

Focus on CSIR Research in Water Resources

CSIR Natural Resources
and the
Environment
2007

CSIR groundwater research into mine closure strategies

All mines have a finite lifespan. In the past South African mines were often simply abandoned when the ore was finished, with little consideration for post-mining environmental conditions. The consequences of this approach, both in terms of environmental degradation and the public's perception of the mining industry have often been severe. However, community expectations and the current legal framework in South Africa are such that the environmental responsibilities, and the financial implications that accompany these, remain with the mine lease holder until a closure certificate is issued by the Department of Minerals and Energy (DME).

In terms of mine planning, this represents a fundamental shift as mine plans must now extend beyond the operational phase (i.e. post-life-of-mine). The potential social, financial and environmental benefits of this shift are significant, these extending to the community, mining houses, and regulatory authorities, alike.

The CSIR Groundwater team is currently working on innovative ways of managing the impact of mine closure, in particular the decant of polluted mine water. Radon isotopes are being used to determine where mine water is contributing to surface water flows, which helps to identify sources of pollution and assists with the critical issue of the apportionment of responsibility between mining companies. The team is also studying the hydrogeological properties of mine dumps (waste rock is dumped at the surface as a slurry) in order to better understand the movement of water and pollutants through these dumps and find ways to reduce environmental damage.



*Abandoned open-cast
gold mine near Johannesburg
with acidic, iron rich polluted water
leaching into it.*



*Discharge of large
quantities of polluted water,
which needs to be managed
sustainably.*



*Taking pH measurements at a
site polluted by mine water
near Johannesburg.*

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Mine closure strategy project and governance

South Africa is a mining economy, with some of the largest gold deposits in the world. This has formed the basis of the South African contribution to the economic output of Africa. Johannesburg is a mining town located on a watershed between two major international river basins. The city and associated industrial complex is now home to a quarter of the entire South African population and accounts for a staggering 10% of the entire economic output of continental Africa. This is the largest concentration of people in a city that is not on a river, a lake or a seashore. In fact a peculiarity of the four most economically developed countries in the Southern African Development Community (SADC) region (South Africa, Botswana and Namibia) is that capital cities, or places of significant economic concentration, are all situated on watersheds. Thus the economic development challenges of places like Johannesburg, Pretoria, Gaborone, Francistown, Windhoek, Harare and Bulawayo are all linked by this unique fact – while water flows downhill their long-term sustainability is driven by the capacity to divert it uphill, and manage the environmental consequences of this complex set of actions.

But this achievement has come at a price. With some of the deepest mines in the world, extracting the ore is dangerous, placing a major need for technologies related to human safety in extreme conditions. Environmental costs have been high too. Given that the Johannesburg conurbation straddles the watershed between two major international river basins – the Orange and Limpopo – impacts to aquatic ecosystems upstream affect all users downstream in a cascade of knock-on effects. The significance of this becomes apparent when one evaluates the mining industry against the background of water resource management. South Africa is fundamentally constrained by water availability, with future economic devel-

opment and hence political and social stability dependent on this. Understanding water, or doing better things with our limited water, is therefore taken very seriously by the CSIR.

When South Africa became a democracy in 1994, the Constitution of the country became one of the first pieces of legislation that mandated sustainable development. A task of the CSIR is to translate this legal mandate into a viable set of strategies underpinned by robust technologies in order to continue to unlock the mineral wealth of the country for the benefit of the citizens. This is no small challenge because the long-term implications of mining are complex and profound. Acid Mine Drainage degrades water quality, and recent research has shown that heavy metal and radionuclide contamination of aquatic ecosystems arising from gold mining is a significant challenge to our existing technologies and scientific capacity as a country.

The Gold Closure Strategy project looks at the future of the gold mining industry and seeks to learn lessons from the past to be applied to the future. It sets out to make a series of strategic-level interventions by advising the policy-makers of the unintended consequences of past activities, and develops a series of interventions that will transform a historically extractive industry into one that is sustainable in environmental, social and economic terms. This is done by understanding the role that governance plays in the overall policy-making process.

The reversal of the trends already visible will be a daunting task. It will challenge the very technological base of the country, but it will succeed because of the high level of political will that exists. The Government is now accountable to the people that elected it and research institutions like the CSIR are strategic capabilities that are somewhat unique on the continent of Africa, which are being mobilized to unleash their ingenuity on this complex problem of historic proportion.



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