NSW GOVERNMENT
Trade & Investment
Mine Safety

Investigation report

Report into the death of an underground mine worker, James Hern, at the CSA Mine, Cobar NSW on 11 June 2014

Report prepared by the NSW Mine Safety Investigation Unit

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June 2015

More information

Mine Safety Investigation Unit, Thornton NSW

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1 Executive summary

1.1 Incident overview

About 11.15 pm on 11 June 2014, 26 year-old James Hern drowned when he entered a water filled sump at CSA Mine, Cobar NSW. Mr Hern and a co-worker were attempting to clear a blockage from the 8820 north sump drain hole that had been deliberately clogged in the preceding shifts.

A strainer in the sump hole had also been removed. This strainer can be viewed in figures 10 and 16 of this report.

The blockage was preventing the 8820 north sump from draining through to the 8790 north level below. The sump contained a considerable volume of water. The depth at the time of the incident was estimated to be 1.43 metres to the drain hole with a calculated volume of 162,800 litres. It is evident from water markings on the mine wall that the sump was full and overflowing into the adjacent access roadways.

Mr Hern and his co-worker were using an integrated tool carrier (IT) with a work basket attached. It was driven into the sump to the approximate location of the drain hole. Working from the basket, Mr Hern attempted to clear the blockage using a scaling bar with a piece of rope attached.

The intention was to use the scaling bar to pierce the blockage and clear the drain. However during the task the scaling bar was lost in the water.

Mr Hern and his co-worker withdrew the IT from the sump and proceeded to the 8790 level below in a light vehicle to determine whether the scaling bar had been successful. There was no water flowing from the drain hole indicating the hole was still blocked.

Both workers then returned to the higher level where Mr Hern removed clothing and walked into the water-filled sump to find the scaling bar and complete the job. A short time later, he disappeared from sight.

The co-worker called out, but with no response he contacted the shift supervisor on the radio system who activated the mine's emergency procedures. Other workers responded to the scene and began search and rescue efforts. Mr Hern was found below the surface with his legs trapped in the drain hole.

Five co-workers entered the water and recovered Mr Hern from the drain hole using the IT and lifting equipment. He was taken by ambulance to Cobar District Hospital but efforts to resuscitate him were unsuccessful and he was pronounced deceased at 12.40 am on 12 June 2014. The post mortem examination determined that the cause of death was consistent with drowning.

1.2 Investigation observations

The investigation has identified a number of system failures relating to the management of risks associated with underground water hazards, the supervision of employees and provision of fit-for-purpose equipment for blocking and unblocking sumps.

In this case, there was no risk management plan in place that considered the hazards associated with work on underground sumps and water bodies. There was no safe work procedure documented to undertake such works. There was no training provided to Mr Hern or his co-worker in relation to the task they were to undertake. There was an over reliance upon Mr Hern and his co-worker to develop their own system of work and assess risks without the relevant information necessary to make such decisions (for example, information about how the drain hole was blocked or alternative methods available to unblock the drain hole). Supervisors and Foremen did not ensure that the task Mr Hern was undertaking was safe and adequately risk assessed.

These failures were exacerbated by the absence of high level risk management controls such as hard barriers (elimination, substitution and engineering controls) to prevent people from exposing themselves to the risk of drowning in an underground sump.

1.3 Foreseeable risk

The risks associated with working in and around water bodies are clearly foreseeable. Mine operators must effectively manage and control these risks to ensure the health and safety of workers.

There was a range of water management issues at the mine before the incident that highlight the foreseeable nature of the risks involved in this incident. These include:

- the regular failure of the pumping system at the 8855 level
- the development of a new mine dewatering program (a change to the management of water at the mine)
- deliberate blocking of the 8820 north drain hole and the adhoc use of inflatable stope bags to block the drain hole
- identification of the 8820 north sump overflowing into adjacent roadways
- attempts to unblock the sump during the day shift before the incident
- identification of safe work methods to remove the water from the sump and unblock it which were not documented or communicated to the service crew
- a history of workers entering sumps to unblock drain holes and undertake sump maintenance at the mine
- the provision of waders to mine workers to undertake work in sumps at the mine.

Accordingly, greater emphasis should have been given to managing the risks associated with the task being undertaken by Mr Hern and the work associated with the mine's dewatering program using the mine's risk management system.

1.4 Safety observations

The implementation of the hierarchy of controls is a well-known and legislated tool to control risks to health and safety. The following risk management controls could have been implemented to control the risks to health and safety in relation to the work undertaken by Mr Hern.

Hierarchy of controls

Elimination

Elimination of the hazard is the best hard barrier (control) that can be applied to reduce or eliminate a risk to health and safety. A foreman at CSA mine reported that production could have ceased and the dewatering system turned off to prevent water flowing to the 8820 north sump. This would have eliminated the need to block the sump in the first place, which would have meant that Mr Hern would never have been required to undertake the task of unblocking the drain hole.

The removal of the water from the 8820 north sump would also have eliminated the risk. It is clear that the submersible pump that was in the 8820 north sump was either not working or ineffective. This is because the pump was plumbed into the dewatering system so water would recirculate. Several supervisors at the CSA mine suggested that an air diaphragm pump could have been installed so water could be pumped down the decline.

Substitution

By substituting the system of work it is possible to reduce the risk to health and safety and reduce the consequence of risk to health and safety. Many alternate systems of work have been identified that may have reduced the risk to health and safety. They include:

- unblocking the drain hole earlier in the work program before excessive water accumulated in the sump

- using an air lance or explosive device inserted into the drain hole from the level below which may have unblocked the drain hole and would have negated the need to enter the 8820 north sump either on foot or in the basket of an IT.

Engineering

Engineering controls represent the lowest hard barrier in the hierarchy of controls. Through consultation with a plumbing equipment supply company, investigators identified an engineering solution for deliberately blocking drain holes. The system includes a fit-for-purpose rubber bladder that can be anchored in a drain hole and inflated and deflated remotely, negating the need to enter a sump in either an IT or on foot to block or unblock a sump drain hole. A picture of the engineering solution is depicted within the report at figure 16.

Another engineering solution identified is appropriate guarding around the drain hole. The strainer that was in the hole before the incident constituted a guard that would have reduced the risk of Mr Hern becoming stuck in the drain hole. Further, a steel mesh grate securely installed over the drain hole would have been an effective hard barrier.

Administrative

Administrative controls are considered soft controls and require a degree of compliance by the workforce, which in turn means that there has to be a higher degree of compliance monitoring by management. They are considered one of the lowest forms of control and should be used in conjunction with hard controls listed above.

The mine's safety management plan (MSMP) is a legislated overarching administrative control that should minimise risks to health and safety. In this incident it was not applied correctly and failed to reduce the risk to Mr Hern. Risk assessments and safe work procedures should have been created using the MSMP. However, these documents were not created. The following is a non-exhaustive list of administrative controls that have been suggested to reduce the likelihood of the incident occurring:

- A broad brush risk assessment should have been conducted during the planning phase of the dewatering activities
- The change management system should have been implemented as soon as the change to the dewatering system was identified
- A safe work method should have been created and communicated to Mr Hern before the task was undertaken
- A Job Safety Analysis should have been insisted on by supervisors before work began in the 8820 north sump
- CSAfes should have been completed by every person working in the 8820 north sump (note this included CSAfes by shift supervisors and foremen)
- Adequate work instructions should have been provided to people that were to work in the 8820 north sump in the days before the incident
- Active supervision, including pre-shift inspections of the 8820 north sump should have been undertaken to ensure that the work place was safe for workers
- Specific directives to all workers not to enter sumps and water bodies at CSA mine should have been clearly articulated to all mine workers.

Personal Protective Equipment (PPE)

PPE is the last line of defence and is not an adequate control for hazards on its own. As with administrative controls mentioned above they are classified as soft controls and require compliance by workers to be effective. Mr Hern removed most of his clothing and PPE before entering the sump. However, due to the nature of this incident, it is unlikely that the PPE available to Mr Hern would have prevented this incident from occurring.

The following non-exhaustive list of PPE is suggested to reduce the risk of drowning in and around water bodies at mines:

- Provide personal flotation devices (life jackets) for anyone working near water bodies.

- Position flotation rings at every water body that presents a risk to a worker.

Note the use of waders is not considered appropriate PPE to prevent the risk of drowning.

1.5 Recommendations

This incident highlights the importance of an effective risk management program in relation to works in and around underground sumps and water bodies. The following recommendations are advanced to improve industry safety and in turn reduce the likelihood of similar incidents reoccurring.

When considering the recommendations below, mine operators are reminded of their obligation to take a combination of measures to minimise the risk, if no single measure is sufficient for that purpose.

Recommended practice for industry

- Mine operators must identify and control the risks associated with work in and around underground sumps and water bodies.
- The risks associated with underground sumps and water bodies must be managed using the hierarchy of controls.
- Elimination, substitution and engineering controls should be used where reasonably practicable.
- All underground sump drain holes should be appropriately guarded and adequately identified.
- All work involving underground sumps should be appropriately planned, risk assessed, documented and supervised.
- Fit for purpose equipment should be used to block and unblock sump drain holes.
- Mine operators should conduct regular reviews of their mine’s safety management plan to verify critical controls are in place for major hazards.
- Company officers are reminded of the importance of their responsibilities and obligations in regard to section 27 of the *Work Health and Safety Act 2011* (NSW) (WHSA).

Contents

2 Purpose of the report

This report concerns the death of James Hern at the CSA Mine, Cobar NSW on 11 June 2014.

This report has been prepared for the Secretary of the Department of Trade and Investment, Regional Infrastructure and Services. It describes the mining workplace incident investigation conducted by the department's Mine Safety Investigation Unit into the cause and circumstances of the incident and contains recommendations based on the detailed analysis of information gathered during the investigation.

The purpose of the report is to assist the Secretary of the department, as the regulator of work health and safety legislation at mines, to learn about the incident and to share information with industry and the community so that proactive steps can be taken to improve industry safety and prevent similar events from occurring.

3 Investigation parameters

3.1 The department's Investigation Unit

The Investigation Unit investigates the nature, circumstances and cause of major accidents and incidents in the NSW mining and extractives industry.

Its role is to carry out a detailed analysis of incidents and report its findings to enhance industry safety and to give effect to the department's Enforcement Policy.

The unit is autonomous within the department and reports directly to the Secretary on all matters in relation to an investigation. It is located separately from the department's Mine Safety inspectorate and is not involved in the activities of the inspectors, or the day-to-day inspection of mines.

3.2 Investigation scope

In accordance with departmental policy, the incident automatically resulted in an investigation by the unit because the incident involved the death of a mine worker.

The investigation was conducted under the *Work Health and Safety Act 2011* (NSW) (WHSA). The unit had authority to conduct an investigation into this matter because the incident occurred at a mining workplace regulated by the department.

The investigation focused on:

- identifying the cause and circumstances of the incident
- identifying whether the WHSA and Regulations have been complied with
- identifying how similar incidents of this nature can be prevented in the future.

3.3 Legislative authority to investigate

Under the WHSA, the regulator of a mining workplace or a coal workplace is the head of the department. The head of the department is the Secretary.

At the time of the incident a mining workplace was defined by the WHSA to mean a place of work to which the *Mine Health and Safety Act 2004* (NSW) (repealed) (MHSA) applied. The MHSA was administered by the Minister for Resources and Energy ('the Minister') and the department.

A mining workplace included 'any place where the extraction of material from land for the purpose of recovering minerals or quarry product is carried out.' The CSA Mine at Cobar is situated on consolidated mining lease No.5, extracted copper ore and is a mine to which the MHSA applied.

The MHSA provided for the appointment of government officials to have oversight of mines. A person who was appointed as a government official under the MHSA was deemed to be an inspector for the purposes of the WHSA. An inspector had powers and functions, including the function of investigating contraventions of the WHSA.

The unit investigators were appointed as government officials under the MHSA and were therefore deemed to have been appointed as inspectors for the purposes of the WHSA and had the powers of an inspector under that Act in relation to mining workplaces. The regulator has also delegated some extra functions to inspectors, namely the power to obtain information for the purposes of monitoring compliance with the WHSA.

3.4 The department's response to the incident

The department's local Mine Safety Operations Inspector of Mines attended the incident scene in the early hours of 12 June 2014. The inspector of mines worked with NSW Police attached to the Darling River Local Area Command and NSW Police Forensic Services Group officers to analyse the incident scene.

As the incident resulted in a fatality, the matter was automatically referred to the Investigation Unit in accordance with departmental procedures. Investigators attended the mine on 12 June 2014 and began a formal investigation into the incident.

The investigation was conducted in consultation with NSW Police and other major stakeholders. Investigation activities included:

- incident scene analysis and photography
- conducting interviews with workers
- issuing statutory notices to the mine operator, supplier and individuals to produce information and documents
- obtaining plans of the incident site
- obtaining records from the police, coroner, emergency services and hospital.
- inspecting departmental files relating to the mine
- analysing large volumes of information and records obtained during the investigation
- identifying the causal chain of events that led to the incident occurring
- identifying what risk control measures were in place at the time of the incident
- identifying controls that may have prevented this incident from occurring.

3.5 Investigation Unit information release

The Investigation Unit published an information release on 23 June 2014. The information release drew attention to the importance of managing risk using the hierarchy of controls. It also highlighted the importance of conducting thorough risk assessments in relation to work in and around sumps and water bodies.

The information release reinforced the need to ensure that open drains and boreholes are appropriately guarded and hard barriers are in place to prevent similar incidents from occurring.

It reported that workers should be prohibited from entering water filled sumps and water bodies and highlighted that there has been several drowning-related incidents at Australian mines, indicating the foreseeable nature of this incident. It also reminded mine operators, supervisors and workers to make themselves aware of the risks associated with tasks involving water-filled drainage sumps and water bodies.

3.6 Investigation status

At the time of writing, the investigation into the cause and circumstances of the death of James Hern at the CSA Mine, Cobar was ongoing. Investigator inquiries will continue until all available information has been obtained from the mine and relevant people.

4 The deceased worker

James Leo Hern was offered full-time employment with CMPL on 1 February 2012. At the time of the incident, Mr Hern was employed as a projects operator within the Mining Department at the CSA Mine. This role consisted of general mine work such as constructing ventilation structures and backfill barricades, unblocking sump drains, lifting sump pumps for general sump housekeeping and installing new pumps in sumps. Mr Hern was undertaking training in development charge up with the goal of gaining a promotion to the position of development operator.

On 15 May 2012, Mr Hern completed probationary employment and was offered permanent employment with CMPL. Mr Hern continued employment with CMPL on a permanent full-time basis until 11 June 2014 (the incident date). Mr Hern had a good employment record, he did not have any disciplinary records against his name and workers reported that he was well liked and completed tasks diligently and to a high quality.

Before starting work at the CSA Mine, Mr Hern worked in numerous construction roles in Victoria and the Northern Territory. References obtained from these employers show Mr Hern to be diligent and safety conscious.

Mr Hern was 26 years old at the time of his death.

4.1 Training

Mr Hern received a general mine site induction when he started work at CMPL (February 2012). This included general training and instruction on the following:

- General above and below ground procedures such as the use of a cap lamp and self-rescuer
- Emergency evacuation procedures
- Risk awareness and risk assessment (including CSAfe and Job Safety Analysis)
- Vehicle procedures
- Radio communication procedures

Mr Hern received further training in work specific procedures such as the safe use of an integrated tool carrier (IT), brick wall building and the safe construction of ventilation control devices.

5 The CSA mine

5.1 The mine

The CSA Mine website provides the following information about the mine:

> CSA Mine is located in Cobar, Central Western NSW. It is operated by Cobar Management Pty Ltd (CMPL) – owned by Glencore.
>
> The mine initially started in 1871 with an erratic production history until 1964, when Broken Hill South Ltd began large scale production. The mine passed to CRA in 1980 and then to Golden Shamrock Mines in 1992. The mine was closed in 1997/8 following its acquisition by Ashanti Goldfields and was reopened in 1999 by Glencore.
>
> Since 1965 the mine has extracted substantial quantities of zinc, lead, silver and copper, but today, CSA Mine focuses on mining copper, with a silver co-product.
>
> The underground mine produces over 1.1 million tonnes of copper ore and produces in excess of 185,000 tonnes of copper concentrate per annum. The concentrate contains approximately 29% copper metal and is exported to smelters in India, China and South East Asia.

The CSA Mine extracts ore from three underground regions known as the QTS North, QTS South and the Eastern Zone. The majority of production is from the QTS North system with the other two zones supplementing production as required.

Mineralisation consists of steeply dipping sulphide and quartz sulphide lenses.

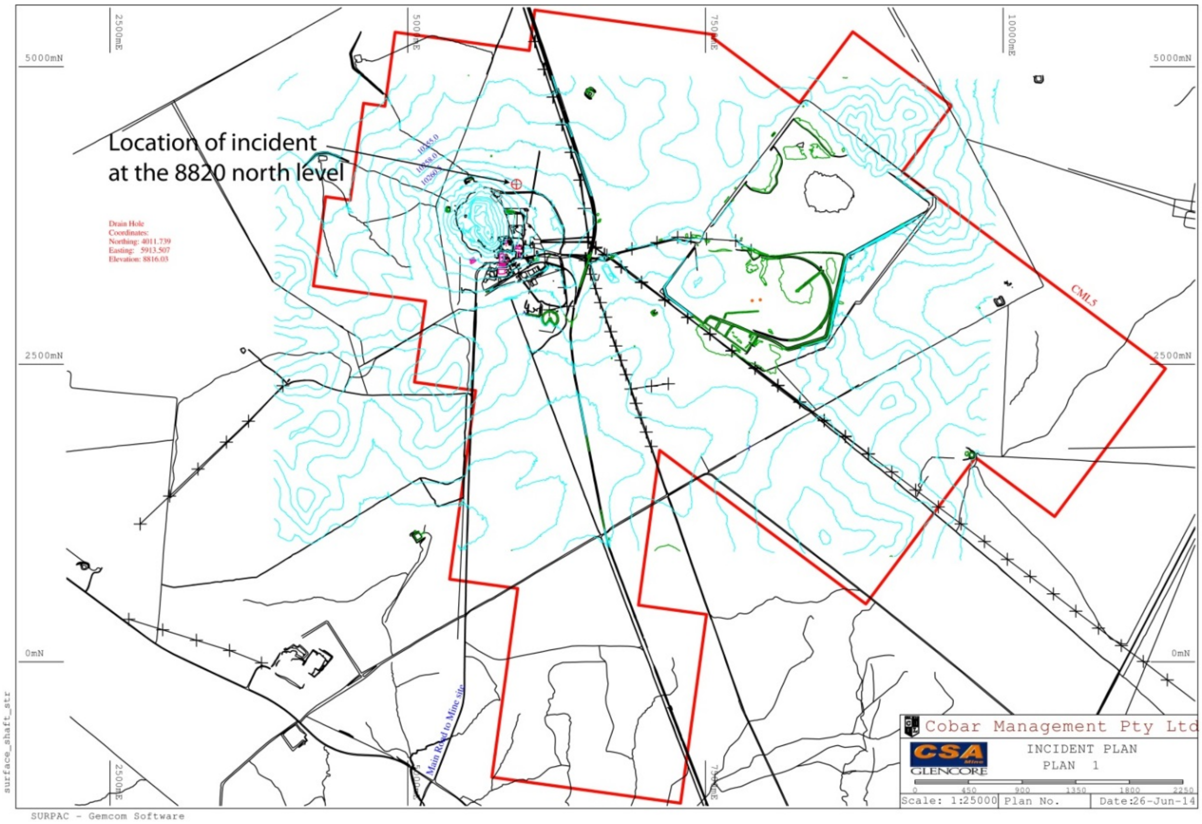
The ore extraction technique used at CSA Mine is transverse and longitudinal long-hole stoping with hydraulic back fill. Stopes range in size from 3000 tonne to 80 000 tonne. The mining sequence is underhand continuous retreat. Ore is transported from the mine to the preparation plant utilising a combination of rubber tyre vehicular haulage and a friction winder.

The CSA mine is currently extracting ore from levels below 1500 meters in depth.

5.2 The location of the incident

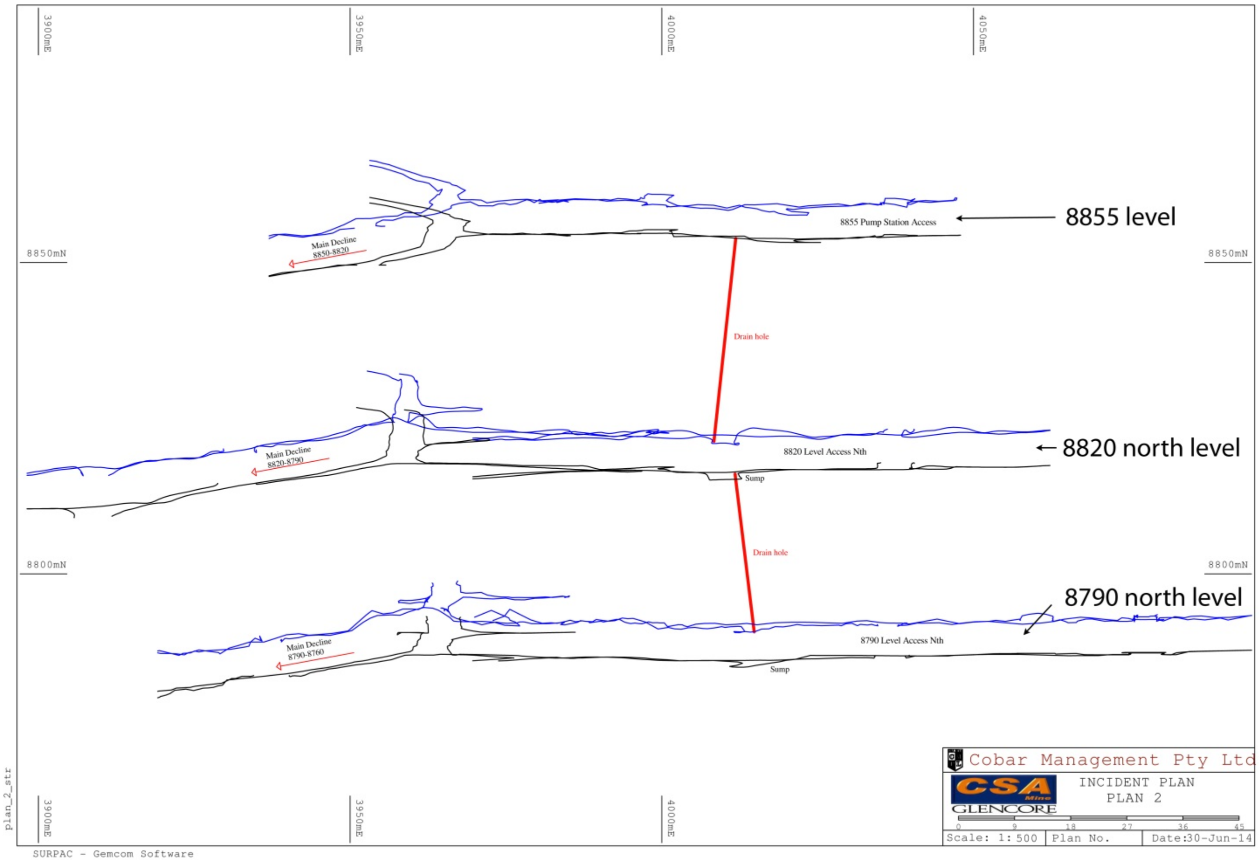
The incident occurred at the 8820 north level sump, which is within the QTS North system at CSA Mine. The CSA Mine is on consolidated mining lease (CML5) which comprises several mining leases including ML4, ML17 and ML121. CML5 was granted to the lease holder on 2 December 1993, renewed on March 2007 and expires on 24 June 2028. A plan of the incident scene relative to CML5 was provided to investigators. It is depicted below.

Figure 1 Incident plan 1 shows the incident scene at 8820 north level sump relative to CML5 note the red text in the upper left hand quadrant depicts the actual coordinates of the drain hole at the incident scene.



The 8820 north level sump is more than 1400 metres below ground. The sump is accessible from the main level access drive off the decline within the QTS North system and is not within an active mining zone. At the time of the incident, the sump was primarily used to wash out concrete agitator trucks used in the shotcreting process at the mine. It was also part of the larger dewatering system at the mine. A section view of the 8820 north incident scene relative to the levels above and below was provided to investigators by the operator of the mine. It is depicted below in figure 2.

Figure 2 Incident plan 2 shows a section view of the 8820 north sump incident scene relative to the level sumps above and below.



5.3 The companies involved

The operator

The MHSA stipulates that a mine holder must not undertake any work directly related to mining, or allow any other person to undertake any work directly related to mining, at a mine unless the mine holder has nominated one person who is the employer with the day-to-day control of the mine as the operator of the mine. Duty bound by this Act, the CSA Mine lease holder nominated Cobar Management Propriety Limited (CMPL) as the nominated operator of the mine with respect to CML5.

Departmental records identify that CMPL was appointed as the nominated operator of the mine by the mining lease holder Isokind Pty Ltd on 2 April 2008.

CMPL is wholly owned by Glideco Pty Ltd and is a subsidiary of Glencore International AG (Figure 3). In its capacity as mine operator, CMPL has the ultimate responsibility for the day-to-day control of the mine. This control includes the power of an employer to direct employees and the power of a principal to direct the activities of a contractor.

The mine operator has a number of important duties under the MHSA. These include but are not limited to:

- establishing a management structure
- implementing a mine safety management plan
- creating a system for dealing with emergencies and incident notification requirements
- ensuring that workers (including supervisors and managers) have the necessary skills, competence and resources to undertake their work safely and to ensure the safety of others.

The lease holder

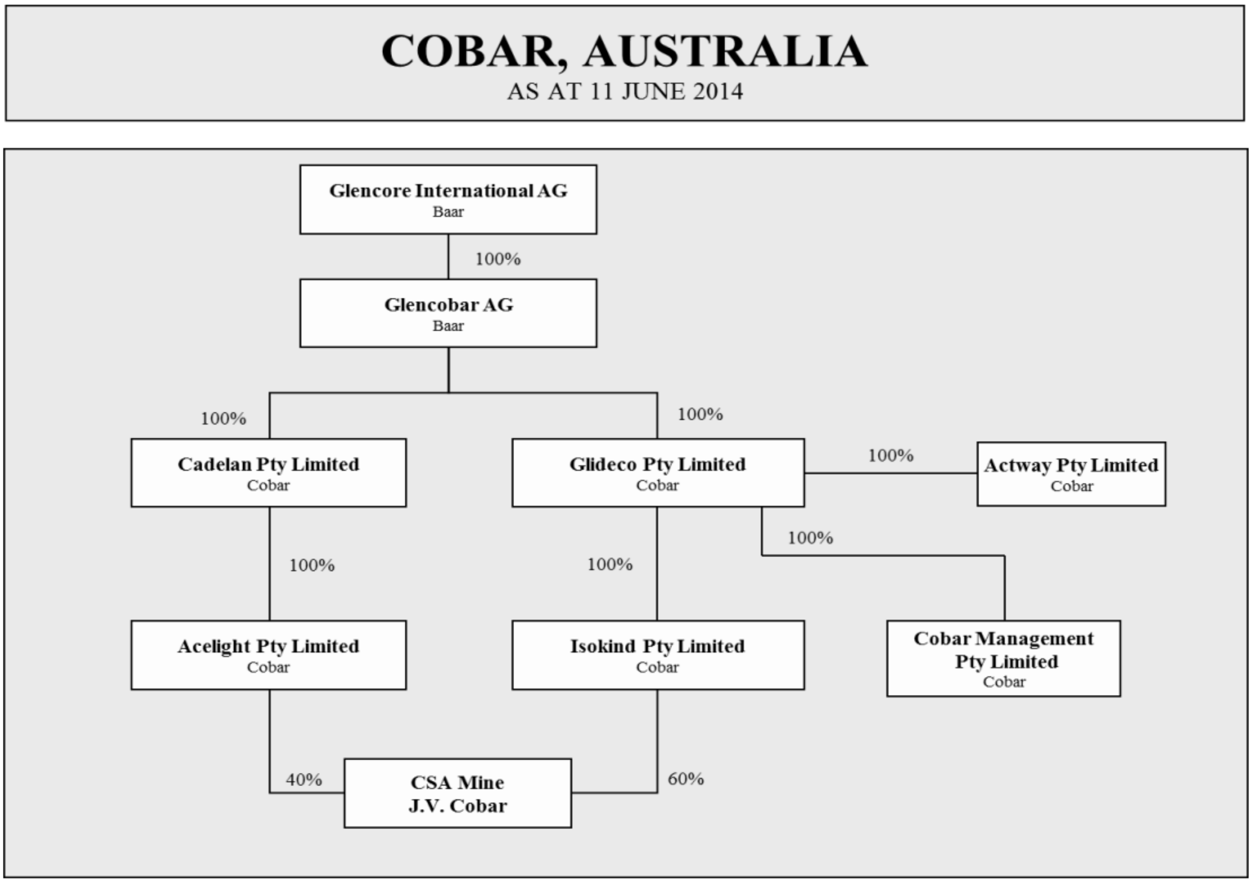
The CSA mine is situated on CML5, which is held by Isokind Pty Limited. Isokind Pty Limited is a wholly owned subsidiary of Glencore International AG. CML5 encompasses an area of 2474.1 hectares. The mine holder also holds two mining purpose leases identified as MPL 1093 and MPL 1094 for water storage dams, and two exploration leases EL 5693 and EL 5893.

CML5 is depicted in figure 1 above.

The corporate structure

Investigators were provided with a corporate structure for CSA Mine (see below). It can be seen in figure 3 that CMPL is wholly owned by Glideco Pty Limited. It also appears that Glideco Pty Limited is the highest level of Australian corporate subsidiary within the structure of Glencore International AG with regard to CMPL.

Figure 3 CSA Mine, Cobar corporate structure.



The ultimate holding company

ASIC documents obtained by investigators show the ultimate holding company of the nominated operator, the lease holder and the mine owners to be Glencore Xstrata PLC (Glencore).

Glencore is one of the world's largest global diversified natural resource companies and a major producer and marketer of more than 90 commodities. Glencore's operations comprise over 150 mining and metallurgical sites, oil production assets and agricultural facilities. Glencore employs around 200,000 people, including contractors.

Glencore's industrial and marketing activities are supported by a global network of more than 90 offices in more than 50 countries.

Glencore's customers are industrial consumers, such as those in the automotive, steel, power generation, oil and food processing industries.

In the first half of 2014, Glencore subsidiaries suffered 10 fatalities across its business interests.

5.4 The health safety management system

The mine operator, CMPL has a number of important duties under the MHSA. These include:

- establishing a management structure
- establishing a mine safety management plan (MSMP)
- ensuring that the work place is safe
- establishing a system for dealing with emergencies
- incident notification requirements.

Investigators obtained the CSA mine MSMP that was in effect at the time of the incident. Investigators determined that CMPL had in place a management structure, a MSMP, a system for ensuring the workplace was safe, a system for dealing with emergencies and a system for incident notification. The investigation focused on whether those systems referred to were applied appropriately and were effective in regard to work undertaken by Mr Hern and his co-worker on 11 June 2014.

CMPL management structure

At the time of the incident, CMPL had a management structure. The management structure consisted of a CEO, production manager, day and night shift foreman and shift supervisors. The structure is depicted below in figure 4 and figure 5.

Figure 4 CMPL management structure

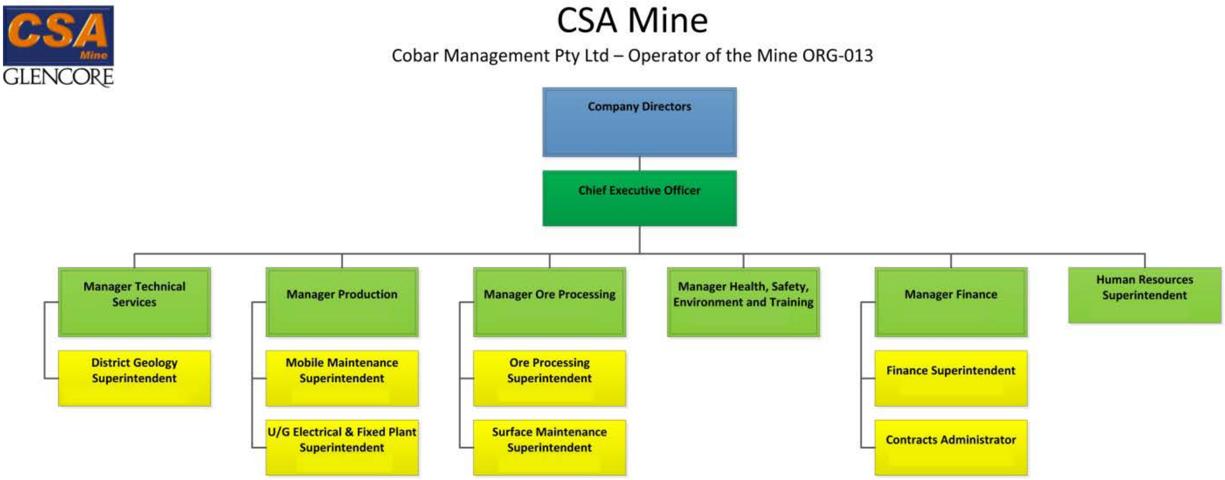
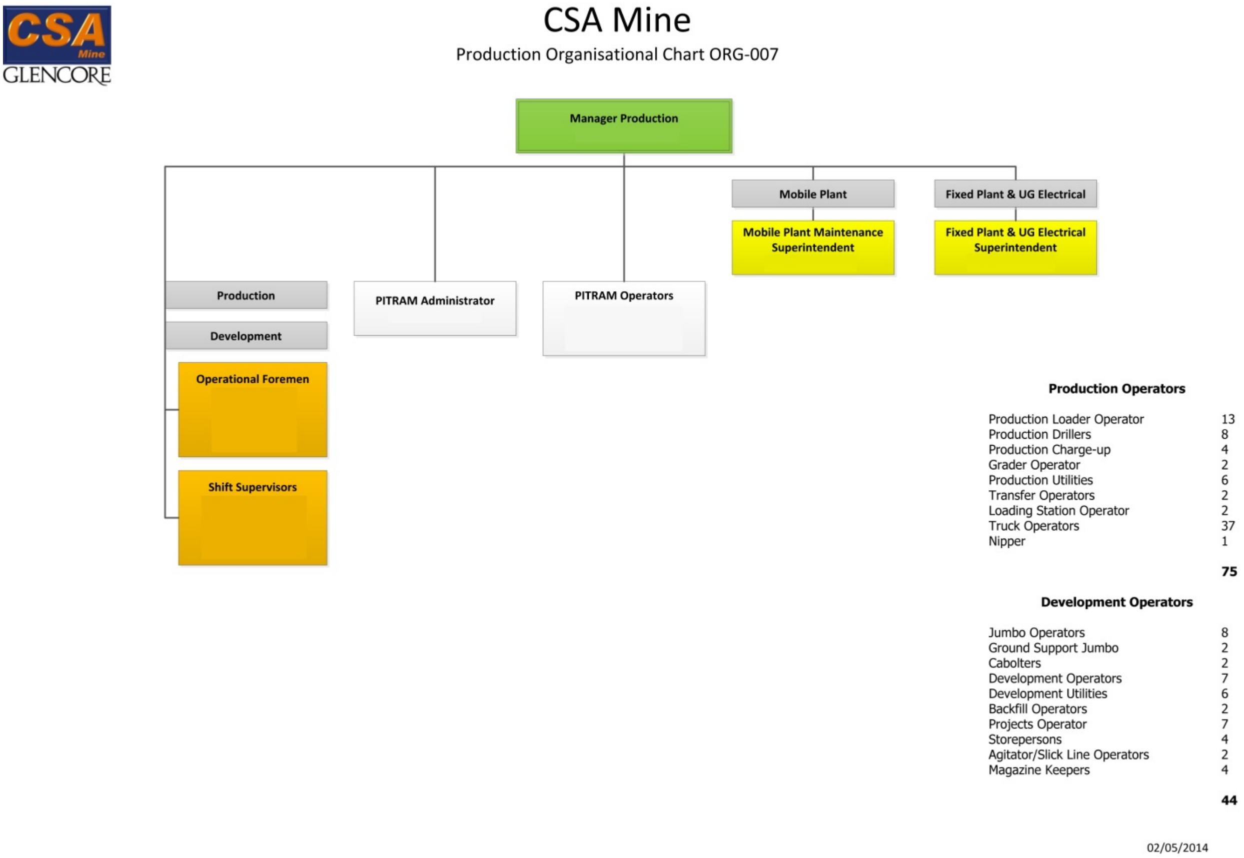


Figure 5 CMPL mining department management structure



CMPL mine safety management plan

At the time of the incident CMPL had a MSMP. Mr Hern and his supervisors had received training in relation to the MSMP.

The MSMP applied to all mining and process operations at the CSA Mine.

The MSMP provides:

- the basis for the identification of hazards and the assessment of risks arising from those hazards
- the development of controls for those risks
- the processes to implement those controls.

The MSMP details the risk management steps required by Mr Hern and his superiors to safely undertake the work Mr Hern was instructed to conduct at the time of the incident on 11 June 2014. At a minimum the MSMP requires:

- employees to complete periodic inspections of their work area throughout the shift to ensure that it is safe, and record these observations on a CSAfe report. All people inducted to the CSA site are provided with information regarding the CSAfe system, and issued a CSAfe report booklet
- supervisors to ensure that the workplace is safe and ensure that all risk management processes are implemented. Note this is a legislated condition and includes people within a supervisory position (production manager, foreman and shift supervisor)
- that a Job Safety Analysis is conducted correctly and where appropriate reasonable controls are developed to actively manage risk
- risks to be managed arising from changes to a system of work (change management).

Work instruction

Service crew workers at CSA mine receive work instructions through a variety of means, they include:

- verbal information at cross shift meeting by an equivalent worker on the preceding shift. For example, if a day shift worker does not complete a task on their shift they may instruct the relieving night shift worker of the job status and provide information on the completion of the task. This may include discussion about the hazards associated with the task.
- verbal instructions at a pre-shift meeting by the shift supervisor. Workers are required to attend a pre-shift meeting where the shift supervisor will provide verbal instruction on the tasks to be completed that shift. Service crew workers may also receive separate verbal work instructions during the shift if an urgent task arises.
- written instructions are provided to service crew in the form of a PLOD sheet. The PLOD sheet provides general shift information and will notify crew of any specific safety considerations.

Shift supervisors obtain their instructions from the shift foreman. Generally, a specific shift job list will be created and communicated to shift supervisors before pre-shift meetings.

Shift foreman create their instructions in consultation with planning engineers once a week at a weekly planning meeting and following the relative forward mining plans, such as the 0-3 month mine plan.

6 Life of mine planning

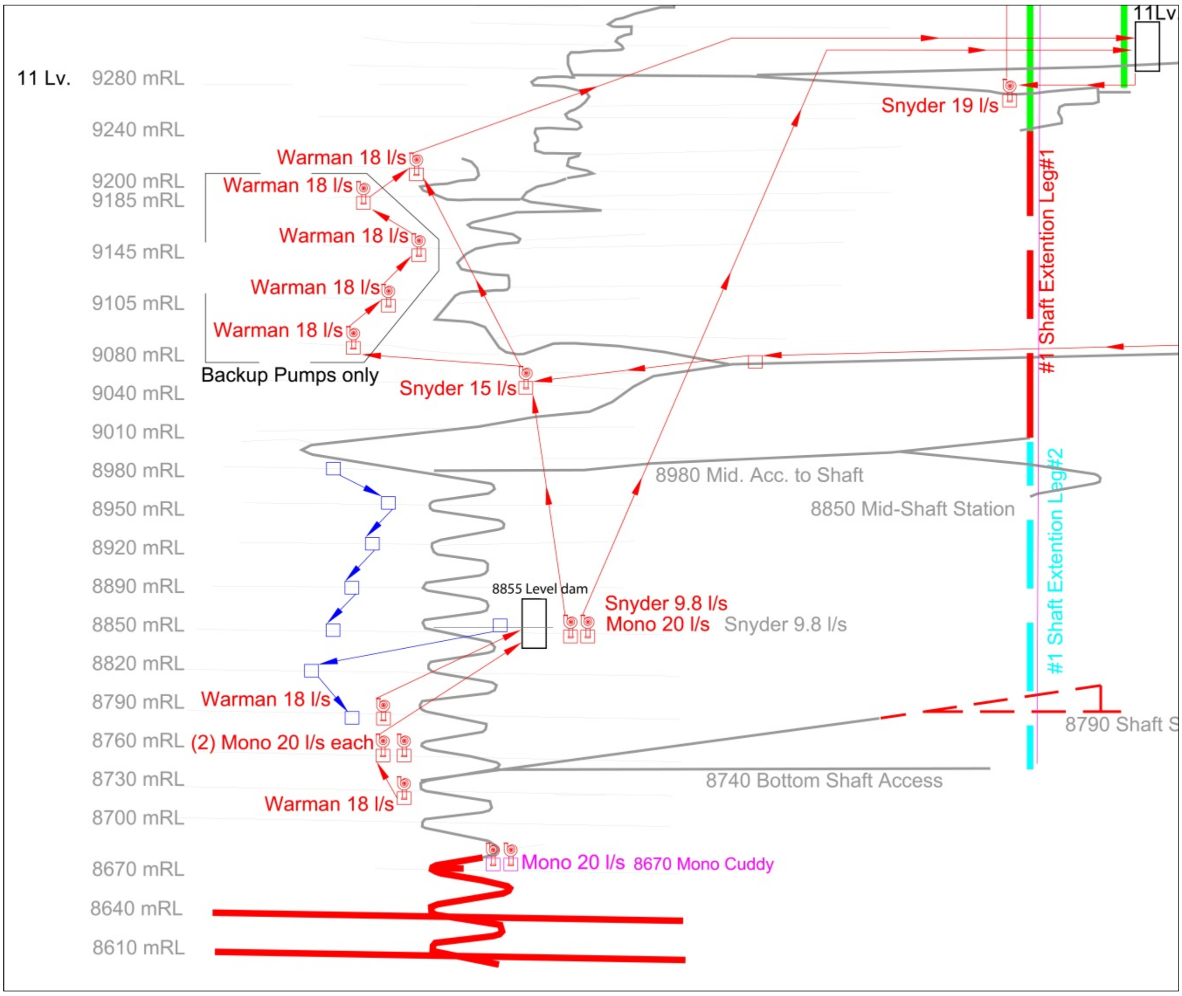
The CSA mine requires water to be pumped into the mine for backfill, dust suppression and to assist with production and development drilling. The mine geology does not hold any water therefore does not produce water during the extraction of copper ore.

Excess water created in the above mentioned process that does not evaporate travels through a dewatering system that incorporates a sump on most levels.

The current system in the QTS North section of the mine used either submersible pumps or sump drains to transfer water to pumping stations on the 8855 level. From the 8855 level water is transferred to the 9 level dam via the 11 level, which can ultimately pump the water from the mine via pumping stations on upper levels. The majority of the water is transferred to underground dams where it is recycled for future use in the mining operations.

A plan of the dewatering system of the QTS North system is included below in figure 6.

Figure 6 is a crop of a larger mine plan provided to investigators. It depicts the dewatering arrangements at the mine in the QTS North system at the time of the incident.



Before 1 June 2014, the mine dewatering system allowed over flow from the 8855 pump station to travel down a drain hole to the 8820 north sump. Drain holes are depicted as blue arrows in the figure above. The 8820 north sump drain hole reported to the 8790 sump where a Warman pump transferred water back to the 8855 pump station. Failure of the pumps at the 8855 level would mean that water would recirculate through the 8820, 8790 and 8855 levels. Water below the 8790 level would be transferred to the 8855 level through separate Warman/Mono pumping arrangements (depicted in figure 6). Water pumped from those levels would also recirculate through the 8820, 8790 and 8855 levels when the pumps at the 8855 broke down.

The 8855 pump station pumped dirty water through either a mono pump or a Wilson Snyder pump to the 11 level, which was either cleaned and reused in the mine or pumped out of the mine.

The water pumped throughout the mine has high solid content. Water with high solid content is known to limit pump life and impact on pump maintenance and service intervals. Water high in solids at the 8855 level was destroying the pumps at the 8855 pump station. The 8855 pumps were subject to continual break down and maintenance issues. These pump break downs caused hazardous conditions in some areas of the mine, which had led to production loss.

A life of mine plan was developed by CSA mine engineers in discussion with consultants. The life of mine plan encompassed a proposal to drill drain holes between the remaining sump levels below the 8790 level. These new drain holes would enable overflow (dirty water) from the sumps to travel to a settling dam at the bottom of the mine at the 8670 level.

Solids would settle out at this dam so relatively clean water could be pumped from the 8670 level with two mono pumps to the 8855 level where clean water would then be pumped through the existing reticulation system. It was intended this system would ensure the 8855 pumps only pumped clean water to prolong their life span and increase pump reliability.

Planning meetings were held and capital was budgeted for the dewatering activities. Investigators requested all risk management documents created as part of these activities, including but not limited to formal risk assessments and change management documents.

No risk assessments have been provided by the operator or located by investigators.

The work being undertaken by Mr Hern and the service crew on 11 June 2014 was part of the life of mine dewatering activities.

6.1 Sump features at CSA mine

Figure 7 depicts the 8820 north sump at CSA Mine as observed by investigators on 12 June 2014. Note elevated water level has subsided due to unblocked drain hole. Photo by Mine Safety Investigation Unit

Sumps at the CSA mine vary considerably in their size, depth and water-holding capacity. However, there are some similarities between them, they are listed below:

- There is a sump on most levels in the QTS north system.,
- Level sump location is typically on the level access road before the main production district. There are a few exceptions to this where the sump is located further towards the mining district.
- The sump will be located at the lowest point in the level so all water will drain to it,
- Sumps have either a submersible pump (flyght pump) or a drain hole for removal of water.
- It is expected that sumps with drain holes will have a plastic strainer in them to prevent blockage.
- Sumps should have some form of demarcation, such as a chain fence with a sump sign attached.
- Sumps require regular cleaning as mud and debris will slowly reduce their water holding capacity.

Examples of two sumps at the CSA mine are depicted in figures 7 and 8.

Figure 8 depicts a sump in the QTS north system above the 8855 level. This sump has an overflow drain hole and does not have a submersible pump. Water from this sump will eventually drain into the 8855 level dam where it can be pumped from the mine. Photo by Mine Safety Investigation Unit.

7 Circumstances of the incident

7.1 Chronology of events leading to the incident

The 8790 to 8760 drain hole

The life of mine dewatering activities required drain holes to be drilled between the sumps in the QTS north system.

Before 30 May 2014, drain holes were drilled between the 8855, 8820 and 8790 level sumps.

On 30 May 2014, a drilling plan, created by the mine's technical services division was approved by the mining section.

The plan required the drilling of a drain hole with a production drill (Simba L6C) between the 8790 sump and the 8760 sump. However, the drilling plan only provided guidance on the position of the hole, its diameter and where it would intersect the 8760 level below. It did not provide guidance to the mining team on how to organise the peripheral work that was required, such as how to manage the existing flow of water into the 8790 sump. There was no risk assessment provided with the drill plan, only guidance on following appropriate break through procedures and ensuring the work area was supported and well ventilated.

The mining team recognised that positioning a Simba L6C production drill rig in an active sump may be hazardous. The mining foremen developed an informal plan to block off the 8820 north sump drain hole to stop overflow water from the 8820 north sump draining to the 8790 sump. This would ensure that the 8790 sump would remain dry and allow drilling to be completed between the 8790 and 8760 sumps.

The blocking of the 8820 North sump drain hole

On 6 June 2014, instructions were included in the day shift foreman's written instructions to set up an electric pump in the 8820 north sump. It was identified that the reason for installing an electric pump in the 8820 north sump was for pumping out the sump if it started to overfill due to the blockage that was intended to be inserted in the 8820 north sump drain hole.

On the same day shift, service crew started work on cleaning out the 8820 north sump, this included removing all water from the sump and facilitating the removal of mud from the sump with a load haul dump (type of front-end loader). This task had to be completed before the service crew could install the submersible pump in the sump.

After the sump had been cleaned out, work began on installing the submersible pump.

Work continued through night shift and into the day shift of 7 June 2014 in preparation for blocking the 8820 north sump. Water that was to be pumped from the 8820 north sump was to be fed via a polyethylene line to the 8790 Warman tank, which would pump it back to the 8855 level.

The service crew could not complete this pump line as a 110mm fixture was required to join the pump to the poly ethylene line. This work was completed on night shift by the night shift foreman on 7 June 2014.

On 8 June 2014, the day shift service crew attended their morning cross shift meeting. At this meeting the day shift service crew were informed that the fixture for the poly ethylene pump line had been completed and it was their responsibility to block the 8820 north drain hole with blast bags. This was a verbal instruction issued by the shift supervisor. There was no written instruction that informed the service crew to block the 8820 north hole nor was there a written instruction about how to complete the task.

On 8 June 2014, the service crew travelled from the surface to the underground store and obtained several blast bags. They then travelled to the 8820 north sump.

Upon arrival, the service crew discovered that the 200mm unlined drain hole was too large in diameter for one blast bag to effectively block the drain hole (operation of the blast bags is discussed later). A picture of the 8820 north sump drain hole is depicted in figure 9.

First, the service crew attempted to place one blast bag in the base of a strainer, which was positioned in the drain hole. This first attempt at blocking the hole failed as the base of the strainer was too small and did not effectively block the hole. A picture of the strainer at the scene is depicted in figure 10. Investigators observed that the base of the strainer was blocked with what is now known to be a blast bag, this is identified in figure 11.

The strainer was then removed from the drain hole and leant against the mine wall. The second attempt to block the drain hole involved inflating two blast bags next to each other (in parallel). This method effectively blocked the drain hole.

Figure 9 the 8820 north sump drain hole that Mr Hern was trapped in into measures just under 200mm at the collar. The unlined drain hole reports to the 8790 sump on the level below. Photo by Mine Safety Investigation Unit.

On completion of the work blocking the drain hole, the service crew left the strainer lying against the mine wall where one of the service crew members had written with orange paint the approximate location of the drain hole (this orange writing can be seen in figure 7). The service crew member who wrote this reported that this was done so the drain hole could be located if the sump over flowed and needed to be unblocked.

Following the blocking of the 8820 north sump, work began on drilling the sump drain hole from the 8790 sump to the 8760 sump. It was not communicated to anyone how the 8820 north sump had actually been blocked. Consequently when the time came to unblock the drain hole, no information was available for the adequate planning of the process.

Figure 10 Investigators found this strainer at the high water level mark of the 8820 north sump at the far end of the access roadway. Investigators observed a blockage in the solid pipe end that appeared to be a blast bag. Photo by Mine Safety Investigation Unit

Figure 11 shows the blast bag in the base of the strainer at the 8820 north level sump scene. Photo by Mine Safety Investigation Unit

Failure of the 8855 Wilson Snyder pump

Mine water draining to the 8855 level dam is pumped to the 11 level as part of the dewatering system. The pumps at the 8855 level are a 20 l/s mono pump and a 9.8 l/s Wilson Snyder piston pump. In the months before the incident, mining staff reported continual maintenance problems with these pumps. During an interview with one of the foreman they estimated that the Wilson Snyder pump at the 8855 level was inoperable for about one shift per week. In an email dated 1 May 2014, the fixed plant superintendent described the main catalyst for the pump issues as being due to the amount of mud in the system. Failure of the 8855 Wilson Snyder pump would generally mean that water would overflow from the level dam into the sump, which would drain (via a drain hole) into the 8820 north sump.

On 10 June 2014, with the 8820 north sump blocked, the 8855 Wilson Snyder pump failed, which meant overflow water from the 8855 dam reported to the 8820 north sump. With a failure at the 8855 level pumping station mine water was overflowing into the 8820 north sump, this water was being diverted by the submersible pump (previously set up by service crew to lower the water level in the 8820 north sump) to the 8790 Warman tank which was pumping it back to the 8855 dam, effectively pumping the water in circles. Water continued to overflow from the 8855 level to the 8820 north sump throughout 10 and 11 June 2014.

Work conducted on the day shift of 11 June 2014

The day shift of 11 June 2014 began at 6 am with the usual pre-shift and cross-shift meetings. During these meetings the night shift foreman informed the day shift foreman that there was water in 8820 north sump.

During the shift, an underground truck driver notified the shift supervisor that there was water coming out of the 8820 south access. This was an unusual occurrence and the shift supervisor requested another service crew worker to inspect the site and identify the source of the water.

The service crew worker travelled to the 8820 south access and identified water coming from the wall in the 8820 south access on the left hand side. He reported that “It didn't look good”. From this point the service crew worker travelled back to the 8820 north access and identified that the water was originating from the 8820 north sump. The service crew worker immediately turned off all electrical equipment in the vicinity (including the submersible pump in the sump) and called the shift supervisor down to look at the water level. The shift supervisor instructed the service crew worker to wait there and monitor the water level.

The shift supervisor attended the site and contacted the day shift foreman and advised him of the elevated water level in the 8820 north sump. The day shift foreman told the shift supervisor that there was something deliberately blocking the sump and to leave it alone.

Believing that the water level was rising and that it posed a threat to men and machinery, the service crew worker took off his clothes and entered the water to remove the blockage from drain hole.

The service crew worker walked out into the sump and started to feel around with his feet for a strainer that he expected to be in the drain hole. While feeling around with his foot he identified that the water level at the drain hole was about head height and felt that the strainer was missing from the drain hole. At this point the service crew worker removed himself from the sump leaving the blockage in place.

During his routine visit underground the day shift foreman attended the 8820 north sump and observed the water level overflowing down into the fresh air rise. The day shift foreman and the shift supervisor agreed that nothing could be done at that point in time and a plan would be devised with the night shift foreman and supervisor for work to be undertaken during night shift.

Following his entry into the sump the service crew worker completed the remainder of his shift and travelled to the surface for the shift change over meeting with the oncoming service crew.

After his trip underground the day shift foreman developed the night shift plan for the night shift foreman, which included the task of unblocking the 8820 north drain hole.

7.2 The chronology of the incident involving James Hern

On 11 June 2014, at the start of night shift the day shift foreman, night shift foreman, shift supervisor and production manager had a pre-shift discussion. They discussed the height of the water in the 8820 north sump and developed a plan to remedy the situation. The plan involved blocking the freshly drilled 8790 drain (which is the level below the 8820 north sump) then unblocking the 8820 north sump. This would enable the water in the 8820 north sump to drain to the 8790 sump, which would make it easier to manage the water. The night shift foreman proposed a possible means of unblocking the drain. He suggested pumping the water in the 8820 north sump to the 8820 south sump.

In the alternative he suggested that if this was ineffective the water could be pumped down the decline to the bottom of the mine so the service crew could access the sump drain hole to unblock it. It was also suggested during the meeting that the drain was blocked with a blast bag and that it was to be either pulled out or burst with a pinch bar (scaling bar).

Sometime during the meeting the shift supervisor left to conduct his pre-shift meeting with work crews (including Mr Hern). The night shift supervisor created the workers specific instructions from the earlier meeting, which have been referred to as a PLOD sheet. The PLOD sheet did not include a reference to the task of unblocking the sump after pumping the water out. The night shift foreman and the day shift foreman continued their meeting to discuss the weekly plan.

At 6 pm Mr Hern entered the CSA mine workplace. Mr Hern attended the pre-shift meeting where he received a verbal instruction to unblock the 8820 north drain hole from the night shift supervisor. There was no written or verbal instruction provided to Mr Hern about how to complete the task or what risk management practices should be applied. Mr Hern and the service crew did not receive or ask for a blank job safety analysis form from the shift supervisor.

Following the pre-shift meeting, Mr Hern attended a cross shift meeting with the service crew worker who entered the sump on day shift. The day shift service crew worker advised Mr Hern and some members of the night shift service crew that they would be required to unblock the drain hole during the night shift. During the cross shift meeting Mr Hern was made aware that there was no strainer in the 8820 north sump drain hole. Mr Hern was advised that there was a balloon in the drain hole and that the water was too deep for an IT.

Following the pre-shift and cross shift meetings on the surface of the mine, Mr Hern and the workforce including the night shift supervisor travelled underground to the 9 level via the men and materials shaft.

In anticipation of the work he would be completing later in his shift Mr Hern obtained 2 scaling bars from the 11 level store.

Mr Hern and his co-worker then started work assisting the setup of a L6C Simba (Production Drill).

Meanwhile the night shift foreman completed his meeting with the day shift foreman and drove underground to the 8980 supervisor office where he met the night shift supervisor. On his drive from the surface to the shift supervisor's office the foreman recalled hearing the shift supervisor issue instructions to Mr Hern and his co-worker to set up services for the production drill at the 8790 level. While at the 8980 supervisor's room the night shift foreman asked the night shift supervisor how long it would be before Mr Hern and his co-worker would start unblocking the 8820 north sump as he would like to be present while the job was undertaken. The shift supervisor advised the night shift foreman that they had a number of jobs to complete before going to the 8820 level and anticipated that they would be at the 8820 level in a couple of hours. The night shift foreman's message about his intention to be present during the 8820 works was not passed on to Mr Hern or the rest of service crew.

As stated earlier in this report, the written and verbal instructions provided to the service crew required the 8790 level to be blocked off before the blockage at the 8820 level was removed. After providing assistance to the production driller, four service crew members (including Mr

Hern) undertook the next task, which involved installing a submersible pump in 8790 level and blocking off the 8790 to 8760 drain hole.

The 8790 to 8760 drain hole was blocked using a completely different method to the one used to block off the 8820 north sump drain hole. According to a service crew worker that undertook the work an old ANFO bag (explosives bag) was bunched up and tied to a piece of rope which was stuffed into the drain hole. The rope was then tied off against the wall to enable the rope to be pulled at a later stage to remove the blockage. Once again, there were no written instructions on how this work was to be completed. Two service crew members did complete CSAfes in relation to this task however, no hazards were recorded. There were four crew members undertaking this task.

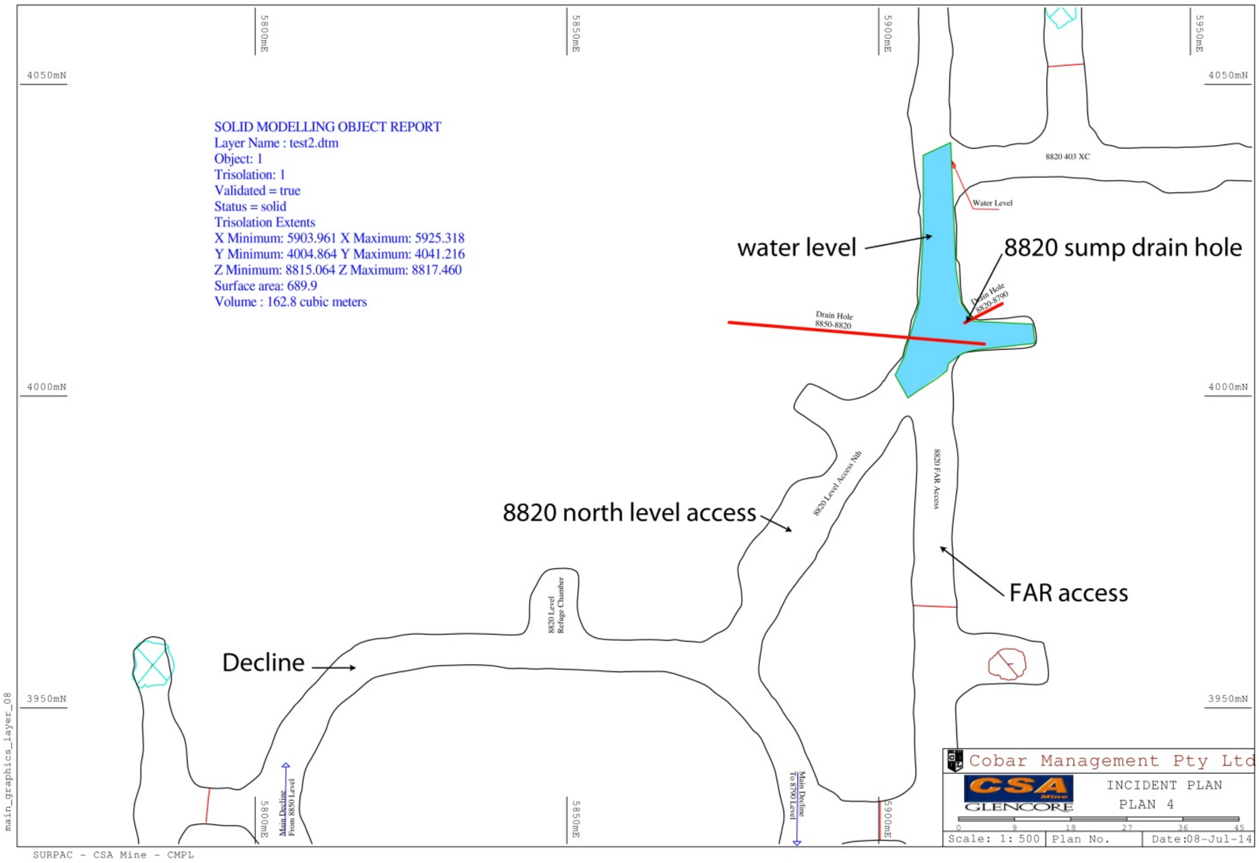
While the service crew was undertaking work at the 8790 level the night shift supervisor travelled to the 9280 level to inspect other work and then travelled to the 11 level to get his light vehicle air-conditioning serviced.

Meanwhile the night shift foreman travelled to other sections of the mine to check on other work including work being undertaken at the 9280 north fresh air rise.

On completion of the work at the 8790 level, Mr Hern and one other service crew member travelled to the 8820 north sump to begin the task of unblocking the drain hole. Mr Hern and his co-worker did not make any attempt to call the shift supervisor or the night shift foreman as they were not instructed to do so.

At this time water was about 1.43m deep at the drain hole with approximately 162800 litres filling the sump and adjacent roadways. The plan below (figure 12) depicts the 8820 north level access with the water level marked in blue.

Figure 12 shows the 8820 north level access including the 8820 north sump and the water level at the time of the incident. Water level is an approximation based on corroborating eyewitness accounts. It is noted that one of the drain holes depicted states it is from the 8850 level to the 8820. Investigators believe that this is incorrect and in fact the drain hole was from the 8855 level to the 8820 level. This has been confirmed with corroborating evidence from other plans and individuals.



Mr Hern and his co-worker attempted to pierce the blast bags that were in the drain hole from the basket of an integrated tool carrier IT6. IT6 was operated by Mr Hern's co-worker. IT6 was driven into the sump to the approximate location of the drain hole with Mr Hern riding in the man riding basket attached to the front. Working from the basket, Mr Hern attempted to clear the blockage using a 1.8 metre long scaling bar. This involved Mr Hern leaning over the man riding basket of IT6 and trying to stab the drain hole with the scaling bar. This process did not work and Mr Hern was transported out of the sump in the basket of IT6.

Mr Hern's second attempt again involved working from the man basket of IT6 and tying a blue nylon rope to the end of the scaling bar. The rope attached to the scaling bar enabled Mr Hern to attempt to spear the blast bags with the scaling bar and retrieve it with the rope. This attempt failed and Mr Hern lost the scaling bar and rope in the water-filled sump.

Mr Hern and his co-worker were unsure if the second attempt had been successful so Mr Hern and his co-worker then withdrew the IT from the sump and proceeded to the 8790 level below in a light vehicle to determine whether the scaling bar had pierced the blockage. There was no water flowing from the drain hole indicating the drain hole was still blocked. Mr Hern and his co-worker then travelled back to the 8820 north sump. Mr Hern removed the majority of his clothing except for his hard hat, gumboots and underwear.

Despite warnings from his co-worker, Mr Hern insisted on travelling out into the sump in the basket of IT6. Mr Hern's co-worker then drove IT6 into the water filled sump. At that time, Mr Hern entered the water from the basket of IT6 by climbing over the handrail and entering the water in the vicinity of the drain hole wearing just underwear, gumboots, a hardhat and cap lamp.

The co-worker reported that he was able to see Mr Hern's cap lamp in the water from the cabin of the IT. The co-worker called out to Mr Hern and Mr Hern replied that everything was fine. After about another 30 seconds had transpired the co-worker lost sight of Mr Hern's cap lamp so he called out again. Mr Hern did not respond. After the co-worker lost sight of Mr Hern in the sump and there was no response the co-worker called the shift supervisor over the two-way radio.

At 11.15pm on 11 June 2014, the shift supervisor received a call over two-way from the co-worker that Mr Hern had gone missing in the 8820 north sump. The shift supervisor advised that he was 20 minutes away on 11 level. Following the call from Mr Hern's co-worker the shift supervisor activated the mines emergency procedures over the two-way radio.

7.3 The rescue attempt

While leaving the 9280 level the night shift foreman overheard the radio call between the shift supervisor and Mr Hern's co-worker. He recalled hearing that Mr Hern had gone missing in the sump. After hearing the emergency call from the shift supervisor the night shift foreman informed the shift supervisor that he would travel there immediately.

As the shift supervisor started his trip to the incident scene from the 9280 level he called the other two service crew members that assisted blocking the 8790 sump earlier that night and requested that they attend the incident scene. One of those service crew workers, an experienced mines rescue member and well trained first aid provider advised that they were already on their way up to assist as they had heard the conversation over the two-way radio.

Others in the vicinity also assisted with the rescue attempt. They included a water cart operator, two contractors and a fitter. All of these workers entered the sump and started trying to locate Mr Hern, and putting themselves at considerable risk.

The rescuers located Mr Hern trapped by his legs in the 8820 north sump drain hole. To confirm Mr Hern was trapped in the drain hole rescuers had to swim under water and feel about with their hands to identify how Mr Hern was stuck. All five rescuers tried in vain to pull Mr Hern from the drain hole. The rescuers then fitted Mr Hern’s harness to him and attempted to free him out of the drain hole using the IT6 lifting hydraulics. As this was being attempted the shift supervisor arrived at the 8820 north sump scene where he observed the first attempted lift. During the first lifting attempt, the harness snapped.

A short time later, the night shift foreman arrived at 8820 north sump. He reported observing IT6 in the sump being operated by Mr Hern’s co-worker and a rescue attempt underway with between five or six workers in the sump.

The rescue workers noticed that the night shift foreman had arrived and requested that he travel down to the 8790 sump to see if the drain hole was still blocked. The night shift foreman travelled to the level below (8790 sump) to see if there was any water discharging from the 8820-8790 drain hole. He reported that no water was coming out of the drain hole. The night shift foreman travelled back to the 8820 north sump and advised that there was no water coming out of the 8820-8790 drain hole.

While the night shift foreman was attending the 8790 sump, the rescuers in the water tied a tow sling around Mr Hern's body and used IT6 to free him from the sump drain hole. The night shift foreman returned to the 8820 level and observed Mr Hern being retrieved from the sump.

During the recovery of Mr Hern the shift supervisor heard the mines rescue member advise all rescuers to move back from the drain hole to prevent someone else getting sucked into the drain hole.

Following the retrieval of Mr Hern from the drain hole, rescuers, led by the mines rescue/service crew workers began cardio pulmonary resuscitation (CPR) on Mr Hern.

During CPR on Mr Hern the underground ambulance arrived and relieved one of the service crew workers from resuscitation. The mines rescue member and the ambulance officer applied a defibrillator to Mr Hern.

While CPR was being applied to Mr Hern the shift supervisor reported that he heard the sump start to drain. He described it as a massive rush, the noise was extremely loud.

The shift supervisor then took Mr Hern's co-worker away from the scene and called the surface to advise that a town ambulance was required.

While continuing CPR the mine ambulance officers and the mines rescue member drove from the scene at the 8820 level to the 9 level shaft access where a NSW ambulance officer and members of mines rescue met them. They continued to work on Mr Hern as they took the shaft man riding cage to the surface.

Mr Hern was transferred to an awaiting ambulance which transported him to the Cobar District Hospital. At 12.40 am on 12 June 2014, Mr Hern was pronounced deceased by the attending physician.

7.4 Cause of death

Post mortem examination occurred at 8.30 am on 17 June 2014. The examination was conducted at the Newcastle Department of Forensic Medicine. The post mortem determined that the direct cause of death was 'consistent with drowning'. There were no other significant conditions reported as contributing to the death of Mr Hern.

7.5 The toxicology report

A quantitative analysis of Mr Hern's blood and urine was undertaken by the NSW Forensic & Analytical Science Service. The analysis determined that there were no drugs or toxins detected in the samples received by the service. The service did detect low levels of blood and urine alcohol. Upon further consultation, the forensic pathologist believes that this low level alcohol could be the result of biological changes after death and not due to the consumption of alcohol by Mr Hern.

8 Causal factors

8.1 Incident analysis

The fit-for-purpose use of stope production hole blast bags

The product used to block the 8820 north sump drain hole was identified to be two 115mm MTi Blast Bags known as Solo bags.

According to the manufacturer, the Blast Bag Solo was designed to improve operator's ability to use bags where an air or external inflation source was not available or practical. The Blast Bag Solo is inflated using an aerosol can filled with an inflation medium of liquefied propellant gas. The amount of gas will inflate the set volume of the bag to the designed pressure consistent with the blast hole diameter. The Blast Bag Solo is used mainly in open pit mining and from time to time underground to support explosive columns and prevent them from slumping in an up hole situation when emulsions are used.

The manufacturer provided the following description of the likelihood a 115mm blast bag was fit for purpose for the blocking of a 200mm unlined sump drain hole.

> The Quokka Solo (115mm blast bag product name) is designed to be used in a blast hole of maximum 115mm. Therefore this would be the maximum possible diameter drill hole that could be blocked from water (to a trickle rather than flow) if under a head pressure of 1.43m. This diameter would ensure uniform contact along the 500mm length of the bag to provide maximum holding capacity. The Quokka Solo is a sealed inflated bag with the inflation source housed internally. Therefore the only way to deflate is by lancing the bag with a retrieval product or with a box cutter if bag is located within reach. The bag should not be lanced or cut if under any load without necessary precautions.

MTi do not manufacture a product which has been designed for the purpose of plugging any size drain hole which can be remotely activated and deactivated.

Figure 13 a product shot of the MTi SOLO blast bag. Evidence suggests that two 115mm diameter versions of this product were used to block the 8820 north sump drain hole by inflating them in parallel in the top of the drain hole. Photo courtesy of MTi

The method of unblocking the 8820 north drain hole

In a response from the manufacturer of the stope blast bags, it was highlighted that there was risk of the aerosol canister inside the bag exploding if the bag was lanced incorrectly. As Mr Hern had no way of knowing exactly where the bags were located (or exactly what was blocking the drain). The use of a sharp spear like object (such as a scaling bar) to burst the bags exposed

Mr Hern to further risk of injury by undertaking the work he was instructed to do by the shift supervisor.

Figure 14 is a picture of a scaling bar seized by NSW Police after it was retrieved by CSA mine staff at the 8790 level collar of the 8820-8790 drain hole. It is believed that this may be the scaling bar that was used in the attempted unblocking of the 8820 north sump drain hole. Photo by Mine Safety Investigation Unit

The use of an Integrated Tool Carrier (IT)

An Integrated Tool Carrier (IT6) was used by Mr Hern's co-worker to transport Mr Hern into the sump for the purpose of unblocking the drain hole. IT6 was equipped with a man riding basket attached to the front of the machine. IT6 was also used in the subsequent recovery of Mr Hern from the sump. A full functionality test was undertaken on IT6 following the incident by the mine. There were no performance issues with IT6 that would have contributed to this incident.

Figure 15 IT6 is the integrated tool carrier that was used to transport Mr Hern into the over flowing 8820 north sump. It was also used in the recovery. Photo by Mine Safety Investigation Unit

Foreseeable risk

The risks associated with undertaking work in and around water bodies are clearly foreseeable. Mine operators must effectively manage these risks to ensure the health and safety of workers.

There was a range of water management issues at the mine before the incident, which highlight the foreseeable nature of the risks involved in this incident. These include:

- the regular failure of the pumping system at the 8855 level
- the development of a new mine dewatering program (a change to the management of water at the mine)
- the deliberate blocking of the 8820 north drain hole and the adhoc use of inflatable stope bags to block the drain hole
- identification of the 8820 north sump overflowing into adjacent roadways
- attempts to unblock the sump during the day shift before the incident
- identification of safe work methods to remove the water from the sump and unblock it which were not documented or communicated to the service crew
- a history of workers entering sumps to unblock drain holes and undertake sump maintenance at the mine
- the provision of waders to select mine workers to undertake work in sumps at the mine.

Accordingly, greater emphasis should have been given to managing the risks associated with the task being undertaken by Mr Hern and the work associated with the mine's dewatering program using the mine's risk management system.

Job planning

Regular meetings were held at the mine that were relevant to this incident. These include life of mine dewatering planning meetings, weekly meetings between engineers and mining foremen, start of shift meetings with foremen and shift supervisors and pre-shift meetings with service crew. However, the mine operator was unable to produce documented risk assessments in any form or safe work procedures regarding the work that was being undertaken by Mr Hern at the 8820 north sump on 11 June 2014.

Risk assessment and hazard awareness

According to the CSA Mine's Safety Management Plan, a CSAfe (proprietary name) is a hazard identification and risk assessment tool designed to identify, assess and control health, safety and environmental hazards before a task is conducted. The CSAfe is also designed to highlight the need for a more formal risk assessment such as a Job Safety Analysis (JSA). A CSAfe must be conducted before each new task is started, for each new work area attended and if a task is not otherwise covered by way of induction, JSA, procedure or permit.

The implementation of the CSAfe system appears to be inconsistent with the mine's own key performance indicators. On the night shift of 11 June 2014, 11 CSAfes were completed by workers. There were at least 24 people working underground on this shift. Between 1 June 2014 and 11 June 2014, 34 CSAfes were completed for work conducted at the 8820 level.

The chief executive officer (CEO) of CMPL reported that between January 2014 and April 2014, the mine did not reach its safety specific personal performance indicator of "Leadership Group compliance audits find 100% of pre-starts and CSAfes completed and 90% JSA's completed".

Investigators spoke to workers during the investigation who conceded that they did not complete a CSAfe on every job they undertook.

There is no evidence of any CSAfes being conducted by Mr Hern or his co-worker regarding the work conducted at the 8820 north level sump on 11 June 2014.

There is no evidence of any JSA being completed by any worker, supervisor, foreman or mine manager in relation to any work undertaken at the 8820 north sump involving the blocking or unblocking of the sump drain hole.

During interview with shift foremen and shift supervisors they reported that a JSA should have been conducted by Mr Hern and his co-worker. If a JSA had been conducted by Mr Hern it would have been required to be signed off by the shift supervisor before work could begin and may have led to the hazard of deep water being identified and an alternate method of work being undertaken.

Generally, the shift supervisor is required to provide a blank JSA for crews that are required to conduct hazardous work and then sign off the completed JSA. Regarding this incident, the pre-shift meeting would have been an opportune time for the shift supervisor to instruct crews on the risk management procedures required to be conducted before the task starts.

The mine operator could not produce an overarching (broad brush) risk assessment conducted for the life of mine dewatering activities nor were there any procedures developed for the blocking or subsequent unblocking of sump drain holes.

Change management

The following excerpt is from the CMPL change management procedure.

> CSA Mine's facilities, operations and systems are subject to continual change and improvement. While necessary for business success, these changes can also introduce new threats, which, if not properly identified, understood and addressed, can result in an unwanted impacts. It is critical that changes, whether made by CSA workers or contractors, are adequately assessed to understand their impact on people, organisations, processes, equipment, the environment, and other assets.
>
> Management of change is a procedure to ensure changes provide the intended benefits without unknowingly compromising health, safety, the environment, process integrity, financial integrity, operational reliability, or profitability of an operation and is a key component of due diligence. Hazards and risks can be identified and mitigated to tolerable levels by applying an effective management of change process...

> ...Management of change is an important application for both risk assessment and risk controls. Given that many accidents are the result of planned and unplanned changes, management of change attempts to assess formal changes prior to their implementation. The management of change process applies to physical engineered changes, as well as procedural and organisational changes.

The CSA life of mine dewatering works represented a major change to the dewatering system. There is no evidence that the mine applied the above change management system in relation to the change to the dewatering system and the impact upon the health and safety of workers.

Supervision

During the night shift of 11 June 2014, the service crew was not visited by either the shift supervisor or the night shift foreman. The night shift foreman did indicate to the shift supervisor that he wished to be present for the work at 8820 north because he believed that there was a significant amount of water present. This was never communicated to Mr Hern or the service crew. Furthermore supervisors believed they knew the hazards that existed at the 8820 north sump scene even though they had not visited it since the drain hole had been blocked. There was no assurance by the supervision on night shift that the 8820 north sump work place was safe.

The shift supervisor, night shift foreman, day shift foreman and production manager knew that the workplace and task contained risks to health and safety (unblocking overflowing sump) and the unblocking of this particular sump was not routine. Mr Hern and the night shift service crew should never have been instructed to undertake the task without provision of adequate risk management assistance. The CSA mine procedures state that a supervisor has to sign off on a JSA before work begins on a non-routine task. This did not occur.

Mining management and planning engineers should conduct pre-shift inspections of workplaces to ensure that they are safe. This may also assist supervisors when determining what risk management controls are implemented before work begins.

9 Remedial actions

9.1 Reasonably practicable solutions

The implementation of the hierarchy of controls is a well-known and legislated tool to control risks to health and safety. The following risk management controls could have been implemented to control the risks to health and safety in relation to the works undertaken by Mr Hern.

Hierarchy of controls

Elimination

Elimination of the hazard is the best hard barrier (control) that can be applied to reduce or eliminate a risk to health and safety. A foreman at CSA mine reported that production could have ceased and the dewatering system turned off to prevent water draining to the 8820 north sump. This would have eliminated the need to block the sump in the first place, which would have meant that Mr Hern would never have been required to undertake the task of unblocking the drain hole.

The removal of the water from the 8820 north sump would also have eliminated the risk. It is clear that the submersible pump that was in the 8820 north sump was either not working or ineffective. This is because the pump was plumbed into the dewatering system so water would recirculate. Several supervisors at the CSA mine suggested that an air diaphragm pump (a portable positive displacement, compressed air operated pump) could have been installed so water could be pumped down the decline.

Furthermore if a well-planned dewatering system with built in redundancy had been engineered and installed at the time of development of the mine the task of blocking and unblocking the sump would have been eliminated.

Substitution

By substituting the system of work it is possible to reduce the risk to health and safety and reduce the consequence of risk to health and safety. Many alternate systems of work have been identified that may have reduced the risk to health and safety. They include:

- unblocking the drain hole earlier in the work program before excessive water accumulation in the sump
- the use of an air lance or explosive device inserted into the drain hole from the level below may have unblocked the drain hole and would have negated the need to enter the 8820 north sump either on foot or in the basket of an IT.

Engineering

Engineering controls represent the lowest hard barrier in the hierarchy of controls. Through consultation with a plumbing equipment supply company investigators identified an engineering solution for deliberately blocking drain holes. The system includes a fit-for-purpose rubber bladder that can be anchored in a drain hole and inflated and deflated remotely, thus negating the need to enter a sump in either an IT or on foot to block or unblock a sump drain hole. This engineering solution was purchased by investigators for about $1800. A picture of the engineering solution is depicted within the report as figure 16.

Figure 16 is a picture of a fit for purpose drain hole blocking system that could have been used to prevent the need to enter the 8820 north sump. Photo by Mine Safety Investigation Unit

Another engineering solution identified is appropriate guarding around the drain hole. The strainer that was in the hole before the incident constituted a guard that would have reduced the risk of Mr Hern becoming stuck in the drain hole. Further, a steel mesh grate installed over the drain hole would have been an effective hard barrier.

Figure 17 shows the 8820 north sump scene on 13 June 2014. Note the strainer in the drain hole provides two purposes. 1. To prevent the hole blocking and 2. As guarding to prevent access to the drain hole. Photo by Mine Safety Investigation Unit

Administrative

Administrative controls are considered soft controls and require a degree of compliance by the workforce, which in turn means that there has to be a higher degree of compliance monitoring by management. They are considered one of the lowest forms of control and should be used in conjunction with hard controls listed above.

The mine's safety management plan (MSMP) is a legislated overarching administrative control that should minimise risks to health and safety. In this incident it was not applied correctly and failed to reduce the risk to Mr Hern. Risk assessments and safe work procedures should have been created using the MSMP. However, these documents were not created. The following is a non-exhaustive list of administrative controls that have been suggested to reduce the likelihood of the incident occurring:

- A broad brush risk assessment should have been conducted during the planning phase of the dewatering activities
- The change management system should have been implemented as soon as the change to the dewatering system was identified
- A safe work method should have been created and communicated to Mr Hern before the task was undertaken
- A Job Safety Analysis should have been insisted on by supervisors before work began in the 8820 north sump
- CSAfes should have been completed by every person working in the 8820 north sump (note this included CSAfes by shift supervisors and foremen)
- Adequate work instructions should have been provided to people that were to work in the 8820 north sump in the days before the incident
- Active supervision, including pre-shift inspections of the 8820 north sump should have been undertaken to ensure that the work place was safe for workers

- Specific directives to all workers not to enter sumps and water bodies at CSA mine should have been clearly articulated to all mine workers.

Personal Protective Equipment (PPE)

PPE is the last line of defence and is not an adequate control for hazards on its own. As with administrative controls mentioned above they are classified as soft controls and require compliance by workers to be effective. Mr Hern removed most of his clothing and PPE before entering the sump on foot. Greater compliance monitoring by CMPL may have prevented the removal of Mr Hern's PPE. However, due to the nature of this incident, it is unlikely that the PPE available to Mr Hern would have prevented this incident from occurring.

The following non-exhaustive list of PPE is suggested to reduce the risk of drowning in and around water bodies at mines:

- Providing personal flotation devices (life jackets) for anyone working near water bodies.
- Flotation rings at every water body that presents the risk to a worker.

Note the use of waders is not considered appropriate PPE to prevent the risk of drowning.

10 Conclusions

The incident involving Mr Hern was preventable. There was a range of water management issues at the mine before the incident that highlight the foreseeable nature of the risks associated with the work undertaken by Mr Hern.

The CSA mine operator failed to effectively manage these risks. If the CSA mine safety management plan had been followed and implemented, the risks associated with the task undertaken by Mr Hern could have been identified and appropriate risk controls (in accordance with the hierarchy of controls) could have been implemented.

Elimination, substitution and engineering controls were clearly available in this case, but they were not implemented prior to the incident. The administrative controls that were in place at the time of the incident were ineffective and did not control health and safety risks to Mr Hern.

If there had been a well-planned and engineered dewatering system with built in redundancy installed at the time of development of the mine the tasks associated with this incident would not have been undertaken.

The above factors in combination led to an achoc system of work which resulted in Mr Hern entering the sump on foot and becoming trapped in the sump drain hole leading to his death.

11 Recommendations

This incident highlights the importance of an effective risk management program in relation to works in and around underground sumps and water bodies. The following recommendations are advanced to improve industry safety and in turn reduce the likelihood of similar incidents occurring in the future.

When considering the recommendations below, mine operators are reminded of their obligation to take a combination of measures to minimise the risk, if no single measure is sufficient for that purpose.

Recommended practice for industry

- Mine operators must identify and control the risks associated with work in and around underground sumps and water bodies.
- The risks associated with underground sumps and water bodies must be managed using the hierarchy of controls.
- Elimination, substitution and engineering controls should be used where reasonably practicable.

- All underground sump drain holes should be appropriately guarded and adequately identified.
- All work involving underground sumps should be appropriately planned, risk assessed, documented and supervised.
- Fit for purpose equipment should be used to block and unblock sump drain holes.
- Mine operators should conduct regular reviews of their mines safety management plan to verify critical controls are in place for major hazards.
- Company officers are reminded of the importance of their responsibilities and obligations in regard to section 27 of WHSA.