Reliable Mine Water Management – Connecting the Drops to Operate "Water Smart" Mines

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Abstract The effectiveness of management practices have a direct impact on a mining company's reputation, access to new reserves, financial performance and social license to operate. Water is a strategic asset for mining companies that has a business value significantly greater than the cost of procurement. Reliable Mine Water Management requires an integrated approach to promote operational efficiency and mitigate strategic and operational risks. "Water Smart" mines reflect a robust corporate governance framework that is flexible enough to manage variability while effectively mitigating risks. This paper provides an overview of the process for developing "Water Smart" mines.

Keywords Mine water management, strategic water risks, water management strategy

Introduction

No mine operates without managing water. The effectiveness of management practices can have a direct impact on a mining company's reputation, ability to access to new reserves, financial performance and social license to operate. Water is a strategic asset for mining companies that has a business value significantly greater than the cost of procurement. In addition, it is the single most important vector for potential environmental impacts throughout the mine life-cycle. Therefore, effective water management is critical to preserving value and exploiting opportunities.

There are numerous examples illustrating the reputational and financial impacts to mining companies resulting from mismanagement of this strategic operational resource. However, by taking an integrated approach to managing water (*i.e.* connecting the drops) operational risks can be can be mitigated in a manner that successfully prevents them from developing into enterprise impacts.

Why operating "Water Smart" mines is important

There are a range of drivers for operating "Water Smart" mines, ranging from global mega-trends to establishing shared-value with local host communities.

Big picture trends

There are several global trends that are driving the need for more intelligent mine water management.

- Population growth is putting increasing pressure on available resources and escalating competition for water. A growing emphasis on managing the water-energy-food nexus is being driven by population growth and mining will have to compete with these interests.
- Increased urbanization is impacting water quality/quantity which also is increasing competition for water between municipalities, agriculture and industry. This drives up costs for source water, decreases available supplies and increases the amount of water requiring treatment prior to use.
- Climate change and extreme weather variations resulting in droughts and floods have impacted operational continuity at numerous mines around the world.

Strategic risks

The three primary strategic risks are reputational, growth potential and maintaining social license to operate. All of these risks have some degree of financial consequence associated with them. For example, access to new reserves is a measure of a company's long-term growth potential, market share, and ultimately, investment attractiveness. Two major projects in Chile (El Morro) and Peru (Mina Conga) have been significantly delayed as a result of revocation or withdrawal of permitting documents, largely as a result of issues involving water resources.

Operational risks

Similar to risks at a strategic level, operational risks tie directly back to financial performance. Operational risks generally can be broadly categorized as outlined below.

- Security of supply is critical to avoid lost production and properly support mine expansions. In arid areas, water use efficiency and demand management are important components of improving security of supply.
- Excess inventory can lead to increased operating costs resulting from the need to treat water, reduced mineral recovery due to the need to use water not "fit to purpose", unauthorized discharges and increased closure costs.
- Inadequate water quality management can increase the amount of contact water that enters the process circuit resulting in elevated operating costs. Continued degradation of process water quality increases freshwater makeup demand and has the potential to impact operational efficiency due to reductions in mineral recovery.

The relationship between operational and strategic risk management

There is a direct link between operational and strategic risks. As illustrated in Fig. 1, effective management of water related risks is a function of:

1. the water management framework (both at a corporate and site level),
2. defining and measuring performance against appropriate metrics, and
3. the degree to which water is incorporated into stakeholder relations.

"Water Smart" mines successfully drive operational practices as they relate to each of

Fig. 1 *The relationship between operational and strategic risk management*

these elements in a manner that significantly reduces the water-related strategic risks a company may face.

Getting to "Water Smart"

At an operational level, getting to "Water Smart" requires developing an Integrated Mine Water Management Plan (IMWMP) tailored specifically for the mine site. However, as illustrated in Fig. 2, the IMWMP is also supported by the corporate water management strategy, guidance documents and site-specific operational procedures.

The purpose of the IMWMP is to:

1. Codify water-related operational practices across functional groups.
2. Define the hierarchy of water management priorities.
3. Establish the process and responsibilities for integrating the IMWMP with the mine plan.
4. Summarize monitoring requirements & environmental compliance standards.
5. Establish the framework for identifying and managing water-related risks (inside and outside the fence line).
6. Drive mitigation actions and continuous improvement.

An effective IMWMP can only be developed by:

1. Involving all operational departments and incorporating key mine facilities throughout the life-cycle.
2. Fully integrating the water management strategy with the mine plan and ensuring operational practices and infrastructure are consistent with the operating environment.
3. Understanding water-related risks both within and outside the fence line at a level of detail sufficient to preserve business value and financial performance.
4. Support the mines ability to meet both internal and external commitments (Fig. 3).

The process of developing in IMWMP begins with the steps illustrated in Fig. 4.

These steps are followed by the codification and continuous improvement phases. The codification phase establishes the organizational structure of the document, outlines key information for critical facilities, summarizes operational performance metrics and details mitigation actions that address material water-related risks. Because the IMWMP is a living document that gets updated in response to major changes in the mine plan, identification opportunities for continuous improvement is an important aspect that ensures the water management strategy consistently delivers business value to the operation. This is an essential aspect of ensuring that, as the end

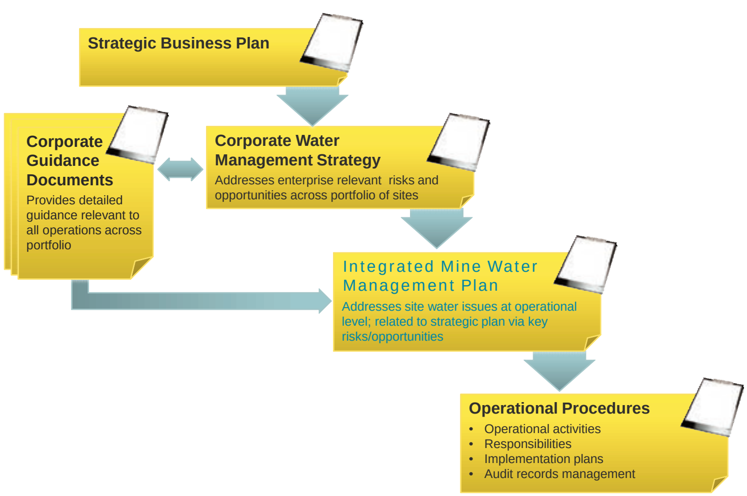

***Fig. 2** The relationship corporate and operational water management strategies (after MCMPR 2006)*

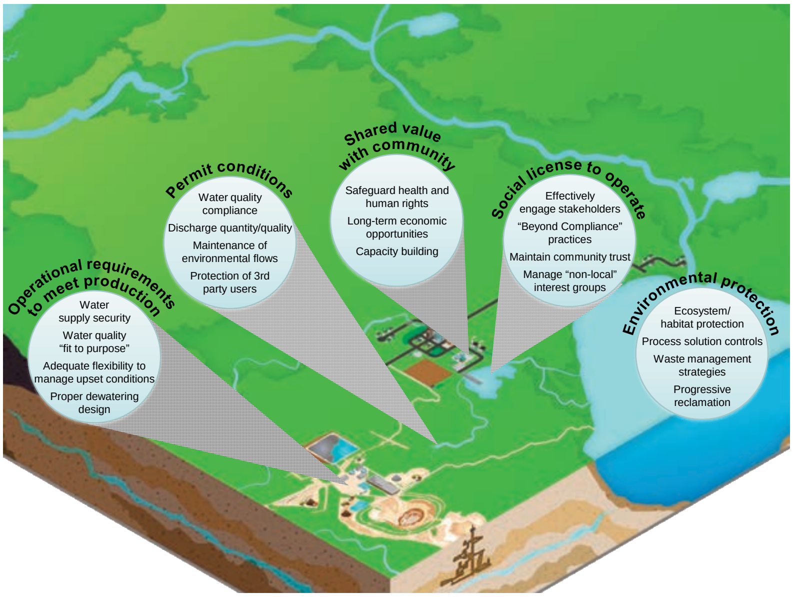

Fig. 3 Internal and external commitments that the IMWMP must support

of mine life approaches, operational practices support minimizing closure costs.

Case studies of success and failure

"Water Smart" principals beyond the fence line to create shared value

One of the largest copper mines in the world is located in an arid environment adjacent to a community experiencing rapid urban growth. Historically, the water supply for the mine, local agricultural users and the municipality was derived from reservoirs. The allocation of water to the principal users in the basin (in order of priority) was the municipality, agriculture and industry (including mining). All domestic and industrial wastewater was discharged directly to the local river which degraded surface water quality.

The mine plan called for an expansion that would triple production capacity and generate an additional US$88 billion in gross revenue over a period of 20 years. In order to support the expansion an additional 1 m^3/s of makeup water was required. However, because of the urban growth, increased agricultural production to support the growing population and arid climate there was insufficient basin yield to support the additional water required by the mine. It was possible to determine this because the mine had a clear understanding of the water resources situation outside their fence line. In addition, they had accurately defined the social and political risks associated with changing the operating rules for the reservoirs to secure the necessary water.

The solution was to build a municipal wastewater treatment plant and use a portion of the treated effluent as the makeup supply required for the increased mine production. Excess treated wastewater was discharged to the river which immediately improved surface water quality and the reliability of supply for downstream agricultural users. By taking an integrated approach to this water management challenge it was possible to establish a reliable supply that was economically, socially

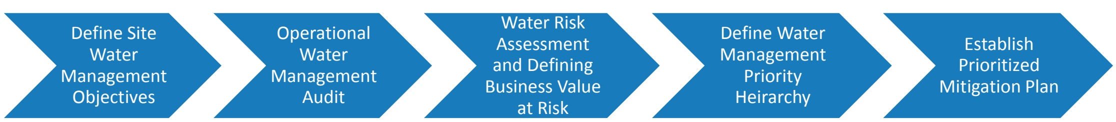

Fig. 4 Initial steps in the IMWMP development process

and politically sustainable.

Operational mismanagement leading to erosion of shareholder value

A uranium mine operated in an area subject to intense monsoonal rainfall was forced to shut down due to excess inventory and risk of a tailing dam failure. This was a direct result of inadequate operational management practices, and inadequate mine water control infrastructure. The mine, which had previously produced up to 10 percent of the world's uranium, was forced to suspend all operations for five months while a solution was implemented to deal with the excess water (Uranium News 2012).

As a result of the lost production the year on year net earnings before interest and tax went from AUS$68 million to a loss of AUS$61 million (Uranium News 2012a). The company also cut the size of its estimated reserves at the Ranger mine, wiping AUS$99 million of inventory value from its balance sheet. These events lead to a decrease in share value of approximately 80 % (Uranium News 2012b).

The potential financial loss could have been mitigated to some extent by incorporating adequate water management infrastructure consistent with the operating environment, establishing a clear set of operational water management priorities and robust contingency plans to deal with extreme weather events. The risks associated with excessive rainfall were known but the business value at risk resulting from inadequate mitigation measures was not factored into decision making. The cost of properly mitigating the risks associated with accumulation of excess water during a monsoon was likely a fraction of the lost business value.

Conclusions

Reliable Mine Water Management requires an integrated approach to promote operational efficiency and mitigate strategic (enterprise level) and operational risks. There is a direct link between effective management of operational risks and strategic risks. "Water Smart" mines reflect a robust corporate governance framework that is flexible enough to manage variability while effectively mitigating strategic risks. To effectively "connect the drops" reliable mine water management involves all operational departments working with a common understanding of the management objectives. This occurs when the water management strategy is fully integrated with the mine plan and is consistent with the operating environment. "Water Smart" mines utilize a water-specific risk management framework to identify and mitigate water-related risks inside and outside the fence line in order to preserve business value and enhance financial performance.

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