NSW GOVERNMENT | Trade & Investment

Published Investigation Report

Serious inrush incident at the Cadia East Mine on 21 February 2010

Report prepared for the Director-General of the Department of Trade and Investment, Regional Infrastructure and Services by the Investigation Unit, Thornton

Mine Safety Investigation Unit

Title: Investigation Report,
Serious inrush incident at the Cadia East Mine on 21 February 2010

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Acknowledgements

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Introduction

The incident that prompted this report

This investigation report sets out the events and examines the causes of an incident that occurred on 21 February 2010 at Cadia East Mine.

The Cadia East Mine is an underground gold and copper mine under development located 23 km SSW of Orange in Central New South Wales.

The incident occurred when the combined water and cuttings from a raise boring process exited from the bottom of the almost completed 5m diameter VR5A raise bored shaft. The shaft extended approximately 271 metres vertically from the surface.

The inrush material travelled 814 metres along a roadway to the top of a second 375 metres deep ventilation shaft where it continued down to a second level in the mine.

The inrush of material pushed a 57 tonne manned bogger (front end loader) for 30 to 40 metres along a drive (roadway) and pushed a 6 tonne unmanned mini excavator 300 metres along a drive.

There were 7 employees significantly exposed to the risk of serious injury or death.

Prepared for the Director General

This report has been prepared for the Director General of the NSW Department of Trade & Investment, Regional Infrastructure & Services (The Department).

The report documents the process and outcomes of the investigation conducted by the Department's Investigation Unit (IU).

The Department's authority

This incident occurred in an underground metalliferous mine and consequently the Department has authority to investigate the matter under the provisions of the *Mine Health and Safety Act 2004 (MHSA)* and the *Mine Health and Safety Regulation 2007(MHSR).*

Section 6, of the *MHSA* identifies places of work under this Act:

'…

*(1) This Act applies to the following places of work (which are called **mines** in this Act):*

(a) any place where the extraction of material from land for the purpose of recovering minerals or quarry product is carried out,

(b) any place where the treatment of any such extracted material, or the treatment of minerals or quarry product, is carried out, if that place is at

or near the place from which the material, minerals or quarry product were extracted, ……'

Investigation Unit Investigators are appointed under Section 127 of the *MHSA*. Investigators have been issued with an identification card under section 48 of the *Occupational Health and Safety Act 2000* (*OHSA*).

Under Section 47A of the *OHSA* Investigation Unit Investigators have been appointed as an Inspector for the purposes of the *OHSA* and accompanying Regulation. As a result Investigators are authorised to exercise *OHSA* functions in relation to a mining workplace, and premises other than a mining workplace for the purpose of investigating any matter under the *OHSA* in relation to a mine.

The Investigation Unit

The Department's Investigation Unit was established to investigate serious mine incidents and report directly to the Director General. It is independent of Mine Safety Operations. The Cadia East Mine incident was assessed under Department procedures and was considered that a formal investigation was the appropriate enforcement response.

The Companies

Newcrest Mining Limited

Profile

Newcrest Mining Limited (NML) is Australia's largest gold producer and the fourth largest gold company in the world by market capitalisation. It is also a top-15 ASX-listed company with a market capitalisation of around A$29 billion.

At the time of writing the company's activities included six operating mines: Cadia Valley Operations (CVO), comprising Cadia Hill and Ridgeway (near Orange, NSW), Telfer Open Pit and Telfer Underground (Pilbara Region, Western Australia), Cracow (Gladstone Region Central Queensland) and Kencana (Indonesia). For the financial year ended 30 June 2010, Newcrest produced 1.76 million ounces of gold and 86.8 kilo tonnes of copper.

Newcrest employ over 10,000 people across 5 countries both in corporate offices and 10 operational mine sites which operate in Australia, Indonesia, Papua New Guinea, Fiji and West Africa.

Head Office Newcrest Mining Limited, Level 9, 600 St. Kilda Road, Melbourne Vic. 3004

Directors

Don Mercer - Non-Executive Chairman
Appointed to the Board and elected Chairman in October 2006.
Chairman of the Human Resources and Remuneration Committee.

Ian Smith - Managing Director and Chief Executive Officer
Appointed to the Board in July 2006 - Cease date: 30 June 2011.

Greg Robinson - Finance Director
Appointed to the Board in November 2006.

Vince Gauci - Non Executive Director
Appointed to the Board in December 2008.
Member of Safety Health and Environment Committee and the Human Resources and Remuneration Committee.

Richard Knight - Non-Executive Director
Appointed to the Board in February 2008.
Chairman of Safety, Health & Environment Committee and member of the Audit and Risk Committee.

Rick Lee - Non-Executive Director
Appointed to the Board in August 2007.
Member of Audit and Risk Committee and the Human Resources and Remuneration Committee.

Tim Poole - Non-Executive Director
Appointed to the Board in August 2007.
Member of Audit and Risk Committee and the Human Resources and Remuneration Committee.

John Spark - Non-Executive Director
Appointed to the Board in September 2007.
Chairman of Audit and Risk Committee and member of the Safety, Health and Environment Committee.

Winifred Kamit
Appointed to the board 1/02/2011.

Cadia Holdings Pty Limited

Cadia Holdings Pty Limited is listed as the main holder of the leases for the Newcrest mining Limited Cadia Valley operations. Newcrest Mining Limited is the ultimate holding company of Cadia Holdings Pty Ltd.

Directors

Ian Smith
Appointed to the Board 8 January 2007.
Cease date: 30 June 2011.

Greg Robinson
Appointed to the Board 8 January 2007.

Stephen Creese

Appointed to the Board 10 December 2009.

The Cadia East Mine

Introduction

The Cadia East Mine is part of the Cadia Valley Operations (CVO) and is 100% owned by Newcrest Mining Limited. The following information has been taken from The Newcrest website.[1]

> 'Cadia East is a mineralised system located on the eastern edge of the Cadia Hill orebody, within the Cadia mineralised corridor. The deposit is a porphyry zone of gold-copper mineralisation extending up to 2.5 kilometres east of Cadia Hill. The system is up to 600 metres wide and extends to 1.9 kilometres below the surface.
>
> The Cadia Hill gold-copper porphyry deposit was discovered by Newcrest Mining Limited in 1992. Cadia East was subsequently discovered in February 1994 as the result of exploration east of the Cadia Hill prospect during the drill-out of that deposit. The high-grade gold-copper mineralisation at depth was discovered in 1996 by drilling beneath previously outlined gold-copper mineralisation.

[1] http://www.newcrest.com.au/

Overview

Cadia East involves the development of the Cadia East deposit into Australia's first panel cave. The mine will be the deepest panel cave in the world and Australia's largest underground mine. Mining studies have identified panel caving as the mining method which will deliver the optimum technical and economic outcomes for development of this orebody.'[2]

A panel caving mining method schematic taken from a Newcrest project document can be viewed on page 7.

Project Status

'The Cadia East orebody is one of the world's largest gold deposits, comprising a Mineral Resource of 2,347Mt containing 33.2Moz of gold and 6.59Mt of copper, along with a current Ore Reserve of 18.7Moz of gold and 3.16Mt of copper. It will underpin production from the Cadia Valley for at least the next 30 years.

The project is based on the construction of an underground mine adjacent to the Cadia Hill open pit mine, and an expansion of the existing Cadia Valley processing plant capacity from 24Mtpa to 26Mpta.'

Mine location, 23km SSW of Orange, Central New South Wales.

Mine Operator Newcrest Mining Limited.

Head office Newcrest Mining Limited, Level 9, 600 St. Kilda Road, Melbourne. Victoria 3004.

Location of incident: Underground Cadia East Mine - VR5A ventilation drive.

Management hierarchy The Cadia East mine management hierarchy at the time of the incident is shown in the diagram on page 8.

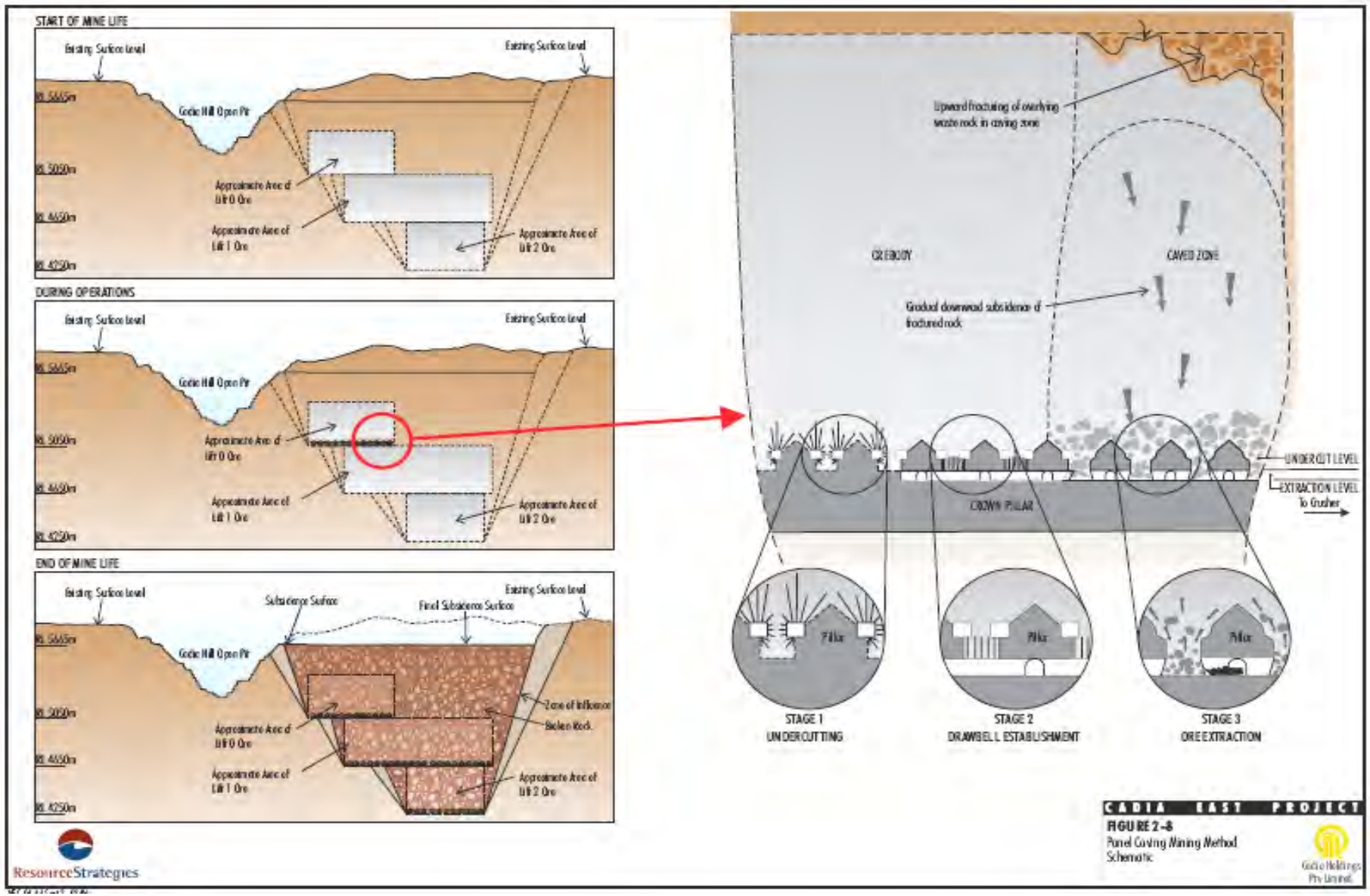
[2] http://www.newcrest.com.au/

Mine Plans The mine provided the plans, geotechnical domains and computer generated views that are listed below.[3]

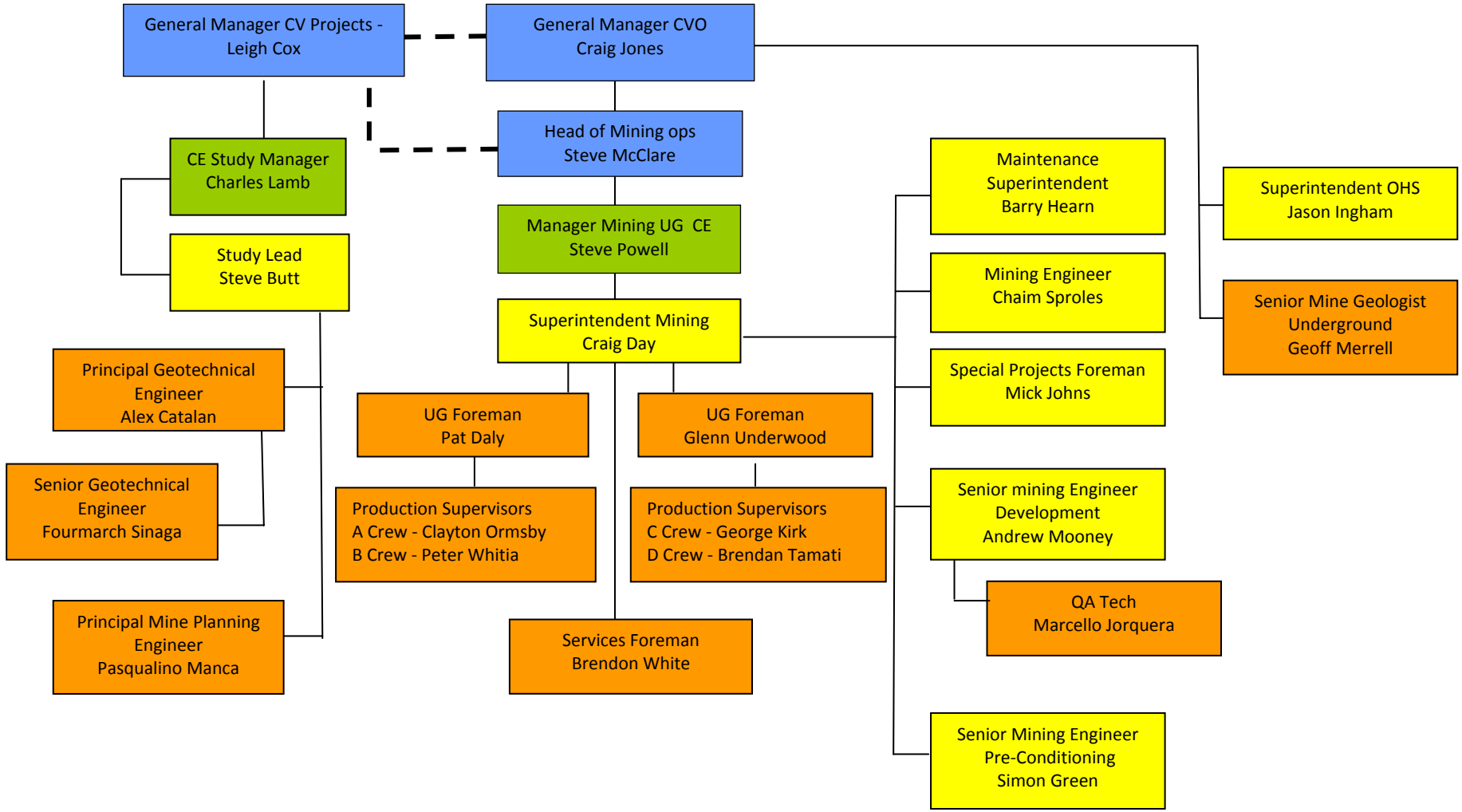
- Plan 1. Cadia East Mine plan of intent.
- Plan 2. Plan view of mine workings – VR5A to VR5B shaft.
- Plan 3. Cross section view of mine workings – VR5A to VR5B shaft.
- Plan 4. Cadia East Decline Plan of Intent.
- Plan 5. Design plan for access to the bottom of VR5A excavation site.
- East-West cross section diagram showing geotechnical domains through the VR5 area.
- North-South cross section diagram showing geotechnical domains through the VR5 area.
- Plan view of 5401 level identifying areas where inrush heights were surveyed.
- Computer generated view of 5401 level identifying areas where inrush heights were surveyed of the height of the inrush.
- Computer generated views of the height of the inrush - Section A.
- Computer generated views of the height of the inrush - Section B.
- Computer generated views of the height of the inrush - Section C.
- Computer generated views of the height of the inrush - Section D.
- Plan 6. Cadia East Emergency and Fire-plans Primary Ventilation Survey.
- Plan 7. Cadia East Emergency and Fire-plans Primary Ventilation Survey. extract - lists where persons were in the mine at the time of the inrush.

[3] The full documents can be found in attachment 3

Panel Caving Mining Method Schematic - Taken from Newcrest project document



Cadia East Mine Management Personnel (at 21 February 2010).[4]



Legend: Colour as taken from the original Cadia Valley Operations Management Structure document. As supplied to the Department.

[4] Reproduced from Cadia Valley Operations Management Structure provided by NML.

The Activity

Boring of Ventilation Shaft

At the time of the incident the mine was constructing a ventilation shaft by the use of a machine called a raise borer. The ventilation shaft is a critical part of the mine's long term ventilation infrastructure and was designated as VR5A.

Raise boring contractor

RUC Cementation Mining Contractors Pty Ltd (RUC). were contracted to excavate the VR5A ventilation shaft and were directed in their activities by Mining Engineer Simon Green, an employee of Newcrest Mining Limited.

RUC did not have any direct control of the underground bogging activity at the bottom of VR5A shaft.

Raise boring excavation rate

The standard raise bore cutting rate was set at 4.5m per shift (9m per day).

The reamed cuttings and water from VR5A shaft formed a slurry and flowed down the drive to an area where other contractors were attempting to install ventilation equipment.

During the week prior to the incident the metreage reamed was increased to expedite the completion of the VR5A shaft in part to accommodate other contractors who were behind schedule to install ventilation equipment.

Bogging operation

At the time of the incident a mine technician was engaged in operating a bogger to clear built up reamer cuttings from the floor below the bottom of the shaft.

Photo of the Raise Borer

This raise borer was used to excavate VR5A.

It is shown set up at a different location.

Photograph taken by Alwyn Piggott 31/08/2010.

The Equipment

Raise Borer

A raise borer is a machine used in underground mining, to excavate a circular hole between two levels of a mine without the use of explosives.

The raise borer is set up on the upper level of the two levels to be connected, on an evenly laid platform (typically a concrete pad). A small-diameter hole (pilot hole) is drilled to the level required; the diameter of this hole is typically 230mm - 350mm (9" - 15"), large enough to accommodate the drill string. Once the drill has broken into the opening on the target level, the bit is removed and a reamer head, of the required diameter of the excavation, is attached to the drill string and raised back towards the machine. The drill cuttings from the reamer head fall to the floor of the lower level. A bogger removes the cuttings from beneath the shaft.

The finished raise has smooth walls and may not require rock bolting or other forms of ground support.

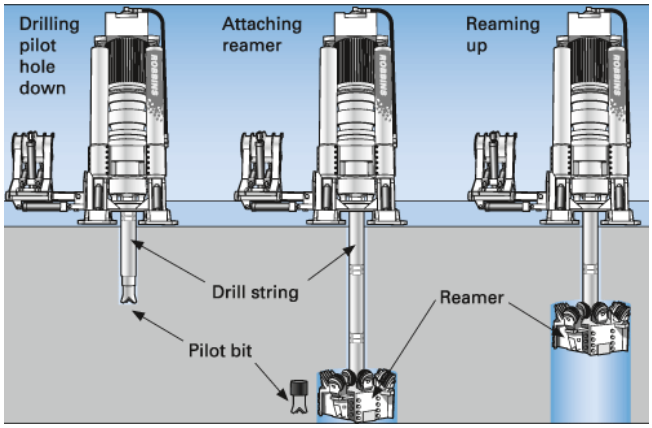


Diagram of the drilling and reaming process.[5]

1. The pilot hole is drilled down to the lower level.
2. The pilot drill is detached and a reamer is attached to the end of the drill string.
3. The reamer is raised and the cuttings fall to the lower level floor.

[5] Taken from Atlas Copco website.http://img01.atlascopco.com/Standard/index.jsp

Picture of a cross sectional view of the reaming process.[6]

A bogger (front end loader) is used to remove the cuttings accumulating on the floor below the shaft.

Photograph of a bogger TORO 0011 LHD.[7]

The same model as the bogger that was used to bog out beneath the raise bore hole and was pushed back 30 to 40 metres by the inrush.

Photograph of a Hyundai Model 55-7 Mini Excavator.[8]

The same model as the excavator that was washed approximately 300 metres along the drive.

[6] Picture from Shaft Drillers international website http://www.shaftdrillers.com/raise_bore_drilling.php
[7] Picture taken from web page http://www.flickr.com/photos/rocbolt/3133882582/
[8] Picture copied from brochure of the machine.

The incident

Incident Overview

The incident occurred on Sunday 21 February 2010, at approximately 10.30 pm, during the process of bogging the material generated by the reaming of the VR5A ventilation shaft.

A number of weeks before the incident a pilot hole had been drilled from the surface to an underground level approximately 271 metres below the surface. The pilot hole had intersected an aquifer or other water bearing area during the course of drilling. After the pilot hole intersected the underground level drive a significant amount of water ran continuously from the hole.

A five (5) metre diameter reaming head was attached to the drill string and commenced back-reaming the drill hole. The shaft was to serve as a ventilation shaft for the underground mine and was designated as VR5A.

As a result of the presence of the water referred to above, the reaming process throughout the life of the operation produced a slurry like material (that is, a mixture of reamer cuttings and water), instead of the usually dry fine clearly defined cuttings (muck) pile.[9]

The raise boring process is depicted on previous pages 8 and 9.

At the time of the incident, a mine technician Paul Southwell was engaged in operating a bogger (L001) to clear the reamer cuttings from the floor below the bottom of the shaft. He said that he had taken approximately 20 buckets of really wet dirt from the road itself to give a good work platform to work on.

Production Supervisor Brendon Tamati had visited the area in a light vehicle (4 wheel drive) half an hour before the inrush and had instructed Paul Southwell to continue bogging. After removing three or four buckets Paul Southwell was heading back up to the base of VR5A shaft and felt his ears pop, he then stopped the machine and looked up at the vent bag as the dust was being blown off it and then the next thing he observed was the machine was covered in mud and it was being pushed back down the drive.

[9] A number of bogger operators described the material as a mud or slurry.

The inrush of material according to Paul Southwell pushed the 57 tonne Bogger he was seated in for 30 to 40 metres back down along the VR5A access drive.

The Inrush Path

The material from the base of VR5A shaft flowed a distance of 814 metres to the top of the VR5B ventilation shaft. The top of VR5B was approximately 100 metres vertically below the base of VR5A.[10]

The following 2 photographs taken after the incident shows the height the inrush material rose in sections of the drive a short distance from the base of VR5A shaft.[11]

Photograph near base of VR5A shaft.

This photograph shows dried mud on the wall of the drive indicating the height the material reached as it flowed down the drive from the base of VR5A shaft.

Photograph taken by Tony Smith 26/02/10.

Photograph at base of VR5A shaft.

This photograph is the section of the drive at the base of VR5A shaft. It shows dried mud in a slumping pattern on the wall of the drive as it flowed from the base of VR5A shaft. It also shows dried mud on the ventilation bag at approximately 7m in height

Photograph taken by Tony Smith 26/02/10.

The following two photographs of the bogger that was removing the wet cuttings from the base of the raisebore hole at the time of the inrush shows the extent of the mud and material covering the machine up to the level of the enclosed cab.

[10] Refer to attachment 3 plan view and cross sectional view of mine workings from VR5A to VR5B shaft.
[11] Refer to attachment 3 computer generated views indicating the height of the inrush material travelling down the roadways.

Photograph of the rear view of bogger (L001) that was pushed down the drive.

Note the mud material that had coated the bogger up to the cabin level.

The machine specifications indicates the height to the top of the cabin is 2.99m.

Photograph taken by Brendon Tamati 22/02/10.

Photograph of the bogger (L001) that was pushed down the drive.

Note the mud material that had coated the front windscreen of the bogger.

Photograph taken by Brendon Tamati 22/02/10.

The following photograph of the L001 bogger parked in the workshop area after the incident provides relative scale to a person.

Photograph of the bogger (L001) that was pushed down the drive.

The bogger is parked in the underground workshop after the incident.

Photograph taken by Tony Smith 26/02/10.

Dried mud coating on the walls of the drive down which the inrush flowed were measured in a number of sections of the drive and computer generated views of the heights surveyed. Section A in attachment 3 is 125m from VR5A and indicates mud heights ranging from 1.1m to 2.7m. Section B in attachment 3 is 250m from

base of VR5A and indicates heights ranging from 1.2m to 1.7m.

Section C in attachment 3 is just prior to a ventilation door approximately 350m from the base of VR5A shaft and indicates heights ranging from 2.3m to 3.0m

The inrush material continued down the drive where it struck a ventilation structure as shown in the following photograph. The structure was approximately 350 metres from the bottom of VR5A shaft.

Photograph of ventilation wall approximately 350m from base of VR5A shaft.

Showing the height of the inrush material on the walls and the ventilation structure located approximately 350 metres from the VR5A shaft. The red lines are indicative of the height of the inrush material in comparison to the two persons standing at the doorway.

Photograph taken by Tony Smith 26/02/10.

Section D in attachment 3 is past the ventilation door and indicates heights ranging from 0.6m to 1.1m.

Photograph of roadway intersection 550m from base of VR5A shaft.

Showing the height of the inrush material on the wall beyond the ventilation structure.

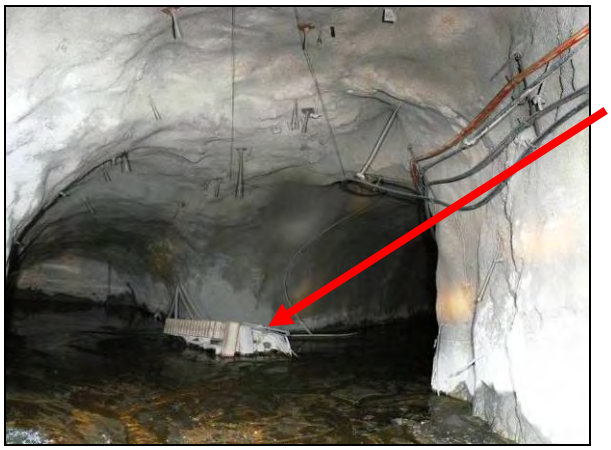
Photograph taken by Tony Smith 26/02/10.

Photograph of ventilation wall at intersection near top of VR5B shaft – 760m from base of VR5A shaft.

Showing the height of the inrush material on the wall beyond the ventilation structure.

Photograph taken by Tony Smith 26/02/10.

The inrush material travelled through the holes in the ventilation structure and continued along the VR5A ventilation drive. It washed a 6 tonne unmanned mini excavator that was close by to the structure 300 metres along the drive to within close proximity of the top of the open VR5B shaft approximately 100 metres below the level of the base of VR5A shaft. The following photograph is of the 6 tonne excavator covered in mud at rest in the vicinity of VR5B shaft.



Photograph of the mini excavator that was washed approximately 300 metres along the drive to top of VR5B shaft.

Excavator on its side with one track visible. The top of VR5B shaft is in the drive to the right of the buried excavator. See the following full photo of this model excavator.

Photograph taken by Tony Smith 26/02/10.

The previous photograph is of the excavator over on its side covered with the inrush material. The following photograph of the same model excavator gives a perspective of the height of the material covering the excavator.

Photograph of a Hyundai Model 55-7 Mini Excavator.

The same model as the excavator that was washed approximately 300 metres along the drive.

The inrush of material then flowed into the top of the 375 metre deep VR5B ventilation shaft where it dropped down to a second level of the mine.

At the base of this shaft a second operator in a Bogger (L005) was exposed to the inrush. This machine was also struck by the wet material and subjected to a higher than normal wind velocity from VR5B shaft. On exit from his machine the operator found wet material to a depth of over 1m in the area.

Photograph of the second bogger (L005) that was operating in the area at the bottom of VR5B shaft.

The bogger is located in wet material near the base of VR5B shaft. The red lines indicate the height of the inrush material.

Photograph taken by Brendon Tamati 22/02/10.

The inrush material finally reached and pooled at the end of a decline that was under development. The “dead end” of the decline is shown in the photograph below that was taken after a great deal of cleanup work had been undertaken.

A jumbo drill crew were preparing their machine in readiness to move the drill to the dead end and commence drilling. They would have been exposed to serious injury if they had been set up in that area.

Photograph of sump at bottom of decline.

A jumbo drill crew were preparing their drill in readiness to move into this area to set up to drill. They would have been at serious risk of injury.

Photograph taken after clean up of this sump.

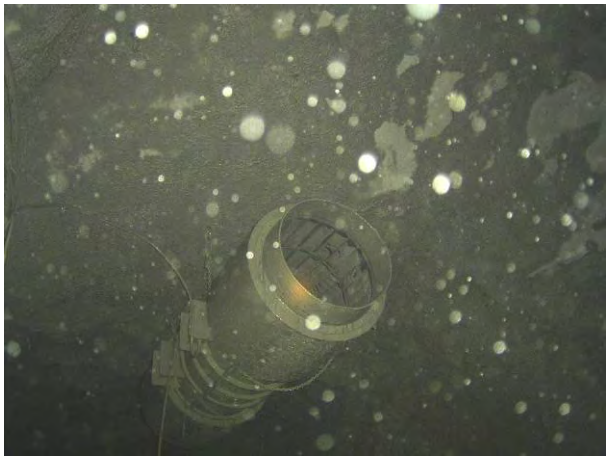
Photograph taken by Tony Smith 26/02/10.

The inrush material washed away part of a temporary structure of piled up material and a brattice that was at the base of the VR5B shaft for controlling mine ventilation. This caused a change to the ventilation in the mine. It took air away from the main decline (main mine access drive) and a workshop.

Photograph of the area at the base of the VR5B ventilation shaft.

The red arrow points to where a brattice arrangement was located prior to the inrush at the base of the VR5B ventilation shaft.

Photograph taken by Brendon Tamati 22/02/10.



Photograph of the fan installed in the drive at the base of VR5B base of the VR5B ventilation shaft.

Note the splatter of the inrush material on and around the electrical ventilation fan.

Photograph taken by Brendon Tamati 22/02/10.

Six persons in the immediate vicinity of VR5B were at risk as a result of the material flow. Apart from the Bogger operator three of these persons were trapped in a

light vehicle for a short period due to the material flow. They had been located in a roadway at a level higher than the material flowing past them. They attempted to escape from the roadway but became trapped in the inrush material.

They waited until the flow subsided and when attempting to exit the area in the light vehicle it became bogged and they were forced to walk out in the inrush material.

The other two were servicing a jumbo drill machine located in a cuddy at an elevation above the inrush material. They were about to enter the drive below VR5B shaft which was subsequently filled with inrush water and mud material.

The following photographs are of the light vehicle trapped in the inrush material

In an area below the VR5B shaft.

Photograph of the light vehicle bogged in the inrush material below VR5B shaft.

Photograph taken by Brendon Tamati 22/02/10.

2nd Photograph of the light vehicle bogged in the inrush material below VR5B shaft.

Photograph taken by Brendon Tamati 22/02/10.

Circumstances of the incident

A constant flow of ground water from the water source that was intersected during the pilot hole drilling was coming down the raisebore hole as reaming took

place. This made bogging from the base of the raisebore shaft become difficult. Water and mud often remained along the drive where bogging took place and was reported as being difficult to remove.

The raise boring machine was isolated and locked out at 2.30pm on 20 February 2010 to allow Boggers to access the bottom of the hole and bog out the heaped fines that had accumulated below the hole. On the early morning of 21 February 2010 it was observed that the raisebore hole was blocked.

A basic JSEA was carried out by Production Supervisor George Kirk during the day shift of 21 February 2010. [12] While he, in carrying out the JSEA identified the risk of an inrush occurring, there was a failure to establish controls to ensure that persons working nearby or on lower levels in the mine were not exposed to risk of injury or death in the event of an inrush occurring.

Crew Foreman Glenn Underwood recognised the impact of an inrush on persons on levels below the VR5A shaft but did not take appropriate action to ensure that the exposure of those persons to an inrush was addressed in the risk assessment which is part of a JSEA.

The Production Supervisor on shift at the time of the incident, Brendon Tamati was made aware of the choked shaft when he came on shift. He was told by George Kirk to make sure the Bogger operator signed off the JSEA. Brendon Tamati had a brief overlook of the JSEA and told the Bogger operator to be aware and "take it easy".

When bogging re-commenced on the night shift to remove the cuttings and mud that had accumulated along the drive and at the base of the raisebore shaft, the inrush occurred.

Employees at Risk

While no one was injured during this incident there was a high potential for serious injury or for a fatality to occur. The dried mud markings left on walls of drives by the inrush were in places higher than a person.[13] The height of the flow and the force within the flow that pushed a 57 tonne Bogger 30 – 40 metres and a 6 tonne excavator approximately 300 metres would have had serious consequences for anyone caught in its flow-path.

[12] Job safety and Environmental Analysis – required when a risk potential is assessed as moderate, high or extreme.
[13] See section plans A-D in attachment 3

There were 7 employees significantly exposed to the risk of serious injury or death.

- Paul Southwell was in the bogger at the base of VR5A shaft as it was struck and pushed along by the inrush.
- Chris Sullivan was the operator of a bogger near the base of the second shaft (VR5B). He stated his bogger was struck by the wet material and subjected to a higher than normal wind velocity from VR5B shaft. On exit from his machine he said he found wet material to a depth of over 1m in the area.
- Adam Whatling, Shane Webb and Matthew Bogie were trapped in a leg 3 incline. They felt an air pressure blast and then saw material over 1m high flowing past below where they were located down into the Leg 3 decline. They were trapped for a period of time. During escape they bogged a light vehicle when attempting to exit the area.
- Phillip Brice and Ben Green were in a blind ended cross cut, the location was elevated and around the corner from the VR5B shaft. They were with a jumbo drill rig and light vehicle. They were preparing to enter a decline sump with the jumbo drill rig. They felt the air pressure blast and then observed the full roadway become clouded with mud particles. They were approximately 10m into the blind ended cross cut and were fortunately shielded from the mud particle blast.

There were about 18 persons working in the mine at levels lower than the base of VR5A shaft at the time of the incident.[14]

A ventilation control installation at the base of VR5B shaft was damaged by the flow of the inrush material. This reduced the ventilation flow and persons below the level of VR5B shaft were exposed to a reduction in air flow.

Other persons exposed to potential injury

After the initial report that the bottom of the raise bore shaft was blocked/choked, a number of employees accessed areas where they were in the path of the potential inrush.

Despite knowledge of the blockage employees went to inspect the site and/or to bog out from beneath the shaft.

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[14] Refer to Attachment 3 Plan 6. Cadia East Emergency and Fire-plans Primary Ventilation Survey and Plan 7. Cadia East Emergency and Fire-plans Primary Ventilation Survey extract - lists where persons were in the mine at the time of the inrush.

- At 0500 hrs on 21 February 2010 an operator, Stephen Robinson said the bottom of the raise was choked.[15]
- At 0800 hrs on 21 February 2010 a supervisor, George Kirk visited the area at the base of VR5A shaft and said it was easy to see it was choked or blocked off.[16]
- At 1600 hrs on 21 February 2010 another operator, Jamie Sherlock went to bog out from beneath VR5A shaft and said it was blocked.[17]
- On the day shift of 21 February 2010 Shift supervisor Darren Writer went with Glenn Underwood to where they were able to look in at the VR5A access drive.
- A supervisor, Brendon Tamati inspected the bottom of the raise at about 10.00pm on 21 February 2010.

Within approximately half an hour of Brendon Tamati's visit to inspect the base of VR5A shaft the inrush occurred.

During the time the previously mentioned persons went to inspect or bog at the base of VR5A shaft they were exposed to the potential of an inrush.

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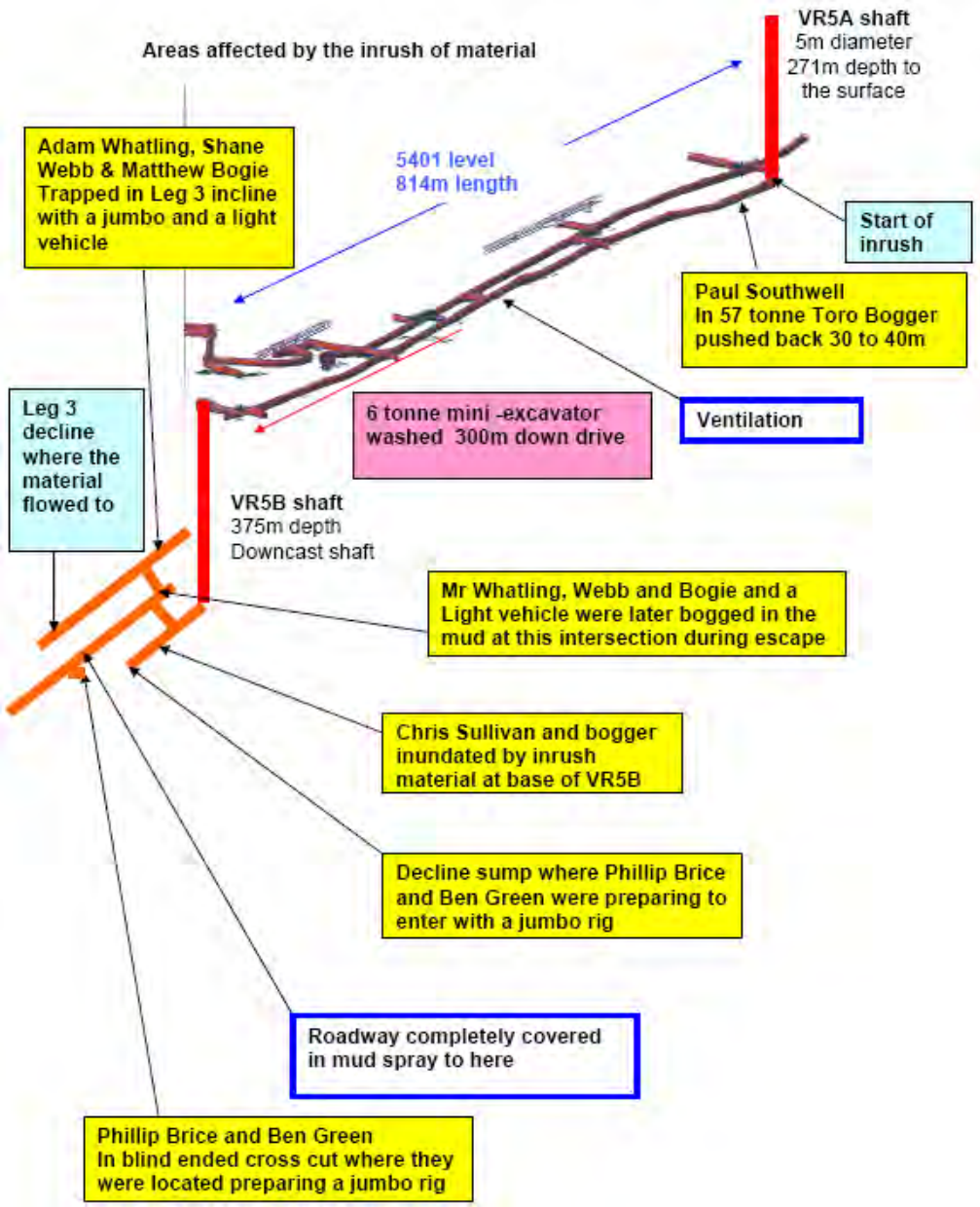
[15] This operator said he had often bogged from the bottom of VR5A during the month before the incident

[16] George Kirk stated this in a record of interview

[17] Jamie Sherlock stated this in a record of interview

The "at risk" employees



Actions post - incident

Actions of the Department

Acting Senior Inspector of Mines, Central West, Mark Stephens, attended the Cadia East mine after a late notification on the afternoon of 22 February 2010. He attended the mine around midday and inspected the area affected by the inrush.

Immediate action

A prohibition notice under Section 93 of the *OHSA 2000* was issued to stop the bogging activity from beneath the bottom of raise bore holes until such times that all safety controls and systems involved in removing material below raise bore holes had been reviewed. The following directions about measures to be taken were prescribed by Inspector Mark Stephens:

> 'All raise bore reaming operations are to cease until all safety controls and systems involved in removing material below raise bore holes have been reviewed. In particular it Is considered essential that a detailed risk review take place by your company of these controls and associated safety systems. This review is to include all procedures and the adherence to such procedures in relation to this activity and to include (but not limited to) adequate and regular site inspections being carried out, as well as ensuring adequate communication takes place between all parties involved to ensure such a high risk issue is managed satisfactorily to ensure the residual risk is at as low a level as possible. A presentation to I&I NSW of the results of this risk review will be necessary for assessment. If I&I NSW assess that the review has been satisfactory and safety systems and controls have improved to such an extent that are satisfactory then raise bore reaming can continue on site.'

Issues drawn to the attention of the mine

Inspector Mark Stephens became aware of the following practices:

The communication of underground foremen, shift bosses and operators between each other and with their superintendent and the mine manager regarding high risk activities had not been adequate. Which in his opinion "may be relevant to the continued safe operation of the mine or the safety of persons working at the mine"

The particulars as to why he considered that the above may be relevant to the

continued safe operation of the mine or the safety of persons at the mine were:

Communication between each of those persons appeared to be inadequate when very high risk safety issues were dealt with as evidenced by the activities leading up to the water inrush incident of 21 Feb 2010.

Pursuant to *Section 131* of the *Mine Health and Safety Act 2004* Inspector Mark Stephens advised the mine of the above information.

Investigating the incident

An investigator from the Investigation Unit visited the mine on 24 February 2010 and commenced the investigation process.

The Investigation Unit conducted a detailed and thorough investigation into the incident.

Feedback to Mine safety operations

The investigation Unit liaised with Mine Safety Operations to provide feedback on initial findings.

Safety Alert

Mine Safety Operations developed and published a Safety Alert:

SA11 – 01 Water inrush from Raisebore Hole.[18]

The Safety Alert was prepared by Inspector Mark Stephens, it contains a précis of the inrush incident and the circumstances of the incident. It also recommends a number of control measures to be considered for minimising consequences of an inrush.

The following is the preamble to the list of recommended control measures:

> 'The risk of an inrush within a mine is a prescribed hazard in the *NSW Mine Health and Safety Regulation 2007."*[19]
>
> A risk assessment is therefore required and effective controls are to be established (using the hierarchy of controls) taking into consideration all possible scenarios regarding potential inrush.'

The Safety Alert provides a reference to The Department's MDG 1030 Guideline for Raiseboring Operations.

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[18] Safety alert at attachment 4

[19] *Mine Health and safety Regulation 2007, Section 37 Inrush*.
Section 47 Control of risk of inrush lists requirements on the operator of a mine to deal with a risk of any possible sudden and unplanned entry of water, gas, rock or other substances into workings of an underground mine.

Action taken by the mine

Immediate action

The *MHSA 2004* required this incident to be notified to the Department immediately the operator became aware of the incident and by the quickest available means.[20] The incident was not notified to the local Inspector of mines until the afternoon of the following day, approximately 14 hours later.

The Manager Mining Cadia East Stephen Powell gave verbal telephone instructions to Superintendent of Mining Craig Day who then relayed the instructions by telephone to Production Supervisor Brendon Tamati. The instructions given were to re-enter the area at the base of VR5B to clean up the inrush material and to reinstate the ventilation structure. This instruction was made prior to the local inspector of mines being notified of the incident.

There was no formal risk assessment carried out prior entering to the area at the base of VR5B to clean up the inrush material and to reinstate the ventilation structure.

Photographs taken by the mine's night shift Supervisor Brendon Tamati following the incident were collected by investigators and are evidence of the nature of the inrush.

Response to Notices

The prohibition notice issued to the mine provided directions about measures to be taken (refer to action taken by the Department on the previous page).

As required by the prohibition notice the company developed a presentation (powerpoint) which was viewed by Mark Stephens and Inspector Robert Jay.

A letter dated 31 March 2010 from Mark Stephens advised the General Manager Craig Jones that the Department was satisfied that the review had been completed satisfactorily and that the prohibition notice had been complied with.

In the presentation, the company also addressed the issues of communications that was raised by Inspector Mark Stephens pursuant to Section 131 of the *Mine Health and Safety Act 2004*.

[20] *Refer to MHSA 2004.Section 88 (1)(a) &(b) and (3)*

The System of Work

Standard Work Procedure requirement

The CVO system of work for bogging at the base of a raise bore shaft was contained in a Standard Work Procedure (SWP) document titled:

"Raise Bore Hole Bogging and Isolation" Number: CED-030.

This SWP contained the following type of information:

- Referenced Documents
- Prerequisite Competency Skills
- Tools Equipment/Material
- Definitions
- Safety
- Actions
- Bogging Cuttings to Stockpile

Within these sections critical information includes

- Isolation procedures.
- Competencies in See-Stop-Control system and the Job Safety and Environment Analysis (JSEA).
- The daily activity report that was designed to record metres advance of the reaming and the number of buckets bogged from the base of the shaft.
- Actions to be taken for entering the area at the base of the shaft.
- Inspection regime and a stated height that the reamed cuttings shall be treated as a serious incident and to be reported.

The SWP stated that a 2m gap was to be maintained at all times between the heaped cuttings beneath the hole and the shaft lip. When the gap at the shaft lip was 1m or less, it was to be treated as a serious incident and reported as such. The raise borer was to stop work and the area barricaded until a JSEA was undertaken.

The Raise borer

At the time of the incident the raise bore reamer was within 10m of the surface and close to completing the 5m diameter boring of the 271 m depth VR5A shaft.

Reaming rate

The standard raise bore cutting rate was 4.5m per shift (9m per day). A decision was made by mine management approximately one week prior to the incident to permit the raise bore to cut as quickly as possible in order to complete the VR5A raise bore.

The following table demonstrates the additional reaming metreage on six shifts during the week prior to the incident.

Date	Metres Reamed		
	Day	Night	Total
13/02/10	4.55	4.55	9.1
14/02/10	4.55	4.55	9.1
15/02/10	4.52	4.56	9.08
16/02/10	4.55	3.03	7.58
17/02/10	**6.03**	**6.03**	12.06
18/02/10	3.01	**6.01**	9.02
19/02/10	**6.02**	**7.54**	13.56
20/02/10	**6.08**	0.00	6.08
21/02/10	0.00	0.00	0.00

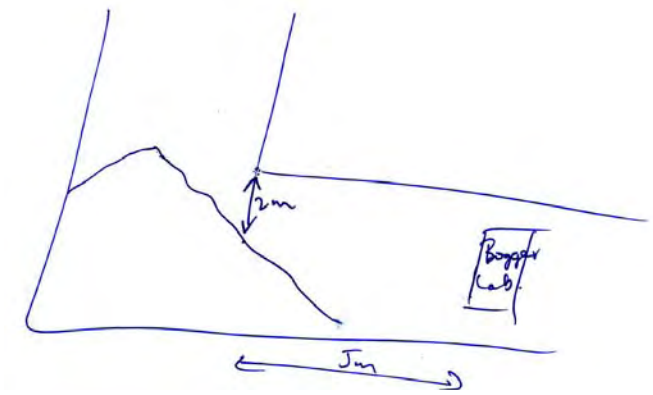
Bogging

When the cuttings were being bogged at the bottom of the shaft, the raise boring machine would be isolated and no cutting permitted.

During an interview with Senior Mining Engineer Chaim Sproles, he drew a cross section of the base of a raise bore hole in which he identified a 2m gap between the brow of the hole and the height of the cuttings in explaining that the cuttings were not to encroach any higher otherwise it must be treated as an incident and a JSEA must then be completed.

Chaim Sproles also depicted a 5m approach limit placed on the Bogger when removing the reamed cuttings. The 5m limit reduces the potential of the Bogger entering beneath the shaft and being struck by any object falling down the shaft.

An extract from the diagram produced by Chaim Sproles is on the following page.



Extract from a diagram that was drawn by Chaim Sproles during an interview.

The reamer cuttings are at the bottom of the shaft.

The 2M gap is shown in the diagram.

Reconciliation of reamed and bogged material

A reconciliation of metres being cut by the raise borer and the number of buckets of material removed per shift was being maintained to provide information to shift supervisors. The cutting material encountered in VR5A shaft was wetter than normally experienced at the mine than at other raise bore sites due to water aquifers in this shaft. The rate of flow of water down the hole was unconfirmed with persons assessing between 5 to 30 litres per second.

Tell tale holes

A series of tell tale holes (usually three) can be drilled up into the raise bore shaft.

In the event that the bottom of the shaft becomes blocked and water builds up in the shaft, it will run out of the tell tale holes to indicate the shaft is blocked. Installing drain holes is not mandatory but is recommended in Department guideline documents and is practised throughout industry.

The VR5A shaft did not have any tell tale holes installed at any time during the excavation process.

Lack of awareness of Department Guidelines

MDG 1030 - Guideline for Raiseboring Operations and

MDG 1030 TR – Technical Reference Material for Raiseboring Operations

The Department document MDG 1030 and the technical reference document MDG 1030 TR were published by the New South Wales Department of Primary Industries in June 2003.

The working group for the MGD 1030 TR included Mines Inspectors and representatives from industry including a Newcrest manager of mining.

The documents address the potential of an inrush. The technical reference document advises pre-drilling of drain holes into the brow as part of control measures.

During interviews some staff indicated they had no knowledge of this document.

The Underground Mining Superintendent Craig Day, when asked if he was aware of guidelines relating to raise bore drillings put out by the Department answered that he couldn't state any.[21]

Underground Mining Foreman, Glenn Underwood indicated he had never seen this document.[22]

Underground Mining Foreman Patrick Daly also indicated he hadn't seen this document.[23]

MDG 1024 – Guideline for Inrush Hazard Management

This document was first published in 1998, revised in February 2007 and re-published in April 2007 This document was developed in support of Clause 33 of the NSW *Coal Mine Health and Safety Regulation 2006* and was only to be seen as one source of assistance.

The NSW Inrush Working Committee included Professor Jim Galvin, Senior Inspector of Coal Mines Ian Anderson, Allan Fisher, Bob Gibson, Professor Jim Joy and Professor Emeritus Frank Roxborough.

The document addresses the following:

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[21] Craig Day indicated this in a record of interview.
[22] Glenn Underwood indicated this in a record of interview.
[23] Patrick Daly indicated this in a record of interview.

- Defines and describes inrush hazards,
- Identification of an inrush hazard,
- Examples of how to identify the existence of an inrush hazard,
- How to identify the magnitude of an inrush hazard,
- Controls for prevention,
- Controls for monitoring,
- Controls for the first response
- Controls for an emergency response, and
- Working within the inrush control zone.

The document was referenced in the Cadia Valley Operations Inrush – Underground Mining Operations Major Hazard management Plan,[24] yet a number of staff during interviews indicated they had no knowledge of the document.

Underground Mining Foreman, Glenn Underwood indicated he had never seen this document.[25]

Underground Mining Foreman Patrick Daly also indicated he hadn't seen this document.[26]

Of note is the following quotation from MDG 1024 under the section on Controls for an Emergency Response:

……" **remember that a conservative approach is best, especially if the nature and the magnitude of the worst case event is not clear."**

This approach would have been appropriate to the circumstances during the course of the lead up to the inrush event on 21 February 2010.

The following diagram depicts a blocked shaft with water building up above the cuttings in the shaft and the water draining from the hole thus providing a "tell tale" that the shaft is blocked and water is building up within the shaft.

[24] Inrush – Underground Mining Operations Major Hazard management Plan – last revised 25/05/06
[25] Glenn Underwood indicated this in a record of interview.
[26] Patrick Daly indicated this in a record of interview.

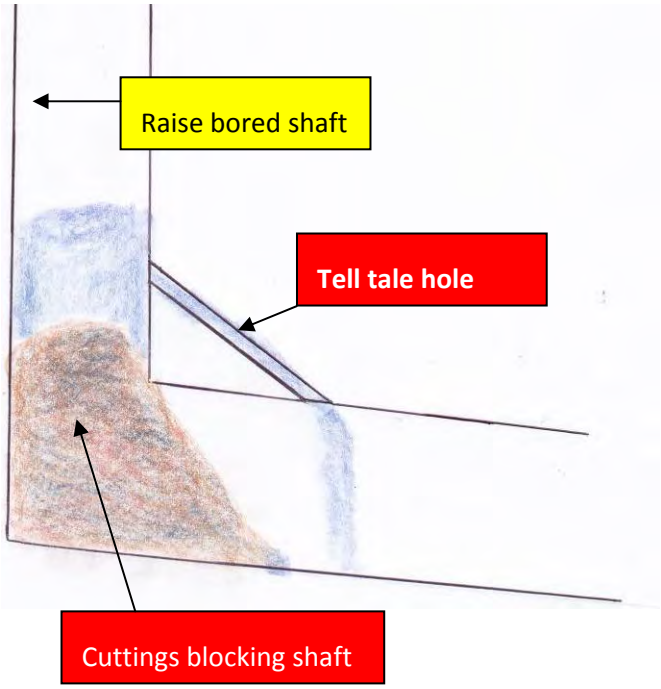


Diagram created by A Piggott.

Representation of a shaft blocked by the build up of cuttings at the bottom and water accumulating up the shaft.

The subsequent flow of water out of the drilled tell tale holes is an indicator of a blocked shaft.

The Manager Mining, Stephen Powell stated that the drilling of tell tales holes was a normal process used at Cadia East Mine. He said the process was not written into any procedural document and that there were no tell tale holes drilled up into the bottom of the VR5A shaft.

Cause of the Incident

The inrush was a result of an excessive build up of reamed cuttings choking the raise bore shaft at its base and the subsequent further build up of the unknown quantity of water and cuttings in the shaft bursting out from the bottom of the shaft.

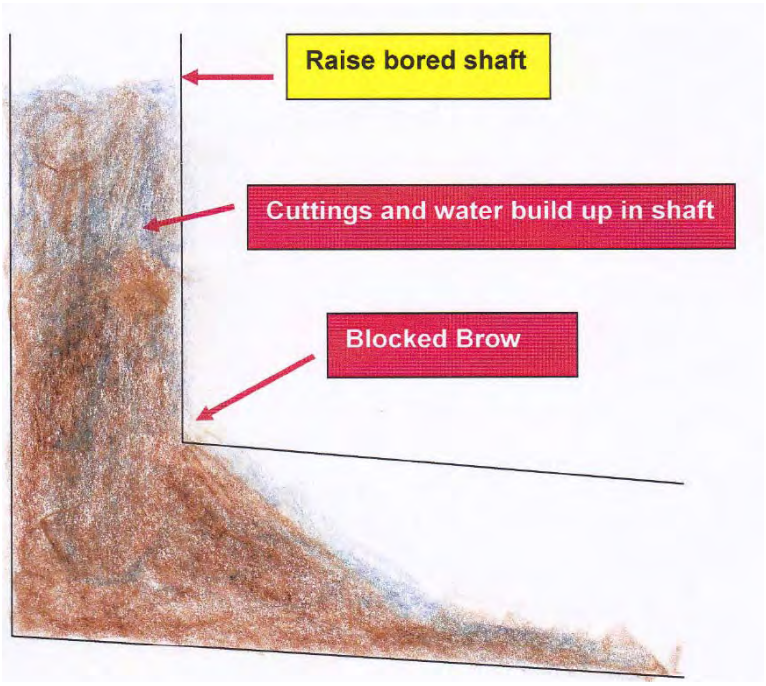


Diagram created by A Piggott.

Representation of the potential for cuttings and water to build up in a shaft when the brow of the hole at the bottom of the shaft becomes blocked.

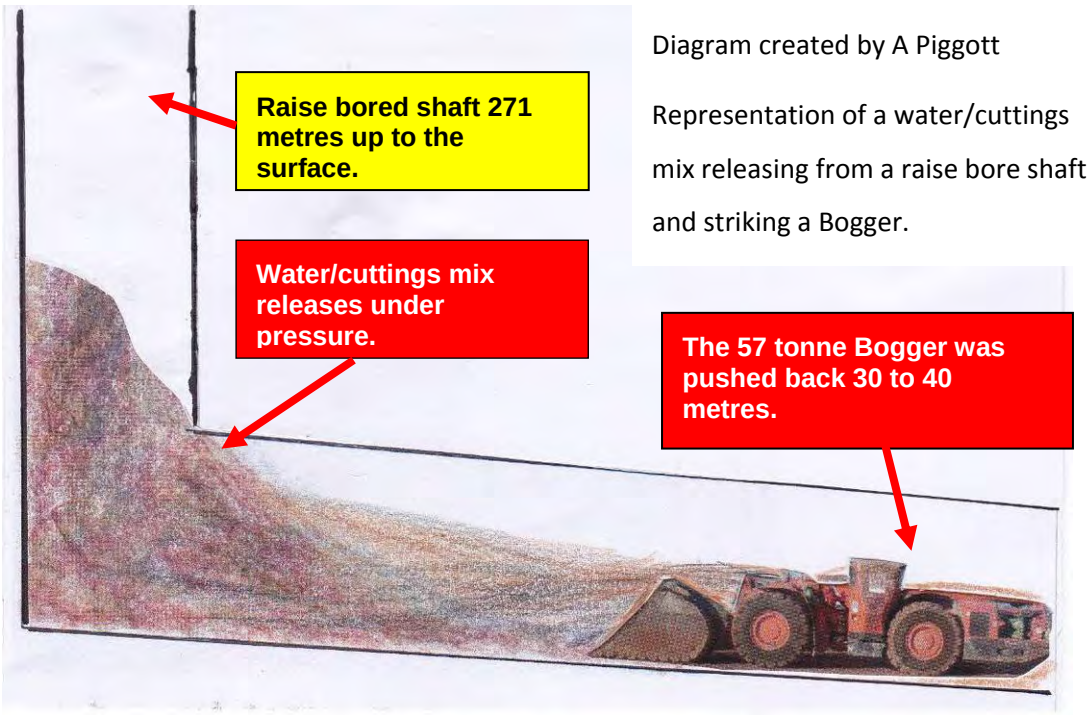


Diagram created by A Piggott

Representation of a water/cuttings mix releasing from a raise bore shaft and striking a Bogger.

Contributing Factors

Failure to carry out up to date risk assessment

Employers have an obligation under the *OHS Regulation 2001* to identify any foreseeable hazard that may arise in the workplace and to assess the risk of harm arising from the identified hazards. Employers then have an obligation to eliminate the hazards. If this is not "reasonably practicable", they must control the risks by implementing measures to lessen the risk of harm to the lowest possible level.[27]

A documented risk assessment was developed for Cadia East RB1 raisebore hole, an earlier raisebore shaft where back-reaming commenced in July 2006. This document was not updated for the raiseboring activities that were current at the Cadia East Mine at the time of the incident of 21 February 2010. It did identify the risk of the potential of an inrush from a choked hole but the residual risk was classified as insignificant and rare.

This risk assessment document did not address the risk from wet reamed material. There was no assessment of catastrophic failure of the material pile and subsequent inrush potential and consequently a failure to identify the build up of water in the shaft once it was blocked.

RB1 was stated to have been a dry hole and bogger operators indicated the reamed cuttings were often up to the brow of the bottom of the shaft. This shaft became blocked on one occasion and George Kirk said that the blockage was removed using a water cannon.

Manager Mining, Stephen Powell stated in an interview that "If you had a dry hole it is not uncommon practice at all to actually choke that hole on purpose." Stephen Powell also said that "allowing the reamed cutting to build up to the bottom of a raise bore shaft was a means of controlling dust from the reaming process." He also indicated that it had been a standard practice in industry not so long ago.

Inspections of choked hole.

There was no inspection of the bottom of the VR5A shaft by a qualified engineer.

Inspections were conducted by staff who had no formal qualifications or training in geotechnical matters.

[27] Sections 9, 10 and 11 *Occupational Health and Safety Regulation 2001*

Failure to consider the implications of a wet shaft.

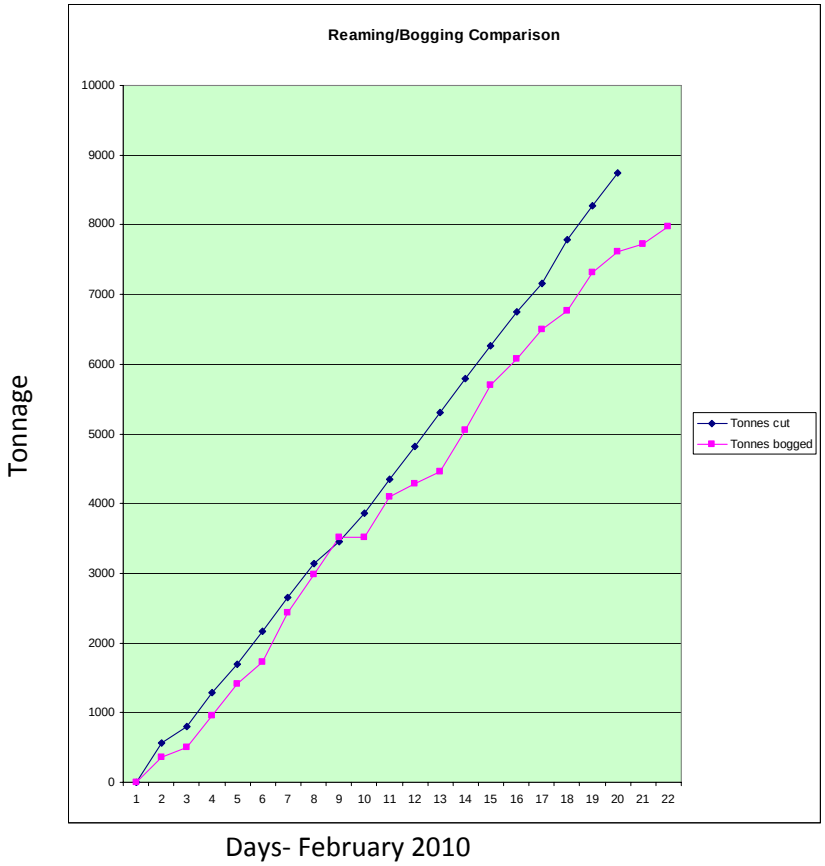
The area where the shaft was excavated was known to be a wet area, when the pilot hole was completed water was seen flowing from the hole. It appears no specific arrangements were made to accommodate the reaming of a “wet” shaft.

Failure to adequately dispose of reamed cuttings

A reconciliation document provided by Newcrest Mining Limited clearly identified that there were less cuttings bogged than were created during the raiseboring process.

The following graphs were produced by Inspector A Piggott, Graph 1 used information from the mine prepared reconciliation document, Graph 2 was Produced using information provided during an interview of a Crew supervisor.

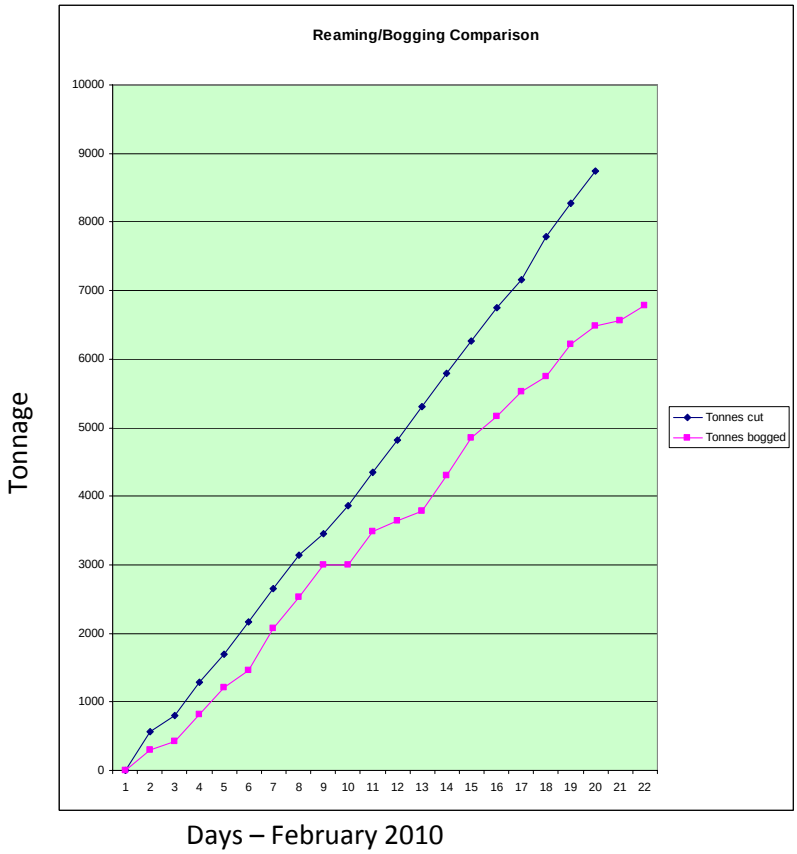
The graphs are not promoted as an accurate assessment of tonnes reamed versus tonnes bogged but merely to show there was a significant variation.



Graph1.

This graph was drafted using a bogger bucket criteria of 20 tonne for each bucket bogged.

The mine reconciliation document identified every bucket load to be 20 tonne.



Graph 2.

This graph was drafted using bucket criteria of 17 tonne for each bucket bogged as indicated by a crew supervisor during an interview.

Flawed reconciliation process.

A Development Engineer, Mr Farell Simanjuntak was given reaming data from the raise borer contractors (RUC) and data of tonnes bogged from beneath the raise bore shaft by the Mining Department. He provided a reconciliation document of the tonnes reamed against tonnes removed from beneath the bottom of the shaft.

In the absence of water a bogger is able to scoop up a considerable amount of "dry" reamed cuttings from beneath a shaft, to the extent they may pile up above the bucket lip as indicated by the blue arrow in the picture below.[28]

Picture modified by A Piggott

Where water does exist and mixes with the reamed cuttings to form a sloppy mix, the bucket can only fill to the lip of the bucket as depicted with the blue arrow in the picture below. [29]

Under these circumstances it would be a guess as to how much water and how much reamed product is in the bucket each time and therefore what amount of the reamed cuttings were removed by the bogger.

Picture modified by A Piggott

The Development Engineer Farell Simanjuntak calculated reconciliation on the basis that the bucket was full of dry cuttings of 20 tonnes and used this figure for every listed bucket taken from the bottom of the shaft be it wet material or dry.

[28] Picture taken from web page http://www.flickr.com/photos/rocbolt/3133882582/
[29] Picture taken from web page http://www.flickr.com/photos/rocbolt/3133882582/

Failure to follow Standard work Procedure.

A standard or safe work procedure (SWP) is a written instruction outlining the preferred method of performing a task/activity whilst emphasising ways to minimise any risk(s) of harm. A SWP outlines the potential hazards and associated control measures to be applied.

A safe work procedure should be developed or reviewed as the case may be after identifying a need for corrective action in an incident/hazard report; or as a risk control measure following a risk assessment of the task/activity.

AS/NZS 4804:2001[30] advocates that "periodic audits of the OHSMS[31] are necessary to determine whether the system (including the organization's policy, objectives and targets, management program, operational controls and audit program), has been properly implemented and maintained and whether the organization has met the performance objectives set within its OHS policy."

All SWPs should be reviewed periodically as a matter of course and audited to ensure proper implementation.

A CVO SWP for the raise bore hole bogging and isolation was approved 3 July 2006, the following quotation is an extract from paragraph 8.6 on page 5.

> 'Raise Drill cuttings at the base must never be allowed to encroach the point where there is a risk of choking the hole. The cuttings must not be allowed to build up to a point where there is less than 2m of vertical gap between the cuttings and the brow. The CED Shift Supervisor is accountable for managing this. The hazard presented by choking the brow of a wet raise drill hole is substantial. In the event that a gap of 1m or less is identified then this shall be treated as a serious incident and reported as such. In such an event the Raise Drillers must stop work and the area barricaded until a JSEA has been completed.'

The above extract identifies that management personnel recognised that the choking of a wet raise drill hole was a substantial hazard. CED Shift Supervisor/s failed to ensure that a choking of the hole did not occur.

Influencing Factors

Failure to properly reconcile the amount of cuttings bogged with the amount reamed. Wet material was running from VR5A shaft and they didn't think it would block.

[30] Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques
[31] Occupational Health and Safety Management Systems

Bogging delays

Cadia East Mine foremen and supervisors had information concerning issues with bogger availability that had delayed the bogging undertaken in the week prior to the incident.

The slurry material from the reaming process was causing blockages in radiators and the bogger to be used to bog on 21 February 2010 had broken fan belts.

Confirmation of blocked shaft

The Superintendent of Mining, Craig Day, mining foremen and crew supervisors were aware that material had blocked the shaft.

There were a number of verbal reports on 21 February 2010 that the material had blocked the shaft:

- A bogger operator reported the shaft was “hung up” at 5.00am,
- A supervisor indicated the shaft was “choked or blocked off” at 8.00am
- A second bogger operator said it was “blocked” at 4.00pm.

The mine surveyor when consulted by Investigator Tony Smith after the incident, estimated that approximately 1,500 tonnes of material remained in the pile at VR5A shaft.

Failure to complete an adequate JSEA

A JSEA undertaken on the dayshift of 21 February 2010 did identify the potential for an inrush. However, It did not fully address the potential of the inrush outcome. It did not take into account the exposure to risk of those persons underground who were working in locations at levels below the choked bore hole.

The Sunday day shift Supervisor George Kirk verbally identified to the Mine Superintendant Craig Day of a potential risk to persons working on levels below the VR5A material pile if it was to fail. The subsequent JSEA document that was created by the supervisor on the Sunday morning failed to adequately address that risk.

The JSEA did not consider the impact on the operator of the bogger who was in the direct path of the potential inrush.

Mine documents that addressed the potential of inrush advocated the use of a remote controlled bogger. The supervisor who completed the JSEA did not include the use of a remote bogger as a means of reducing the risk to personnel.

The JSEA did not identify safer systems of work other than using the bogger on the lower side of the material pile when the material was known to be wet.

The mine superintendent, the Cadia East Mine project manager and a number of other management personnel confirmed during interviews that the JSEA was not adequately completed.

JSEA approval process

CVO have a training document that addresses JSEA training. Training is for a duration of four and a half hours. The learning outcomes for the training course is as follows:

- Legislative requirements for safety inspections in the workplace.
- Legislative requirements for environmental management.
- Employer, supervisor and employee responsibilities.
- The concept of safe production.
- Energy sources in the workplace.
- The principal concepts of hazard, likelihood, consequence, risk and risk analysis.
- Use of risk analysis matrices.
- How and when a JSEA should be conducted.
- JSEA approval process.
- JSEA task sequential stepping.
- Successfully completing a JSEA.

The JSEA worksheet consists of a table for the following:

- Breakdown of the task steps
- Hazard identification.
- Inherent risk ranking.
- Controls.
- Residual risk.

A completed JSEA document is subject to an approval process. The Cadia Valley Operations Task Hazard Analysis document provides information of the approval requirements.

Tasks are given a JSEA risk ranking from Low to Extreme and dependent upon the risk ranking is the level of the approval process. The risk ranking is based on the Future Risk Potential (FRP)[32] of an event

The risk ranking levels and the approval process is reproduced in the following table taken from the CVO Task Hazard Analysis document.

JSEA Risk Ranking	CVO JSEA Approval Process
Low	**Work to proceed**
Moderate	**Supervisor sign – off**
High	**Superintendent sign – off**
Extreme	**Department Manager sign – off**

Risk ranking of inrush

The FRP of an inrush from the bottom of a raise while bogging was identified in CVO documents as E(8) – an extreme risk. [33]

The following table was extracted from the JSEA Training presentation document.[34] With reference to the table the inrush was assessed as possible with a major consequence outcome.

Future Risk Potential

LIKELIHOOD	CONSEQUENCES				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	H (15)	H (10)	E (6)	E (3)	E (1)
Likely	M (19)	H (14)	H (9)	E (5)	E (2)
Possible	L (22)	M (18)	H (13)	E (8)	E (4)
Unlikely	L (24)	L (21)	M (17)	H (12)	E (7)
Rare	L (25)	L (23)	M (20)	H (16)	H (11)

[32] See definition in glossary of terms.
[33] Inrush – Underground Mining Operations Major Hazard Management Plan
[34] V11 – 004 JSEA Training presentation document

CVO requirements for assessed FRP of Extreme

"Where the assessed FRP is Extreme a JSEA must be completed, controls identified and implemented and the process reviewed, approved and signed off by the Department Manager. The JSEA must also be reviewed by OHS personnel."[35]

The Production Supervisor George Kirk who completed the JSEA on 21 February 2010 did not ensure the document was signed off by a Department Manager or that it was reviewed by OHS personnel.

The investigation

Lines of Inquiry

Lines of inquiry followed during the investigation included:

- The safety of employees underground at the time of the inrush.
- Availability of safeguards in the event of an inrush

The inquiry included the collection and examination of:

- Information from consultant who reviewed geotechnical data provided by the mine.
- Documents and records focusing on documents relating to tasks associated with the bogging from beneath a raise bore shaft.

Site inspections

Department officers inspected the scene

Inspector Mark Stephens attended the mine on 22 February and inspected the site of the inrush.

On 25 February Senior Investigator Tony Smith visited the mine where he initially met with mine personnel and commenced document collection.

On 26 February Senior Investigator Tony Smith went underground in the company of Jason Ingham, Steve McClare and Lea Constantine (Blake Dawson

[35] Extract from CVO Task Hazard Analysis document

Lawyer). He inspected the area where the inrush occurred and photographed areas where the inrush material had flowed during the incident.

Further documents were collected and interviews were conducted on site thereafter.

On 31 August 2010 Tony Smith and investigators Tim Flowers and Alwyn Piggott visited the mine where they met Jason Ingham, they completed an underground induction and in the company of Steven McClare went underground to the area where the incident occurred for inspection of where the event took place.

Obtaining Information

A number of persons gave information

The following persons assisted the investigation by providing information.

Craig Jones	General Manager
Steven McClare	Head of Mining
Stephen Powell	Manager Mining Cadia East
Chaim Sproles	Senior Mining Engineer
Andrew Mooney	Senior Mining Engineer – Development
Simon Green	Senior Mining Engineer – Pre-Conditioning
Steven Butt	Study Lead of Mining
Geoff Merrell	Senior Mine Geologist
Farrell Simanjuntak	Mining Engineer
Nicholas Pascoe	Mining Engineer
Jason Ingham	Superintendent OHS
John Ayton	OHS Advisor
Brendon White	Act. Mine Superintendent
Craig Day	UG Mining Superintendent.
Glenn Underwood	U/G Mining Foreman
Patrick Daly	U/G Mining Foreman
George Kirk	Production Supervisor C Crew
Brendon Tamati	Production Supervisor D Crew
Peter Whitla	Production Supervisor B Crew
Pasqualino Manca	Principal Mine Planning Engineer

Darren Writer	Shift Supervisor
Paul Southwell	Mine Technician
Chris Sullivan	Mine Technician
Adam Whatling	Mine Technician
Phillip Brice	Mine Technician
Ben Green	Mine Technician
Matthew Bogie	Mine Technician
Jamie Sherlock	Mine Technician
Stephen Robinson	Mine Technician
Brett Arnold	Mine Technician
Darren Kissell	Mine Technician
Paul Southwell	Mine Technician
Michael Tink	Mine Technician

Documents and records

System documents

Cadia East Mine assisted by providing a number of documents. The documents and records that were provided to the Department and examined included:

- The Mine Health, Safety and Environment System Manual.
- Standard Work Procedures.
- Company standard for inrush hazard.
- Contract documents.
- Purchase order.
- Minutes of safety meetings.
- Industry documents.
- Department Guidelines.
- Employee training records.
- Company System Audit.

Findings

Summary of findings

The incident

- When the pilot hole intersected the VR5A drive, no JSEA or Risk Assessment was done to assess the hazards presented by the presence of water.
- Cuttings from the reaming process of the VR5A shaft piled up beneath the bottom of the shaft to the extent that the bottom of the shaft became blocked.
- An unknown quantity of water and cuttings built up in the shaft.
- As a bogger commenced removing material from the area below the shaft, the inrush of water and cuttings into the mine workings occurred.

Reaming rate change

Concurrent to the raise boring of the VR5A shaft was the installation of structures associated with the VR5A ventilation drive.

The slurry mix of cuttings and water from the reaming of VR5A shaft flowed down to and pooled in the area where the installation was taking place. The contractor representative Olly Oliver said there was no way mechanical construction could take place under those conditions.

A decision was made to place the ventilation installation on hold and concentrate on the completion of the VR5A shaft. To expedite the completion of the shaft the raise boring contractor was instructed to increase reaming rate to 12m per day.

System of work deficiencies

- Failure of the reconciliation system with regard to the amount of material reamed and the amount of material bogged from beneath the shaft. Calculations on what was bogged were based on a fixed amount a Bogger bucket had the capacity for. There was no allowance for the reduced amount of cuttings in a bucket because of the water content.
- A standard work procedure stated that

  > 'The cuttings must not be allowed to build up to a point where there is less than 2m of vertical gap between the cuttings and the brow. The CED shift supervisor is accountable for managing this.'

After isolation of the raiseborer and carrying out other tasks such as ensuring sufficient air circulation to the area, the

> 'Supervisor and Bogger Operator to enter the area together and inspect.'

Due to the nature and amount of material that flowed down the drive from the bottom of the shaft supervisors did not always inspect the bottom of the shaft.

- The system of drilling drain holes (tell tales) into raise bore shafts was practised at Cadia East Mine but not included in any standard work procedure. Drain holes had not been drilled up into the VR5A shaft.
- The CVO Inrush Underground Mining Operations Major Hazard Management Plan detailed the hazard management requirements for those hazards assessed as high or extreme with respect to an inrush incident in underground mining operations at Cadia valley operations.

The following information was reproduced from a table in the document. Note the "Extreme" ranking for rush of rock, mud or water from an orepass, or from bottom of a raise while bogging.

Item	Potential Hazard Event	Rank	Consequence	Likelihood
8	Rush of rock, mud or water from an orepass, or from bottom of a raise while bogging	E(8)	4	3

The following information was also reproduced from the CVO Inrush Underground Mining Operations Major Hazard Management Plan document.

Note that remote bog is listed as a planned response.

Form of review (What is being measured)	Trigger or Key Decision Point	Planned Response	Accountability	Notification
Water & % fines in drawpoints (SLC, orepasses or raise)	Critical mixture of fines and water	• Identify & control water inflows into pass • Physical barricade in access isolate pass if required • Isolation of bottom of pass if hung up or open • Remote bog	Manager, Underground Mining operations	General Manager

- In the CVO Inrush Underground Mining Operations Major Hazard Management Plan, for the risk of an inrush, remote bogging was a planned response when there is a critical mixture of fines and water. [36] It was known at the breakthrough of the pilot hole that VR5A was a "wet" hole, the mine made no provision to set up systems to enable remote bogging in the event of a choked / blocked shaft.
- The CVO "Inrush - Underground Mining Operations Major Hazard Management Plan" document current at 21 February 2010 was last reviewed on 25/06/2006.

CVO Requirements

- CVO guidelines required regular self assessment of their Safety Management Systems (SMS). [37]

Mine Safety Management Plan Review / Audit Process.

According to the CVO Mine Safety Management Plan (MSMP) all mine SMS undergo regular review. The following is an extract from the Mine Safety Management Plan:

"***All SWPs, JSEAs and work permits undergo regular review to ensure they remain consistent to the actual task they represent and compliant to legislated requirements, Standards, industry best practice and codes of practice under which they are performed."***

[36] Remote bogging - bogging with an "unmanned" machine set up to receive radio signals from an operator stationed in a place remote from and safe from the area where the bogging takes place.
[37] Defined in the CVO Mine Safety Management Plan as "Safety Management System: Policies, Standards, Group Audit Protocols and Procedures to manage safety and health."

The following review and audit processes table is an extract from the MSMP. Designed to monitor and enforce compliance to requirements of the CVO MSMP, Legislated obligations and NML OHS Standards and Policy.

Action	Accountable/ Responsible Persons	Planned Frequency
Review OHS impacts and initiatives regarding Strategic and Operational Action Planning	General manager Department Managers OHS Superintendent	Monthly Principal mechanisms for review: • Monthly Manager's meeting • Contractors/Projects Meetings • Central Safety Group • Safety Working Groups • Monthly Site Safety Committee meeting
	General manager Department Managers OHS Superintendent OHS Committee	Once every 12 months At the following milestones: • Introduction of Legislation, Standards, Company Policy or others that affect the performance of this plan • At key "triggers" assigned to an event included in CVO Major Hazard management plans
Internal Audit of CVO MSMP	General manager OHS Superintendent	Staggered audit/review process against the 24 Group Safety and Health Standards – Once every 12 months
external Audit of CVO MSMP	General manager Newcrest Group Manager OHS External provider	Once every 2 years

CVO MSMP Standards

The following two Standards are from Section 2 of the MSMP and relate to the evaluation and review of the SMS.

ST- 23 SYSTEMS EVALUATION[38]

"CVO performs a self assessment of the CVO SMS for compliance to the NML SMS at a planned once every two years to ensure that the systems required have been implemented and continue to remain effective."

[38] Extract from the MSMP

ST- 24 SYSTEMS REVIEW[39]

"The intent of this Standard is to ensure that systems exist to formally review all management systems, identify deficiencies and facilitate continuous improvement. This review will evaluate the overall appropriateness and applicability of the system (e.g. is the system still relevant to the structures of the organisation and is it meeting the requirements of the Strategic Objectives).

At CVO the measures in place in relation to systems review include:

- A systems review of the CVO SMS for compliance to the Newcrest SMS:
  - Once every three years;
  - Through directive from Newcrest;
  - Upon identification of an opportunity for improvement;
  - Upon introduction of or change to a legislated obligation; recognised Standard or Code of Practice;
  - Through change to the workplace, processes or environment;

Where an accident or incident occurs at CVO or other Newcrest site that identifies a failure within the CVO or other site SMS."

If the CVO "Inrush - Underground Mining Operations Major Hazard Management Plan" had been reviewed in accordance with CVO requirements as identified above, there would have been an opportunity to address the anomaly namely, the document listed as a planned response remote bog, but there was no provision of a remote bogger on site. The anomaly could have been resolved by ensuring there was remote bogging capability at the mine or by identifying other appropriate control measures.

According to Manager Mining Stephen Powell there had not been a remote bogger capability on site since about 2005 or 2006.

Assessment deficiencies

The inrush outcome was the result of a non-engineering qualified inspection of the way the water and cuttings mix was behaving during the raiseboring of the

[39] Extract from the MSMP

ventilation shaft. The cuttings mixed with water formed a slurry which appeared to flow continuously down the drive leading management persons to presume this would continue and unlikely to build up to block the bottom of the shaft.

- The failure to implement a risk assessment when the reaming rate was increased was a lost opportunity to assess the change in characteristics of the slurry that had decreased in water content.

- The Mine Superintendant Craig Day and other site mining engineers and geo-technical engineers do not appear to have personally inspected the material conditions at VR5A in the week leading up to the incident.

- Inspection of the material pile was conducted by the person who created the JSEA. The person did not have the training to assess the geo-technical status of the material pile. There were no records or information given to support knowledge in this discipline.

Information

Lack of information available to Craig Day, Glenn Underwood, George Kirk or Brendon Tamati to assess the potential of an inrush as a result of a blocked raisebore shaft.

The JSEA failed to identify the risk and controls even though Glenn Underwood had considered the potential of inrush.

Instruction

At the change over of day shift to night shift George Kirk told Brendon Tamati to carry on from where the previous bogger operator was up to, he was to be observant and he told Brendon to keep his eye on it.

Brendon Tamati was not instructed to keep staff clear of the potential inrush path.

Supervision

Craig Day did not attend the mine to assess the risks associated with the choked VR5A raise bore shaft. Glenn Underwood informed him of the choked hole by telephone and they discussed issues about how to manage it.

They discussed bogging their way up to the brow for further identification. They were to continue on rather than to carry out an engineered assessment

Craig Day confirmed there was no discussion about any alternative method of unblocking the raise.

Pre-incident preventative measures

Preventing Inrush

1. By Following the principle in the NML SWP for Raise Bore Bogging and Isolation.

Specifically ensure that the amount of reamed material did not rise up far enough to choke the hole.

It was clearly stated at paragraph 8.6 of the SWP that: “Raise Drill cuttings at the base of raise must never be allowed to encroach the point where there is a risk of choking the hole…”

2. By ensuring an accurate reconciliation process.

When reconciling tonnes reamed – v – tonnes bogged the amount in the bucket of the Bogger must be more accurately assessed.

3. Formalise the practice of drilling angled holes through the roof of the drive up into the bottom area of the raise bore shaft.

Include the process of drilling angled holes in documents that address the potential of inrush in the mine.

4. Drill angled holes up into the bottom area of each shaft prior to reaming.

Where there is a “wet” shaft the drilled holes serve as tell tales. Water seen draining through the holes indicates a likely blockage of the bottom of the shaft.

The drain holes may also serve to control the amount of water building up above the blockage.

5. Regular inspections by the Supervisor.

Interviews disclosed that this did not always happen. Because of the slurry material they couldn’t drive a light vehicle through the sump up to the bottom of the hole. It was usually accessible only in a Bogger.

Supervisor George Kirk was asked how often he went up to inspect the area and his response indicated it was primarily left to the Bogger operators to inspect the bottom of the raise bore hole.

Optimum cleaning of reamed material from beneath the hole, along the drive and in the sump could have improved access for a supervisor in a light vehicle to effect regular inspection.

6. Carried out a Risk Assessment at the time of the decision to increase the amount of material that was reamed.

This would have provided an opportunity to address:

- the impact of an additional amount of cuttings,
- identify a change in the consistency of the cuttings/water mix, and
- to recognise that the change to a "drier" mix could lead to stacking of the mixture rather than remaining as a slurry flowing down the drive.

7 Provision of information on raiseboring activities and the hazard of an inrush.

Ensured that supervisors, foremen and all managers associated with raiseboring activities were aware of and understood the documents that were available for the raiseboring task and for addressing the hazard of an inrush.

This would have assisted them in determining the processes to be put in place at the outset and to better address the potential development of a choked hole.

8 Training of supervisors to identify factors that create a choked hole and how to properly manage the process to avoid choked holes.

Supervisors would then have been able to recognise signs associated with the development of a choked hole and avoid the realisation of a choked hole

Preventing Exposure

1. Glenn Underwood recognised exposure of personnel working on levels below the "choked" hole and should have ensured this situation was addressed in the JSEA that was developed to address the situation of the choked hole.

George Kirk did not include this in the JSEA that was developed, nor did he pass the information on to the next shift.

The risk assessment associated with the JSEA should have identified all persons "exposed" to a risk and appropriate steps taken to ensure they were removed from the exposure and not exposed to an injury outcome.

2. Failure to remove all persons from areas of potential danger.

No assessment of where the material would go if an inrush occurred.

Persons in the line of the likely path of an inrush must be removed to an area of safety the moment there is knowledge of a blocked shaft.

3. Using a tele remote Bogger.

A number of mine documents identified the need for using a tele remote Bogger for such a situation as a choked hole.

There was no Bogger at the Cadia East Mine or at the Ridgeway Mine that was set up for remote bogging nor was there an aerial set up in the drive up to the base of VR5A shaft to facilitate remote bogging.

An aerial and other installations to facilitate remote bogging should be installed during the development work of excavating the drive to the area beneath the bottom of the planned shaft.

Relevant published reference material

I&I NSW **Safety Alert**	http://www.dpi.nsw.gov.au/minerals/safety/safety-alerts SA11 – 01 Water inrush from raisebore hole.
I&I NSW **MDG 1030**	Guideline for Raiseboring Operation.
I&I NSW **MDG 1024**	Guideline for Inrush Hazard Management.
Safe Work Australia	A draft Code of Practice - Inundation and Inrush Hazard Management. The finalised Code of Practice is soon to be available on the Safe Work Australia website. www.safeworkaustralia.gov.au/
Relevant Australian Standards	**AS 4801:2001** Occupational Health and Safety Management Systems – Specification with guidance for use. **AS 4804:2001** Occupational Health and Safety Management Systems: General guidelines on principles, systems and supporting techniques. **AS 4360:2002** Risk management.
I&I NSW **Industry Assistance**	http://www.dpi.nsw.gov.au/minerals/safety Access this site for safety alerts, safety bulletins, mine design guidelines and other industry information.
Maroelabult Mine disaster report South Africa	**Published by the Department of Minerals and Energy South Africa 200**5. The report is no longer available on the website. Direct contact with DME South Africa is required to obtain a copy. **What** A mud rush occurred from the connecting cross-cut ore pass between two decline shafts some 170m below the surface. This resulted in the death of seven workers and the injury of another four . **Why** The two main contributing factors which resulted in the accident were: water was allowed to accumulate in the ore pass – no control mechanisms were in place at the discharge end of the ore-pass to contain the mixture of water and mud.

	Recommendations As far as possible all seepage/groundwater must be dammed off and piped to collection points away from the tipping areas. Re-enforce dangers and consequences of water inadvertently running into ore passes. Re-enforce importance of reporting All blockages, correct procedures of equipping and maintaining water control systems. Install control doors or other means at the discharge ends of ore-passes to protect against falling and/or rolling material and/or rocks. Install/construct Bulk Head walls at connecting cross-cuts boundering the ore-passes.

Attachments

- **Attachment 1**- Summary of recent investigations and enforcement action at the Cadia Valley Operations.
- **Attachment 2** – Glossary of terms.
- **Attachment 3** – Mine Plans
- **Attachment 4** – Safety Alert

Attachment 1- Summary of Department action at Newcrest Mining Limited sites.

Major incident and prosecution history.

27 May 2000	Fatal injuries sustained by Mr Nick de Bruin.
Citation	Morrison v Akula (formerly known as RaiseBore Australia Pty Ltd). Nick de Bruin was a director of this contracting company engaged by Newcrest to carry out raiseboring activities. The department filed charges against Akula. The defendant was fined $136,000. No charges laid against Newcrest.
24 June 2003	Fatal electric shock sustained by Damian Pusterla.
Citation	Poonindie Pty Ltd (trading as Ted Wilson & Sons). Three men were dismantling a shearing shed for transport near a homestead on property owned ultimately by NML. Damian Pusterla received a fatal electric shock. NSW DPI determined that the incident did not occur on a mining lease and was handed over to NSW WorkCover. NSW WorkCover proceeded with a prosecution on the matter. The defendant was fined a total of $100,000. No charges laid against Newcrest.
24/08/08	**Serious injuries to Bruce Slessor.** Bruce Slessor, an employee of Newcrest Mining Ltd sustained serious and permanent head injuries when struck by the root ball end of a tree log that was being levered out from a pile of felled scrub timber with a backhoe bucket. At the time of the incident Bruce Slessor was obtaining the timber logs for his personal use. The department fully investigated the incident but charges were not laid against Newcrest.

Enforcement history.

The Department's COMET database records indicate that there were 208 incidents at the Cadia Valley Operations between 2000 and 2011.

The following enforcement notices were generated and issued by Mine Safety Operations.

19/02/00	Electric shock.
14/03/00	Electrical incident.
21/08/00	Electrical explosion.
08/11/02	Truck roll-over.
08/02/03	Battery explosion.
24/06/03	Fatal – electrocution.
09/09/04	Electric shock – 3 persons.
08/06/06	U/G assessment.
19/12/06	Assessment – earth leakage.
6/02/07	240v electric shock.
19/03/07	1100v electric shock.
20/08/07	Fatigue management.
25/09/07	Electric shock.
25/09/07	Electric shock.
13/06/08	Maintenance effectiveness.
18/08/08	Electric shock.
24/01/08	Electric shock 110v.
23/04/08	Meeting re Electrical requirements.
23/05/08	Electric shock 415v.
24/08/08	Slessor incident.
24/08/08	Slessor incident.
06/07/09	Presentation – 2nd egress.

21/07/09	Electrical components concerns.
28/09/09	Inspection.
07/11/09	Fall of ground.
10/11/09	Underground inspection.
12/11/09	Electric shock.
04/02/10	Review ventilation systems.
21/02/10	Inrush incident.

Review of COMET incident reports at Cadia Valley Operations for the three year period prior to 15/3/10.

Cadia East underground Mine – 12 reported incidents

Date	**Incident**
21/11/08	Fire on a loader in the decline.
24/1/09	Fire on dump truck in decline.
8/2/09	Fire on truck in UG workshop.
12/5/09	LHD roll over on surface.
2/8/09	Truck rolled over at stockpile.
9/9/09	Truck rolled over at stockpile.
16/9/09	Fire on truck in decline.
24/9/09	Truck brakes failed in decline.
29/1/10	Employee complaint that poor ventilation of primary vent circuit at the mine causing issues with diesel particulates from vehicles.
18/2/10	Two person injured when EWP dropped suddenly.
21/2/10	Inrush incident.
2/3/10	Truck tipped over from loader contact.

Cadia Hill Open Cut mine – 30 reported incidents.

Date	Incident
19/3/07	Person slipped on wet concrete - Broken leg.
19/3/07	110v electric shock from pump in washery.
22/3/07	Two car collision on entry road.
22/3/07	40,000t Rock fall from high wall hit drill rig.
4/4/07	Haul truck hit windrow.
13/4/07	Load shifted on truck while dumping hit head and broke side window.
2/7/07	110 v Electric shock.
1/8/07	Misfire in 52 holes.
25/9/07	Electric shock received from cable not isolated when hand digging a hole.
4/10/07	Fire in surface toilet ceiling fan.
10/12/07	Electric tingle from lap top.
24/1/08	Electric shock from emergency stop button.
16/5/08	Three people within blast zone.
22/5/08	Employee complaint of electric shock.
23/5/08	Electric shock 415v.
12/6/08	3.3kv arc blast.
24/8/08	Bruce Slessor SBI incident struck by log standing near a backhoe.
23/9/08	Crane rolled down access road 34m operator didn't apply hand brake.
15/10/08	Light vehicle roll over after hitting windrow.
27/10/08	Fire on pump station diesel engine.
12/12/08	Rock fall onto truck from Highwall.
16/12/08	Fire on v belts on tailings pump in gold room.
23/12/08	Persons fingers crushed using forklift to load excavator implement into truck tray.
5/1/09	18mm piece of steel punch embedded in thigh when hit with copper hammer.
19/3/09	Fire on face shovel for 9 hours and destroyed shovel, hydraulic line rupture.
26/5/09	Potential oil injection whilst driller looking for a leak.
15/6/09	Contractor Crushed finger adjusting vibrating screens.
12/8/09	Contractor complaint driving 3 hours after 12 hour shift.
5/10/09	Person received electric shock from office partition.
12/11/09	Person received electric shock winding up powered and wet extension lead.

Ridgeway Gold Mine – 29 reported incidents.

Date	Incident
29/3/07	Apprentice using MIG welder received electric shock.
2/6/07	Injured Person struck by rock being scaled down.
9/11/07	Two person injured by emulsion fumes charging face.
28/12/07	Light vehicle rolled 15m down decline.
11/1/08	Person dislocated shoulder lifting bar from light vehicle.
17/1/08	Person injured when using ute to change belt rollers.
20/1/08	LHD hit light vehicle with person inside whilst passing underground.
5/4/08	Leaking oil caused fire on concrete truck.
19/4/08	Electrical fire in dash of integrated tool carrier.
30/5/08	Employee complaint that procedures during bogging at draw points without water sprays and barricade signage not to standard.
25/7/08	Fire on haul truck due to oil spay onto turbo.
18/8/08	Person received electric shock 240v live extension lead pins.
23/9/08	Oil fire on truck when battery lead used for towing.
24/9/08	Person exposed to 1000v flash over at circuit breaker on jumbo rig.
5/1/09	Person cut finger moving pump with broken handle on a jumbo.
16/1/09	Fire on dump truck battery box.
19/1/09	3 persons underground lit aerosol can in horseplay.
4/2/09	Uncontrolled movement of compressor due to tow ring breaking.
9/2/09	Person broke finger when lifting pump onto Ute tray.
11/2/09	Person received fractured leg whilst removing and strapping steel liners.
19/2/09	Person received crush injury to finger by falling jumbo steel.
17/3/09	Roof fall occurred when rock bolts were drilled out.
29/3/09	Light vehicle ran away after being parked.
19/5/09	Unplanned detonation of a misfired primer in a draw point whilst being loaded.
28/9/09	Seismic event during blasting at Ridgeway Deeps Mine.
3/10/09	Workshop overhead gantry crane came off the rails and fall to the ground.
7/11/09	Unplanned rock fall of 40 tonnes.
1/1/10	Employee complaint regarding seating in the Toro loader.
17/2/10	Operator fell 1.4 metres from platform fracturing leg whilst working on a fan cradle.

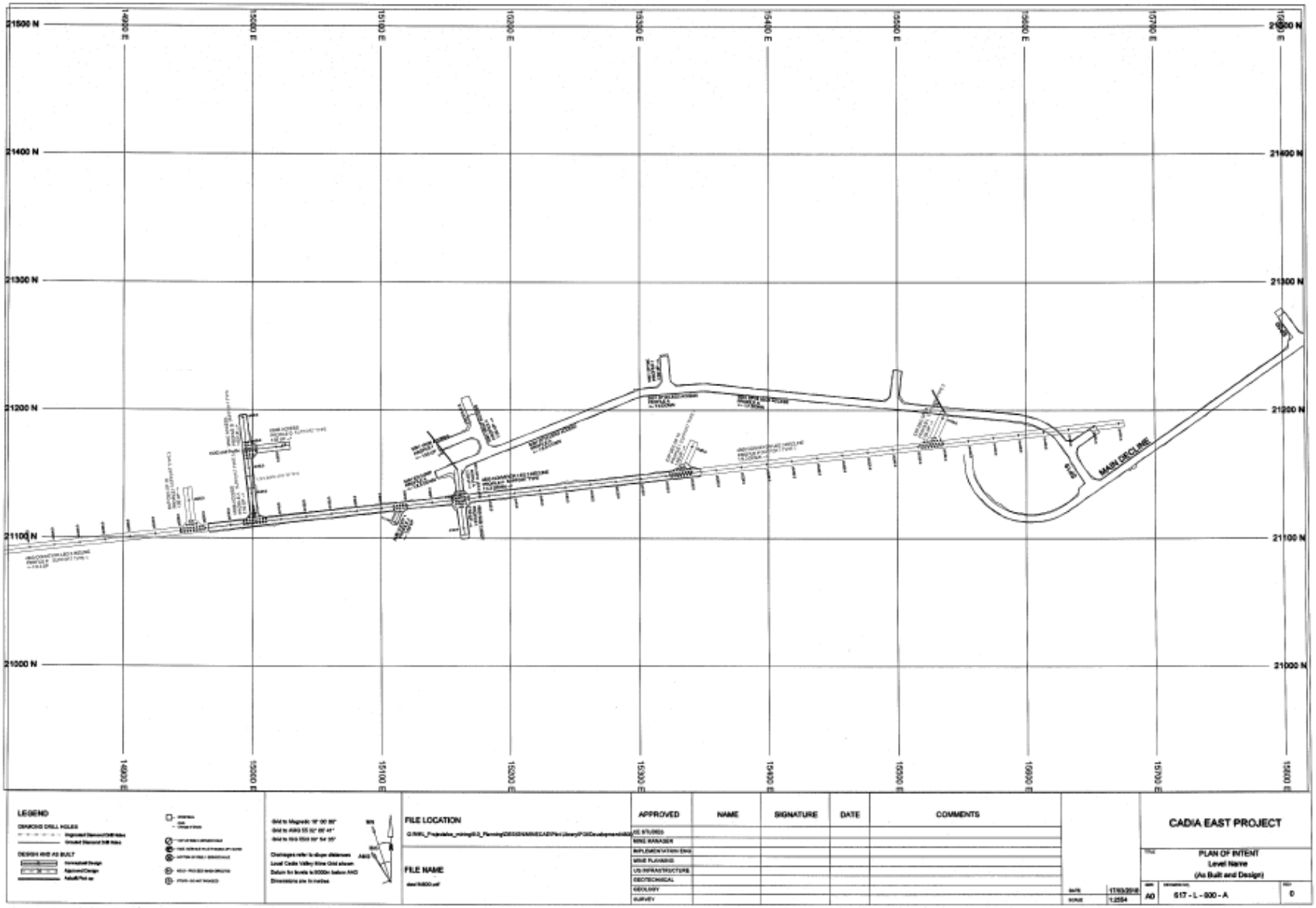
Attachment 2 - Glossary of terms

	This glossary of terms is relevant to the understanding of terms used within this report and may not accurately reflect wider meaning or understanding in industry.
Aquifer	An underground geological formation or group of formations, containing useable amounts of groundwater that can supply wells and springs.
Bogger	A term used to describe a low profile front end loader designed specifically for underground mining application. Also known as an LHD.
Brattice	A type of hessian or cloth, that is suspended across drives to redirect or restrict ventilation.
Brow	The lip at the bottom of the raise bore shaft.
Decline	A sloping underground opening, usually driven at a grade about 15 to 20%, for machine access from level to level. Often also called a ramp.
Drive	A generic term which describes all travel ways in underground mines, including adits, ramps, main headings, cut throughs, cross cuts etc.
FRP	Future Risk Potential – In relation to any event that could result in injury, illness, property damage, process loss or environmental impact, means the combined likelihood and potential consequence of that unwanted event occurring or recurring.
Incline	Refers to an underground opening, a drive sloping upwards.
JSEA	Job Safety and Environmental Analysis. Also known as Job Safety Analysis, Task Hazard Analysis, Job Hazard Analysis and Task Analysis.
Jumbo Drill	A jumbo drill uses two rock drills at a time to drill many holes in the end of a tunnel. The holes are filled with explosive and blasted. The ore is broken up and is removed with a loader (bogger). 
LHD	A load haul dump machine, ie a tractor with a bucket or scoop on the front.

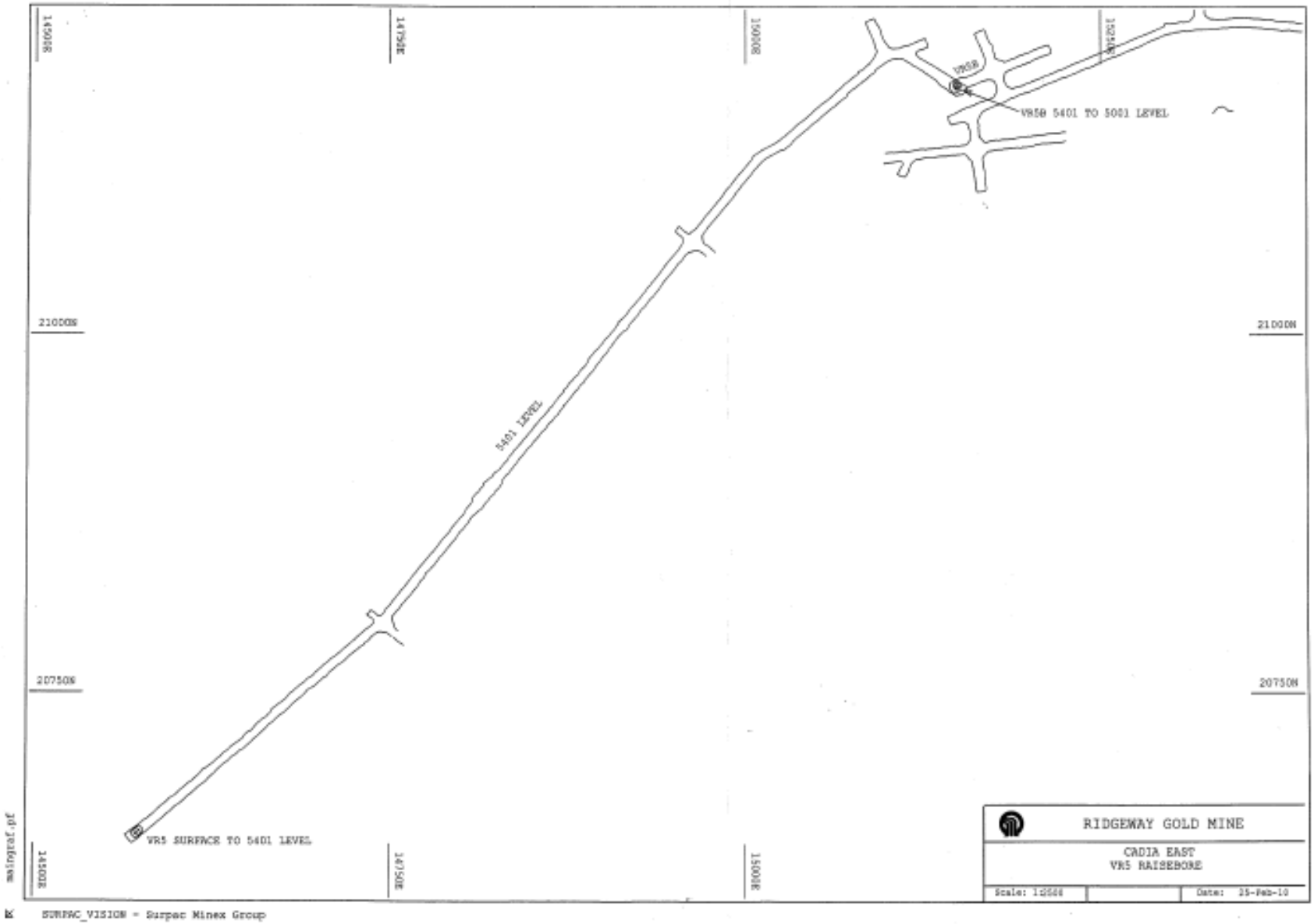
Mine Technician	Refers to non-management employees who operate the mining equipment and those that provide labour support to them.
Panel Cave	A method of mining - A stoping method in which relatively thin blocks of ore are caused to cave by successively undermining small panels.
Portal	Roadway entry into an underground mine. 
Raise Borer	A drilling machine used to drill a pilot hole from one level to a lower level in a mine and after a reamer is attached to the drill string the pilot hole is back-reamed creating a larger diameter hole.
Rill	The flow of the material down the heaped pile of cuttings.
ROI	Record of interview.
SWP	Can have 2 meanings - Safe Work Procedure or Standard Work Procedure. A written instruction outlining the preferred method of performing a task/activity whilst emphasising ways to minimise any risks of harm. A SWP outlines the risks and associated control measures to be applied.

Attachment 3- Mine Plans

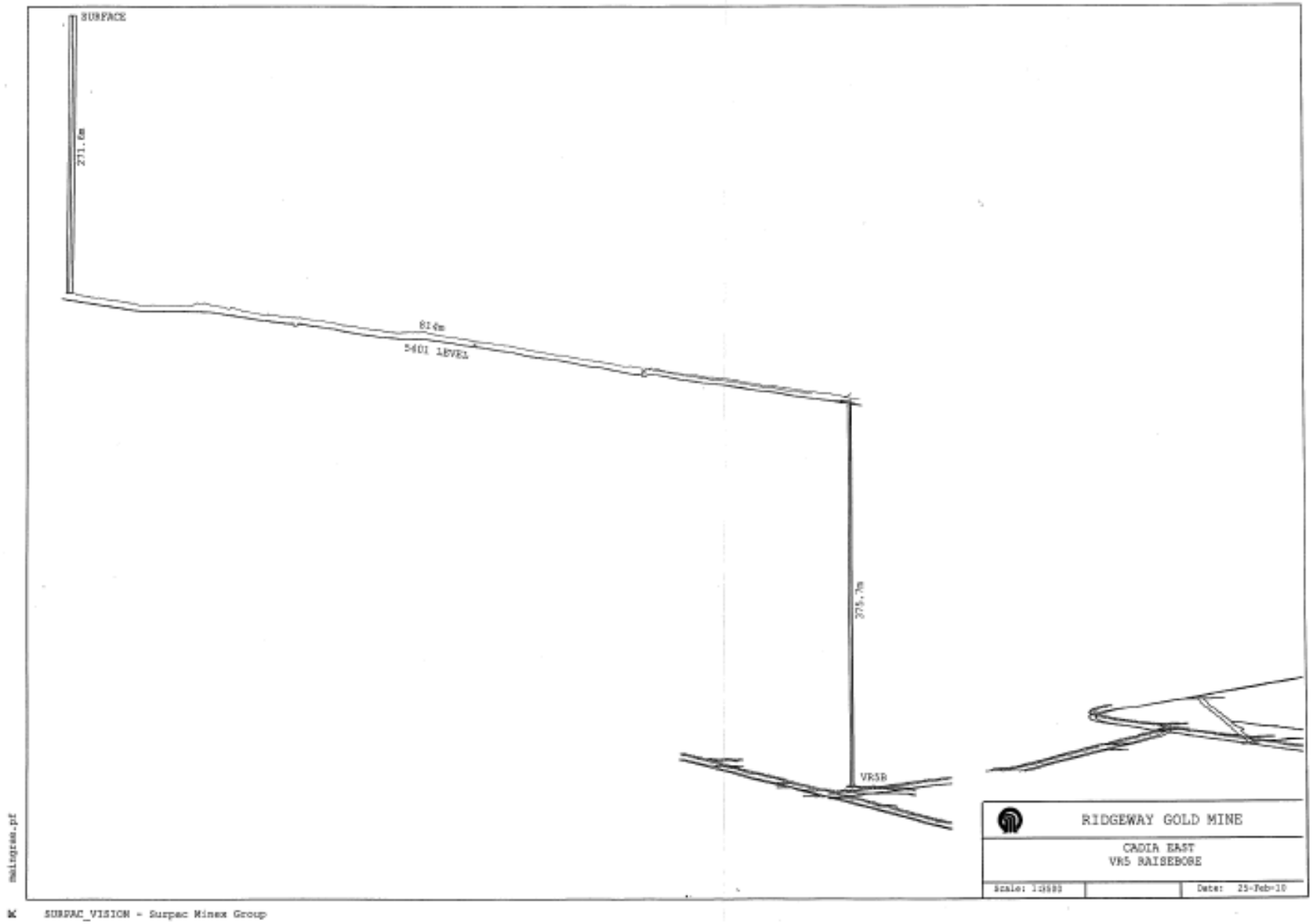
Plan 1. Cadia East Mine plan of intent.



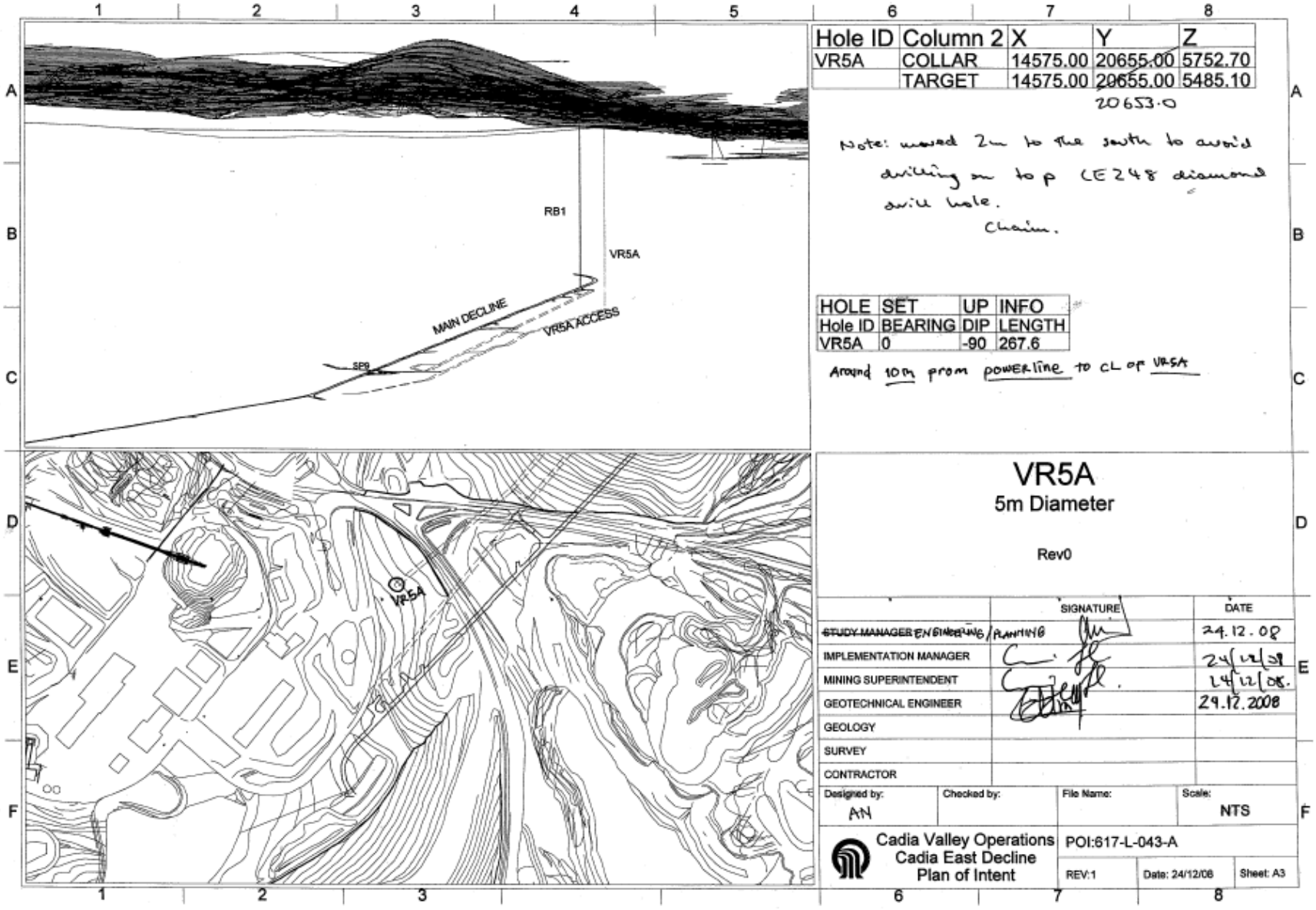
Plan 2. Plan view of mine workings – VR5A to VR5B shaft.



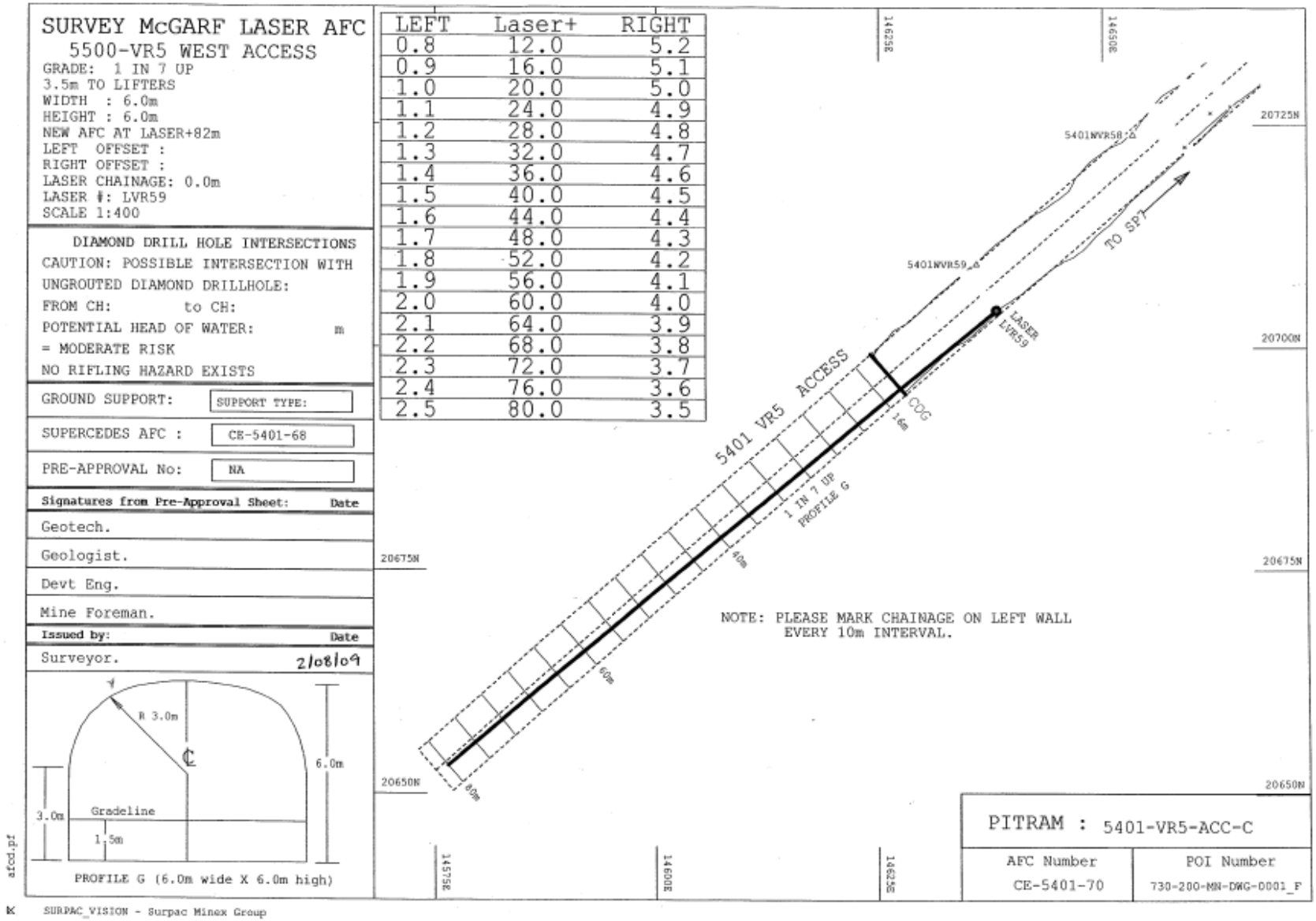
Plan 3. Cross section view of mine workings – VR5A to VR5B shaft.



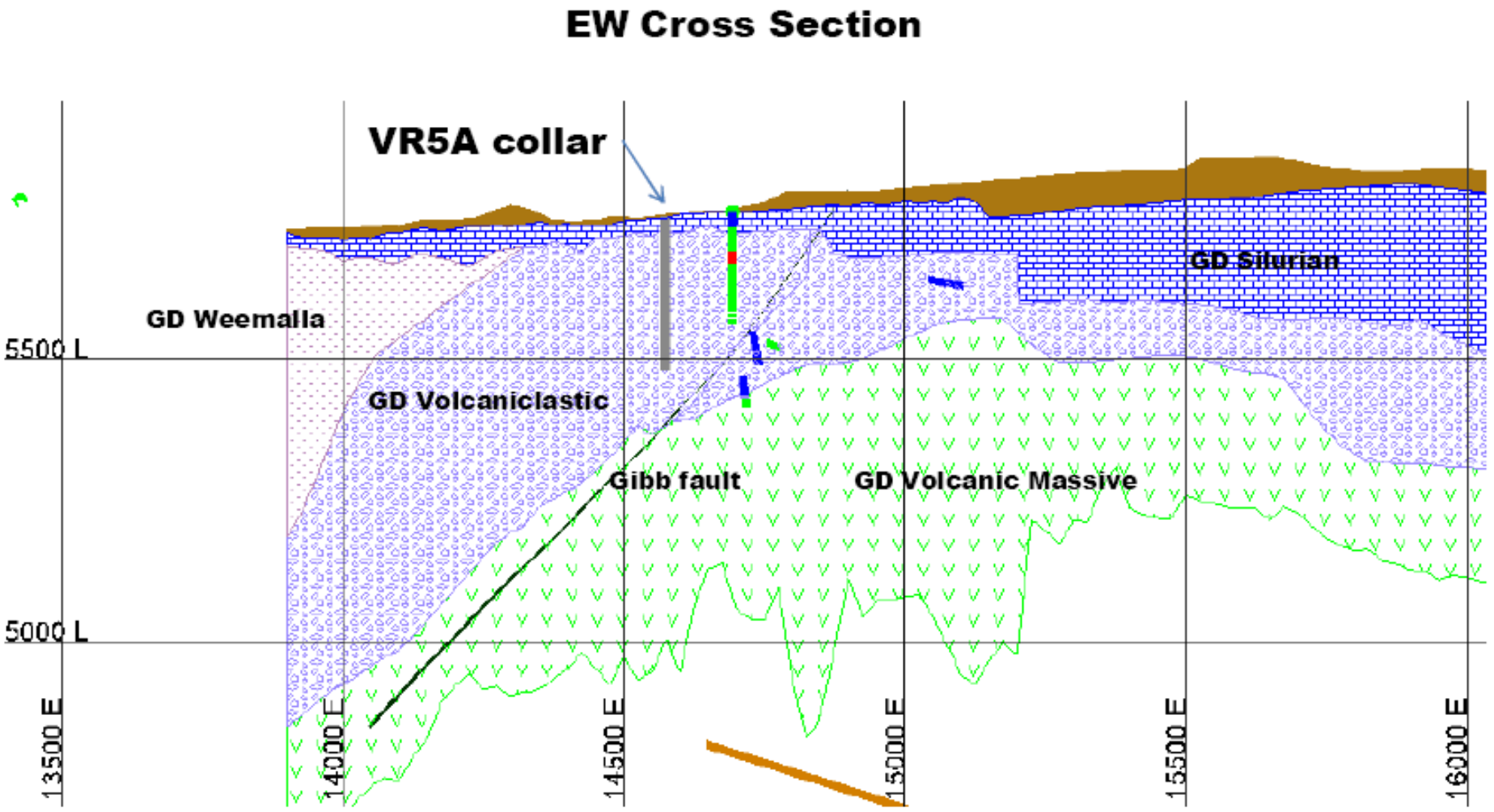
Plan 4. Cadia East Decline Plan of Intent.



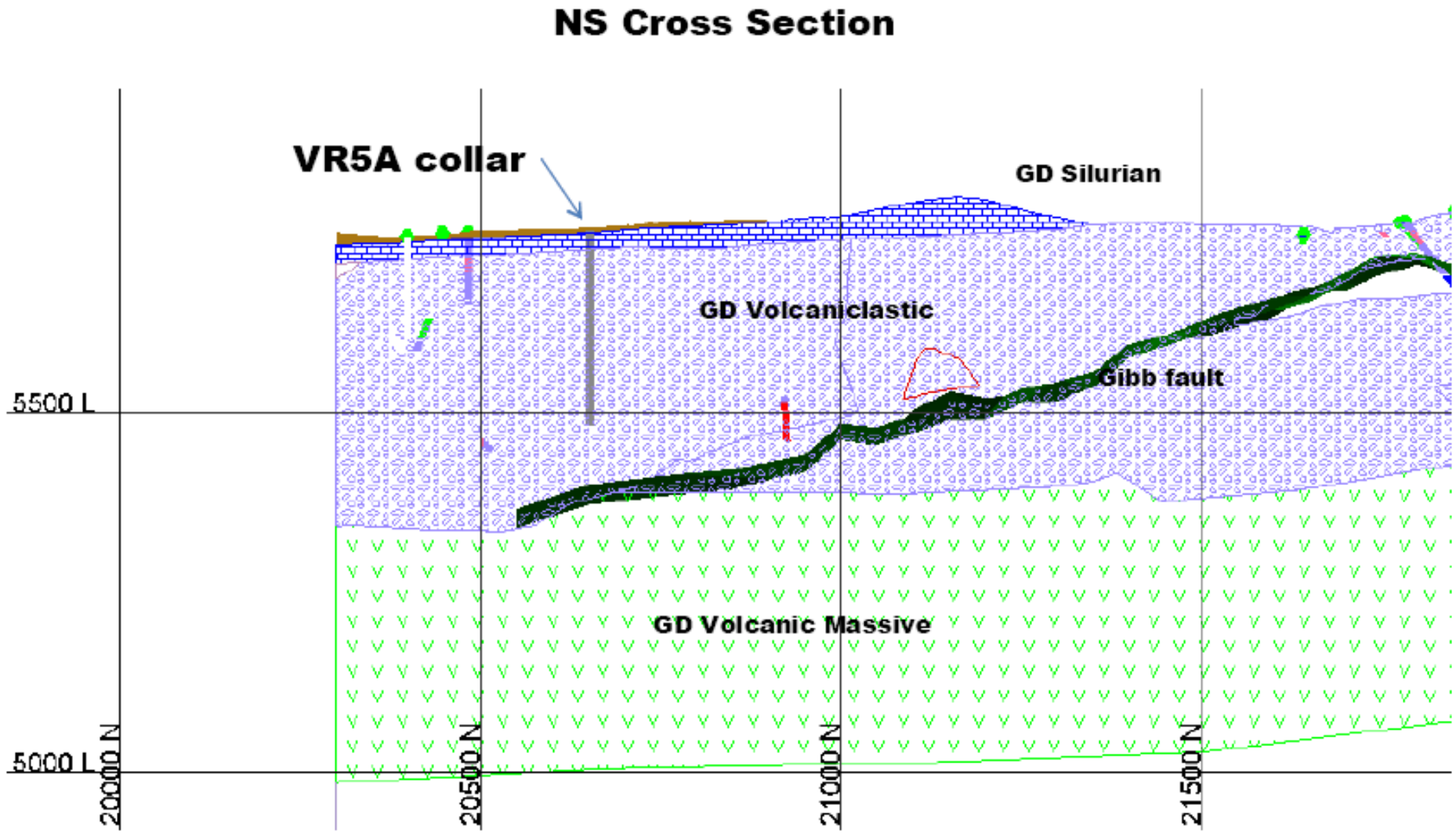
Plan 5. Design plan for access to the bottom of VR5A excavation site.



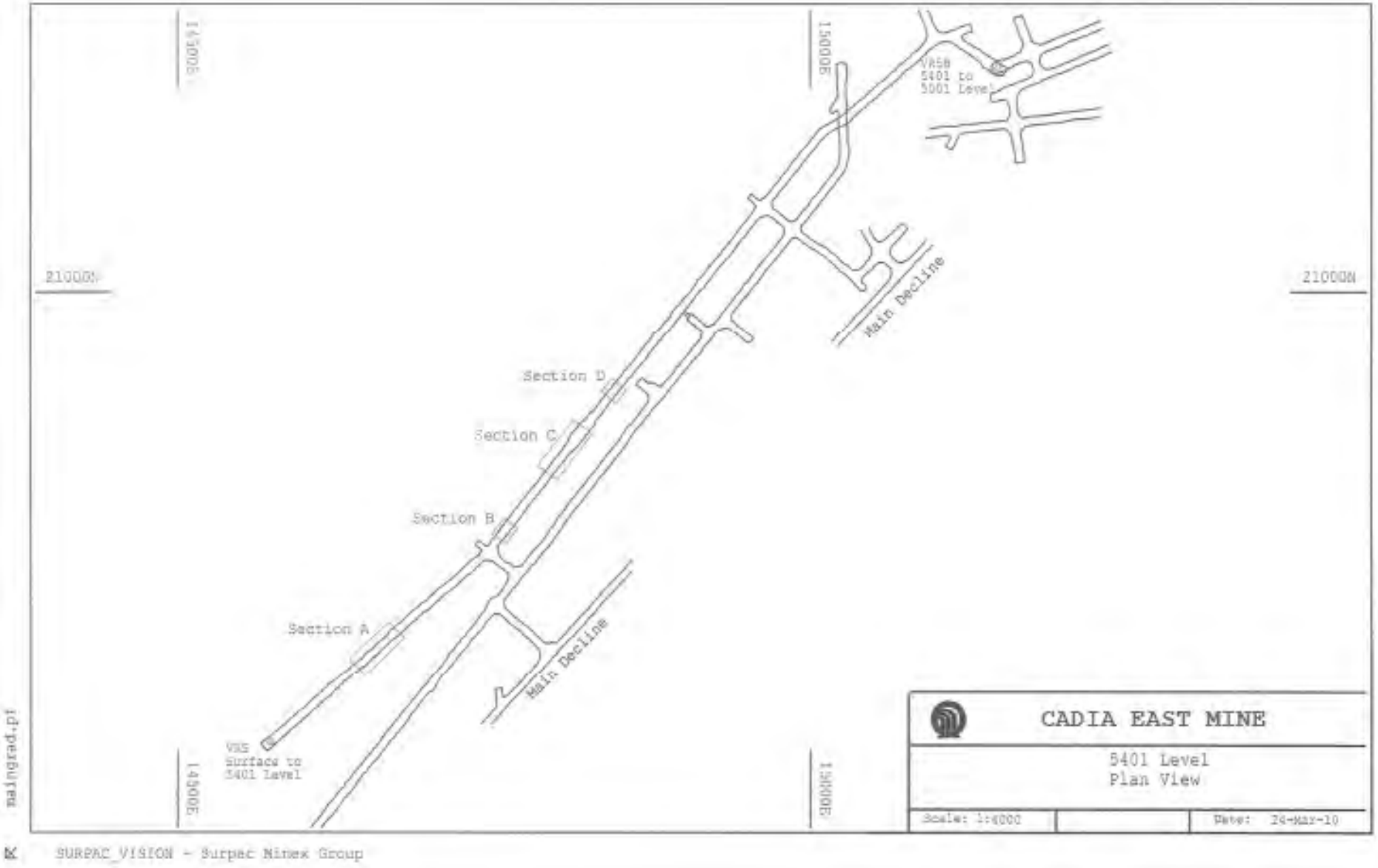
East-West cross section diagram showing geotechnical domains through the VR5 area.



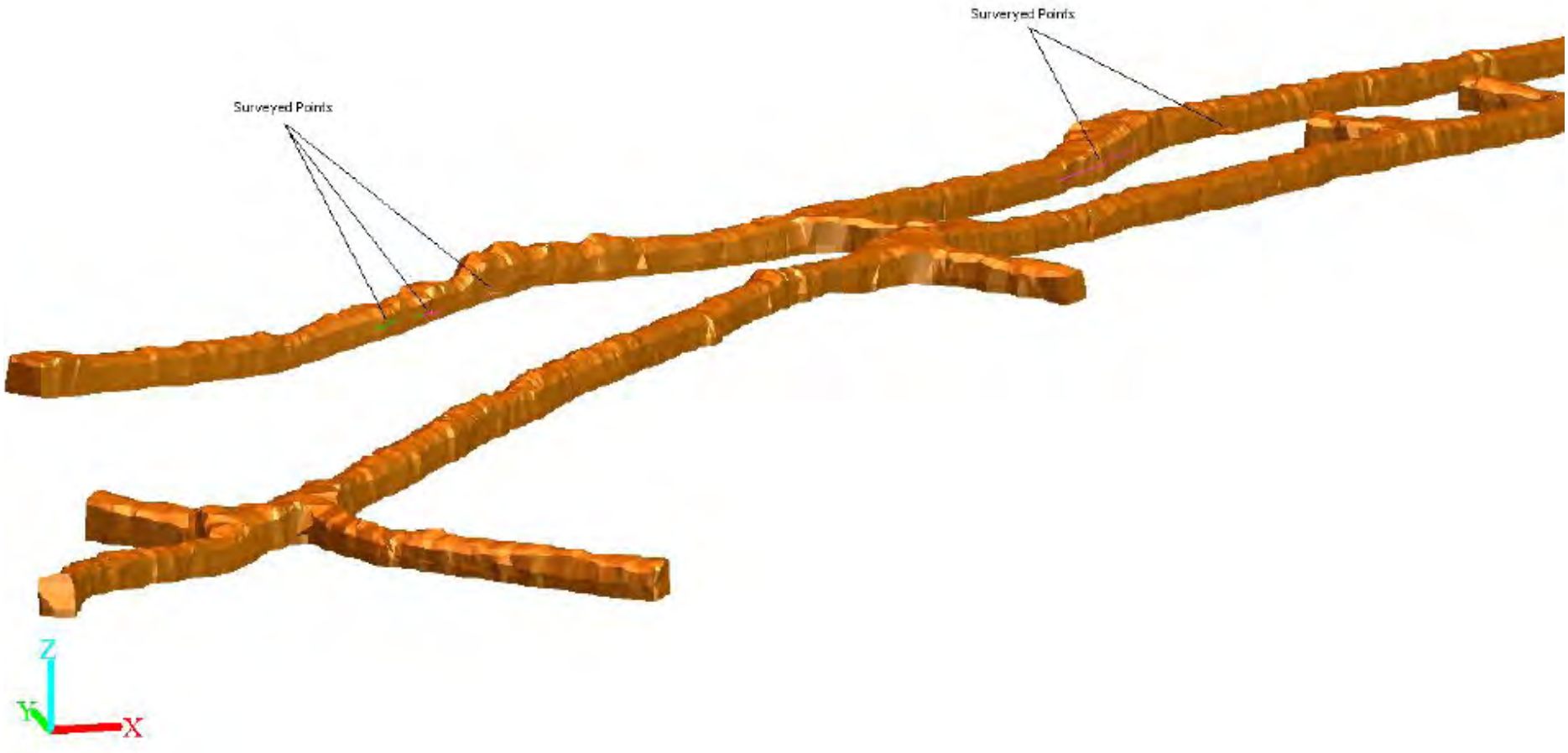
North-South cross section diagram showing geotechnical domains through the VR5 area.



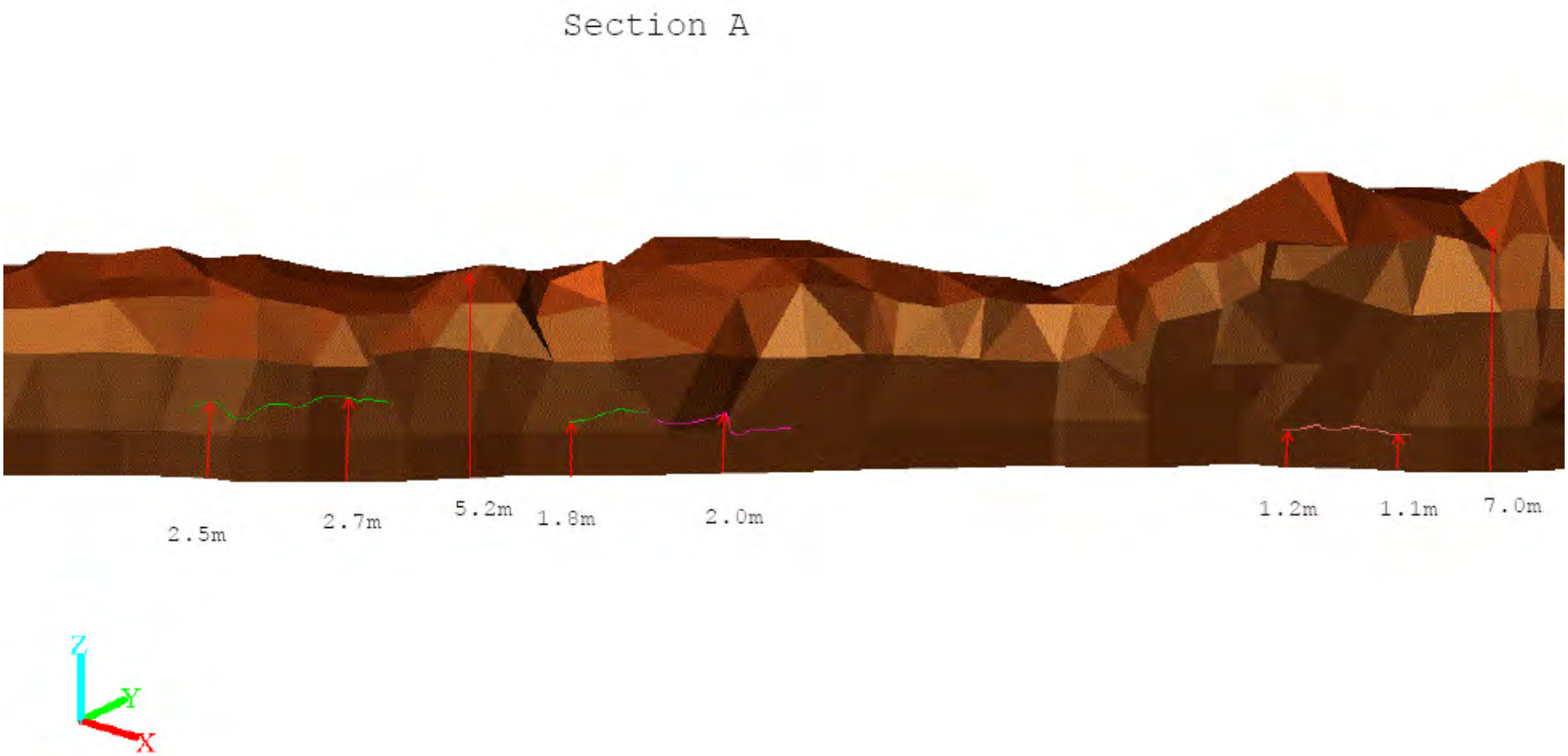
Plan view of 5401 level identifying areas where inrush heights were surveyed



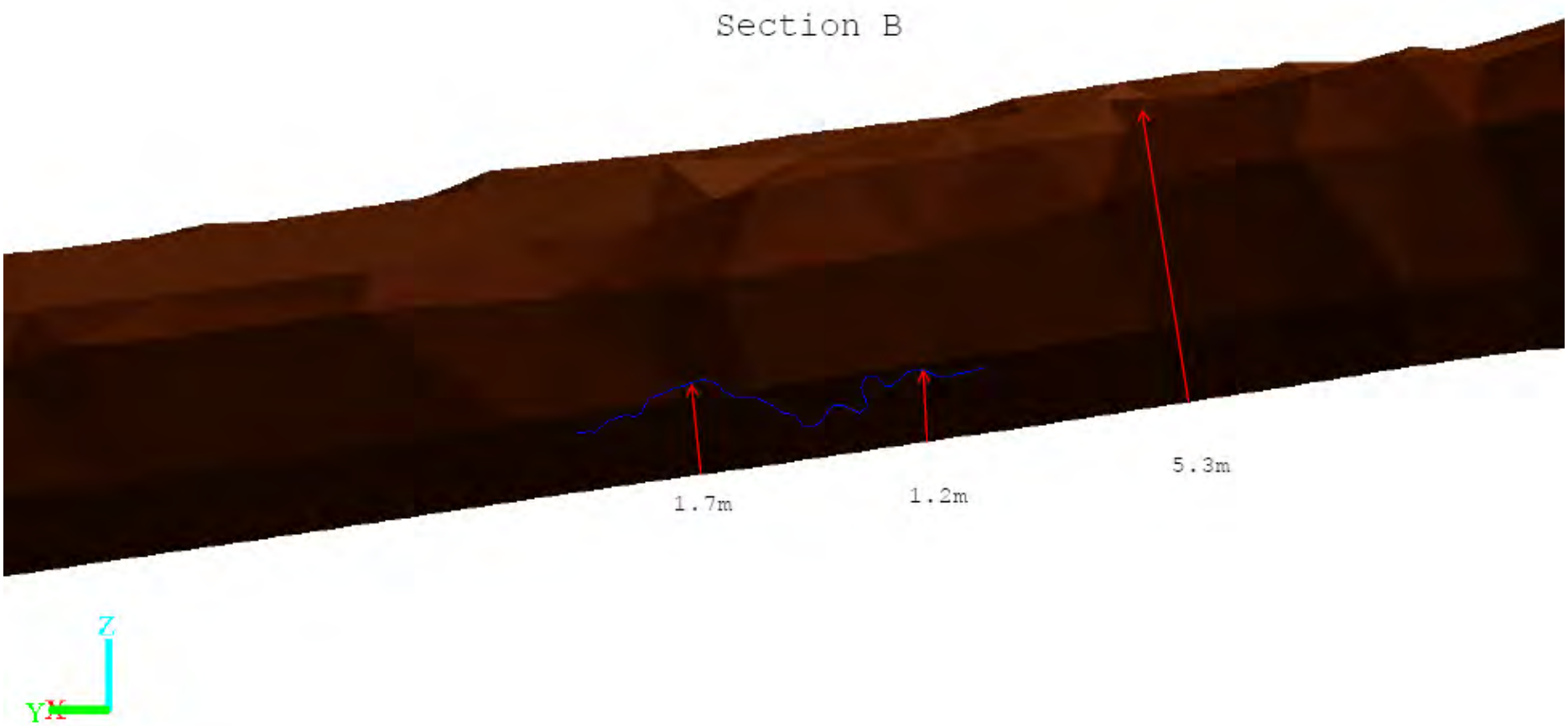
Computer generated view of 5401 level identifying areas where inrush heights were surveyed of the height of the inrush.



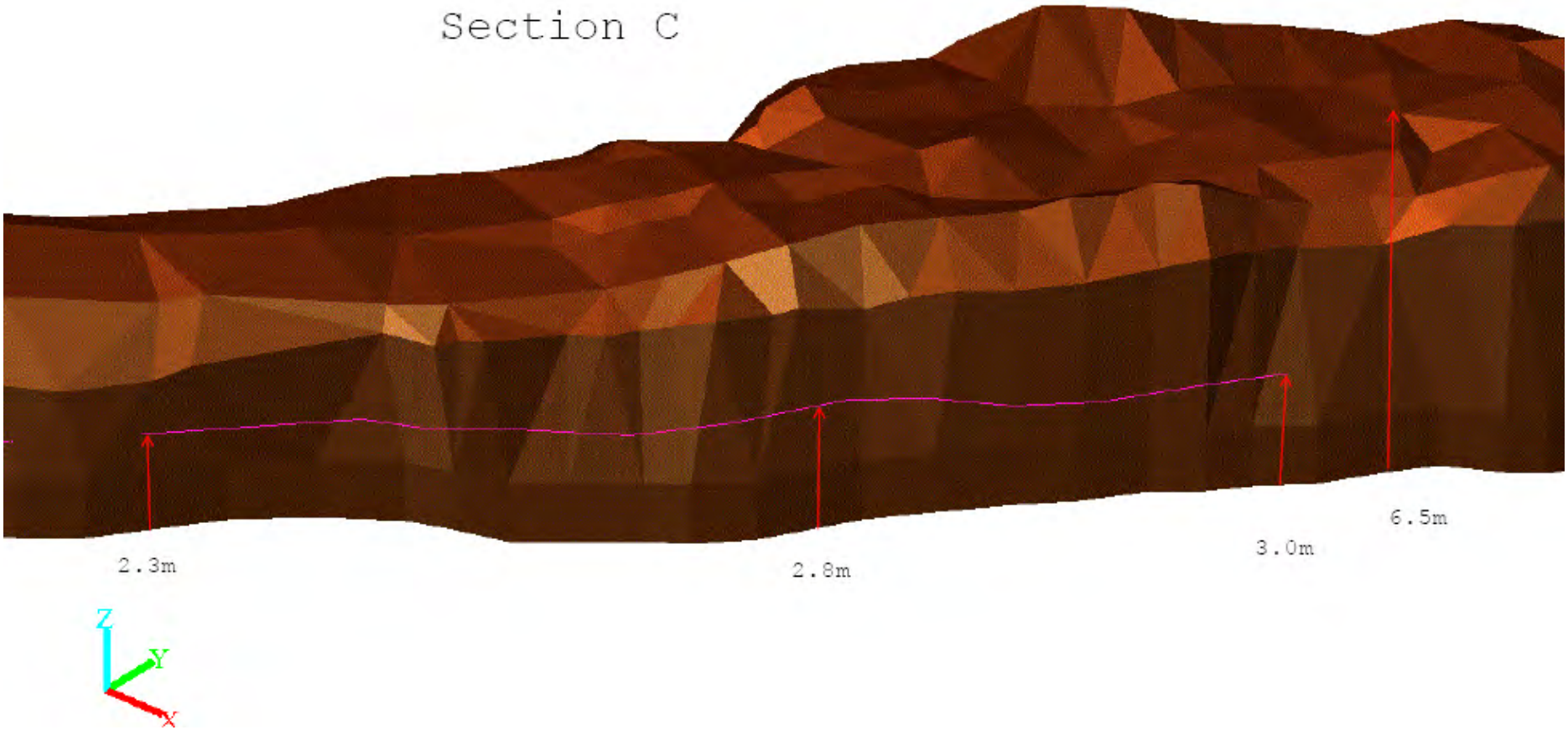
Computer generated views of the height of the inrush - Section A



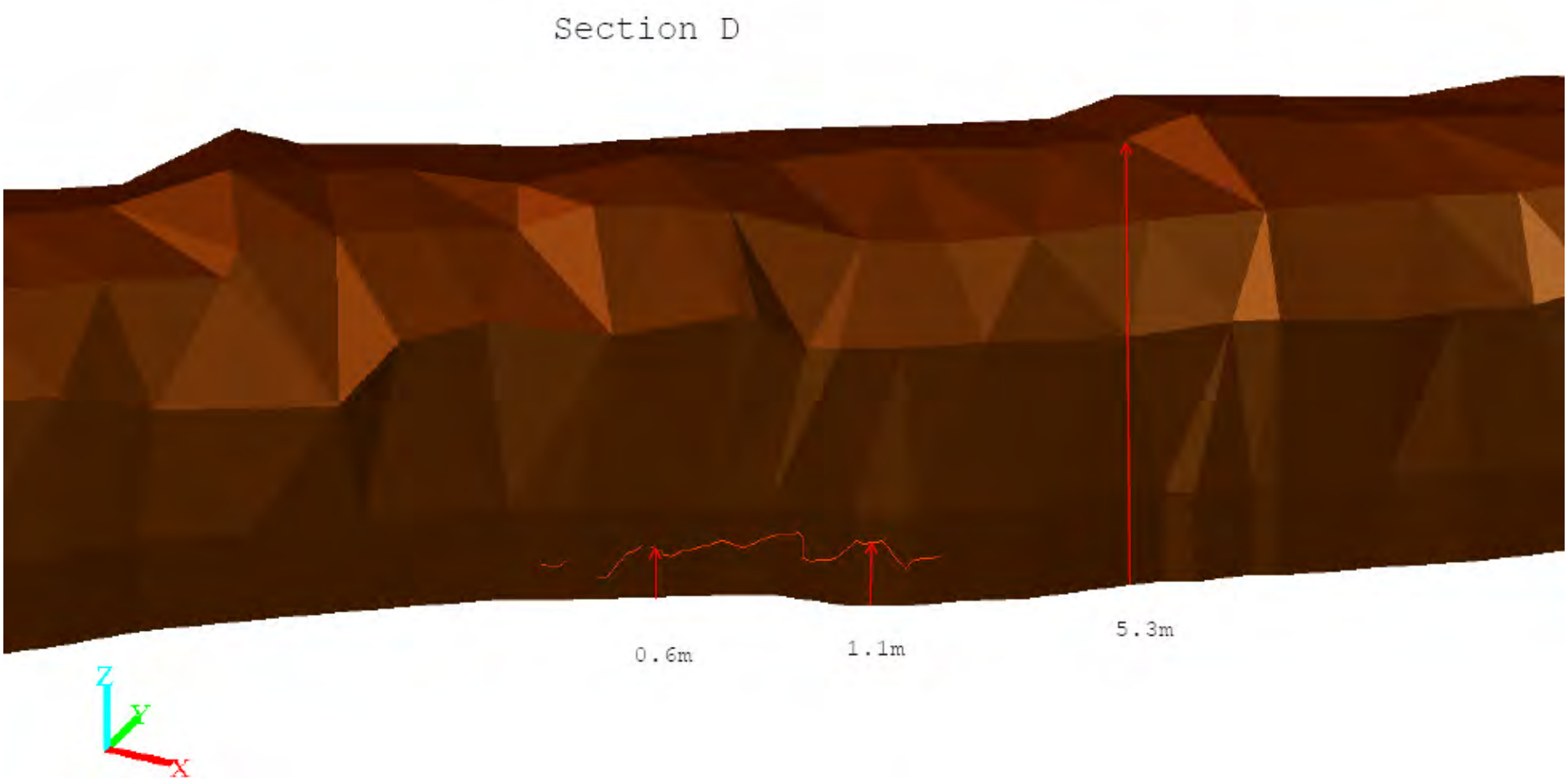
Computer generated views of the height of the inrush - Section B



Computer generated views of the height of the inrush - Section C



Computer generated views of the height of the inrush - Section D



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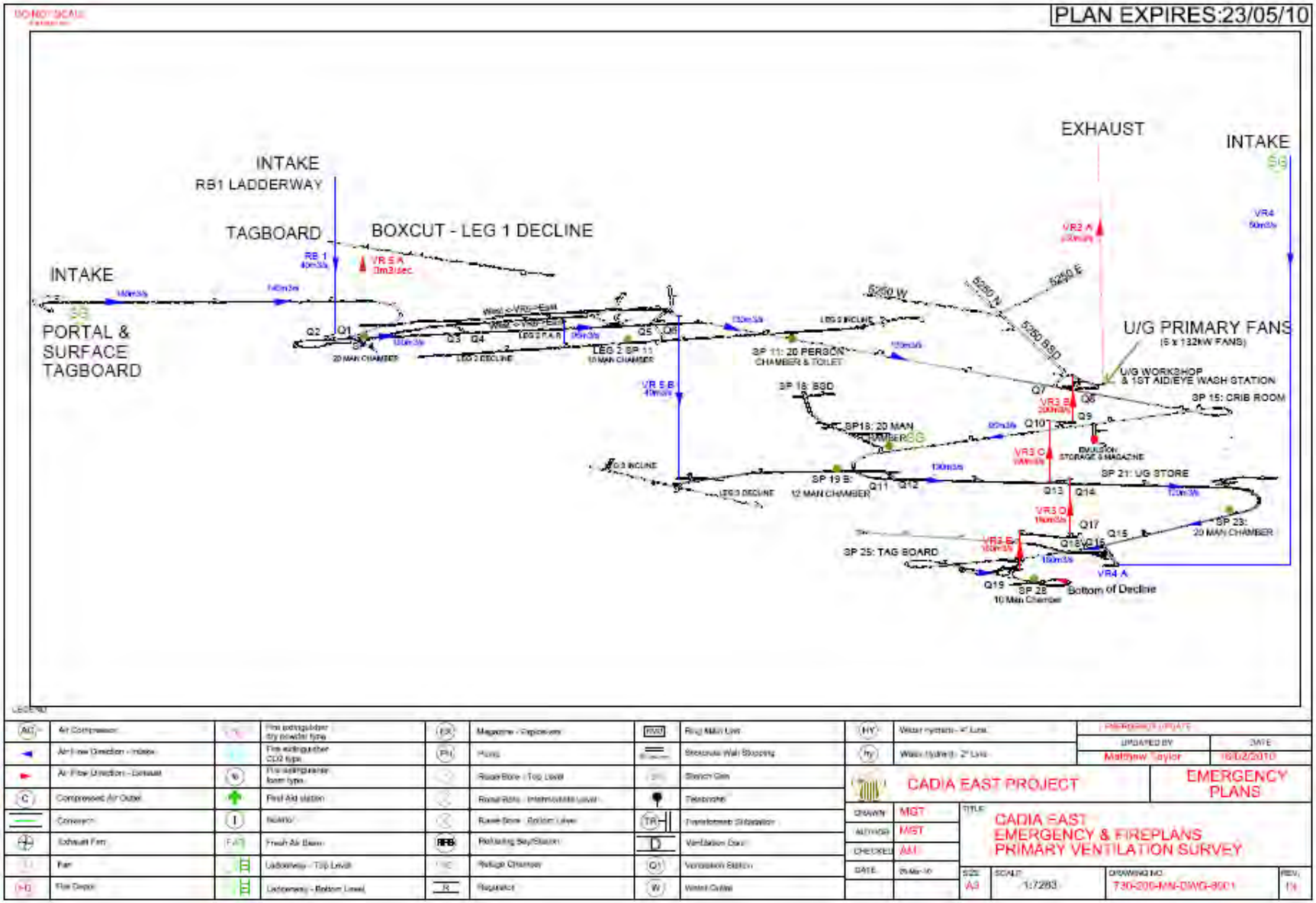
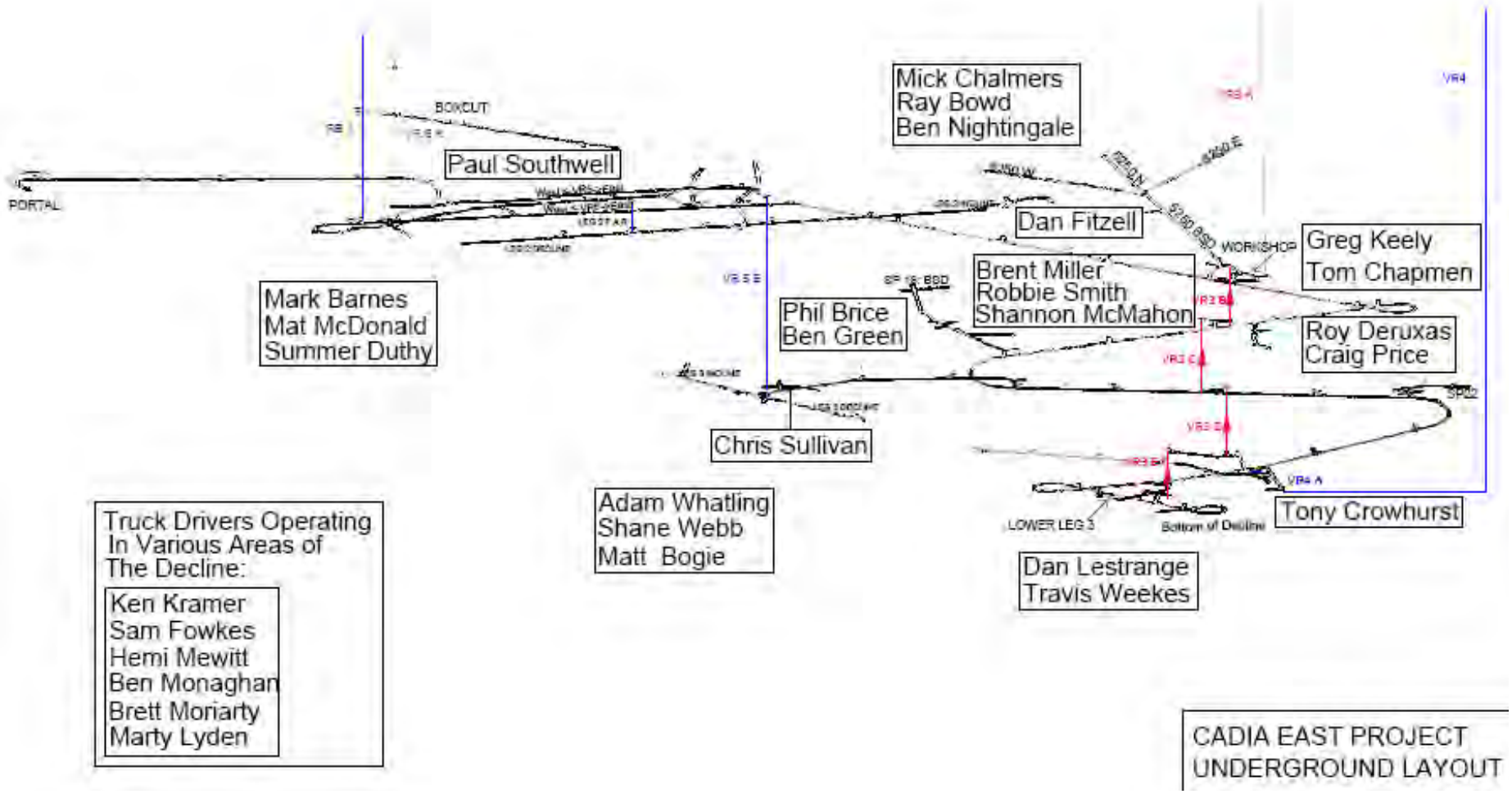
Plan 6. Cadia East Emergency and Fire-plans Primary Ventilation Survey.



Plan 7. Cadia East Emergency and Fire-plans Primary Ventilation Survey extract - lists where persons were in the mine at the time of the inrush



Attachment 4 – Safety Alert

NSW GOVERNMENT | Industry & Investment

SAFETY ALERT

Water inrush from Raisebore Hole

INCIDENT

An inrush of water and mud occurred at the base of a raisebore hole that was approximately 270 metres deep and 5 metres in diameter.

The inrush occurred on night shift when bogging operations were being undertaken at the base of the raisebore hole. The inrush material flowed into the mine workings placing a number of persons at risk.

Fortunately no one was injured during the event, however, there was potential for fatalities and/or serious injuries to occur.

The photo shows the rear view of the bogger that was removing the wet cuttings from the base of the raisebore hole at the time of the inrush.

Note the inrush material visible on the machine up to the enclosed operator cabin.

CIRCUMSTANCES

A constant flow of ground water was entering the raisebore hole during reaming. As a result, a quantity of mud and water had built up.

Prior to the incident it was observed that the raisebore hole may have been choked off or partially blocked.

A Job Safety Analysis (JSA) was carried out during the shift prior to the inrush occurring.

The JSA identified the risk of an inrush occurring, however it failed to identify adequate controls to minimise the risk to persons, especially persons working at lower levels of the mine.

ABN 72 189 919 072
www.dpi.nsw.gov.au/minesafety

Mine Safety Report No: SA11-01
File No 09/5514
Comet ID: 317580481001
Prepared by: M. Stephens
Phone: 02 6360 5350
Date Created: January 2011

RECOMMENDATIONS

The risk of an inrush within a mine is a prescribed hazard in the *NSW Mine Health and Safety Regulation 2007*.

A risk assessment is therefore required and effective controls are to be established (using the hierarchy of controls) taking into consideration all possible scenarios regarding potential inrush.

It is recommended that when raiseboring operations are taking place that the risk of an inrush and its consequences are minimised by considering the following control measures:

- Plan and prepare for the use of tele-remote bogging at the base of the raisebore hole in case a blockage of the raisebore hole takes place.
- Drill drain holes into the raisebore hole to allow effective drainage and monitoring of water flows from the raisebore hole. Drain holes should allow water to be released if it builds up in the raisebore hole due to a blockage.
- Establish clear procedures to decide at what height of cuttings and circumstance at the base of the borehole would trigger the decision to carry out tele-remote bogging and/or a JSA.
- Always cease reaming well before the cuttings have built up to choke off the brow. Also if the brow is choked off then reaming must cease.
- Maintain a reconciliation of the tonnage reamed against the tonnage bogged. However, be aware of the inherent errors that can occur including human reporting errors as well as when water is present as amounts of water and material can vary a great deal from bucket to bucket.
- Conduct regular inspections in a safe manner, by competent persons, at the base of raisebore holes during reaming operations to assess the level of build up of the cuttings and to be sure the established safe work procedures for bogging are being strictly followed.
- Where possible take appropriate measures to prevent any peripheral water from entering the raisebore hole.
- Establish a 'no go' zone at the base of the raisebore hole except for bogging activities.
- If circumstances change, a JSA should take place immediately to identify any new hazards and assess the risks associated with the change. The JSA should also take into account the potential risk to persons working at lower levels of the mine should there be any potential for an inrush to occur.
- If circumstances have changed, appropriate communication should take place with all persons that may be affected in the mine so that any new control measures are well known and understood by everyone.

- Provide information and training for all persons involved with bogging at the base of the raisebore hole so they are aware of the hazard and potential risk of an inrush should it occur.
- Reference MDG 1030 *Guideline for Raiseboring Operations*, available for downloading at the Industry & Investment website: http://www.dpi.nsw.gov.au/minerals/safety/publications/mdg

NOTE: Please ensure all relevant people in your organisation receive a copy of this Safety Alert, and are informed of its content and recommendations. This Safety Alert should be processed in a systematic manner through the mine's information and communication process. It should also be placed on the mine's notice board.

Signed

Rob Regan
DIRECTOR
MINE SAFETY OPERATIONS BRANCH
INDUSTRY & INVESTMENT NSW

View more safety alerts at www.dpi.nsw.gov.au/minerals/safety/safety-alerts. If you would like to receive safety alerts by email, enter your contact details at www.dpi.nsw.gov.au/minerals/safety/signup