NSW GOVERNMENT

NSW Resources Regulator

CONSOLIDATED REPORT

GROUND OR STRATA FAILURE – SLOPE STABILITY – STAGE 2 - OPEN CUT COAL MINES

March 2021 – November 2021

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Document control

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Executive summary

A crucial part of the NSW Resources Regulator's Incident Prevention Strategy involves targeted assessment and planned inspection programs for mines and petroleum sites. This is a focus on assessing an operation's control of critical risks through evaluating the effectiveness of control measures in the mine's safety management system.

The Regulator has developed a bowtie hazard management framework and standardised assessment checklist for each program plan. Under each program plan, the effectiveness of the safety management system at each mine site is assessed against a standard set of control supports and critical controls.

Because of the various controls derived from the bowtie analysis for the principal hazard of ground or strata failure – slope stability within the open cut coal industry, the overall program plan was split into three stages. This report summarises the assessment findings from stage two of the program, which covered 19 mines between March 2021 and November 2021.

For stage two of the program, the threats, consequence, and critical controls assessed for the material unwanted event (ground or strata failure – slope stability) are shown in Table 1. Stage one was completed in March 2021, and stage three will cover the remaining controls derived from the bowtie.

Table 1: Threats, consequence and critical controls for the material unwanted event (ground or strata failure - slope stability – open cut coal mines) – stage 2

THREAT/CONSEQUENCE		CRITICAL CONTROL
Threat	1. Ground conditions 2. Unconsolidated material 3. Natural or induced seismic event	PC 1.5 – Excavate to design
Threat	1. Ground conditions 2. Unconsolidated material 3. Water	PC 1.6 – Water management
Threat	1. Ground conditions 2. Voids or other workings beneath wall 3. Unconsolidated material 4. Water	PC 1.7 - Separate people from the ground or strata hazard

	5.	Natural or induced seismic event	
Consequence	1.	One or more fatalities	MC 1.1 - Roll over protection system (ROPS), Falling object protection system (FOPS)

Legislative requirements and published guidance relating to the principal hazard of ground or strata failure is listed in Appendix A. Figure 1 presents safety compliance findings for each de-identified mine and critical control assessed for the material unwanted event of ground or strata failure. Explanatory notes on the assessment system are also listed in Appendix B.

Key findings

Relatively high levels of compliance were found for the nominated controls of this assessment program. The key findings were:

- Processes were implemented that ensure the pit walls were excavated to design, followed by verification processes and there were procedures for when design could not be achieved
- No issues were identified with the implementation of the nominated water management controls for ground or strata failure. Run-off diversion and drainage was effective
- Not all sites had a procedure for workers and equipment when accessing or working under highwalls, low walls or dump areas.

Recommendations

Key recommendations are listed below:

- When workers and/or equipment are accessing and working beneath pit walls, they should follow a procedure derived from a risk assessment
- Physical barriers or windrows should be installed to delineate exclusion zones where practicable
- Excavated sump outlines should be picked up by survey and recorded on a plan.

Introduction

The Regulators planned assessment programs provide a planned, risk-based and proactive approach to assessing how effective an operation is when it comes to controlling critical risk. These programs apply the following principles:

- a focus on managing prescribed 'principal hazards' from the Work Health and Safety (Mines & Petroleum Sites) Regulation 2014
- evaluation of the effectiveness of control measures implemented through an organisation's safety management system and
- consideration of the operation's risk profile.

The objective of risk profiling is to identify the inherent hazards and the hazard burden that exist at individual operations in each mining sector in NSW. The information is then used to develop the operational assessment and inspection plans that inform the program.

Scope

Planned inspection programs include two assessment types:

- Targeted assessments, incorporating:
  - desktop assessment of:
    - compliance against legislation with respect to the management of health and safety risks associated with ground or strata failure – see Appendix A for details
    - the definition of the controls the mine utilises to prevent and mitigate the risks to health and safety associated with ground or strata failure
  - a workplace assessment of the implementation of those controls through the inspection of plant and worker interviews.
- Planned assessments, which involve a workplace assessment of the implementation of controls through the inspection of plant and worker interviews only.

The process

The process for undertaking an assessment under a planned inspection program generally involves the following stages:

- preliminary team meetings, preparation and review of documents
- execution of an on-site assessment involving:
  - An on-site desktop assessment of relevant plans and processes measuring legislative compliance of the relevant plans (targeted assessments only)
  - the inspection of relevant site operations (both targeted assessments and planned inspections)
- discussion and feedback to the mine management team on the findings and actions that need to be taken by the mine operators in response.

Assessment findings

Threats, consequence and controls assessed

Threats:

- Ground conditions
- Unconsolidated material
- Natural or induced seismic event

Critical control: PC 1.5 – Excavate to design

Control objective: Stable walls. Walls are excavated to the design and cleaned back to hard.

Performance requirement:

1. walls are excavated to design
2. loose material is cleared from the wall.

Specific findings for this critical control included:

- Operations personnel had access to plans showing planned wall excavation angles
- Machine guidance was available to assist operators with excavating walls to the design
- Routine inspection reports verified that walls were inspected for overhanging or loose rocks
- If the primary excavation unit could not achieve the wall angle or clean the walls back to hard, secondary equipment was allocated to the task (such as a backhoe or wall chain)
- Reconciliation processes were in place to verify that walls were excavated to design
- Documented processes were in place for when major design changes were required.

Threats:

- Ground conditions
- Unconsolidated material
- Water

Critical control: PC 1.6 – Water management

Control objective: Water is diverted or removed to prevent ground or strata failure.

Performance requirement:

1. Control measures for ground or strata water damage risks are implemented.

Specific findings for this critical control included:

- Run-off diversion and drainage was seen to be effective e.g. no significant instances observed of water running over or pooling near pit walls
- Pit pumping arrangements for removing dynamic water were observed to be adequate
- Not all sites had a process in place to ensure that excavated sump outlines were picked up by survey and recorded.

Threats:

- Ground conditions
- Voids or other workings beneath wall
- Unconsolidated material
- Water
- Natural or induced seismic event

Critical control: PC 1.7 – Separate people from the ground or strata hazard

Control objective: Water is diverted or removed to prevent ground or strata failure.

Performance requirement:

1. Ground or strata failure is identified as a hazard.
2. Indicators of potential ground or strata failure are identified.
3. People are protected from ground or strata failure.

Specific findings for this critical control included:

- Not all sites had a procedure in place for workers and equipment when accessing or working under highwalls, low walls or dump areas

- There was variation across sites on the requirement for physical barriers (windrows) around exclusion zones where it was practicable to install them
- Physical barriers were absent where there was a high risk of rock falls
- Most sites had effectively implemented separation controls to protect people from ground or strata failure hazards.

Consequence:

- One or more fatalities

Critical control: MC 1.1 – Roll over protection system (ROPS), Falling object protection system (FOPS).

Control objective: Protect workers from being crushed in ground failure events.

Performance requirement:

1. Identify ground or strata failure hazards that may lead to mobile plant roll over.
2. Engineered design for rollover protection is fitted to exposed mobile plant.

Specific findings for this critical control included:

- All sites had effective standards in place for installing and maintaining certified ROPS/FOPS rated cabins.

Findings by mine

Figure 1 presents aggregate assessment findings by critical control, providing a summary view of the status of each mine's hazard management processes. Importantly, the system recognises the value of fully implemented and documented controls by awarding an additional point if both elements were assessed as present. More details explaining the assessment system are at Appendix B.

Figure 1: Assessment findings for the planned inspection program – ground or strata failure – slope stability – open cut coal mines – Stage 2 – overall results

	Threat			Consequence
	1. Ground conditions 3. Unconsolidated material 5. Natural or induced seismic event	1. Ground conditions 3. Unconsolidated material 4. Water	1. Ground conditions 2. Voids or other workings beneath wall 3. Unconsolidated material 4. Water 5. Natural or induced seismic event	One or more fatalities
	PC1.5	PC1.6	PC1.7	MC1.1
Mine	Excavate to design	Water managment	Separate people from the ground or strata hazard	Roll over protection system (ROPS), Falling object protection system (FOPS)
Mine A	Green	Green	Red	Grey
Mine B	Green	Green	Green	Red
Mine C	Green	Green	Green	Green
Mine D	Green	Green	Green	Green
Mine E	Green	Green	Green	Green
Mine F	Green	Green	Green	Green
Mine G	Green	Green	Green	Green
Mine H	Green	Green	Green	Green
Mine I	Green	Green	Green	Green
Mine J	Green	Green	Green	Green
Mine K	Green	Green	Green	Green
Mine L	Green	Green	Green	Green
Mine M	Green	Green	Green	Green
Mine N	Green	Green	Green	Green
Mine O	Green	Green	Green	Green
Mine P	Green	Green	Green	Green
Mine Q	Green	Green	Green	Green
Mine R	Green	Green	Green	Green
Mine S	Green	Green	Green	Green

Green (=100%)
Yellow (>= 80% and <100%)
Orange (>= 65% and <80%)
Red (<65%)

Notices issued

Of the 19 sites assessed under the inspection program, 7 separate mines were given notices relating to the principal hazard of ground or strata failure, while some mines were given notices in relation to other matters. For the purposes of this report, contraventions related to other matters were removed from the analysis. The notices issued for ground or strata failure were examined in detail and Table 2 lists the notices issued by type and details.

Table 2: Notices issued for the planned inspection program – ground or strata failure – slope stability - open cut coal mines – stage 2

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.195 prohibition notice	-	-
s.191 improvement notice	8	4
s.23 notice of concerns	3	3
Total	**11**	**7**

Of the combined 11 notices issued, there were some common themes that were apparent throughout the program plan. Table 3 summarises the type of contraventions and also outlines the total occurrences encountered. These themes can be related back to the critical controls outlined earlier and identify some trends that were of concern.

Table 3: Notices issued - prevalence of categories of concern

IDENTIFIED CONCERN CATEGORY
Absence of a procedure for workers and equipment when accessing or working under highwalls, low walls or dump areas.
Physical barriers were absent where there was a high risk of rock falls.
The Open cut district inspection form, completed by the open cut examiner (OCE), did not include all active areas with ground or strata failure risks (such as stockpiles).
Sites not having a process in place that requires excavated sump outlines to be picked up by survey and recorded.

Further information

For more information on safety assessment programs, the findings outlined in this report, or other mine safety information, please contact the Regulator:

CONTACT TYPE	CONTACT DETAILS
Email	cau@regional.nsw.gov.au
Incident reporting	To report an incident or injury call 1300 814 609 or log in to the Regulator Portal
Website	www.resourcesregulator.nsw.gov.au
Address	NSW Resources Regulator 516 High Street Maitland NSW 2320

Appendix A. Legislative requirements and published guidance relating to the principal hazard ground or strata failure

The following is a list of certain legislative requirements for the management of ground or strata failure risks referred to in this report, as provided by the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 and Work Health and Safety Regulation 2017.

- Work Health and Safety (Mines) Regulation 2014 [NSW]
  - Schedule 1 (1) Ground or strata failure
  - Clause 30 Mining induced seismic activity
- Safety Bulletin SB20-01 Failure of highwalls, low walls, and dumps
- Safety Bulletin SB19-09 Lack of bunding on accessible edges
- Safety Bulletin SB18-11 Windrow management and demarcation
- Safety Bulletin SB17-03 Rocks breach catch bund

Appendix B. Assessment system explained

The Regulator uses a bowtie framework to proactively assess how mine sites manage their principal hazards. Bowties are a widely used risk management tool that integrates preventative and mitigating controls onto threat lines that relate to a material unwanted event.

As part of program planning, controls were categorised by the Regulator's Mine Safety Inspectorate in accordance with the International Council on Mining and Metals handbook. Only controls deemed critical[1] are assessed under a planned inspection program. For a control to be assessed as effective, each of its control supports must be in place and operational.

Assessment findings results calculation

During the program, each control support assessed at each mine was rated and the findings recorded. Points were awarded depending on whether there was evidence that the control support was documented and/or implemented. Importantly, the system recognises the value of fully implemented and documented controls by allocating four points if both these elements were present.

For finding outcomes, points were awarded for each control support identified within a critical control. An overall assessment result for the critical control was then calculated as a proportion of the maximum possible points for that critical control. For example, if a critical control comprises ten control supports and five were assessed as fully implemented ('documented and implemented') and five were found to be 'not documented and not implemented' then the overall assessment result for that critical control would be 50%.

Table 4: Finding outcome and points

FINDING OUTCOME	POINTS
Documented and implemented	4
Implemented but not documented	2
Documented but not implemented	1
Not documented and not implemented	0

[1] Critical Control Management Implementation Guide, International Council on Mining and Metals (ICMM), 2015.

Critical control calculations also took into account instances where control supports were not applicable to the mine being assessed or when control supports were not able to be assessed during a site visit.

The overall assessment result for each critical control was assigned a colour based on the assessment bands presented in the table below. The colour band results were then used to identify industry focus areas requiring improvement.

Table 5: Assessment results and colour code

CRITERIA	COLOUR
An assessment result of 100% of possible points	Green
An assessment result of ≥ 80% but < 100% of possible points	Yellow
An assessment result of ≥ 65% but < 80% of possible points	Orange
An assessment result of < 65% of possible points	Red