

Challenges facing tourist attractions due to acid mine drainage in the West Rand, Gauteng

Professor Llewellyn Leonard* and Ms. Alecia Langton
University of Johannesburg
Bunting Road Campus
Auckland Park
Johannesburg
lleonard@uj.ac.za

*Corresponding author

Abstract

The West Rand is known for its gold mining industry, including its tourist attractions. The local municipality describes the area as 'unspoiled wilderness' that must be carefully managed to preserve its heritage. However historical mining activities has resulted in the formation of acid mine drainage with impacts on the tourism industry. Anecdotal media reports have indicated local streams contaminated with acid mine drainage and impacting on tourism sites. The issue of mining impacts on tourism sites in the West Rand has been limited researched. Within this context, this paper explores potential impacts and challenges that tourist attractions experience in the West Rand due to acid mine drainage. In addition to systemic analysis involving semi-structured qualitative interviews with key informants, two case studies are explored, the Krugersdorp Game Reserve and the Cradle of Humankind World Heritage Site. These attractions were examined since they are major tourist attractions in the West Rand, and both sites have made media headlines for being under threat of contamination. Such impacts on tourist sites could have serve implications for the tourism industry. Results indicate that contradictory and varying perspectives by informants surrounding impacts of acid mine drainage on tourism sites have not resulted in consensus and clarity on how wide ranging these impacts may be. Equal partnerships and co-ordination between all stakeholders is required to work collectively and effectively to address acid mine drainage issues and potential impacts on tourism sites. Financial and human scientific resources will also be required at the lesser well known tourism sites to assist in curbing the impact of acid mine drainage

Keywords: mining, acid mine drainage; tourism; West Rand, Gauteng Province

Introduction

The West Rand is known for its rich gold mining history which is an integral part of many small towns in the region, namely Randfontein, Krugersdorp, Carletonville, Westonaria and Magaliesburg (West Rand District Municipality, 2015). However, the legacy of the greatest gold rush in mining history is now haunting the now growing tourism industry due to acid mine drainage (AMD). Numerous tailing dams and old mines are littered throughout the West Rand's landscape (Davenport, 2013) due to lack of sustainable methods by past mining corporations that were based around the district, with the area now facing an increase in AMD (Earth Life Africa, 2011). The tailings dams are processed material that contains gold and pyrite, which results in AMD (Blain, 2013). The surface and ground water is being affected by the chemicals associated with the historic gold mining industry (Hobbs and Cobbing, 2007). With many old mines in the area being abandon due to gold minerals on the decline, these mines were left untreated, resulting in the flooding of many underground mining tunnels (McCarthy, 2010). This is a cause for concern since the water is now rising towards the surface (Mathews, 2014).

Unfortunately, the West Rand has gained attention for receiving countless reports in major South African media outlets about the threat of AMD and associated dangers facing tourism

attractions (Bega, 2011). These reports have fuelled anxieties around when and where decant will take place and who will be affected by AMD (Bobbins, 2015). The topic of AMD gained attention when it made headlines that one of South Africa's major attractions and a United Nations Educational and Scientific Council Organisation (UNESCO) protected site - the Cradle of Humankind World Heritage Site, situated in the West Rand was under threat from AMD (see for example, Mail and Guardian, 2011). However, although the subject of AMD has been researched academically (Durand *et al.*, 2010) the gap lies in what challenges tourists attractions are facing and what measures are being taken (if any) to protect these sites, including how the state, mining industries, tourist attractions and civil society are working collectively to address AMD risks.

The majority of the West Rand's attractions are based around the beauty of the natural landscapes (West Rand District Municipality, 2015). The Cradle of Humankind World Heritage Site contains a unique landscape and fossil sites. It was in the 1890s that Dr Robert Boom, a medical practitioner, worked on excavations in Sterkfontein near Krugersdorp found numerous fossils, which he linked to the remains of the Taung baby that had been found a few years earlier (South Africa Tourism, 2015). However, it was the preserved skull of a female specimen that he nicknamed Mrs Ples, who had lived about 2.5 million years ago (Cradle of Humankind World Heritage Site, 2015). The West Rand is also home to a number of nature reserves like the Cradle Nature Reserve and the Rhino and Lion Nature Reserve. Other reserves and parks in the district include the Krugersdorp Nature Reserve, Garden World in Mulder drift and the Elephant Sanctuary Guest Lodge in Magaliesburg - to name but a few (Gauteng Tourism Authority - GTA, 2015). The accommodation industry is also growing and based on the natural environment having an important role within the tourism industry (West Rand District Municipality, 2015).

The West Rand is host to a significant natural attraction market, as most attractions are based on fauna and flora, including partaking in activities that deal with the environment like hikes, horse riding, farm activities, and the observation of animals within nature reserves (GTA, 2015). When looking into the tourism industry of the West Rand, there is a danger that if the acidic water reaches these attractions, they would eventually be contaminated and lost (Durand *et al.*, 2010). South Africa is also a water scarce region; hence it relies heavily on ground water to supply the nation (Davenport, 2013). The challenge the West Rand is facing is that the ground water is rising above the acceptable safe limit due to it being contaminated and as a result it is coming into contact with surface water and therefore flowing into other outlets such as rivers, dams and will impact the local water systems (McCarthy, 2010). Thus, the danger is that the acidic water will eventually harm anything it comes into contact with, including the tourism industry and communities that surround contaminated areas. The Cradle of Humankind World Heritage Site hosts a number of irreplaceable karats landscapes and fossil sites (Hobbs and Mills, 2012). The possibility of flooding in the future and all existing evidence of human ancestry may cease to exist if not treated appropriately. There are also a number of other attractions, as well as the local community member's benefiting from the tourism industry in the area that will be hugely negatively affected in terms of employment and health by being at risk to the contaminated water (Hobbs, 2007). This could influence tourism in the district negatively (Hobbs and Mills, 2012). However, with the increase coverage of AMD impacts by the South African media, it has contributed to rising public awareness and pressure on government to solve these problems (Sandham and Winde, 2004).

Therefore the challenge of the AMD threat is not isolated and needs to be dealt with by many social actors from government, civil society and the tourism industry. A major cause for concern is that once these attractions are contaminated they would be considered a health risk to tourist, as well as impacting on conservation via significant loss of land. The

result of AMD reaching tourism sites would be hazardous for both locals and tourists who visit the attractions in terms of health risks, and with ground water levels raising the main concern is to protect and preserve tourism sites like the numerous fossil caves. The release of mining waste will result in irreversible destruction to the ecosystems (Durand, 2012). The worst case scenario is if attractions would be closed down due to the safety of the public being exposed to contaminated areas (Blain, 2013). If issues of water being contaminated is not treated, the contaminated areas will likely have the chance of being claimed a radioactive area, with loss of landscape beauty (Sandham and Winde, 2004).

Within this context, this paper explores potential challenges that tourist attractions potentially face from historical mining impacts and what has been done to protect these sites. More specifically this paper will examine how various stakeholders (government, civil society and the private sector) are working to address impacts of AMD and what are the possible plans and safety methods being implemented to protect tourist sites. In addition to systemic analysis involving semi-structured qualitative interviews with key informants, two case studies are explored, the Krugersdorp Game Reserve and the Cradle of Humankind World Heritage Site. These attractions were examined since they are major attractions, with both sites having made media headlines for being under threat of contamination. Both these attractions also have the Tweelopiespruit, Rietspruit and the Bloubankspruit river systems that flow through them (Durand, 2012). A cause for concern is that these river systems have some degree of contaminated water (Hobbs and Mills, 2012). Although the media have primarily reported that the problem of AMD exists, it is unclear what the actual impacts are on tourism attractions within the district.

AMD in South Africa and tourism

South Africa possesses some of the world's most wide-ranging and progressive legislations in order to protect and conserve the country's resources; these legislations include the National Environmental Act (Act no. 107 of 1998), the Environmental Conservation Act (Act no.73 of 1989), and the Mineral and Petroleum Resource Development Act (Act no.28 of 2002) to name a few (Durand *et al.*, 2010). These laws and regulations provide a well protective system, however this is not the case in practice as enforcement and regulation of environmental legislation is weak (Fig, 2005). Nevertheless, for mining specifically, the Department of Water and Sanitation conducted a mine water management policy position draft for internal consultation and discussion during July 2015 (Department of Water and Sanitation, 2015). The purpose of the policy is to provide the position of the department on mine water management, which according to the department "strives to strengthen the position of the water resources from mine water contamination for short and long term." The policy document states "one needs to start by posing policy questions in order to fully understand the existing scenarios." It refers to the rethinking and focus of the whole mining life cycle, the various liabilities that it involves and the management of such. However, with historical impacts of AMD in the West Rand from previous mining industries, a more proactive approach is needed to solve the existing problem of contamination instead of focusing on the existing mining life cycles. According to Bobbins (2015) in response to AMD concerns, government, through the National Department of Water Affairs (DWA), introduced a set of immediate and short-term interventions to overcome decant in the West Rand. These have allowed AMD to be framed as an environmental emergency. DWA has also set in motion a process to develop a long-term solution that, through a broader and more inclusive approach, will solve various AMD issues over time. However, in relation to both these two government interventions – very few stakeholders or members of the public know enough about AMD and its governance to understand what the real challenges are and how they should respond, with the current trajectory of government-led responses having suspended meaningful public engagement and debate. This has resulted in misinterpretation of facts and misunderstanding, which in turn has exacerbated the anxieties of affected communities and interested stakeholder groups.

Although AMD is a concern for tourism in other countries¹ (Septoff, 2005), the Cradle of Humankind located in the West Rand is the only UNESCO protected site in the world that is under threat from AMD (Hobbs and Mills, 2012). According to Hobbs and Mills (2012) based on their research on the landscape, less than 30 percent of ground water resources at the World Heritage Site is at risk from AMD, with two out of fourteen recognised fossil sites being vulnerable to risk, with three sites attracting moderate risk, and with other sites remaining low. Contaminated water flows between the Vaal River system southwards and the Limpopo River system northwards; with the Tweelopiespruit, Rietspruit and the Bloubankspruit waters in contact with the acidic water. The water flows through leading attractions such as the Krugersdrop Nature Reserve and the World Heritage Site. Contaminated water is through surface water and not groundwater, therefore the threat is geographically separated for the time being from the caves where ground water is located. In 2011, it was reported that the water in the Tweelopiespruit was seriously contaminated; therefore affecting the Bloubankspruit (Durand, 2012). Durand (2012) raises the point that, “when tourists become aware of the nature and scope of the AMD problem, this may be detrimental to the reputation of the tourist attraction.” Nonetheless, on a positive note it was reported by Mining Weekly (2013) that life has returned to the severely affected system, suggesting resilience of the water environment and its ability to recover from the harsh impact of AMD (Vermeulen, 2013). However, the improvement was also due to the refurbishments of the mine water treatment plants which was custom-built by the DWA in 2012 (Vermeulen, 2013).

For the Cradle of Humankind site, there is a challenge of continuing to monitor the rise of the AMD and it is through the implementation of the water monitoring plan that management have the ability to measure the severity of the challenge that is being experienced. Scientific and industrial research is being put in place (Cradle of Humankind, 2014). With the backing of various stakeholders and pressure from local and international groups to act against AMD there is a sense of hope for the World Heritage Site, however, the same cannot be said for other tourist sites in the area that may face the same challenges (Vermeulen, 2013). For example, although the Krugersdorp Nature Reserve is an important tourist site; it does not have the same backing in terms of stakeholders, as the UNESCO protected World Heritage Site. Contaminated water from the Randfontein mining area is transferring from shafts and streaming northwards to the Krugersdorp area, which hosts the Cradle of Humankind and the Krugersdorp Game Reserve (Ochieng *et al.*, 2010). In 2011, one of South Africa’s major newspapers, the Saturday Star, published an article stating that several animal deaths occurred, as well as younger animals dying since most water sources were severely contaminated (Bega, 2011). Death is said to increase when the mothers of the young refuse to drink the contaminated water, therefore the young do not get the required nutrition leading to a negative knock on effect.

In 2009, the Kruger National Park also made headlines with the deaths of crocodiles in the Olifants River System since the water was polluted with AMD (Travers, 2009). As the problem increased, the DWA made public the water quality results for the Hippo Dam which streams through the reserve (Earth Life Africa, 2011). The regulatory limit for sulphate is 600mg/l and according to the water quality results based on the water which is exposed to the wildlife was at 3,700mg/l (Bega, 2011). Although many deaths and miscarriages of

¹ In the United States it has been reported that AMD from the Zortman Landusky mine in the state of Montana has extensively harmed biological life within the Little Rocky Mountains. The mine filed for bankruptcy and was therefore abandoned impacting on the environment. Similarly in Mexico, the Questa Molybdenum mine severely impacted on the environment due to contaminated water (Septoff, 2005).

animals have been reported in the reserve, no epidemiological studies or autopsies have been done, therefore the causes of death remain speculative (Durand, 2012).

Not far from the West Rand lays one of South Africa's most recognisable attractions- Gold Reef City which is also under threat from AMD. Looking at Gold Reef City's history, it was previously a working mine, but once the gold ran out, it was rejuvenated into one of Johannesburg's biggest tourist attracts. Unfortunately it has been reported during past years that Gold Reef City is in danger of being polluted by AMD via underground historic mines (Bega, 2012). The mine museum has been placed on a higher level as a safety precaution and no tours are conducted lower than 80 meters underground. The area is being closely monitored by the DWA and Gold Reef City. In order to secure Gold Reef City from disaster, water levels will need to be maintained at a depth of at least 250m below the surface area (McCarthy, 2010).

Methodology

To conduct this research on the challenges being faced by tourist attractions within the West Rand by AMD a qualitative research approach was used. Semi-structured interviews with key informants (local and provincial government, civil society such as non-governmental organisations - NGOs, tourism attraction representatives and the mining industry) were conducted. In order to obtain in-depth knowledge about the topic at hand, individual interviews were conducted by the second author. The study aimed to obtain the views of key informants with knowledge of the topic at hand. Interviews were digitally recorded and transcribed to get the level of details required. The challenges faced while attempting to recruit participants was that there was no response to emails or phone calls made for interviews from most informants approached. With regards to the Krugersdorp Game Reserve it was difficult to get hold of any informants resulting in no official contact with the game reserve. There were also no responses from the local municipality of the West Rand and the Department of Water and Sanitation. Of the twenty five informants approached – six informants were secured for interviews. All participants agreed that their names could be identified in the study, except for one informant from the mining industry who chose to remain anonymous. Grounded theory was used to analysis the data and involved three phases in analysing data; these included gathering and reading different sets of data, following the process of comparing the various data sets to identify common themes. Six themes were formulated. However, this paper reports on results for impacts of AMD on the environment and tourism generally, including issues of governance surrounding AMD in the West Rand. Additionally, findings for the case studies are also incorporated into the discussed themes.

Results

AMD and the impacts on the environment and tourism

Participants from the tourism industry all agreed that there was a problem with AMD impacting on tourism in the West Rand, albeit to varying degrees. Many participants mentioned that existing rivers and areas as part of the tourism landscape have been negatively affected by AMD. These included impacts on the biodiversity and ecology. Francois Durand (personal communicate, 28 August 2015), senior lecturer at the University of Johannesburg, Department of Zoology stated how AMD has impacted on the environment generally:

“...many aspects of the environment have been affected by acid mine drainage; including the ecology, but also it has had an impact on the biodiversity of the area and also it has

threatened the environment in several ways including the positioning of 'yellow boy' at the bottom of the river which is a type of iron hydroxide...which causes irreparable harm to the environment...it [also] allows alien plants to take over...[the environment] will take a very long time to rehabilitate if the people [government and industry] decided to do so".

This suggests that rehabilitation of old mining sites, dealing with the issue of AMD and rehabilitation of the environment by AMD damage was not taking place or not taking place fast enough. This therefore had potential to negatively impact on tourism in the region. As mentioned, there were varying opinions on how wide ranging AMD impacts on the environment were. While some participants such as Peter Mills (Interview, 22 September 2015) Environmental Manager at the GTA noted that only a very small area within the West Rand was affected by AMD, other informants noted the problem to be much wider. For example, Mariette Liefferink (Interview, 25 July 2015), CEO at the Federation for Sustainable Environment - NGO noted that the mining industry created the largest gold and uranium mining basin in the world which covers the whole of Gauteng, and is now filling up with acid mine water. Therefore the South African Government has declared it an emergency since August 2012 (although not enough action has been taken to curb the problem). The wide ranging impacts of AMD was also supported by an anonymous participant from the mining company Sibanye Gold, mentioning that the extent of AMD was vast and affecting almost the entire area of the Witwatersrand basin accompanied by the acidic water, suggesting impacts of AMD on tourism environments. However some informants noted that tourists' attractions were considered to be less endangered by AMD as most of these tourist areas fell within areas where AMD had little impact. This was discussed further by Judith Taylor (Interview, 17 September 2015), campaigner at the Earth Life Africa NGO, "*the tourist effect is not as heavy in the West Rand because there are relatively few[er] tourist attractions...*" However, even if this may be the case, impacts of AMD on tourism attractions cannot be ruled out as noted in the literature.

Of interest is that the Sterkfontain Caves, Swartkrans Bolts farm and the new Naledi discovery were noted to be located under the area of acid mine risk. However, representatives from the GTA highlighted that the fossils themselves were not at risk as yet, as they were being monitored - resulting in the protection of these areas. According to Mills (Interview, 22 September 2015) noting for fossils in the area: "*when it is said the fossils are under threat it is a broad statement as the actual fossils are kept safe.*" Anthony Patron content writer from the GTA also stated that "*the level of risk is relatively low because most of the sites where the fossils have been found to-date are not on the immediate water system.*" Mills suggested that the attractions main issue of contamination water was more sewage water which the local municipality had little control over. Contradictory to Mills, Francois Durand (personal communicate on, 28 August 2015) disagreed that the AMD was not a serious problem and predicted that the issue of AMD would get worse in the future even though currently the water in the caves seemed stable. However, contradictory and varying perspectives by informants surrounding impacts of AMD on tourism sites have not resulted in consensus and clarity on how wide ranging AMD impacts were.

Cradle of Humankind Heritage Site

Some informants did however note that the Cradle of Humankind Heritage Site was at threat in future from AMD. Anthony Patron and Peter Mills from the GTA insisted that the World Heritage Site was in danger of AMD. However, it was noted that acidic water on the site became less of a threat as it moved through the area. According to Anthony Patron (Personal communicates, 22 September 2015) from the GTA:

“...we know that there’s quite significant environmental impact by the presence of acids and heavy metals in the water that decants into the area. Curiously enough...the readings of these heavy metals and other results of acidity seem to decrease as the water moves through the...area [where the fossil caves are situated]”

Thus Mills and Patron stated that the fossils and therefore tourism itself was not in danger as yet. The acid mine water becomes less concentrated as it moves through the environment. Francois Durand (personal communicate on, 28 August 2015) also noted that tourists are not exposed to any danger from AMD:

“...there is the low level danger of people being exposed to these elements...[however] when you travel further in the area to visit other attractions like Swartkrans and Bolts Farm then only do you see the impacts of acid mine drainage”.

Although there is evidence of acid mine water in the area, these are not on the usual routes that tourists are exposed to. Nevertheless, Francois Durand (personal communicate, 28 August 2015) explained that if the situation did get worse, this would negatively impact on the perception visitors have due to the ecological destruction. Mariette Liefferink (Interview, 25 July 2015), noted that tourists do not want to be offended by an ‘ugly’ landscape, as tourists are extremely sensitive to the environment they visit, thus if something is considered as less attractive the interest will weaken, as the scenic beauty of the area is an attraction in itself. As a result, the Cradle of Humankind World Heritage Site’s tourism areas have not decreased in tourism numbers since tourists are also not aware that other parts of the attraction may be impacted.

Krugersdorp Game Reserve

Consequently, impacts of AMD on the Krugersdorp Game Reserve was more of an issue than for the Cradle of Humankind site. The Krugersdorp Game Reserve has gained attention from the South African media for being exposed to contaminated water, which ultimately affects the environment and the animals that live within the reserve (King, 2015). Mariette Liefferink (personal communicate, 25 July 2015), referred to the game reserve when she mentioned how AMD impacted the tourism industry of the reserve, *“...it is a beautiful area but it’s contaminated, so that detracts from tourism”*. Liefferink further explained that the game reserve was not well visited because of the contaminated water, including the visual aspects and poor conditions of the animals, suggested that tourists are informed to some degree about AMD issues affecting the tourism attraction (as opposed to the Cradle of Mankind Heritage Site). Since the Tweelopiespruit flows through the game reserve, the reserve is dealing with contaminated water. Judith Taylor also mentioned that the water is “definitely” compromised. This idea was also supported by Francois Durand (personal communicate, 28 August 2015), stating that the game reserve was by far worse off than that of the Cradle of Humankind, and this is demonstrated by evidence from the water colour of the Hippo Dam which is orange.

“...originally the pollution was limited to the inflow up to the dam at that time the level of pollution was relatively low as the river never exceeded 80ml per day at that stage. With the environment changing, you can see that the water of the hippo dam has turned orange”.

However, Durand stated that on the positive side the Krugersdorp Game Reserve has springs that produce clean and good quality water where the animals drink from.

Governance

National and provincial government limitedly enforced regulations surrounding mining development due to unequal relationships between government and the mining industry (including capacity constraints within government). This therefore contributed to AMD having negative environmental (and hence tourism) impacts. The DWA, Department of Minerals and Energy and the mining industries were involved at varying levels to curb the impact of AMD. Mills (Interview, 22 September 2015) noted that although the DWA initiated the high density operational plant, which was mandated with the efforts of the mining houses - partnership between the two entities was hindered:

“All the mines in this area supply water to a central database at the Department of Water Affairs but they [mines] measure what they want to measure and they give the good measurements so the condition of the water in the mining area is not good”.

An informant from Sibanye Gold did note that government and mining companies do recognise the impacts of AMD - *“...the severity and urgency of the AMD crisis is real and the mining industry and government are well aware of it”*. The informant did note that funds were set aside in government for treatment of AMD water, with the mines in the West Rand having built a treatment monitoring plant in Randfontein that doses the decanting water with lime, which then settles out the heavy metals in a safe and secure environment. This statement is supported by Liefferink (Interview, 25 July 2015), stating that Sibanye Gold specifically is currently pumping water in the area. However, Francois Durand noted that stakeholders were not working collectively to tackle the problem of AMD:

“...we have the problem that the government is in denial [about AMD]...they respond to the issue as not being their responsibility...[with] responsibilities lying with the mines as they caused the problem.”

The above response suggests lack of co-ordination between government and industry in working together effectively to address the issues of AMD. Although government and the mines have made it known that they would work together to find a solution to AMD impacts such as demonstrated by the Department of Environmental Affairs inspection report which was conducted in December 2014 (Department of Environmental Affairs, 2014). The report noted operational activity and compliance monitoring inspection with old Rand Uranium Mine Plant in Randfontein. However, Durand criticises such inspections since no added efforts have been taken to solve problems:

“...all that happens is that the government takes tax money and throws it to this problem thinking that the mines will use it to solve the problem and they haven't so far. The best that they have done so far for a year is adding lime to the water...”

Thus, government and mining companies were not really proactive in trying to curb the impacts of AMD and find effective solutions to address the problem. Liefferink (Interview, 25 July 2015) noted that although government has attempted to produce solutions for AMD impacts, there was also no money to ultimately support efforts to curb AMD since it was considered too expensive. This however contradicted Durand's statement above regarding government having funds via tax payer's money to solve AMD issues. As Liefferink noted government had already invested millions in treatments, but which she describes as totally ineffective in trying to solve the problem.

“... it's a treatment that only removes the acidity, in other words the metals in the acid mine water drop out and it becomes solids but the solid metals can again be dissolved in the water and then it becomes acidic. So it's a totally incomplete method and besides that, the current treatment of acid mine drainage can only reduce the salts”.

Referring specifically to the Cradle of Mankind Heritage Site, Mariette Liefferink (Interview, 25 July 2015) noted that the DWA has stopped their monitoring of AMD at the Cradle of Humankind in 2013, with monitoring done by efforts of the private sector. Supporting this statement, Peter Mills (Interview, 22 September 2015) explained that the World Heritage Site has appointed the Council for Scientific and Industrial Research (CSIR) to do status reports (perhaps due to lack of expertise and capacity within government); the monitoring system measures the ground water levels, surface water levels, the springs, and the river flow in terms of quantity and quality. Only 25% of the Cradle of Humankind is stated to be impacted by acid mine water, and of that 25% about 4% has been severely impacted.

Anthony Patron noted that the Cradle of Humankind management authority is working in cooperation with the DWA to control AMD problems impacting on the tourism site. Mills (Interview, 22 September 2015) continued to explain that alongside the countless efforts by the Cradle of Humankind to monitor the water systems and AMD; they received assistance from private land owners within the area. Mills noted that there will be continuous budgeting and monitoring of the water because the monitoring programme has previously shown water quality changes. In other words the water quality is not stable and at times can get worse.

Judith Taylor as part of the Earthlife South Africa core group's future plans involve working with the South African Human Rights commission. They are working with the Centre for Environmental Rights – a public interest law group, as well as lawyers for human's rights to look at how they can get action to protect the affected communities, environmental resources and work against AMD impacts. There is thus an urgent need to enforce rules and regulations for mining development to protect the environment and tourism resources generally. According to Mariette Liefferink (Interview, 25 July 2015), “The problem in South Africa is the systemic failure of our state departments to enforce contraventions with the environmental legislations.” Overall, results indicated that there has been a lack of co-ordination between various stakeholders to work effectively to curb the impacts of AMD on the environment.

Discussion and conclusion

Results indicated that all participants (i.e. government, industry and civil society) agreed that there was a problem with AMD impacting on tourism in the West Rand, albeit to varying degrees. Whilst some participants mentioned that the area vulnerable or already contamination by AMD was the entire Gauteng region, other participants mentioned that some areas were worse off than others. Whilst provincial government indicated that AMD was not a serious problem impacting on tourism sites, most representatives from civil society sector indicated that AMD was a concern for tourism and should not be underestimated, suggesting AMD perspectives depending on political positioning. Although representatives from the GTA highlighted that the tourist fossil sites were not at risk as yet from AMD, as they were being monitored - resulting in the protection of these areas, representatives from civil society disagreed that the AMD was not a serious problem and suggested that the issue of AMD would get worse in the future even though currently the water in the caves seemed stable. However, contradictory and varying perspectives by informants surrounding impacts of AMD on tourism sites have not resulted in consensus and clarity on how wide ranging AMD impacts were. Thus, more accurate scientific clarity on how wide ranging AMD impacts

are on tourist sites in co-ordination between all stakeholders is required to work collectively and effectively in addressing the problem of AMD and potential impacts on tourism sites. Unfortunately poor governance of AMD has not assisted in curbing the impacts of AMD. National and provincial government limitedly enforced regulations surrounding mining development due to unequal relationships between government and the mining industry (including capacity constraints within government). This therefore contributed to AMD having negative environmental (and hence tourism) impacts. The DWA, Department of Minerals and Energy and the mining industries were involved at varying levels to curb the impact of AMD. Partnership between government and industry was hindered since the mines were accused of selective monitoring of AMD impacts to downplay the actual impacts of AMD. Clearly the impacts of AMD cannot be solved with unequal relationships between stakeholders and lack of transparency from industry on reporting AMD contamination. An effective working committee comprised of stakeholders from government, industry and civil society is urgently needed to work collectively to monitor and address the impacts of AMD generally and on tourism sites.

There were clearly differences surrounding the impacts of AMD between tourism sites such as the Cradle of Humankind World Heritage Site and the Krugersdorp Game Reserve. Consequently, impacts of AMD on the Krugersdorp Game Reserve was more of an issue than for the Cradle of Humankind site. The Cradle of Humankind World Heritage Site had not seen a decrease in tourist numbers as informants noted that contamination was not an issue for tourism routes. Visual evidence of contamination was noted for the Krugersdorp Game Reserve with the water colour of the Hippo Dam being orange. Unfortunately, the DWA had stopped monitoring of AMD at the Cradle of Humankind in 2013, with monitoring done by efforts of the private sector. The Krugersdorp Game Reserve was not well visited because of the contaminated water, including the visual aspects and poor conditions of the animals, suggested that tourists are informed to some degree about AMD issues affecting the tourism attraction (as opposed to the Cradle of Mankind Heritage Site). Thus, in addition to protected sites such as the Cradle of Humankind Heritage Site, financial and human scientific resources will also be required at the lesser well known tourism sites to assist in curbing the impact of AMD.

References

Bega, S. (2011). Wildlife at risk from tainted water, **Saturday Star**. Retrieved in July 2015 from <http://groenforum.co.za/wp-content/uploads/2011/08/Saturday-Star-Krugersdorp-Game-Reserve.pdf>

Bega, S. (2012). **Gold Reef City AMD alarm**, Saturday Star. Retrieved in April 2015 from <http://www.iol.co.za/saturday-star/gold-reef-city-amd-alarm-1.1243648#.VS02itKqqko>

Blain, S. (2013). **Acid mine water rises under Gold Reef City**. Retrieved in April 2015 from <http://www.bdlive.co.za/national/science/2013/10/11/acid-mine-water-rises-under-gold-reef-city>

Bobbins, K, (2015). **Acid Mine Drainage and its governance in the Gauteng City-Region**. Retrieved in December 2015 from http://www.gcro.ac.za/media/reports/amd_occasional_paper_final_web.pdf

Cradle of Humankind (2014). **Cradle of Humankind World Heritage Site: Annual Report 2014**. Retrieved in July 2015 from http://www.provincialgovernment.co.za/entity_annual/92/2014-gauteng-cradle-of-humankind-world-heritage-site-annual-report.pdf

Cradle of Humankind (2015). **Welcome to the Cradle of Humankind**. Gauteng Tourism. Retrieved in July 2015 from http://www.gauteng.net/cradleofhumankind/the_destination/

Davenport, J. (2013). **Digging Deep: A History of Mining in South Africa**. South Africa, Jeppestown: Jonathan Ball Publishers.

Department of Environmental Affairs (2014). **Inspection Report: The immediate term intervention for the treatment of acid mine drainage in the western basin of the Witwatersrand Gold Fields**, Gauteng Province. Retrieved in October 2015 from file:///G:/research/Inspection%20report%20for%20western%20basin_1.pdf

Department of Water and Sanitation (2015). **Mine Water Management Policy Position Draft for Internal Consultation and Discussion**. Retrieved in October 2015 from file:///G:/research/Draft%20policy%20position%20paper%20on%20Mine%20Water%20Management_July%202015.pdf

Durand, J.F. (2012). The impact of gold mining on the Witwatersrand on the rivers and karst system of Gauteng and North West Province, South Africa, *Journal of African Earth Sciences*, 68, 24-43.

Durand, J.F., Fourie, M. and Meeuwis, J. (2010). The threat of mine effluent to the UNESCO status of the Cradle of Humankind World Heritage Site, *The Journal for Transdisciplinary Research in Southern Africa*, 6(1), 73-92.

Earth Life Africa (2011). **Plans for dealing with acid mine drainage – a call for public consultations**, Media release, 24 February. Retrieved in April 2015 from <http://earthlife.org.za/2012/02/plans-for-dealing-with-acid-mine-drainage-a-call-for-public-consultations/>

Fig, D. (2005). Manufacturing amnesia. *International Affairs*, 81(3), 599–617.

Gauteng Tourism Authority. (2015) **Gauteng Nature and Wildlife**. Retrieved in April 2015 from http://www.gauteng.net/best-of/category/nature_wildlife_2

Hobbs, P. J., and Cobbing, J. E. (2007). **The hydrogeology of the Krugersdorp Game Reserve area and implications for the management of mine water decant**. Division of the Geological Society of South Africa Conference, Bloemfontein, 8-10 October

Hobbs, P. J. and Mills, P. J. (2012). **Managing the Threats to the Karst Water Resources of the Cradle of Humankind World Heritage Site**, South Africa, Gauteng Tourism Authority. Retrieved in June 2015 from http://www.gauteng.net/cradleofhumankind/management/reports_available/

Mail and Guardian (2011). Acid mine drainage reaches Cradle of Humankind, **Mail and Guardian**. Retrieved in April 2015 from <http://mg.co.za/article/2011-01-15-acid-mine-drainage-reaches-cradle-of-humankind>

Mathews, C. (2014). **Five-year Plan Launches to Treat Acid Mine Drainage in Gauteng**. The Federation for a Sustainable Environment. Retrieved in July 2015 from <http://www.fse.org.za/index.php/mining-nuclear/item/383-five-year-plan-launched-to-treat-acid-mine-drainage-in-gauteng>

McCarthy, T. S. (2010). The impact of acid mine drainage in South Africa. **South African Journal of Science**, 107(5-6), 1-07.

Ochieng, G. M., Seanego, E. S., and Nkwonta, O. I. (2010). Impacts of mining on water resources in South Africa: A review. **Scientific Research and Essays**, 5(22), 3351-3357.

Septoff, A. (2005). 'HardRock Mining: Acid Mine Drainage', **Earth Works**, 1-2.

South Africa Tourism. (2015). **Where Our Ancestors Walked, The Cradle of Humankind, Gauteng**. Retrieved in July 2015 from <http://www.southafrica.net/za/en/articles/entry/article-the-cradle-of-humankind-gauteng1>

Travers, R. (2009). **Crocodile deaths continue in the Olifants River**. Retrieved in July 2015 from <http://www.sanparks.co.za/about/news/?id=1252>

Vermeulen, A. (2013). Return of microinvertebrates in the West Rand stream a sign impact AMD has lessened. **Mining Weekly**. Retrieved in July 2015 from <http://www.miningweekly.com/article/life-returns-to-amd-affected-river-systems-2013-05-03>

West Rand District Municipality. (2015). **West Rand District Municipality Contextualisation**. Retrieved in July 2015 from http://www.wrdm.gov.za/wrdm/?page_id=4352

Sandham, L. A. and Winde, F. (2004). Uranium pollution of South African streams—An overview of the situation in gold mining areas of the Witwatersrand. **GeoJournal**, 61(2), 131-149.