Surfaces and externalities: acid mine drainage on the Witwatersrand, South Africa

David Fig

The gold-bearing areas of South Africa are concentrated along the “ridge of white waters”, the Witwatersrand. As gold mining reaches its limits, pumping of water from the deep-level mines has come to an end. The resulting build-up of mine water underground reached the west Rand in 2002, resulting in contamination of river systems, game reserves and world heritage sites. In the near future, further acid mine drainage will surface in the east and central Rand areas, corrroding and weakening the built and natural environments in central Johannesburg. How should government respond when most of the old gold mining companies have left or gone out of business without dealing with their pollution legacy?
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- “Problems related to mining waste may be rated as second only to global warming and stratospheric ozone depletion in terms of ecological risk. The release to the environment of mining waste can result in profound, generally irreversible destruction of ecosystems.” United States’ Environmental Protection Agency, 1987.¹
- “Amongst the many things I learnt, as a president of our country, was the centrality of water in the social, political and economic affairs of the country, continent and indeed the world. I am, therefore, a totally committed ‘water person’.” Nelson Mandela, 2002.²

1. Introduction

For over 125 years, the area around Johannesburg has been at the centre of the mining of the richest underground gold-and uranium-bearing reefs in Southern Africa. Mining has occurred over an arc of approximately 75 kilometres, along a geological ridge of “white waters”, the Witwatersrand or rand, which also constitutes the continental divide: to the north of the ridge, surface water flows into the Limpopo catchment and out into the Indian Ocean; to the south, surface water flows into the Vaal, and subsequently via the Orange/Gariep river into the Atlantic (Turton et al., 2006: 316).

By the turn of the second decade of the twenty-first century, the gold is mostly no longer viable to mine, and with a few exceptions, the mines have closed down. Many of the companies which exploited the resource have disappeared. However they have left an expensive legacy of environmental pollution, without having internalised these costs in their balance sheets or having been required by the state to pay them. Until recently, the state imposed little obligation on the mining companies, or their shareholders, to account for cleaning up the damage.³

Because of the deep level of the gold-bearing ore, the Witwatersrand goldfields could only be exploited by means of huge capital investments, mostly from abroad, in the late nineteenth century. The mining industry demanded that African peasants be alienated from their land and taxed in order for them to seek paid work on the mines. This initiated the migrant labour system which drew on the whole region of Southern Africa for its manual workforce. Contradictions between the mining industry and the Kruger state led to the South African war of 1899-1902. The Transvaal republic was defeated and recolonised, and a British dominion consisting of all of current South Africa was established in 1910. Under this Union, mining interests were seen as a vital source of tax and other revenue for the state.
This led to the state privileging the ‘minerals-energy complex’ (Fine and Rustomjee 1996), allowing racist employment practices to endure, and allowing the industry to escape responsibility for its negative impact on the environment.

Part of the damage to the environment is the result of mismanagement of tailings dams, the huge piles of solid and liquid waste which for the most part lie above ground. Increasingly, however, attention is having to be paid to the problem of acid mine drainage, which consists of liquid flows of polluted water from the mines into the surface watercourses and underground aquifers in the areas surrounding the former mines. These water resources have sustained life in the area for hundreds of years, including provision of drinking, washing and cooking water, agricultural use (watering of crops and cattle), supporting biodiversity, heritage, tourism and leisure activities, and indeed, also supplying water used in industrial and mining enterprises.

Fresh water in South Africa is scarce and the supply fully accounted for in terms of existing use. Much of the country is semi-arid, and only 14 per cent of its surface is available for arable farming. Cities are facing water stress and in some cases, due to drought, municipalities have had to recycle sewerage or institute expensive desalination projects.

Johannesburg and its environs serve both the bulk of the country’s industry, as well as a population of approximately nine million (18% of the country’s people). It is one of 7% of the country’s municipalities to have competent water management facilities. However, should the surrounding catchments become badly polluted, this would represent what the Department of Water Affairs has called a “potential environmental catastrophe” (DWA, 2009: 22). All kinds of industrial and agricultural processes would be compromised, contingent jobs could be lost, people and animals would experience health problems, and huge structural damage done to the built and natural environments, including to the Johannesburg city centre and a significant world heritage site, the Cradle of Humankind.

Is this alarmist? Many of the water scientists and geologists are already warning that the need for government action is urgent if the problem is to be forestalled. Some have argued that time for action is running out. Government has been slow to act; despite years of publicity, the issue is only being considered at cabinet level for the first time in February 2011 (Pressly 2011b).

This chapter will try to define the problem in general, then outline the specific experiences in different mining basins in the Witwatersrand gold-uranium complex. It will look at some of the technical solutions offered by science and business, and raise questions about the policy arena in which this issue is being played out. It will conclude with observations about the management of complex environmental issues in contemporary South Africa in the context of a Constitution which guarantees environmental rights to its citizens.
2. Acid mine drainage: the problem

Acid mine drainage is the name given to water which becomes contaminated when it interacts with sulphide-bearing rocks in the presence of oxygen. There are vast amounts of underground iron pyrite (fool’s gold, Fe₃S₄) in the Witwatersrand basin and when these interact with oxygenated water, sulphuric acid is formed. Other minerals break down in the acidic conditions, causing their metals to enter into the solution and further contaminate the water. These conditions occur when neglected old mine shafts and the underground cavities that have been mined out start to fill with rainwater, or with groundwater flowing from other areas. With the closure of many mines, the practice of pumping out the contaminated acid mine drainage has more or less ceased, and the underground cavities and shafts have started to fill up. Because there is almost no pumping at present, the level of acid mine drainage is constantly rising underground, at different rates in the different basins on the Witwatersrand.

Since August 2002, the acid mine drainage has been decanting (flowing uncontrollably from underground) and entering the watercourses on the surface of the West Rand basin. Because the acid mine drainage is highly corrosive (pH of around 2-3 makes it highly acidic), toxic (due to dissolved heavy metals) and often radioactive (uranium and its daughter products are present underground), it has the ability to contaminate the catchment areas not only at the point of decant, but for kilometres downstream (Naicker et al., 2003: 40). It also has the capacity to dissolve dolomitic geological formations, creating the possibility of increased sinkholes, and the potential to destroy the cave systems and archaeological sites linked to the Cradle for Humankind, which is one of South Africa’s and the world’s most important areas for the conservation and future excavation of hominid finds. The danger is compounded by the prediction that unless urgent action is taken, the Central Rand basin, which straddles an area from Boksburg to Roodepoort, including the central Johannesburg business district, will begin to see a decant, and this may cause immeasurable damage to an area of much higher population density and economic activity.

Gold and uranium mining wastes were calculated at 221 tons per year, or 47 per cent of the 468 tons of mining waste per year measured in 1997, and thus form the largest single source of waste and pollution in the country (DWAF, 2001). Much of the waste from the mined-out ores was placed in 270 tailings dams across 400km² of the Witwatersrand, for the most part unvegetated and unlined. These too have become a source of seepage, as oxygenated rain water has interacted with the pyrites and other sulphides and metals in the waste. Not only is there acid mine drainage in the run-off, but wind erosion results in air and further water contamination, and some catastrophic dam failures (Merriespruit, Westonaria) have had severe consequences for the environment and human health (Oelofse et al., 2007: 1-2).

Faced with the potential decant in the Central Wits basin, government has been tardy in providing a solution. It has, moreover, continued to allow the decant to occur in the Western Basin without undertaking significant remediation. It faces a huge task, and needs huge resources to tackle the problem, which will not be short-lived. The damage is being caused due to closure and/or abandonment of mines by companies that may no longer be in
existence. Until the 1990s, there were no enforceable closure plans, and companies who had benefited from mining the gold failed to leave any funds for post-closure remediation. The companies that continue to mine have not been able to fund the prevention of the decant of an entire basin, which includes the acid mine drainage emanating from all the other mines in the basin. It is left to the state to finance the bulk of the remediation, with some expectations of private sector involvement. It is possible that the cabinet will pronounce on this matter when it finally releases the report made to an inter-ministerial committee by its technical task team.

The hydrogeology of the Witwatersrand is such that there are distinct basins, comprised of collections of gold mines in the West, Central and East Rand, as well as the Far Western, Free State and KOSH (Klerksdorp, Orkney Stilfontein and Hartebeestfontein) basins. Each of these basins comprise interconnected mining tunnels and underground cavities in which the acid mine drainage occurs, each basin having its own water flow patterns, and levels to which the contaminated water has risen. Since the basins on the Rand each have a distinct experience of acid mine drainage, they will be discussed in turn.

3. West Rand Basin

Because the decant of acid mine drainage in the West Rand basin has been under way since 2002, this basin has received by far the most extensive publicity and public attention. The basin is located beneath Krugersdorp/Mogale City and Randfontein. It includes, on the surface, the Wonderfonteinspruit, which flows south into the Vaal, and the Tweelopiespruit, which flows north into the Crocodile. The sizeable township of Kagiso is located close to Krugersdorp, and an array of informal settlements have sprung up within the Wonderfonteinspruit catchment. Their inhabitants are negatively affected, as well as those who draw water from local boreholes, as are the residents of the Potchefstroom area, who rely on the watercourse to supply their household water and may be exposed to higher levels of leukaemia (Winde, 2010c).

In the 1950s, Chamber of Mines Research Organisation produced a report to the CSIR noting the potential problems associated with mine closure. These included the deterioration of water and air quality, increasing seismic activity and the formation of sinkholes (Frost, 1957). Further concerns were raised in technical and scientific reports throughout the 1960s (Adler et al., 2007: 33; Jordaan, et al., 1960; FSE, 2010a), but it was only in the 1990s, once many mines had closed, that attention was once again drawn to the problems arising from mine closures. In 1996, mine consultant Garfield Krige was involved in predicting that the decant from the mines would occur around 2002 (JCI, 1998). As mines developed and became deeper, so the practice of pumping relatively clean groundwater, which had not yet acidified, out of the mines was instituted. However, with closures, and to avoid taking on post-closure financial burdens, the mining companies in the Krugersdorp/Randfontein areas ceased pumping, allowing the old mine tunnels to fill up with groundwater. By 1998, when the last company, Harmony Gold, stopped pumping operations at its Central Ventilation Shaft, the underground cavity, or void, started to fill up with contaminated water. Mine
ownerships changed, responsibilities were not regulated, and the predictions of 1996 slowly forgotten.

When the decant occurred in August 2002, the specialists, mining houses and authorities were astounded by the magnitude of the event, with an outflow of 20 million litres per day. Contaminated water entered the surface watercourses of both the Wonderfontein- and Tweelopiespruit.

In a recent interview (Kardas-Nelson, 2010: 20), Krige noted:

The Department of Water Affairs was completely aware that the voids would start filling up. The fact that the Department did not take proper decisions over that period, from 1996 to now, gave all the mines time to get rid of their liability. The Department should have said 2002 is the deadline. Instead, in 2002 the water started to decant, and it caught everybody off guard, even though everybody knew about the whole thing. It is now 2010 and nothing has been done.

The failure to prevent the decant has led to serious pollution problems in the two catchment areas, arising from deposits of sulphates, heavy metals and radioactive metals. All these pose serious health risks to organisms, ecosystems and to human beings. Sulphate concentrations have been measured at around 5000mg/litre, way beyond the point at 600mg/litre where human health will be affected. The metals, largely manganese, aluminium, iron, nickel, zinc, cobalt, copper, cadmium, arsenic, and lead, are toxic and potentially carcinogenic. As a result of the decant they are present at levels well above those of regulatory concern (Van Eeden et al., 2009: 55).

Of serious concern is the impact of the radioactive metals, such as uranium, thorium, radium and polonium, which are chemically toxic in addition to their radioactivity. Annually around 50 tons of uranium are discharged into the catchments of the West and Far West Rand. Radioactive materials have been leaching out of the tailings dams and through the decant, and accumulate in the sediments of the watercourses. (Coetzee et al., 2006). These sediments can have their radioactive content mobilised by animals drinking from or by children playing in the streams. Through ingestion of water or contaminated plants and animal products, they enter the food chain. The impacts of these materials include genetic and reproductive damage, blood diseases, kidney disease, compromise of immunity, organ failure, and cancers (Winde, 2010b).

When pumping was still current, much of the mine effluent from the West Rand basin ended up being directed into the Robinson Lake, the source of the Rietspruit, the main tributary of the Tweelopiespruit. At one time, property developers were keen to sell lakeside properties for their leisure value. However, the lake was declared a radiation area by the National Nuclear Regulator, having a uranium concentration of 16 mg/litre. This should be compared against a background concentration of uranium in water at 0.0004 mg/litre, and means that the load in the lake is 40 000 times higher than background. A site inspection (30 January 2010) revealed that there was no vestige of organic life left within the lake. The same holds for the entire Tweelopiespruit, now designated as a Class 5 river, one that is acutely toxic (Fourie, 2006).
In the West Rand basin, human settlements have been built on radioactive land, and in some cases, people in informal settlements, such as those close to the Tudor Dam, have been cultivating crops like maize for sale and consumption in the area. Housing materials have been made out of bricks fashioned from reclaimed tailings materials. Even an upmarket Tuscan-style retirement village, Amberfield, was constructed within 500 metres of a tailings dam, on land contaminated by radioactive dust. It is now an abandoned ghost town, surrounded by billboards advertising the lavish life once promised there. On private farms in the vicinity of the Wonderfonteinspruit, farmers have been prevented from allowing their cattle to drink water from local streams and dams by order of the National Nuclear Regulator, for fear that they would disturb the sediments and mobilise the radioactive materials in the water.

The decant flowing into the Tweelopiespruit has already contaminated the dams in the Krugersdorp Game Reserve, especially in the Hippo Dam, where the acidity and radioactivity have become a threat to the many species of fish, amphibians and mammals including the resident hippopotami (Hobbs and Cobbing, 2007a).

One of the most serious potential threats caused by acid mine drainage in the area may be to the integrity of the Cradle of Humankind, declared a world heritage site by UNESCO in December 1999. Known principally for the Sterkfontein caves complex, the Cradle is one of the richest hominid fossil sites in the world, and is the longest continuous palaeo-anthropological excavation. It recently yielded important new finds such as Little Foot, probably the most complete hominid fossil yet discovered, as well as an extraordinary discovery of examples of a new hominid species, *Australopithecus sediba*. Many of the fossils are preserved in dolomitic limestone rock formations, which when eroded, for example through the percolation of rainwater, leave a series of chimney-like openings, revealing where bone remains have accumulated, often due to the activities of scavenging animals (Clarke and Partridge, 2010: 15).

Should a large scale decant of acid mine drainage enter the underground caverns in the Cradle of Humankind World Heritage Site, the limestone of the dolomitic rock may be so decisively eroded by the acidity that they are eaten away or collapse in sinkholes near the surface. This could destroy the use of the area for further scientific research and excavation, badly compromising South Africa’s undertakings to UNESCO to preserve the site for global humanity. Moreover, the destruction of the possibility of new finds that reveal the origins of humanity, and further establish our common ancestral heritage (important in a country whose history is marked by racism), will be a serious blow to the construction of new vision for humankind, of sense of our continent’s place in pre-history and history, and of a common identity. Tourism establishments in the area account for 7 000 permanent and 2 200 casual jobs (Durand *et al.* 2010: 85). The Management Authority of the Cradle has been monitoring the impact of the decant on the Cradle (see Gauteng government, 2010) without detecting much damage at yet. However there is a need for the Management Authority to be far more pro-active and precautionary in helping to solve the overall problem posed by the decant. This can be achieved by working more effectively with other officials and civil society stakeholders.
The extensive summer rains experienced over the seasons of 2009-10 and 2010-11, and attributed to the La Niña phenomenon, have resulted in much more elevated underground water levels and extended the magnitude of the decant in the West Rand basin. In the other basins, the danger presented is that of the decant arriving more suddenly than predicted and foreshortening the time period in which a solution must urgently be found.

Despite the intensification of the decant in the West Rand basin, government and its many agencies and regulatory bodies have failed to implement an adequate remediation strategy. In April 2009 a *Remediation action plan for the Wonderfonteinspruit catchment area* (Van Veelen, 2009) was drafted and later that year issued for public comment by the commissioning bodies, the Department of Water Affairs (then DWAF) and the National Nuclear Regulator (NNR). Together with the Chamber of Mines, the Mining Interest Group and the Federation for a Sustainable Environment, the DWAF and NNR had formed a co-operative initiative to support the crafting of the action plan. The plan was, however, criticised by Earthlife Africa’s Acid Mine Drainage Working Group, amongst other things on the grounds that inadequate recognition was given to the danger of uranium, and to how the polluted material removed from the sites would be managed (Earthlife Africa, 2010). Criticism also came from scientists attached to the Specialist Task Team (Profs Stoch, Winde and Cohen).

It seems like the state’s response to the intensified decant after January 2010 was to spend R6.9 million on neutralisation, adding lime to the affected watercourses in order to elevate the very acidic pH (Adatia, 2010). However, this has been seen as a highly inadequate response to the need for a broader and more sustainable solution. Although some sulphates are removed by the neutralisation, the remaining levels are still extremely high (3700 parts per million compared with the regulatory limit of 600 ppm). Liming precipitates the heavy metals, which enter the sludge in the rivers. The metals can be mobilised (dissolved again) in the water if the residues are disturbed. Liming also adds to the huge salt load in the water, requiring further treatment to remove dissolved contaminants (FSE 2010b). It is feared that neutralisation, despite its problems, may be advocated as one of the recommendations presented to cabinet by the inter-ministerial committee as a part-solution to the decant problem in the West Rand basin.

4. The East Rand basin

The Grootvlei gold mine lies on the edge of the town of Springs, at the eastern end of the Witwatersrand. It is the only mine in the East Rand basin still pumping water out of the shafts in order to prevent flooding and the disruption of mining activities. Because all the abandoned mines in the East Rand basin are linked underground, the pumping at Grootvlei mine is essential for preventing the decant of the entire basin’s acid mine drainage. Grootvlei is located adjacent to the sensitive Blesbokspruit wetland, and this includes the nearby Marievale Bird Sanctuary. The Blesbokspruit has since 1986 been recognised globally as a wetland of international importance under the Ramsar Convention, the only such site in Gauteng province (see www.ramsar.org).
Alarm bells rang when the mine started discharging its untreated pumped out water into the adjacent wetland in the mid-1990s. Randgold and Exploration Co. Ltd, the then owners, consistently refused to install filters to remove the contaminants from its effluent. As a result, there were mass deaths of fish, crabs and other life-forms. Birds were driven away from the wetland, one of their key habitats.

The then Minister of Water Affairs, Prof Kader Asmal, took action in June 1996 by ordering the mining company to switch off its pumps. Randgold claimed that this would mean that its shafts would fill with water, and that the jobs of 6 000 workers would be jeopardised. Asmal responded by insisting that Randgold should invest R10 million in sediment settling ponds for receiving the water, rather than discharging it raw into the neighbouring wetland. Without the plant, Asmal claimed that there were no long-term prospects for the mine. He claimed that the department would be assessing not only the technology, but whether or not the jobs the mine created were worth sustaining balanced against environmental pollution and the high costs of the remediation (US Water News Online, 1996). Cabinet instructed Grootvlei to develop a pilot plant by November 1998 and a full desalination facility by December 1999 (Van Wyk and Munnik, 1998: 7).

Within a decade, Grootvlei had been acquired by a company called Pamodzi Gold, which claimed to be “the only JSE-listed gold mining company in South Africa to be owned and controlled by historically disadvantaged South Africans (HDSAs)” (Boyd ed., 2007: 188-9). A spate of acquisitions of mines on the East and West Rand and in the Free State goldfields followed. However, by 2008, Pamodzi had run out of capital, and was beginning to default on its payments to employees, contractors and loans. An envisaged R200 million loan failed to materialise, and the company was forced to go into liquidation.

The liquidators gave preference to bids from a company called Aurora Empowerment Systems, possibly because the company chairman was listed as Khulubuse Zuma (the president’s nephew), its CEO was Zondwa Gadaffi Mandela (the former president’s grandson, eldest son of his daughter Zindzi) and a third board member was Michael Hulley (the lawyer who had represented president Zuma in his corruption suit). None of these had any mining experience. They were able to convince the liquidators that they would raise the necessary R597 million for Pamodzi’s Grootvlei and Orkney mines, and took control of these mines in October 2009. The liquidator accepted a R10 million deposit, and set a date for the rest of the payment to be made. This date has been extended continually, the latest deadline being set at 28 February 2011. On three occasions, Aurora has made claims to having backing from foreign investors (Malaysian, Swiss and Chinese in succession). None of these have materialised, and the company has imitated Pamodzi in its failure to pay miners, contractors and the liquidators. The difference has been that the Department of Mineral Resources has been reluctant to press for the company’s liquidation on the grounds that the state would be saddled with the mine’s considerable environmental liabilities.

Within four months of taking control over the mines, Aurora began to default on its liabilities. In February 2010, workers were only paid a portion of their salaries, and from March payments ceased entirely. The company also failed to pay its employees medical expenses and their unemployment insurance. It allowed acid mine drainage to be deposited
in the Blesbokspruit, attracting a visit from the Blue Scorpions, the enforcement arm of the Department of Water Affairs on 10 March. From 19 March 2010, 2,000 workers, distraught by their failure to be paid -- downed tools, leaving only one hundred workers remained involved in essential care and maintenance. This included workers staffing the water pumps.

In early April 2010, it was reported that angry workers had converged on management offices, throwing stones and harassing mine officials. The latter were escorted off the mine in a motor convoy with the assistance of the police. Five miners were injured by police firing rubber bullets at them.

Pressures on the care and maintenance workers to join the strike became overwhelming by the first week of June; they had remained on duty to pump water from Shaft 3, and within days of their stoppage, water began to flood the underground pump station room. Had this continued, the entire mine would have been flooded. Suddenly the maintenance workers were offered the chance to receive their pay and although this was not realised, they returned to their posts an hour before catastrophe was averted.

For the majority of workers at Grootvlei, housed in nearby company hostels, life began to become desperate. The hostel electricity and water supply was cut, catering services were terminated, toilets started to malfunction, and medical attention ceased. This posed acute problems for the striking workers, who were left to forage and seek handouts in order to survive. Some reported that they were living on a diet of thin maize porridge and tea. Diabetic workers complained that they were eating so little food that their medication was not working. The lack of sanitary facilities was forcing workers to defecate in the nearby bush, and there was insufficient water for bathing. Many of the workers spoke of having to take their children out of school because they could no longer pay fees and transport. Others suffered from breakdowns of their marriages, because they were no longer in a situation to support wives and children. Workers from other African countries said they could not afford to go home because it cost too much to get passports renewed.

The mine started to be invaded by ‘illegal’ miners, working on their own account to extract the small amounts of gold still available, largely using mercury to extract the metal. Many of these illegals stay underground for months on end, supplied at exorbitant prices by smugglers delivering food and drink. It is not clear whether the illegals were comprised of unemployed residents of nearby informal settlements, or whether some of the desperate striking workers had begun to engage in mining on their own account as a means of survival. As the tensions mounted, six workers were charged with theft by Aurora for allegedly stealing R16 million worth of underground cables. At the same time, there were reports that the company was stripping its own assets. In August 2010, there was an incident underground which remains murky, but resulted in outsourced mine security shooting between 4 and 12 illegal workers. The security guards claimed that one of their colleagues had been shot the previous day and another held hostage. The company also claimed that the deaths had mostly resulted from faction fighting amongst the illegal miners. The police placed a number of the mine security guards under arrest.

Since February 2010, most miners had received no pay, and their unions, the National Union of Miners and Solidarity, initiated a case in the Labour Court to obtain payment of their
members in late November. The court decided that the miners should be paid, and nothing further has occurred, prompting the unions to call for mine management to be arrested for contempt of court.

Criminal charges were laid against the company by the Blue Scorpions, acting for the Department of Water Affairs, in mid-May 2010. The legal liability of management is that they can be fined R10 million for causing serious pollution, and can face jail sentences. However, Aurora has not yet been required to answer to any of these charges, perhaps due to the political protection which its board members may receive. Throughout most of this debacle, management has acted with impunity, arguably violating the “code of ethics” which the company claims to aspire to on its website (see www.auroraempowerment.com).

Khulubuse Zuma embodies all the contradictions of black empowerment, leading an ostentatious and lavish lifestyle, owning multiple luxury vehicles and turning up at the wedding of South Africa’s police commissioner in a rare gull-wing Mercedes sports car, to the delight of the paparazzi. Most recently he has been reported to have consorted with a Taiwanese ex-criminal, who served a sentence for murder in South Africa, in order to persuade Shandong Gold, a Chinese public corporation, to invest in Aurora (Sole, 2011: 2-3). His starving unpaid workforce is witness to Aurora’s reputation as being immune from regulation due to nepotism and political connections.

The continued destruction of Grootvlei, a once prosperous mine, signals that the pumping in the mine has ceased, and slowly the acid mine drainage will rise and decant, possibly at first in the streets of Nigel.

5. The Central Basin

Predictions vary amongst scientists as to the exact date of the potential decant, should too little action be taken to prevent it. Some scientists believe that the decant will begin as early as February 2012, while others claim it could take a further two or three years, giving a better margin of time for its prevention.

Should the decant occur, it is likely to start in Boksburg, but could also occur in downtown Johannesburg. McCarthy identifies the most important risk zone as extending along and 500 metres to the south of the Main Reef road, as well as along the northern side of the M2 highway (2010: 20). Because of its corrosive nature, the acid mine drainage would eat at the city’s limestone foundations, seriously corroding pipes and the steel that reinforces concrete in buildings, causing subsidence and potential collapse. Should this be allowed to happen, there will be high bills resulting from serious structural damage, costs of relocation, and costs of treating water-borne diseases and the higher costs of doing remediation after the event. Government has made little provision to cover such damages. These costs will be exacerbated by the higher population density and the concentration of the built environment in the area of the Central Basin. This may have implications for the health impact of the decant, since far more people may be exposed to the contamination.
Meanwhile the acid mine drainage in the Central Basin continues to rise steadily at an average level of 15.2 metres a month (McCarthy 2010: 17, fig. 12), at which rate the decant can be expected in under three years.

6. Policy questions

(a) Regulation

In view of the magnitude and potential consequences of the problem of acid mine drainage, and of regulating pollution from the mining industry more generally, we have to ask whether we are being well served by current legislation and administrative practice. Clearly one of the issues is that for over a century our economy has favoured mining and prepared to allow the industry to pass on the costs of environmental and public health protection to others. Their costs have generally been externalised and either borne by the state or taxpayers in general, or inscribed in affected human bodies and ecosystems. The industry has justified this by claiming that the high tax regime it faces means that the state benefits from mining revenues and can hence afford to bear the externalised costs. In turn the state has been complicit with the industry in order to secure and enhance this revenue stream.

With the advent of a new Constitution, and legislation reflecting a post-apartheid reality, as citizens we are entitled to a “clean and healthy” environment as a matter of enshrined right (s 24 of the Bill of Rights). As such recent laws have made clear two key principles: the precautionary principle (which speaks to avoiding predictable harm or potential harm where there is uncertainty) and the principle that the polluter should pay for any harm caused to people and the environment.

What has prevented these principles from being enforced? Part of the answer lies in the question of the state’s continued complicity with mining capital. During the years of segregation and apartheid, the state wilfully turned a blind eye to the industry’s damaging impact on the environment. While some of this analysis has focused on the behaviour of current mine-owners, it needs to be made clear that the heaviest responsibility lies with the major mining houses which profited from South African gold and uranium during the boom years. Key gold mining companies like the Anglo American Corporation, Gencor, Goldfields, and Johannesburg Consolidated Investments, have largely been transmuted into new legal structures, but clever corporate forensics could establish the extent to which they were beneficiaries over the lifetime of their mining operations. Clearly this would require a good deal of political will, which is unlikely to be forthcoming. For example, the state has not supported the efforts by civil society organisations to obtain restitution from key transnational corporations which benefited from apartheid. The same reluctance to take on the mining industry still applies. Instead, the state and its taxpayers are likely to be saddled with any remaining bills for mining pollution.

Even the post-apartheid governments have witnessed overlapping interests between the political elite and the mining industry. Instead of the change of regime being a new
opportunity to reform mining radically, to reflect a new balance between the interests of the market and protecting ecological integrity, the new laws simply tried to expand opportunity for new entrants into the field of mining as an attempt to redress past racial economic inequities. The new elites saw environmental protection as a barrier to their entry into new areas of the economy. Mining has always been exempt from the practice compulsory in other industries of holding an environmental impact assessment of new projects; instead, for mining, there is an environmental management reporting system administered by the Department of Mineral Resources rather than being subjected to more stringent regulation by the Department of Environmental Affairs. A flaw of both these regulatory systems is that they only regulate individual sites, and do not examine the accumulated impacts on a region of new developments.

The question of state complicity has meant that the state has failed to regulate effectively. Statements by former minister Buyelwa Sonjica that the problem of acid mine drainage has been “exaggerated” (I-Net Bridge, 2010), or the outburst by planning minister Trevor Manuel in parliament that unspecified private sector interests were dominating the agenda6 (SAPA, 2010; De Lange 2010b: 6-8) are reflections of the state’s inability to respond adequately to the urgency of the problem after years of neglect.

Perhaps the test of the state’s decisiveness was the raid of the Blue Scorpions on the premises of Aurora’s Grootvlei mine on 10 March 2010. The subsequent criminal charges that were laid against the Aurora management for deliberately allowing the pollution of the Blesbokspruit seem not to have been taken up by the courts, probably because of management’s familial relationships with key members of the political elite.

The National Nuclear Regulator has entirely failed to protect the public from the radioactivity associated with acid mine drainage. A recent report on the impacts of uranium and other radioactive substances in the Wonderfonteinspruit catchment which did not note any immediate danger to communities (NNR, 2010) has been decisively challenged by a number of radiation experts. Prof Chris Busby, a member of the International Society for Environmental Epidemiology and the European Committee on Radiation Risk subsequently visited some of the tailings dams and informal settlements in the Wonderfontein catchment during December 2010. Busby warned that radiation levels were 15 times higher than normal, and recommended that the question of radiation exposures to the public in this area be addressed properly, and scientifically overseen by an independent committee of experts. Busby felt that some informal settlements subject to radioactive contamination needed urgently to be relocated (Mammburu, 2010). Dr Rianne Teuel of Greenpeace Africa has questioned the scientific accuracy of the NNR report’s methodology and criticised its study as being unprofessional. She has further drawn this to the attention of the International Atomic Energy Authority in Vienna (personal communication, 27 January 2011). These are damming critiques of the regulator, whose entire raison d’être is protection of the public from the ill-effects of radioactivity, and which is facing the future expansion of the nuclear industry in South Africa with questionable scientific approaches and methodologies.
(b) Liability

The companies whose shareholders profited from their gold and uranium mining holdings on the Witwatersrand over the past 125 years were clearly responsible for the consequences of mining waste on the environment and on human health and livelihoods. These mining companies have never been required to assume legal liability for the damage they have caused. Without a very thorough forensic study, it would be extremely difficult to assign the proportion of damage to each mining company. And given that many of the original companies are no longer in operation, assigning liability to them retrospectively might prove fruitless.

Since liability cannot easily be enforced against companies that have gone out of business or been liquidated, there should be clear demarcations in law about what liabilities the state should assume. Where liability is established under current legislation (Van Eeden et al., 2009: 58-62), it is essential that the rule of law operates to penalise transgressors. More attention needs to be placed on the post-closure plans of all existing mine owners, and that realistic funds for dealing with mine waste and pollution be determined upfront, and adjusted at regular intervals to reflect changes in circumstances affecting the mine during the course of its operation. The state should also establish a broader fund for addressing the problem of acid mine drainage. Where feasible it should demand that – along with current mining houses – former mining companies which profited from Witwatersrand gold and uranium should make retrospective contributions to such a fund proportionate to the extent of their many years of profits as part of redress and corporate social responsibility.

(c) Disputes over solutions

Various solutions have been put forward towards addressing the problem of acid mine drainage on the Witwatersrand. It should be noted that the problems of mining waste management (historic and current) will be present for many years ahead (Oelofse 2008: 6). Solutions need to be sustainable, use resources efficiently and have an eye on the long term.

Clearly neutralisation, or adding lime to watercourses, reduces acidity in the short term, but has long term implications for the mobilisation of salts, as well as toxic and radioactive substances in the water. It is therefore not a sustainable or holistic solution. The pollution load in the Vaal catchment is already extremely critical (Tempelhoff et al., 2007).

Pumping and subsequent treatment of the acid mine drainage is one of the key solutions advocated in the medium term (McCarthy, 2010). However this is an extremely expensive and energy-intensive process. Water Affairs regional director Marius Keet claimed in evidence before the parliamentary portfolio committee that a single pump station on the East Rand would cost R185 million to install (Masondo, 2010).

Mining companies that formed the Western Basin Environmental Corporation (WBEC) have established the Western Utilities Corporation (WUC) which has put forward a plan to offset costs of remediation (Noseweek August 2009: 13). It proposed setting up a treatment plant to turn 75 million litres of acid mine drainage a day (later expanding to 300 Ml/day) into
water for industrial use (grey water) or, if the economics allow, to class 1 drinking water standard. The purification process would be the CSIR’s alkaline-barium-calcium process, which through precipitation removes heavy metals and sulphates from contaminated water, converting the by-products into marketable raw materials, the sales of which would offset the costs (De Lange 2010a: 4-5).

This proposal has been treated by the state with scepticism, and although it was ready to be implemented (with Rand Water as a potential customer), it was vetoed by the inter-ministerial committee, for reasons articulated by ministers Sonjica and Manuel. Their objection was to private capital making profits from the pollution it had caused.

Others have supported non-pumping solutions. Prof Anthony Turton of Free State University has proposed that, after pumping out the contaminated water, the underground voids be utilised for storage of fresh water resources. This, he argues, would prevent the acid mine drainage from forming underground, and would also solve the huge problem of water evaporating from open-air dams under South African conditions. Evaporation is the largest contributor to water loss, and can be overcome by storing water in old mines. Other scientists have argued for more intensive use of passive solutions, such as running acid mine drainage through wetlands which have the capacity to remove the toxic matter.

Most recently, researchers at the University of Cape Town have developed a technology that freezes acid mine drainage in order to enable the extraction of useful salts and potable water. If used, mines would be able to market the salts commercially. The research team has teamed up with an industrial engineering company to pilot the technology. It claims that the freezing process will be much cheaper than using evaporative crystallisation (Bugan, 2011).

The variety of solutions point to the need for an impartial evaluation process, and it is hoped that the inter-ministerial committee’s team of experts (TOX) will perform such a role. However the TOX reported its findings to cabinet in October 2010 and these remained outside the public domain prior to a cabinet meeting in February 2011 which was expected to adopt the findings (Pressly, 2011a, 2011b).

(d) Public participation and activism

Without the activism of non-governmental organisations, the extent of the problem would not have been highlighted and constantly brought to public attention. Foremost is the work of Mariette Liefferink of the Federation for a Sustainable Environment, who has worked tirelessly for a number of years. Not only has she been a public advocate of the need for solutions, but has personally kept the media and affected communities informed, mobilising resources to draw attention to the problem in new and creative ways. Most serious news reports will contain comment by Ms Liefferink. She has appeared before a number of parliamentary committees, informed ministers and worked with some of the key players to ensure that the problem becomes closer to resolution. Her approach has also been to make the science intelligible to ordinary people, and to that end she has worked alongside academic and scientific experts, with her own expertise being recognised through awards and an honorary associateship from Northwest University. Non-governmental organisations helped to get her appointed as the community representative on the board of the National...
Nuclear Regulator. Becoming an insider in this arena has given her insights especially into the shortcomings of the NNR. It is clear from the record that Ms Liefferink’s activism has been extremely important in raising public awareness of the acid mine drainage problem (Christie, 2010: 17; Liefferink and Van Eeden, 2010).

Another non-governmental organisation that plays an active role in addressing the issues is the Johannesburg branch of the membership-based Earthlife Africa, which has an Acid Mine Drainage working group and operates an active website with reliable information (see for example Earthlife Africa, 2010a and 2010b). Recently the formation of the Centre for Environmental Rights in Cape Town has begun to work with the FSE, Earthlife and other non-governmental organisations to craft potential litigation strategies for making progress on the problem. As information on the problem increases, so it is likely that activism will spread to other areas affected by acid mine drainage, especially to the Northern Cape and Mpumalanga. The latter is the site of large coal deposits and thousands of new applications for mining rights to exploit the coal.

Public activism creates the political space to demand a place for the public in the decision making processes, and for it to be consulted by government prior to the setting of policy. During the Mandela presidency, public participation in policy processes became the norm, and this was a fruitful time in which new legislation was being contemplated in almost every sphere of government. As the post-apartheid government consolidated its power under the Mbeki presidency, so it became more opaque, resenting public participation in ways that set the democratic process back. Ironically under the Zuma presidency space for public consultation has expanded, albeit reluctantly, in some areas of government. It is important for the NGOs and activists concerned with acid mine drainage to realise the complexity of the issue and the fragmentary way with which it is being dealt officially. However it is only by activists expanding the political space for deeper participation that solutions will find public acceptance. It is incumbent on the activists to keep stressing the urgency for government action, and to challenge notions of the problem being seen as exaggerated or ridiculous.

7. Conclusion

It is time for an integrated policy overhaul which will both recognise the urgency of the acid mine drainage, correct the regulatory deficit, establish the rule of law, and actively seek solutions that protect public health, the natural environment, the integrity of precious sites such as the Cradle of Humankind, as well as safeguarding the built environment and the livelihoods of millions of citizens.

While it is important to use overarching processes like the National Planning Commission to play a co-ordinating function in this regard, the outburst of scepticism from the Minister is not helpful in building public confidence in the new Commission’s neutrality.

The Inter-Ministerial Committee that is currently charged with developing policy solutions to the crisis also seems cumbersome and lacking in transparency. Its sluggish approach to
releasing the report of its team of experts does not augur well, as the time frame for implementing appropriate solutions is narrowing daily.

Public confidence in the ability of the National Nuclear Regulator to undertake its mandate is rapidly evaporating. This points to a need for a radical overhaul of this institution, so that it accommodates public concerns, a vital component of re-establishing its social licence to operate as a public protector and discontinuing its role as an apologist for industry.

The Management Authority of the Cradle for Humankind also needs to come to the party in a more pro-active and precautionary fashion.

If the issue is, as the United States Environmental Protection Agency frames it, second only in importance to climate change, we all need to ensure that it receives the same kind of public attention. It should be incumbent on the Inter-Ministerial Committee to convene a national-scale public summit at which these matters can be discussed transparently amongst all the stakeholders, including a healthy amount of public participation. This would have the broad objective of establishing policy ground rules, upholding the rule of law, assigning appropriate and effective institutional responsibilities, and crafting sustainable solutions to the problem.

\[1^\text{Manders et al., 2009: 1.}\]


\[3^\text{The National Environmental Management Act, No. 107 of 1998 established the legal principle that the polluters should pay for damage caused by their actions.}\]

\[4^\text{Also known as Mooi River. The term spruit is the Afrikaans for stream or rivulet. The name Wonderfontein means miraculous spring. The water in its catchment forms the basis of the municipal supply for the town of Potchefstroom further downstream.}\]

\[5^\text{Rachel Adatia from Earthlife Africa reported that in January 2011 the remediation action plan was still not being implemented. The Department of Water Affairs was expecting the National Nuclear Regulator to be doing the implementation, but the NNR is taking no practical action. Personal communication, 31 January 2011.}\]

\[6^\text{In response to a statement on 10 August 2010 made by Independent Democrat MP Lance Greyling that decisive government action was necessary on the question of acid mine drainage, Manuel responded: “What we need is a rational discussion... informed by an empirical basis, because the idea that there will be acid mine drainage running through the streets of Johannesburg next week, and that we should all walk around in gum boots, is completely ridiculous.” (SAPA. 2010).}\]


Liefferink M and Elize S van Eeden (2010) Proactive environmental activism to promote the remediation of mined land and acid mine drainage: a success story from the South


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