

NSW Resources Regulator

INVESTIGATION REPORT

Report into the serious injury of an operator at the Mannering Colliery, Doyalson, NSW on 22 January 2016



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Executive summary

Overview

At 1.40 pm on 22 January 2016, an operator was driving a load haul dump (LHD) vehicle in an underground roadway at Mannering Colliery when a damaged roof support strap entered the open cab and hit the operator in the head. The impact resulted in a serious laceration to the operator's head. The laceration extended from near his left ear to his left eye. The injury resulted in his temporal artery being damaged.

The operator parked the LHD and applied pressure to the wound with his hand to stem the blood flow. He staggered about 120 m into the mine to get help. Other workers gave him first aid and evacuated him from the mine. The operator was transported to Wyong Hospital via ambulance and treated. The wound required 60 stitches.

The mine is on the southern side of Lake Macquarie in Doyalson NSW. The mine operator is LakeCoal Pty Ltd (LakeCoal). LakeCoal contracted LD Operations Pty Ltd (LD Operations) to provide labour and services to the mine for a project to build an underground link from the mine to the adjacent Chain Valley Colliery. Both LakeCoal and LD Operations are part of the LDO Group. The LDO Group is a group of companies that operates mines and provides services to the mining industry, predominantly in the Hunter region.

At the time of the incident, the mine was transitioning from being in a state of care and maintenance to recommencing operations. This involved the introduction of new personnel and plant to the mine.

It was the operator's first day on duty underground at this mine and it was also the first time a personnel transport vehicle identified as SMV003 was used in the underground roadways. This vehicle was 50 mm higher than other vehicles used at the mine.

The investigation identified that the roof support strap (W strap) was broken when SMV003 travelled the road into the mine and then out of the mine before the operator entered the mine in the LHD. SMV003 had made contact with the W strap, tore it in two and rotated one section to point in the direction of vehicles that were travelling inbye.

Safety observations

The mine is about 40 years old. An inspection of roof support and W straps identified signs of previous impacts and structural damage to roof support in the vicinity of the incident site. The mine also has areas of low roof and is prone to the level of the floor of the mine rising, which is known as floor heave.

While on care and maintenance, the mine managed the risk of vehicles making contact with the roof by having minimal personnel in the mine in conjunction with the knowledge that the vehicles in the mine at the time had been used for years without incident. The mine also relied on daily inspections to identify hazards.

The mine was in care and maintenance and a transition period was in effect between the repeal of the *Coal Mine Health and Safety Act 2002* and associated Regulations and the existing work health and safety legislation. The mine was not required to have an overall health and safety management plan. Instead, the

mine relied on a combination of inherited management plans and the mine operator's procedures from other mining operations.

The management plan for underground roadways identified the minimum height of the roadways but did not identify the maximum height of underground vehicles. The mine relied on an existing procedure used by LD Operations to induct new plant and machinery. It did not detail the maximum height of underground vehicles for the Mannering site. This resulted in mine personnel being required to develop a maximum height for new plant. The factors considered to establish a height limit for new plant was:

1. the height of the existing vehicles
2. the height limit for the men and materials drift (entrance tunnel to the underground roadway)
3. the minimum height of the underground roadways.

The development of the maximum height figure did not consider other dimensional differences between the existing underground vehicles and the new underground vehicle such as wheel base and overhangs, nor did it consider that the roadways were undulating.

The clearance between the existing personnel transport vehicle and the minimum roadway height was 150 mm. The clearance figure that was adopted for new personnel transport vehicle (SMV003) was 100 mm. This resulted in the loss of 33% of the roof clearance.

The operator and contractor undertook two separate risk assessments (WRACs) before the incident (May 2014 and November 2015) that identified hazards and additional controls.

The additional controls that were identified in the May 2014 WRAC were not implemented due to a decision not to proceed with the link road project at that time. The additional controls that were identified in the November 2015 WRAC particular to this incident were to:

- conduct a roadway height audit and set barricades to height of existing fleet
- review introduction to site document and include the height of plant.

At the time of the incident, some height audits were conducted in relation to services such as pipes and cables around the pit bottom area due to this area having more vehicle movements. But the additional controls that were identified in the November 2015 WRAC were scheduled to be put in place by 20 February 2016. They had not been completed when the incident occurred.

Remedial measures

After the incident, the mine undertook a roadway height audit by attaching two poles with a cross bar at the front and rear of the SMV003 set at the required height and barricaded areas that did not conform.

The mine has also finalised its work health and safety management plan, which includes a principle hazard management plan for roads and other vehicle operating areas.

Industry recommendations

Mobile plant interactions with roof supports and other services in underground coal mines is a well-known risk to the mining industry. When operating or travelling in mobile plant, the consequences of being struck by, or hitting damaged roof supports or other metal structures can include serious injury or death.

This incident highlights the importance of effective change management and risk management programs in relation to the operation of mobile plant in underground mines. The following recommendations are advanced to improve industry safety and in turn reduce the recurrence of similar incidents.

When considering the recommendations, 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.

Mine operators should:

1. ensure the mine strata management plan encompasses procedures for inspecting the condition of roadways, strata support, reporting of damage and repair or replacement of strata support in a timely manner
2. ensure the mine change management plan makes provision for introducing new plant and equipment to site. Such provisions should include a detailed risk assessment and have regard to changes in plant size and dimensions and the likely consequences.
3. conduct frequent physical audits of mine roadways to ensure adequate clearances for plant to operate
4. identify low roof areas, rectify if possible, erect 'low roof' warning signs and where necessary prohibit entry to mobile plant
5. use fit-for-purpose plant and ensure operator cabins provide adequate protection for operators
6. provide adequate information and training to workers about the potential risks associated with operating mobile plant underground in site inductions and training resources.

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Purpose of the report

The purpose of the report is to assist the Secretary of the department, as the regulator of work health and safety at mines and petroleum sites, to understand 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.

Investigation parameters

Major Investigations and Emergency Response Unit

The Major Investigation and Emergency Response Unit (MIER) investigate the cause and circumstances of major incidents in the NSW mining, petroleum and extractives industry. The unit's role is to carry out a detailed analysis of incidents and report its findings to enhance industry safety and to give effect to the NSW Resources Regulator's compliance and enforcement policy.

Investigation scope

MIER had authority to conduct an investigation into this matter as the incident occurred at a mining workplace regulated by the department. The incident was determined to be of a serious nature and was allocated for an investigation by the MIER. The investigation was conducted under the *Work Health and Safety Act 2011* (WHS Act) and the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* (WHSM Act).

The investigation focused on:

- identifying the cause and circumstances of the incident
- identifying whether individuals and companies complied with WHS Act, WHSM Act and associated regulations
- assessing the suitability of existing control measures
- identifying how future incidents of this nature can be prevented.

Legislative authority to investigate

MIER investigators are appointed as government officials under the WHSM Act and are consequently deemed to be appointed as inspectors for the purposes of the WHS Act, which includes the powers of an inspector under the WHS Act for mining workplaces. The regulator has also delegated some additional functions to inspectors, including exercising the power to obtain information for the purposes of monitoring and enforcing compliance with the WHS Act.

The regulator's response to the incident

The mine operator, LakeCoal, notified the department on the 22 January 2016 of the incident at 4.20 pm.

A Resources Regulator inspector issued the mine with an improvement notice on 26 January 2016 under s191 of the WHS Act that required the mine to:

1. review the introduction to site arrangements for mobile plant with emphasis on dimensional parameters and adequate clearance in underground roadways
2. investigate the cause and circumstances of the incident forwarding all findings and recommended actions to the inspector and industry safety and health representative.

An inspector conducted an onsite examination of the incident scene on 27 January 2016. A prohibition notice under s195 of the WHS Act was issued that required the mine to:

1. keep the personnel transport (SMV003) out of service until it was checked for compliance with specified dimensions
2. modify SMV003 if it was non-compliant to specified dimensions
3. stop using rubber-tyre vehicles to transport passengers underground until an audit of the clearance along the mine's underground travelling roads was completed
4. communicate audit findings to the workforce, inspector of mines and industry safety and health representative
5. check all mobile plant used underground in relation to its compliance with maximum tolerable dimensions with results recorded and forwarded to the inspector of mines.

An inspector conducted interviews with the operator and two witnesses on 8 February 2016.

The mine lodged an incident notification form with the department on 24 February 2016. The regulator considered the incident notification and actions taken by the inspector and determined that the MIER would investigate the incident.

The case was allocated to an investigator within the MIER on 8 March 2016. The MIER investigation team undertook the following:

- incident scene analysis and photography
- survey of the area
- seized the damaged W strap
- assessment of the damaged W strap
- issued statutory notices for the provision of information and documents
- conducted interviews with personnel from the mine
- collected plans of the incident site
- analysed departmental files relating to the mine
- analysed large volumes of information and records obtained during the investigation
- identified the causal chain of events that led to the incident
- identified what risk control measures were in place at the time of the incident
- identified controls that may have prevented this incident from occurring.

Investigation information release

The Resources Regulator published an investigation information release, [IIR16-01 Severe head laceration from damaged roof support](#) on 23 March 2016. The information release identified the importance of managing risks to health and safety arising from the operation of mobile plant in underground coal mines.

Mannering Colliery operations

Mannering Colliery is a small underground thermal coal mine adjacent to the Vales Point Power Station (power station) and is about 35 km south of Newcastle on the southern side of Lake Macquarie as shown in figure 1 below.

Development of Mannering Colliery began in 1960 in conjunction with the construction of the power station and at that time was named Wyee State Coal Mine. Production commenced in 1961 with extensive mining (first workings and secondary extraction) in both the Great Northern and Fassifern seams. All recent mining occurred in the Fassifern Seam, which lies at around 150 to 205 metres deep. The mine, Vales Point Power Station and the Chain Valley Colliery are in the same vicinity as shown in figures 1 and 2 below.

Figure 1: Mannering Colliery, Chain Valley Colliery and Vales Point Power Station.

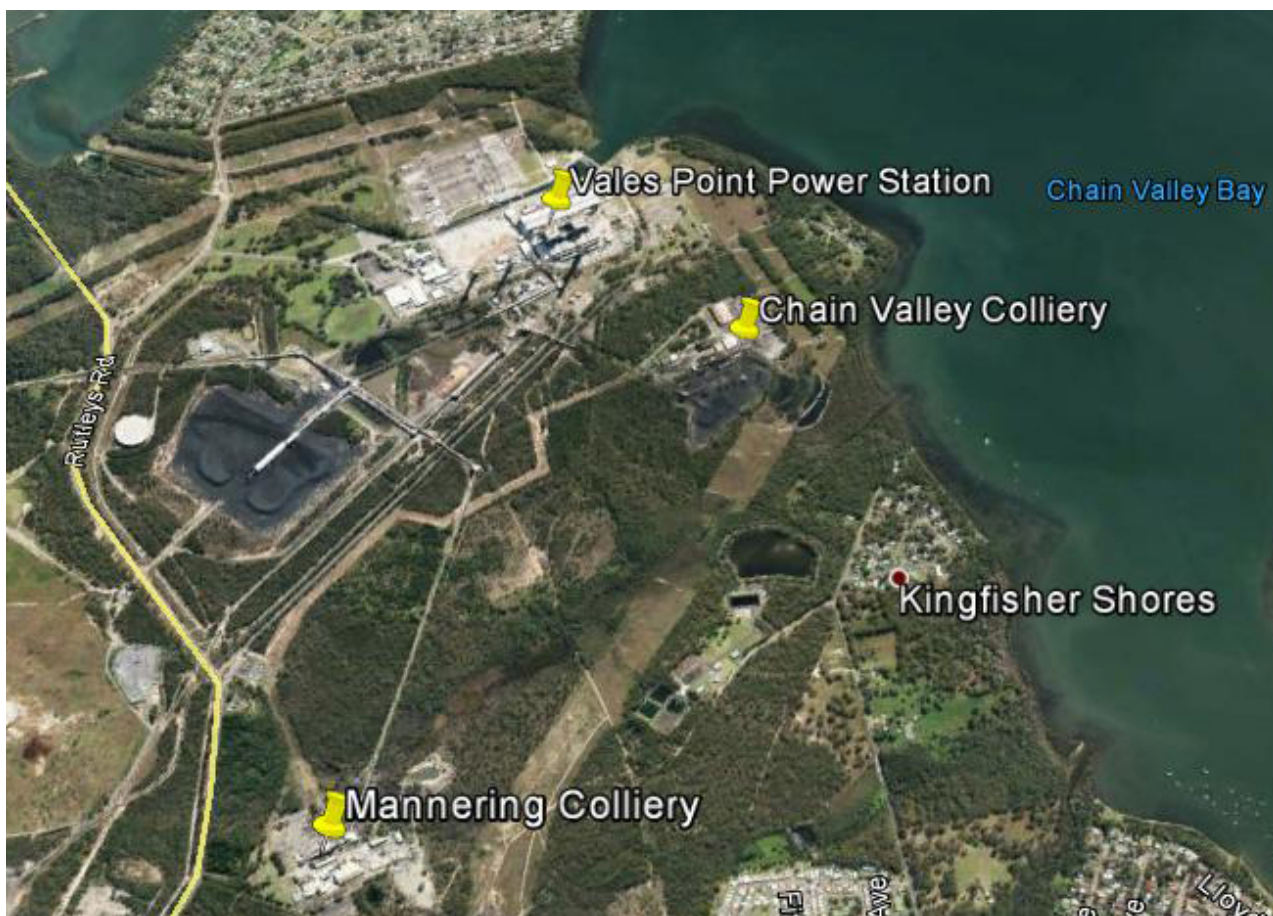


Figure 2: Mannering Colliery surface facilities and conveyor (Vales Point Power Station in background).



Mine holder and mine operator

Mining operations ceased on 30 June 2002. The previous mine operator, Powercoal Pty Ltd, placed the mine into care and maintenance. Generally the only activity occurring at the mine is monitoring and maintenance activities to ensure the mine remains in a safe, stable condition. This allows mining companies to recommence mining if the economic viability improves.

Centennial Mannering Pty Ltd (Centennial Mannering) acquired the mine on 7 August 2002. Centennial Mannering were both mine holder and mine operator. The mine was reopened and renamed Mannering Colliery with production recommencing in January 2005. The Mannering Colliery encompasses Consolidated Coal Leases (CCL) 721, 719, part 707, part 722, part 720 and part mining lease ML1052.

Centennial Mannering put the mine into care and maintenance in December 2012.

Centennial Mannering appointed LakeCoal Pty Ltd (LakeCoal) as mine operator for the Mannering Colliery on 17 October 2013. LakeCoal is also the mine operator of the adjacent Chain Valley Colliery.

Centennial Mannering made application to sublease the Mannering Colliery (including CCL 721) to the Chain Valley Colliery, the sublessee being LakeCoal and Fassi Coal Pty Ltd on 11 September 2014. The application was approved on 2 October 2014.

LakeCoal entered into a contract with LD Operations Pty Ltd for the provision of labour and other services at the Mannering Colliery on 10 October 2014.

Both LakeCoal and LD Operations are part of the broader LDO Group of companies that are based in the Hunter Valley.

Both the Mannering Colliery and Chain Valley Colliery planning consents were modified in November 2014 to allow an underground linkage within the Fassifern Seam. This included first working headings and a conveyor belt system between the two collieries. Once constructed, the link would enable coal from Chain Valley Colliery to be transferred to the Vales Point Power Station via the Mannering Colliery conveyor.

A third modification was approved for Mannering's planning approval on 16 December 2015. The modifications included:

- an increase in the maximum rate of run of mine (ROM) coal handling and dispatch at the mine from 1.1 Mtpa to a maximum of 1.3 Mtpa
- an extension of the project approval period from 31 March 2018 to 30 June 2022
- minor vegetation clearing adjacent to infrastructure for asset protection from bushfires.

LakeCoal made a business decision in December 2015 to progress the underground link road project between Mannering Colliery and Chain Valley Colliery.

Mannering Colliery lodged a notification of recommencement of normal mining operations on 17 March 2016.

Mining activity at Mannering Colliery

Care and maintenance

While the site was on care and maintenance there were minimal workers onsite to maintain the mine before January 2016. Between May 2014 and January 2016 this included:

- the mine manager (mining engineering manager)
- two deputies (job shared)
- two tradesmen
- one maintenance engineer.

The activity at the site was limited from Monday to Friday and involved one shift that went underground and was usually limited to one or two people.

The main objective was to maintain the mine from an electrical, mechanical and mining engineering perspective, activities included inspections of:

- the roof conditions
- the roadway conditions
- the pumping systems and;
- occasionally running other infrastructure such as conveying belts from time to time to ensure they were operational.

There were limited vehicles underground that were onsite when LakeCoal took over as mine operator from Centennial Mannering. These consisted of a load haul dump EIMCO 913 (LHD031) and a PJB Minecruiser personnel transport. The PJB Minecruiser was replaced due to its age with a hired PJB Minecruiser (PJB2545). The original vehicles had been operating underground at the mine for several years at their height and the replacement PJB Minecruiser was of a similar height and dimension. During this period the mine manager reported to LakeCoal on issues relating to the mine.

Transition from care and maintenance

Mine personnel were informed that the site was going to transition from care and maintenance to recommence mining operations just before Christmas 2015. Staff returned from the Christmas/New Year break on 4 January 2016 and increased activity at the mine. The 18 days between returning from the Christmas break and the incident on 22 January 2016 was described as being “very hectic” with interviews for new employees and new equipment being organised.

The employer

At the time of the incident, the operator had been employed by LD Operations since 20 January 2016 (two days). The majority of personnel onsite including the mine manager were also employed by LD Operations.

LD Operations is part of the LDO Group which was founded in 2005 and provides private contract coal mining services to the sector through several companies within the group. Companies within the group (such as LakeCoal Pty Ltd) are the statutory operator (mine operator) of Chain Valley and Mannering collieries.

The LDO Group also contracts services to assist projects with safety and risk management processes.

LD Operations is the holder of 10% of the shares in LDO Coal Pty Ltd who is the ultimate holding company of LakeCoal.

The contract

LD Operations entered into a contract for work it would undertake at the mine. This contract was signed on 10 October 2014.

The contract stipulated that LD Operations was to provide LakeCoal with services, which are described as the provision of labour supply services on a full-time or casual basis, professional services and workshop services.

The contract detailed that compliance with both LD Operation’s and LakeCoal’s health and safety management system was a site requirement.

The injured worker

Profile

At the time of the incident, the operator was 24 years of age. His role included preparing the mine for the start of the link road project as well as general mine maintenance. This involved operating underground mining equipment including the load haul dump underground loader (LHD031).

At the time of the incident, the operator had been working in the mining industry for about five years. He had experience as a general mine worker.

The operator had undertaken a number of training units delivered by the LDO Group.

Cause of injury

The direct cause of the injury was contact with a broken steel roof support, a W strap.

The incident

The location of the incident

The incident occurred in an underground roadway at the Mannering Colliery within coal lease CCL721.

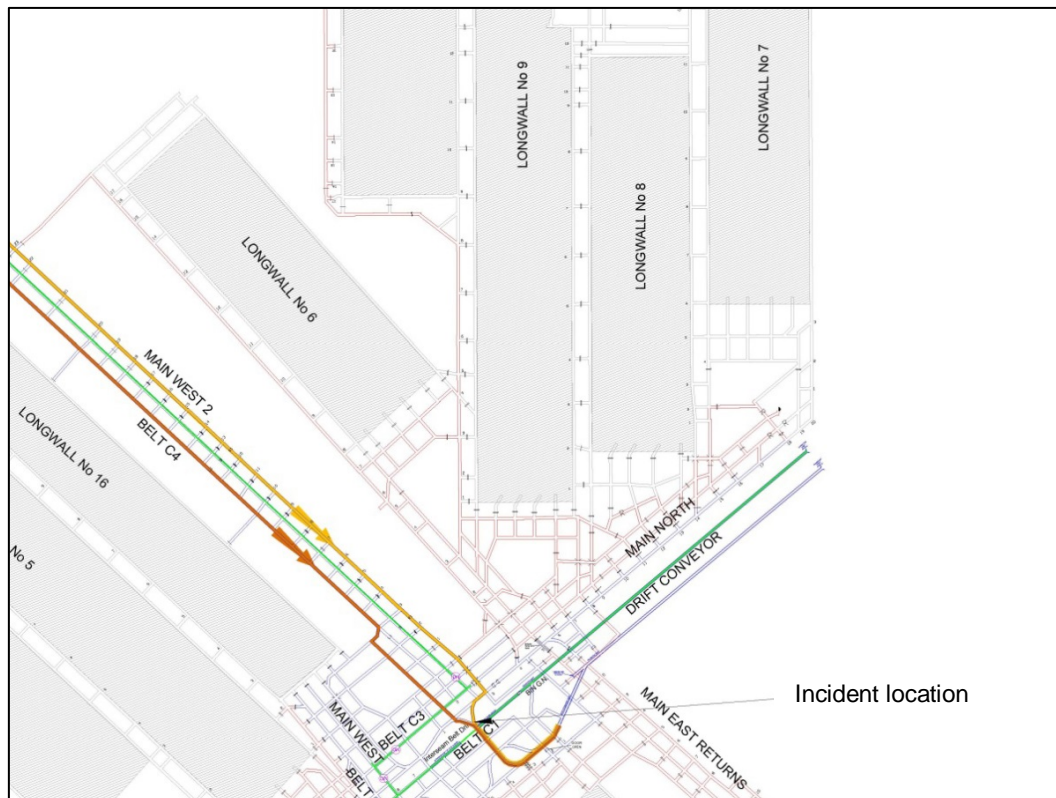
The contact with the broken W strap occurred at the entrance to the roadway that leads to Longwall 7. The entrance to the roadway was at a junction with the main travel road as shown below.

Figure 3: The incident scene looking inbye (from the side closest to the entrance of the mine) toward the scene. Roadway to Longwall 7 to the right.



The arrangement of the junction of the roadways and incident location can be seen below, the main travelling road is identified as Belt C4 roadway with the entrance to the secondary egress roadway identified as Main West 2 which in turn has a branch identified as Main North that goes to Longwall 7.

Figure 4: Map showing incident site and Longwall 7.



Circumstances of the incident

The vehicles that were underground on the day of the incident were:

- an EIMCO 913 load haul dump machine designated as LHD 031
- a Juggernaut load haul dump machine designated as JUG 01
- an SMV driftrunner 5000 series personnel transport vehicle designated as SMV003
- a PJB minercruiser mark 6 personnel transport vehicle designated as PJB 2545.

The shift on 22 January 2016 began at 7 am. The mine manager approved the vehicle induction document for SMV003. This vehicle was then taken underground for the first time.

Two electricians used SMV003 to inspect the pump at Longwall 7 about 8 am. The driver of SMV003 was an electrician that had been at the mine since January 2014. The passenger was a leading hand electrician that was new to the mine and had begun duties a week before.

Before going underground, the driver of SMV003 had a conversation with the health, safety and community co-ordinator (HSEC) in relation to SMV003 being underground for the first time. He was told that the height of the vehicle was 1800 mm and he was to be careful taking it to the pump.

The driver of SMV003 reported that he was driving the vehicle carefully as he had travelled the roadway a number of times and knew it was rough with low roof areas. He had not reported the condition of the roadway before, as he did not feel it was a safety issue.

On the way into the pump both occupants of SMV003 reported hearing the vehicle make contact with the roof at, or near, the incident site. Both felt the contact was minor, and recalled hearing scraping but the vehicle was not jolted. They did not stop and inspect for damage. The passenger, being new to the mine, assumed it was normal to make contact with the roof due to low roof clearance.

After the inspection, it was decided to remove the pump for repairs.

The mine deputy travelled to the pump at 9.30 am in the smaller PJB 2545 that had been in long term use at the mine. The deputy picked up the leading hand electrician and drove him out of the mine. The deputy passed the incident site twice and did not see any damage to the W strap. The leading hand electrician reported that he attempted to look for damage while travelling out of the mine but didn't see any damage.

The other electrician then drove SMV003 out from the pump on his own and reported making similar minor contact with the roof at the same location. He did not stop and inspect for damage as he again felt the contact was of a minor nature. These circumstances suggest that this contact most likely caused the W strap to be broken in two as shown in figure 5.

Figure 5: Damaged W strap hanging in roadway looking inbye at the scene



The deputy then arranged for the operator to travel in an underground loader to pick up the pump and transport it out. The LHD was identified as an EIMCO 913 with the site identification of LHD 031.

Due to the operator being new to the site, the deputy and the electrician travelled to the pump at in the smaller PJB 2545 about 1.30 pm with the operator following. The operator told investigators that he was not familiar with the roadway network and was travelling at a low speed in second gear.

On entering the roadway intersection, the operator lost sight of the vehicle in front as the roadway curved to the right. The operator was on the left hand side of the roadway. He had limited vision from the cabin of the

LHD to the right side of the vehicle. Mine infrastructure was against the right wall of the roadway as can be seen below. The broken W strap was on the left hand of the roof pointing toward the loader.

Figure 6: The incident scene looking inbye (from the side closest to the entrance of the mine) toward the scene.



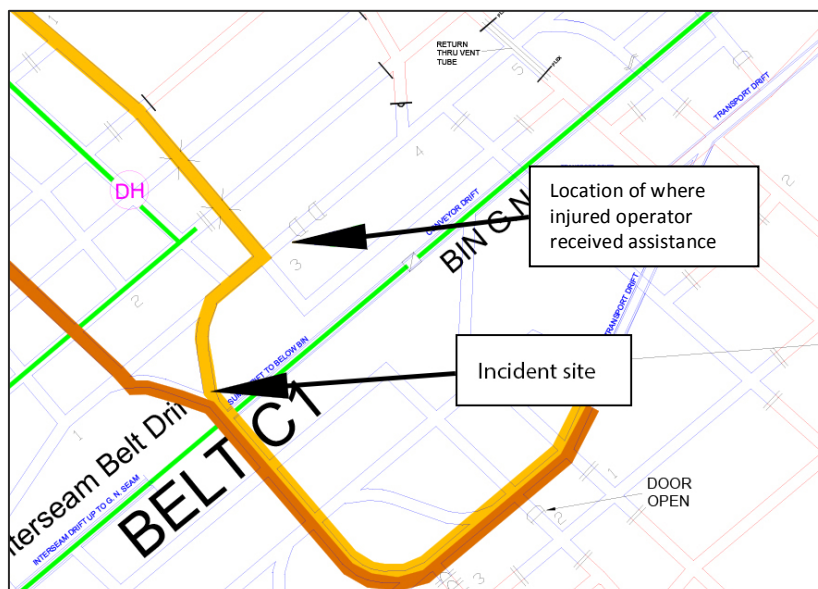
The operator said he was concentrating on the vehicle ahead of him at the same time as navigating the right hand bend in the roadway. The operator heard the W strap make contact with the canopy of the LHD as it entered the cabin and hit his head. Although the operator was wearing a hard hat, the broken W strap made contact near his left ear. Figure 7 shows the probable location of the LHD at the time of the incident and the broken W strap hanging from the roof.

Figure 7: Position of W strap and similar type of machine - looking outbye toward the scene.



The vehicle in front had stopped about 120 m inbye from the incident site to wait for the arrival of the LHD to allow both vehicles to go through the doors together. The doors and the incident site can be seen in the figure 8.

Figure 8: Map showing incident site and double doors.



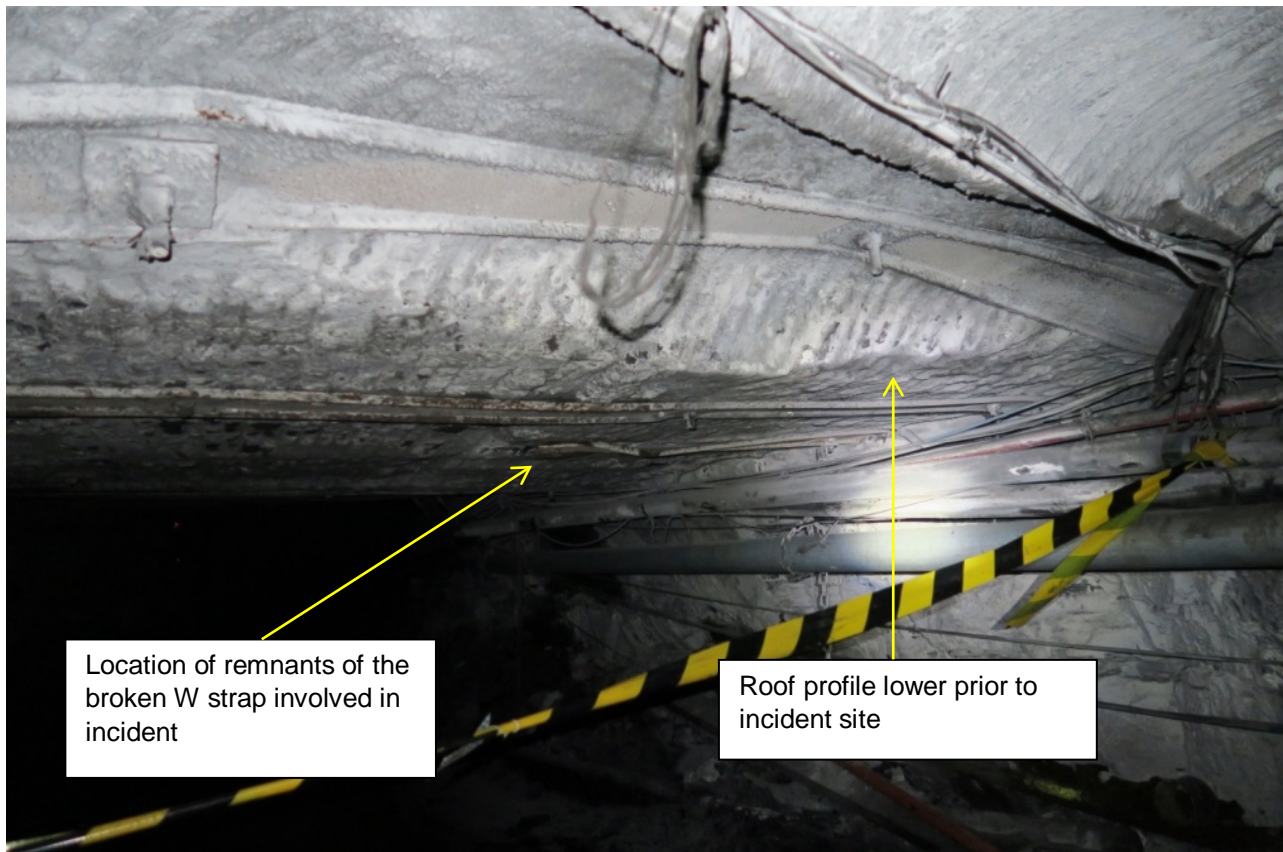
The deputy and the electrician saw the operator staggering down the roadway toward them about 1.40 pm. They provided first aid and carried out an immediate evacuation from the mine.

The operator suffered a 10 to 12 cm laceration to the left frontal temporal region that damaged the temporal artery and required 60 stitches.

The incident site

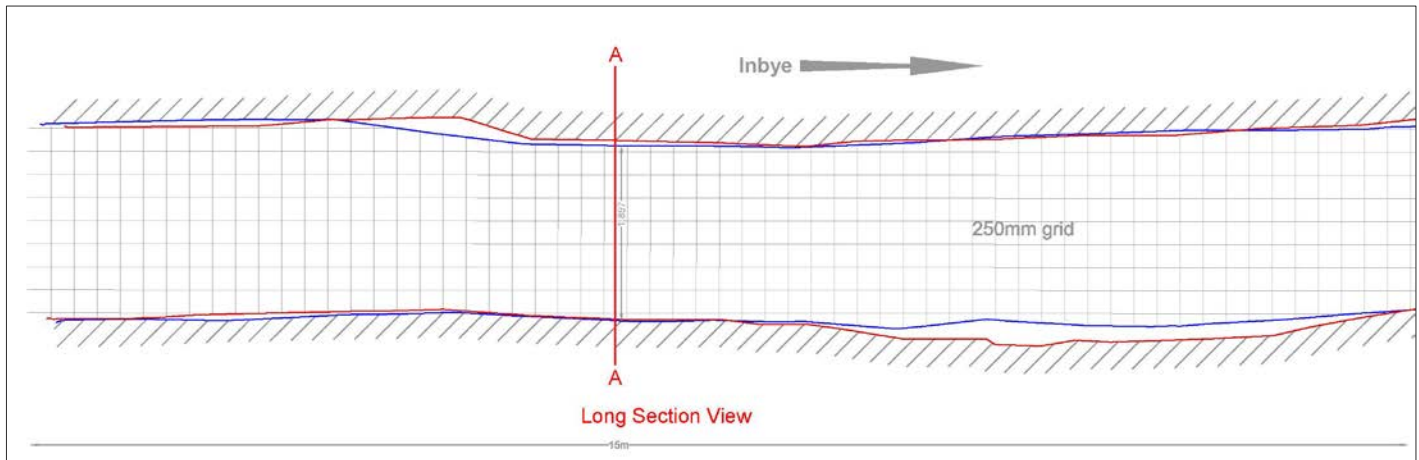
The incident occurred where the mine roof profile lowers.

Figure 9: The incident scene looking inbye. Visible lowering of the roof.



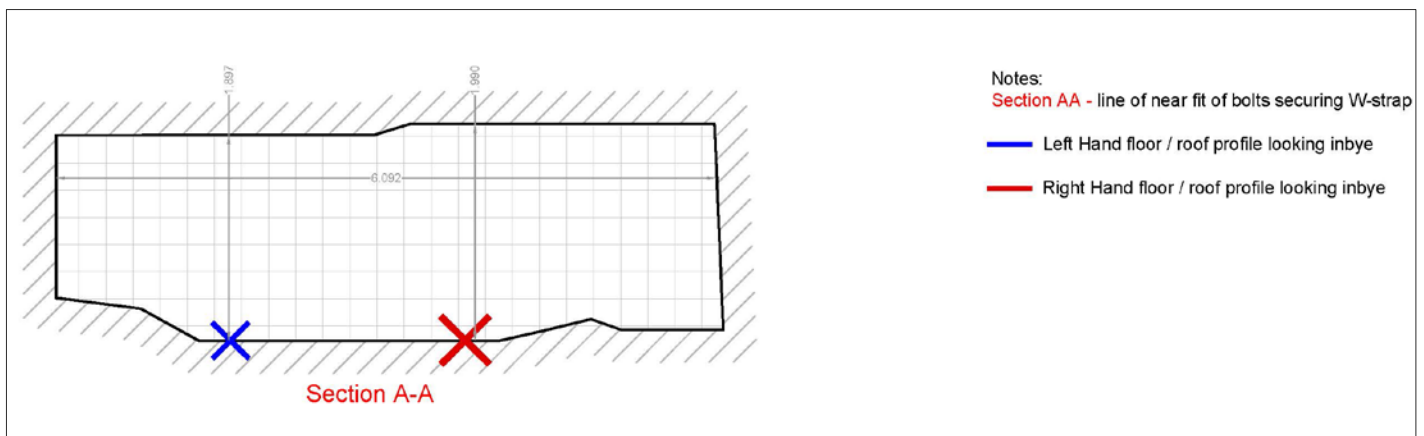
Plans produced by the mine after the incident show that the roof of the roadway lowered by approximately 0.28 m at the incident site. There was also a depression in the floor about 2.8 m inbye of the incident site to depth of approximately 0.28 m.

Figure 10: Long section of the incident scene, section AA location of W strap



The cross section of the roadway at the incident site shows that the roadway height was 1.897 m on the left hand side of the roadway and 1.990 m on the right hand side of the roadway as shown in figure 11 below.

Figure 11: Cross section at the incident scene.



The operator and passenger of SMV003 reported that they felt the front of SMV003 going down and the rear going up coinciding with the contact with the roof. These accounts are consistent with the surveyed road and roof conditions.

An examination by investigators of other W straps in the vicinity of the incident site identified numerous W straps that had been damaged from impacts.

Figure 12: Damaged W straps the vicinity of the incident.



The damaged W strap

The mine removed the section of W strap that was hanging down into the roadway and also cut a smaller section from the remnants of the W strap that was left on the right hand side roof of the roadway. Before this, photographs and measurements of the scene were taken.

The W strap was torn into two sections with the section on the right hand side of the roof being mostly intact and attached to the roof, whereas the section on the left hand side of the roof was loosely attached to the roof with the remainder hanging down into the roadway pointing toward oncoming traffic.

Figure 13: The incident scene looking inbye at the damaged W strap hanging from the roof.



The section of W strap that remained attached to the roof showed signs of previous impacts.

Figure 14: Remaining section of W strap that was involved in incident showing signs of previous impacts.



Analysis of the damaged W strap

Both sections of W strap that were removed from the roof underwent metallurgical analysis.

The section of W strap that was left hanging from the roof and into the roadway was about 1820 mm long and 275 mm wide. The section contained two bolt holes on the longitudinal centre line, about 40 mm in diameter and spaced 1400 mm apart (centre to centre). The smaller section was about 1120 mm long and did not contain bolt holes.

Both sections of strap were corroded and the shorter section had more mechanical damage than the longer section. The strap had fractured transversely about 180 mm from the centre of a roof bolt hole, as can be seen on the right hand of the longer section of W strap.

Figure 15: The two sections of damaged W strap.



Controls in place at time of the incident

The controls in place in relation to the hazard created by vehicles making contact with the roof supports in the underground roadways were:

- minimum roadway height of 1.9 m
- introduction to site process for vehicles new to the site
- deputies inspections
- competency of operators.

Requirements of underground transport management plan

At the time of the incident, the Centennial Mannering Underground Transport Management Plan, Mannering Colliery HMP01 was in effect.

The plan dictated a minimum height of 1.9 m for underground roadways. The plan did not state the maximum height of underground vehicles and what workers should do if they made contact with the roof and/or sides of the roadway with a mine vehicle.

Introduction to site of new equipment

New vehicles were required to be subject to an existing introduction to site procedure. The procedure stated that a site specific risk assessment was to be conducted when new plant was introduced to the mine.

Introduction to site of Driftrunner - SMV003

Evidence identified that SMV003 was the vehicle that hit the roof and damaged the W strap before the incident. This vehicle was new to the mine and was the first time it had been used in the underground roadways at the mine.

The introduction to site document did not identify a maximum height (or any other dimension) for vehicles operating in the underground roadways.

Mining supervisor inspections

Leading up to the incident, a mine supervisor (deputy) made inspections of the mine in accordance with the then Coal Mine Health and Safety Regulation 2006 (repealed). Those inspections included roadways that were being used by mine personnel.

There was no undermanager in place at the mine and the deputy reported directly to the manager mining engineering who also undertook his own inspections of the mine from time to time.

Competent operators

The mine operator expected that operators of plant would be competent enough to be able to identify areas of the mine that were too low to operate plant and would not use plant in those areas.

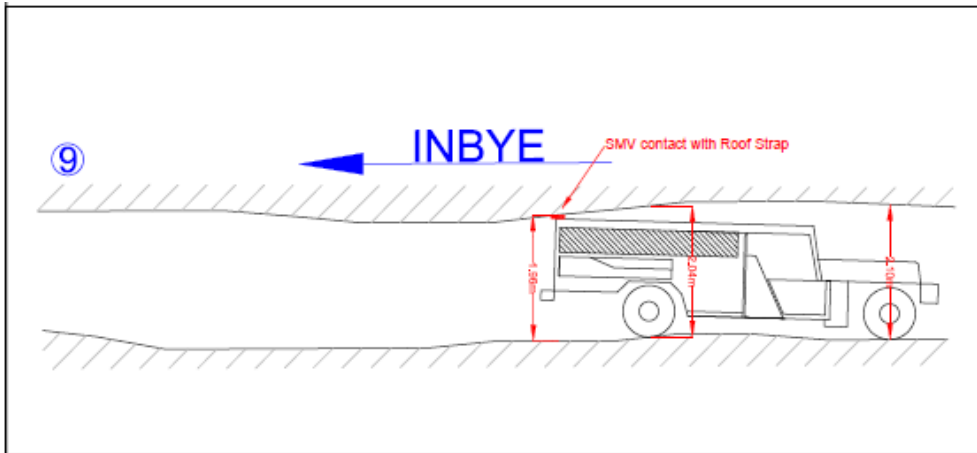
The mine provided training to new plant operators and previously experienced operators underwent a competency assessment involving a trainer observing the person operating the plant and making a judgement on their competency. There was a reliance on plant operators to identify hazards.

Survey information

The mine operator undertook a survey of the scene, this data indicated that:

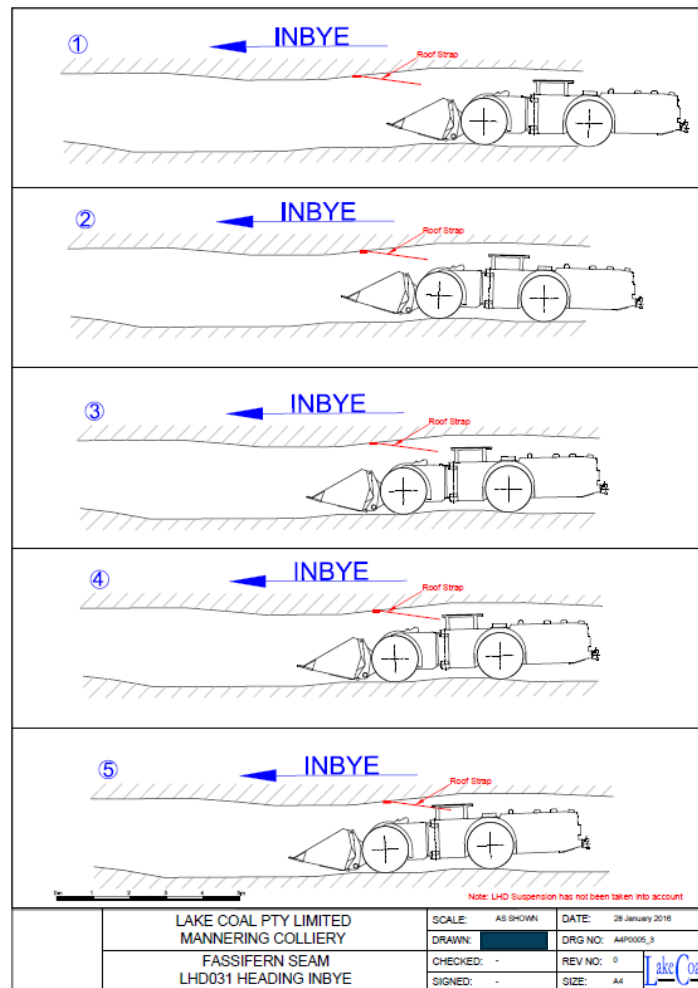
- the roadway measured as spot points was mostly to the required 1.9 m (1.897 m on the left hand side of the roadway and 1.990 m on the right hand side) as shown in figure 11
- spot measurements did not take into account the length of the vehicle and the effect of undulations in floor and roof, which results in the operational height being lower than 1.9 m
- the position of the strap in the roadway immediately before hitting the operator as indicated by the survey was as a result of SMV003 making contact with it when travelling outbye as shown in figure 16.

Figure 16: Survey plan of SMV travelling outbye and likely contact point.



The mine survey also documented how the broken W strap interacted with the LHD as shown below.

Figure 17: Interaction of W strap and the LHD 031



The health and safety management system

At the time of the incident LakeCoal did not have a health and safety management system in place in accordance with clause 14 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (WHSMR). This was because the mine was in care and maintenance and an exemption applied.

Rather, the mine was required to ensure the ongoing management of major hazards, emergency response, contractors, and incidents as well as ensure compliance with the health and safety legislation applicable to coal mines.

Causal factors

The convergence of a number of factors resulted in the materialisation of the risk. These factors are:

1. The risk controls measures identified by the mine in 2014 and 2015 were not implemented before the introduction of additional personnel and vehicle at the mine.
2. The SMV003 introduction to site and height limit controls did not take into account:
 - a reduction of 33% of clearance when compared to the existing man transport
 - differences in size and dimensions of the plant
 - the effect of hills and hollows in the roadway.
3. Inspections of the underground roadways at the mine failed to identify damaged W straps that may have posed a hazard.
4. Operators did not report collisions or contacts with roof or ribs despite there being substantial evidence to suggest it was a common occurrence.
5. There was an expectation that plant operators were experienced enough to know to stop and inspect for damage after making contact with roof or walls.
6. There was an absence of roadway height auditing before the incident.
7. The presence of the previously damaged W strap that had its structural integrity compromised.

Foreseeable risk

The Resources Regulator provides guidance material in the form of the Mine Design Guidelines (MDGs) to assist mine operators to manage and control health and safety risks. MDG1009 contains information about the risk to health and safety in relation to the collision between vehicles and mine infrastructure.

Table 1: Extract from MDG 1009

Hazard	Source example	Risk to health and safety	Possible control
Structures/ pipe cables	Pipes, pipelines, electrical cables, services, air and water, ventilation, control devices and belt structure.	Collisions between vehicles, people and items. Electric shock	<ul style="list-style-type: none"> • Ensure road way design takes into consideration structures and pipes and cables and good roadways are provided to provide easy access for mine workers; • Provision of adequate roof clearance • Installation procedure and standards for structures • Inspection programme and TARP
Strata conditions	Poor roof, ribs and low clearance Type and condition of road floor, steep gradients and poor horizon control	Injuries due to impact MSD injuries Uncontrolled vehicles	<ul style="list-style-type: none"> • Roadway design to ensure strata conditions are considered • Strata support plans outlining the design requirements • Transport rules • Education and training • Fit for purpose equipment

Remedial actions

Following the incident the mine operator undertook a number of actions to eliminate or minimise the risks associated with mobile plant collisions with underground mine infrastructure including:

- removing SMV003 to the surface and measuring to ensure compliance with the 1.8 m height restriction
- conducting a roadway audit and barricading areas identified as being too low
- conducting toolbox talks with workers about the incident
- removing the damaged W strap from the incident scene and inspecting other W straps
- lowering the floor of the roadway at the incident site to a height of 2 m
- undertaking a roadway height audit monthly to ensure adequate height clearances
- implementing a vehicle dimension assessment as part of the plant induction process
- developing and implementing a:
 - Roads and Other Vehicle Operating Areas Principal Hazard Management Plan specific to the Mannering Colliery
 - Mine roadway target action response plan (TARP).

Operator protective structures

Mobile plant operator cabins should make provision for operator protective structures (refer clause 214 and 215 of the Work Health and Safety Regulation 2011 and clause 28 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014). The investigation considered operator protective structures that are being installed on new types of LHDs that are similar to LHD 031. These structures are being installed to prevent operator interaction with the articulation of the vehicle but such structures would also guard against material entering the operator's cabin as can be seen in figure 18.

Figure 18: Guarding on a 7 Tonne LHD.



Another type of new LHD had more comprehensive structure on the operator's cabin. This LHD was smaller in size and the articulation was located on the other side of the cabin when compared to LHD 031. The structures were on the three open sides of the canopy as shown in figure 19.

Figure 19: Guarding on a 5 tonne LHD.



These operator protective structures are easily installed as seen in figure 20.

Figure 20: Guarding before and after installation.



Investigators also viewed a number of older LHDs that had protective structures retrofitted to the operator cabins. Investigators were informed that they were also installed to prevent operators accidentally accessing the articulation area. The retrofitted structures are bolted onto the existing cabin frame in a similar fashion to the new LHD vehicles as shown in figure 21.

Figure 21: Retrofitted guarding on LHD vehicles.

