon end of the

[20] Appendix- 5. Drill and Blast\Post BL422 Observations.msg

design shell. The Senior Mining Engineer also stated that there was no formal process in place at the mine for when a post blast assessment was to be made.

8.4 Geotechnical Management

8.4.1 TARP - TPPH 001.5 Ground Control

From the time of the blast incident occurring, the excavation activities in Strip 19 of the Southern Terrace Pit were operating under the Normal Level (Green) TARP. The investigation found that the geotechnical conditions in the Southern Terrace Pit Strip 19 from post blast on the 16 June 2019, to the time of the incident occurring, should have triggered Level Two within TARP (TPPH 001.5 Ground Control)[21]. Evidence shows that there were sections of the pit walls where no pre-split barrels were visible before the accident occurred and there was significant material left on walls creating non-compliance to design as a result of poor wall control. Also the designed highwall batter had not been achieved and this resulted in significant over steepening or undercutting of the pit wall. These conditions existed along the eastern echelon pit wall that failed and also along the pit's southern highwall[22].

The following table sets out the Level Two requirements listed in TARP TPPH 001.5. (Table 1)

LEVEL	TRIGGER	ACTIONS AND RESPONSIBILITIES
Level 2	**Rock Strength:–** • Signs of movement or failure such as rilling or tension cracking evident at crest **Rock Structure:-** • Potentially unstable structures increasing in size and frequency, cracks greater than 2cm • Rock falls of excessive quantity and size >10cm but landing within primary standoff zones (20m from wall toe) • Slope Stability Radar showing RED alarm level – Significant propagation / dilation of tension cracks • Increased rilling on face • Strata dipping into the pit **Water / Mud:-** • Significant abnormal levels of water suggesting drainage of adjacent water storage	**Primary Access control:-** • Formal Risk Assessment, approved by Site Geotechnical Representative, the area Supervisor, OCE and SSE is required for any person to work within the Primary Standoff zone under Level 2 TARP conditions. • Install an appropriate bund at, but not within the primary standoff distance, or as directed by Site Geotechnical Representative **Mine Workers:-** • Immediately advise all Mine Workers to leave the affected area and secure access. • Immediately notify the Area Supervisor. **Supervisors:-** • Notify OCE and Production Superintendent. • Verify all Mine Workers have left the affected area. • Arrange for the area to be barricaded and access restricted, in consultation with the OCE. • Ensure hazard is communicated to all workers in or near the affected work area.

[21] Appendix- 2 .ROI\ROI - sch4p4(6) doc Paragraph 398
[22] Appendix- 6. Geotechnical\TPPH 001.5 Ground Control.pdf

	structures or significant groundwater inflow • Significant mud or water build up above operational work areas • Sudden change in water conditions, e.g. disappearance of water on crest, unexpected increase in seepage • Dam or water infrastructure located within 50m of excavation crest • Development of large piping holes in granular material **Blasting**:– • Significant blast damage, no pre-split barrels visible • Significant material left on wall creating non-compliance to design as a result of poor wall control **Mining Practices**:– • Design highwall batter not achieved with variance greater than 2 degrees resulting in significant over steepening or undercutting of walls • Catch berms slumping or not present	• Hand over details of the hazard to the oncoming shift Supervisor for inclusion in the shift pre-start meeting. • Increase frequency of inspections as required. • Assess the requirement for geotechnical monitoring (either Slope Stability Radar or Site Geotechnical Representative) as required and in consultation with the OCE and Mine Planning Superintendent. **OCE's**:- • Inspect the area with the area Supervisor • Ensure the area is adequately bunded and access is restricted – place restricted access signs as per relevant mine site SOP's. • Change the access to reflect TARP Level 2 conditions. • Include TARP levels on OCE report and notify oncoming OCE of status. • Participate in and sign off on hazard assessments. • Assess the requirement for geotechnical monitoring (either Slope Stability Radar or Site Geotechnical Representative) as required and in consultation with the Area Supervisor and Mine Planning Superintendent. During inspections, verify the correct TARP level is in place based on the severity of the hazard. **Production Superintendent**:- • Inform the Mine Manager and affected Superintendents of the hazard and TARP level. • Review hazard assessment and remediation plans (if deemed necessary) from Mine Planning, ensuring adequate controls are included. • If required, ensure remediation plans are implemented including all relevant controls as determined by Mine Planning and Geotechnical. **Mining Manager**:- • Notify the SSE and appropriate 3rd parties as required. • Assess requirement for remediation plan.

		• Assess requirement for investigation and root cause analysis. **Mine Planning Superintendent**:- • Ensure the affected area has an appropriate dig plan which references the identified hazard and TARP level. • If required, ensure remediation plans are sufficient given TARP level, and that sufficient Geotechnical guidance has been given. • Ensure any agreed Geotechnical controls area implemented for future plans affected by this hazard. • Ensure given hazard is recorded in the Geotechnical Hazard Map, and an associated design layer is recorded in the Active Hazards directory for inclusion in Mine Plans. • Initiate event investigation protocol as required. **Geotechnical Engineer or Project Geologist**:- • Conduct technical assessment of the hazard. • Issue recommendations to reduce risk as required. • Provide management and remediation recommendations to Mine Planning for inclusion in Mine Plans. • Ensure the hazard is recorded in the Geotechnical Hazard Map, and an appropriate design layer is provided to Mine Planning for inclusion into the Active Hazards directory. • Advise Supervisor, OCE and affected Superintendents of any changes to TARP levels as a result of specialist monitoring (either physical or Slope Stability Radar). • Participate in and support incident investigations as required. **Mine Planning Manager / Principal Engineer:-** • Initiate event investigation protocol as required. • Review and approve any revised dig plans and / or remediation plans.

		• Initiate revisions or changes to the GPL, GCMP, PHMP or TARP's as a result of incident investigation outcomes. • Communicate with 3rd parties as required.

Table 1- Level 2 requirements listed in TARP TPPH 001.5.

The investigation could not find any evidence of where the actions and responsibilities underlined in the above table had been followed or carried out. Documented communications showed that particular persons in positions listed above were aware of hung-up material being present on the pit walls in Strip 19. The photo in (Figure 9) shows that it was visually apparent that a fired pre-split line ran along the eastern echelon with considerable cling on material on the inner pit side of this pre-split line.

At the time of the incident occurring, the Production Superintendent's position was vacant and had been vacant for a considerable period of time, at least eleven months. There was no evidence to show that the responsibilities of the Production Superintendent had been delegated to another Senior Official so the actions and responsibilities assigned to this position within the TARP would be complied with.

The investigation revealed that the C Crew OCE and C/D Crew day shift Mine Seven Supervisor[23] had knowledge of hung-up material along the eastern echelon pit wall in the Southern Terrace Pit, but had not then followed the response requirements set out within the mine's TARP.

A CMW was assigned the task by a supervisor on day shift 20 June 2019 to use an excavator to try and remove the hung-up material from on top of the wall. During this process, the CMW raised concerns directly with the C Crew OCE regarding the hung-up material, cracking and the presence of pre-split holes.

[23] Appendix- 2 .ROI\ROI - sch4p4(6) doc Paragraph 366

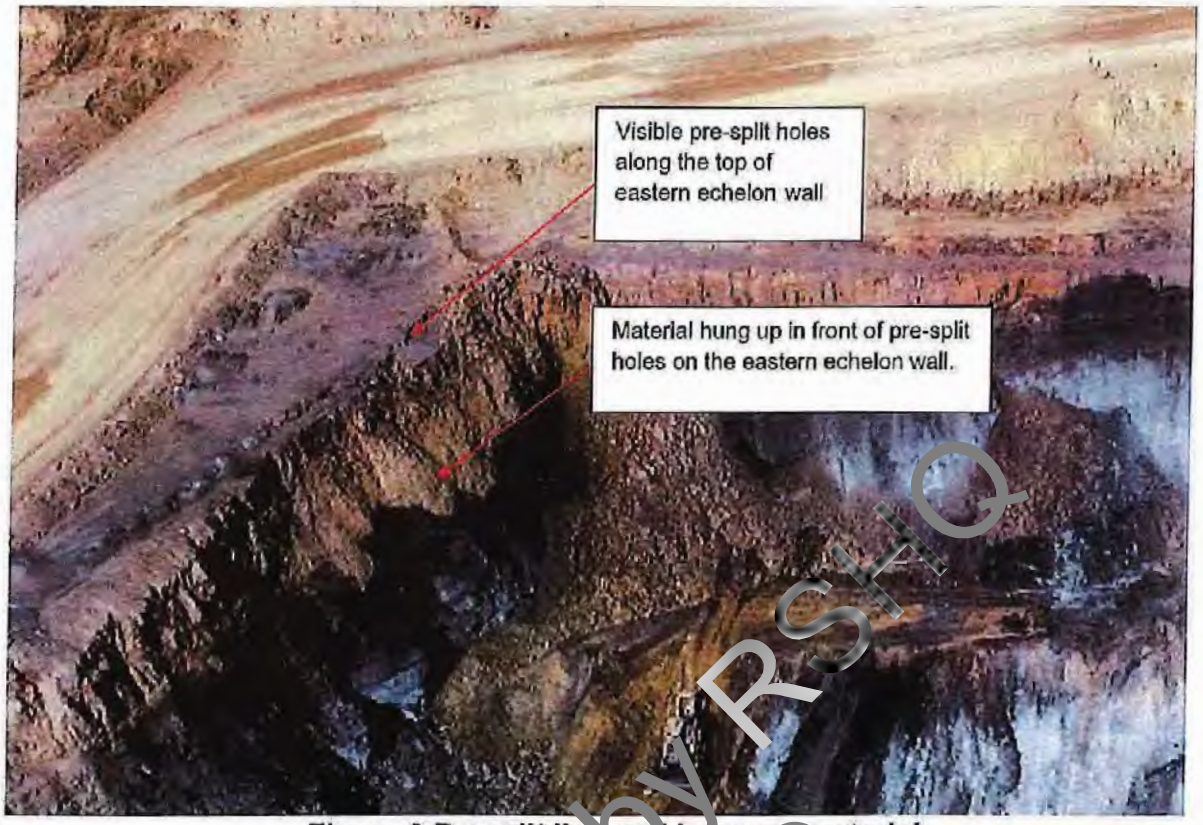


Figure 9 Presplit line and hung up material.

8.4.2 Open Cut Examiner Inspection Records

All OCE inspection records from 1 June 2019 through to 26 June 2019 were examined in the investigation. This examination revealed the following[24 25 26 27]:

There were many occasions where OCE's had not updated their shift inspection report with current information. Examples of this are:

1. OCE reports from day shift 5 June 2019 through to night shift 25 June 2019 all stated a geotechnical TARP Level One (yellow) for the dozer push operations. However mine's 12hr Dig Plans show that the dozer push operations were in Strip 12 in the Southern Terrace Pit from 5 June 2109 to 16 June 2019, and then relocated to Strip 19 Southern Terrace Pit on night shift 16 June 2019. This TARP geotechnical rating level was not updated when the dozer push operation relocated to Strip 19 Southern Terrace Pit.
2. All OCE reports from day shift 6 June 2019 to night shift 18 June 2019 stated there was a JSEA in place for the dozer push operations and an associated comment "joint plain intersection in echelon". Again this was not updated when the dozer push operation relocated to Strip 19 on night shift 16 June 2019.

8.4.3 Geotechnical Inspections

The mine was unable to provide evidence of where geotechnical inspections of pits had been carried out as required by the mine's SHMS[28]. The SHMS required site wide inspections of mine voids, dumps and structures to be carried out on a fortnightly basis by

[24] Appendix-6. OCE Reports\190605 - NS OCE REPORT - sch4p4(6) pdf
[25] Appendix-6. OCE Reports\190606 - DS OCE REPORT - sch4p4(6) pdf
[26] Appendix- 8. OCE Reports\190623 - DS OCE REPORT - sch4p4(6) pdf
[27] Appendix- 8. OCE Reports\190623 - NS OCE REPORT - sch4p4(6) pdf
[28] Appendix- 6. Geotechnical\Geotechnical Hazard Map and Alerts.pdf

the appointed site geotechnical representative. This can be either a Middlemount Coal resource or a contracted geotechnical professional as appointed by the SSE.

Up until the time of the incident occurring, there had been five "Geotechnical Hazard Map" reports produced for the mine during 2019. These reports were dated 16 January 2019, I February 2019, 15 February 2019, 1 March 2019 and 19 June 2019. These reports did not state whether the geotechnical inspections were conducted by a Middlemount Mine resource or a contracted geotechnical professional. Alarmingly the report dated 19 June 2019 did not identify Strip 19 in the Southern Terrace Pit as being potentially hazardous. Also this report contained no evidence of any geotechnical inspection being conducted in this area.

8.4.4 Rock Fall Modelling

At the time of the incident the mine was not applying an effective rockfall modelling process to determine appropriate exclusion zones capable of containing any potential rockfall material within an exclusion zone. At the time a 10m standoff was in place along all pit walls within Strip 19 in the Southern Terrace Pit, contrary to that required under the SHMS where hang-up material was present. The mine's Geotechnical PHMP required a geotechnical person to determine the standoff distance where a TARP Level Two existed in pit walls higher than 25m. A geotechnical person had not determined the standoff distances required in Strip 19 in the Southern Terrace Pit.

Following the incident occurring, the mines inspectorate issued Middlemount Mine with a directive to take the following actions before activities in pits could recommence:

1. Identify all areas where post blast cling-on (hang up) material on pit walls persist in front of the pre-split row.

2. Establish appropriate exclusion zones (determined by way of rockfall modelling software) capable of containing any potential rockfall or failure of cling-on material within the exclusion zone.

3. Until the exclusion zones have been established by way of modelling, access to such areas shall be prevented.

4. A person with geotechnical competencies is to conduct a geotechnical risk assessment of all pit walls in relation to stability.

5. Implement appropriate controls to ensure risk to persons from geotechnical hazards is within acceptable limits and as low as reasonably achievable.

6. Review the current geotechnical monitoring program and associated Trigger Action Response Plans (TARPs) of the mine to ensure that they are adequate and effective.

As a result of Middlemount Mine undertaking the above actions and using appropriate rockfall modelling software the standoff distances increased in Strip 19 from 10m to 47m where hung-up material was present. This demonstrated that the prior to the accident occurring, the mine was not applying an effective rockfall modelling process to determine appropriate exclusion zones.

8.4.5 Standoff Distances

The mines Geotechnical Principal Management Hazard Plan states the primary standoff distances from pit walls. (**Table 2**)

Wall angle and height	Less than 40°	Less than 45° but greater than 40°	Greater than 45° but less than 25m high	Greater than 45° and greater than 25m high
Item				
Highwall toe	Bund only	Bund only	10m	15m
Lowwall toe	Bund only	5m	10m	15m
Highwall crest	Bund only	Bund only	5m	5m
Lowwall crest / dump crest	Bund only	5m	5m	40° from toe line
TARP level 1 triggers	5m	5m	15m	20m
TARP level 2 triggers	5m	5m	25m	Geotech to determine
TARP level 3 triggers	Geotech to determine	Geotech to determine	Geotech to determine	Geotech to determine

Table 2 – Standoff distances contained in Geotechnical Principal Management Hazard Plan.

There was clear visual evidence of where hung-up material was present in two sections of pit walls in Strip 19 of the Southern Terrace Pit, including the eastern echelon wall. Given the pit walls in these sections were far greater than 45° and 25m in height and this hung-up material triggered TARP Level Two, the mine should have had a geotechnical person determine the appropriate standoff distances. The mine could not provide any evidence of this having occurred.

The investigation team also observed that there was no bunding or any other means of delineation in place to define the actual standoff distances from the pit walls. It is common practice for coal mines have these standoff areas defined by a visual demarcation, so operators understand where the no go zones actually are.

8.4.6 Previous Mine Record Entries & Directives

On 27 June 2018 Sch4p4(6) attended Middlemount Mine to investigate a complaint that had been reported to Sch4p4(6)[29]. Within this complaint there was a concern pertaining to ground control management at the mine. Sch4p4(6) identified a number of issues relating to ground control management in his investigation and these are stated in the associated mine record entry. As a result of the issues identified by Sch4p4(6) he issued a Directive stating the SSE must review his Safety and Health Management System in relation to Ground Control Management. The review must address but not be limited to the issues highlighted in the Mine Record Entry". This directive was required to be completed by 13 December 2018.

On 17 and 18 July 2018 an inspection of Middlemount Mine was conducted by Ms Jacqui VINNICOMBE accompanied by Mr CALLINAN. The mine record entry for this inspection states that numerous ground control risk management issues were identified by Ms VINNICOMBE and these were then communicated to Sch4p4(6) Sch4p4(6) One of the main issues identified was that the mine did not have Geotechnical Model. Subsequently on 18 July 2018 a Directive was issued to the Middlemount mine SSE requiring the development of a Geotechnical and Hydrological Model which was required for the fundamentals of safe slope design to establish an acceptable level of risk. This Directive required the model to be developed by 30 November 2018[30].

Further email communications were made by Middlemount Mine to inspectors VINNICOMBE and CALLINAN on 31 August 2018 and within this communication the mine provided a timeline which showed the development of the above models would be

[29] Appendix-7. Mine Record Entry\Mine Record Entry - sch4p4(pdf
[30] Appendix- 7. Mine Record Entry\Mine Record Entry- sch4p4(6) .pdf

completed by 31 December 2018[31] [32]. The Directive's date for completion was extended by Mr CALLINAN as per advice given by Ms VINNICOMBE.

On 21 March 2019 a teleconference meeting was held between Ms VINNICOMBE and Middlemount Mine representatives that included Sch4p4(6) Sch4p4(6) The purpose of this meeting was for Middlemount Mine to provide an update on their progress in addressing two Directives listed above which were still open at this point in time. This also included confirmation being provided by Middlemount Mine representatives that the Geotechnical PHMP had been rewritten and uploaded to the overarching Safety and Health Management System (SHMS) and effectively implemented. The Geotechnical PHMP includes revised TARPs and a subordinate and more detailed technical document, GCMP (Ground Control Management Plan). A subsequent postal mine record entry authored by Ms VINNICOMBE provided details of this meeting.

On 5 April 2019 Sch4p4(6) provided an email communication to Ms VINNICOMBE which detailed the mine's progress on addressing the two directives listed above. This communication also made reference to the mine's Geotechnical PHMP and Ground Control Management Plan as both being incorporated into the mine's SHMS, and to the extent that the requirements of the directives had been closed out on site. Based on this evidence provided by Sch4p4(6) the two directives were closed out in the inspectorate's database by Ms VINNICOMBE and Mr CALLINAN on 5 April 2019.

Within the documentation requested by the investigation team as part of this investigation was the mine's current Geotechnical PHMP and Ground Control Management Plan[33]. The Ground Control Management Plan provided by the mine was still very much in a draft format. It had never been approved by the SSE or the Principal Mining Engineer who was the process owner for this plan, as indicated it had been in previous communication to Ms VINNICOMBE and Mr CALLINAN. The Geotechnical PHMP provided also made reference to the Ground Control Management Plan.

The development of the mine's Ground Control Management Plan had never been completed, nor had this document ever been approved to be part of the mine's SHMS as previously communicated to Ms VINNICOMBE and Mr CALLINAN.

8.5 Communications

The Middlemount Mine Safety and Health Management System does not contain a specific document that outlines the site communication process. The investigation identified that system relies on email communication for a significant amount of information communication.

8.5.1 Pre-start meetings

At the commencement of each shift, CMW's attend pre-start meetings which are run by the shift OCE and Supervisors. These meetings commence with the OCE presenting the previous shift statutory report. This provides an opportunity for the OCE to inform CMW's of any hazards identified during the previous shift. The hazards communicated are not limited to ones identified by the OCE themselves, but should include hazards raised by other CMW's.

The investigation identified that CMW's had raised concerns about the hung-up material on the echelon wall with the C Crew OCE, A&B and C&D Crew day shift Mine Seven

[31] Appendix- 7. Mine Record Entry\Mine Record Entry- sch4p4(6) 27-11-18.pdf
[32] Appendix- 7. Mine Record Entry\Mine Record Entry- sch4p4(6) 21-3-19.pdf
[33] Appendix- 11. SHMS Documents\draft GCMP JH.docx

Supervisors, yet it was not communicated at the pre-start meetings or documented in any statutory report[34].

At pre-start meetings the relevant supervisor presents the 12 hour Dig Plans[35] [36]. These plans are presented in the form of a power point presentation. The plans convey the activities that are being conducted in each work area. The plan highlights the machinery being used, the activity itself, known hazards that need to be managed and whether there is any risk assessment covering these activities.

In the shifts prior to the incident, the 12 hours dig plans mentioned the hung-up material on the eastern echelon wall and the requirement to scale walls as they were dug down. The hung-up material on the eastern echelon wall was not scaled down even though its presence was communicated.

8.5.2 Drill and Blast

All communication of drill and blast designs are done via email. The drill and blast design is communicated within the Technical Services Department and Senior Production Personal. Supervisors and OCE's do not have specific drill and blast designs communicated to them. Supervisors do receive communication regarding the overall blast performance[37].

The blast design for Strip 19 Southern Terrace included a pre-split along the echelon wall. This practice is not common at Middlemount Mine. The inclusion or presence of this pre-split was not effectively communicated.

There was no email correspondence to supervisors or OCE's regarding the presence of the pre-split on the echelon wall. There was evidence of email correspondence to the Mine Manager and within the Technical Services Department that highlighted the inclusion of a pre-split on the echelon wall in the form of drill plans. This information was not communicated to supervisors and OCE's, or any additional CMW's.

8.5.3 Pre-Split on Echelon Wall

The blast design with a pre-split on the echelon wall was not common practice at the Middlemount Mine[38]. Its inclusion in the design was to straighten up the wall to expose additional coal at the toe of the wall.

The investigation identified that there were some key personnel that did have knowledge of the presence of the pre-split on the echelon wall and did not communicate this to CMW's so they had the opportunity to mitigate the risk of the hazard the hung-up material posed. The presplit was detailed on the drill and blast design, but was not included in any of the communication pathways available[39] [40] [41].

[34] Appendix- 2 .ROI\ROI - sch4p4(6) Paragraph 105,107
[35] Appendix- 4. Dig Plans\12 Hour Dig Plan 21-6-19 DS.pptx
[36] Appendix- 4. Dig Plans\12 Hour Dig Plan 25-6-19 DS.pptx
[37] Appendix- 5. Drill and Blast\BL422_BlastPack Distribution_05JUN19@1441.msg
[38] Appendix-2 .ROI\ROI - sch4p4(6) Paragraph 201
[39] Appendix- 5. Drill and Blast\BL422_BlastPack Distribution_05JUN19@1441.msg
[40] Appendix- 5. Drill and Blast\Post BL422 Observations.msg
[41] Appendix- 5. Drill and Blast\BL422 review - quick notes.msg

Interviews conducted with operators working in Strip 19 found that they had no knowledge of the presplit, thus they were not aware of there being hung-up material on the eastern echelon wall[42] [43] [44].

8.5.4 Dig plans

The mine produces three day and twelve hour dig plans. The twelve hour dig plans are developed by supervisors and are presented to the workforce at the prestart meetings. The Site Senior Executive and Mining Manager also attend these meetings on a regular basis. These plans are presented in the form of a power point and contains photographs of each work area and states the activities being conducted[45].

Photographs clearly showed the presence of the presplit on the eastern echelon wall and the significant amount of hung-up material in front of it.

Figure 10 - 12 Hour Dig Plan day shift 20 June 2019

The dig plans from dayshift 22 June 2019 to dayshift 25 June 2019, mention hang-up and full reach on echelon. This means the excavator is to stay away from the wall by the length of its bucket arm to achieve the 10m standoff distance. The plans also mention to "scale highwall as we go down". **(Figures 11, 12)**

[42] Appendix- [redacted] sch4p4(6) Paragraph 121,163,165
[43] Appendix- [redacted] sch4p4(6) Paragraph 317
[44] Appendix- 2 [redacted] sch4p4(6) Paragraph 139, 280
[45] Appendix- 4. Dig Plans

TASK/OBJECTIVE
• Conventional push, • Digger 65 Throw roll • Hotseat digger 65 if possible both cribs to maximise roll throw. • Scale highwall as we go down.
AREAS OF AWARENESS
• Hang up, on the eastern echelon, High roll
JSEA

Figure 11 – Twelve hour dig plan 21 June 201

TASK/OBJECTIVE
• Conventional push, • Scale highwall as we go down. • Digger 46 will continue mining A 35M strip against end wall, maintain safe separation.
AREAS OF AWARENESS
• Hang up. Full reach on echelon.
JSEA

Figure 12 – Twelve hour dig plan 25 June 2019

8.6 Training and Assessment

Sch4p4(6)

The training transcript of relevant workers also indicted that they were trained in the requirements of PHMP Geotechnical, Geotechnical Awareness, Standard Operating Procedures and Mine Operating Procedures. This included all OCE's and Supervisors[47].

The investigation revealed that a number of supervisors on site that had not formally been authorised by the Site Senior Executive to be supervisors, and they were:

- C&D Crew day shift Mine Seven Supervisor
- Principal Mining Engineer
- 3 x OCE's

[46] Appendix- 1. Training\ sch4p4(6) Training Transcript.pdf
[47] Appendix- 1. Training\MCPL Geotechnical Training.pdf

8.7 Management Structure

The Management Structure[48] provided by Middlemount Coal was approved and issued on 24 July 2018. The structure identifies seven site based positions, and one non-site based position being the Electrical Engineering Manager. The structure references a Mining Operations Superintendent as a senior position, however the position is not contained within the organisation structure. There is a reference to a position of Pit Superintendent. The investigation identified that this position was vacant before and at the time of the incident. The person named as the Technical Services Superintendent in the senior positions is different to that in the organisation structure.

Minimum competencies have been included in the management structure, but it does not state the actual competencies held by persons in a senior position. The only competencies identified are those required by the Coal Mining Safety and Health Advisory Council. There is no reference to the additional competencies required that would enable the position to effectively assist in the development and implementation of the Safety and Health Management System.

The organisation structure identifies the SHMS responsibilities for positions however there is duplications of these responsibilities between positions without clear direction. SHMS documentation for mining and drill and blast is allocated to all but one position which has the potential to cloud who is responsible for what documentation. The SHMS responsibilities for the PHMP 1 Geotechnical, has also been allocated to different positions. The Technical Services Superintendent has been allocated responsibilities for MP 016 Ground Control Management Plan which is not contained in the Safety and Health Management System.

The intent of the Management Structure is to ensure that person named in it have the competencies that allows them to assist in the development and implementation of the SHMS. Having clearly defined SHMS responsibilities ensures the persons named, know their obligations for ensuring the SHMS is implemented. The Management Structure in place at Middlemount did not adequately meet this intent.

8.8 Inspections

Inspections of the surface excavations are conducted by OCE's and appointed supervisors. In addition each coal mine worker is required to conduct an inspection of the workers specific work areas.

The inspections conducted by OCE's are statutory inspections and a report is completed for each inspection. Mine supervisors conduct inspections but do not complete any documented report.

While CMW's do conduct an inspection of their work area, they also do not complete a documented report. All CMW's complete a documented personal risk management assessment for the tasks they are conducting.

Statutory reports conducted by an OCE are required to detail the hazards identified during the inspection. The hazard of the hung-up material on the echelon wall was never included in any statutory report, even though it had been reported by CMW's to the C Crew OCE[49].

Supervisors conducted continued inspections throughout their shift but do not complete a documented report. Any hazards identified during the shift that can't be immediately

[48] Appendix- 11. SHMS Documents\MP 015 Management Structure Management Plan.docx
[49] Appendix- 8. OCE Reports

mitigated must be reported to the OCE, who then must include a record of it in their statutory report[50].

An additional inspection required to be conducted by the Middlemount Mine SHMS is a geotechnical inspection. Prior to commencing mining operations in any new area or mining block, a preview will be conducted to check on the proposed mine design with respect to geotechnical or other risks.

In relation to Strip 19 Southern Terrace, there was no geotechnical input into the design or visual inspection of the area following the blast. The significance of this inspection not being conducted was the opportunity to ensure that the extraction of overburden and coal was conducted to design.

9. Incident Cause Analysis Method

A systematic safety investigation analysis method called Incident Cause, Analysis, Method (ICAM) was undertaken by Inspectors BULGER, CALLINAN, LOGAN, ESTERHUIZEN, SUR and Principal Investigation Officer TOLHURST. The analysis method was used to identify local factors and failures within the broader organisation and productive system (e.g. communication, training, operating procedures, incompatible goals, organisational culture, equipment, etc.) which contributed to the accident. Through the analysis of this information, ICAM provides the ability to identify deficiencies and to prevent recurrence. This method was used to present the accident findings in terms of:

9.1 Absent / failed defences

These failures result from inadequate or absent defences that failed to detect and protect the system against technical and human failures. These are measures which did not prevent the outcome or mitigate the consequences of an individual or team action that resulted in an incident or near miss.

1. The mine did not apply a risk management process to the activities being conducted in Strip 19 South Terrace prior to the shot being fired, or mining commencing.
2. The standard and quality of safety inspections conducted was not adequate.
3. The standard and quality of communication regarding the presence of the pre-split on the echelon wall was not adequate or effective.
4. The standard and quality of communication regarding the presence of the hazard of the hung-up material on the echelon wall was not adequate or effective.
5. The Safety and Health Management System did not contain a robust plan and design process for pre and post blasting activities.
6. The Safety and Health Management System did not contain a process for identifying and reviewing hazards after a blast was fired and before mining commenced.

9.2 Individual / team actions

These are the errors or violations that led to the incident. They are typically associated with personnel having direct contact with the equipment, such as operators and maintenance personnel. They are always committed 'actively' (someone did or didn't do something) and have a direct relation with the incident. Human error types are slips, lapses, mistakes, and violations.

[50] Appendix- 11. SHMS Documents\SOP 141 Safety Inspections.docx

1. The C Crew OCE did not convey information regarding the presence of the pre-split on the echelon wall.
2. Senior mine management did not convey information regarding the presence of the pre-split on the echelon wall.
3. Concerns raised by CMW's about the hazard of the hung-up material on the echelon wall were not managed by the C Crew OCE or C&D Crew day shift Mine Seven Supervisor.
4. The Technical Services Department did not have an effective communication and peer review process during the design and approval process for the blast at Strip 19 South Terrace.
5. Senior mine management did not ensure that overburden extraction was conducted as to pit design.
6. An exclusion bund erected to prevent access to the hazard of the hung-up material on the echelon wall was removed by the following shift. The reason for the exclusion bund was not effectively communicated to the oncoming shift.

9.3 Task / environmental conditions

These are the conditions in existence immediately prior to or at the same time as the incident. These are the conditions that directly influence human and equipment performance in the workplace. These are the circumstances under which the errors and violations took place and can be embedded in task demands, the work environment, individual capabilities, and human factors.

1. Due to poor drill and blast design and operational issues, significant amount of hung-up material was present on walls.
2. The 35m strip profile, meant there was a lower blast profile which made it impossible for excavators to scale all the hung-up material off the walls.
3. It was unusual to have a pre-split on an echelon wall. As a result there was a lack of awareness amongst operators and the hazards associated with the excavation of the material and highwall management.
4. Due to scheduling and production pressures, the blast design approval process was rushed and as a result a design issue was not detected.
5. Overburden removal commenced before an assessment of the hazards caused by the blast was conducted.
6. A significant reduction in the powder factor in the area of the echelon, resulted in blocky hung-up material.
7. The geological profile contained a weaker lower strata section. As a result the energy from the blast was released through this area and not evenly through the echelon wall.
8. Significant attempts were made to scale the hung-up material from the high and end wall. No attempt was made to remove the hung-up from the echelon wall.

9.4 Organisational factors

These are the underlying organisational factors that produce the conditions that affect performance in the workplace. They may lie dormant or undetected for a long time within an organisation and the repercussions may only become apparent when they combine with the local conditions and errors or violations to breach the system's defences. These may include fallible management decisions, processes, and practices.

Organisational Factor types identified:

OR- Organisation

PR- Procedures

DE- Design

RM- Risk Management

MC- Management of Change

IG - Incompatible Goals

MM- Maintenance Management

CO - Communication

OC - Organisational Culture

RI - Regulatory Influence

1. **OR-** The Ground Control Management Plan was still in draft and not approved, but referenced in the mine's SHMS as being a live document.
2. **OR-** Activities conducted in Strip 19 South Terrace did not comply with the Ground Control Management Plan's requirements.
3. **OR-**The Technical Services area of the mine was not adequately manned with competent staff.
4. **OR-** Production pressures resulted in a change of pit design to uncover a larger block of coal.
5. **OR-** There was a limited planning and review process of the pit and blast designs between technical services area, production area and the drill and blast contractor.
6. **OR-** Blast design process was inadequate which resulted in a design error not being detected.
7. **PR-** The Safety and Health Management System did not contain a robust handover process from the technical services department to production post blast.
8. **PR-** The Ground Control Management Plan was still a draft version.
9. **PR-** The Management Structure document does not identify the required competencies for senior positions and supervisors.
10. **DE-** The design of the excavator involved in the incident, saw the operator cabin be positioned facing the echelon wall at time of failure.
11. **DE-** The blast at Strip 19 South Terrace was drilled and loaded not in accordance with the approved design.
12. **DE-** The mine strip design was changed from 85m to 35m for Strip 19 South Terrace.
13. **DE-** There was a blast hole design error in the distance from the pre-split holes to the first production holes.
14. **DE-** The overburden material was removed not as to pit design.
15. **RM-** There was no risk management process applied to the extraction of overburden material and the hazard of hung-up material.
16. **RM-** There was no hazard identification process post blast and before production commenced.
17. **MC-** No risk management process applied for the change of pit width from 60 to 85 to 35 metres.
18. **MC-** No risk management process applied for the inclusion of a pre-split line on the echelon wall.
19. **IG-** Production pressures resulted in dozers commencing removal of material before excavators could effectively scale walls of hung-up material.

20. **IG-** Change of mine strip design to 35m from 85m lowered the blast cast height which made scaling walls of hung-up material difficult.
21. **IG-** Dozers continued to remove material in the area of echelon wall after it was identified that excavators could not reach the hung-up material.
22. **IG-** No blast effective analysis conducted before production commenced.
23. **IG-** Production is conducted on a continual roster with engineering personal only available Monday to Friday.
24. **MM-** The cameras on the excavator were not operational thus not recording key operational activities and potentially the failure of the echelon wall.
25. **CO-** The presence of the pre-split on the echelon wall was not effectively communicated via any of the available communication tools.
26. **CO-** The blast was conducted over a week-end and the analysis of the blast by the technical services department was not communicated until the Monday. As a result production commenced before the hazard analysis was communicated.
27. **OC-** Production based decision making.
28. **OC-** Historical evidence of the mine having repeat occurrences of not digging to design.
29. **OC-** Production Department does not have an approachable culture to identifying hazards.
30. **OC-** Production pressures gave way to hazard identification and mitigation.
31. **RI-** Management had an inadequate response to addressing issues raised with the Ground Control Management Plan.
32. **RI-** Management displayed a general disregard in the response to issues raised with the Ground Control Management Plan.
33. **RI-** Ms VINNICOMBE and Mr CALLINAN closed out their directives based on Sch4p Sch4p4(6) providing a letter stating that the Ground Control Management Plan had been reviewed and finalised.

10. Conclusions

The mine design for coal extraction in the southern terrace area was predominately conducted in strips that were 60m wide but varied in length. The previous strip was widened to 85m to increase production. The width of Strip19 was reduced to 35m to bring the mine design back into the normal strip widths. With the change to a smaller width of 35m, it reduced or lowered the blast profile and as a result there was not enough blasted material on the ground to enable the excavators to ramp up onto and scale back the material hung-up on the walls. The mine did not conduct a risk assessment or a change management process before making the changes to the mine design.

There was a significant change in the blast design by the inclusion of a pre-split line being included on the eastern echelon wall. This practice was not common at the Middlemount Mine. Generally the mine only has production holes drilled and initiated in this area. During extraction, the excavators would scale back material until they encounter a hard surface.

The mine did not conduct a risk assessment or a change management process before making the changes to the blast design. The pre-split was included on the echelon wall to straighten up the angle of repose, thus enabling additional coal to be extracted from the base of the wall.

Following blast 422 at the southern terrace, there was no post-blast geotechnical inspection conducted to potentially identify hazards. No review or documented process

was engaged that would have enabled a safe manner of extraction to be formalised and implemented. Machinery was deployed to begin extraction before any such process was followed.

Poor blast design resulted in large amounts of hung-up material being present in front of the pre-split lines. Sound mining practice requires this hung-up material to be removed back to the solid pre-split line. This practice is commonly identified as digging to design. Attempts were made to dig to design along the southern and western walls. In relation to the eastern echelon wall, there was no significant attempt to dig to design thus not removing the hung-up material present that later failed and engulfed the excavator being operated by Sch4p4(6)

Members of the Technical Services Team and Senior Management were aware of the inclusion of a pre-split line on the echelon wall. There is no evidence that its presence was communicated to the OCE's, supervisors and the general workforce. The investigation did identify that a least one OCE and supervisor were aware there was a pre-split on the echelon wall. They did not communicate this to any other CMW's. The fact there was a pre-split on the echelon wall should have been communicated to all CMW's at their pre-start meetings. There is evidence that emails were sent to Senior Management regarding the blast design and the blast results. The photos contained in the twelve hour and three day dig plans clearly showed the presence of the pre-split line and the hung-up material in front of it.

The Site Senior Executive, Mine Manager and at least one OCE and supervisor were aware of the pre-split line on the eastern echelon wall. These people also had knowledge of the large amounts of material hung-up in front of the pre-split line. With this knowledge they should have ensured that the material that failed and engulfed the excavator operated by Sch4p4(6) was removed during the mining process.

The investigation identified that the C Crew OCE and C&D Crew day shift Mine Seven Supervisor had specific knowledge of the hung-up material in front of the pre-split line on the eastern echelon wall. CMW's had raised concerns about the presence of the pre-split line and the material in front of it. A CMW was assigned the task by the C&D Crew day shift Mine Seven Supervisor to use an excavator to try and remove the hung-up material form on top of the wall. During this process, the CMW raised concerns directly with the C Crew OCE regarding the hung-up material, cracking and the presence of pre-split holes. Concerns were also raised by an Excavator Operator and a Dozer Operator regarding the hung-up material on the eastern echelon wall.

The Ground Control Trigger Action Response Plan outlines actions and responsibilities for positions once a trigger has been reached. The conditions in Strip 19 were at yellow Level Two trigger which required significant actions to be taken by such positions as Supervisors, OCE's, Mining Manager and Geotechnical Engineer. The investigation found that even though TARP Level Two conditions existed, the required actions and responsibilities were not followed by any position.

11. Actions taken post incident

11.1 Mine Record Entries & Directives

On Friday 28 June 2019, a Mine Record Entry containing the following two Directives was issued to Middlemount Mine:

1. Incident Scene Security

The mine is to maintain security of the accident scene in the Southern Terrace Pit area until such time as the inspectorate notifies the mine that the scene can be released. Whilst the accident scene is quarantined no person is to enter the area unless in the presence of the mine's inspectorate.

2. Suspension of all activities in or near excavations

The mine is to take the following actions before any activities can commence in or near any pit excavation at the mine:

- *Identify all areas where post blast cling-on (hang up) material on pit walls persist in front of the pre-split row.*
- *Establish appropriate exclusion zones, (determined by way of rockfall modelling software) capable of containing any potential rockfall or failure of cling-on material within the exclusion zone.*
- *Until the exclusion zones have been established by way of modelling, access to such areas shall be prevented.*
- *A person with geotechnical competencies is to conduct a geotechnical risk assessment of all pit walls in relation to stability.*
- *Implement appropriate controls to ensure risk to persons from geotechnical hazards is within acceptable limits and as low as reasonably achievable.*
- *Review the current geotechnical monitoring program and associated Trigger Action Response Plans (TARPs) of the mine to ensure that they are adequate and effective.*

On Friday 5 July 2019, a further Mine Record Entry containing the following Directive was issued to Middlemount Mine. This directive replaced Directive 2 that was issued on 28 June 2019:

3. Suspension of mining activities in or near excavations

Other than the areas listed within the following brackets (CENTRAL PIT - CC16_B20_25_SHORT TERM - STAGE 1; V3_STRIP 20 - SOUTH TERRACE PRESTRIP - STAGE 1; and STRIP 20 - CENTRAL NORTH PIT SHORT TERM - STAGE 1) the mine is to take the following actions before any activities can commence in or near any pit excavation at the mine:

- Identify all areas where post blast cling-on (hung-up) material on pit walls persist in front of the pre-split row.
- *Establish appropriate exclusion zones, (determined by way of rockfall modelling software) capable of containing any potential rockfall or failure of cling-on material within the exclusion zone.*
- *Until the exclusion zones have been established by way of modelling, access to such areas shall be prevented.*
- *A person with geotechnical competencies is to conduct a geotechnical risk assessment of all pit walls in relation to stability.*
- *Implement appropriate controls to ensure risk to persons from geotechnical hazards is within acceptable limits and as low as reasonably achievable.*
- *Review the current geotechnical monitoring program and associated Trigger Action Response Plans (TARPs) of the mine to ensure that they are adequate and effective.*

11.2 Safety Newsflash

On Friday 28 June 2019 the DNRME's coal mine inspectorate distributed the following Safety Newsflash to the site senior executive at all coal mines in Queensland-

Department of Natural Resources, Mines and Energy

Resources Safety and Health Newsflash

An early report about an incident that may require action at your mine

Fatal accident as open cut coal mine pit wall failed

What happened?

On Wednesday 26 June 2019 at approximately 12.20pm, a 55 year old coal mine worker was fatally injured while he was operating an excavator at an open cut coal mine in Queensland's Bowen Basin.

The coal mine worker was operating an excavator when an adjacent pit wall approximately 40 metres high has suddenly failed. This resulted in fallen material engulfing the excavator and partially crushing the excavator's cabin. The excavator's operator was fatally injured. The causes of this pit wall failure are unknown at this time.

How did it happen?

A formal investigation by the Queensland mines inspectorate is underway.

Safety Newsflashes Purpose

1. Draw attention to the occurrence of a serious incident(s) in the mining industry
2. Increase Risk awareness
3. Promote mines to examine and check that their controls are adequate

All mines should review their strata management plans particularly in relation to pit wall stability.

The investigations are ongoing and further information may be published as it becomes available. The information contained in this publication is based on knowledge and understanding at the time of writing.

Great state. Great opportunity.

Queensland Government

For further information contact Luca Rocchi, Chief Inspector of Mines
Date: 28/06/19 Email: luca.rocchi@dnrme.qld.gov.au Phone: sch4p4(6)

11.3 Safety Alert

On Tuesday 9 July 2019 the DNRME's coal mine inspectorate distributed the following Safety Newsflash to the Site Senior Executive at all coal mines in Queensland-

Queensland Government

Department of Natural Resources, Mines and Energy

Fatal incident when excavator engulfed after pit wall failure

Mines safety alert no. 364

What happened?

On Wednesday 26 June 2019 at approximately 12.20pm, a 55 year old coal mine worker was fatally injured while he was operating an excavator at an open cut coal mine in Queensland's Bowen Basin. The coal mine worker was operating an excavator when an adjacent pit wall approximately 40 metres high suddenly failed. This resulted in fallen material engulfing the excavator and partially crushing the excavator's cabin.

Queensland Police Service attended at the mine and handed over control of the scene to the Queensland Mines Inspectorate.

Equipment: Excavator (350 tonne)

Hazard: Gravity / Fall of ground

Cause: The cause of the incident is currently under investigation.

Comments:
While this incident involved an excavator conducting overburden removal, mines should consider the recommendations below for all activities conducted in open cut excavations.

Recommendations:
The Mine Site Senior Executive should:

- Ensure sufficient geotechnical data for safe pit design and modelling is collected, analysed, interpreted and communicated.
- Ensure the geotechnical risk management strategy includes risk based modelling to determine appropriate exclusion zones, capable of containing any potential rockfall material within the exclusion zone.
- Ensure that a visual demarcation is placed along all exclusion zones. Examples being: earth bund, witches hats or fencing.
- Ensure a person with geotechnical competencies conducts scheduled geotechnical risk assessments of all pit walls in relation to stability.
- Review the current controls to ensure risk to persons from geotechnical hazards is within acceptable limits and as low as reasonable achievable.
- Review the current geotechnical monitoring program and associated Trigger Action Response Plans (TARPs) to ensure that they are adequate and effective.
- Ensure adequate training programs are in place to enable all personnel to receive appropriate and regular training in geotechnical hazard awareness, and have a clear understanding of the appropriate TARPs.

Authorised by the Chief Inspector of Coal Mines | Luca Recchi
Further information contact: Kevin Poynter | Regional Inspector of Mines | +61 7 4936 0126
Version 1, 9 July 2019
Follow our updates on
Place alert on noticeboards and ensure relevant people in your organisation receive a copy.
See more safety alerts and bulletins at https://www.dnrme.qld.gov.au
And the hazard database at https://www.business.qld.gov.au/industry/mining/safety-health/mining-safety-health/mining-hazards/hazards

12. Recommendations

1. Mines should ensure sufficient geotechnical data for safe pit design and modelling is collected, analysed, interpreted and communicated.

2. Mines should ensure the geotechnical risk management strategy includes rockfall modelling to determine appropriate exclusion zones, capable of containing any potential rockfall material within the exclusion zone.

3. Mines should ensure that a visual demarcation is placed along all exclusion zones. Examples being, earth bund, witches hats, signage or fencing.

4. Mines should ensure a person with geotechnical competencies conducts scheduled geotechnical risk assessments of all pit walls in relation to stability.

5. Mines should review their current controls to ensure risk to persons from geotechnical hazards is within acceptable limits and as low as reasonably achievable.

6. Mines should review their current geotechnical monitoring program and associated Trigger Action Response Plans (TARPs) to ensure that they are adequate and effective.

7. Mines should ensure adequate training programs are in place to enable all personnel to receive appropriate and regular training, in geotechnical hazard awareness and have a clear understanding of the appropriate TARPS.

8. Mines should ensure their Safety and Health Management System contains a process that verifies that extraction is conducted to design. It should ensure regular inspections of mining areas are conducted.

13. Appendices

1. Training
2. Records of Interviews (ROI)
3. Photographs
4. Dig Plans
5. Drill and Blast
6. Geotechnical
7. Mine Record Entry
8. OCE Reports
9. Statement – Sch4p4(6)

sch4p4(6)

11. SHMS Documents
12. SIMTARS 3D Scan
13. Drone Videos