

Strategic Evaluation of Water Resources and Management of Water for the Fast Track Expansion of Industry

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ABSTRACT

The development of new mines in South Africa's Limpopo and North West Province as well as the expansion of existing mines in the area requires a large amount of water. This has added a considerable strain to water resources in these areas. The mining community as part of its responsibility realises that in order to develop mines the management and supply of water forms an integral part of the process. The process involves more efficient use of their existing water resources and creating partners with existing local water users in the area.

The strategic water evaluation is the initial starting block to understand the water requirement, water sources and areas of water supply and management that will need attention. This paper outlines the initial process required to identify potential problems that can be expected with respect to water supply and management of water for the mines so that actions can be implemented sooner rather than later.

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1 Introduction

Mining and industrial growth needs large quantities of water to sustain its development. South Africa and indeed most of southern Africa do not have abundant water resources and the management of water at the processes has become an important item to ensure that the sectors can sustain their operations.

Mines are usually situated in areas where there is often no formal infrastructure in place to bring water to the mine and thus the mines need to source water, transport the water to the mine, possibly clean the water and then manage the water to ensure that water is not wasted and that the environment is not polluted.

This paper outlines the methodology and principles that are followed to ensure that the mining and industrial sectors source water in an environmentally friendly manner, which is economically viable.

Once the water has been delivered on site the management of water forms an integral part of the day-to-day workings of the mine. This paper highlights the basic principles for mine water management and also deals with specific water management issues around the tailings dam.

2 Water Supply Scheme

The approach adopted is to define the water requirements for the mine and determine their quality requirements and identify what second grade sources of water could be available to meet these. Once the sources were matched to the users the gaps between demand and supply were quantified and used as a basis for the decision on a water supply scheme.

The scope of work required to develop an economically and environmentally friendly water supply scheme is outlined below:

Potential water demand

- Identify the expansions planned for the next twenty years, by meeting with managers or representatives.
- Liaise with process design engineers on water volume and quality requirements for existing and future processes.
- Liaise with the process design engineers on defining inevitable losses from the process circuits. Plant managers will need to subscribe to a policy of no-spill.
- Confirm design losses versus the recorded losses for existing processes.
- Collate the information obtained to provide a time line showing progressive increments in water demand over the next 20 years.

Potential water supply

- Identify, quantify and characterise sources of second grade water.
- Identify other potential water sources within a 100 km radius and determine the quantities and quality of water available.
- Develop indicative costs and economic analysis to make these water sources available to users (which might include treatment in some cases).
- Identify potential water supply synergies between neighbouring mining groups to develop water sources holistically.

Gap analysis and reporting

- Match the sources to the users, with respect to quality and location.
- Define the supply gaps with time.
- Report on the results and recommendations.

3 Mine Water Management

The management of water resources in South Africa has been a key principal in the Department of Water Affairs and Forestry over the last four years. The government is implementing its “water for all for ever” policy and this means that additional water resources are required to sustain the additional demand for water.

The Industry and Mining sectors in South Africa use vast quantities of water in their processes and have in the past not managed their water. The attitude of the Mining and Industrial sectors has changed and the management of water is a principle the majority of the sectors believe in. The sector is now actively involved in the management of water both on their own properties as well as a partner in a more regional focus.

For the Mining and Industry sector the key to water management is to “keep clean water clean and to contain and reuse dirty water”.

To keep “clean water clean” involves the diversion of clean stormwater away from the plant so that the clean water does not get contaminated by the residues within the plant area. By diverting the clean stormwater away from the plant the amount of contaminated water to cater for within the plant circuits is minimised.

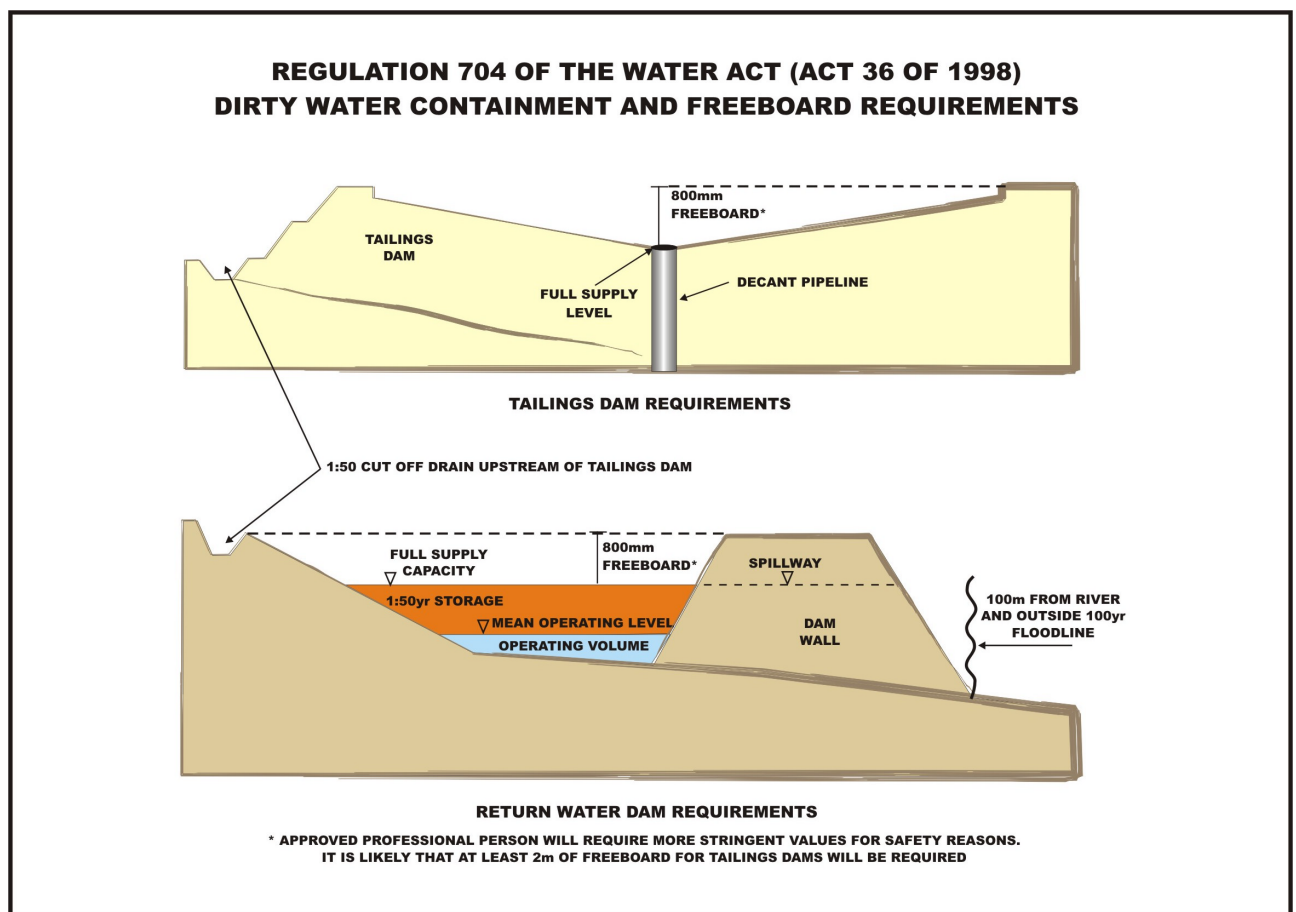
To “contain and reuse dirty water” involves a far more intricate water management procedure and may involve the construction of stormwater drains to collect the dirty process water and stormwater emanating from the plant. These canals may flow into a storage area or sump from where the water can be pumped back into the process water circuit.

It is possible that if the quality of water cannot be used in the process then the water may need to be treated before it can be released back into the environment. If the expense to treat the water or technology is not practically available to treat the water then the water may need to be evaporated in large storage dams.

Management of water also means that the plants try to maximise the use of non-potable water and minimise the use of drinking water.

4 Specific Tailings Dam Water Management

An example of how water management on the mine is required to meet the legal requirement of the Water Act is presented in the schematic figure below.



As can be seen from the above figure the tailings dam requires the following water management items.

At least 800 mm of freeboard is required above the decant penstock and the top of the wall. This is the minimum requirement and will be set by the approved professional person who will likely set the freeboard above 2 m from a safety aspect.

The upstream stormwater needs to be diverted away from the tailings dam so that the dirty water handling is minimised. The size of the diversion structure must be able to divert the 1:50-year storm away from the site.

The penstock decant structure should be able to discharge the 1:100-year storm falling on top of the dam within 5 days. The length of time required to decant the water is dependent on safety and mines frequently reduce the decant times to 3 days. A picture of a penstock is presented in the photo below.





The decant pipe needs to discharge the water from the penstock to the return water dam (RWD) and the pipe should not flow greater than 75% full.

The water then flows into the RWD and the size of the RWD needs to contain the mean operating level plus the 1:50-year 24-hour storm before spillage over the spillway is allowed. The RWD requires a freeboard of 800 mm from the spillway invert to the crest of the wall.

Upstream of the RWD the clean stormwater needs to be diverted away from the RWD to minimise the size of the RWD.

Both the RWD and tailings dam are required to be 100 m from the nearest stream and outside the 1:100-year floodline.

5 Water Reticulation Management

The water within the mine lease area is usually transported many kilometres across the mine in a complex pipeline reticulation system. Many of these pipes are old, leaking, too small and have been vandalised. This results in extensive losses of water from the water reticulation system. It is

important to identify the problems within the pipeline reticulation network and upgrade or budget to upgrade the system to minimise the water leaks.

6 Conclusions

This paper has given an indication of how the mines and industries:

- Source water;
- Use water on site;
- Manage water to minimise waste.

The pressure on mines and industries has intensified over the last few years and innovative solutions to source and manage water are essential.