The contribution of mining to clean water and sanitation (SDG 6): Case studies from South Africa

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Abstract

Water is essential to all life, and, in their Global Risks Report 2017, the World Economic Forum rates the current water crisis as one of the top five global risks. Access to a secure and stable water supply is also critical to all mining operations, many of which occur in water-stressed areas. In South Africa, water security risks are compounded by the fact that mines frequently occur in close proximity to human settlements, and it is thus critical to consider other users such as communities and the environment when using and managing water. This paper outlines case studies that show how mining companies in South Africa are realizing the benefits of public-private partnerships in terms of securing their own water supply, whilst contributing to the sustainable development of the communities in which they operate by promoting access to clean water and participating in water conservation and infrastructure development. Whilst these case studies show that mining companies can play a crucial role in regional water supply, the challenges are significant and complex. In South Africa, the Mine Water Coordinating Body, established in 2016 and active since early 2017, brings together mining organizations and government departments to collectively address these challenges and find solutions to the complex regulatory, institutional and financial barriers to improve mine water management and reuse.

Background

Meeting the United Nation's Sustainable Development Goals (SDGs)[1] by 2030 will require commitment of, and collaboration between, all sectors and stakeholders, including governments, non-governmental organizations, the private sector and communities. One of the sectors of key relevance to many developing countries, is that of mining. Although mining has the potential to make a significant contribution to sustainable development in mineral resource-rich countries, it can also lead to degradation of the surrounding environment and impact negatively on the health and well-being of local communities.

It was in this context that the World Economic Forum (WEF) published an atlas in 2016[2], which maps the relationship between mining and the SDGs, and highlights opportunities for mining companies to make positive contributions towards achieving these goals. In accordance with this atlas, an SDG of particular relevance to the mining sector is that of Clean Water and Sanitation (SDG 6). This is because mining operations can impose long-

[1] "Sustainable Development Goals: 17 goals to transform our world", UN, accessed 29 July 2017, http://www.un.org/sustainabledevelopment/sustainable-development-goals/
[2] "Mapping mining to the Sustainable Development Goals: an atlas", WEF, accessed 29 July 2017, http://www3.weforum.org/docs/IP/2016/IU/Mapping_Mining_SDGs_An_Atlas.pdf

term, and sometimes permanent, impacts on the availability and quality of local water resources, and consequently on the quality of life and traditional livelihoods of surrounding communities who depend on local water resources for domestic use, agriculture and livestock farming. These risks can, furthermore, translate to very real tensions and conflicts between mines and external stakeholders (communities, governments and other industries), particularly where mineral resources occur in water-stressed, environmentally sensitive or culturally sensitive areas[3]. Conversely socio-political pressures and regulatory reforms threaten the industry's access to a secure and stable water supply, thereby posing a very real and critical risk to the financial and practical viability of mining operations[4,5].

Case studies, cited in documents by the International Council on Mining & Metals (ICMM)[6], the International Finance Corporation (IFC)[7] and Columbia Center on Sustainable Investment (CCSI)[8], bear testimony to the paradigm shift in the approach of mining companies to mine water management over the past 5-10 years. Today, most mining companies recognize that responsible use and sound custodianship of water is a critical business issue, and have found innovative pathways to improve water efficiency, minimize pollution of water resources, and avoid competing with other users for water. Many companies around the world are also realizing the benefits of going beyond merely managing impacts and using site water more efficiently. By adopting a more collaborative and participative approach, these companies are making a significant contribution to the provision of clean and adequate water on a local and even regional scale. This can lead to establishing trust and enhancing company reputation, ultimately reducing the risk of conflict and improving water security. In this way a scenario of "shared value" is created, that mutually benefits both the industry and the communities in which it operates[9].

In South Africa, mining companies are setting the bar in terms of contributing to the provision of clean water in water-stressed areas through collaborative partnerships with government and civil society, under the auspices of the Mine Water Coordinating Body

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[3] Lyuna Zarsky, "Behind Latin America's anti-mining protests: water concerns", accessed 26 August 2016, http://www.worldpoliticsreview.com/articles/16079/behind-latin-america-s-anti-mining-protests-water-concerns.

[4] Barbara Lewis, " Water scarcity tops list of world miner's worries", accessed 7 March 2017, http://www.reuters.com/article/us-africa-mining-water-idUSKBN15M26S.

[5] Nicolas Maennling, Sophie Thomashausen, Diana Nielsen, and Ajay Vempati, "Mining and water: a perspective on legal and regulatory risks", accessed 24 July 2017, http://water.columbia.edu/files/2015/11/IssuespaperCCSI_29-October_LP.pdf.

[6] "Water management in mining: selection of case studies", ICMM, accessed 24 July 2017, http://www.icmm.com/en-gb/search?q=Mine+water+case+studies.

[7] "Water in the mining sector: shared water, shared responsibility, shared approach, ICMM, accessed 24 July 2017, http://www.icmm.com/en-gb/search?q=Water+in+the+mining+sector.

[8] Perrine Toledano and Clara Roorda, "Leveraging mining investments in water infrastructure for broad economic development: models, opportunities and challenges", accessed 24 July 2017, http://ccsi.columbia.edu/files/2014/05/CCSI-Policy-Paper-Leveraging-Mining-Related-Water-Infrastructure-for-Development-March-2014.pdf.

[9] "Water, mining and communities: creating shared value through sustainable water management", IFC, accessed 24 July 2017, https://www.commdev.org/water-mining-and-communities/.

(MWCB)[10]. This body, established as an outcome of the broader Strategic Water Partnership Network (SWPN)[11] in early 2017, aims to promote effective mine water management and re-use through cross-sectoral and multi-stakeholder engagement and innovation. South Africa is the 30th driest country in the world, and is currently experiencing its worst drought since 1904. Whilst mining typically accounts for less than 3% of national water consumption, mining activities are mostly concentrated in water-scarce and populated areas, placing additional strain on the limited water resources. This situation has been aggravated by poor water management practices and governance by the mining industry in the past, leaving a legacy of degraded and polluted environments which impact negatively on the health and traditional livelihoods of surrounding human settlements. Reports by civil society organizations[12,13,14] provide documented evidence of the adverse effects of mining on the surrounding environment and communities in South Africa, and the consequential incidents of mine-community conflict around the country, many of which center around water security and pollution.

This paper presents two case studies which highlight how mining operations in South Africa are rising to these challenges by engaging in activities that are not only reducing their own footprints, but also promoting access to clean water and water conservation on a local and regional level.

Case study 1: Mine water reclamation in the Mpumalanga coal fields

Coal mining is a major economic activity in the north-east Mpumalanga Province, with a total of 239 operating mines and 788 derelict and ownerless mines being recorded in 2015[15], mostly lying in and around the towns of eMalahleni and Middelburg. Apart from 84% of South Africa's coal production, the province also accounts for 46.4% of the country's major arable soils, and is the heart of South Africa's maize production. Historically, coal mining has had a significant impact on the environment, with saline neutral and acidic metal-rich discharge from coal workings and discard piles resulting in extensive pollution of water resources and land in the province, and concomitant adverse effects on surrounding eco-systems, community health and crop productivity. The area is also one of the fastest growing regions in South Africa, and the municipalities are battling to provide potable water to the rapidly expanding population.

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[10] "Mine Water Coordinating Body established in South Africa", WRG 2030, accessed 29 July 2017, https://www.2030wrg.org/mine-water-coordinating-body-mwcb-established-in-south-africa/.

[11] "Creating shared value through innovative partnerships: Strategic Water Partnerships Network", WRG 2030, accessed 24 July 2017, http://www.2030wrg.org/wp-content/uploads/2014/08/SWPN-SA-brochure-2013.pdf.

[12] "The cost of gold: environmental, health and human rights consequences of gold mining in South Africa's West and Central Rand", Harvard Law School International Human Rights Clinic, accessed 24 July 2017, http://hrp.law.harvard.edu/areas-of-focus/human-rights-the-environment/.

[13] "Full disclosure: the truth about corporate environmental compliance in South Africa", CER, accessed 24 July 2017, https://fulldisclosure.cer.org.za/2015/.

[14] "Policy gap series", Bench Marks Foundation, accessed 24 July 2017, http://www.bench-marks.org.za/.

[15] "Zero hour: poor governance of mining and the violation of human rights in Mpumalanga", CER, accessed 27 July 2017, https://cer.org.za/news/zero-hour.

Paradoxically, whilst civil society struggles with water-scarcity above ground, the mines in the Province, some of which have reached the end of their working life and others which are still operating, are constantly having to deal with an excess of ingress groundwater. This mine ingress water poses a challenge to both operating and closed mines as it is contaminated by elevated levels of salts and metals, and is often highly acidic. It is thus unfit for human consumption or use and, without adequate management and resources, can lead to pro-longed pollution of groundwater and, ultimately, surface waters.

It was against this background, that Anglo American's coal division (Anglo Coal), BHP Billiton Energy Coal South Africa (now owned by South32), and the eMalahleni Municipality embarked on a joint initiative to install the first commercial plant in the world for recovering potable water from acid mine drainage (AMD) in 2007[16]. The operational eMalahleni Water Reclamation Plant (EWRP) uses a combination of lime neutralization (HDS process), reverse osmosis (HiPRO process) and ultrafiltration to treat contaminated mine water from three operating Anglo mines and one defunct coal mine belonging to South32, removing 99% of the metals and salts. This plant is currently producing 30 ML/day potable water of which 25 ML/day is sold to the eMalahleni municipality, supplying 12% of the cities daily water needs and effectively providing drinking water for 60 000 people. Currently the plant is undergoing expansion and modification to treat mine water from additional collieries and extend capacity to 50 ML/day. The EWRP has been operating successfully for a decade with constant monitoring, routine maintenance and safety at the center of its function. Its success and impact has been recognized through several national awards. These include a gold medal by the South African Institute for Engineers, a Mail & Guardian's Greening Future Award and the sustainability category of Nedbank Capital's Green Mining Awards. The project was also recognized by the United Nations Framework Convention on Climate Change (UNFCCC) in 2011 as one the Lighthouse Projects in their Momentum for Change awards at COP17.

On the back of the success of the EWRP, a mine water reclamation demonstration plant was commissioned at Optimum opencast coal mine[17], followed by a second full-scale plant at Glencore's Tweefontein Colliery in 2016. The Tweefontein plant also uses the HiPRO desalination process to treat excess mine to drinking water standard, producing 15 -20 ML/day potable water, a portion of which is to be supplied to the local municipality at municipal tariffs.

These mine water treatment plants, whilst contributing significantly to the yield of the Middelburg and Witbank dam catchment areas, are not without their challenges. The costs of the treatment processes are relatively high, whilst the treatment processes produce significant quantities of gypsum sludge (from the HDS neutralization and clarification processes) and salt brines (from the HiPRO process). In an attempt to reduce the costs of waste disposal (which typically amount to between 25% and 30% of the total costs of the process), and potentially generate additional income to cover the costs of water treatment, 66 houses were constructed using the gypsum sludge from the EWTP as

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[16] P. Günther, W. Mey and A. van Niekerk, "A sustainable mine water treatment initiative to provide potable water for a South African city: a public-private partnership" (paper presented at the Water in Mining Conference, Brisbane, QLD, 14 - 16 November 2006)
[17] V. Cogho and A. van Niekerk, "Optimum coal mine water reclamation project" (paper presented at the International Mine Water Conference, Pretoria, South Africa, 2009)

building material in a proof-of-concept pilot project in 2010. Following the success of this project, the EWRP currently sells the bulk of its gypsum waste to a local construction company for use as building material.

The HiPRO brines from both plants are currently still disposed of in evaporation ponds. These require a huge amount of land and each one costs upwards of R100 million to construct. Furthermore, the life span for such ponds is only about five years and the risk of leaks into the surrounding soil is a danger. To address these issues, the world's first full-scale working unit for the eutectic freeze crystallization (EFC) of brines will soon be operational at the Tweefontein Colliery in Mpumalanga. The unit has been purchased by Glencore and built and designed by Prentec, based on the technology developed at the University of Cape Town's Department of Chemical Engineering. This plant will recover 5 ML/day desalinated water, as well as potentially useable salts from the hypersaline brines[18].

Apart from augmenting the supply of drinking water in the Province, opportunities are also been explored for mining and agricultural sectors to work together to achieve food security, whilst simultaneously contributing to the protection of water sources. Under the auspices of the MWCB, the South African Water Research Commission (WRC), Anglo Coal, Exxaro and South32 are currently undertaking a demonstration project on 60 Ha of allocated land on the Mafube Colliery, using poor quality mining water to cultivate salt tolerant crops such as soybean and wheat[19].

Case study 2: Unique water partnerships for Mogalakwena platinum mine

With 90% of their operations occurring in water stressed regions in the Northwest and Limpopo provinces, Anglo American's Platinum (Amplats) division has also adopted a collaborative, shared value approach to water management. In particular, the Mogalakwena mine, which is the largest open pit platinum mine in the world, is situated in the very arid and water-stressed Bushveld complex in the Northern Limpopo province, 35 km from town of Mokopane and 65 km from the city of Pholokwane. It is surrounded by 64 villages with a total population of 350 000, which make up the local Mogalakwena municipality. In line with Amplats water management strategy to reduce the use of potable water in its operations, and following an extensive test campaign, the Mogalakwena mine entered into an agreement with the municipalities of Mokopane and Pholokwane whereby secondary water from the sewage treatment plants would be use in the ore processing plant. In return, Amplats committed to assisting with the development and upgrading of various water supply, treatment and storage facilities, and the construction of a new pipeline from the town of Polokwane. The mine's parent company Anglo American has taken this partnership a step further by collaborating with the Development Bank of Southern Africa (DBSA) and the Investment Climate Facility for Africa (ICF) to implement

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[18] Ambre Nicolson, "World first in waste-water treatment", UCT news, accessed 29 July 2017, https://www.news.uct.ac.za/article/-2017-07-13-world-first-in-waste-water-treatment.

[19] "South African industry works towards ensuring water sustainability" Mining Review, accessed 28 May 2017, https://www.miningreview.com/?s=South+African+industry+towards+ensuring+water+sustainability.

a capacity building support programme at Mogalakwena, and 10 other municipalities across South Africa.

More recently, the mine has started to provide 12 villages, and two primary schools in the area with water from its deeper boreholes as a temporary measure, due to water shortages and the poor quality of locally available borehole water. This arrangement was put in place following violent community protests in August 2015, during which a lack of potable water provision was highlighted as a key community concern. In terms of relieving the water situation over the long-term, Amplats is currently collaborating with the South African Government and other stakeholders on the Olifants River Water Resource Development Project (ORWRDP), which includes construction of the De Hoop Dam and associated distribution components by 2019. This cross-sectorial partnership will meet the mining sectors requirements on the Eastern Limb and Northern limb of the Limpopo Province, and provide water to local communities, agriculture and other industries. Approximately 1.9 million people are eventually expected to be provided with clean water through tis collaborative endeavor.

Concluding remarks

The mining sector is facing increasing regulatory and social pressures to both demonstrate efficient use of water resources on an operational and site level, and contribute positively to water planning on a local and regional scale. Case studies in South Africa have demonstrated that, by adopting innovative solutions and entering into partner agreements with local government and communities, mining companies can secure access to water for their operations whilst simultaneously contributing to regional supply of clean water and sanitation.

However, whilst the benefits of adopting a “shared value” approach to mine water management can be significant, so are the challenges. Application within the South African mining industry remains relatively constrained and largely limited to major multi-national organizations. Firstly, the construction and operation of plants to reclaim mine water for drinking water purposes is expensive; for example the provision of potable water by the eMalahleni Mine Water Plant remains heavily subsidized by the mining industry. Furthermore, despite efforts by many mining companies to reduce their water footprint, these efforts are not always appreciated, and there is still much work to be done to overcome cultural barriers and trust deficits within, and between, the various stakeholders. Another major barrier to the development and effective implementation of water management plans and activities in South Africa is the lack of institutional capacity and coordination between the various government bodies; a constraint that is aggravated by a poor understanding of current water resources and the factors influencing their likely availability and demand over the long-term, particularly in mining-intensive regions.

Meeting these challenges will require more than a few isolated public-private partnership initiatives. What is needed is the establishment of multi-partner networks to create and support inclusive approaches for the management of mine water on both an operational and regional scale, and to align practical activities with the discourse about mining’s contribution to the UN’s Sustainable Development Goals. In South Africa, the establishment of the Mine Water Coordinating Body and its sister organization, the Strategic Water Partner Network, is certainly a step in the right direction. However, it is essential that these organizations are extended to include a wider range of partners in order to facilitate decision-making that integrates the (often conflicting) perspectives and

priorities of the multiple parties affected by mining operations. Such decisions should, furthermore, be underpinned by a sustained programme of research and development which drives technology innovation, and develops the necessary understanding and tools to overcome the business strategy and governance challenges involved.

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