

Water and Mining

Developing risk criteria for water management aspects of mine closure

A Water Research Commission (WRC) study has produced a guidance document defining the technical aspects and procedures that need to be followed in order for mines to be able to manage and minimise their long-term risks and liabilities and to provide the regulator with the requisite information to be able to review and approve a post-closure water management plan.

Background

Despite the existence of best practice guidelines for mine closure, a stalemate 'chicken and egg' situation exists in South Africa where mines are unable to obtain mine closure because of perceived unknown/unmanageable post-closure risks to the water resource. This is a complex problem with causative factors originating from both the mining industry and the regulator.

There is a definite need to unlock this stalemate as its continuation is bad for all parties concerned. The onus rests on the regulator to make the necessary policy and/or regulatory shifts to provide clarity on what is required for mine closure to be approved, while at the same time ensuring that it fulfils its mandate of protecting the national water resource.

A risk to all stakeholders and future taxpayers in South Africa is posed by the perpetuation of a status quo stalemate situation where mines do not undertake and submit the correct scientific assessments of post-closure risk because of a perception that they will never be approved by the regulator, or where the regulator is unwilling to approve a suitable post closure risk assessment because of either a lack of confidence in its own ability to make a correct decision regarding the validity of the assessment, or because the regulatory is striving to enforce a zero risk option.

This WRC research project defined the technical aspects and procedures that need to be followed in order for mines to be able to manage and reduce their long-term risks and liabilities, and to provide the State (the regulator) with the requisite information to be able to review and approve a post-closure water management plan.

The main focus of the research was on the major sources of water resource contamination that can persist up to and after mine closure, specifically contamination that may result from the mine workings (underground or opencast) and the various types of mine residue deposits.

The role of a post-closure water management plan in relation to a mine closure plan is shown in Figure 1. The mine closure plan is an overarching plan, which needs to integrate the outputs of various specialist studies and management plans, including the post-closure water management plan. The post-closure water management plan also feeds into the mine's integrated water and waste management plan.

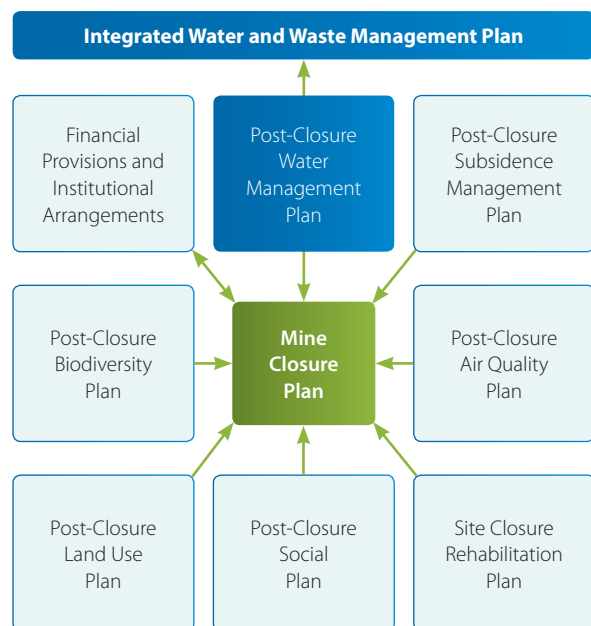


Figure 1: Role of the post-closure water management plan within a mine closure plan.

Finding a suitable approach to water management after mine closure

The proposed solution to the problem facing mine closure is to adopt and implement the following principles:

1. Planning for successful and sustainable mine closure and post-closure water management is a process that starts at the earliest stage in the mine's life and progresses in terms of certainty and clarity as the mine proceeds along its lifecycle.
2. In certain cases, where a planned mine comes with too much probable risk, a decision might be made not to start such a mining operation.
3. The Department of Water and Sanitation (DWS) needs to engage with the mines with regard to their planning for mine closure and post-closure water management throughout the mine lifecycle and not only consider the mine closure question at the end of mine life.
4. The DWS must clearly state the mine closure questions to which it seeks answers at each stage of the mine lifecycle, and must also provide guidance on how these questions should be addressed.
5. The mines must apply the best practice risk-based impact prediction methodology as defined in the DWS Best Practice Guidelines as it is aligned to the international best practice.
6. The interests and views of all stakeholders must be considered in developing closure and post-closure water management objectives that the mine's closure plan must strive to meet.
7. The risk assessment and impact predictions underpinning the mine closure and post-closure water management plan must be undertaken by suitably qualified persons and must incorporate specialist independent review that is integrated throughout the whole impact prediction process.

While most of the above issues are captured in the existing DWS Best Practice Guidelines, clarity is required on the mine closure related questions that the mine needs to address in each of its lifecycle phases in order to meet the information needs of the DWS.

It is therefore also important that the information routinely provided to the mine in terms of updated integrated water and waste management plans includes the required information on the mine's closure and post-closure water management plan relevant to the lifecycle phase that the mine finds itself in.

The following definition of lifecycle phases is used:

- Exploration and prospecting
- Mine planning
- Construction and commissioning
- Mining operations
- Last five years of mining operations before planned closure
- Mine decommissioning
- Post-closure management

While it is obvious that close-related considerations become more important as mines progress along the lifecycle path towards mine closure, there are in fact mine closure considerations that need to be considered during most of the abovementioned lifecycle phases.

Answering key questions

It needs to be recognised that there are a number of closure-related issues that need to be considered in each phase of a mine if the post-closure risk to the water resources is to be minimised.

Key questions in the exploration and prospecting phase

Key questions that should be asked and answered by way of an appropriate risk assessment and impact prediction exercise are the following:

1. How will the proposed drilling programme affect the integrity of the groundwater resources in the area where prospecting and exploration is intended to take place?
2. How will the proposed exploration programme affect the surface water resources in the area where prospecting and exploration is intended to take place?
3. What are the geochemical characteristics of the waste horizons that will be generated should the planned mine proceed and how should this mine residue be managed?

Key questions in the mine planning phase

Mines that enter the mine planning phase will be faced with considering alternatives for a wide range of features and actions associated with the planned mine. The interest in this phase of the mine lifecycle with regard to mine closure and water management relates only to those actions that will persist throughout the life of the mine, and which may potentially have impacts and risks beyond mine closure.

The important questions to ask during this phase include:

1. Do any construction activities potentially pose a long-term post-closure water management risk, and is prevention of these risks addressed in the environmental management plan for the construction phase?
2. Have the post-closure risk management measures developed during the planning phase been properly implemented during the construction phase?

Key questions during the mine operations phase

Any extensions to underground or opencast workings or development or new mine residue disposal facilities that are contemplated during the mine operations phase should be subjected to the same questions and risk assessments and impact predictions as described in the mine planning phase.

The difference would be that the assessment should be capable of being undertaken on a quantitative basis as opposed to a screening level basis as there should be good data sourced from historical mining operations that can be used in predicting the impact of future mining operations.

Key questions that should be asked during this phase include:

1. Are all existing mine residue facilities thoroughly characterised in terms of their physical and geochemical heterogeneity and their probable post-closure water balances?
2. Are all mine workings thoroughly characterised in terms of their physical and geochemical heterogeneity and their probable post-closure water balances?
3. Where unacceptable contaminant loads are predicted, what water management and treatment alternatives would be required to treat these loads to an acceptable level and are the financial provisions for such water management/treatment included in the mine's closure financial provisions?

While mines will only be required to compile provisional mine closure plans during that part of the operating phase that is further than five years from closure, this time should be used productively to ensure that all predictive models are developed and calibrated and that a reasonably confident assessment of the measures required at closure and post-closure can be made and financially provided for.

Key questions at five years before planned mine closure

At this point of impending closure an important shift occurs with regard to the mine closure planning process from the

water management perspective. At this point, the mine closure plan which has been in a continuous evolving provisional plan stage throughout the life of mine, needs to be converted into a final and approved mine closure plan and post-closure water management plan.

The following key questions need to be asked and answered:

1. Have the final closure objectives with regard to water management been defined and set?
2. Have all interested and affected stakeholders been consulted in the setting of these final closure water management objectives?
3. Has the mine developed and calibrated a predictive model that is capable of predicting all points of discharge from the mine workings in terms of location, volume, and quality for all contaminants of concern for a period of time until such discharges are acceptable in terms of agreed objectives?
4. Has the mine developed and calibrated a predictive model that is capable of predicting all points of discharge from the mine residue disposal facilities in terms of location, volume and quality for all contaminants for a period of time until such discharges are acceptable in terms of agreed objectives?
5. Where objectives are not met at the time of mine closure, have appropriate post-closure water management/treatment measures been specified, designed and costed by a suitably qualified person and have financial resources and institutional arrangements been made to implement and finance these measures for as long as they are required?
6. Is the mine's closure and post-closure water management plan integrated into a regional post-closure water management plan?

The point of considering approval of mine closure

At the point where the mine has implemented the management measures contained in the approved mine closure and final post-closure water management plan, the mine would then approach the DWS to approve the granting of mine closure. At this point, it is assumed that the mine will have followed the procedures set out in the Best Practice Guidelines.

Key post-closure questions

After mine closure has been approved, residual water management/treatment measures that may need to be implemented for a specified number of years will be managed by third parties agreed to at the point of approval of mine closure.

1. Confirm that no information comes to light that was known at the time of mine closure application but that was not disclosed.
2. Are the implemented water management/treatment measures continuing to be implemented and do they continue to meet the defined objectives?

Problem solved

If all the above questions are answered by way of undertaking assessments aligned with the procedures set out in the Best Practice Guidelines and as expanded on in this study, then there should be little new information or surprises at the time that the mine requires approval from the DWS for closure.

The DWS will have an information trail that leads from the start of the mine up until closure for all new mines, and will also have a clearly defined set of questions (and desired answers) for mines that are already in operation and that enter this process at some advanced stage in the mine lifecycle.

The additional benefit to the mines is that the questions that are being asked and the studies that need to be undertaken to answer the questions, are fundamentally aimed at identifying and maximizing the opportunity for the implementation of pollution prevention strategies.

The old maxim that 'prevention is better than cure' most certainly applies to mine-water management, and the investment of time and resources into answering these questions will provide payback in terms of reduced costs for the mine closure and post-closure water management plan, and the surety that the final application for mine closure can be approved by the DWS.

Most importantly, by following the processes and methodology described in this report and the Best Practice Guidelines, the mine will have undertaken the appropriate risk management process to understand, manage and minimise its long-term exposure to risk and liability associated with post-closure water impacts.

Further reading:

To order the reports, *Developing of risk criteria for water management aspects of mine closure* (**Report No. 2127/1/14**) and *Guidance for the mining industry for the management of post-closure water* (**Report No. TT 628/14**)

contact Publications at Tel: (012) 330-0340,
Email: orders@wrc.org.za or Visit: www.wrc.org.za to
download a free copy.