WATER USE AND SUSTAINABLE DEVELOPMENT IN COAL MINING – A CASE STUDY FROM CENTRAL QUEENSLAND[1]

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ABSTRACT

The use of water to support mining operations in remote areas represents a significant challenge to all mineral companies operating in Australia. When infrastructure and management systems provided by the company are also involved in supplying local communities and rural industries, the multiple stakeholders and different values involved introduce a complexity that reflects overlapping and sometimes conflicting priorities associated with the concept of sustainable development.

This paper describes a joint project between BMA Coal and the University of Queensland's Sustainable Minerals Institute which used a modified risk management technique to evaluate a section of the BMA water infrastructure in Central Queensland. The Sustainability Opportunity and Threat Analysis (SOTA) technique has been designed to consider opportunities, as well as threats, that could affect the viability of an operation and its ability to contribute to sustainable development objectives. Once key threats and opportunities have been identified, the focus is then on selecting controls for managing priority risks/opportunities and developing indicators for gauging progress in these areas.

The technique was applied to the water life cycle for a portion of the BMA system including both operating mines and communities. In the process a number of broad issues suitable for inclusion in company strategic planning processes were identified. The risk management approach proved to be a useful tool for focusing attention on sustainability issues which might not otherwise be captured. The main challenges have been to ensure that opportunities as well as risks are properly identified, and that sufficient regard is paid to the interests and concerns of external stakeholders.

[1] This is a modified version of a paper presented at the Minerals Council of Australia's Sustainable Development 03 Conference, held in Brisbane in November 2003

INTRODUCTION

Access to a reliable source of water is an essential requirement for coal mines. Even those mines that do not wash their product through a preparation plant need significant quantities for dust management, drilling, human consumption and numerous other uses. Current corporate reports provide statistics showing that approximately 200L of fresh water can be consumed for every tonne of coal produced, although that can vary both upwards and downwards according to operating practice and circumstances. The transformation of this fresh water to dirty water which must then be managed through the mines systems and storages generates additional challenges. In Central Queensland the combination of extended drought conditions, continued new coal developments, a beleaguered agricultural sector and a new regulatory regime for managing water has placed the issue at the top of the public agenda. Water availability is now a limiting factor on development in the region.

BHP Billiton Mitsubishi Alliance (BMA) operates seven coal mines in Central Queensland, supplied by fresh water extracted from borefields, rivers and dams. It owns and operates 570 km of pipelines, through which it moves approximately 22,000 megalitres of fresh water per year to its own and competitors' operations, and to local mining communities such as Moranbah, Middlemount and Dysart. The location of the network is shown in Figure 1. The overall BMA high priority allocation totalling 20,700 MLpa is not large when compared to the total irrigation allocations of approximately 165,000MLpa for the Nogoa/Mackenzie system supplied by the Fairbairn Dam. However, it remains a significant amount when considered in the context of local systems and communities, especially when irrigation allocations have been severely reduced due to drought conditions.

In recent years, growing awareness of water issues has seen most operations in the region, including BMA's mines, move to recycle as much water as possible from tailings dams back into the coal preparation plant in order to reduce fresh water offtake. However, this has resulted in other impacts associated with the effects of saline water on plant performance and maintenance, and in some cases a gradually deteriorating body of water due to continual recirculation and evaporation. A significant challenge is to manage large site storages of "dirty" water of varying quality so as to minimise discharges to the local environment, while at the same time allowing for natural drainage processes from whatever rain might fall across and upstream of the site. Water management is a key part of the environmental plan for all mines in the region.

In 2002, the University of Queensland's Sustainable Minerals Institute (SMI) commenced a project under the guidance of its industry sponsors to investigate the issue of sustainability metrics for the mineral industry, with a particular focus on how these could be developed and applied at the site level. It was agreed at an early stage to adopt a risk management approach, with a view to facilitating the identification of relevant site issues prior to developing metrics to assess performance against them. This approach evolved into the Sustainability Opportunity and Threat Analysis (SOTA) project. As the name suggests, the

SOTA method focusses on identifying opportunities as well as threats, and on addressing the social, economic and environmental dimensions of the issues under consideration. In essence, the project aims to blend the themes of risk management and sustainable development into a simple operational tool.

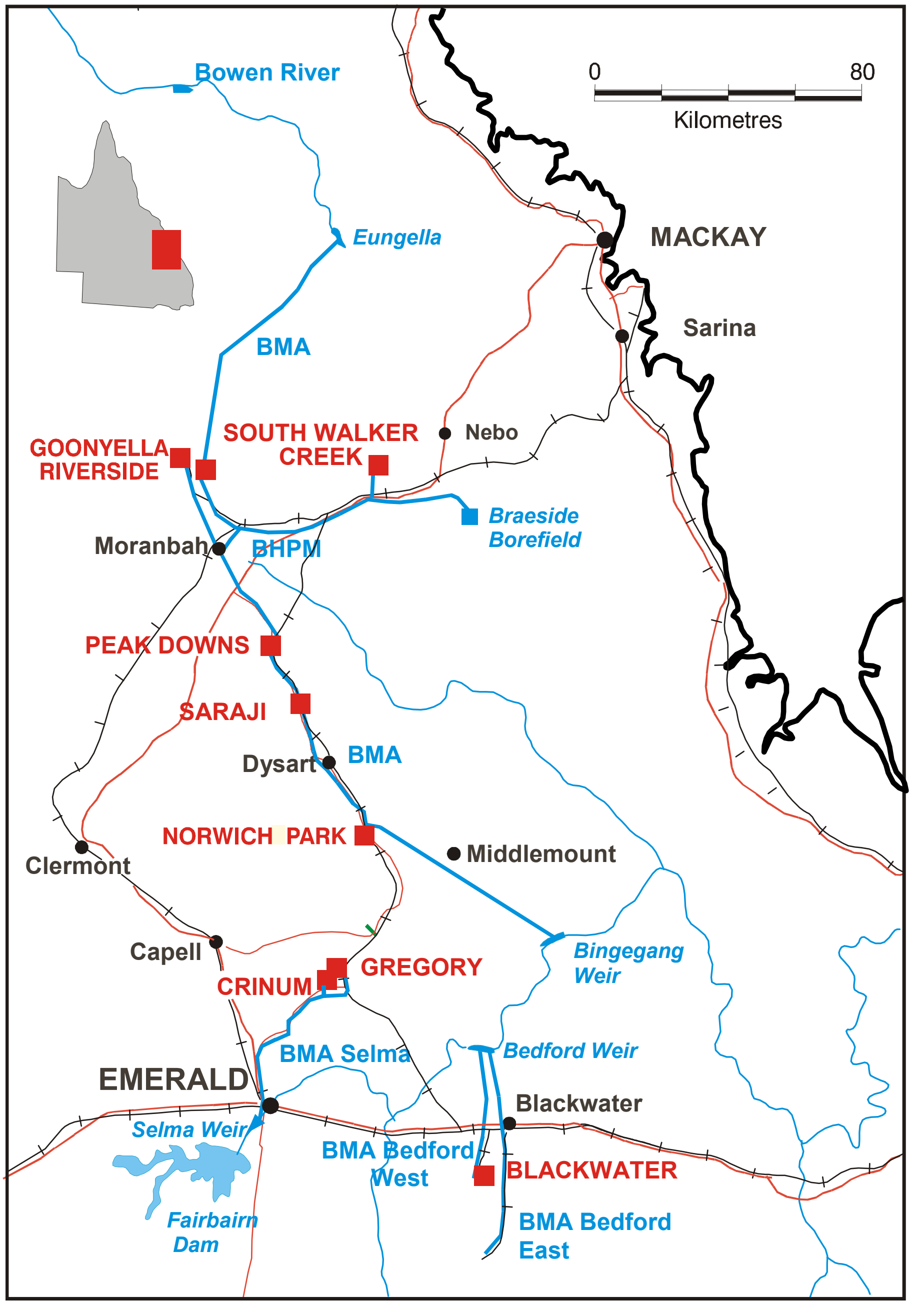

Figure 1 – Location of BMA mines and water infrastructure in CQ

As an industry sponsor of SMI, BMA suggested that the SOTA approach could usefully be trialled by examining the management of water in a portion of their overall system, since this clearly represented a multi-dimensional challenge. The remainder of this paper describes the resultant project, which was carried out by SMI and BMA personnel between January and April 2003. A brief summary of the SOTA process is followed by a description of its application in this context, and a summary of the key conclusions from the process.

THE SOTA PROJECT

Risk management and mining

The minerals industry in Australia has developed a significant history of applying risk management techniques over recent years. The rapid growth in this area has been driven largely by a focus on the need to improve health and safety performance in many parts of the sector, but the techniques have also been applied to other specific issues such as environmental performance and broader aspects of business risk. For example, the field of Environmental Risk Management has been actively developed in recent years (e.g. Environment Austrailia, 1999) and it is common to find qualitative risk ranking tables within Environmental Impact Assessment and EMOS documents.
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In 2001, the Minerals Council of Australia commissioned a national project to derive “good practice” guidelines for the application of risk assessment. Several large mining companies and government agencies provided input and guidance to the project, the outcomes of which were generally consistent with the process model described in AS4360. The most recent version of the guideline was published in July 2003 (MISHC, 2003), and reviews in detail the various types of risk assessment methods and their applicability to different situations. Many mining companies have established risk management procedures, some with several different consequence or severity scales that reflect different dimensions of concern such as health and safety, environmental, and financial impacts. Formal risk management is now effectively a key part of the business process for most operations in the industry. Its importance was reinforced by the inclusion of risk management as a separate principle of operation in the recently released International Council on Mining and Metals Framework for Sustainable Development (ICMM, 2003).

Sustainable development in the mineral industry

There are several frameworks that interpret the concept of sustainable development in the context of the minerals industry. Notable amongst these is the ICMM Framework for Sustainable Development, an outcome of the Global Mining Initiative. The ten principles described in the framework focus mainly on business process issues, and seek to address the key social and environmental impacts caused by mining activities. At the same time, the focus of traditional company safety reports has been broadened over the last five years to incorporate environmental and broader social impacts. Many organisations in the sector are now producing integrated sustainability reports. Several of them, including WMC in its 2002 Sustainability report, have adopted the visual representation of sustainable development as a series of three overlapping circles.

For the purposes of the SOTA project, it was decided to use a similar representation of sustainable development, since this is a familiar graphic used in the literature to emphasise the need to integrate the social, environmental and economic aspects of the activity under consideration. A model using broad impact categories derived from a variety of sources, including the Global Reporting Initiative (GRI), was therefore constructed.

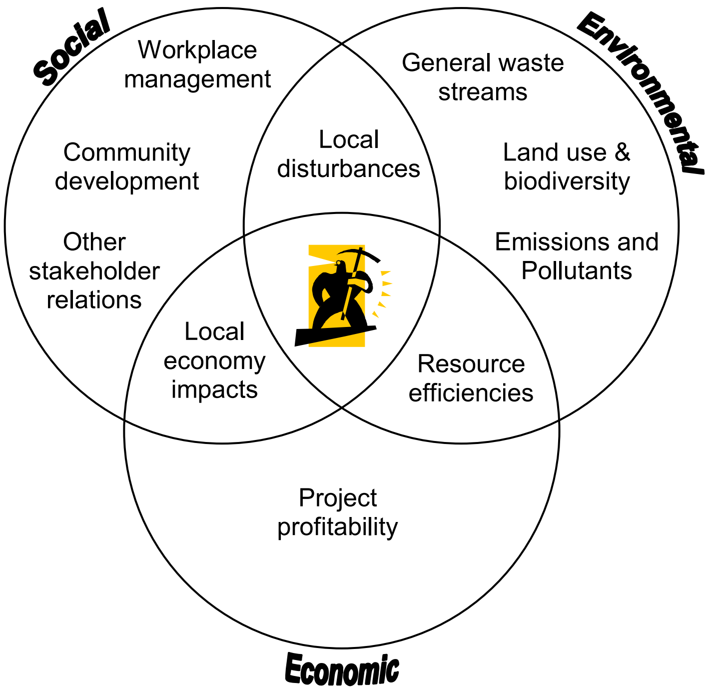

Figure 2 – an impact-based model of sustainable development

Note that these are broad categories that will sometimes overlap, but are intended only to provide a framework to review the types of impacts (both positive and negative), that might occur due to a mining operation.

The SOTA Process

The SOTA process involves constructing a nominal "Hazard" inventory of sources of impacts on the areas identified in Figure 2 above, followed by an interactive workshop involving site-based personnel. The workshop employs a qualitative risk assessment approach, since the nature of many of the impacts involved does not lend itself to detailed quantitative assessment. The process as summarised in Figure 3 follows closely the model described by AS4360, but with a few differences as outlined in the following description.

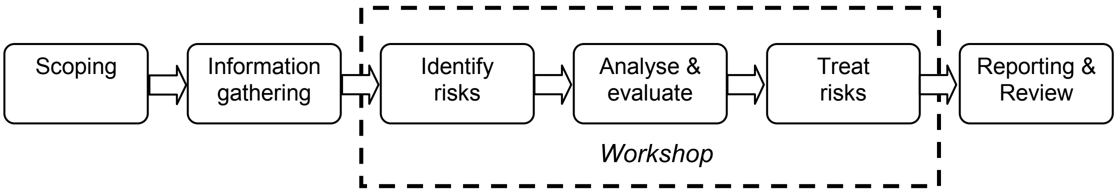

Figure 3 – The SOTA Process

- Scoping - the first stage involves addressing the reasons for the process and the environment in which it is to be conducted, and agreeing the scope of the exercise. This is often the most crucial part of the whole process, since it should provide everyone involved with a clear picture of the whole process and desired outcomes.

- Information gathering – An additional step of information gathering has been explicitly added between the “Scoping” and “Risk identification” phases of AS4360. This is to emphasise the importance of collecting and organising relevant information into a suitable framework prior to commencing the workshop process.
- Identify risks – the first part of the workshop involves systematically reviewing the system and impact areas under consideration, and identifying opportunities or threats that could develop. This stage should be as interactive as possible, aiming to capture all inputs and to defer judgement of likelihoods or consequences until the next stage.
- Analyse and evaluate – this middle stage of the workshop combines the AS4360 steps of analysing and evaluating risks. Qualitative scales of likelihood and consequence are assigned to each identified opportunity or threat, and the combination of those two values is used to create an overall risk rating. Once all outcomes have been assessed, a prioritised list can be created.
- Treat risks – the final stage of the workshop involves the discussion of potential controls to address those opportunities or threats considered high enough priority to warrant further action.
- Report and review – following completion of the workshop, a report summarising the process and the outcomes is prepared and circulated to all participants, and a review session organised after a suitable time has elapsed.

Within the AS4360 process flow diagram, feedback loops for communication and ongoing monitoring are included. These have been omitted here for the sake of simplicity, but are clearly important elements to the overall process. Since SOTA represents a broad, scanning exercise it is important that any agreed actions are picked up by existing business planning and monitoring processes. It also provides an opportunity for subsequent discussion on relevant metrics for the issues identified by the process, allowing operations to measure both impacts and progress towards agreed objectives.

BMA PIPELINE STUDY PROCESS

Scoping the project

In order to trial the process in a real setting, BMA proposed that the SOTA tool be applied to a section of their water infrastructure and associated operations and stakeholders, covering the Bingegang pipeline system in Central Queensland. This system extracts water from the Mackenzie River (a tributary of the Fitzroy River) and pumps it northwards to the mines of Norwich Park and Saraji and the associated community of Dysart, also supplying Anglo Coal’s operation at German Creek and the Middlemount community. Anglo Coal contributes to the maintenance of the pipeline in this area. In addition to these major consumers, a series of small offtakes for rural stock and domestic consumption supplies water to many grazing properties along the way.

Following an initial visit to site and discussion with management of the Norwich Park operation, a scoping meeting was held to define the boundaries of the exercise. The essential elements of the agreed scope included the geographical boundaries of the analysis, extending from the Bingegang Weir on the Mackenzie River up to and including the Norwich Park mine and community of Dysart; a short to medium term timeframe considering up to five years from the present; and a broad range of impacts covering social, environmental and economic aspects of the pipeline operations. It was also agreed to keep the analysis an internal process, with the option to involve external stakeholders at a later stage when and if necessary. Existing BHPBilliton risk analysis protocols were chosen for the risk assessment process, since these offered consequence categories covering social, environmental and economic impacts. However, as is the case with most qualitative risk analysis consequence scales, the outcomes considered only canvassed negative outcomes. A mirror image set of positive outcomes was therefore constructed in order to help focus the workshop on assessing the magnitude of potential opportunities that might be suggested.

At this early stage it was apparent that the exercise would divide relatively cleanly between issues associated with the pipeline and supply of water to external organisations and communities, and those issues specific to the Norwich Park site and its immediate environment. It was therefore decided to run two separate workshops in order to facilitate the involvement of relevant personnel with expertise specific to these areas.

Gathering information and generating prompt lists

The next stage of the project involved gathering information relating to the system, and organising it into a form that would facilitate the consideration of appropriate issues during the workshop. The first requirement was to break down the system into components, and this was done by constructing a schematic diagram of the system as shown in Figure 4. This indicates the sequence of offtakes and the relative quantities of water involved, from Bingegang Weir to the storage at Dysart and the outflows beyond. An accompanying table listed the details of each offtake including existing entitlements, actual consumption, and BMA's obligations at each location. A separate series of diagrams was used to summarise the management of water on Norwich Park site, covering the distribution of raw water from the pipeline as well as the management of tailings recycling systems and minewater pumped from operating pits.

A list of stakeholders was also generated for input into the workshop process. Stakeholders were defined broadly as anyone who would have an interest in the management of water within the system, although clearly some groups were more directly affected than others. The management of water within the region is an extremely topical issue, due to the combination of prevalent drought conditions and the recently issued draft Resource Operations Plan, a Queensland DNRM document which gives effect to the Water Allocation Management Plan for the Fitzroy Basin. Therefore, in addition to the obvious interests of mining companies and the associated communities, a number of government agencies and community groups such as the Fitzroy Basin Association were considered to be stakeholders to be factored in to the process.

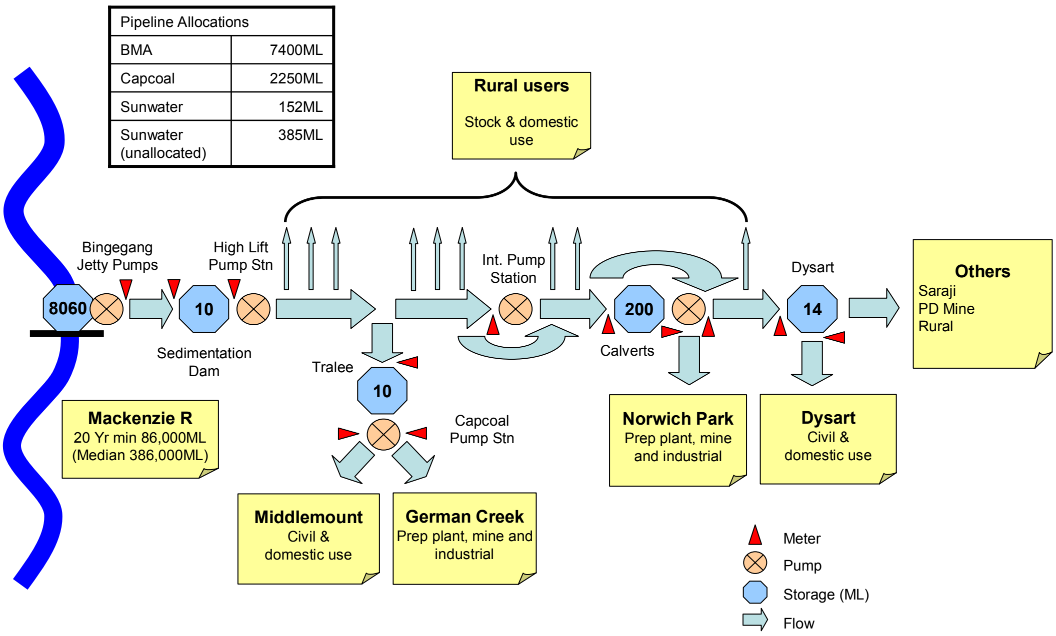

Figure 4 – Bingegang pipeline system

Finally, a broad list of prompts was compiled and organised into the impact categories shown in Figure 2, in a form generic enough to be used at each location. For example, under the heading of resource efficiencies prompts relating to leaks and evaporation dealt with the issue of water losses in the system, whilst energy use focussed attention on the efficiency of pumping activities involved in moving water from one location to another. All of these documents were collated and circulated in advance to workshop participants.

Risk assessment workshops

Each of the two workshops covered approximately a day and a half and followed a similar course. Firstly, the system diagrams were used to allow the group to consider each element in turn, with the additional prompt lists of stakeholders and sustainability categories providing reminders of the breadth of issues to be considered. Participants identified the negative and positive outcomes associated with each location, without attempting to analyse each issue under consideration. This produced a comprehensive list of threats and opportunities.

The second stage of each workshop involved systematically working through the list of outcomes, using the risk analysis scales to assign both likelihood and consequence to each in turn. The calculation of an overall risk ranking based on consequence and likelihood allowed the prioritisation of the list. Those threats and opportunities that scored above an agreed threshold were flagged for consideration at the next stage.

The final part of the risk assessment workshops involved considering each prioritised opportunity or threat, and suggesting any additional controls that might be needed to achieve the desired outcome. Controls for threats addressed methods of reducing consequence or likelihood, whilst those for opportunities defined proactive steps to enable the positive consequence to be realised.

The roles of the SMI participants in the workshop included the facilitation of the overall process, prompting the consideration of issues based on the material provided, and reflecting other stakeholder perspectives in the discussion.

Reporting and review

Following the completion of the workshop, the outcomes from each stage of the process were circulated to all workshop participants to ensure that all information had been captured correctly, and allow for any additional issues to be identified. A full report describing the process and outcomes was then compiled and finalised following interaction with members of the project team. Although the risk assessment workshop was conducted by focussing on each element of the system in turn, the outcomes were re-organised according to their main impact category, thereby re-introducing and emphasising the sustainability theme which underlies the overall process.

OUTCOMES

Summary of findings and examples

A total of 158 specific outcomes were considered and evaluated, consisting of 27 opportunities and 131 threats. Of these, potential controls were discussed and recorded for 89 issues – the remaining issues fell below the cut-off level in the risk ranking table. Many of the individual outcomes could be clustered together into broad findings, some of which are listed below to provide examples of the nature of the issues which emerged from the analysis:

- Measurement and balancing of water flows – even though both the pipeline and the minesite featured a large number of water meters which were being read on a regular basis, it was not possible to generate reliable raw water balances from the data available. This led to different perspectives on the relative importance of different flows of raw water from the pipeline and an overall lack of confidence in the data, particularly on the minesite.
- Some opportunities were identified on the minesite to replace raw water flows from the pipeline with recycled water from other storages. For example, the use of relatively clean dam water was suggested as an alternative for vehicle washdown, to replace the high pressure raw water currently sourced from the pipeline.
- The quantities of water consumed by mining communities were of the same order of magnitude as those consumed by mining and processing operations. Several potential opportunities were identified to work with government, local authorities and community groups to improve the effectiveness of water management practices in such communities.

A full register of risks including discussion of possible new controls for each specific opportunity or threat was provided as part of the final report

Learnings from the process

This application of the SOTA technique was the first extensive trial, and as such offered an opportunity to learn from the process. One of the key issues to emerge related to the difficulty of developing and maintaining an opportunity focus. As noted above, threats outnumbered opportunities by a factor of almost five to one. This is partly due to the fact that risk management is traditionally associated with avoiding negative outcomes, notwithstanding statements to the contrary in documents such as AS4360. A key learning was therefore a requirement for process facilitation to build an emphasis on positive outcomes into the workshop.

In several cases, a number of individual issues raised over the course of the process focussed attention on one particular element of the system. The holistic approach of considering all dimensions of water management thus allowed clusters to emerge, which otherwise might not have been so obvious had separate and individual issues been considered in isolation and by different sections of the organisation.

The nature of some of the impacts involved can make this a subjective process at times, and for this reason a diverse range of participants in the workshop is useful. As previously mentioned, the workshop was conducted with BMA and SMI participants only. Whilst external stakeholder viewpoints were explicitly recognised and discussed, there was a tendency for those involved to revert to considerations of pure business risk rather than broader stakeholder outcomes. This issue was recognised during the workshop, and again flags a need for facilitation processes to address this aspect when no external participants are involved.

Future activities

BMA is proposing to undertake this form of analysis on other parts of the water supply system supplying their mines. This will provide the sustainability context to a very significant part of the infrastructure in Central Queensland. An essential pre-requisite to undertaking any further analyses is to gain a more comprehensive understanding of the consumption of water in the various parts of the mining operations. To this end, a more comprehensive water flow monitoring network is being installed at each mine. This will enable accurate water balances to be defined at each mine and allow the opportunities for substitution of water of other qualities to be identified.

In the sustainability context, it is considered that the reliance on raw ‘clean’ water for most site uses can be further reduced. Large volumes of lower quality water are being accumulated on the mines, even in periods of drought. Therefore substitution of lower quality water for the raw water in some of these uses will better balance the consumption / disposal equation on the minesites. The treatment of lower quality water to allow its use in particular parts of the mining process is also being evaluated. Again the consumption / disposal balance can be modified if more of the water accumulating on the mine can be reused.

The SOTA technique also has a place in other evaluations undertaken by mining operations. It has significant potential in the development of mine life plans and eventually in mine closure plans where non-mining stakeholders are involved in the planning process.

CONCLUSIONS

As noted earlier, the SOTA approach offered benefits in terms of integrating a wide range of broad impacts associated with a particular activity, in this case the management and supply of water to mining operations and external stakeholders. The risk management approach was well accepted by those involved, and provided a useful framework for evaluating and prioritising issues identified by the group as a whole. Subsequent discussion with SMI industry sponsor representatives emphasised the benefits of extending the process to involve external stakeholders in the process, and plans are underway to develop a trial in this area.

As a result of recurring drought conditions and increased community focus, water management is now high on the agenda for most mining operations in Australia. In many cases this extends beyond the minesite and its immediate environmental issues to much broader concerns around competing demands and social obligations. The principles of sustainable development encourage the valuation and appropriate pricing of environmental assets such as fresh water, and this is being reflected in recent reforms and initiatives at a number of levels. There are both opportunities and threats involved for mining companies in this area, and it is essential that these be recognised and appropriately managed.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the permission of BMA to publish this paper, and also the contributions of other SMI sponsors and ACARP in funding the SOTA project including this case study.

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