



Environment compliance report

Dams at NSW mines

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Executive summary

The NSW Environment Protection Authority (EPA), Department of Planning and Environment (DPE) and Department of Planning and Environment – Resources Regulator (RR) have completed joint NSW Government agency compliance audits focused on the environmental management of tailings, wastewater holding and sedimentation dams ('dam facilities') at NSW mines to help improve environmental performance.

The audits focused on:

- requirements relating to the management of dams in environment protection licences issued by the EPA
- development consents and project approvals issued by the DPE
- mining lease(s) issued by the RR
- requirements of *Part 2 Managing risks of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014, Commitments made by mine operators in documents pertaining to the operation and maintenance of dams* as required by RR.

The audit process included compliance audits conducted at a selection of mines in NSW.

The objectives of the audits were to:

- assess the level of compliance with statutory requirements relating to the management of dam facilities
- assess the adequacy and appropriateness of the mines' current management practices, procedures and monitoring activities in relation to managing dam facilities
- improve the level of awareness and understanding of the environmental and operational compliance issues in relation to the management of dam facilities.

This report summarises the findings of the compliance audits completed by the three agencies. It also:

- provides information on best practice guidance on how mines can manage dams and improve environmental performance
- informs other initiatives that the NSW Government is implementing to ensure mines improve their environmental performance.

Key findings

Overall, while there were several non-compliances observed, they were mostly considered to be of low environmental significance (low-risk). However, all non-compliances are considered important and must be addressed, and the audits present an opportunity for improvement by the industry.

The findings of the audits demonstrate that mines have opportunities to improve their management of dam facilities by:

- managing the water levels in the dams to minimise or prevent overtopping and uncontrolled discharges during storm events
- constructing and maintaining dam capacities to reflect dam sizing calculations
- managing seepage from dam walls to prevent pollution of waters
- controlling and preventing stormwater run-on to dam facilities to maintain design capacity
- maintaining plant and equipment to minimise the potential for pollution of waters
- reporting in a manner which ensures consistency of information to relevant agencies

- ensuring that sampling and analytical methods and procedures used in the monitoring and analysis of water discharges are in accord with licence requirements
- ensuring that all the required information is included in all management plans
- ensuring that risk assessments include the operation and maintenance of dams, and principal hazard management plans are prepared where required
- ensuring that operation, maintenance and monitoring of all dams is in accordance with the requirements of the operation and maintenance manual for the facility
- testing and updating dam safety emergency management plans on a regular basis
- including all the required information in the Pollution Incident Response Management Plan (PIRMP)
- ensuring that all staff undertaking dam inspections and maintenance have received appropriate training
- ensuring that recommendations from surveillance reports, and corrective actions identified through routine inspections, are actioned and closed in a timely manner.

A systematic and rigorous process of follow-up actions has been put in place by the three agencies to ensure issues identified at the audited sites are being addressed.

Related initiatives

The following related initiatives may also assist relevant stakeholders – including the mining industry – to identify ways in which the management of dam facilities (and water quality) can be undertaken more effectively to reduce the impact on the environment:

- EPA's *Environment Compliance Report: Coal ash dams and emplacements*
- EPA's Strategic Environmental Compliance and Performance Reviews, and Environmental Compliance Reports
- Department of Industry's *Mine Safety Regulatory Reform: Incident Prevention Strategy*.

1 Introduction

The Environment Protection Authority (EPA), NSW Department of Planning and Environment (DPE) and Department of Planning and Environment – Resources Regulator (RR) have completed a joint NSW Government agency compliance audit campaign, focused on the environmental management of tailings, wastewater holding and sedimentation dams ('dam facilities') at NSW mines. The goal of this whole-of-government initiative was to help improve environmental performance.

Why have mines been selected for auditing?

While acknowledging the importance of the mining industry to the state economy, the NSW Government also recognises the importance of minimising the impact of mining on the environment. Given the potential for failures and discharges from dam facilities, the Government has identified maintenance and operating procedures of dams at NSW mines as a priority area for immediate attention.

In July 2015, a spill occurred from a coal reject stockpile at Clarence Colliery near Lithgow, resulting in many tonnes of coal fines and coarse reject material being dispersed into the environment around the mine site. Heavy rainfall in December 2015 and January 2016 also led to several coal mines in the Hunter Valley reporting failures or discharges from dam facilities on their premises.

Following these events, there has been an increase in Government and community interest in ensuring that dams at mines are being operated and maintained properly to prevent any future dam failures from occurring.

Importance of managing dams

The correct management of dams at NSW mines is important as failures can impact on water quality, adversely affect local amenity and pose a risk to the community. The failure of a large dam has the potential to cause death and destruction due to the power of the flood wave being released. Further, many dams, including tailings dams, contain toxic materials which may additionally endanger the local environment.

Overtopping of embankment dams, via the mismanagement of dam water levels, is also of concern. Contributing factors impacting on capacity, such as the management of clean water run-on to dams and seepages from dam walls, are all considerations that must be undertaken when managing any dam facility.

Regular and effective inspection, reporting, monitoring and maintenance of dam facilities is key to ensuring they are managed to minimise the risk of impact from their operation.

Joint audit program on dams

The issues associated with the management of dams at mines are regulated by several NSW Government departments. The EPA has regulatory responsibilities under the *Protection of the Environment Operations Act 1997* for surface water and groundwater pollution from all dams on scheduled premises in NSW. The Department of Planning and Environment– Resources Regulator (RR) regulate mines under the *Mining Act 1992*, *Work Health and Safety Act 2011* (the general WHS laws) and the *Work Health and Safety (Mines and Petroleum Sites) Act 2013*. DPE regulates mines under the *Environmental Planning and Assessment Act 1979*.

As part of a collaborative whole-of-government approach to the regulation of NSW mines, a joint-agency environmental compliance program has been undertaken by the EPA, DPE, and the RR, focusing on the environmental and operational management of tailings, wastewater holding and sedimentation dams ('dam facilities') at NSW mines, and how industry is minimising or preventing the impact of these dam facilities on the environment.

Types of dam facilities

Generally, mine water management systems include:

- the collection, management and distribution of water pumped from underground workings and open cut pits
- runoff and seepage from overburden emplacement areas
- active mining and disturbed areas
- management of water affected by mineral handling and processing activities.

Mine water management systems typically comprise various dams, including water storage dams, tailings dams, pollution control and sediment dams, and the associated infrastructure including pumps and pipelines.

Prescribed dams

The NSW Dam Safety Committee (DSC) is responsible for ensuring the safety of dams whose failure would cause serious community consequence. The DSC prescribes these dams under the provisions of the *Dams Safety Act 1978* and uses a consequence category system to determine the need to prescribe a dam. Generally, all dams with an Extreme, High or Significant consequence category will be prescribed.

The consequence category is also used to determine the inspection, monitoring and surveillance frequency of each dam, generally in accordance with the Australian National Committee on Large Dams (ANCOLD) *Guidelines on Dam Safety Management* (August 2003).

On mine sites, prescribed dams may include raw water dams, mine water dams or tailings dams.

Tailings dams

Tailings consist of ground rock and process effluents that are generated in a mine processing plant. Mechanical and chemical processes are used to extract the desired product from the run of the mine ore and produce a waste stream known as tailings. The unrecoverable metals, minerals, chemicals, organics and process water are directed, normally as slurry, to a final storage area commonly known as a tailings management facility or tailings storage facility.



Figure 1: Storage of tailings from mining operations (Photo: N Wilmot/EPA)

Tailings can be stored on the surface in a tailings dam, in previously mined open-cut voids, or underground in the case of underground mines.

Water recovered from mine voids and decant water recovered from tailings dams is directed to wastewater holding ponds and often reused for activities such as dust suppression.

Sediment dams

The scale and nature of mines mean that they have the potential to produce significant amounts of sediment, which can impact on surface runoff and groundwater quality through contamination with dissolved and suspended materials.

The purpose of sediment dams is to capture any sediment laden runoff from the mine site. The dams are designed to allow sediment to settle out rather than be transported away with the runoff. The NSW Government's *Managing Urban Stormwater: Soils and Construction* (2008), also called the Blue Book, provides best practice design criteria and construction notes for sediment basins. Amongst other design considerations outlined in the Blue Book, the overarching design objectives that sediment basins must meet are:

- appropriate water quality standards at the outlet
- critical structural integrity and stability standards
- sufficient volume for water and collected sediment
- they are designed to treat the type of sediment materials they receive
- timely dewatering to ensure volume is available.

Over time the sediment can build up and reduce the space available for storing water. The sediment level in dams should be monitored, and excessive build-up periodically cleaned out.

The sediment laden water in the dams is often directed to a larger wastewater holding dam prior to being reused for dust suppression, directed to a utilisation or irrigation area or being discharged via a licensed discharge point.



Figure 2: Sedimentation dam collecting sediment laden runoff from a partially rehabilitated area of a mine (Photo: N Wilmot/EPA)

Raw water and wastewater holding dams

Raw water and wastewater dams are dams that have been specifically designed to hold large volumes of water. Typically, the primary purpose of these dams is to store water for use in processing operations or for reuse in dust suppression. Wastewater holding dams may also operate as the final holding dam prior to off-site release of water.



Figure 3: Wastewater holding dam for the containment of potentially saline mine water runoff (Photo: J Ehmsen/RR)

Relevant legislation

The environmental impacts from mining are primarily regulated through the following legislation:

- *Environmental Planning and Assessment Act 1979* – assessment and approval of new mines and extension of existing mines
- *Mining Act 1992* – mineral exploration licences and mining leases, including provisions for environmental management and rehabilitation
- *Protection of the Environment Operations Act 1997* – environment protection licences that regulate environmental impacts during operations
- *Work Health and Safety (Mines and Petroleum Sites) Act 2014*
- *Dams Safety Act 1978*.

Environmental Planning and Assessment Act 1979

Mining, like other forms of development, requires development approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Once a mining proposal or project application is approved, DPE issues a project approval under the EP&A Act.

The project approval will include specific conditions for managing and monitoring the performance of water management infrastructure, including dams associated with the project.

Conditions on project approvals for mining projects address environmental management of impacts, and typically include the following dam facilities requirements:

- dam specific conditions (including water balances, monitoring seepage/leachate from water storages)
- preparation and implementation of a site water management plan
- obligations to implement best practice environmental management
- regular monitoring of environmental performance
- independent environmental and compliance auditing
- reviews of all management plans after incidents, annual reports, independent audits
- public reporting of environmental performance on mines' websites.

Annual environmental management reports

Annual environmental management reports or annual reviews (ARs) are one of the principal tools proponents use to report environmental management performance to the DPE and the community relating to dam facilities. The AR is prepared by the proponent and generally published on their website. Proponents report the status of any:

- approvals
- mining leases
- non-compliances
- incidents
- environmental risk management and control strategies.

Proponents also report on activities for the previous 12-month period, including:

- mining, mine development and rehabilitation in relation to the Mining Operations Plan (MOP)

- environmental performance in relation to the collective conditions of approvals, leases and licences
- community relations and liaison.

The AR must also outline any proposed improvements in environmental performance and management systems and proposed targets for the next 12-month period.

The water management section of the AR provides the opportunity for the proponent to discuss the overall performance of a project's water management facilities, including the identification of any non-compliance or incidents relating to dam facilities.

The DPE reviews the AR, assesses compliance, and takes enforcement action as required for identified non-compliances, in accordance with the DPE Compliance Policy (DPE 2016).

Independent environmental audits

Independent environmental audit reports (IEA reports) are the other key document the DPE reviews to assess a proponent's environmental management performance in relation to dams.

While not generally as frequent as annual reporting, independent environmental auditors provide a fresh set of eyes to audit a broader set of project approval/licence/lease conditions and aspects of environmental performance.

IEA reports often contain feedback from specialist audit team members who focus on high-risk environmental issues, identified during agency consultation, undertaken as part of the audit process.

As well as the review of compliance for project approval/licence/lease conditions, review of a site's Site Water Management Plan provides an opportunity for an auditor or specialist audit team member to discuss the overall environmental management performance of a project's dam facilities, including the identification of any non-compliances or incidents relating to dam facilities.

Proponents are generally required to commit to an action plan to remedy any identified non-compliances as a result of the IEA process. Further, the DPE reviews, assesses and takes enforcement (if required) against identified non-compliances in IEA reports in accordance with its Compliance Policy.

Mining Act 1992

The *Mining Act 1992* establishes the administrative framework for obtaining rights (titles) to minerals and incorporates provisions regarding royalties, land access and the protection of the environment, among other things.

Environmental impacts from exploration and mining are primarily regulated by issuing titles subject to environmental conditions. Failure to comply with environmental conditions is an offence and may result in the issue of a direction or penalty infringement notice, suspension of operations, prosecution or cancellation of a title.

Poor environmental performance, such as the breach of environmental conditions, may also result in the refusal of an application for a new title or the renewal of an existing title.

In addition, every titleholder must satisfactorily rehabilitate their site and provide a security deposit to cover the full cost of rehabilitation if the titleholder fails to fulfil their rehabilitation obligations. The amount of security is adjusted over time to ensure it reflects the full rehabilitation liability.

The RR expects compliance with the Mining Act and conditions of title and strongly encourages titleholders to undertake voluntary audits of operations that review and assess the effectiveness of their environmental controls. Where a titleholder is in breach of their

environmental conditions, any enforcement action will be decided on a case-by-case basis, with the RR consulting other government agencies to ensure a consistent, effective regulatory approach.

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) allocates responsibilities for pollution prevention and control to the EPA, local councils and other public authorities. The EPA is the appropriate regulatory authority for:

- regulating activities listed in Schedule 1 of the POEO Act
- ensuring compliance with environment protection licences
- regulating activities carried out by the state or a public authority.

Premises that undertake scheduled activities and meet the licensing threshold in the POEO Act are licensed and regulated by the EPA. Most mines undertake the scheduled activities of 'mining for coal', 'coal works', 'mining for minerals', 'mineral processing' or 'crushing, grinding or separating' as defined in Schedule 1 of the POEO Act. For a full list of scheduled activities and the classifications under them, refer to [Schedule 1 of the POEO Act](#).

Environment protection licences issued under the POEO Act set environmental performance requirements. Licences may specify a required performance outcome or a specific environmental management practice. Licence conditions consider factors such as the surrounding environmental conditions, the type of activity and the available technology. Pollution reduction programs and pollution studies are often attached to licences, requiring licensees to carry out work within a specified timeframe to comply with environmental requirements. Depending on the type of activity carried out, licensees may be required to undertake monitoring for water, noise or air pollution.

The POEO Act sets out a series of offences for actions that may pose a risk to the environment. These include water pollution (s.120), leaks and spills of substances (s.116) and air pollution (ss.124–132). These offences apply to industries and activities whether they are licensed or not.

Under the POEO Act, officers are authorised to exercise regulatory functions including:

- powers of entry and search
- powers to question and identify persons
- powers to issue notices.

The types of notices include:

- notices to provide information and records
- clean-up, prevention, prohibition, compliance cost and noise-control notices (see [Chapter 4 of the POEO Act](#), 'Environment protection notices')
- penalty notices
- notices to vary environment protection licences including attaching pollution reduction programs.

Work Health and Safety (Mines and Petroleum Sites) Act 2013 and associated Acts

The *Work Health and Safety (Mines & Petroleum Sites) Act 2013* and the *Work Health and Safety (Mines & Petroleum) Regulation 2014* (WHS (M&PS) Regulation), together with the *Work Health and Safety Act 2011* and the *Work Health and Safety Regulation 2011*, provide for health and safety in mining in NSW, and are collectively referred to as the WHS laws.

Under the WHS laws, mine operators must develop and implement a safety management system as the primary means of ensuring, so far as reasonably practicable, the health and safety of workers and that the health and safety of others is not put at risk from the mine or work carried out as part of mining operations. In most cases, the safety management system will include specific plans for hazards and risks at the mine, such as any principal mining hazard management plans and principal control plans for matters such as:

- inrush and inundation
- emergencies
- electricity
- health
- explosives
- plant and other mechanical risks.

There are also specific controls for a wide range of matters such as:

- air quality, ventilation and dust
- electrical safety
- operation of belt conveyors
- coal dust explosion and spontaneous combustion
- operation of shaft conveyances.

For coal mines, work carried out in respect of a tailings dam is classified as a high-risk activity under the WHS (M&PS) Regulation. High-risk activities have the potential for major safety implications if not planned and carried out in a systematic and integrated manner, considering the risks associated with the activity and the methods available to manage those risks. The high-risk activities scheme under the WHS (M&PS) Regulation allows the regulator to review the arrangements for the proposed activity to assess the adequacy of planning and controls. Notice of proposed high-risk activities must be given to the regulator before undertaking the activity, and 'waiting periods' are prescribed. The scheme does not require the regulator to approve activities and the responsibility for ensuring that activities are conducted safely remains with the mine operator.

Dams Safety Act 1978

The Dams Safety Act enables the formation and ongoing activity of the Dams Safety Committee (DSC)¹, which is required to:

- maintain surveillance of prescribed dams
- examine and investigate the location, design, construction, reconstruction, extension, modification, operation and maintenance of prescribed dams
- obtain information and keep records of dams
- formulate measures to ensure the safety of dams in NSW.

¹ Note that the Dams Safety Bill 2015 was assented to on 28 September 2015 but has not yet commenced (with the exception of Clause 5 of Schedule 2). When the new Act commences, the Dams Safety Committee will become Dams Safety NSW.

2 Audit methodology

Selecting mine sites to be audited

A range of factors was considered in selecting mines for this audit program. All mines audited hold current planning approvals under the EP&A Act, hold mining lease authorities under the *Mining Act 1992*, and undertake one or more of the scheduled activities as defined in Schedule 1 of the POEO Act:

- mining for coal
- coal works
- mining for minerals
- mineral processing
- crushing, grinding and separating (limited to mine sites).

The selection process was jointly conducted by the EPA, DPE and RR using a risk-based approach as well as the following considerations:

- the site having one or more prescribed dams as outlined in Schedule 1 of the Dams Safety Act²
- proximity of the tailings, wastewater and sedimentation dams to the receiving environment (and potential to impact on waters/settlements)
- sensitivity of the receiving environment
- past incidents in relation to discharges and site water management from dams/compliance history.

Scope, criteria and method of assessment

EPA audits

Audit scope

The scope of the EPA audits included an examination of activities undertaken at the premises in relation to the mine dam facilities and associated surface water management. These activities included:

- management of water levels in the mine dam facilities
- management of stormwater run-on into the dam facilities
- management of seepage from dam walls
- transport of wastewater between facilities
- monitoring and recording of data and information as per the licence conditions
- maintenance and operation of plant and equipment associated with the mine dams
- preparing, keeping, testing and implementing a Pollution Incident Response Management Plan (PIRMP).

² The Dams Safety Committee (DSC) is a statutory authority created under the Dams Safety Act to oversee the safety of dams in NSW and to prevent significant uncontrolled loss of their storages. The DSC regulates the safety of prescribed dams under the Act that are classified as Extreme, High and Significant consequence category dams and Low consequence category dams over 15 metres high. DPE is responsible for regulating mine sites through various regulatory instruments including mining leases. Provisions for 'prescribed dams' under the Dams Safety Act, and the requirements of the DSC, are included as conditions in mining leases issued to NSW mines. Therefore, compliance with these requirements can be assessed by DPE.

The temporal scope of the audits was limited to:

- the day of the audit inspection for observations relating to activities undertaken at the premises in relation to mine dams
- 24 months before the end of the audit inspection for monitoring, reporting and supporting documentary evidence.

It should be noted that the scope of the EPA audits did not include groundwater or raw water dams.

Audit criteria

The audit criteria (the requirements against which the auditor assesses audit evidence) were:

- conditions attached to environment protection licences that relate to the dam facilities
- the legislative requirements for PIRMPs – Part 5.7 of the POEO Act and Chapter 7, Part 3A of the POEO (General) Regulation 2009, in relation to the management of dam facilities.

Method of assessment

A compliance audit is an assessment of an auditee’s activities to determine whether they comply with the relevant regulatory requirements. Audit findings are generated by evaluating evidence collected before and during the site inspection against audit criteria.

The EPA conducts a risk assessment of non-compliances as part of the audit process to identify the relative significance of any identified non-compliance. The risk assessment involved assessing each non-compliance against two criteria:

- the likelihood of environmental harm occurring considering current and past environmental performance and potential contributing factors
- the level of environmental impact because of the non-compliance such as the quantity and toxicity of the material and the sensitivity of the receiving environment.

The ranking process coded the risk for each non-compliance as high (code red), moderate (code orange) or low (code yellow) using the matrix in Table 1.

Table 1: Risk analysis matrix (Source: DEC 2006)

		Likelihood of environmental harm occurring		
		Certain	Likely	Less likely
Level of environmental impact	High	Code red	Code red	Code orange
	Moderate	Code red	Code orange	Code yellow
	Low	Code orange	Code yellow	Code yellow

There are also a number of licence conditions that do not have a direct environmental significance, but are still important to the integrity of the regulatory system. These conditions

relate to administrative, monitoring and reporting requirements. Non-compliance with these conditions is given a code blue risk assessment.

The percentages of non-compliances found in each category during the audit process are shown in Table 2. The overall findings of the audit process are shown in Table 3.

Table 2: Percentage of EPA non-compliances found in each risk category

Colour code of issue	Red	Orange	Yellow	Blue	Total
Percentage of issues	0	2%	22%	76%	100%
Number of issues	0	3	31	107	141

Table 3: EPA assessment of audit findings

Finding	Compliant	Non-compliant	Not determined	Total
Percentage of audits	81%	16%	3%	100%
Number of compliance assessments	710	141	29	880

Further information: The EPA's public register contains details of all licences issued under the POEO Act, see epa.nsw.gov.au/prpoeoapp.

DPE audits

Audit scope

The scope of the DPE audits included discussions with management, document review, interviews with staff and a site inspection of activities undertaken at the premises in relation to the dams and associated surface water management. These activities included:

- management of water levels in the mine dams
- management of stormwater run-on into the dams
- management of seepages from dam walls
- transport of water between dams
- inspection, monitoring and recording of data and information
- maintenance and operation of plant and equipment associated with the mine dams
- notification of incidents associated with the mine dams.

The temporal scope of the audits included:

- the day/s of the audit inspection for observations relating to activities undertaken at the premises in relation to dam facilities
- 36 months prior to the end of the audit inspection for monitoring, reporting and supporting documentary evidence.

The scope of the DPE audit included raw water, dirty water, mine water and tailings dam facilities and their associated water management infrastructure.

Audit criteria

The audit criteria (the requirements against which DPE’s auditor assesses audit evidence) were:

- Project Approval conditions and where applicable, Statement of Commitments related directly to dam facilities
- environmental management commitments detailed in a project’s management plans (as required by the Project Approval). While the Site Water Management Plan is generally the predominant plan for the management of dam facilities, other plans such as Air Quality Management Plans and the Erosion and Sediment Control Plan may include commitments in relation to the management of dam facilities.

Method of assessment

The DPE assesses each requirement within each Project Approval condition/Statement of Commitments and environmental management commitments in management plans against evidence provided/collected.

Evidence took the form of documentation, in the form of reports, drawings, surveys or sign off forms, feedback from site interviews or observation made during the auditor’s site inspection.

The outcomes of the assessment were assessed as ‘compliant’, ‘non-compliant’ or ‘not applicable at the time of audit’. The overall findings of the audit process are shown in Table 4.

Table 4: DPE assessment of audit findings

Finding	Compliant	Non-compliant	Not applicable/ determined	Total
Percentage of audits	69%	15%	16%	100%
Number of compliance elements	482	105	114	701

Further information: DPE project approvals or development consents issued by the Minister under the EP&A Act are available at majorprojects.planning.nsw.gov.au/page/determinations.

RR audits

Audit scope

Given that the Resources Regulator is not a primary environmental regulator for mines, and there is considerable overlap between the obligations contained in Mining Operations Plans and the management plans required and approved by DPE, the Resources Regulator’s focus for the joint audit program involved reviewing and assessing compliance against the safety management requirements for mine dams.

Specifically, the Resources Regulator’s scope included:

- review of rehabilitation progress at each site and the ability of rehabilitated areas to reduce the water and sediment loading to dams on site
- review of any principal hazard management plans related to dams on each site (for example, plans for inrush or inundation)

- review of the mine's safety management systems in relation to management, monitoring and maintenance of dams
- review of any high-risk activity notifications or emplacement area approvals, and associated documentation, related to emplacement areas for coal mines
- assessment of the level of on-site implementation of risk management controls and management strategies in relation to management, monitoring and maintenance of dams – this included an assessment of compliance against the obligations contained in any relevant management plans pertaining to the management of dams on site.

The scope did not include any technical assessment of the engineering design or construction of dams; although where any issues of concern in this regard were identified during the audit, these issues were referred to the Regulator's Mine Safety Unit for further investigation and action if required.

Audit criteria

The audit criteria against which the operational performance was assessed included:

- the requirements of Part 2 *Managing risks* of the WHS (M&PS) Regulation as they relate to the operation and maintenance of dam facilities, specifically:
 - Division 1, Subdivision 1 *Control of risk*
 - Division 1, Subdivision 2 *Safety management system*
 - Division 2, Subdivision 1 *Identification of hazards*
 - Division 2, Subdivision 2 *Principal hazard management plans*
 - Division 6, Subdivision 1 *Emergency plans*
- commitments made by the mining company in documents pertaining to the operation and maintenance of dams, including:
 - operations and maintenance manuals
 - Dam Safety Emergency Plan.

Method of assessment

The audit process involved:

- interviews of mine personnel
- a review of documentation and samples of records provided by each mine
- a site inspection of the operations to determine the level of compliance of the project and the status of the project's operational performance.

All information obtained during the audit process was verified by the audit team where possible. For example, statements made by site personnel were verified by viewing documentation and/or site inspections where possible. Where suitable verification could not be provided, this has been identified in the audit findings as 'not determined'.

The outcomes of the assessment were categorised as 'compliant', 'non-compliant', 'observation of concern' or 'not determined'.

The overall findings of the audit process are shown in Table 5.

Table 5: RR assessment of audit findings

Finding	Compliant	Non-compliant	Observation of concern	Not determined	Total
Percentage of audits	55%	3%	25%	17%	100%
Number of compliance elements	69	4	32	21	126

Further information: Mining leases issued by the Division of Resources & Energy can be obtained from the Titles Administration System (TAS) database and graphics from commonground.nsw.gov.au.

Mines audited

Fourteen mines regulated by the EPA, DPE and RR were audited jointly (see Appendix A and Figure 4 for the locations of the mine sites).

The type of mines audited were:

- one copper mine
- one copper-gold mine
- two gold mines
- one lead-zinc mine
- nine coal mines.

Some audited sites had many dams. At all audited sites, an audit inspection was conducted of all prescribed dams and in some cases a representative sample of sediment and wastewater holding dams was selected for audit inspection.

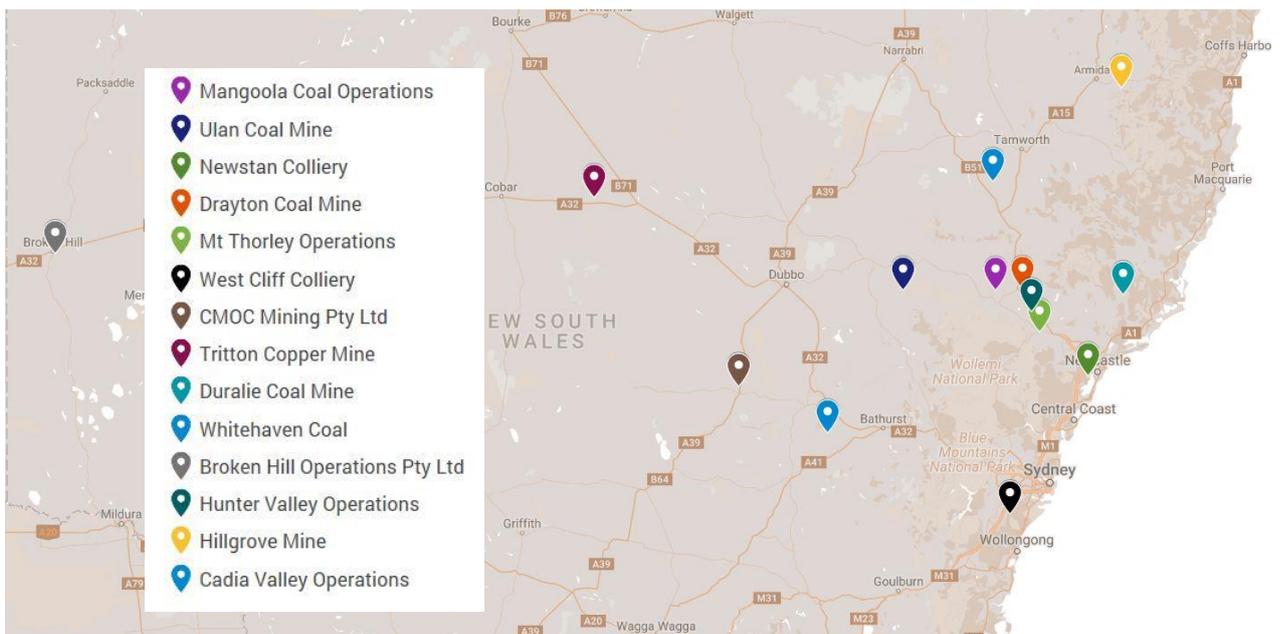


Figure 4: Locations of audited mine sites

3 Considerations for managing dam facilities and related audit findings

While mining has historically affected its surrounding environment, stringent regulation, advances in technology and changes in management techniques have reduced many negative impacts. Increasingly, regulators are requiring mining companies to reduce the environmental impact of mining and minimise the footprint of their activities.

Mining companies carefully manage water on mine sites to prevent the release of contaminated water into the environment. Various control techniques can be used to reduce the potential for water contamination and minimise the volume of water requiring treatment.

This section of the report collates and summarises the various best practices for managing dam facilities and related issues identified and reported on the individual compliance audits conducted by the EPA, DPE and RR. This section also highlights good practices (outlined in text boxes) observed during audit inspections that contributed to the competent management of dam facilities. The information in this section is provided to encourage all mines, where appropriate, to consider adopting these practices to minimise the footprint of their activities and corresponding environmental impact.

Risk assessment

Mines are required to:

- undertake a comprehensive risk assessment of their activities, including the operation and maintenance of dams on site
- identify the major risks
- document and put in place appropriate controls to effectively mitigate the risk.

Risk mitigating controls, including engineering standards, must be applied in the design and construction, and supervised by a qualified and experienced dam engineer.

The RR identified the following issues associated with the risk assessment process:

- One mine did not have any evidence of a documented risk assessment that included dams, but it was noted that this site was progressing risk assessments at the time of the audit (one site).
- A review of the risk assessments undertaken showed that on some sites, the documented controls to be implemented would not address the identified risk. For example, one mine had identified a risk of less than adequate dam design and construction; however, the documented risk control was listed as 'water management plan'. A review of the water management plan did not identify anything that would relate to the adequate engineering design and construction of dams on site. In this situation, the identified control would not be effective in mitigating the risk (one site).

Good practices observed at the mine sites audited:

Four mines were observed to have very comprehensive risk assessments in place for all dams on site with appropriate risk controls identified. These risk assessments had generally been undertaken at a corporate level in response to recent national and international high profile dam incidents.

Design and sizing

The design capacity of a dam is based on the anticipated operational output, precipitation and the risk level of the dam, which is determined by a dam sizing calculation.

The water from tailings, sedimentation and wastewater dams (dam facility) contains various contaminants and is not typically discharged. A good dam facility is appropriately designed and sized with optimal capacity for the life of the dam, to ensure its environmental and operational safety.

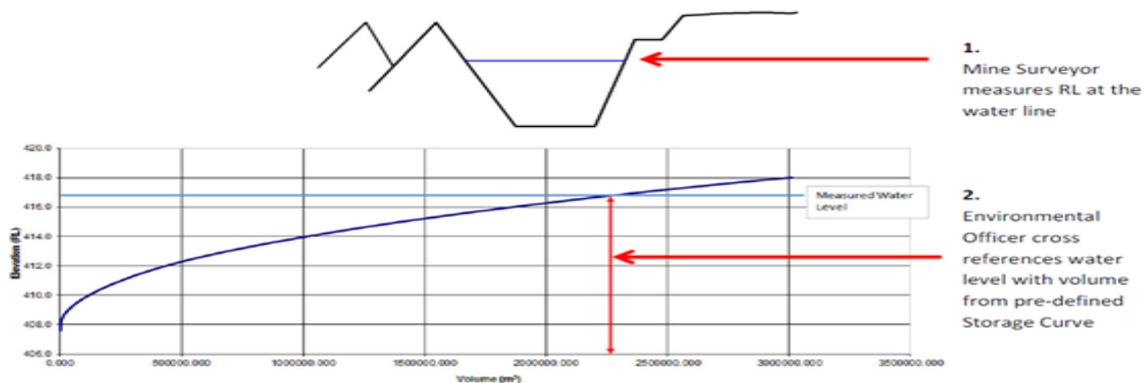
Tailings and sedimentation dams are different to conventional dams in that the water capacity is reduced as sediment and tailings build up. A good operation regularly reviews the level of sediments, and hence its dam's capacity to reflect operational output and any changes that would impact the dam's storage ability.

The dam sizing calculation for a sediment dam is also influenced by:

- the type of sediment treated
- the regional rainfall in the mine locality
- how quickly the dam can be reliably dewatered.

Accurately determining the capacity of tailings and sediment dams requires more than just measuring the water level. As sediment and tailings build up, the dam's capacity does not correlate with the water level. This is illustrated in Figure 5 (Hansen 2014), with sediment and tailings reducing the overall capacity while the water level remains constant. Methods that may be employed to accurately measure the water level of a tailings or sediment dam include hydrographic surveying systems, such as a remote craft fitted with an echo sounder or LiDAR device.

Without sediment and tailings build-up the relative level correlates to capacity



With sediment and tailings build-up the relative level does not correlate to capacity

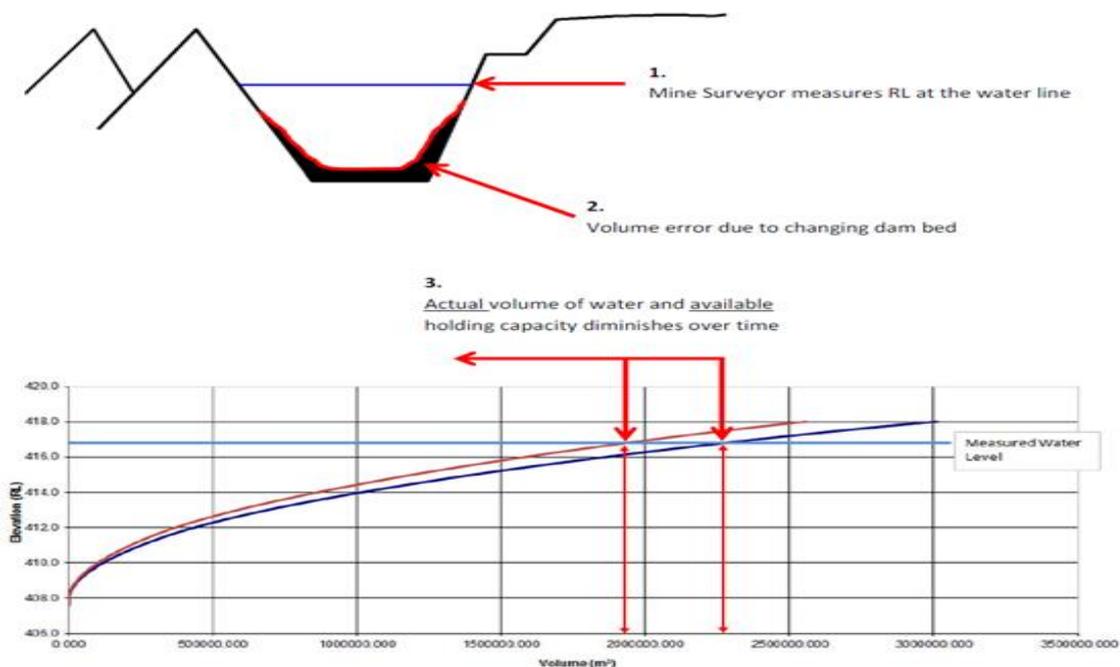


Figure 5: Sediment or tailings build-up impacts the reading of water level (Hansen 2014)

Design and sizing assessments (DPE)

The DPE identified the following non-compliances associated with the design and sizing of dam facilities at mines:

- Pegs/markers had not been installed in all dams or were not clearly visible in all dams. Some dam structures were not compliant with design volumes (one site).
- No 'as built' surveys or recent bathymetric surveys were available to confirm the current capacity of sediment dams (one site).
- Dam capacity documentation did not reflect management plan sizing (one site).
- Construction Review Report dam capacity did not align with the capacity nominated in the management plan (one site).
- No sediment dam sizing calculations were provided to allow confirmation of sediment dam sizes (one site).

- Multiple sediment dams were not constructed in accordance with the Blue Book, reducing effectiveness and the ability to desilt and implement a five-day management period (one site).
- Detailed design plans for the management of all Aboriginal heritage sites had not been provided (one site).

Prescribed dams (RR)

The DSC is responsible for ensuring the safety of dams where failure would cause serious community consequences. The DSC prescribes these dams under the provisions of the Dams Safety Act and uses a consequence category system to determine the need to prescribe a dam. Generally, all dams with an Extreme, High or Significant consequence category will be prescribed.

The DSC requires that the design of dams is undertaken by suitably qualified dam engineers. The design of prescribed dams must be submitted to the DSC as required.

Construction of prescribed dams must be undertaken by civil contractors and supervised by suitably qualified civil engineers. Construction reports must be available for prescribed dams and submitted to the DSC as required.

No issues were identified relating to the designing of prescribed dams by suitably qualified dam engineers or the submission of designs and construction reports of prescribed dams by the mines to the DSC.

For dams, other than prescribed dams, it was noted that there was generally a lack of design and construction documentation available, although most dams inspected appeared to have been constructed in a reasonable manner.

The RR identified the following issue relating to the design of non-prescribed dams:

- One dam inspected during the audit program was observed to have been constructed to standards below what would normally be expected. For this dam, the dam wall appeared to be sloping such that on the lower side of the wall, there was insufficient freeboard. This issue was referred to the Mine Safety Unit and, after further inspection, a notice under Section 23 of the WHS (M&PS) Act was issued requiring remedial works to the dam.



Figure 6: Inadequate dam wall construction with no operational freeboard and a noticeable low point in the dam wall (Photo: J Ehmsen/Resources Regulator)

Systems

Management plans and procedures

Management plans are crucial to the operations of large scale activities such as mining. They provide a structured approach to managing activities and achieving objectives. Management plans include objectives, procedures and a set of practices.

Principal hazard management plans (RR)

Principal hazard management plans form part of the safety management system for a mine. Based on the meaning of 'principal hazard' outlined in Clause 5 of the WHS (M&PS) Regulation, principal hazards are any hazards that have a reasonable potential to result in multiple deaths in a single incident or a series of recurring incidents. A reasonable potential refers to a real possibility or likelihood that the risk might eventuate. A series of recurring incidents refers to the type of incidents that have the potential to recur because workers will likely be exposed to the same hazard. Mines must identify any such hazards and prepare a principal hazard management plan to help ensure the hazard is adequately managed. Mine operators are required to conduct, in relation to each principal hazard identified, a risk assessment that involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with the principal hazard, and ensure that the best control measures are adopted for managing the risks associated with the hazard. Mines are required to prepare principal hazard management plans for inundation and inrush following completion of their risk assessments, if inundation and inrush are considered to represent principal mining hazards for the site.

The RR identified the following issues with principal hazard management plans:

- One mine audited had undertaken a broad-brush risk assessment which included the operation and maintenance of dams but had not completed a specific risk assessment

for inundation and inrush, and consequently had not determined whether this represented a principal hazard or not. Another mine had not completed its risk assessments at the time of the audit, and hence had also not determined whether inundation or inrush would represent a principal mining hazards. It was noted that under the savings and transitional provisions of the WHS (M&PS) Act, each site had until February 2017 to have its inrush management plan prepared (two sites).

- It was noted that some open cut mines had very detailed inrush and inundation management plans prepared. However, it was noted during discussions with site personnel that there appeared to be a lack of understanding of the need for an inrush and inundation risk assessment, particularly for open cut mines and surface operations, and the preparation of an inrush and inundation management plan should any significant inrush or inundation risks be identified (four sites).
- One mine had not prepared an inrush and inundation management plan. The completed risk assessments at the mine had identified the potential for loss of life in the event of a dam wall failure. Based on the meaning of 'principal hazard' outlined in Clause 5 of the WHS (M&PS) Regulation, such dams should be considered as potential inundation and inrush sources and the mine should have prepared an inrush and inundation management plan for those dams (one site).

Water management plans (DPE)

To comply with regulations and ensure that the quality of water leaving mine sites is not adversely affecting water users downstream, mining companies develop water management plans to minimise the potential for water contamination, and to prevent the release of polluted water into the environment.

A good operation incorporates their water management plan into their standard operating procedures and ensures that the water management plan is kept up to date. A water management plan:

- considers all water that is generated, collected and supplied on the site and its potential to pollute
- provides operating procedures to prevent and mitigate pollution incidents.
- may include the site water balance, water monitoring program, erosion and sediment control (ERSED) plan and a response plan.

The effectiveness of a water management plan depends on its implementation and applicability to operating conditions.

The DPE identified the following non-compliances associated with the management plans for dam facilities at mines:

- The management plan did not include section on minimising water use (one site).
- Although information was provided showing planting works were satisfactorily completed within 12 months, no documentation was provided to confirm the Vegetation and Landscape Management Plan was lodged with council (one site).
- There was no reference to applying Trigger Action Response Plan (TARP) trigger levels to the tailings dam seepage pits observed in groundwater monitoring bores TARP (one site).
- While the dam and tailings storage facility maintenance manual provided generic recommended actions for erosion, there were few actions specific to dams on site (one site).
- No Land Disturbance Approval Form was provided as required by the ERSED plan (one site).

- No Generic Soil Sample Sheet Form was provided as required by the ERSED plan (one site).
- No Rehabilitation Planning and Implementation Form was provided as required by the ERSED plan (one site).
- No Inspection of Erosion Form was provided as required by the ERSED plan (one site).
- The process to compensate affected landholders was not included in the Surface Water and Groundwater Response Management Plan (one site).
- The Water and Erosion Sediment Control Plan was not updated as per the requirements of consent conditions (one site).
- There was no evidence of consultation with other agencies for the preparation of the ERSED plan (one site).
- No Surface Water Monitoring Plan, Groundwater Monitoring Program or Surface and Ground Water Response Plan was available (one site).
- The Site Water Management Plan did not reflect the on-ground management and current storage capacity of dams (one site).
- Implementation of the Remediation Management Plan was delayed by weather conditions and trial results (one site).
- Various issues associated with the water management plan were not implemented to the satisfaction of the Secretary (one site).
- The Surface Water Monitoring Program did not contain specified baseline data (one site).
- An estimate of salt (in tonnes in the system) had not been included in the Annual Site Water Balance (one site).
- The ERSED plan did not contain specified inspection and maintenance requirements (one site).
- The Environmental Management Strategy did not list dams that will be inspected on a weekly, monthly or annual basis (one site).
- Inspections of erosion and sediment control structures were undertaken, although weekly inspection of all erosion and sediment works was not undertaken. Erosion and sediment control inspection scheduling was inconsistent. There was confusion with implementing the Ground Disturbance Permit process (one site).
- The management plan's definition of an incident was inconsistent with approval (one site).
- There was no evidence of a management plan review following submission of the annual report (one site).
- Governance review statements indicated that improvement activities in the water management plan had not been completed (one site).

Training and competency

Both the ANCOLD *Guidelines on Dam Safety Management* (ANCOLD 2003) and the DSC guidance sheet DSC3G: *General Dam Safety Considerations* (DSC 2010b) identify that personnel involved in the operation and inspection of dams should undertake relevant training in dam safety management, with refresher training being undertaken every five years. All mines must have systems in place for managing staff training and competency.

The RR identified the following issues associated with the training requirements for dam safety personnel:

- Staff involved in undertaking dam inspections had either not done appropriate dam safety training at all, or had completed such training more than five years ago (five sites).

- Not all mines had specifically identified the training and competency requirements for inspecting and operating the dams and consequently, did not have appropriately trained staff doing the dam inspections (five sites).

The DPE identified the following non-compliances associated with training for dam facilities at mines:

- The site environmental representative had not undertaken any external dam safety training courses at the time of the audit (one site).

Incident/emergency management

Dam safety emergency planning (RR)

Best practice for dam safety emergency plans (DSEPs) is generally considered to be outlined in the ANCOLD *Guidelines on Dam Safety Management* (ANCOLD 2003), and DSC guideline DSC2G: *Emergency Management for Dams* (DSC 2010a). The ANCOLD guidelines state that it is essential that the DSEP be tested periodically by conducting a drill simulating emergency conditions. ANCOLD recommends a drill be conducted at least once every ten years for high and significant category dams.

The DSC2G guideline states:

For DSEPs to remain effective it is imperative that they be regularly updated and tested. In this regard, the DSC requires DSEPs to be updated annually, and to be reviewed and tested at least once every five years with actions in this regard to be reported in surveillance reports for each dam.

Clause 93 of the WHS (M&PS) Regulation requires the operator of a mine to test the emergency plan for the mine at intervals of no more than 12 months.

Dam safety emergency planning was the second highest ranked element for the number of non-compliances, observations of concern and suggestions for improvement. Whilst evidence was generally sighted to confirm that all mines had plans to test their general emergency management plans at regular intervals (usually annually), it was noted that over half the DSEPs had not been tested in the last five years. Three mines were noted to have undertaken actual DSEP drills, with another two mines completing desktop exercises. One mine provided evidence that its notification and evacuation process for community members was tested on an annual basis to confirm that correct neighbour details were recorded and that the method of messaging was being received and understood.

The RR identified the following issues associated with dam safety emergency planning:

- Mines had contact details for potentially affected neighbours recorded in their DSEPs; however, it was noted that there was no process in place to review and confirm these contact details on a regular basis (e.g. during an annual review) (eight sites).
- The DSC requires DSEPs to be updated annually for all prescribed dams. No evidence was sighted to indicate that the DSEPs were reviewed or updated on an annual basis, and it was noted that the DSEPs did not always reflect the organisational structure or current status of the dam (five sites). For example, for one mine, the consequence category for a prescribed dam had been amended, however this was not reflected in the DSEP. Similarly, there were three mines where the organisational structure or personnel had changed, which may impact on the roles and responsibilities for dam safety management; however, the DSEPs had not been updated to reflect the changes.

Pollution Incident Response Management Plan (EPA)

The purpose of requiring licensees to have a Pollution Incident Response Management Plan (PIRMP) is to improve the management of pollution incidents and facilitate better coordination with the relevant response agencies. The objectives of these plans are to:

- ensure comprehensive and timely communication about a pollution incident to staff, the community and to regulators/response agencies
- minimise and control the risk of a pollution incident at the facility by requiring the identification of risks and the development of planned actions to minimise and manage those risks
- ensure that the plan is properly implemented by trained staff, identifying persons responsible for implementing it, and ensuring that the plan is regularly tested for accuracy, currency and suitability.

Since 2012, under [Part 5.7A of the POEO Act](#), all operators are required to keep, test and implement a PIRMP. This requirement improves the way pollution incidents are reported, managed and communicated to the general community (see www.environment.nsw.gov.au/resources/legislation/201200227egpreppirmp.pdf).

The EPA identified the following issues associated with the PIRMPs of sites audited:

- **inventory of pollutants** – not including the wastewater contained in tailings, sediment or wastewater dams as a potential pollutant on site or the maximum quantity stored (ten sites)
- **maps** – not providing maps showing the location of the site, stormwater drains, potential pollutants (including wastewater/sediment/tailings dams), nearest residences or the surrounding area likely to be affected by a pollution incident (nine sites)
- **testing plans** – not testing the plan at least once every 12 months or within one month of a pollution incident,
- **Plans** – the plans not including the dates the plan was tested, the name of the person carrying out the test or the way the plan would be tested and maintained (eight sites)
- **contact details** – not providing all the names or contact details of key personnel or relevant authorities (eight sites)
- **safety equipment** – not including the description of any safety equipment on site (two sites)
- **staff training** – not including the nature and objectives of any staff training (two sites)
- **arrangements for minimising harm to persons on the premises** – not clearly referencing other plans which detail the arrangements for minimising the risk of harm to any person on site during an incident (one site)
- **early warnings** – not including a description of how any identified risk of harm to human health would be reduced by means of early warnings or updates to persons on or off site (one site)
- **notification procedures** – not including the procedures to be followed in notifying a pollution incident to the local authorities and for coordinating with the authorities in combating a pollution incident (one site)
- **availability of plan** – not making the plan available to an authorised officer when requested (one site)
- The PIRMP not containing a requirement to notify the DPE of an incident (one site).

Further information: Additional guidance for licensees on how they can improve their level of compliance with the requirements to prepare and implement a PIRMP is available at <http://www.epa.nsw.gov.au/resources/licensing/130721ECRPIRPMP.pdf>.

Incident reporting and corrective actions

An effective dam safety management system needs to have established systems to record, track and close out corrective actions.

All mines audited were found to have systems in place for logging and tracking corrective actions (e.g. CMO or INX or similar). However, in many cases, these systems were not being utilised to record and track issues raised during either routine dam inspections or surveillance inspections. Some mines had separate spreadsheets for recording and tracking actions, however these were not routinely monitored and there was no process for escalation if issues were not addressed in a timely manner.

Thus, several mines had not actioned recommendations from surveillance reports, and in some cases, actions had remained outstanding for almost two years.

Operation of dam facilities

Managing water levels

Water levels in mine dams are managed to prevent the pollution of waters and land by uncontrolled discharges and dam failures. Two aspects are considered when managing dam water levels – the control of stormwater run-on to the dam and minimising water levels in the dam to prevent uncontrolled discharges to surface waters.

To minimise the level of water present in mine dams, dam water may be reclaimed through decant facilities which can include pump or gravity collection systems. The water collected is reused directly in mine processes. Water inflow to tailings dams can also be controlled by lowering the water content of the tailings slurry. Adjusting operational parameters to produce a thicker slurry or paste reduces the amount of water entering the dam; however, this must be monitored to ensure that it does not cause other impacts, such as issues with its transport, and dust issues.

Key considerations for managing water levels include ensuring:

- adequate freeboard is maintained for a minimum 72-hour storm event without overtopping
- pumps are appropriately sized
- equipment including pumps are maintained and operating effectively
- back-up pumps, back-up power and other such contingencies are in place and in working order, especially where electric pumps are used
- employees are trained and competent in the operation of the water management system
- operating procedures are up to date, accurate and implemented
- emergency procedures are in place.

The DPE identified the following non-compliances associated with managing water levels for dam facilities at mines:

- actions were not undertaken as required by the Water Management Plan Action Plan (one site)
- the location of the moisture probes did not adequately monitor the discharge from the irrigation sprinklers in the irrigation area to the south-west of the main water dam (one site)
- significant adverse vegetation impacts were observed in the irrigation area (one site)
- while DSC approval stipulated that the tailings dam was not to store water, the tailings dam was observed containing significant volumes of water (one site)
- discharge was occurring off site as a result of the leakage from a pipe sourced from a mine water discharge dam (one site)
- the sediment fence was not installed in accordance with the Blue Book (one site)

- the annual review report reviewed over three years illustrated breaches of water discharge limits (one site).

The EPA identified the following operational issues:

- operating the water level of a wastewater holding dam at its near full supply level capacity, causing overtopping during a storm event (two sites)
- not having adequate controls to ensure sufficient freeboard in a wastewater holding dam (one site)
- not having adequate controls in place to minimise water levels in sedimentation dams to prevent discharges and causing issues with seepages from the dam wall (one site).

Good practices observed at the mine sites audited:

- use of solar powered web cams on dams to remotely access information on dam levels
- during normal operation, on-site water storage dams (e.g. sediment dams) were maintained at low levels to ensure that adequate capacity was available in the event of a storm or period of prolonged rainfall
- using level sensors with float switches in prescribed dams to detect high water level and overflow water level in the dams, via alarms
- using electronic telemetry systems for information on water level changes and movement of water around the site.

Freeboard

The freeboard will vary with the size of the dam, area of catchment and likely wave action, and is designed to maximise the containment of stored wastes and minimise the number and size of outflows during storm events. The freeboard is usually set to contain a minimum 72-hour storm event without overtopping.

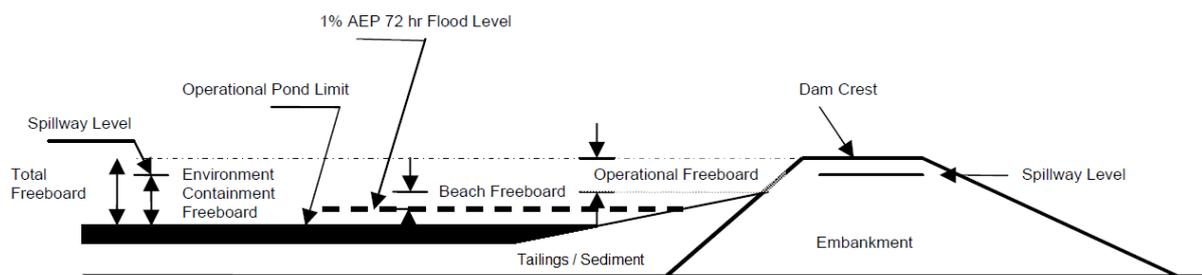


Figure 7: Diagram showing the various types of freeboard, including an environment containment freeboard (adapted from DSC 2012, p.9)



Figure 8: High and high high level float switch system used to monitor water levels in a dam. The system sends an SMS alarm to the operator/s and management when the maximum operational storage level is reached (high level) or when the water level reaches the spillway level (high high level). The information is telemetered using an independent solar power source (Photo: E Howard/EPA)



Figure 9: Close up of the float switch system with the high level, and high high level float switches (Photo: E Howard/EPA)

Site water balance

Balancing the water inflows and outflows in mine dams is critical to their management and to prevent environmental harm. Inflows of a water balance include water contained in the slurry, precipitation and stormwater run-on; outflows include return water, evaporation and seepage.

Water balance is carried out when designing the mine site to inform the dam design capacity and operational limitations and risks. The water balance is also used during operations to allow forecasting of dam water levels and scheduling of operational activities to prevent dam overflow or spill. A good operation has its water balance regularly revised and updated, particularly after any changes have been made to its operations. A good operation also consults its water balance to inform operational decisions and activities.

Controlling stormwater run-on

Dams should be planned and designed so that clean water and other wastewater streams are segregated and managed separately. Controlling the amount of clean water that enters a dam system is the primary method used to minimise the volume of water that needs to be stored and treated in dams. Clean stormwater runoff should be diverted around the site or away from operational areas wherever possible.

Properly sizing dams will help prevent overtopping of dams and reduce the likelihood of uncontrolled discharges polluting nearby surface waters. The size and characteristics of the catchment area of any dam should be quantified and factored into the design and design volume of the dam.



Figure 10: Stormwater diversion drains in place to prevent clean stormwater runoff from entering the tailings and sedimentation dams on site (Photo: M Hatzakis/EPA)

The EPA identified the following issues:

- a diversion drain had not been constructed near a tailings dam to divert storm runoff away from the dam. This stormwater runoff was also not factored into the design capacity of the dam during construction (one site)
- not managing the stormwater inputs to sedimentation dams to minimise the potential for water in the dams to be contaminated with coal contact water and coal fines and reducing the capacity of the dam (one site)

- not adequately controlling stormwater run-on to a sedimentation dam to prevent the uncontrolled discharge of potentially contaminated waters from the site (one site).



Figure 11: Sedimentation dam used to capture stormwater runoff from an area where coal stockpiles are located, resulting in coal fines and coal contact water reporting to the dam; a build-up of coal fines can be seen in the dam (Photo: E Howard/EPA)

Seepage

Seepages can potentially develop through the embankments, foundations and floor of a dam. The amount of seepage loss will depend on the permeability of the various materials used for the construction of the dam facility. The environmental impact of contaminated seepage may be a significant factor especially in the overall management of a water balance.

All dams have some level of seepage as the impounded water seeks paths of least resistance through the dam and its foundation. Because mine dams hold polluted water, seepage from mine dams must be controlled to prevent pollution of water and land.

Mine dam seepage, if not properly controlled, can cause the pollution of waters and can also lead to seepage-induced failure of the dam.

Controls to manage seepage include barrier and collection systems such as impermeable liners, filters, trenches, drainage systems and collection wells. Routine maintenance and monitoring of dam walls should be carried out, along with monitoring of seepage quality and volume. Minimising the amount of water collected in the dam will also reduce seepage. Collected seepage must not be discharged to waters. Operators generally pump the seepage water back into the dam and therefore proper operation and maintenance of pumping systems is imperative.

Knowledge of the dam's history is important to determine whether the seepage condition is in a steady or changing state. It is important to keep written records of points of seepage exit, quantity and content of flow, size of wet area, and type of vegetation, for later comparison. Photographs provide invaluable records of seepage to see change over time.

Considerations in managing seepages:

- regular surveillance and maintenance of the internal embankment and foundation drainage outlets
- regularly monitor and document the rate and content of flow from each pipe outlet for toe drains, relief wells, weep holes, and relief drains
- maintenance consists of removing all obstructions from the pipe to allow for free drainage of water from the pipe
- removal of typical obstructions including debris, gravel, sediment, mineral deposits, calcification of concrete, and rodent nests.

Good practices observed at the mine sites audited:

- use of solar powered web cams on dams to access information on dam levels remotely
- managing dams in a low draw down state.

The EPA identified the following issues:

- seepage was not being managed in a manner that prevents surface water pollution (two sites)
- not having a monitoring procedure in place to ascertain the condition of the dam seepage trench and to monitor water levels and water quality monthly as planned and after heavy rainfall events (one site)
- seepage from the tailings dam wall was not being managed in a manner that will prevent contaminants entering the dirty water system, increasing the risk of polluting waters (one site).

The DPE identified the following non-compliances associated with seepage from the dam facilities at mines:

- off-site discharge occurring because of seepage from the tailings storage facility (two non-compliances)
- while seepage was occurring, none of the inspection and monitoring checklists and records reviewed identified storage dam seepage as an issue (one site).

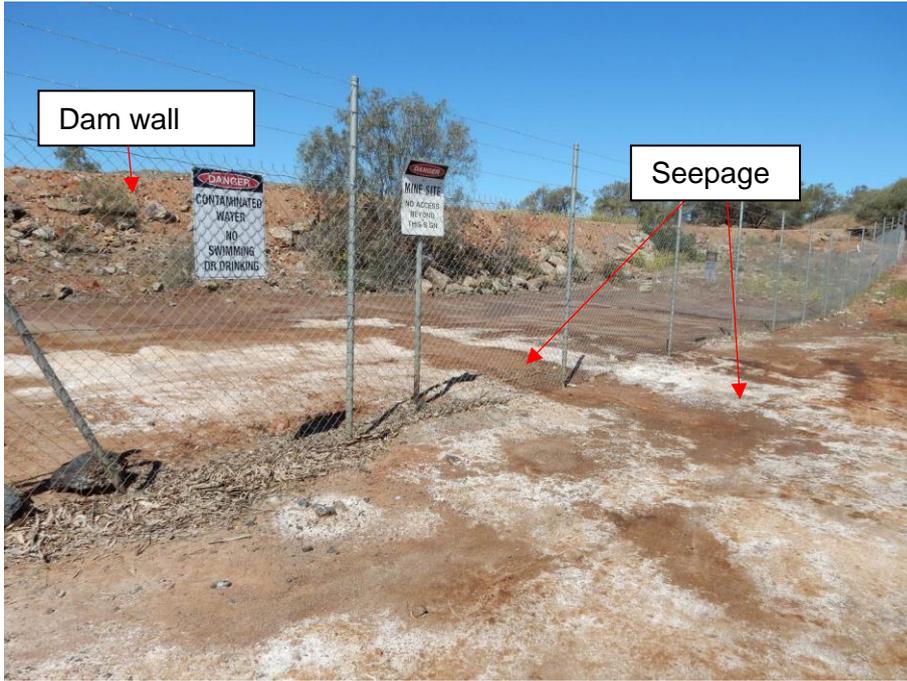


Figure 12: Seepage through a dam wall (Photo: L Silk/EPA)



Figure 13: Seepage collection system not being operated properly; seepage was pooling outside the sump and likely to flow to a clean diversion dam (Photo: L Silk/EPA)

Dam inspections

Routine inspections and monitoring of dam water levels are an important management tool that should be used to help prevent and minimise environmental impacts associated with such activities. It is important to record inspection, monitoring and performance data to enable analysis and assessment and to make informed decisions about site operations. Monitoring in relation to mine dams is vital because of the pollutant potential of any discharges from dams.

Good operations routinely carry out inspections and monitor dam water levels. Routine inspection informs operators of any issues before they become major issues. Monitoring dam water levels informs operational decisions to prevent dam overflows or spills.

The DPE identified the following issues of non-compliance associated with inspections of dam facilities at mines:

- no inspections sheets were available for heavy rainfall events (two sites)
- while prestart checklist and subsequent maintenance scheduling was observed for light vehicles, no prestart checklists were observed for pumps (one site).

Monitoring

Monitoring can be broadly defined as the systematic collection, analysis and interpretation of data to effectively track, manage or alter site management activities.

Water quality from mining operations should be regularly and reliably monitored so the level of impact on the surrounding environment can be determined. Water monitoring programs are designed to provide quantitative information on water quality levels and, providing they are well planned, should also provide information on trends.

Monitoring is an important management tool that should be used to help minimise the environmental impacts associated with activities. It can be used by industry to collect information to characterise changes in environmental emissions and to enable appropriate action to be taken when data indicates that the quantity and/or nature of emissions is changing.

Effective monitoring requires the results of measurements to be analysed and assessed on an ongoing basis, against previous results and relevant criteria, so trends may be identified.

Monitoring is not just the collection of data but also the use of this data to make informed decisions regarding site operations.

Weather conditions have a significant impact on the water level of a dam. Weather conditions can cause dam water levels to rise, as is the case during a precipitation event, or fall, caused by evaporation. As such, monitoring weather conditions is necessary for the competent management of mine dams. Accurate monitoring of weather conditions requires weather stations to be maintained to operate correctly. This includes ensuring:

- the weather station is calibrated
- the sensors are free from dust
- the power source is uninterrupted
- the location of the weather station is free from obstruction and other physical features that impact on the ability to monitor accurately.

Concentration limits and water quality monitoring

Best practice management of water quality requires assessing the impact of mining activities on concentration levels in the surrounding environment and the effectiveness of the controls that may be applied.

Water quality monitoring can be used to assess the effectiveness of measures implemented to prevent or minimise pollution of waters. A regular review of water quality monitoring data and analysis of trends encourage adaptive management and continuous improvement.



Figure 14: Monitoring equipment collects data and information to help manage site activities and operations (Photo: N Wilmot/EPA)

To properly monitor any actual or potential environmental issue, samples or measurements must be taken at sufficiently regular intervals and with appropriate rigour to provide a reliable basis for such an analysis or assessment.

It is essential that monitoring reflects the true nature and environmental impact of any environmental issue. The monitoring process should be outlined in a monitoring plan tailored specifically for each site. The plan should detail the actions, responsibilities and timeframes for monitoring, how data is to be collected and analysed, and what information needs to be extracted to manage site operations.

Monitoring that is undertaken to satisfy the requirements of an environment protection licence must be based on the relevant standards and approved methods (EPA March 2004, refer to DEC 2004). In the case of water, where an analysis method is not specified in the manuals, the EPA requires that monitoring be undertaken in accordance with any methodology that a licence condition requires, or if there is no such requirement, any methodology that has been approved by the EPA in writing.

Good practices observed at the mine sites audited:

- five-day forecasting of weather conditions to initiate management responses to predicted storm events
- using information from two weather stations to verify the actual versus predicted rainfall.

The EPA identified the following water discharge limit condition issues:

- exceeding pollutant concentration limits for discharge to waters (five sites)
- stormwater and other surface water holding ponds identified in the Site Water Management Plan have not been constructed and maintained to accommodate the stormwater runoff generated in a 100-year (24-hour) Average Recurrence Interval rain event (one site).

The EPA identified the following issues in relation to the monitoring of water pollutants in accordance with the *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (DEC 2004) and monitoring at the frequency required by the licence:

- not using the methods specified in the approved methods document and not seeking approval for the use of alternative methods of sampling or analysis from the EPA (11 sites)
- the sampling procedure did not specify how samples are collected to be representative of the condition being investigated (one site)
- not monitoring the pollutant concentrations of discharges at the required frequency (three sites).

The DPE identified the following issues of non-compliance associated with monitoring of dam facilities at mines:

- the commitment to install and monitor three monitoring piezometers per void water dam was not implemented (one site).

Reporting

A document management system for tracking, managing and storing documents is necessary to maintain the consistency of information across various procedures, work instructions and policy statements. Inconsistency can cause errors in the decision-making process and creates little confidence in the quality of the outputs.

Mines are required by conditions in their various statutory instruments, such as environment protection licences and annual environmental management reports, to submit various monitoring reports to the respective regulatory agencies such as the EPA and DPE.

The EPA identified the following issues in relation to reporting conditions:

- not recording the required details for water samples that were taken (i.e. date or time, name of person taking sample, location) (one site)
- not providing written notification to the EPA within the required timeframe for four incidents that had occurred that caused or threatened material harm to the environment (one site).

The DPE identified the following issues associated with reporting of dam facilities at mines:

- the annual review report was not completed within three months of the end of the financial year (one site)
- quarterly water monitoring results were not available on the website; no quarterly monitoring summary was available (one site)
- the review of monitoring results confirmed the electrical conductivity of the main water dam was above trigger levels; a soil survey and evaluation report was provided for 2014 but not for 2015 or 2016 (one site)
- there was no identification of trends over the life of the project related to dams provided in the annual review report (one site)

- while an annual water balance was provided for 2015, the report highlighted a significant departure in dam water volumes in the main water dam compared to predicted volumes (one site)
- the ERSED plan was not published on the website at the time of the audit (one site)
- no records were kept of erosion and sediment control works; reporting and document procedures need to be developed and implemented (one site)
- the annual review report did not identify trends in monitoring data between years and over the life of the project (one site)
- while inspections identified that dams required clearing of sediment, this need was not entered or tracked into the site's maintenance planning system (one site)
- the annual review report did not address various requirements and was requested to be resubmitted (one site)
- reportable incidents were not reported to both the EPA and DPE on all occasions (one site)
- only the 2016 annual review was available on the website; at least the last three years of annual reviews are required to be available (one site).

Surveillance reporting (RR)

Twelve of the mines included in the audit program had prescribed dams under the Dams Safety Act on their sites. It was noted that each of these mines had generally undertaken surveillance inspections and reporting at the frequencies required by their respective consequence categories. Evidence was sighted to indicate that these surveillance reports had been submitted to the DSC as required.

Good practices observed at the mine sites audited:

One of the two mine sites which had no prescribed dams had opted to treat its dams as if they were prescribed based on the results of the risk assessment that had been undertaken. For this site, annual dam inspections were undertaken of each dam on site by a qualified independent external dam engineer and an annual surveillance report was prepared, generally in the format of a Type 3 surveillance report under the DSC guidelines.

Whilst the mines were undertaking the surveillance inspections and reporting, the key issue appeared to be in the recording, actioning and tracking of recommended actions. Very few sites could demonstrate timely implementation of surveillance recommendations, with some surveillance reports repeating recommendations the following year after no actions were taken.

Maintenance

A maintenance program ensures environmental and operational incidents are minimised and prevented. The maintenance of a dam includes maintenance of its associated plant and equipment such as gauges, pumps and piping. Associated plant and equipment impact on the operational performance of a dam. A maintenance regime that is consistently and regularly carried out resolves operational issues at their onset and prevents them from becoming critical and costly. In summary, maintenance results in efficient and effectively performing dams.



Figure 15: Scouring in emergency spillway
(Photo: C Caselia/EPA)

A good maintenance program against deterioration for any dam will prolong its life and reduce the risk of failure. All components of a dam are susceptible to deterioration. It should be noted that some repairs, such as heavy scouring or riling of an embankment, should be conducted in consultation with an engineer so the integrity of the dam facility is not compromised.

Some considerations in maintaining dam facilities include:

- operation of the dam facilities, including the inflow and outlet devices
- periodic and timely maintenance of embankments and spillways to prevent riling, deterioration, blockages and possible failure
- controlling vegetative growth which may obscure the view of the surface of an embankment and impinge on inspections of the dams
- maintenance checks for diversion drains
- knowledge of critical maintenance issues as well as proactive/preventative maintenance
- filling animal burrows
- removing all underbrush and trees from the dam, and establishing a good grass cover to minimise bank erosion
- routine technical inspections of the dams regarding the dam crest and/or access roads
- repairing fencing to keep livestock from entering the dam
- maintaining monitoring points
- removing debris from spillways and outlet conduits
- calibration of monitoring equipment
- back-up diesel pumps where premises operate electric pumping systems
- safety and security measures and location of locks and emergency contact details of the operator.



Figure 16: Spillway not properly maintained

(Photo: W Wickremeratne/EPA)

Good practices observed at the mine sites audited:

- preventative maintenance schedule for critical parts of the plant
- follow-up procedures and reporting outstanding maintenance issues at pre-start meetings to ensure all defects were promptly actioned.

The EPA identified the following issues associated with the maintenance of dam facilities:

- gully and rill erosion were evident on the inner walls of dams (two sites)
- trees of a moderate size were located on the exterior wall of a tailings dam (one site)
- a gauge board used to monitor dam water levels was damaged and lying on the ground (one site)
- a return pipe located adjacent to a prescribed wastewater holding dam had a broken seal, causing wastewater to discharge via a licensed discharge point (one site)
- sediment build-up in the sediment dams impacted on their design capacity (one site)
- there was no routine inspection regime of mine dams to detect issues such as erosion, seepage and leaks so any potential issues could go undetected for some time (one site)
- not undertaking the required maintenance to desilt a storage basin to retain the basin's design storage capacity (one site)
- pipelines used to convey seepage water from a tailings dam to an intermediate dam were leaking and not being contained (one site)
- sediment build-up was evident within the wastewater holding dam, decreasing the holding capacity and increasing the likelihood of more frequent discharges of dam water causing pollution of waters (one site).

The DPE identified the following non-compliances associated with the maintenance of dam facilities:

- signal cabling associated with the moisture probes in the irrigation management system was observed in poor condition (one site)
- while maintenance manuals were provided, no evidence of implementing actions was documented (one site)

- leakage of water from pump and pipework was sourced from a mine water discharge dam (one site)
- while inspections showed a general level of compliance, significant erosion was observed at the inlet to a sediment control dam (one site)
- the dam contained excessive build-up of sediment and a large erosion scour was observed at the inlet to one of the sediment control dams (one site)
- the dam contained excessive build-up of sediment (one site)
- vegetation was growing under/over level control signage, trees were growing on dam walls and sediment fences were poorly installed and in poor condition (one site)
- maintenance was required on dams: level markers required cleaning, there was seepage, vegetation was growing on a dam wall (one site).

Dam safety

Dam safety inspections (RR)

The Australian National Committee on Large Dams (ANCOLD) published the *Guidelines on Dam Safety Management* (ANCOLD 2003), which are generally considered to represent best practice in relation to the management of dams. These guidelines identify that dam safety and surveillance programs should generally be included in the contents of an operation and maintenance manual.

The inspection process is integral to identifying and rectifying any issues associated with the safe operation and maintenance of the dam, and inspection frequencies are generally specified by the dam engineers in response to the nominated consequence category of each dam. For inspections to be effective in mitigating the risk of serious dam wall failure, the inspection process needs to be undertaken at the specified frequency, with documented inspection checklists or reports being maintained.

It is not only important that the inspection process is documented, but that inspectors are trained in how to complete and document their inspections effectively. Where corrective actions are identified, these must be recorded, actioned, and closed out in a timely manner.

The following issues (non-compliance, observations of concern and suggestions for improvement) were identified in relation to dam safety inspections:

- mines not demonstrating that they have effective inspection, monitoring and reporting processes in place (12 sites)
- mines not having documented inspection procedures (one site)
- not completing inspection checklists at the frequency documented in the operation and maintenance manual (four sites)
- inconsistent recording of routine inspections in the inspection checklists:
 - completion of the daily checklist relating to the tailings storage facility was only completed 15 times in a sample of 27 daily checklists reviewed during the audit (one site)
 - a review of a sample of the weekly inspection checklists showed that there were at least four weeks where the inspections had only been completed twice weekly, whereas the operation and maintenance manual specified that routine inspections were to be undertaken three times per week (one site)
 - the daily Tails Dam Inspection Sheet included an item labelled 'Operational freeboard (at wall)'. Some inspectors had left this checklist item blank, some commented 'Good' or 'OK', while others had recorded the actual freeboard level (e.g. 0.5 metres). The annual surveillance reports for this facility concluded that provided the specified freeboard criterion was maintained, the dam could be operated safely. Given this

conclusion, it was critical that accurate information on the freeboard level be recorded and maintained (one site)

- inspection processes at some sites were very cursory and may not be effective in identifying issues associated with the operation and maintenance of dams:
 - It was noted during the audit site inspection that a large tree had fallen across the spillway of one dam, effectively blocking the spillway (Figure 17). However, a review of the inspection checklists for the week prior to the audit showed that this had not been picked up during the routine inspection process; hence no action had been taken to remove the tree. It was noted that each of the checklists reviewed had the 'Spillway obstructions' box ticked as OK with no actions required (one site).
 - A movement survey monument on one dam was observed to have been damaged, while a water level gauge board in another dam had fallen over so it would not be able to be used for water level gauging (Figure 18). Neither of these issues appeared to have been identified in the routine inspections, and consequently no corrective actions had been initiated (two sites).



Figure 17: Fallen tree blocking the grassed spillway on a sediment dam
(Photo: J Ehmsen/Resources Regulator)



Figure 18: Damaged gauge marker board on a major water storage at one site
(Photo: L Silk/EPA)

Dam safety monitoring

All mines that have prescribed dams are required to establish dam safety monitoring programs for their dams with monitoring principally comprising:

- piezometers (Figure 19) with water levels recorded on a regular basis
- regular surveys of movement survey prisms or monuments (Figure 20)
- water level monitoring either through electronic water level sensors or manually read gauge boards (Figure 21).

For the monitoring programs to be effective in identifying potential issues with the dam structures, it is important that any monitoring equipment installed is regularly inspected and maintained.



Figure 19: Example of an automatic monitoring piezometer installed on a dam wall
(Photo: J Ehmsen/Resources Regulator)



Figure 20: Example of a movement survey prism on a dam embankment
(Photo: J Ehmsen/Resources Regulator)



Figure 21: Example of manually read gauge marker boards in a tailings dam
(Photo: J Ehmsen/Resources Regulator)

The RR identified the following key issues relating to dam safety monitoring programs:

- surveillance inspections by dam engineers had recommended additional monitoring equipment be installed (e.g. additional piezometers or monitoring survey prisms); however, it was noted during the audit that such additional monitoring had yet to be installed (two sites).

The inspection and maintenance of monitoring equipment was also identified as an issue. At several sites, the auditors observed damaged gauge marker boards and survey prisms, and at one site a monitoring probe was observed lying in the grass adjacent to a seepage monitoring well.

Operational control for dam safety

Mines are required to develop, implement and maintain operation and maintenance manuals to ensure the proper operation of prescribed dams. Most mines audited did have operation and maintenance manuals for their prescribed dams and water management plans that generally related to other dams on site.

Given that inspection and monitoring are the key risk control measures proposed by most mines for the risk of dam wall failure, it is important that monitoring and inspection regimes are documented, and are understood and implemented by dam operators. It is also imperative that the dams are operated in accordance with the documented requirements of the operation and maintenance manual.

The following issues related to operation and maintenance manuals were identified by the RR:

- manuals and plans did not always reflect the actual operational regime of the dams on site – it was also noted that manuals did not always document the inspection and monitoring requirements for the dams (one site)

- a surveillance report for one dam at a mine had indicated that the maximum operating level of the dam should not exceed 2.8 metres below the spillway invert – this requirement was not included in the operation and maintenance manual for the dam, and at the time of the audit, it was observed that the dam was operating at a higher level than the maximum operating level recommended (one site)
- water levels in the dam were surveyed by the mine surveyor on a weekly basis and there was a network of piezometers around the dams which were monitored monthly; however, neither the water level surveys nor the piezometer monitoring were included in the operation and maintenance manual for the dams (one site)
- monitoring was not always undertaken in accordance with the program described in the operation and maintenance manual – if the monitoring regime was amended for any reason (e.g. because of a surveillance report recommendation), the operation and maintenance manual should be updated to reflect the change (one site).

Good practices observed at the mine sites audited:

It was noted that one mine site had adopted the innovative practice of installing solar powered automatic water level sensors and webcams on its sediment dams as a means of being able to easily ascertain the status of any sediment dam at any time, without the need for operators to be out in severe weather manually reading water level gauges. The webcams also enabled the facility to confirm any alerts issued by the water level sensors. The webcams automatically captured a still photograph every 30 minutes, which was stored as a record of dam water levels along with information from the water level sensors.



Figure 22: Solar powered automatic water level sensor and webcam installed on a sediment dam (Photo: J Ehmsen/Resources Regulator)

Emplacement area approvals (RR)

Emplacement area approvals are only relevant to coal mines and hence, were not applicable to any of the industrial and metallic mineral mines in the audit program. Where emplacement area approvals were current for the coal mines audited, the conditions of the approvals were generally being met.

4 After the audits

Follow-up

The EPA, DPE and RR required any issues identified during the compliance audits to be dealt with by the mines to improve their environmental performance. These included:

- undertaking monitoring in accordance with specified requirements and at the frequency specified in the licence
- maintaining and updating procedures for monitoring schedules to ensure consistency in how and when samples were collected and analysed
- ensuring that water quality analytical reports contained all the required information as specified in the approved methods manual (DEC 2004), so the information collected was reliable
- having samples analysed for pollutants at laboratories that were accredited by a certification authority such as NATA, and in accordance with the methods specified in the approved methods manual (DEC 2004), to provide confidence that results accurately reflected what was occurring on site
- undertaking routine inspections and monitoring at the frequencies specified in the operation and maintenance manuals for the dams
- maintaining and updating the operation and maintenance manuals, and dam safety emergency plans as and when operations changed
- ensuring appropriate training programs were completed by all staff involved in the inspection and maintenance of dams
- a notice under the WHS (M&PS) Act issued to one mine, regulated by the RR, for remedial works to be undertaken to address deficiencies identified in the standard of dam construction.

The follow-up actions were incorporated into individual EPA, DPE and RR work plans to ensure that all issues identified by the audits in action plans were being addressed by the mines.

Each agency will follow-up with each mine audited to ensure that the action plans are being implemented. Several mines are already addressing many of these issues because of the individual audit report process.

The mines that were not audited in this program are encouraged to use this summary report and individual audit findings to inform their review of processes and procedures and improve their compliance and environmental performance.

Integration with regulatory reviews

The EPA, DPE and RR will use the findings of this review to guide the review of environment protection licences, development approvals and mining leases. Section 78 of the POEO Act requires the EPA to review environment protection licences once every five years.

These regulatory reviews:

- focus on desired environmental outcomes
- enhance consistency between regulatory instruments issued to an industry
- improve the effectiveness of the regulatory system
- strengthen each department's accountability to stakeholders.

Integrating these reviews with other regulatory activities, such as inspections, assessments and compliance audit programs, results in a holistic approach to regulation of industry.

The audit findings will also help the EPA, DPE and RR assess any future applications for new licences, development approvals and mining leases. They will also make sure the regulatory requirements effectively deal with any potential environmental impacts.

5 Related initiatives

Joint NSW Government agency environmental compliance audits on the management of dam facilities sit within a broader framework for the management of mine dams. Related initiatives are outlined here.

Environment Protection Authority

The following related initiatives may also assist relevant stakeholders – including the mining industry – to identify ways in which the management of dam facilities can be undertaken more effectively to reduce the impact on the environment.

Environment compliance report: Coal ash dams and emplacements

[This report](#) (EPA 2017) outlines the findings of a compliance audit program undertaken by the EPA in 2015, focused on the level of compliance with conditions of environment protection licences that relate to coal ash dams and/or emplacements, and to improve licensee awareness and understanding of related environmental and compliance issues.

Strategic Environmental Compliance and Performance Reviews and Environmental Compliance Reports

The EPA undertakes a [program of Strategic Environmental Compliance and Performance Reviews](#). The aim of these reviews is to encourage industries to improve their environmental performance. The reviews combine assessing compliance with legislative requirements along with reviewing best environmental management practices to encourage improved environmental performance.

The EPA also undertakes focused compliance audits conducted on any enterprise it regulates. Compliance audits assess an enterprise's compliance with environmental legislation and regulatory requirements.

See [Strategic Environmental Compliance and Performance Review: Industry Monitoring](#).

Department of Planning and Environment – Resources Regulator

The [Mine Safety Regulatory Reform: Incident Prevention Strategy](#) (DI 2016) includes the development and implementation of a scheduled and targeted safety assessment program for mines and petroleum sites. The strategy focuses on the regulator and its role in keeping NSW employees of the mining and extractive industries safe.

Appendix A: Mines audited

The following mines participated in the joint audit program of dams at NSW mines.

Accountable party	Type of premises	EPA Environment protection licence no.	DPE Development approval no. (DA) Project approval no. (PA)
Ulan Coal Mines Ltd	Coal mine	394	DA 113-12-98 PA 08_0184
Centennial Newstan Pty Ltd (Newstan Colliery)	Coal mine	395	DA 73-11-98
HV Operations Pty Ltd (Hunter Valley Operations)	Coal mine	640	DA 450-10-2003 PA 06_0261
Hillgrove Mines Pty Ltd (Hillgrove Mine)	Coal mine	921	DA 98/35
Anglo Coal (Drayton Management) Pty Ltd (Drayton Coal Mine)	Coal mine	1323	PA 06_0202
Mount Thorley Operations Pty Ltd (Mount Thorley Operations)	Coal mine	1976	SSD - 6465
Endeavour Coal Pty Ltd (West Cliff and North Cliff Collieries)	Coal mine	2504	PA 08_0150
Sumitomo Metal Mining Oceana Pty Ltd (CMOC Mining Pty Limited)	Copper-gold mine	4784	PA 11_0060
Cadia Holdings Pty Ltd (Cadia Valley Operations)	Gold mine	5590	PA 06_0295
Tritton Resources Ltd (Tritton Copper Mine)	Copper mine	11254	DA 41/98
Duralie Coal Pty Ltd (Duralie Coal Mine)	Coal mine	11701	PA 08_0203
Werris Creek Coal Pty Ltd (Werris Creek Coal)	Coal mine	12290	PA 10_0059
Broken Hill Operations Pty Ltd (Consolidated Mining Lease 7)	Lead-zinc mine	12559	PA 07_0018
Mangoola Coal Operations Pty Ltd	Coal mine	12894	PA 06_0014

Glossary

Appropriate regulatory authority	The EPA, a local authority or a public authority prescribed for the purposes of section 6(3) of the <i>Protection of the Environment Operations Act 1997</i>
Audit	A systematic, independent and documented verification process of objectively obtaining and evaluating audit evidence to determine whether specified criteria are met
Audit criteria	The audit criteria are defined requirements against which the auditor compares collected audit evidence; criteria may include regulatory requirements, standards, guidelines or any other specified requirements
Audit scope	The scope defines the extent and boundaries of the audit such as locations, organisational units, activities and processes to be audited, and the time-period covered by the audit
Coal works	Any activity (other than coke production) that involves storing, loading or handling coal (whether at any coal loader, conveyor, washery or reject dump or elsewhere) at an existing coal mine or on a separate coal industry site
Compliance	There is sufficient and appropriate evidence to demonstrate the particular requirement has been complied with and is within the scope of the audit
Crushing, grinding and separating (mine sites)	Processing of large rocks down to a size suitable for transport
Development consent	Consent under Part 4 of the <i>Environmental Planning and Assessment Act 1979</i> or an approval under Part 3A of that Act, to carry out development, and including, unless expressly excluded, a complying development certificate
Environment protection licence (EPL)	A licence that authorises the carrying out of scheduled development work or scheduled activities, or controls water pollution arising from non-scheduled activities, issued under Chapter 3 of the <i>Protection of the Environment Operations Act 1997</i> and in force
Mineral processing	Treatment of ore for recovery and/or concentration of valuable minerals prior to shipment to a smelter or refinery; includes crushing, grinding, screening, concentration and dewatering
Mining activities	Activities of prospecting, extraction and primary in situ processing of minerals
Mining for coal	The mining, processing or handling of coal (including tailings and chitter) or related mining activity at underground mines or open-cut mines
Mining for minerals	Ores recovered by mining include metals, coal, oil shale, gemstones, limestone, dimension stone, rock salt, potash, gravel, and clay
Mining lease	A lease granted under Part 5 of the <i>Mining Act 1992</i> ; includes a consolidated mining lease
Mining operations plan (MOP)	A plan documenting site activities and progress towards the required environmental and rehabilitation outcomes

Monitoring	To be aware of the state of a system; involves data collection, data analysis and interpretation of the data to determine the state of the system and how the system is changing
Non-compliance	Clear evidence has been collected to demonstrate the particular requirement has not been complied with and is within the scope of the audit
Open-cut (mining)	Mining carried out on, and by excavating, the Earth's surface for extracting ore/coal, but does not include underground mining
Prescribed dam	A dam, or proposed dam, for the time being specified or described in Schedule 1 of the <i>Dams Safety Act 1978</i>
Project approval	An approval to undertake a development project issued by the Minister for Planning, or delegate, under Part 3A of the <i>Environment Planning and Assessment Act 1979</i>
Public register	<p>The public register under s.308 of the <i>Protection of the Environment Operations Act 1997</i> (POEO Act) is an online searchable database and contains:</p> <ul style="list-style-type: none">• environment protection licences• applications for new licences and to transfer or vary existing licences• environment protection and noise control notices• convictions in prosecutions under the POEO Act• the results of civil proceedings• licence review information; submissions regarding licence review can be made at any time• exemptions from the provisions of the POEO Act or regulations• approvals granted under cl.9 of the POEO (Control of Burning) Regulation• approvals granted under cl.7A of the POEO (Clean Air) Regulation
Sample	A portion, piece or segment that is representative of a whole
Scheduled premises	An activity listed in Schedule 1 of the <i>Protection of the Environment Operations Act 1997</i>
Sediment dam	A structure used to capture sediment laden runoff from a site
Spillway	Structure which discharges flows
Tailings	Ground rock waste product that remains after the desired minerals have been removed from the ore
Tailings dam	A waste storage area often used to store washed coal reject (coarse and/or fine reject); the waste material is often stored as a slurry and may be dewatered to recover water and, in some instances, any viable coal
Wastewater holding dam	A structure containing water that has been adversely affected in quality and in the instance of mining operations, any water that is mine affected

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