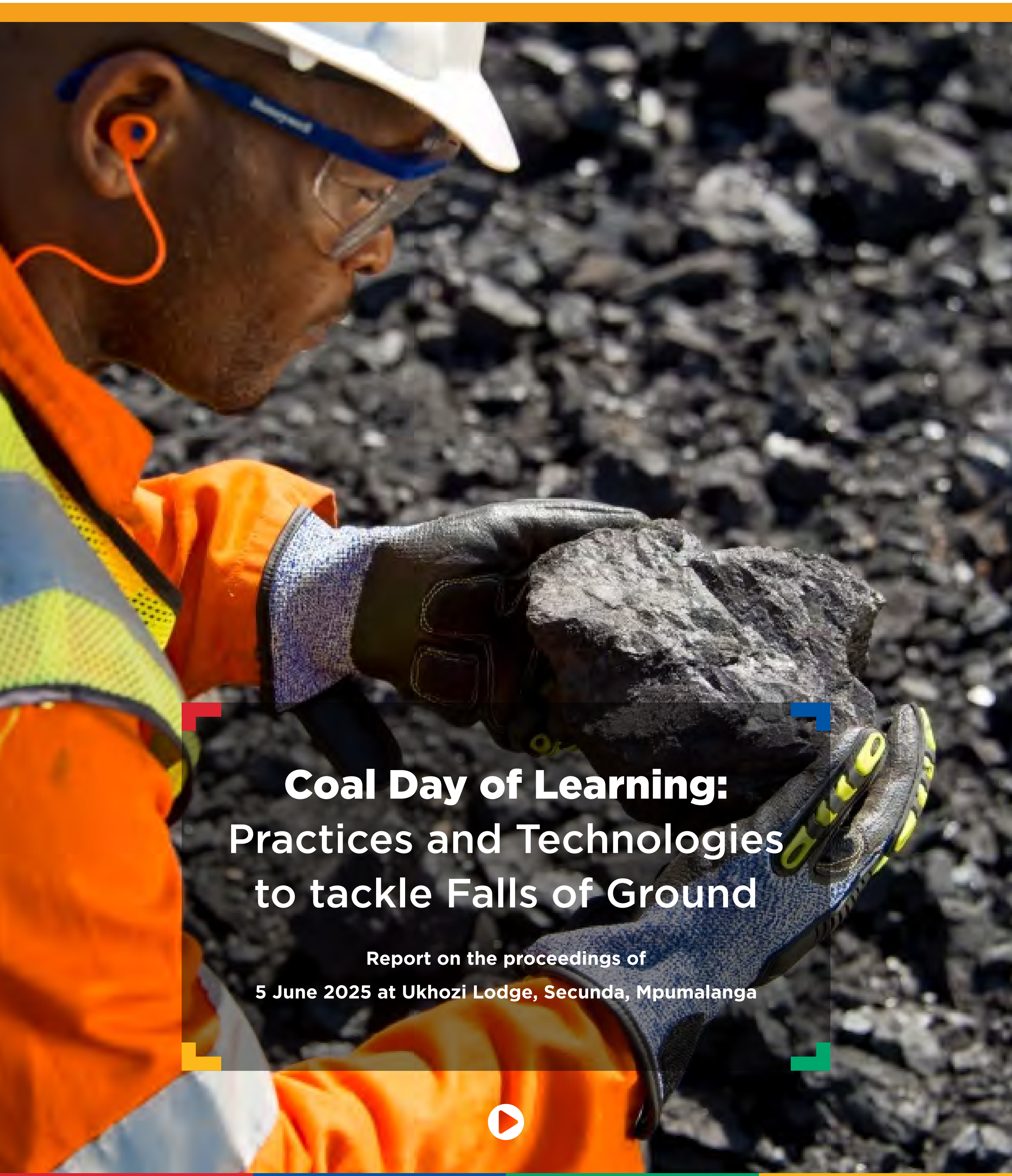
MINING INDUSTRY
OCCUPATIONAL
SAFETY & HEALTH

MINERALS COUNCIL
SOUTH AFRICA



# Coal Day of Learning: Practices and Technologies to tackle Falls of Ground

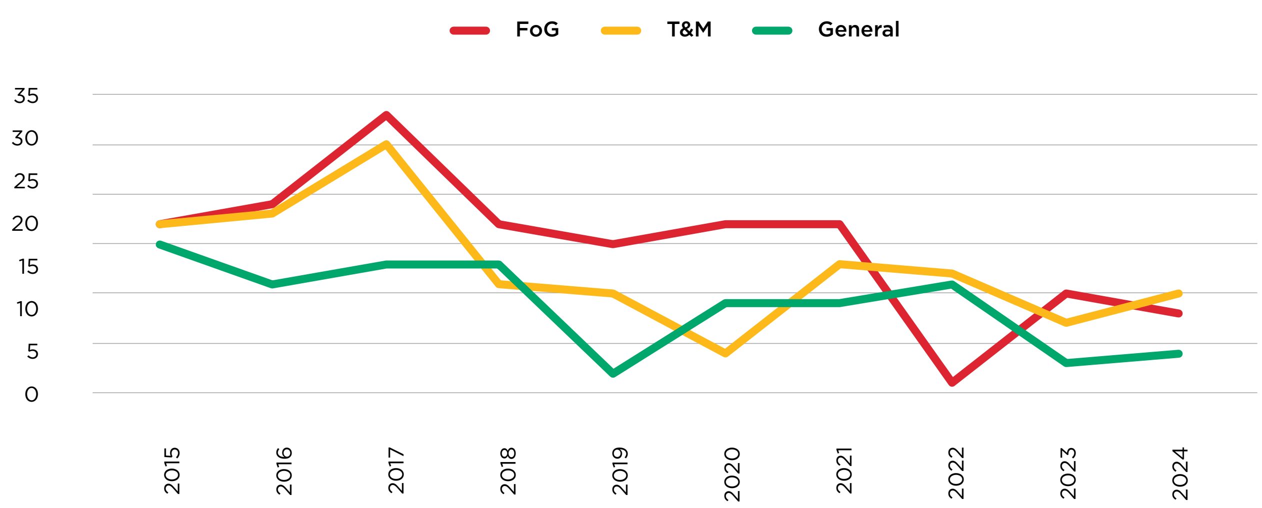
Report on the proceedings of
5 June 2025 at Ukhozi Lodge, Secunda, Mpumalanga

# Table of Contents

# Background

Falls of Ground (FoG) remain one of the leading causes of fatalities and serious injuries within the South African mining industry, consistently contributing to a significant portion of mining-related incidents as indicated in Figure 1. Despite notable improvements and relatively lower incident rates in the coal sector compared to hard rock mining, Falls of Ground continue to pose a substantial challenge.

The mining industry's commitment to "zero harm" underlines the necessity for ongoing vigilance and proactive risk management. Sharing innovative practices, operational learnings, and collaborative approaches among stakeholders is crucial for not only reducing current FoG incident rates but also for enabling sustainable improvements in mining safety. The imperative to work collectively in curbing Falls of Ground is evident, as every shared lesson and adopted best practice directly contributes to safeguarding the lives of mineworkers and fostering a culture of continuous improvement in mine safety.



Major Contributors of Fatalities

**Figure 1:** Major contributors to fatalities

# Introduction

Over 100 mining professionals convened in Secunda, Mpumalanga, on June 5, 2025, for the Coal Day of Learning, an event dedicated to practices and technologies aimed at tackling Falls of Ground in the coal sector. This event brought together expertise from across the industry, with five key presentations delivered by leading mines and industry experts. The diverse assembly included mine management, engineers, rock engineering practitioners, geologists, and safety practitioners, demonstrating the sector's deep commitment to the ongoing challenge of Falls of Ground prevention.

The agenda for the day was structured to maximise practical value and knowledge transfer. The session began with welcoming remarks from Nzama Baloyi, Vice President: SHE of Sasol Mining, followed by a keynote address and an overview of industry safety performance, delivered by the President of the South African Colliery Managers' Association (SACMA). Sessions included discussions on strategies for cultivating a strong health and safety culture, advancements in orebody knowledge, as well as a series of in-depth presentations on technical safety management in coal mines.

A crucial segment of the programme featured presentations by professionals from various mining houses. These talks included insights on managing intersection failures, innovative strategies for overloaded mesh, geological fault risk management, best practices for managing skin failures in out-bye areas, and techniques for ensuring sidewall stability. This session served as a forum for exchanging front-line learnings and solution-oriented approaches, providing attendees with practical takeaways to apply in their own operations.

Throughout the day, various presentations were delivered, focusing on strategies for managing Falls of Ground and the implementation of robust support systems. The discussions emphasised the significance of systematic inspections, innovative technologies, and collaborative approaches to risk management, ultimately aiming for a zero-harm environment in coal mining.

This report provides an overview of the presentations and discussions held during the event.

1

# Keynote Address

**George Hattingh**
SACMA President

# Keynote Address

### Mr. George Hattingh

**SACMA President, General Manager, Sasol Mining**

Email: george.hattingh@SASOL.com
Website: www.sasol.com

The keynote address titled “Falls of Ground – Past, Present, and Future,” delivered by George Hattingh, the SACMA President, focused on the critical issue of Falls of Ground (FoG) safety in the coal mining industry. The address highlighted the following key points:

- **Historical context and current statistics:** Hattingh provided an overview of Falls of Ground fatalities and serious injuries from 2015 to 2025, illustrating trends and emphasising the need for ongoing vigilance. The data showed fluctuations in fatalities, with a notable decline in recent years, particularly in 2022.

- **Innovations and equipment development:** The address discussed advancements in mining technology, including the development of new equipment and monitoring devices aimed at enhancing safety. Innovations such as remote-controlled continuous miners and improved roof bolting techniques were highlighted as critical to reducing Falls of Ground incidents.

- **Current challenges:** Hattingh outlined several challenges facing the industry, including technological gaps, a shortage of skilled professionals, and leadership accountability issues. He highlighted the need for better training and the integration of safety practices into daily operations.

- **Call to action:** The keynote concluded with a strong call to action for industry leaders to prioritise FoG safety. Hattingh urged all stakeholders to champion safety initiatives, invest in predictive technologies, and foster a culture of accountability and proactive risk management.

- **Future goals:** The address underscored the importance of collaboration among industry associations, employers, and workers to drive common safety standards and share best practices, ultimately aiming for a zero-harm environment in coal mining.

Overall, the keynote address served as a rallying point for the industry, emphasising the collective responsibility to prevent Falls of Ground and protect the lives of miners.

## 2

# Strategies for Cultivating and Sustaining a Strong Safety Culture

**Fleckson Magweregwede**
Centre of Excellence Manager
Mine Health and Safety Council

# Strategies for Cultivating and Sustaining a Strong Safety Culture

**Mr. Fleckson Magweregwede**
**Centre of Excellence Manager**
**Mine Health and Safety Council**

Email: fmagweregwede@mhsc.org.za
Website: www.mhsc.org.za

The presentation on "strategies for cultivating and sustaining a strong safety culture" emphasised the importance of fostering a positive health and safety culture within the mining sector. It outlined key strategies, including the need for effective collaboration among all stakeholders, the establishment of robust occupational health and safety management systems, and the cultivation of desired safety behaviours at all organisational levels. The presentation highlighted the evolution of health and safety culture through various stages, from reactive to interdependent cultures, and stressed the significance of leadership commitment in driving safety initiatives. Additionally, it discussed the role of technology and continuous improvement in enhancing safety performance, ultimately aiming for zero harm in the workplace.

## 3

# Advanced Orebody Knowledge (AOK)

**Michelle Pienaar**

Programme Manager:
Advanced Orebody Knowledge
Mandela Mining Precinct

# Advanced Orebody Knowledge

## Ms. Michelle Pienaar

**Programme Manager:**
**Advanced Orebody Knowledge, Mandela Mining Precinct**

Email: MPienaar@mandelaminingprecinct.org.za
Website: www.mandelaminingprecinct.org.za

The presentation on Advanced Orebody Knowledge (AOK) focused on creating a "Glass Rock" environment to enhance geological confidence and reduce risks associated with mining operations. It highlighted the integration of innovative technologies, such as the Smart Drill, which utilises machine learning for improved diamond drilling practices and real-time geological data collection. The presentation also discussed various geophysical methods, including Ground Penetrating Radar (GPR) and Tunnel Seismic Profiling (TSP), aimed at detecting geological structures and ensuring safety ahead of the mining face. Additionally, it emphasised the importance of research dissemination and collaboration among industry stakeholders to advance mining safety and efficiency. Overall, the AOK initiative aims to leverage technology and research to improve mine design, planning, and operational safety.

## 4

# Geological Fault Risk Management at Exxaro Grootegeluk Mine

# Geological Fault Risk Management at Exxaro Grootegeluk Mine

**Mr. Reginald Mathivha**
**Senior Rock Engineer, Exxaro**

Email: reginald.mathivha@exxaro.com
Website: www.exxaro.com

## 1. Introduction

Exxaro Grootegeluk mine is situated 20 km from Lephalale in South Africa's Limpopo province (see Figure 1). This open pit mine employs 3,200 people and produces 26 Mtpa final coal products, using a conventional truck and shovel operation. This mine has an estimated minable coal reserve of 3 261 Mt, and a total measured coal resource of 4 719 Mt, from which semi-soft coking coal, thermal coal, and metallurgical coal can be produced.

The geological formations present in Grootegeluk Coal mine include the Volkrust formation and the Vryheid formation. The Grootegeluk pit is bounded by significant geological faults, specifically the Daarby Fault to the north and the Eenzamheid Fault to the south. These faults create a structurally controlled deposit, which is essential for the mining operations. The presence of these faults poses safety risks, including bench scale failures that can negatively impact personnel and equipment, as well as ineffective blasting outcomes if these faults are not adequately considered in the blast design.

The Exxaro Grootegeluk Coal Mine employs a comprehensive approach to geological fault risk management, emphasising a culture of consistency as reflected in their promotional materials, which state, "Consistency is our culture", "Consistency is our identity," and "Consistency is our way of work".

This report summarises the key components of their fault risk management strategies, including understanding geological faults, data collection, fault characterisation, and future management strategies.

Figure 1: Exxaro Grootegeluk locality map

## 2. Understanding Geological Faults

Geological faults are defined as planar fractures in rock that can lead to significant displacement, posing safety risks to mining operations. These risks include bench scale failures that can impact personnel and equipment, as well as ineffective blasting outcomes if faults are not considered in blast designs. Additionally, faults can act as conduits for groundwater, leading to flooding in active mining areas and causing ore dilution.

## 3. Risk Management Strategies

### 3.1 Data Collection

Effective risk management begins with thorough data collection. The Exxaro Grootegeluk Coal Mine utilises:

- LIDAR highwall mapping provides safe, high data density, and accurate measurements. This method is essential for capturing detailed topographical information that aids in understanding the geological features of the mining area.
- Fault-induced failure back-analysis to assess failure conditions and confirm shear strength properties.
- Core logging, which involves manual logging of core samples, Downhole Geophysical logging to confirm the orientation and location of the fault structures and laboratory testing to determine shear strength properties.

### 3.2 Fault Characterisation

Fault characterisation at the Exxaro Grootegeluk Coal Mine involves a detailed analysis of the geological faults present in the mining area. This process is crucial for understanding the orientation and behaviour of different fault sets, which can significantly impact mining operations.

The characterisation begins with a Fault Sets Stereo Plot (see Figure 2), which is a stereographic projection that illustrates the orientation of various fault sets. This plot is colour-coded to indicate the density of poles to fault planes, with warmer colours representing higher concentrations of faults. This visual representation helps in identifying critical areas where faults may pose risks.

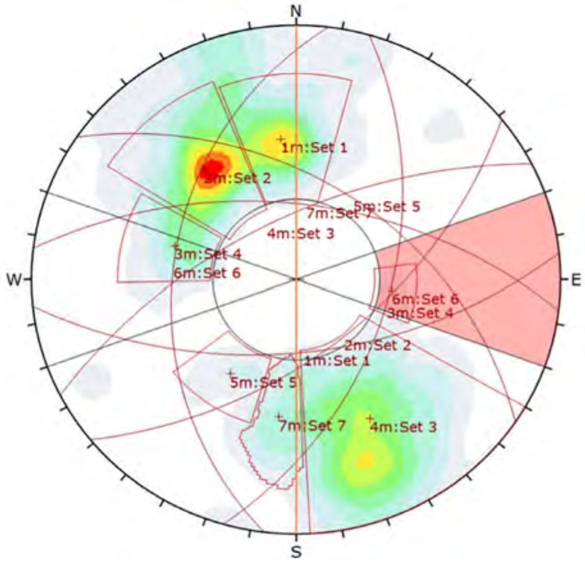


Figure 2: Stereographic projection that illustrates the orientation of various fault sets

Additionally, a 3D Fault Model is created to provide a more comprehensive view of the fault network within the mining area. In this model, the faults are depicted as yellow lines, allowing for a clear understanding of their spatial relationships and potential interactions (see Figure 3). This 3D visualisation is essential for planning safe mining operations and mitigating risks associated with fault-induced failures.

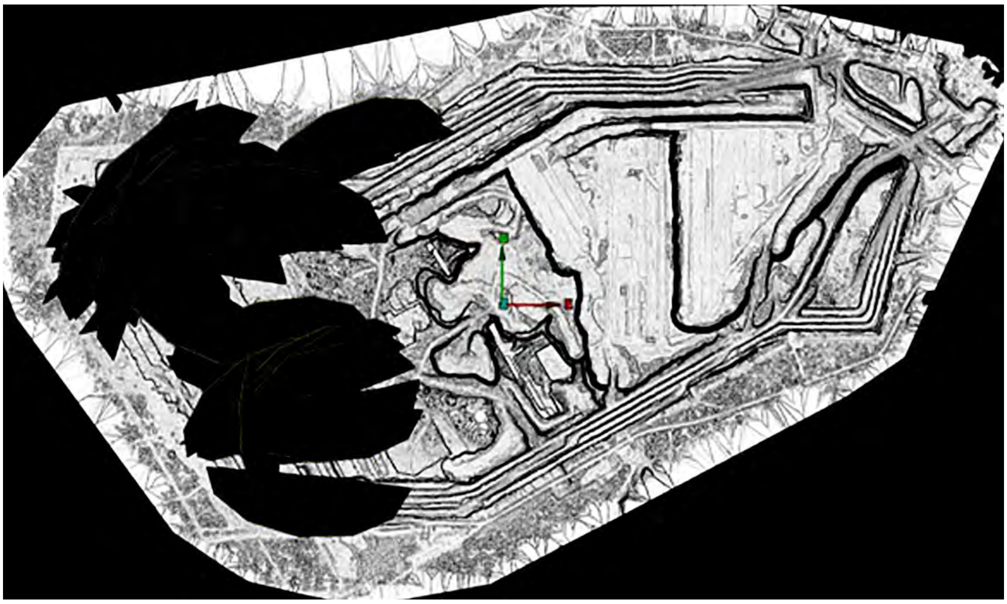


Figure 3: 3D Fault model

Furthermore, the Projected Fault Model - Strike offers an aerial view of the fault network projected onto the surface, again represented by yellow lines (see Figure 4). This projection aids in assessing how surface operations may be affected by the underlying fault structures. Overall, the fault characterisation process at Grootegeluk is a critical component of the mine's risk management strategy, ensuring that safety and operational efficiency are maintained.

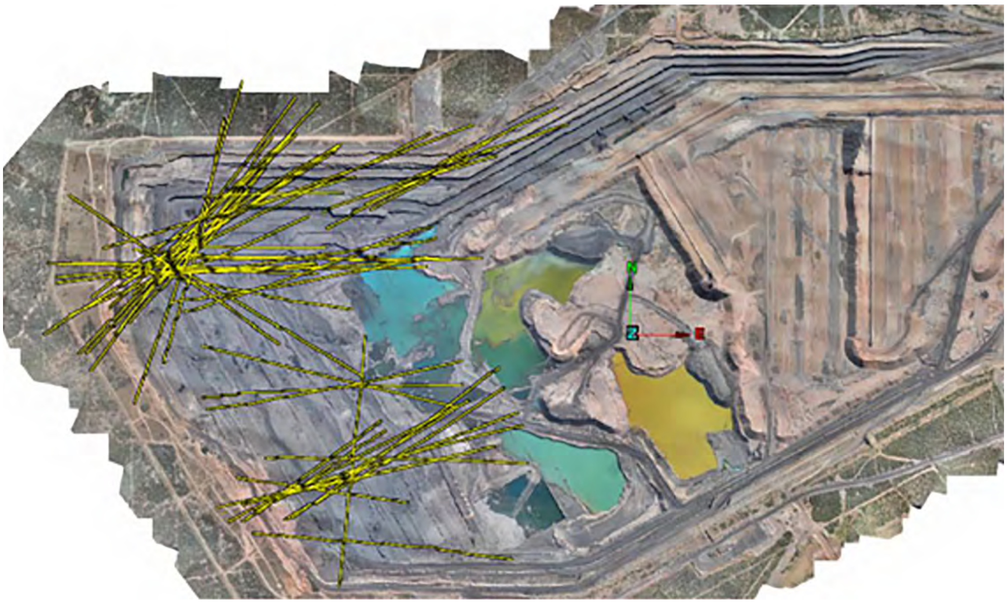


Figure 4: Projected fault model – strike indicating an aerial view of the fault network projected onto the surface

### 3.3 Kinematic and Numerical Analysis

The kinematic and numerical analysis at the Exxaro Grootegeluk Coal Mine plays a crucial role in understanding and managing geological faults. This analysis involves the use of advanced modelling techniques to assess the stability of rock masses and predict potential failure conditions. The mine employs numerical modelling to simulate the behaviour of rock under various stress conditions, which helps in identifying areas at risk of failure.

Additionally, the kinematic analysis focuses on the movement and interaction of fault planes, providing insights into how these movements can impact mining operations. This includes evaluating the potential for bench-scale failures that could endanger personnel and equipment. The integration of these analyses into the overall risk management strategy allows for proactive measures to be implemented, such as adjusting blast designs to account for fault presence.

### 3.4 Other Strategies

The mine has established several risk management strategies, including crest and toe demarcation standards, specialised training for mining operations, and the inclusion of fault considerations in blast block designs. Proactive numerical modelling and a ground control hazard plan are also integral to their approach, ensuring that potential risks are identified and mitigated before they impact operations.

**Crest and toe demarcation standards** are critical for ensuring safe mining operations near faulted areas. This involves clearly marking safe zones to prevent accidents related to potential ground failures.

**Training** in mining operations is tailored to provide personnel with the necessary knowledge and skills to identify and address geological hazards, ultimately improving overall safety.

Incorporating fault considerations into **blast block design** is another effective approach (see Figure 5).

By factoring in fault data during the design process, the mine can reduce the likelihood of poor blasting results, which may arise if faults are not properly acknowledged.

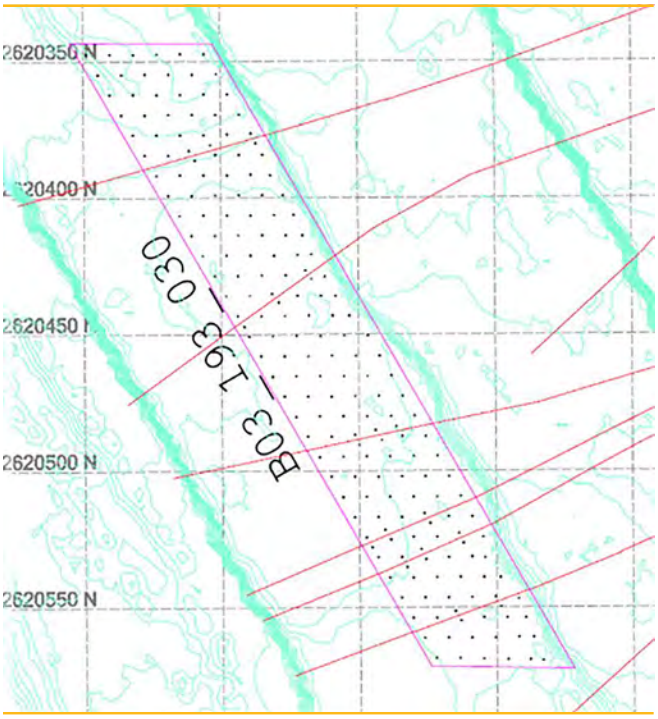


Figure 5: Plan indicating a blast block that incorporates faults into the design

Additionally, **proactive numerical modelling and analysis** are also integral to the Grootegeluk fault risk management approach. This approach allows for the simulation of potential fault behaviour under various conditions, helping to predict and mitigate risks before they manifest in the field.

Finally, the **Ground Control Hazard Plan**, which provides a framework of specific control measures and designated hazard zones, is implemented to ensure safe operations in areas affected by geological faults.

## 4. Future Management Strategies

The future management strategies at Exxaro Grootegeluk Coal Mine focus on implementing a high-precision loading system. This system is designed to enhance operational safety and efficiency by displaying critical mining block information, such as block elevation, material types, and faulting boundaries, directly on the in-cabin screen for operators.

One of the key features of this system is its ability to indicate the proximity to faulted ground, which serves as a guide for operators while loading. This real-time guidance is intended to help minimise risks associated with working near geological faults, thereby improving safety for personnel and equipment.

Overall, these strategies reflect Exxaro's commitment to integrating advanced technology into its operations, reinforcing its focus on safety, production, and cost control.

# Conclusion

In conclusion, the Exxaro Grootegeluk Coal Mine's fault risk management strategy is a multifaceted approach that prioritises safety, production, and cost control. By integrating detailed data collection, fault characterisation, and advanced modelling techniques, the mine aims to mitigate risks associated with geological faults effectively. The commitment to enhancing these strategies with innovative technologies, such as high-precision loading systems, reinforces Exxaro's dedication to maintaining a safe and efficient mining operation.

## 5

# Back-bye Management Strategy at Seriti Khutala Colliery

# Back-bye Management Strategy at Seriti Khutala Colliery

**Mr. Dakalo Matumba**
**Strata Control Specialist, Seriti**

Email: dakalo.matumba@seritiza.com
Website: www.seritiza.com

## 1. Background and Locality

Khutala Colliery is situated on the western side of the Witbank Coal Field (WCF), in the northern section of South Africa’s Karoo Basin. The mine exploits multiple coal seams, with seam thicknesses ranging from 0.18 m to 10.26 m and depths between 20 m and 100 m, depending on the seam. The geological profile includes laminated sandstone, mudstone, and silty mudstone, which present unique challenges for ground control, particularly in the backbye (previously mined) areas.

## 2. Introduction

This report provides a comprehensive overview of the presentation delivered on 5 June 2025, detailing the Backbye Management Strategy at Khutala Colliery. The discussions outlined the historical context, current challenges, incidents, and strategic responses related to ground control and roof support in the backbye areas of Khutala Colliery.

## 3. Historical Roof Support Strategies

The historical support strategies employed at Khutala have evolved over the years, with various support systems implemented since 1991. These include mechanical bolts and resin anchors, which have been critical in maintaining roof stability.

**Khutala Colliery Locality**

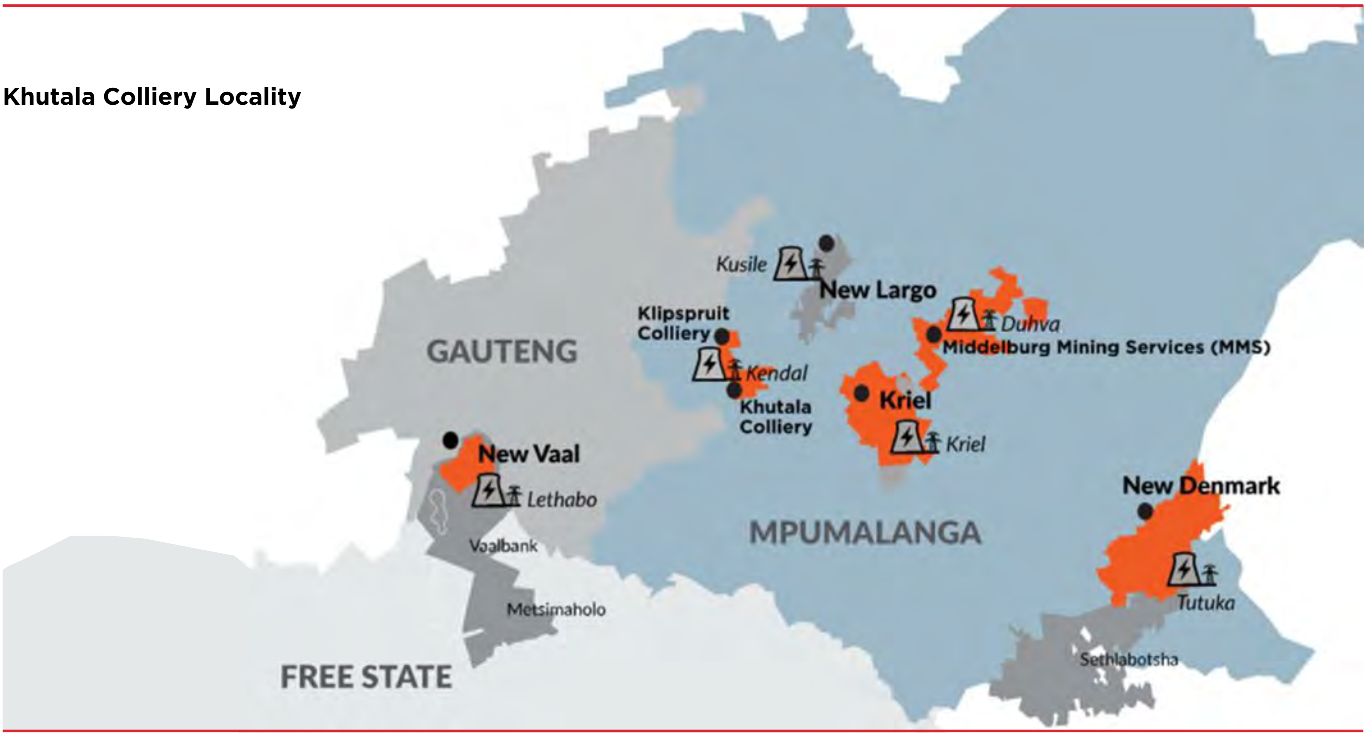


Figure 1: Location: Western side of the Witbank Coal Field (WCF), northern part of South Africa’s Karoo Basin.

**Roof Support History Timeline**

| 1991 | 1997 | 1998 | 2004 |
|---|---|---|---|
| Installation of 2 x 1.5 m x 16 mm mechanical bolts per row. | Introduction of Voest onboard support with staggered bolts. | Adoption of 3 x 1.8 m x 18 mm point anchor resin bolts. | Implementation of 4 x 1.8 m x 20 mm full column resin bolts. |

Despite these efforts, evolving ground conditions and the ageing of installed supports have necessitated a review and enhancement of support strategies, particularly in the backbye areas.

## 4. Current Backbye Ground Conditions

Recent assessments have identified several ground control issues prevalent in backbye areas that require attention:

- **Roof Slabbing:** Occurs between and around roof bolts, leading to ineffective support and loose hanging roof bolts.
- **Delaminated Roof Slabs:** Identified in areas previously supported with mechanical anchor bolts, indicating a risk of further slabbing.
- **Geological Structures:** Faults and dykes not previously fully supported, contributing to localised instability.
- **Roof Debris Accumulation:** Roof nets accumulate debris and require regular bleeding and maintenance.
- **Damaged Support Infrastructure:** Torn roof nets and deteriorated support elements necessitate replacement and reinforcement.

## 5. Backbye Falls of Ground Incidents

Several incidents of roof and sidewall failures have been documented in the backbye areas:

- Weak laminated coal strata (0.2 m–0.3 m thick) have failed in inadequately supported areas.
- Roof slabs of laminated sandstone have fallen onto belt structures, causing operational disruptions and equipment damage.
- Coal blocks have detached from pillar sidewalls, exacerbated by heavy rainfall and lack of areal support.
- Large brow failures have occurred in travelling roads, attributed to total seam mining and inadequate support during air-crossing construction.

These incidents underscore the need for a robust and dynamic backbye management strategy.

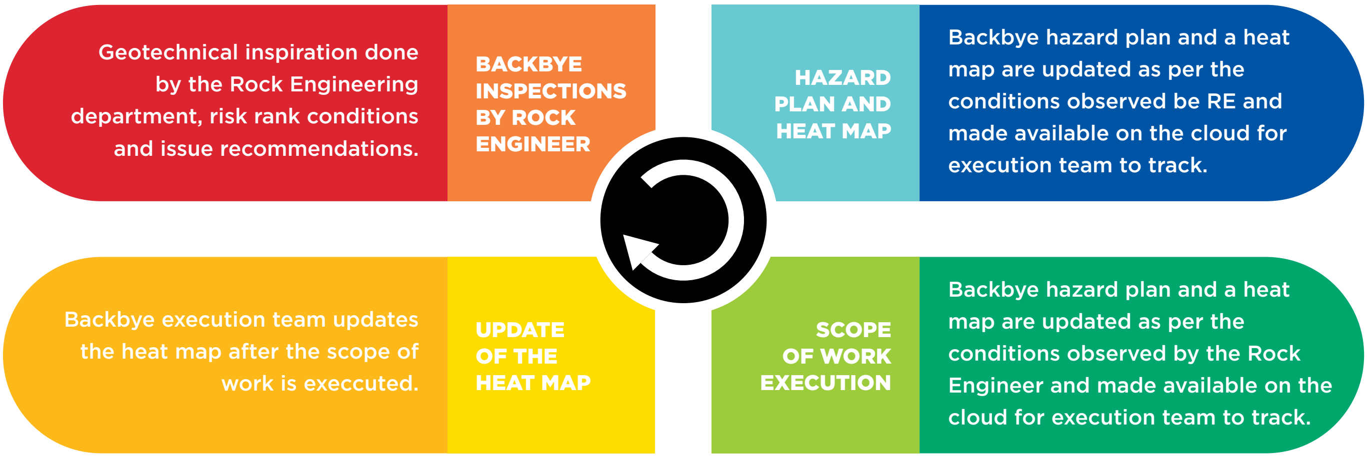
## 6. Backbye Management Strategy

The backbye management process is structured as a circular flow, encompassing inspections by the Rock Engineering (RE) department, updates to hazard plans, execution of work scopes, and subsequent updates to heat maps. This systematic approach ensures that all stakeholders are informed and that safety measures are effectively implemented. The current strategy is a systematic, multi-step process.

### 6.1 Backbye Management Process Flow

The backbye management process flow is a systematic approach that includes geotechnical inspections conducted by the Rock Engineering (RE) department, which assess conditions and issue recommendations, followed by the updating of a hazard plan and heat map based on these observations, and culminates in the execution of the scope of work by the backbye execution team, with subsequent updates to the heat map after the work is completed.

**Backbye Management Process Flow**



**BACKBYE INSPECTIONS BY ROCK ENGINEER**

Geotechnical inspiration done by the Rock Engineering department, risk rank conditions and issue recommendations.

**HAZARD PLAN AND HEAT MAP**

Backbye hazard plan and a heat map are updated as per the conditions observed be RE and made available on the cloud for execution team to track.

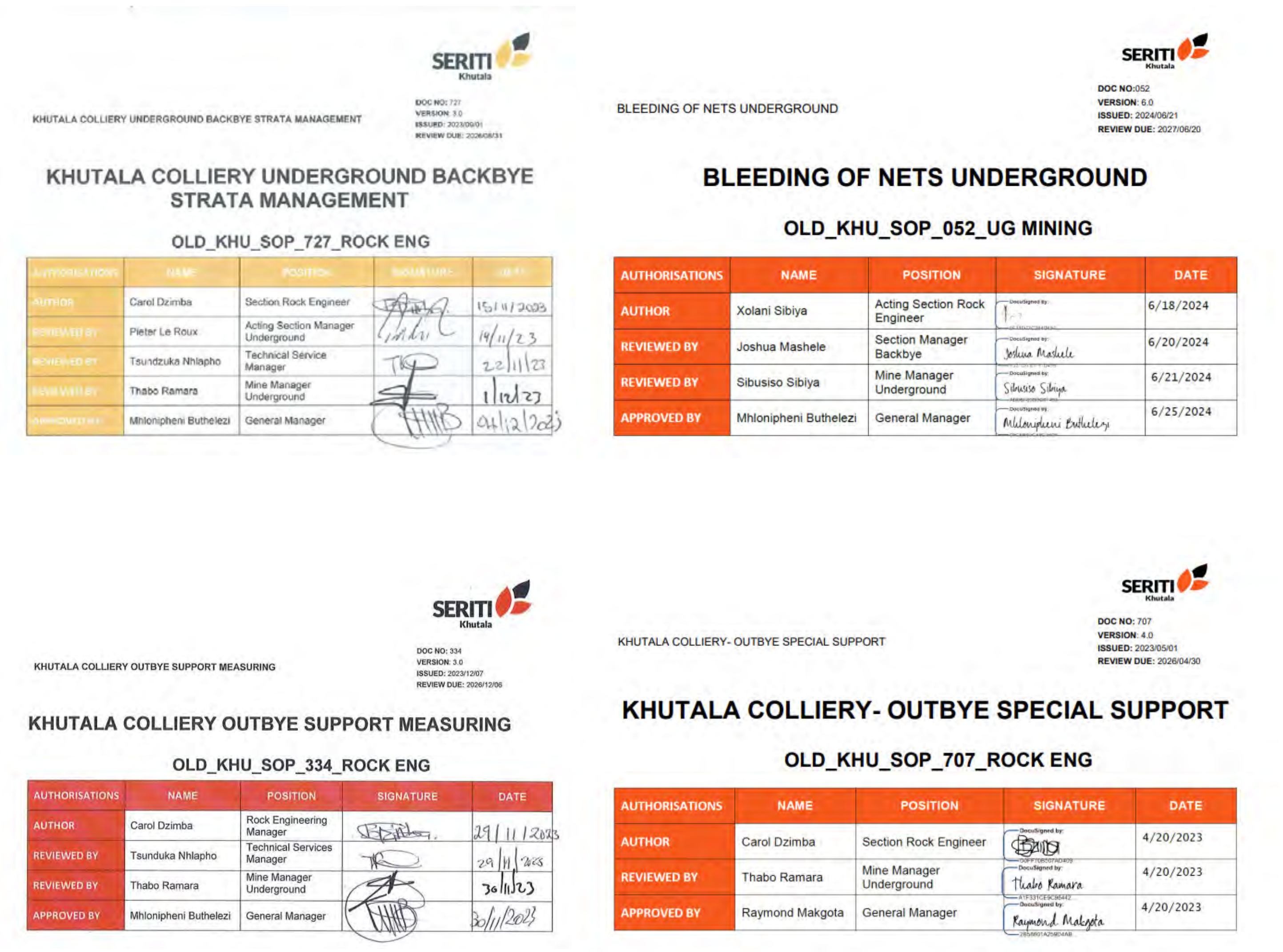
**SCOPE OF WORK EXECUTION**

Backbye hazard plan and a heat map are updated as per the conditions observed by the Rock Engineer and made available on the cloud for execution team to track.

**UPDATE OF THE HEAT MAP**

Backbye execution team updates the heat map after the scope of work is execcuted.

Figure 2: Khutala Colliery backbye management process flow



KHUTALA COLLIERY UNDERGROUND BACKBYE STRATA MANAGEMENT

**DOC NO:** 727
**VERSION:** 3.0
**ISSUED:** 2023/09/01
**REVIEW DUE:** 2026/08/31

**KHUTALA COLLIERY UNDERGROUND BACKBYE STRATA MANAGEMENT**

**OLD_KHU_SOP_727_ROCK ENG**

| AUTHORISATIONS | NAME | POSITION | SIGNATURE | DATE |
|---|---|---|---|---|
| AUTHOR | Carol Dzimba | Section Rock Engineer | | 15/11/2023 |
| REVIEWED BY | Pieter Le Roux | Acting Section Manager Underground | | 14/11/23 |
| REVIEWED BY | Tsundzuka Nhlapho | Technical Service Manager | | 22/11/23 |
| REVIEWED BY | Thabo Ramara | Mine Manager Underground | | 1/12/23 |
| APPROVED BY | Mhlonipheni Buthelezi | General Manager | | 04/12/2023 |

BLEEDING OF NETS UNDERGROUND

**DOC NO:**052
**VERSION:** 6.0
**ISSUED:** 2024/06/21
**REVIEW DUE:** 2027/06/20

**BLEEDING OF NETS UNDERGROUND**

**OLD_KHU_SOP_052_UG MINING**

| AUTHORISATIONS | NAME | POSITION | SIGNATURE | DATE |
|---|---|---|---|---|
| AUTHOR | Xolani Sibiya | Acting Section Rock Engineer | DocuSigned by: | 6/18/2024 |
| REVIEWED BY | Joshua Mashele | Section Manager Backbye | DocuSigned by:<br>Joshua Mashele | 6/20/2024 |
| REVIEWED BY | Sibusiso Sibiya | Mine Manager Underground | DocuSigned by:<br>Sibusiso Sibiya | 6/21/2024 |
| APPROVED BY | Mhlonipheni Buthelezi | General Manager | DocuSigned by:<br>Mhlonipheni Buthelezi | 6/25/2024 |

KHUTALA COLLIERY OUTBYE SUPPORT MEASURING

**DOC NO:** 334
**VERSION:** 3.0
**ISSUED:** 2023/12/07
**REVIEW DUE:** 2026/12/06

**KHUTALA COLLIERY OUTBYE SUPPORT MEASURING**

**OLD_KHU_SOP_334_ROCK ENG**

| AUTHORISATIONS | NAME | POSITION | SIGNATURE | DATE |
|---|---|---|---|---|
| AUTHOR | Carol Dzimba | Rock Engineering Manager | | 29/11/2023 |
| REVIEWED BY | Tsunduka Nhlapho | Technical Services Manager | | 29/11/2023 |
| REVIEWED BY | Thabo Ramara | Mine Manager Underground | | 30/11/23 |
| APPROVED BY | Mhlonipheni Buthelezi | General Manager | | 30/11/2023 |

KHUTALA COLLIERY- OUTBYE SPECIAL SUPPORT

**DOC NO:** 707
**VERSION:** 4.0
**ISSUED:** 2023/05/01
**REVIEW DUE:** 2026/04/30

**KHUTALA COLLIERY- OUTBYE SPECIAL SUPPORT**

**OLD_KHU_SOP_707_ROCK ENG**

| AUTHORISATIONS | NAME | POSITION | SIGNATURE | DATE |
|---|---|---|---|---|
| AUTHOR | Carol Dzimba | Section Rock Engineer | DocuSigned by: | 4/20/2023 |
| REVIEWED BY | Thabo Ramara | Mine Manager Underground | DocuSigned by:<br>Thabo Ramara | 4/20/2023 |
| APPROVED BY | Raymond Makgota | General Manager | DocuSigned by:<br>Raymond Makgota | 4/20/2023 |

Figure 3: Example of the Khuthala colliery standard operating procedure

### 6.2 Standard Operating Procedures

Standard Operating Procedures (SOPs) are integral to the backbye management strategy, detailing authorisations and responsibilities for various roles within the organisation. These SOPs are designed to ensure compliance with safety standards and to facilitate effective communication among team members (see Figure 3).

### 6.3 Backbye Support Rule

Various roof and sidewall support rules form part of the backbye management strategy. Table 1 details the systematic support patterns as well as the diagrams illustrating the support patterns.

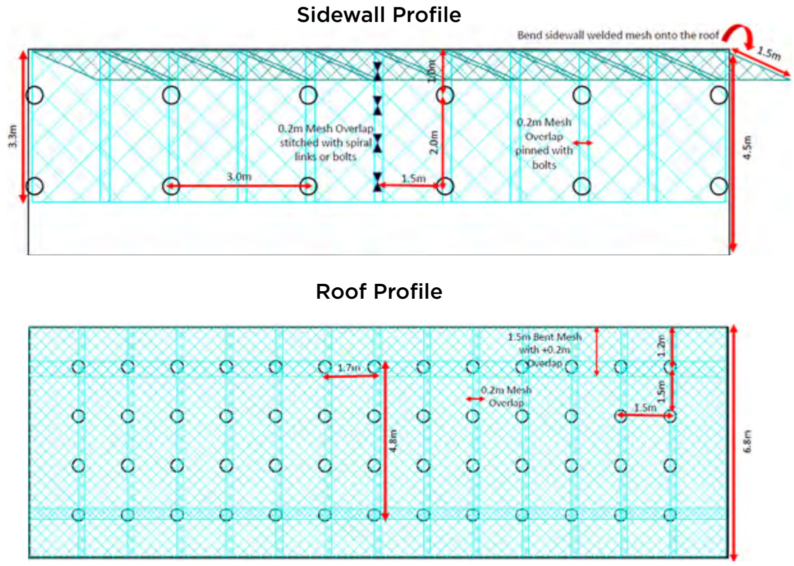
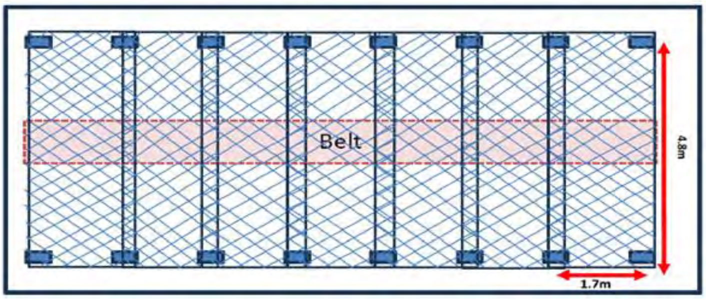
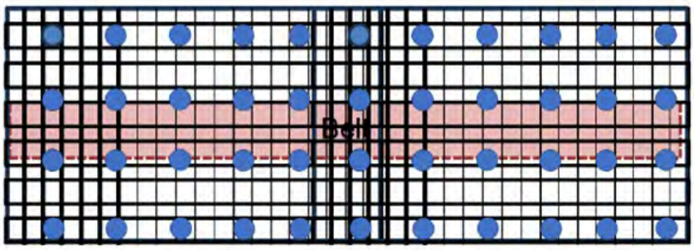
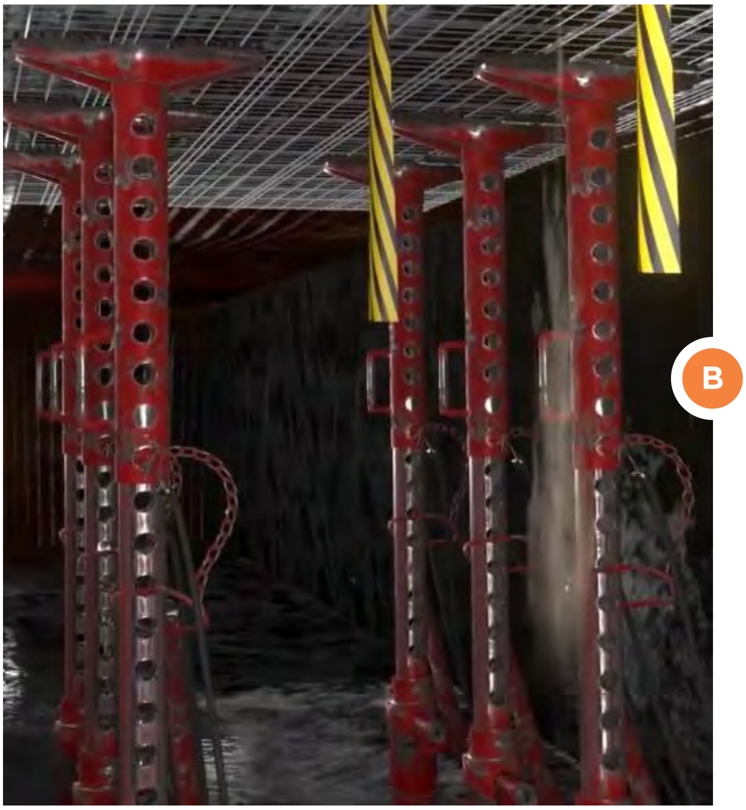
| SUPPORT PATTERN | SUPPORT PATTERN DIAGRAM/ILLUSTRATION |
|---|---|
| Systematic Roof and Sidewall Welded Mesh Support Pattern.<br>The diagram depicts the roof and sidewall support using welded mesh and bolts. |  |
| Suspension of Roof Mesh with Hydraulic/Temporary Support Jacks.<br>The diagram illustrates a roof support system that employs hydraulic or temporary support jacks alongside a conveyor belt. This system is designed to suspend the mesh on the roof. |  |
| Systemic Roof Welded Mesh Support Pattern Using Double Nuts/Q-links.<br>The diagram shows a roof support system that incorporates a welded mesh pattern suspended with double nuts or Q-links in the conveyor belt road. |  |

Table 1: Systematic support patterns

The following figures are photographs captured in situ that demonstrate the various support patterns utilised as described in Table 1. The images provide a visual representation of the support systems in place, where the systematic roof and sidewall areal support is installed.

**A**

**Systematic roof and sidewall welded mesh support pattern**



**B**

**Suspension of roof welded mesh with hydraulic/temporary support jacks**

**C**

**Systemic roof welded mesh support pattern using double nuts/Q-links**

Figure 4: Support patterns

### 6.4 Critical Control Verifications

Critical control verifications for back-bye support verifications are scheduled monthly and assigned to both execution and rock engineering personnel. They are designed to track overall back-bye conditions and support status. Actions are raised on Isometrix where non-compliance is identified.

### 6.5 Hazard Plan

A hazard plan outlining the ground conditions in the backbye areas is maintained. The hazard ranks areas by risk, noting where support is missing, nets that require bleeding, or high-risk areas. This process ensures that high risk zones receive prioritised attention and intervention.

### 6.6 Specialised Support

This approach is employed by the internal mining teams to install roof support above the conveyor belt by utilising portable hand-held roof bolter machines, commonly referred to as Gophers, along with scaffolding to facilitate work over the conveyor belt while it remains operational. This method ensures that safety and efficiency are maintained during the support installation process.

## Conclusion

**In conclusion, the Khutala Backbye Management Strategy is a vital framework designed to enhance safety and operational efficiency within the underground mining environment. The strategy emphasises the importance of systematic inspections and the implementation of robust support systems, as outlined in the backbye management process flow, which includes stages such as hazard mapping and execution of work scopes by the backbye execution team.**

**The ongoing monitoring and updating of conditions, as well as the implementation of corrective actions, are crucial for maintaining a safe working environment and ensuring compliance with established safety standards.**

**Overall, the Khutala Backbye Management Strategy reflects a proactive and collaborative approach to managing the complexities of underground mining, prioritising the safety of personnel and the integrity of mining operations.**

## 6

# Managing Intersection Failures at Seriti Kriel Colliery

# Managing Intersection Failures at Seriti Kriel Colliery

**Mr. Lindokuhle Khumalo**
**Strata Control Officer Senior, Seriti**

Email: lindokuhla.khumalo@seritiza.com
Website: www.seritiza.com

## 1. Introduction

Kriel Colliery's intersection failure management is a critical aspect of ensuring safety and operational efficiency in mining activities. The management strategies are informed by geological complexities and historical data on Falls of Ground (FoG) events. The Kriel Block F area is primarily focused on the No. 4 seam, which is exclusively dedicated to the Kriel Power Station, while additional resources in the No. 2 and 5 seams remain uncommitted under the current Coal Supply Agreement.

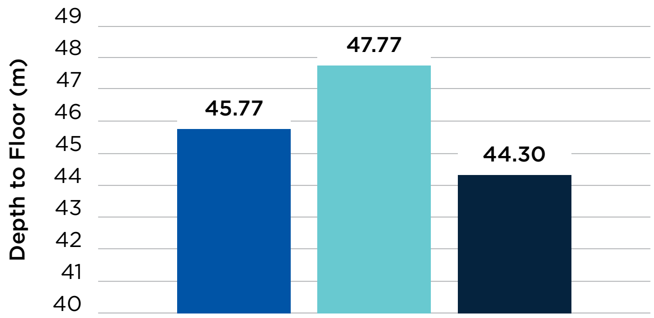
## 2. Overview of Intersection Failures

Several significant FoG events (intersection failures) occurred in 2021 and 2024. Each event was analysed for its geological context, including the challenges posed by poor ground conditions and proximity to geological features such as dykes, the lithology of the roof strata, prevailing ground conditions, mining depth as well as the excavation and support parameters.

## 3. Understanding The Falls of Ground Risk at Kriel Colliery

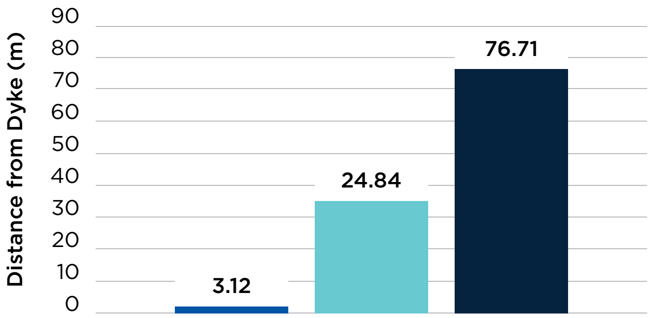
The complexity of Kriel's geology significantly impacts the risk of intersection failures. The mining dimensions, including bord width and pillar centers, are critical factors in assessing this risk. Figure 1 presents bar charts comparing various metrics such as depth to floor, distance from dyke, maximum bord width and time between mining and failures across different Falls of Ground events. Figure 2 defines intersection sizes and their classifications, including small, normal, enlarged, and oversized intersections.

**Kriel FoG 2024: Depth to Floor**



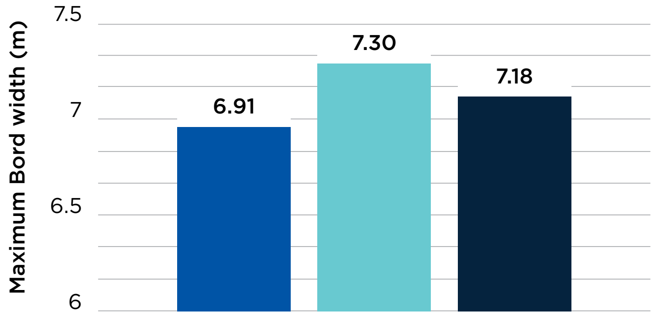
| | DEPTH TO FLOOR |
|---|---|
| ■ Fezela (17 January 2024) | 45.77 |
| ■ Fezela (08 June 2024) | 47.77 |
| ■ Ngwenya (08 July 2024) | 44.30 |

**Kriel FoG 2024: Distance from Dyke**



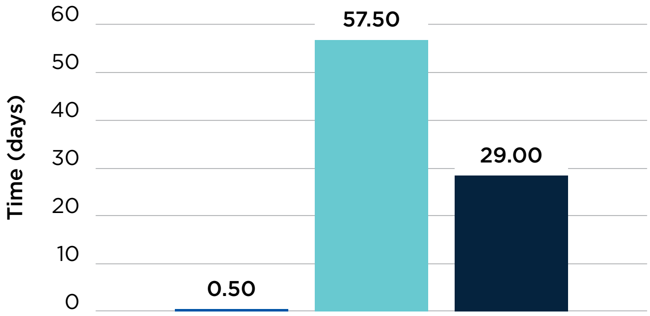
| | DISTANCE FROM THE DYKE |
|---|---|
| ■ Fezela (17 January 2024) | 3.12 |
| ■ Fezela (08 June 2024) | 24.84 |
| ■ Ngwenya (08 July 2024) | 76.71 |

**Kriel FoG 2024: Maximum Bord Width**



| | DISTANCE FROM THE DYKE |
|---|---|
| ■ Fezela (17 January 2024) | 6.91 |
| ■ Fezela (08 June 2024) | 7.30 |
| ■ Ngwenya (08 July 2024) | 7.18 |

**Kriel FoG 2024: Time Between Mining and Failure**

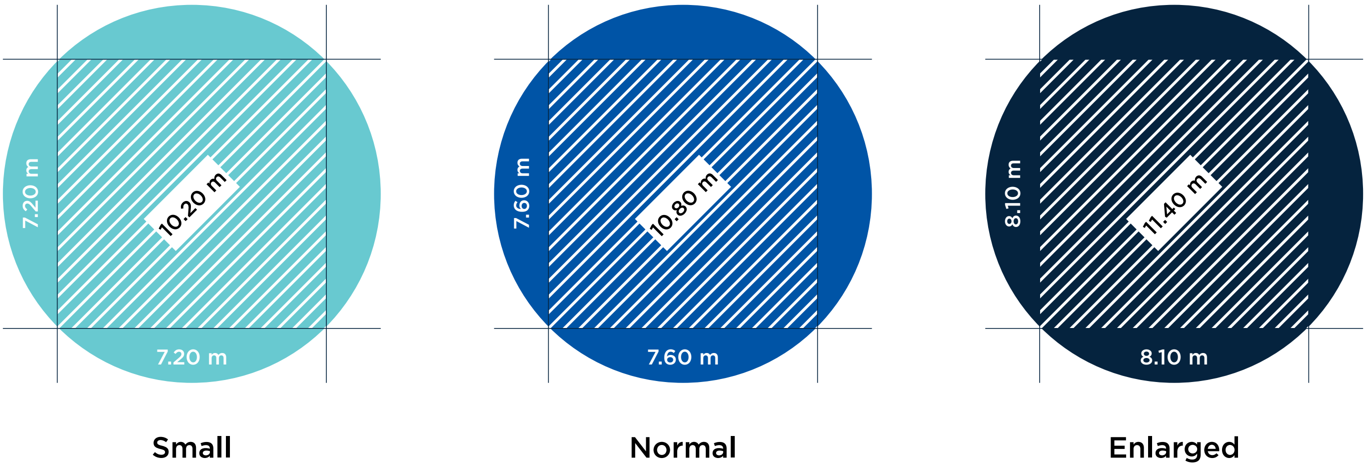


| | TIME BETWEEN MINING AND FAILURE |
|---|---|
| ■ Fezela (17 January 2024) | 0.50 |
| ■ Fezela (08 June 2024) | 57.50 |
| ■ Ngwenya (08 July 2024) | 29.00 |

Figure 1: Bar charts comparing various mining parameters and significant failures

**Defining of Intersection Sizes**

| INTERSECTION CLASS | ROAD WIDTH | TYPICAL OFFLINE % | POLYGON AREA | CIRCLE AREA |
|---|---|---|---|---|
| **SMALL** | up to 7.20 m | 0 % | 51.80 m² | 81.30 m² |
| **NORMAL** | 7.20 m - 7.60 m | 6 % | 58.20 m² | 91.30 m² |
| **ENLARGED** | 7.60 m - 8.10 m | 6 % - 12 % | 65 m² | 102 m² |
| **OVERSIZED** | 8.10 m + | 12 % + | > 65 m² + | > 102 m² + |

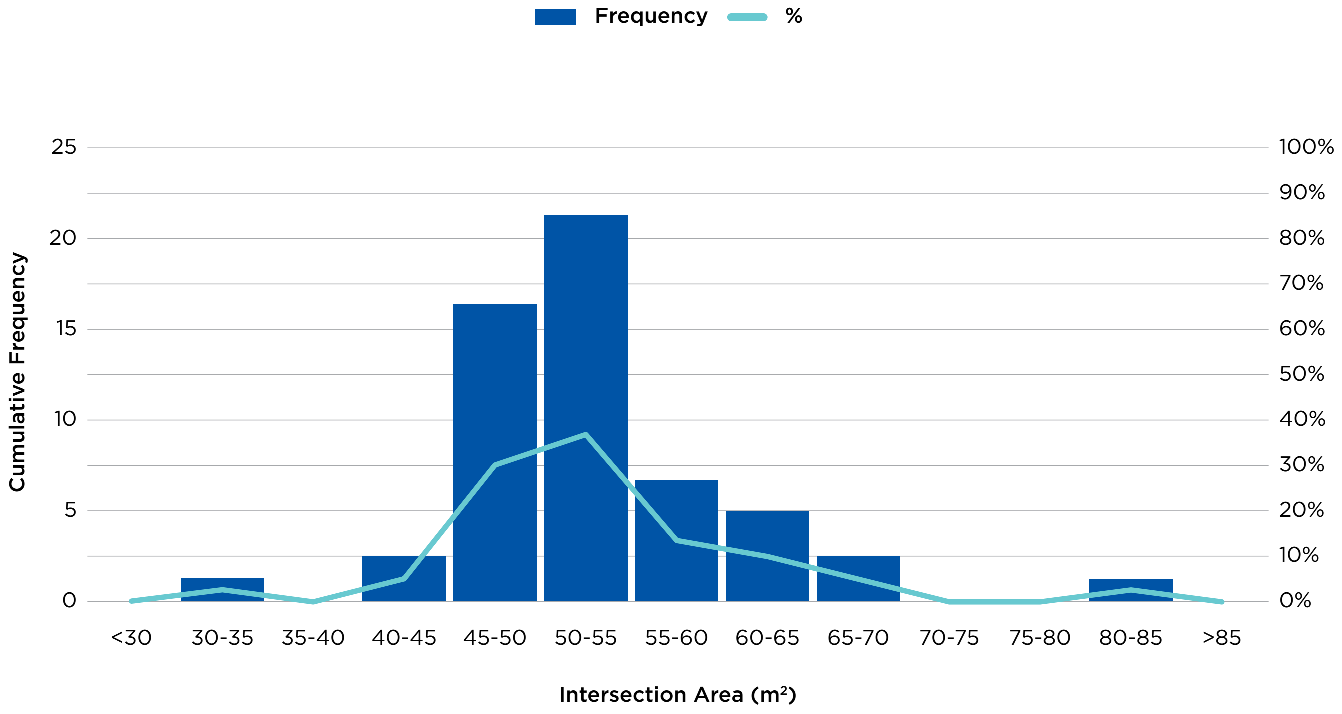


The graphs displayed in Figure 7 indicate the cumulative frequency data and comparison of intersection sizes across different areas. Key insights from the graphs include:

- All groups have their highest frequency of intersection areas in the 50–55 m² range.
- Intersection sizes in Ngwenya are relatively uniform, with most falling within a narrow mid-range. However, outliers were quite excessive when mining was conducted at a bord width of 7.20 m.
- Fezela and Phumba have the most tightly clustered intersection areas, suggesting greater uniformity.
- Ihlosi shows the greatest variability, with a wider spread and some larger intersections.
- Bhubesi and Ihlosi both show a slight right skew, indicating occasional larger intersections.
- The cumulative frequency lines confirm that most intersections for all groups fall within the 45–60 m² range, with Fezela being the most concentrated. However, wider bords of 7.20 m created quite a number of outliers which are in the range of oversized intersection spans.

Figure 2: Definition of intersection sizes and their classifications, including small, normal, enlarged, and oversized intersections

**Ngwenya Intersections**



**Ngwenya Intersections**

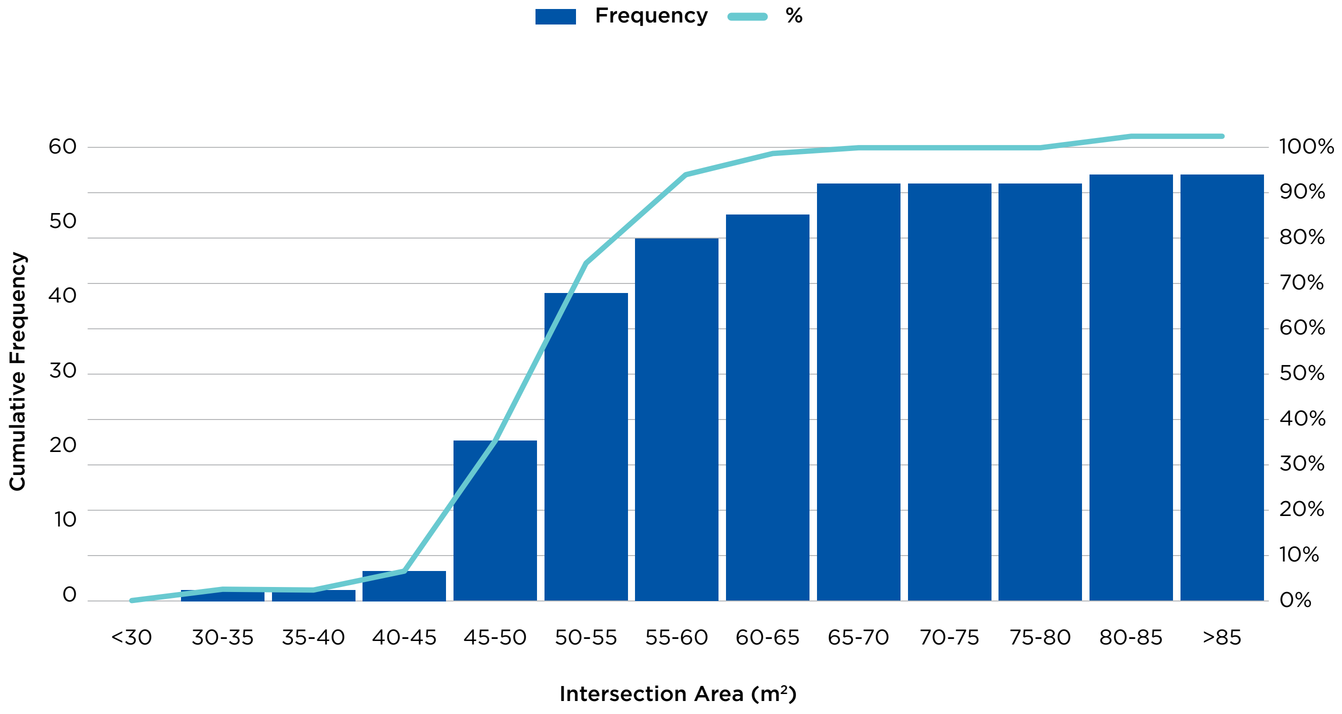
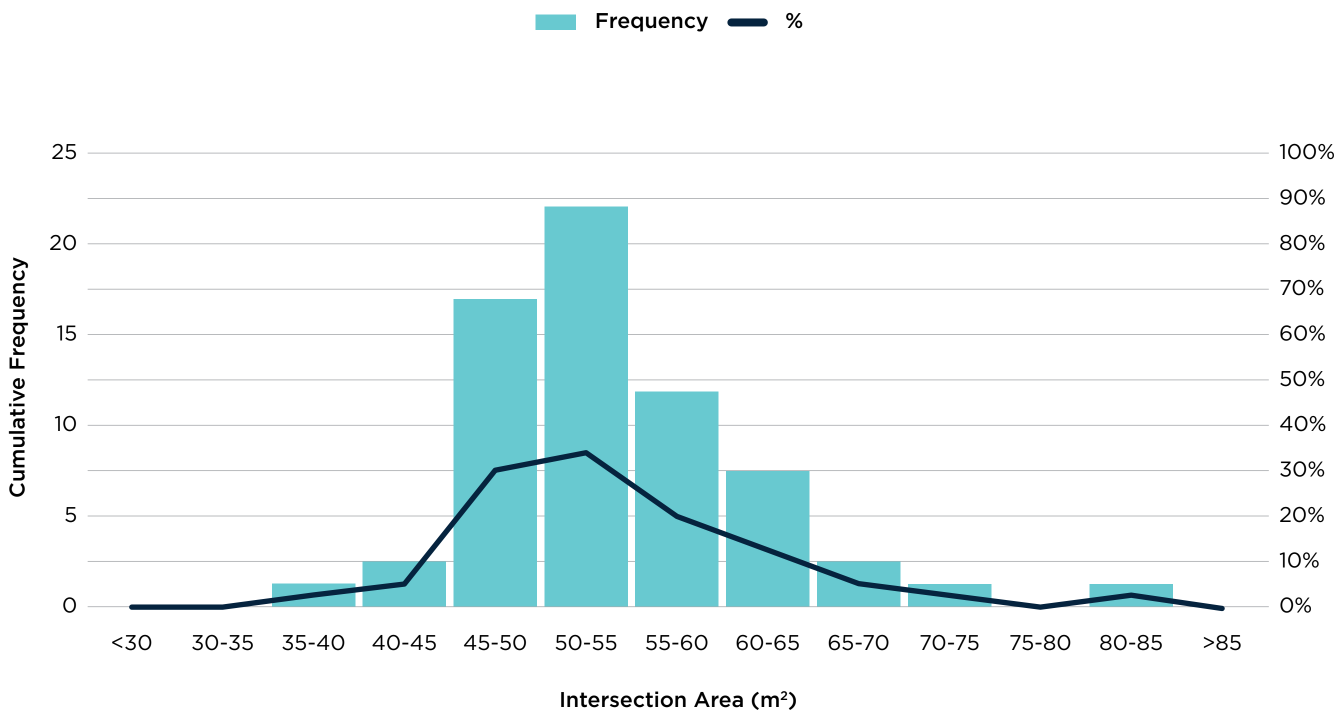


Figure 3: Graphs representing the frequency distribution of intersection areas for various locations
Each graph displays cumulative frequency data and comparison of intersection sizes across different areas

**Bhubesi Intersections**



**Ihlosi Intersections**

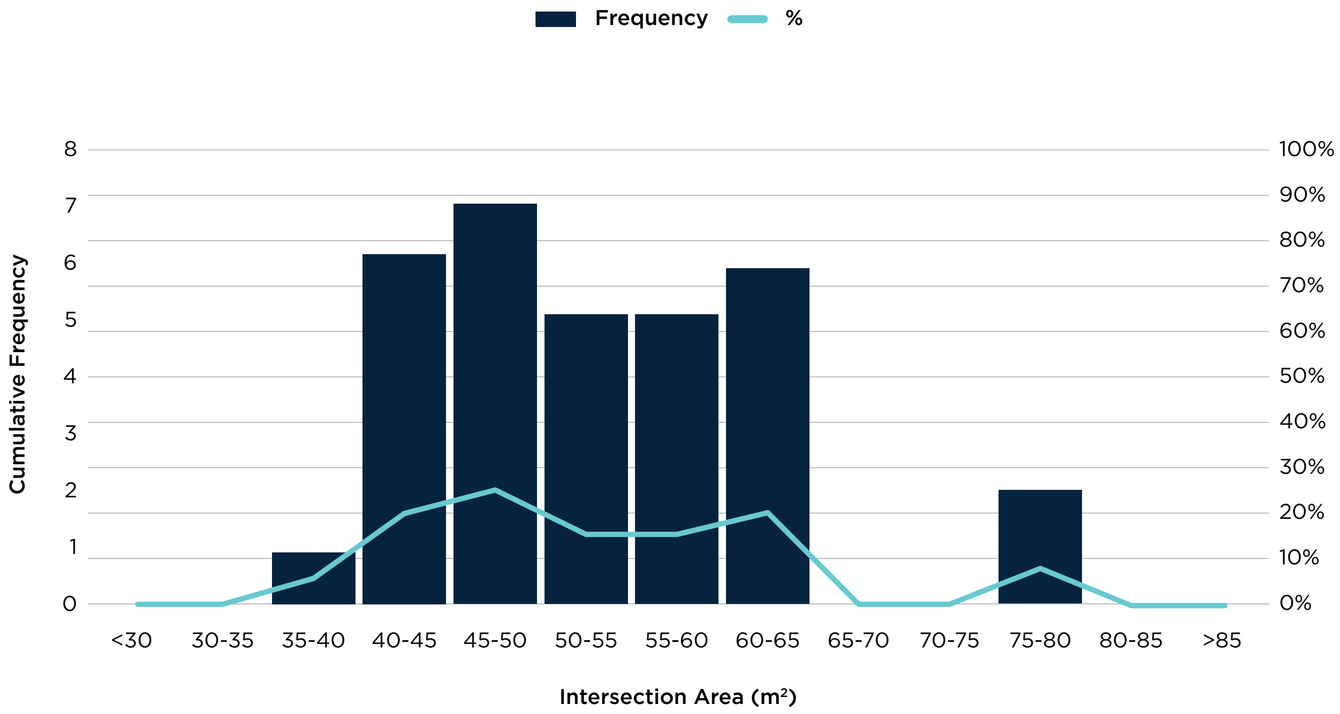
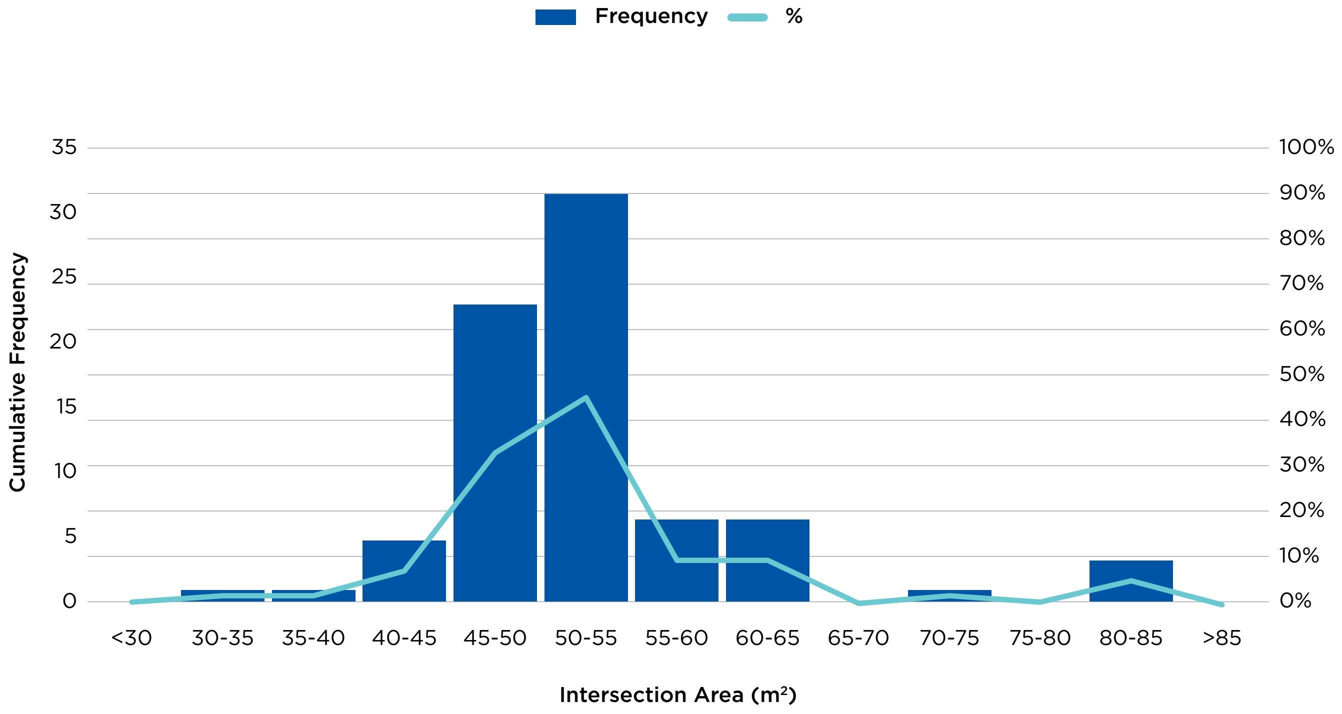


Figure 3: Graphs representing the frequency distribution of intersection areas for various locations
Each graph displays cumulative frequency data and comparison of intersection sizes across different areas

### Phumba Intersections



### Fezela Intersections

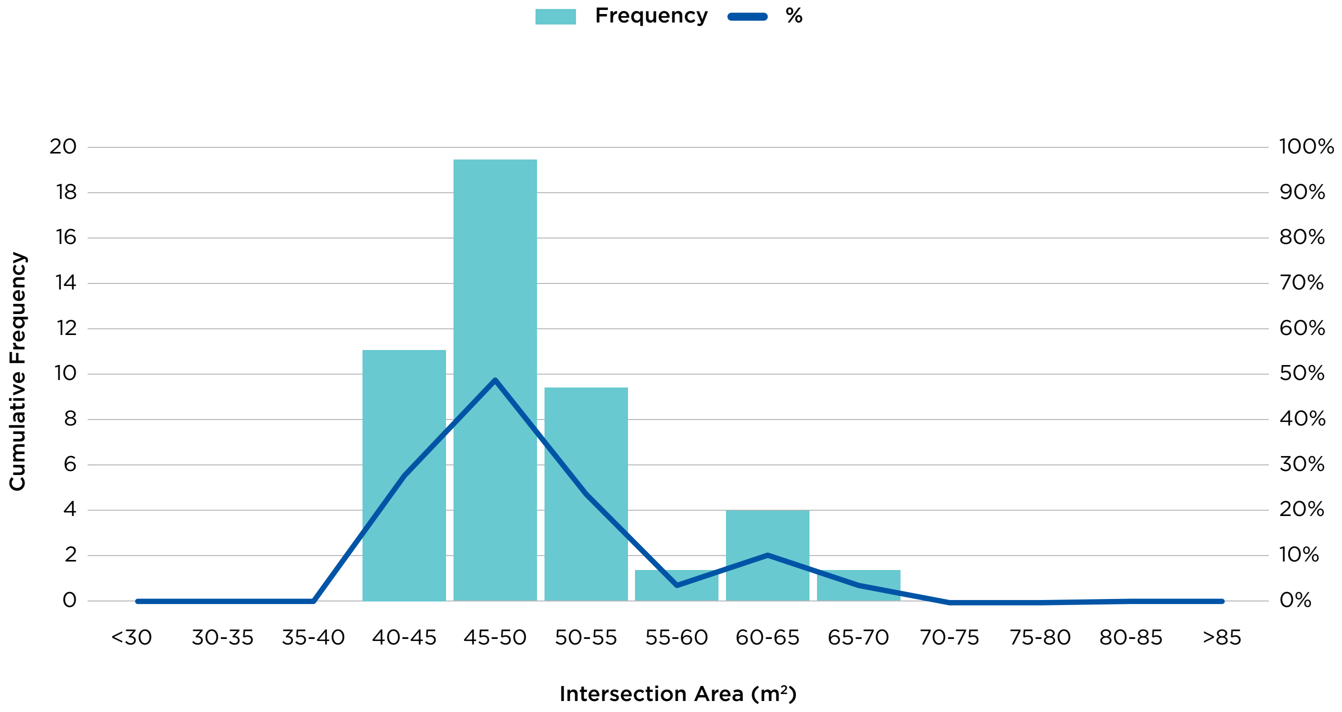


Figure 3: Graphs representing the frequency distribution of intersection areas for various locations
Each graph displays cumulative frequency data and comparison of intersection sizes across different areas

## 4. Failure Mechanism

The failure mechanism at Kriel Colliery is illustrated through a series of diagrams (see Figure 4) that depict the roof under stress, showing the initiation of failure in the corners. The diagrams indicate various stages of failure, with arrows demonstrating the direction of loading in the roof strata.

Key aspects of the failure mechanism that were confirmed through numerical simulation of rock mass in the Rocscience RS2 Software package include the maximum shear strain and maximum vertical displacement indicated in Figure 5.

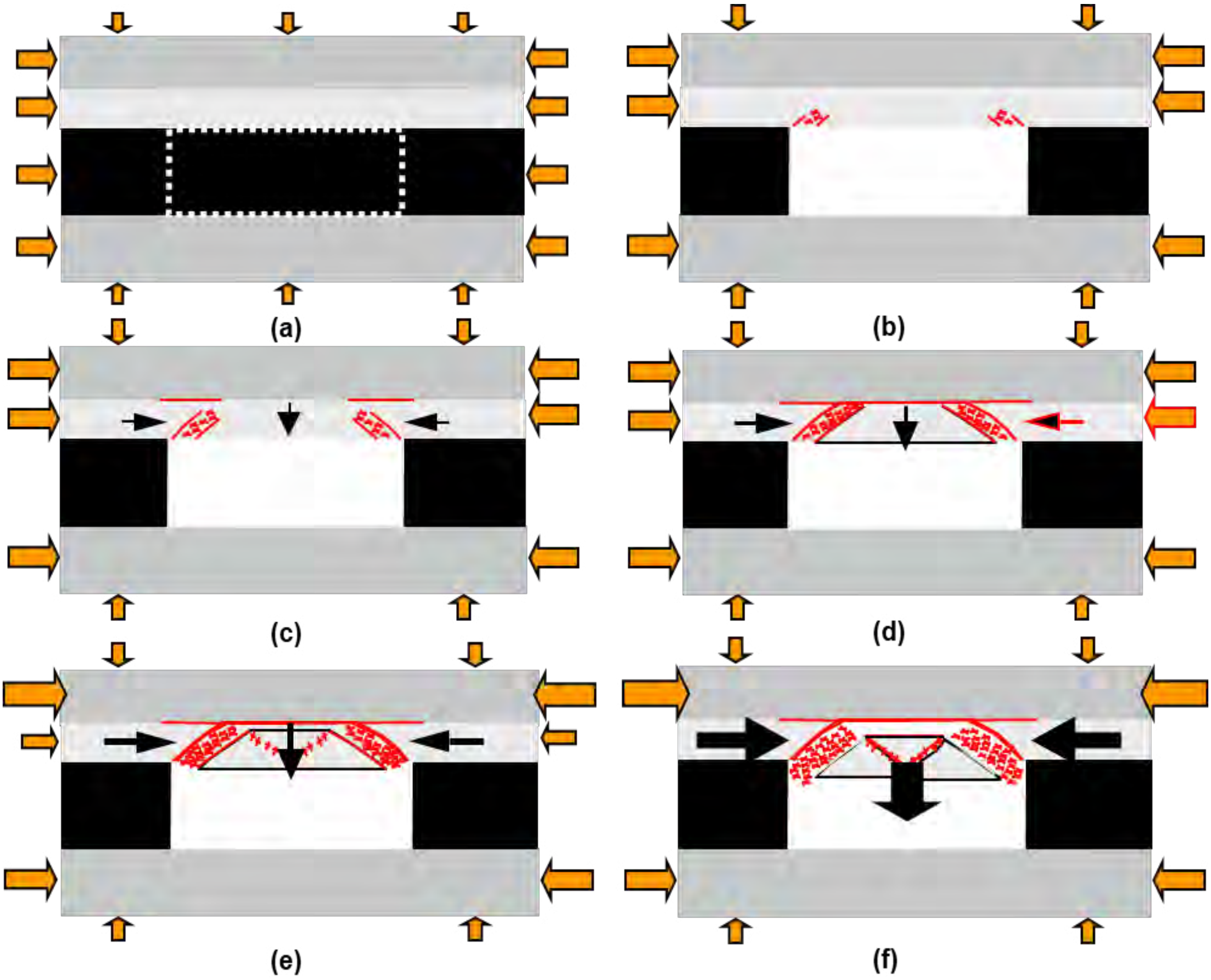


Figure 4: Diagrams depicting the roof under lateral loading and failure progression

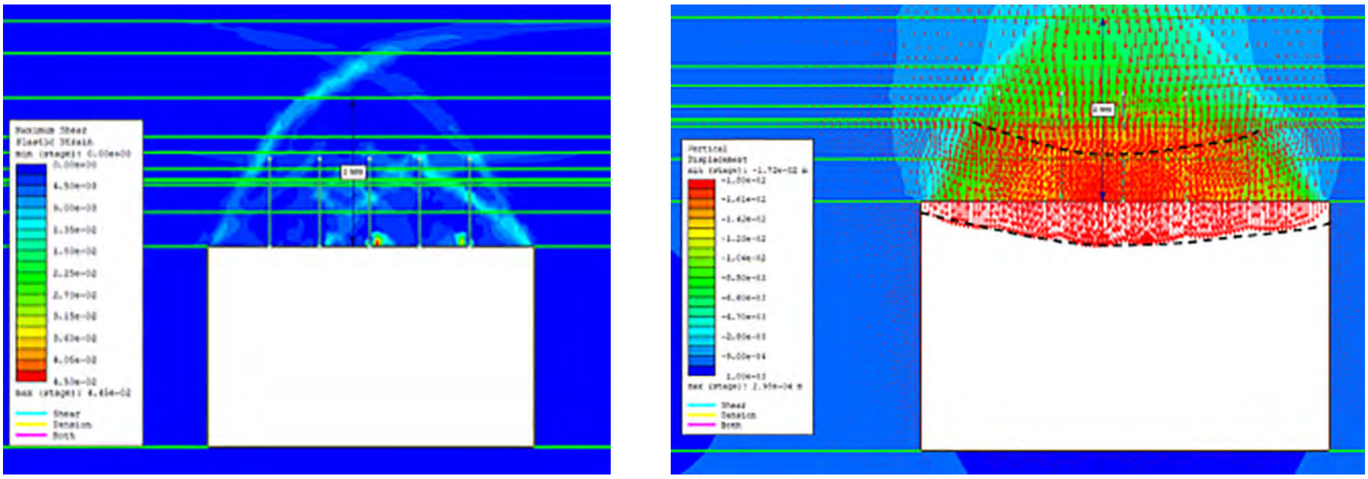


Figure 5: Simplified RS2 simulations of the possible failure mechanism

The insights gained from the simulations are crucial for developing strategies to mitigate risks associated with intersection failures in the mining operations at Kriel Colliery.

## 5. Management Strategies

Kriel's strategy for managing intersection failures includes several key components outlined below.

### 5.1 Devolatilised Ground Strategy

This strategy aims to avoid mining through devolatilised ground, with secondary support consisting of 2.8m bolts implemented where mining through devolatilized ground cannot be avoided.

### 5.2 40 m Zoning

A critical strategy involves avoiding mining within 40 m of dolerite intrusions, which necessitates increased support density and bolt length. This approach is informed by learnings from previous Falls of Ground events, allowing for more effective support recommendations.

### 5.3 Systematic Support Patterns and Excavation Parameters

The systematic support patterns and excavation parameters at Kriel Colliery were reviewed to enhance stability during mining operations (See Table 1). This adjustment is part of a broader strategy to improve safety and support effectiveness in the face of geological challenges.

| PARAMETERS (MAXIMUM) | INITIAL DESIGN | REVISED DESIGN |
|---|---|---|
| **BOLT LENGTH AND DIAMETER (FULL COLUMN RESIN)** | 1.8 m x 20 mmØ | No change |
| **BOLTS PER ROW** | Four (4) | No change |
| **BOLT SPACING BETWEEN INDIVIDUAL BOLTS** | 1.4 m | 1.5 m |
| **BOLT SPACING BETWEEN ROWS** | 2 m | 1.5 m |
| **SPACING BETWEEN PILLAR SIDEWALL AND THE FIRST BOLT** | 1.5 m | 1 m |
| **BORD WIDTH** | 7.2 m | 6.5 m |

Table 1: Initial and revised support and excavation parameters

### 5.4 Secondary and Specialised Support

The secondary and specialised support measures at Kriel Colliery are designed to enhance the stability of mining operations, particularly in areas prone to geological challenges. The systematic roof support consists of 2.80 m x 20 mmØ full column resin (FCR) bolts. This systematic support is installed concurrently with welded mesh to ensure comprehensive coverage and stability across the exposed areas.

In addition to the standard support measures, specialised support includes the installation of four 6 m long full-grout anchors per row, arranged in a grid spacing of 1.5 m x 1.5 m. This specialised support is crucial for addressing fault development and ensuring that the integrity of the excavation is maintained, especially in areas where geological anomalies are present.

Currently, there are trials underway for installing 4 m long anchors at Kriel, which involve training all operators to ensure effective implementation of the support. The combination of systematic and specialised support strategies aims to mitigate the risks associated with intersection failures and enhance overall safety in the mining environment.

## 6. Future Projects

Looking ahead, Kriel Colliery is focused on several future projects aimed at improving safety and stability in mining operations. One such project is the CSIR/Coaltech Stress Measurement Project, which aims to measure stress field components in geologically complex areas using advanced methods. Additionally, the monitoring of hydraulic pressure in the roof using piezometers is proposed to assess the impact of groundwater pressure on roof stability, particularly in shallow mining areas where the depth from surface is less than 40 m.

## Conclusion

**Kriel's intersection failure management is a multifaceted approach that combines historical data analysis, geological understanding, and strategic planning to mitigate risks associated with mining operations. The ongoing commitment to safety and operational excellence is evident in the strategies adopted and the future projects planned, ensuring that Kriel Colliery remains a leader in responsible mining practices.**

## 7

# Practices for Sidewall Areal Coverage

# Practices for Sidewall Areal Coverage

**Mr. Matthew Barnard**
**Principal Rock Engineer, Thungela Resources**

Email: matthew.barnard@thungela.com
Website: www.thungela.com

## 1. Background and Introduction

Thungela Resources was formed from Anglo American Coal South Africa demerger in 2021, operating primarily in Mpumalanga Province with international operations, extracting No. 2 and No. 4 seams across diverse mining operations:

- Four underground mining operations are currently active.
- Three opencast operations support thermal coal production.
- Underground mines range from newly established mines to some at the end of their life.

The practices for areal coverage support for ribsides (i.e. pillar sidewalls) are critical for ensuring safety and operational efficiency in these mining environments. The ribside is the wall of an excavation in a mine, formed when coal or rock is removed.

The importance of continuous improvement in mining practices is underscored by the quote from Mark Twain: "Continuous improvement is better than delayed perfection". This philosophy drives Thungela's approach to enhancing safety and operational practices, particularly in the context of ribside meshing.

## 2. Problem Statement

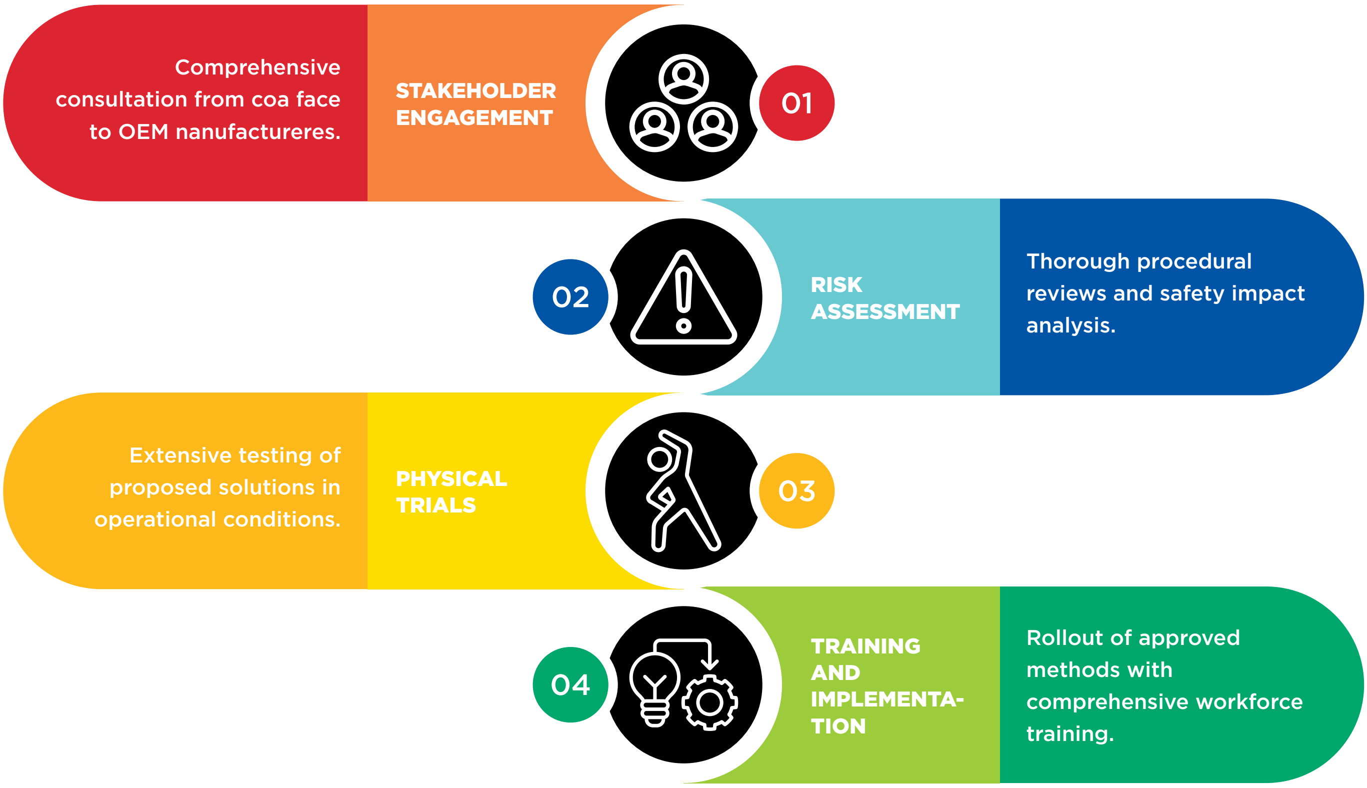
Historically, the use of straps (also referred to as w-straps or oslo straps) for ground support in mining operations has been common with the advantages including ease of installation and offering confinement along geological features; however, this method has significant limitations, particularly in terms of limited areal coverage and poor suitability for friable conditions.

A tragic fatal accident highlighted the inadequacies of existing equipment and processes, revealing that critical aspects were overlooked during the management of change process, including the consideration of ribside meshing. To deal with these inadequacies, a decision was taken to cease ribside areal support installation. Installation of the ribside areal support could only occur with authorisation from the Rock Engineer and Mining Manager. This decision led to production teams feeling disempowerment to address hazards and further led to the deterioration of ground conditions where areal coverage is not installed.

## 3. Solution Development Process

To address the unsustainable nature of the previous practices, as highlighted in the problem statement, it became essential to implement a structured approach that includes engagement with stakeholders, procedural reviews, and risk assessments. This systematic process aims to ensure that any new methods developed are not only effective but also safe and compliant with operational standards (See Figure 1).

**Systematic Approach to Safety Improvement**



01 **STAKEHOLDER ENGAGEMENT** Comprehensive consultation from coa face to OEM nanufactureres.

02 **RISK ASSESSMENT** Thorough procedural reviews and safety impact analysis.

03 **PHYSICAL TRIALS** Extensive testing of proposed solutions in operational conditions.

04 **TRAINING AND IMPLEMENTATION** Rollout of approved methods with comprehensive workforce training.

Figure 1: Systematic process steps to safety improvement

## 4. Innovative Methods for Installing Mesh on Ribsides

To effectively implement the new ribside support practices, Thungela Resources developed two safe methods for installing mesh on the ribsides. These methods utilising Z-Hooks and double-nut washers with the aim of enhancing safety and operational efficiency in the mining environment.

Technical evaluation demonstrates that both Z-Hook and double-nut washer methods provide effective areal coverage for ribsides. Both methods have been rigorously assessed for safety and procedural compliance, ensuring that they are risk-assessed and suitable for implementation in the mining environment.

Both methods underwent rigorous testing and risk assessment, proving their effectiveness in different operational scenarios. Implementation success depends on proper training, consistent application of procedures, and ongoing monitoring of performance metrics.

### 4.1 Z-Hooks

This process includes marking drill depths, drilling holes, and inserting Z-Hooks, which are then used to secure the mesh. Z-Hooks offer superior rock contact and stability but require longer installation time, making them ideal for primary meshing applications.

The installation process for Z-Hooks involves several key steps to ensure proper support for ribside areal cover:

## Ribside Areal Cover Installation Procedure using Z-Hooks

1. First, the area where the Z-Hooks will be installed is identified and marked.

2. Next, the correct drill depth is marked on the drill steel, and holes are drilled for the Z-Hooks.

3. Once the holes are prepared, the Z-Hooks are inserted using a roof bolter, where the Z-Hook and insertion tool are positioned in the bolter chuck, ready for insertion.

4. After the Z-Hooks are installed, the mesh is placed onto the hooks, ensuring it is securely attached to the rock surface as illustrated in image 1.

5. Finally, the mesh is bolted in place, completing the installation process and ensuring the area is made safe as depicted in image 2.

This systematic approach to Z-Hook installation enhances the stability and safety of the mining environment.

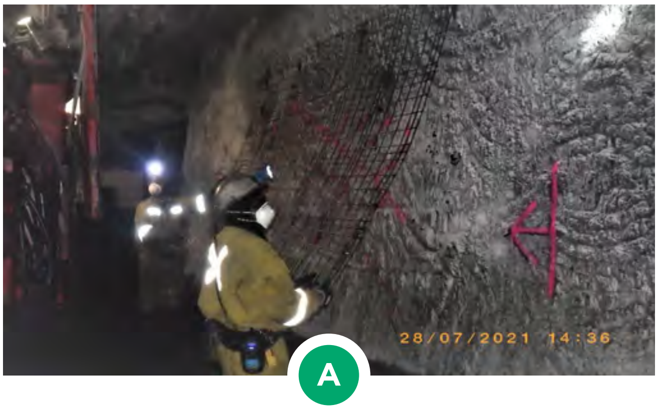


Image 1: Placing the mesh sheet onto the Z-Hooks – Note the distance between people and sidewall

(b) Mesh placed, ready for bolting

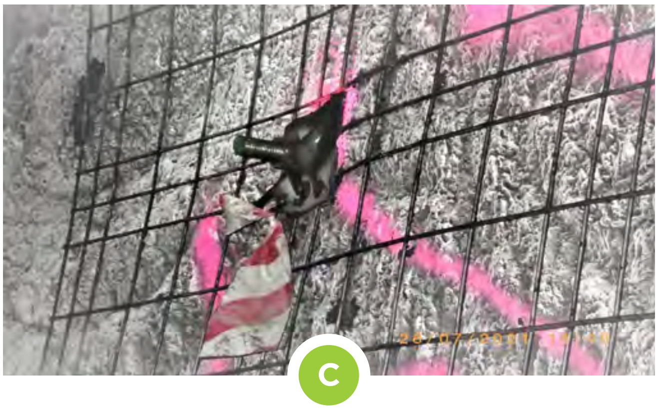


Image 2: Mesh bolted against the ribside

### 4.2 Double-nut Washers

This method allows for faster installation but may result in gaps between the mesh and the rock surface, which can lead to more deformation of the ribsides. The process involves hanging mesh onto existing ribside bolts and securing the mesh with double nut washers (see image 3).

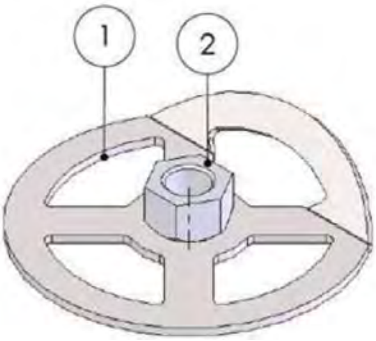


Image 3: Drawing depiction of a double-nut washer

The installation procedure for double-nut washers involves several key steps to ensure effective ribside support.

**Ribside Areal Cover Installation Procedure using Double-Nut Washers**

1. First, the ribside or pillar of concern is bolted to secure the major blocks, providing a stable foundation for the mesh installation.
2. The mesh is hung on the bolts that have been installed, allowing it to be positioned correctly against the rock surface.
3. Finally, the mesh is secured using double-nuts, which are screwed onto the threads of the bolts, ensuring that the mesh remains firmly in place.

# Conclusion

The practices for areal coverage support for ribsides at Thungela Resources reflect a commitment to continuous improvement and safety in mining operations. By addressing the limitations of previous methods and implementing new, safer techniques, Thungela aims to enhance operational efficiency while prioritising the safety of its workforce. The insights gained from stakeholder engagement and procedural reviews have been invaluable in shaping these practices. As emphasised in the takeaway points, the importance of assessing and managing change, along with a holistic approach involving all stakeholders, cannot be overstated.

In conclusion, the ongoing journey of improvement in ribside support practices at Thungela Resources serves as a model for the mining industry, demonstrating that proactive measures and innovative solutions can lead to safer and more effective mining operations.

## 8

# Managing Overloaded Mesh

# Managing Overloaded Mesh

**Mr. Martin Steenkamp**

**Senior Rock Engineer, Sasol Mining**

Email: martin.steenkamp@sasol.com
Website: www.sasol.com

## 1. Background

The project on managing loaded mesh was initiated in response to a high-severity incident that occurred during mesh bleeding operations in one of the Sasol Secunda mines. This incident involved two personnel stationed on a belt structure when cutting the mesh, where the size of loose material on top of the mesh was underestimated, leading to unsafe working conditions. The incident highlighted the need for improved safety measures and strategies for managing loaded mesh effectively.

Understanding the circumstances that led to this project provides essential context for the strategies and solutions explored in the following sections.

## 2. Introduction

The presentation on managing loaded mesh provided an in-depth exploration of the challenges and strategies associated with the management of mesh in mining operations. It emphasised the importance of understanding mesh loading stages, assessing conditions, and implementing effective management strategies to ensure safety and operational efficiency.

With this foundation, it is important to examine the specific incident that prompted a reassessment of mesh management practices.

## 3. Incident Review

The incident triggered a comprehensive review of current practices related to mesh bleeding and management. The review identified critical factors contributing to the incident, such as improper positioning during cutting and inadequate tools that did not allow for safe operation from a distance.

The lessons learned from the incident informed a systematic approach to evaluating mesh conditions, which is detailed next.

## 4. Mesh Condition Assessment

A significant aspect of the project involves the development of a mesh condition assessment sheet (see Table 1), which categorises mesh conditions into three levels: none/slightly loaded, loaded, and overloaded (see Figure 1). This assessment sheet evaluates:

- **Mesh/Loading Condition:** The degree of deformation and integrity of the mesh.
- **Failed Material:** The size and impact severity of any material that has failed.
- **Risk Exposure:** The level of risk associated with sudden mesh failure.

Each criterion is assessed to determine the necessary actions, ranging from no action required for low-risk conditions to implementing a bleeding strategy for high-risk scenarios.

| | | | | | |
|---|---|---|---|---|---|
| **MESH CONDITION ASSESSMENT SHEET** | | **REFERENCE NUMBER** | | **DATE** | |
| **MINE** | | **AREA PANEL** | | **SPLIT NO** | |

| **CRITERIA** | **LOW** | **MODERATE (LOADED)** | **HIGH (OVERLOADED)** |
|---|---|---|---|
| **MESH / LOADING CONDITION (ASSESSMENT ON THE AMOUNT OF DEFORMATION ON THE SHEET)** | No deformation because of material build-up | Limited bulging | Severe bulging |
| | Bulging because of poor installation | Less than 500mm sag from roof elevation | More than 500mm from roof elevation |
| | No deformation to aperture around bolt plates | Limited deformation to aperture around bolt plates | Severe deformation to aperture around bolt plates as well as along edges of mesh sheet |
| | No welds strained | Welds strained but none failed due to shear | Shear failure on welds especially close to bolt plates |
| | All strands intact | Strands failed in tension (< 20%) | Strands failed in tension (>20%) |
| | No mechanical damage (Mesh hooked by equipment) | Limited mechanical damage (< 20% of strands affected) | Severe mechanical damage (>20% of strands) |
| | No corrosion | Limited corrosion | Severe corrosion impacting the integrity of the sheet |
| | 3 block overlap | 2 block overlap | 1 block overlap |
| **FAILED MATERIAL (ASSESSMENT ON THE SIZE OF THE MATERIAL AS THAT CAN BE LINKED TO IMPACT SEVERITY SHOULD FAILURE OCCUR)** | Few small pieces<br>Once-off failure within competent roof area | Accumulation of numerous small pieces<br>Isolated slabs<br>Roof above failed material stable and not resting on the failed material.<br>View of roof not obscured (Roof above failed material still visible for inspection)<br>Time dependant failure and potential further loading in mesh | Excessive small pieces<br>Multiple slabs<br>Large slab<br>No opening / gap between failed material and roof - view of roof above material obscured<br>Extend of failure cannot be verified<br>Possibility of multiple layers resting on mesh which can dislodge when mesh fails<br>Expecting further time dependant failure |
| **RISK EXPOSURE (ASSESSMENT ON EXPOSURE TO RISK OF SUDDEN MESH FAILURE)** | No need for access to the area | Occasional access required | Frequent access required |
| | Area can be permanently barricaded | Area can be temporarily barricaded and access managed where and when required | Not possible to manage access through barricading due to permanent access required. |
| | Isolated area where risk is present | | Excessive or extensive areas |
| | Area can be declared safe | Area can only be declared safe if mitigation is implemented | Area can only be declared safe once rehabilitation strategy is implemented |
| | | E.g. Monitoring and additional support | |
| **OUTCOME** | **LOW** | **MODERATE (LOADED)** | **HIGH (OVERLOADED)** |
| **STRATEGY** | No action required<br>Area can be declared safe | Install straps as per procedure | Implement bleeding strategy as per procedure or mitigation as recommended through JSA and site-specific risk assessment |

Table 1: Mesh condition assessment sheet

Figure 1: Photographs indicating loaded (left) and overloaded (right) mesh conditions

Having established the criteria for assessing mesh conditions, the report now turns to the various strategies available for managing loaded mesh.

## 5. Management Strategies

The management of loaded mesh is critical for ensuring safety and operational efficiency. Various strategies have been developed to address the challenges associated with mesh loading, including mesh bleeding, strapping, and double nutting.

### 5.1 Mesh Bleeding

The mesh bleeding strategy involves removing potential energy from loaded mesh, thereby eliminating risks once the mesh is bled, although it requires careful planning and supervision due to the complexities involved in cutting under tension.

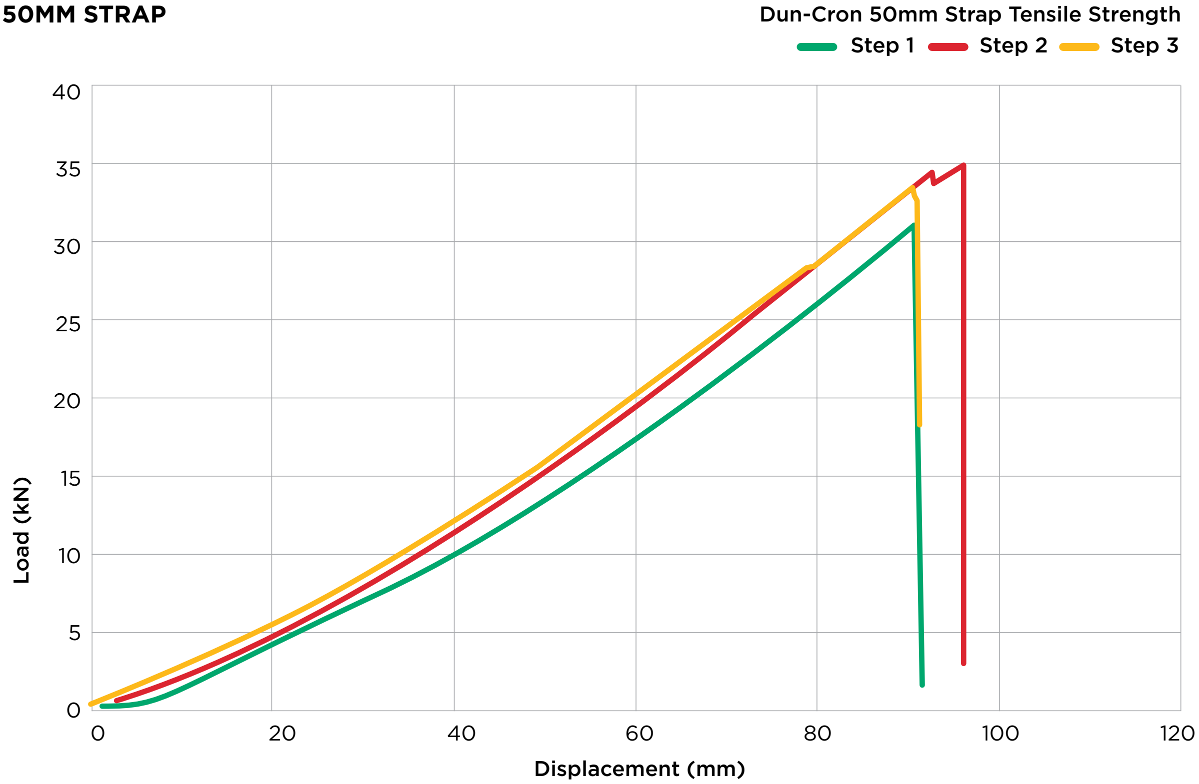
### 5.2 Strapping

Strapping using the DTM Strap (see Figure 2) serves as support unit that can be quickly installed, especially in urgent situations, but it does not remove the load and requires ongoing monitoring. The design specifications for the straps used in managing loaded mesh include several critical features to ensure their effectiveness and safety. Each strap is designed to support a maximum load of 2 tons, which effectively doubles to 4 tons when installed in a cross-bracing pattern. Additionally, the straps are equipped with a built-in tell-tale system that triggers at a load of 1.7 tons, providing a clear indication of when the strap is nearing its load limit.

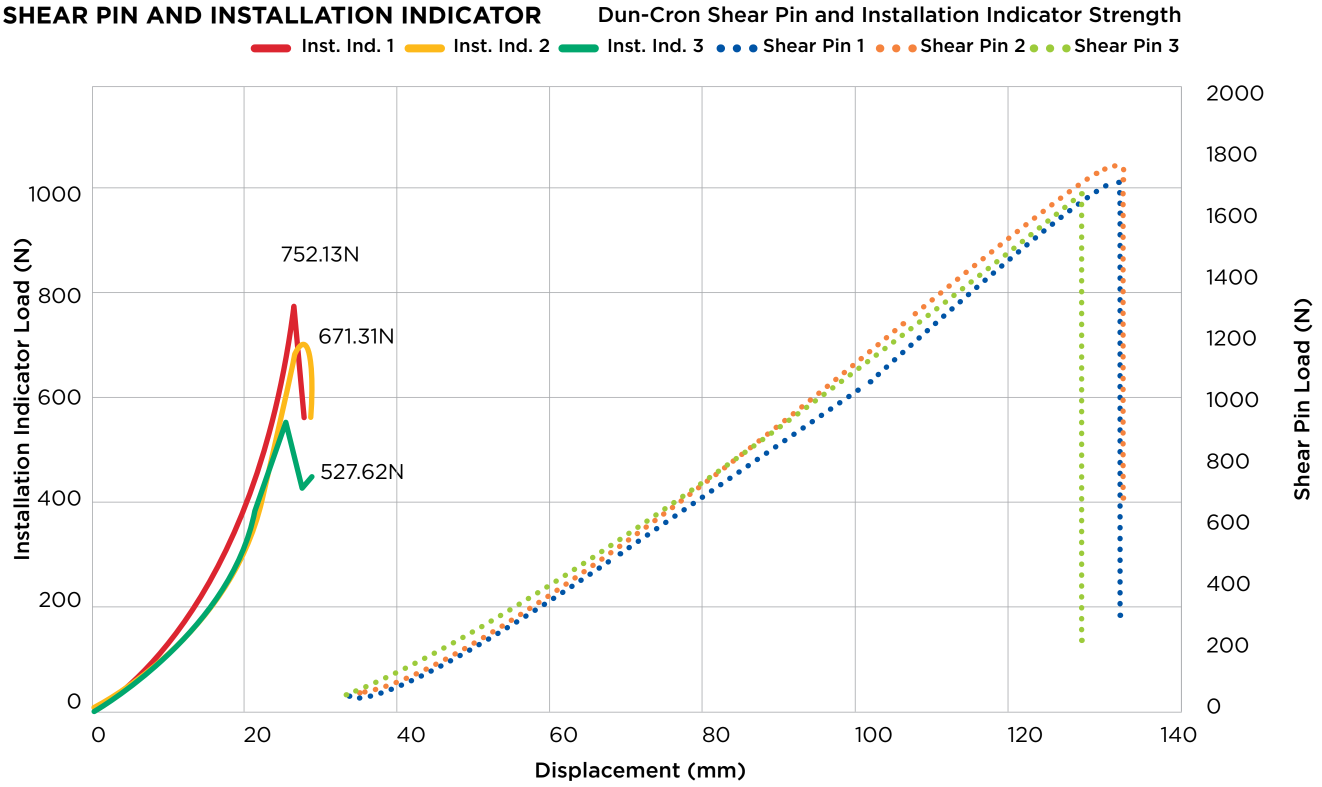
Furthermore, the straps incorporate a ratchet mechanism that allows for tensioning up to 70 kg, with a tension indicator integrated into the tell-tale box to monitor the applied tension. All load specifications have been verified and certified by an independent testing facility, ensuring compliance with safety standards (See Figure 3). Regular future tests will also be conducted as part of the supplier's quality assurance and quality control (QAQC) process.

Figure 2: DTM Strap used for strapping loaded mesh

## 50MM STRAP



## SHEAR PIN AND INSTALLATION INDICATOR



## RATCHET AND DOUBLE J-HOOK

Figure 3: Load-deformation test graphs of the DTM Strap

## 5.3 Double-Nutting

Additionally, the double nutting strategy replaces existing support with a new mesh sheet, providing a new cycle of support resistance, yet it also does not eliminate the load and may necessitate working at heights.

The advantages and disadvantages of different strategies for managing loaded mesh are compared in Table 2.

| STRATEGY | ADVANTAGES | DISADVANTAGES |
|---|---|---|
| **Strapping:**<br>This method involves applying support (straps) to areas with loaded mesh | Equipped with a built-in tell-tale to indicate loading.<br>Ease of installation.<br>Cost effective.<br>Can be installed from the ground level, eliminating the need for step ladders or working from heights.<br>Future maintenance is simplified. | While straps provide additional support, they do not remove the load; instead, they manage it through monitoring and reinforcement.<br>As a new system, straps need to demonstrate their effectiveness and reliability over time.<br>There may be reluctance from service providers to implement this system, as it could lead to a reduction in income by replacing the need for traditional bleeding and re-support work. |
| **Mesh bleeding:**<br>This strategy involves the removal of loaded mesh under tension. | Replaces existing support with new support, creating a new cycle of support resistance.<br>This process ensures that the load is effectively managed, and the risk is eliminated once the mesh is bled. | The loaded mesh must be removed while under tension, which poses safety risks.<br>the safe position for cutting the mesh is not always clearly defined and must be determined for each specific scenario.<br>the installation of new support is required before the area can be declared safe, which adds to the complexity and time required for the operation.<br>Difficult and time-consuming process, leading to potential shortcuts being taken to expedite operations, which can compromise safety.<br>Financial implications are considerable, as the process involves both the removal and replacement of support, impacting overall costs. |
| **Double-nutting:**<br>The process typically requires the installation of another mesh sheet over the existing one secured with a bolt plate and nut, which is referred to as "double nutting." This approach is particularly useful when the original mesh is still intact but requires additional support to handle the load. | Replaces the existing support with new support, thereby establishing a new cycle of support resistance.<br>Double nutting can be installed from ground level, which enhances safety by minimising the need for personnel to work at heights.<br>Generally, less costly than bleeding and replacing entire mesh sheets, making it a more economical option for managing loaded mesh. | The initial load is not removed; instead, it is merely managed.<br>The additional support provided by the second mesh sheet is limited, which means that if the original sheet fails, the new sheet may also fail under similar conditions.<br>There is a potential requirement for the team to work from a step ladder to keep the mesh in place prior to securing it with a plate, which can introduce safety risks. |

Table 4: Advantages and disadvantages of the strategies for managing loaded mesh

The following sections outline the critical conditions and resources necessary for the effective implementation of various strategies aimed at managing loaded mesh. These enablers are vital for ensuring that each strategy can be executed safely and efficiently.

| **STRAPPING STRATEGY** | |
|---|---|
| **PRE-ASSESSMENT OF AREAS** | Strapping should only be applied in areas that have been pre-assessed for suitability, particularly those with loaded mesh. This ensures that the strategy is implemented in locations where it can be most effective. |
| **SAFE ACCESS REQUIREMENTS** | It is essential to have safe access from both sides when treating overloaded mesh. Additionally, access from underneath is necessary when installing straps in extensive areas with loaded mesh, which helps to maintain safety during the installation process. |
| **STANDARD OPERATING PROCEDURE (SOP)** | A comprehensive SOP must support the strapping process. This document outlines the necessary steps and safety measures to be followed during installation, ensuring that all personnel are aware of the procedures. |
| **SPECIALISED STRAP** | The use of a special strap that includes a built-in tell-tale monitoring system is critical. This system allows for real-time monitoring of the strap's condition, enhancing safety and effectiveness. |
| **PRETENSION INDICATOR** | Straps should have a built-in pretension setting or indicator to ensure that they are installed with the correct tension. This feature is vital for maintaining the integrity of the support provided by the straps. |
| **EASE AND SPEED OF INSTALLATION** | The strapping system must be designed to be easy and quick to install. This is particularly important in urgent situations where extensive areas require immediate attention. |
| **QUALITY ASSURANCE AND QUALITY CONTROL (QAQC)** | A proper QAQC process is necessary to verify compliance with design specifications. This ensures that the strapping system meets safety and performance standards. |
| **DESIGN LOAD CONSIDERATIONS** | The design load of the straps must exceed that of the original mesh sheet. This ensures that the new support system can effectively handle the loads it will encounter. |
| **MESH BLEEDING STRATEGY** | |
| **SPECIAL CUTTING TOOL** | A specialised cutting tool is required to allow for cutting from a safe distance of at least 2.5 m away from the fall path. This distance is crucial for maintaining the safety of personnel during the operation. |
| **METHOD STATEMENT** | It is necessary to have a comprehensive method statement that guides the team on the procedures to follow for different scenarios. This statement should be derived from a thorough risk assessment to ensure that all potential hazards are addressed. |
| **SUPERVISION** | The involvement of higher-level supervision is critical to elaborate the cutting strategy and determine the safe position when cutting from various locations. This oversight helps to ensure that safety protocols are strictly followed during the operation. |
| **DISCIPLINE** | The team must exhibit discipline in complying with the established procedures, as these may not always represent the quickest or easiest methods. Compliance with these procedures is vital for maintaining safety and effectiveness during the bleeding process. |

## 6. Future Projects

The future projects at Sasol Mining focus on enhancing the management of loaded mesh through innovative testing and assessment methods.

- One key initiative is the underground mesh sheet load and deformation testing, which aims to evaluate the performance of different mesh sizes under load conditions.
- Another significant project is the implementation and calibration of the mesh condition assessment sheet. This initiative seeks to integrate learnings over time into the current assessment sheet, providing improved guidance on the state of mesh loading and the strategies to address various scenarios. The assessment sheet will also be incorporated into the existing Ground Management System, ensuring that it is a part of the overall safety and operational framework.
- Additionally, there is a project focused on determining the stages of mesh loading using a mesh feeler gauge. This project aims to develop criteria for assessing mesh conditions and risk exposure based on displacement measurements, which will enhance the ability to monitor and manage mesh integrity effectively.
- Lastly, the mesh sheet build-in load indicator project proposes inserting 3.15 mm wire strands at predetermined intervals within a 4.0 mm wire diameter weld mesh sheet. This approach assumes that these strands will fail before the remaining strands, allowing for early detection of loaded conditions.

## 7. Preventive Controls

While management strategies address existing issues, it is equally crucial to consider measures that can prevent mesh loading problems from arising in the first place. These preventative controls are aimed at minimising the need to manage loaded and overloaded mesh in future. The proposed strategies include:

- Reducing the maximum spacing between lines to a maximum of 1.5 m, or even 1.0 m for long-term excavations, can help ensure better support and stability of the mesh.
- Managing the minimum overlap between mesh sheets is emphasised, with a recommendation for a "3 Block Overlap" to enhance integrity. This overlap strategy is crucial as it ensures that bolts are placed in a manner that requires multiple wires to tear before the mesh fails, thereby increasing safety.
- Increasing the wire diameter to a minimum of 4.0 mm and applying a heavy galvanising coating to reduce damage due to corrosion over the long term. This is particularly important as corroded mesh sheets often require bleeding and replacement, which can be costly and time-consuming.
- Conducting a review of mesh handling and installation practices, as well as revisiting the Roof Skin Assessment sheet to ensure that all procedures are optimised for safety and efficiency.

# Conclusion

Overall, while the preventative controls focus on proactive measures to reduce the likelihood of mesh loading issues, the existing management strategies and future projects primarily address the consequences of such issues once they arise. This contrast highlights the importance of integrating both preventative and reactive approaches in the overall management of loaded mesh in mining environments.

The discussions underscored the critical need for effective management strategies to enhance safety in mining operations. By understanding the stages of mesh loading, utilising assessment tools, and implementing innovative management strategies, the mining industry can significantly reduce the risks associated with loaded mesh. Continuous improvement and collaboration among stakeholders are essential for fostering a culture of safety and operational excellence.

# Concluding Remarks

The Coal Day of Learning proved to be an invaluable platform, fostering lively discussions, the sharing of frontline experiences, and the open exchange of innovative ideas among mining professionals. The depth and breadth of insights presented throughout the day reflected the collective commitment of the coal mining sector to advancing safety practices, particularly in managing Falls of Ground. By bringing together diverse expertise, the event encouraged collaboration and collective problem-solving—essential ingredients in the ongoing journey towards zero harm.

A special note of gratitude goes to all those who contributed to this successful event: presenters who generously shared their knowledge and practical learnings, and every participant whose thoughtful engagement enriched the conversations.

It is only through continued collaboration and the open exchange of knowledge that the industry will drive meaningful progress. The spirit of partnership and the professional commitment demonstrated during the Coal Day of Learning lay a strong foundation for ongoing improvement and for achieving the aspiration of zero harm in mining operations.

MOSH

MINING INDUSTRY
OCCUPATIONAL
SAFETY & HEALTH

www.mosh.co.za

MINERALS COUNCIL
SOUTH AFRICA

www.mineralscouncil.org.za