Trade & Investment Mine Safety

Investigation report

Incident involving exposure to risk while operating a dozer at Mount Thorley Warkworth on 15 May, 2011

Extract of report prepared by the NSW Mine Safety Investigation Unit

January 2013 www.resources.nsw.gov.au/safety

Title: Investigation Report
Incident involving exposure to risk while operating a dozer
at Mount Thorley Warkworth Mine on 15 May 2011

Published by NSW Trade & Investment

Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (January 2013). However, because of advances in knowledge, users are reminded of the need to ensure that information on which they rely is up to date and to check the currency of the information with the appropriate officer of the NSW Department of Trade and Investment, Regional Infrastructure and Services or the user's independent advisor.

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Introduction

The department's authority

The Department of Trade and Investment, Regional Infrastructure and Services administers the *Coal Mine Health and Safety Act 2002* (CMHSA) and the *Mining Act 1992*.

Under the CMHSA a coal workplace is defined as "a place of work to which the CMHSA applies." The places of work to which the CMHSA applies are listed in section 8 of the CMHSA.

The department has authority to investigate the incident as it occurred at an open cut coal mine as defined by the CMHSA.

The site of the incident was in the Moorlands Pit area of the Mount Thorley Operations (of the two integrated coal mines), which is in the Colliery Holding of Mount Thorley Operations Pty Ltd comprising Coal Lease CL219 of the *Mining Act 1992*.

The incident that prompted this report

This report concerns a notifiable incident that occurred on 15 May 2011 at the Mount Thorley Warkworth mine near Singleton in the Hunter Valley, NSW. The incident exposed a male employee to serious risk.

The man was employed by Coal & Allied Mining Services Pty Limited. He reversed a Caterpillar CAT D11T and sunk into an unmarked deep water sump. He was trapped in the cabin of the submerged dozer in deep water and struggled to open a door of the fast-filling cabin. He eventually escaped from the cabin of the dozer when the water pressure on the outside and inside of the cabin balanced, and was then able to swim free.

The mine

Mount Thorley Warkworth is an integrated operation of two open cut mines located adjacent to each other 15 km south west of Singleton in the NSW Hunter Valley region. The operation supplies international and domestic markets with up to 10 million tonnes of semi-soft coking coal and thermal coal per annum.

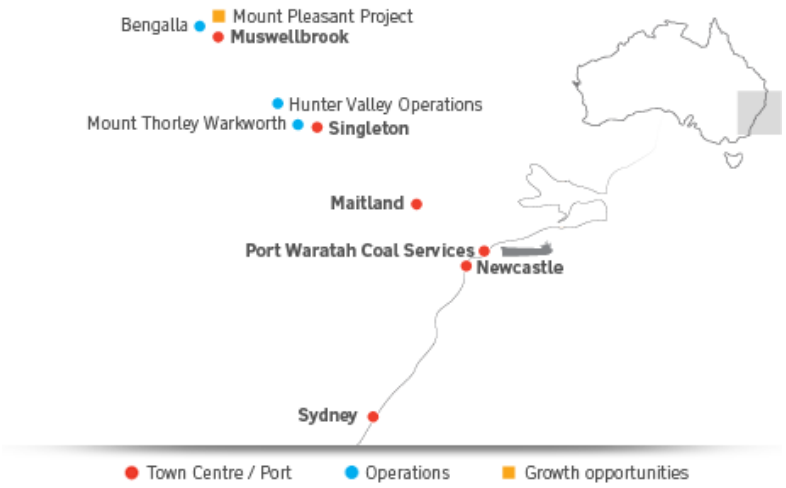

Figure 1: Location of Mount Thorley Warkworth[1].

[1] Source: <www.riotintocoalaustralia.com.au/34_new_south_wales.asp>

Mount Thorley has been in operation since 1981, and after a business restructuring of mining company R.W. Miller & Company Pty Ltd, Coal & Allied Industries Limited (Coal & Allied) became managers of the mine in 1989. Warkworth Mining began operations in the same year as Mount Thorley and in 2001 Coal & Allied bought an interest in the mine. In January 2004 the two mines were integrated. In February 2012 Coal & Allied was granted approval by the Planning Assessment Commission to extend mining within its existing Warkworth lease.

Operator of coal operation

The colliery holder, Mount Thorley Operations Pty Limited, has nominated Rio Tinto Coal (NSW) Pty Ltd as the operator of the Mount Thorley coal operation. Rio Tinto Coal (NSW) Pty Ltd was also nominated as the operator of the Warkworth coal operation.

Mine ownership

Coal & Allied manages the integrated Mount Thorley Warkworth mine on behalf of the joint venture partners; Mount Thorley Operations Pty Ltd and Warkworth Mining Ltd.

Mining process

Mount Thorley Warkworth is two open cut, multi-seam, mines that use the dragline, truck and shovel method of mining. The mine operates two coal handling preparation plants and a train loading facility. Operations are centred in the Wittingham Coal Measures of the Hunter Coalfield, which is part of a Permian coal basin known as the Sydney basin.

After being washed and prepared for sale at the coal preparation plant, the coal is loaded onto trains for transportation 90 km to the Port Waratah coal terminal in Newcastle where it is shipped to international customers.

An example of shovel and truck mining from the Moorlands Pit of Mount Thorley is shown in Photograph 1.

Photograph 1: Overburden being removed by shovel and trucks[2].

[2] Sourced from mine planning document as supplied by mine

Management structure of the mine

The operator, Rio Tinto Coal (NSW) Pty Ltd, had prepared a health and safety management system for the Mount Thorley and Warkworth mines, as required by the *CMHSA*[3]. As part of the system a document was prepared that set out the management structure of the coal operation.

The person at risk was part of the mining services Crew 'C' and was supervised by the Supervisor Mining Services.

Supervision at the mine

The management structure of the mine included competent people to perform supervisory functions at the coal operation. The management structure had a number of different supervisory levels; manager mining, superintendents, mining supervisors and supervisors.

Mining supervisors at the mine were referred to as open cut examiners.

The *CMHSA* requires that supervisors comply with the mine's health and safety management system and that supervisors also must inform the operator if he or she becomes aware that the conduct of the coal operation is not consistent with the provisions of the (then) *OHSA* or the *CMHSA* or regulations under either Act.

Mining supervisors perform statutory functions at the operation and are required to have, at least, a 'Certificate of competence to be an examiner of an open cut mine' to perform such functions. The mining supervisor has functions that include the supervision of all people within a production area of the open cut mine. The mining supervisor must regularly attend those places were people under his or her supervision are working.

The tasks and activities that are expected of the mining supervisor are set out in the mine's written role descriptions. The primary purpose, as stated in the role description of mining supervisors was; '*....to lead people within their team to safely achieve their production targets*'. Mining supervisors were also required to carrying out at least one safety inspection each shift, record results of those inspections, and to bring safety concerns to the attention of those who may be affected and also to those in a more senior management role.

Circumstances of the incident

Events before the incident

Water leaches out of the Moorelands Pit highwall and forms pools on the bench below. Sometime before 1 May 2011 a sump was excavated to drain the water from the coal bench to allow the blasting and mining of the coal.

On 1 May 2011, an excavator operator and a dozer operator had found what appeared to be a sump while working in the area. The excavator operator advised his team supervisor that he had found the sump. The supervisor instructed him to clean the sump out.

The excavator operator cleaned the sump out and constructed a windrow around it. He then requested by two-way of the open cut examiner that a sump warning sign be placed near the sump to show its location. As it was the end of the shift, the cleaned out sump was noted on the open cut examiner report for the day for the oncoming shift to place the warning sign.

The mining supervisor for the next shift said a sump sign was installed on the evening of 1 May 2011. There was no record of the sign made on the open cut examiner report for that shift.

[3] *CMHSA*

Examination of the open cut examiner reports for that week recorded the sump warning sign as being put in position five days later on 6 May 2011 at the northern end of the coal bench against the highwall.

On 7 May 2011, the D crew mining supervisor raised concerns about the location of the sump that was recorded on the open cut examiner reports. He wrote his concerns on the report. The next shift (Crew A) open cut examiner noted the previous shift supervisors concerns on the open cut examiner report and visited the area to determine the actual location of the sump and to find out what had happened to the sign that was supposedly showing its location. The open cut examiner discovered that the sign had been moved some 80 m away from the water to the opposite (eastern) side of the bench. The open cut examiner, relocated the sign to an area near where he thought the sump was from his recollection of being in that area six days before. Due to the changes from mining and the ingress of more water on the bench he found it difficult to locate the sump accurately.

On 9 May 2011, the excavator operator, was back in the Moorland Pit area. He noticed that the 'sump' sign was in the wrong location. He called the mining supervisor and requested permission to relocate the sign. Permission was granted and the operator moved the sump warning sign to the site of the sump that he had cleaned out on 1 May.

Sometime between 9 May and 13 May the sign was moved about 150 m north on the coal bench to a location near the end of the expanse of water where a pump was to be used to drain water from the bench (see Photographs 3 and 4). There was no record kept on the open cut examiner reports or anywhere else of the relocation of the sign or who had moved the sign.

Photograph 3: Pump at the northern end of the expanse of water.

Photograph 4: Sign in front of the area where the pump was located at the northern end of the bench.

Regardless of whether the sump warning sign was at the correct location before its move the northern end of the bench, no attempt was made to identify that there was a sump within that area. No signs, barricades or anything else was left at the southern end of the expanse of water to denote that there was a sump (Photograph 5).

Photograph 5: Water spread across the coal bench at Moorlands Pit (view looking south).

Figure 2 shows the expanse of water on the coal bench, the location of the deep water sump at the southern end, and the location of the water pump and sump warning sign at the northern end.

The pump and the sign at the northern end identified that this was the location of the only sump in the coal bench.

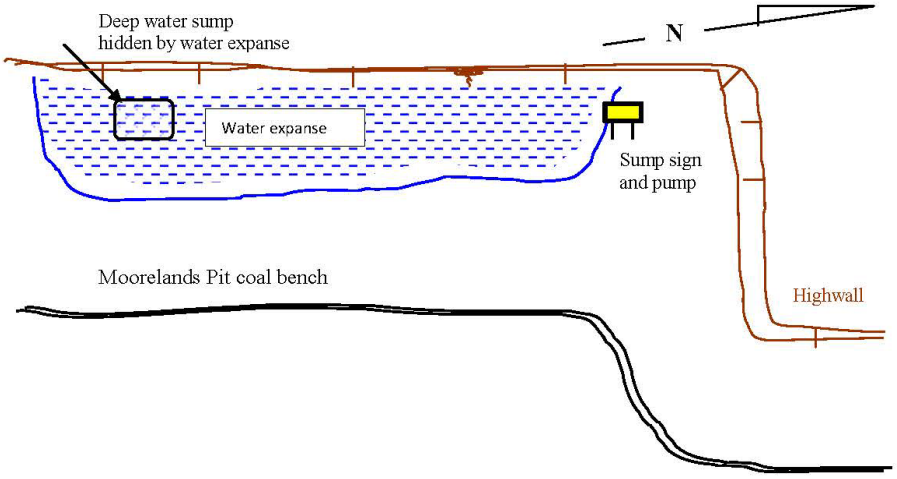

Figure 2: Moorelands Pit coal bench

The incident

The dozer operator was normally a member of the Pit Services Crew 'C' and reported to a mining supervisor. The operator was a competent mineworker who usually operated a dozer but could also operate many of the mine's associated equipment, such as trucks, graders and front end loaders.

On Sunday 15 May 2011 the dozer operator arrived at the mine and was placed with the Coal and Partings production team that was to work in the Moorelands Pit. He reported to the supervisor and support open cut examiner for coal and partings, and was sent to operate the dozer. The dozer operator had worked at in the Moorelands Pit previously. He had started work with the coal and partings team at the coal bench on Friday 13 May 2011, ripping coal with his dozer ahead of a front end loader that was loading the haul trucks.

On the day of the incident the employee exposed to risk was operating a CAT D11T dozer and was told by his mining supervisor to move the pooled water from the southern end of the coal bench to the pump at the northern end. The purpose of moving the water was to gain access to a strip of coal that was covered by the water. At 7am the mining supervisor and the dozer operator went to the southern end of the water on the coal bench and got out of their vehicles to meet. The mining supervisor inspected the area from the eastern side of the water expanse and gave the dozer operator his work instructions. No attempt was made to determine the depth of the water. As the pump at the northern end was marked with a sump warning sign, both men assumed this was the only sump on the bench.

The dozer operator was instructed to cut a drain in the coal bench, in the eastern side of expanse of water, to get the water to move more freely towards the pump at the northern end. The drain was to be cut right up to near the pump. To do that the dozer operator had to travel through,

and work in, the water on the bench. He had been informed by his mining supervisor that the area covered by the water hadn't been mined so the floor would be hard.

The dozer operator started work at the southern end and used the edge of the dozer blade to create the small drain to the north and towards the marked sump. After tipping a small drain, he reversed his dozer back through the expanse of water, and began pushing water to the north with the blade of the dozer. He saw that water was escaping out the southern end through a gap between the windrow of partings material (interburden) near the highwall. He decided to reverse over the low section between the partings and the highwall to repair the windrow by pushing more material up into the area to prevent the water escaping.

At 7.30am the dozer operator reversed over the pile of partings and felt the dozer sliding into deeper water. He attempted to drive the dozer out of the water but could not get enough traction and began to sink. The dozer sank into the deep water sump (Photograph 6).

Photograph 6: CAT D11T dozer submerged in the sump.

The dozer operator later told investigators he was unable to open either of the cabin doors due to the water pressure. He said that although he initially panicked, his training in emergency response allowed him to calm down and wait for the water to fill the cabin.

There was nothing in the cabin to enable the dozer operator to smash through the windows. As the water rose inside the cabin he tried to open the right hand door by banging on the door lever to escape. After several attempts to open the door he waited until the water almost completely filled the cabin and the pressure equalised. He was able to open the door and escape. The man swam about 10 m to the water's edge and bank of the windrow where the people who were first at the scene were gathering.

Photograph 7: Water mark at the top of the external part of the cabin of the dozer[4].

Photograph 8: Inside the cabin of CAT D11T dozer showing water mark on the ceiling[5].

[4] Photograph taken by WesTrac during the recovery process
[5] Photograph by the mine

Injuries, rescue and medical treatment

As water began entering the dozer cabin, the operator called an emergency over the two-way radio and called for help. There was some confusion in the first response when team members started looking in the northern end of the coal bench where the marked sump was located. The responding team members then travelled to the southern end and found the submerged dozer and the dozer operator.

When the emergency crew arrived, the operator had escaped from the submerged dozer, swum to the windrow and climbed up where he was given dry clothes by a grader driver.

The dozer operator suffered a minor strain to his hand. He did not need to go the hospital. First aid was administered at the mine's first aid station. The dozer operator returned to his normal duties within two weeks of the incident.

Photograph 9: CAT D11T dozer in the sump after water was pumped out.

Findings

Risk and the requirements of law

The operator of the coal operation, and the employer, were required by legislation[6] to identify hazards, assess risk and eliminate or control foreseeable risks.

In particular, section 9 of the *Occupational Health and Safety Regulation 2006* (*OHSR*) required that employers identify hazards arising from the physical working environment, including the potential for drowning.

The coal mine health and safety legislation imposes the duties of the *OHSA* (now WHSA) upon the operator of a coal operation as well as specific duties to ensure the health and safety of persons at the coal operation. The operator must prepare a health and safety management system for the coal operation that includes system elements for risk management. The health and safety management system must provide the basis for the identification of hazards, and the assessment of risks from those hazards, as well as the development of controls for those risks and the reliable implementation of those controls. The health and safety management system must be consistent with Australian/New Zealand Standard AS/NZ 4804: 2001 *Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques*.

Furthermore, the *Coal Mine Health and Safety Regulation 2006* (*CMHSR*) requires that the health and safety management system contain arrangements for inspection of the places were people are working, supervision and the communication before and during work of safety matters to those in the supervisors work area, and communication between supervisors of safety matters on consecutive shifts.

Risk foreseeable

The possibility of operators of mobile plant, such as dozers, at open cuts and surface operations inadvertently entering deep water sumps is considered foreseeable. The potential for hidden deep water sumps at open cut mines and the consequence of mobile plant entering a deep unmarked water sump is well known to the mine operator and to the coal mining industry.

It is required that appropriate safeguards are in place to ensure that people operating mobile plant do not work in or around deep water and sumps.

Incident facts

1. On or before 1 May 2011 a sump was dug by an excavator at the southern end of the Moorelands Pit. A windrow was constructed around the sump by the excavator operator to identify a danger and a 'Warning, Sump inside this area' sign was positioned near the sump the same day.
2. Heavy rain increased the amount of water pooled on the bench. The pooled water had hidden the sump and also a windrow that had been placed around the sump.
3. On 7 May 2011 the sump warning sign was moved to a position north of the sump.

[6] *Occupational Health and Safety Act 2000* and Regulations, and *Coal Mine Health and Safety Act 2002* and Regulations

4. On 9 May 2011 the sump warning sign was again positioned near the sump.
5. Between 9 and 13 May 2011 the sump warning sign was moved about 150 m north to a location near a pump.
6. There was no warning sign, safety barriers, danger tape or flagging, windrow or any other visible method to identify the sump and the danger of deep water.
7. On 15 May 2011 instructions were given to the dozer operator to work in the expanse of water.
8. The supervisor and operator failed to identify the potential hazard of deep water and operation of the dozer near deep water.
9. At 7.30am the dozer sunk into the unmarked deep water sump and was almost submerged. If the dozer operator had not escaped the dozer cabin the consequence of the incident may have been much worse, seriously effected by water immersion or drowning.
10. The dozer was not a contributing factor to the incident.
11. There was an ad-hoc system for recording the location of sumps and for communicating such locations to supervisors.
12. There were no written instructions or safe work procedures for provision of permanent signs or other methods of identifying sumps and the dangers of such, and the recording of the location of the sump.
13. There were no written instructions or safe work procedures for working in and around water in the open cut and working areas.

Cause of the incident

Investigators have determined that the primary cause of the incident was the failure to put in place safeguards designed to stop mobile plant from entering deep water sumps.

There are a number of causal factors that have contributed to the incident.

Equipment and machinery

The dozer was examined to determine if there were any issues or defects that may have contributed to the incident. Functionality testing was carried out by the original equipment manufacturer, WesTrac, which prepared a report. The report showed there were no electrical or mechanical issues or engine over speeds logged on the Electronic Control Mechanism on the dozer before or at the time of the incident. In the report, the manufacturer concluded that the engine and electrical system were in good condition before the incident.

There were no factors related to the dozer that contributed to the incident.

Organisational factors

Mount Thorley Warkworth had a documented health and safety management system, known as the 'Mount Thorley Warkworth Health, Safety, Environment and Quality Management System'. The health and safety management system included policies, procedures and training documents for the various system elements, including a procedure for 'Hazard Identification and Risk Management'.

The Hazard Identification and Risk Management procedure included accountabilities for management and supervisors at the mine. Managers were to audit the risk management process and were to ensure that work methods were assessed to identify and remove hazards. Superintendents and supervisors were accountable for the day-to-day actions associated with identifying hazards and effective risk controls. Supervision is further discussed in a later section.

Risk management

The mine, in accordance with its risk management procedure, conducted a broad-brush risk assessment of in-pit mining activities in July 2009. Within that risk assessment it was identified that driving equipment into a sump was a hazard. The resultant impact of operators entering bodies of water and (machinery) falling into unidentified sumps was recorded as 'result in jarring of neck and back'. The risk of the hazard was assessed as of 'minor' consequence and likelihood of 'unlikely' giving a risk rating of 'Low' if the following actions were undertaken, and such controls were in place:

- Windrow placed around known sumps
- Signs installed
- Open cut examiner to maintain records keeping of sumps and placed into daily records for active work areas
- Prestart meetings to discuss hazards within work areas
- "Take 5" (pre-task hazard assessments) completed
- Have trained and competent operators
- Operator to carry out inspection of work area
- Experienced operators check for sumps when driving into water bodies using ripper (not common practice)
- Pumps may be used to de-water areas[7]

The proposed (further) controls included in the risk assessment were 'Review and formalise notification process for sumps in work areas' and 'Maintain current controls.' No record of such a review or formalisation of the notification process for sumps was discovered by investigators. The risk assessment failed to consider that a dozer could become submerged in deep water and that there was a potential for drowning of the operator, whether from being trapped in a water-filled cabin or from immersion in water after escape.

The mine had also identified that excavations and open holes were a risk to people and machinery at the coal preparation handling plants and associated surface facilities. As such, a procedure 'barricades and cordons' was prepared that contained information on the placement of barricades and cordons around excavations. However, the barricades and cordons procedure did not apply to mining areas and operations.

On the day of the incident, no pre-task hazard assessments (Take 5s), as required by the mine's Hazard Identification and Risk Management procedure and noted in the 2009 risk assessment, were undertaken.

Information and instructions

The dozer operator was given little information about the water and potential dangers.

[7] Extract from MTW-03-RA-MINE-501-0305 Production Dozing Operations – in pit operations.xls

There were no written instructions or safe work procedure (SWP) for the excavation of, provision of signs for, and keeping record of, the location of sumps.

There was no written procedure for identifying the hazard of, and risks associated with, working near water of unknown volume and depth.

However, during the investigation, managers and employees did mention informal (ad-hoc) methods that had been used for sump identification, identified as the open cut examiner and daily activities reports.

Signs and barriers

The mine was aware of risks associated with sumps and had signs for warning where sumps were located.

There was no method to identify and provide a warning of the danger of the sump in the area where the operator was working.

Windrows were used at the mine to identify dangers and edges of voids such as sumps. The sump windrow was to prevent people and machinery from accessing the sump, particularly if it filled with water. But dozers, when cleaning up mining benches or horizons for drilling and blasting or mining, regularly breached such windrows and removed them as part of that clean up process. The increased water from the heavy rain obscured and covered the windrow around the sump.

The failure to have the sump adequately and appropriately identified led to the incident.

Supervision

The mining supervisor met the dozer operator at the southern end of the water that covered the coal bench. He instructed him to work in the water area but had not identified any hazard.

The mine's Hazard Identification and Risk Management procedure required supervisors to verify that all hazards within their work area were to be identified and appropriate controls put in place. No attempt was made by the supervisor to determine the depth of water. No information was given by the supervisor that would help the operator to work safely in the water-covered area. The supervisor told investigators that he had seen the sump warning sign and pump further north and assumed it was the sump as recorded on the open cut examiner reports.

Records of sump locations

As required by the *CMHSA* and regulations, the mine had an inspection program that included inspection by mining supervisors (open cut examiners) of the area where mining operations were conducted. The mine had such supervision and inspection programs. The inspections were recorded on open cut examiner reports that were completed for each shift and each production area (daily reports). The daily open cut examiner reports were used for the communication of work instructions and other issues between the mining supervisors on each shift. The reports were available for supervisors to view. The reports also recorded, and brought to the attention of the oncoming mining supervisor, the location of sumps and other safety issues.

The daily open cut examiner reports from 1 May 2011 up until the incident of 15 May show that a sump was recorded, but there was no clear description of the location of it (examples shown in Table 1 below). There was no way of preventing the removal and misplacing of a sump warning sign. This exposed workers to the risk of inadvertently entering the deep water sump.

Date	Entry
1 May to 6 May 2011	Sump installed at MTO Nth end of dig against Highwall – windrow placed around sump but signage needs to be placed
7 May 2011	Sump installed at MTO Nth end of dig against Highwall – Location unknown of sump in question
7 May – 15 May 2011	Sump installed at MTO Nth end of dig against Highwall – Signage in place of last known position

Table 1 Extract of open cut examiner daily reports 'Miscellaneous Hazards' section.

The open cut examiner reports failed to be an effective method of recording and communicating the hazard of sumps within the mining area. There was no monitoring of the open cut examiner reports to determine the accuracy of recordings.

Actions post-incident

Actions of the mine

The mine has completed an investigation and taken the following actions to prevent recurrence of the incident.

1. A Rio Tinto 'incidentgram' was completed and distributed to all Rio Tinto operations. The incidentgram was also discussed at mine pre-start briefings.

2. A written instruction, (Work Instruction: MTW-10-WI-MINE-200-008 Digging and Delineating a Sump) was developed for the excavation and marking of sumps. The work instruction:
   - outlines the responsibilities of open cut examiners, operators of excavators, supervisors and pump crews in the process of creating, maintaining and removing a sump in the mine.
   - provides guidance material to the dozer operators when working in and around water and managing pooled water.
   - requires a buoy to be installed on or over highwalls in locations where sumps are under the highwall to identify their location.
   - requires the placement of crossed marker poles with reflective strips at the top of a windrow delineating the location of a sump.
   - is part of the training package for new employees and for refresher training of existing employees.

3. The written training package and operations manual for dozer operation was reviewed to include:
   - the review and update of the dozer training package to reinforce the general practice of entering water in a forward direction only and place restrictions on what depth of water a dozer may enter.
   - dozer training package put in place and used for new employees and in refresher training for existing dozer operators.

4. The mine also proposed to evaluate the system to escape from dozer cabs when a machine becomes immersed in a void that contains water, slurry or other material that restricts the opening of the cabin doors.

Actions of the department

Mine Safety Operations inspectors responded to the incident notification. Two inspectors attended the mine soon after the incident, ensuring that the incident scene was safe and secure.

The Investigation Unit conducted a detailed and thorough investigation into the incident. Investigation notices was issued under section 89 of the *OHSA*. The Investigation Unit requested the original equipment manufacturer, WesTrac to provide an independent report after its inspection of the dozer.

Support to the dozer operator

The dozer operator was contacted and given information to explain the investigation processes and what would happen. This information included the roles of the department and Investigation Unit, and other parties, such as the mining company and industrial unions.

Issues drawn to mine operator's attention by Investigation Unit

A number of issues were drawn to the attention of the operator of the coal operation and the mine management during the investigation. These included, but were not limited to, the failure to have a documented process for the excavation of a sump and the failure to record the exact location of sumps.

Letter of concern issued to mine operator

The department regards the incident as a serious one. It involved considerable risk to the dozer operator and highlighted a number of deficiencies in the health and safety management system at Mount Thorley Warkworth. In addition to the investigation, and the actions already taken to correct the deficiencies in the systems at the mine, the department issued a letter to the employer and mine operator expressing concern about the potential breaches of health and safety legislation.

The department expects that the operator of the mine, Rio Tinto Coal (NSW) Pty Ltd, will continue with voluntary compliance and demonstrate a preparedness to work with the department to promote the lessons learned from this incident. The department also took the opportunity to promote and encourage proactive behaviour of officers of Rio Tinto Coal (NSW) Pty Ltd and Coal & Allied Mining Services Pty Limited consistent with the due diligence obligations of the *Work Health and Safety Act 2011*.

The investigation

Coal workplace inspections

On 16 May 2011 two investigators responded to the incident and attended the mine. They met mine management and explained the investigation process.

On 18 May two investigators attended the mine where they met the mine manager. The investigators took photographs and video at the incident. During the inspection the investigators examined mine records and documents. Notices were issued for the mine to produce further information and documents.

An investigator returned to the mine on 11 September 2012 to verify the actions taken by the mine and to review the implementation of the amended written procedures described previously.

Information and documents

The inquiry included the gathering of information and documents:

- information from the employer and operator of the coal operation
- information from the person at risk, witnesses and other workers
- information from the original equipment manufacturer of the dozer
- documents and records; with a focus on safe systems of work, identified risks and the control of such risks

The following department guidelines were reviewed in the course of the investigation:

- MDG 1 *Guideline for Free-steered Vehicles*
- MDG 15 *Draft Guideline for mobile and transportable plant for use in mines*
- MDG 28 *Draft safety requirements – reclaim tunnels and coal stockpiles*

Industry best practice

Legislation[8] requires that risks to health and safety are to be eliminated. In the case where the elimination of risk is not reasonably practicable duty holders are required to minimise the risk to the lowest level reasonably practicable by the following (in order of priority):

1. Substituting the hazard giving rise to the risk with a hazard that gives rise to a lesser risk.
2. Isolating the hazard from the person put at risk.
3. Minimising the risk by engineering means.
4. Minimising the risk by administrative means (for example, by adopting safe working practices or providing appropriate training, instruction or information).
5. Using personal protective equipment.

The legislation allows for a combination of the above measures to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient. In practical terms, control of risk at coal operations usually requires such combinations of risk controls.

But the order of controls should not be forgotten, with Substitution, Isolation and Engineering Minimisation being the priorities ('hard barriers') before administrative means and personal protective equipment ('soft barriers'). Best practice will always be to have a number of controls implemented to prevent the risk.

[8] *CMHSR*

While in this case the hazard of the sump could not be eliminated, there were many controls that were reasonably practicable for the hazard and risk presented by the sump. Such controls are listed below. It should be noted that many, if not all, of the controls had been implemented by the mine by September 2012.

Controls for the risk of sumps

Permit to dig

Sumps should not be dug without the approval of the mining supervisor for the inspection area. A written record is kept of the request and authorisation to dig. The record includes an accurate location of the sump. Locate by survey.

Windrows and signs

A physical barrier, such as a windrow, is constructed around the sump. The windrow indicates an edge and present danger. Cautionary or danger warning signs are to be placed at all directions of access to the sump. No sign is to be removed until the sump no longer presents a risk to people in the area. When against the highwall identify the sump by additional means such paint marks on the highwall, danger markings or poles on the top of the highwall, or marker buoys or signs hung over the highwall edge.

Other physical methods of identifying the risk should be employed as well as the windrow and signs, such as traffic cones or crossed-sticks.

Record of location and re-locating sumps

When a sump has been dug the location must be noted. The sump should be surveyed and the co-ordinates recorded and kept. The sump location must be recorded on the open cut examiner inspection sheets to inform supervisors of the risk in the inspection area.

As open cuts and work areas such as the coal bench in the Moorelands Pit are susceptible to water inrush from rain and water issuing from the coal seam and strata the physical barriers, signs may become covered, as was the case with the incident sump. When such change to the physical working environment has occurred, the sumps should be relocated and identification re-established if none of the previous markers remain.

Coal operations, both surface and underground, are now highly mechanised and technical workplaces. There are many modern systems that are readily available to assist in locating known sumps. GPS technology can be used in surveying the sump, and to assist in locating the sump by way of hand-held and mobile GPS units. The co-ordinates of known sumps can be pre-loaded into hand held units.

Mobile plant such as dozers may have GPS equipment installed. The sump co-ordinates can be pre-loaded into the dozer unit and an alarm set that will give an audible and visible warning when the dozer comes within a set distance of the sump.

Safe work procedures

The above controls require the development of, and implementation of, written instructions and procedures to ensure that all controls are placed correctly and in a timely manner.

Monitoring and auditing

The standards for risk management of sumps will not be maintained unless monitored and audited. Such monitoring and auditing procedures should be in place to verify the performance of the safeguards to prevent machinery entering deep water sumps.