Policy Gap 12

Soweto Report: “Waiting to Inhale”

A survey of household health in four mine-affected communities
Below: Close up of the water shown in the photograph above at an unprotected mine dump in Soweto.
Acknowledgments

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• Ms Michelle Coetzee for the language editing of the report.

• The Bench Marks research team took all photographs within the report.

Disclaimer: The views and recommendations expressed in this publication are those of the author, Bench Marks Foundation: they do not necessarily reflect the views or policies of the funding partner Christian Aid - Fleiszer Legacy and should not be so attributed.
Foreword

This Report (Policy Gap 12) by the Bench Marks Foundation on household health and well-being in near-mine communities living in the South Western Townships (Soweto) of Johannesburg, Gauteng Province, marks ten years of Policy Gap Reports on mines and communities in South Africa. The Bench Marks Foundation was established by churches to investigate the ethics (or lack thereof) of investment through the lens of Corporate Social Responsibility (CSR). We ask: are investment benefits only for those who seek to maximise profits, or do they also address the key challenges faced by our society (such as unemployment, poverty, education, health, housing and human development) so that people may live respectable lives in human dignity in safe and healthy environments?

In this research report, we document household health and well-being in four mine-impacted communities located in the East and North of Soweto situated close to the reef in the central and western basins of the Witwatersrand. Historically, this reef was one of the most intensely mined areas on the planet, with mines like the Crown Mine producing almost half of all gold ever produced in the world.

There have been many scientific studies on the impact of abandoned, derelict and ownerless mines on the Witwatersrand, focusing mainly on water and dust pollution. However, very few studies have ever attempted to integrate the history, geology, economics and politics of mining with the impact of this industry on household well-being, health and safety. As such this Policy Gap Report differs from previous reports in that it is not about a mine, or a mining corporation and its CSR policies and how a community experiences that mine as a corporate neighbour. Instead, the report is about the evolution of Soweto, in relation to the development of mining and of Johannesburg as a racial and class segregated city.

In answering the question of how the townships and communities south of the reef came to be largely black and poor, while those North of the reef became predominantly affluent and white with a mining and mine waste belt in-between, we hope to address questions about the generally poor health and well-being of the communities under review.

Six communities were surveyed using intensive historical investigation, interviews, questionnaires and focus group discussions. One community, Danville in Mafikeng, North West Province, served as a control group. The communities of Riverlea, Diepkloof, Meadowlands and Doornkop (Snakepark) formed the core of the investigation, while Davidsonville was briefly investigated out of curiosity because the community had taken an offending mining company to court and had won their case. The Bench Marks Foundation, therefore, thought that the experience of Davidsonville would be of use once the Foundation begins with its Monitoring School activities in Soweto.
The Bench Marks Foundation hopes that this study will shed light on many health challenges faced by Soweto residents because of a long history of mining near the township. It must be noted that, historically, those residing in Soweto and Riverlea, which is now considered to be a part of Soweto, had no choice about where they wanted to live; they were forcibly relocated from other areas that were safer, with healthier environmental conditions than Soweto. The residents also had no choice in the size of yards, design or building materials used in the construction of their houses. Thus, they had no choice in the roofing materials used (asbestos). They also had no choice in the location of their houses or the distance of their homes from toxic, radioactive mine dumps. Nor did anyone ever inform or educate them about the implicit dangers associated with operating abandoned, derelict and ownerless mines.

Taking cognisance of these facts, the Bench Marks Foundation hopes that the mining industry, government at all spheres, Chapter Nine State Institutions supporting constitutional democracy, civil society, the media and Church and faith-based organisations will deem it necessary and appropriate to act on the recommendations contained in this study.

The Rt. Rev. Dr Jo Seoka
Chairperson,
Bench Marks Foundation

Mr John Capel
Executive Director,
Bench Marks Foundation
The Bench Marks Foundation

The Bench Marks Foundation is an independent non-governmental organisation (NGO) established by the South African Council of Churches (SACC), the Ecumenical Service for Socio–Economic Transformation (ESSET), Industrial Mission of South Africa, CDT Foundation and the Justice and Peace Department of the South African Catholic Bishops Conference.

Its international partners are:
- The Interfaith Centre on Corporate Responsibility (ICCR) – USA
- The Taskforce on Churches & Corporate Responsibility (TCCR) – Canada
- The Ecumenical Council for Corporate Responsibility – UK
- The Christian Centre for Socially Responsible Investment – Australia

Together with our international partners, we share a measurement instrument called the Principles for Global Corporate Responsibility: Bench Marks for Measuring Business Performance. This instrument is a comprehensive set of social, economic and environmental criteria and business performance indicators drawn from a body of internationally recognised human rights, labour and environmental standards and principles. The Bench Marks Foundation is mandated by the churches to monitor the investment practices of multinational corporations to ensure that they respect human rights, operate in a way that protects the environment and do not externalise costs, that profit making is not done at the expense of other interest groups, and that those most negatively impacted upon are heard, protected and accommodated within the business plans of the corporation.

The Bench Marks Foundation works with research institutions, such as its partner, the Bench Marks Centre for CSR at the North-West University (Potchefstroom Campus), other NGOs, and religious and community organisations across the Southern African Development Community (SADC). It does evidence-based research and strengthens communities to engage on a more level footing with corporations and governments through the Bench Marks Monitoring School. It promotes public awareness through media outlets, websites, blogs, Facebook and other social media. It has produced many reports, articles, opinion pieces and published in many academic journals.

The Foundation was launched in 2001, and an office established in 2003 in Johannesburg. The Rt. Rev Dr Jo Seoka chairs the organisation and is the founding chairperson of the Foundation. The Bench Marks Foundation aims to ensure that the operations of big corporations do not in any way undermine community life and destroy the environment and that investment is done in a way that respects the integrity of creation, is just, equitable and promotes human development. The Bench Marks’ concerns are that private corporations, often with the support of government leaders, make very large profits while communities suffer high levels of inequality and poverty. The Bench Marks Foundation is equally
concerned about the destruction of our air, water and soil resources that results from industrial activities such as mining.

**The Bench Marks Centre for CSR**

The Bench Marks Centre for Corporate Social Responsibility (CSR) at the Potchefstroom Campus of the North-West University (NWU) was formally established at the beginning of 2012, and the Centre was launched on 23 January 2012 by Bishop Jo Seoka in Potchefstroom. The Centre is a partner to the Bench Marks Foundation (BMF). The Centre’s core activities consists of research, teaching, community engagement and consultancy. The Centre is primarily engaged in research in the mining sector, but the study focus does not exclude other sectors. Research work in the retail sector as well the financial sector has also been done.

The vision of the Centre is to contribute to sustainable development in the province, in the country and in SADC through the enhancement of research and training in the corporate social responsibility arena, as well as through relevant and effective community engagement.

Through its mission statement, the Centre aims to:

- Stimulate and conduct high-quality, innovative research and training on corporate social responsibility;
- Provide the space for dialogue amongst various stakeholders, in particular government, civil society and the private sector;
- Create synergy between basic and applied research (“theory/policy and practice”);
- Create a specific research focus in CSR at the Potchefstroom Campus of the North-West University; and
- Learn from the studied experiences of communities that are living through and experiencing existing CSR-CSI programmes and initiatives, with a view of changing it to benefit people and the planet, contrary to only enhancing profits.
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<th>Description</th>
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<tbody>
<tr>
<td>AD</td>
<td>Anno Domini</td>
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<tr>
<td>AMD</td>
<td>Acid Mine Drainage</td>
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<tr>
<td>ARD</td>
<td>Acid Rock Drainage</td>
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<td>ASTM</td>
<td>Standard Test Method</td>
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<td>CANSA</td>
<td>Cancer Association of South Africa</td>
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<td>CER</td>
<td>Centre for Environmental Rights</td>
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<td>COJ</td>
<td>City of Johannesburg</td>
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<td>CRG</td>
<td>Central Rand Gold</td>
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<tr>
<td>CSIR</td>
<td>Centre for Scientific and Industrial Research</td>
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<tr>
<td>DMR</td>
<td>Department of Mineral Resources</td>
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<tr>
<td>DRD</td>
<td>Durban Roodepoort Deep</td>
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<td>DWAF</td>
<td>Department of Water Affairs</td>
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<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<td>EMO</td>
<td>ERGO Mining Operations</td>
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<td>EMP</td>
<td>Environmental Management Plan</td>
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<td>ERPM</td>
<td>East Rand Property Mines</td>
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<td>FSE</td>
<td>Federation for a Sustainable Environment</td>
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<td>GDARD</td>
<td>Gauteng Department of Economic and Rural Development</td>
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<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
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<td>ICRP</td>
<td>International Commission on Radiological Protection</td>
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<tr>
<td>JSE</td>
<td>Johannesburg Stock Exchange</td>
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<tr>
<td>LHR</td>
<td>Lawyers for Human Rights</td>
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<td>LRC</td>
<td>Legal Resources Centre</td>
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<td>MPRDA</td>
<td>Minerals and Petroleum Resources Development Act</td>
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<tr>
<td>µSv</td>
<td>microSievert</td>
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<tr>
<td>mSv</td>
<td>milliSievert (measure for radioactivity)</td>
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<td>NASREC</td>
<td>National Arts, Sport, Recreational and Expo Centre</td>
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<td>Non-governmental Organisation</td>
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<td>National Nuclear Regulator</td>
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<td>NORM</td>
<td>Naturally Occurring Radioactive Material</td>
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<td>North-West University</td>
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<td>Particulate Matter</td>
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<td>Reconstruction and Development Programme</td>
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<td>Radioactive Waste Management Fund</td>
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<td>South African Labour Development Research Unit</td>
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<td>South African National Roads Agency</td>
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<td>Abbreviation</td>
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<td>South African National Standards</td>
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<td>South African Police Services</td>
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<td>South African State Oil Company</td>
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<td>Social and Labour Plan</td>
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<td>SOWETO</td>
<td>South Western Townships</td>
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<td>TB</td>
<td>Tuberculosis</td>
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<td>TDS</td>
<td>Total Dissolved Solids</td>
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<td>TSF</td>
<td>Tailings Storage Facilities</td>
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<td>TWF</td>
<td>Tailings Waste Facilities</td>
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<td>United Kingdom</td>
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<td>Voices of the Poor Concerned Residents</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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<td>Witwatersrand Native Labour Association</td>
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EXECUTIVE SUMMARY

This report stems from the Bench Marks Foundation’s concern about issues of ethical investment, corporate social responsibility and accountability in South Africa. This year, 2017, marks ten years of reporting by the Bench Marks Foundation on the impact of mining on near-mine communities and on the environment. Most of our work up to now has focused on rural communities on the platinum belt in the North-West Province and Limpopo, the diamond fields along the west coast of South Africa, and the coal fields in Mpumalanga. Yet, our offices in Marshall Street, Johannesburg, are in the heart of the city where the mining revolution in South Africa first captured the global imagination after the discovery of gold in 1886.

The focus of this report is on the people who provided the sweat equity for that mineral revolution, but who were precluded by political fiat from participating in either the ownership of the mines or in the wealth generated by them, namely the African majority in South Africa. Their labour was needed, but their presence in the ‘City of Gold’ was resented. Consequently, they were forced to live on the worst, least valuable land in the city, namely the land on which both urban and mine waste was deposited.

Industrial mining in Johannesburg is more-or-less done and dusted. However, the destructive environmental and health impact of mining on the near-mine communities rages on unabated.

The research team involved in this study chose the communities of Riverlea, Diepkloof, Meadowlands and Doornkop (in Snake Park) as focus communities because they are located where the mine waste belt ends. The people in these communities live in the shadow of immense mine waste dumps and, as this report will show, with dire consequences. The team chose the Community of Danville in Mafikeng as a control study, because Danville is a township with housing that has asbestos roofs and in all ways approximates Riverlea, Diepkloof, Meadowlands and Snake Park, except that there is no mining in close proximity to Danville (past or present).

The report starts with a socio-geological historical overview that addresses key questions about popular international and national perceptions about Soweto. Although the first forced resettlements of people in Kliptown (a township in Soweto) took place between 1904 and 1906, academic interest in Soweto’s history seems to start only with the student uprisings of 1976.

This is followed by an outline of the geological history of the Witwatersrand in general and the basin in which Soweto, as a collection of townships, evolved. This geological history is important because many of both the positive and negative impacts of mining the longest-
lasting gold reef in the world derive from it. The impacts on water, air, soil, ecosystems and human health and well-being, hydrology and metrology is also investigated, for on the Rand the predominant directions of the wind will determine ‘who eats dust’, and in which direction sewage and waste flows.

The history of Soweto is then traced, showing how it was shaped by concerns for the health and well-being of Johannesburg’s ‘white European’ population, and their racial attitudes towards the ‘black African’ population. The dependence of the ‘white’ population and that of the mining industry on the cheap labour supplied by the black population led to an overdeveloped suburban society on the northern side of the ridge that separates Johannesburg from the underdeveloped, poverty stricken South Western Townships (Soweto), where cheap dormitory housing was built for Johannesburg’s black working class. This separation of races was central to apartheid, which had a political dimension, an economic/class dimension, a physical geographical dimension and an ecological dimension, which, as Vandana Shiva points out, is unfolding globally as we speak (Shiva, 2012).

Finally, the empirical findings from the four Soweto communities, Riverlea, Diepkloof, Meadowlands and Doornkop (in Snake Park informal settlement) are outlined in more detail, although it has been touched upon throughout the report. The health concerns raised are traced to their possible origins in the impacts of mining along the Eastern, Northern and North-Western rim of Soweto. A control study was carried out in Danville Township near Mafikeng, where there is no mining at all (past or present).

The major findings are:

- Acid mine drainage (AMD) is a real threat to the well-being of the inhabitants of all the townships adjacent to mining activities, whether in active operation, ownerless, derelict or abandoned;
- While laws and regulations exist and existed in the past, failure by previous and current governments to enforce the laws and regulations has caused the problem to spiral out of control;
- That ‘townships’, the industrial zones, a school and a higher education facility near mine waste facilities such as tailings dams was a calculated geological location, as well as the deliberate siting of tailings dams near townships;
- That there is a deliberate location of mine waste near rivers and water sources, and extensive spillage from mining operations and mine waste facilities into streams, wetlands and rivers;
- Mining voids fill up with water. As a result, heavy metal contamination is caused when metals such as uranium, arsenic, cobalt, copper, cadmium, lead, silver and zinc contained in excavated rock or exposed in an underground mine come into contact with water and decant on the surface;
Mine tailings waste facilities: it was found to be common that mine tailings waste facilities (TWFs) are unguarded, unfenced and not properly signposted;

Dust levels downwind from mining activities are a constant threat to the health and wellbeing of the inhabitants of the adjacent townships, particularly during the windy season; and

The selected households of Danville Township in Mafikeng, North-West Province, in the control study, presented with fewer ailments than those of the researched near-mine communities in Soweto.

The full details of the findings, as well as recommendations to various stakeholders responsible for remedial action, including a recommendation with regard to an awareness programme for the members of the researched townships, are provided under ‘Findings and Recommendations’ at the end of this report.
1. **INTRODUCTION**

The South-Western Townships (Soweto) Mining and Community Health Research Project is a three-year venture that commenced in 2014. It was commissioned by the Bench Marks Foundation (BMF) and funded by Christian Aid - Fleiszer Legacy. The Bench Marks Centre for CSR (BMC) at the North-West University (Potchefstroom Campus) is a partner of the BMF and participated in the research. This study was undertaken to establish whether there was a link between working and abandoned mines and mine waste bordering the township of Soweto, and health problems in the community residing in the township.

The extraction of minerals such as gold, uranium, silver, lead, copper, coal and platinum from the earth is carried out in a manner that is inherently threatening to human health. Many studies have focused on work-related illnesses suffered by mineworkers, yet relatively few have been conducted on the greater impact of mining on the wider environment and its effects on people living downwind and downstream of the mines.

The researchers drew on both literature and an empirical study conducted in five geographical areas in greater Soweto, namely Diepkloof, Riverlea, Snake Park, Davidsonville and Meadowlands. A control study in the selected households of Danville Township in Mafikeng, North-West Province was also conducted. The results of the research show a negative relationship between operating and abandoned mines and the health status of communities in the five areas.

2. **OBJECTIVES**

The main objective of this research was not only to fill a gap in the scientific literature, but also to address health risks for people living near working and abandoned mines and mine waste and to build up evidence-based information elicited from the general population and that of Soweto. This could be used in possible actions against badly managed mine operations, or against mine owners that illegally abandoned mines near Soweto. Thus it was necessary to establish a link between both working and abandoned mines, as well as mine waste bordering the township of Soweto, and health problems in the township community. These issues have not been researched in Soweto.

The secondary research objectives are to:

(i) Determine how mining activities and their disposal of toxic waste impact the health of the people living in identified townships in Soweto;

(ii) Develop guidelines on how mines can address and minimise the health risks of people living near mines;
(iii) Build up evidence-based information on the people in the above-mentioned townships in Soweto whose health has been affected negatively by the disposal of toxic waste; and

(iv) Compare the results of the research with the results of a control group in Danville Township in Mafikeng, North-West Province.

3. METHODOLOGY

3.1 Research procedures

Two basic research procedures were used for the project, namely:

- Literature review; and
- Qualitative and quantitative information collection methods.

The literature review was used specifically to construct an overview of the mining industry in South Africa and to review applicable policies and practices. More generally, it was also used to conceptualise and contextualise all the facets of the research. Books, scientific journal articles, popular articles, newspapers, reports, annual reports of mining companies, government reports, health reports, maps, conference proceedings and databases, as well as the internet, were used as sources. Relevant mining, geological, geographical and metrological studies of the Witwatersrand were also sourced, as well as a review of the historical, sociological and legislative research of the Witwatersrand area.

Both quantitative and qualitative approaches were adopted to gather empirical information. The qualitative approach (through interviews and focus groups) was followed because it enabled the respondents to expand their points of view without being limited to fixed answers in a questionnaire. The Household Health Survey Questionnaire was used to elicit specific, quantifiable information available around household demographics, incidences of illnesses, and the availability of health services.

There are important elements for increasing the trustworthiness of qualitative research (Fitzhenry et al., 1970, pp. 71, 104) such as:

- **Reliability/Consistency of the data**: the extent to which the investigations are repeatable with the same subjects, or in a similar context;
- **Applicability**: the degree to which the findings can be applied to other contexts and settings, or to other groups; and
- **Validity**: the degree to which the findings are premised solely on information supplied by the informants and the conditions of the research and no other biases.

The researchers tried their utmost to guide the research according to these elements during the study.
3.2 Data collection methods

The two dominant data collection approaches employed within any scientific research study are either quantitative or qualitative in nature (Mouton et al., 2006, p. 579). Considering the research objectives, questions and purpose of this study, the most appropriate approach for this research was a mixed-method (including both quantitative and qualitative methods) in order to gain an accurate understanding of the correlation between the constructs (Van Dijk, 2015, pp. 30-31). Mixed-method research is described as “the systematic combination of qualitative and quantitative methods in research” used to generate different types of data, which could enhance the quality of the study (Du Plessis & Majam, 2010, pp. 456, 459). The mixed-method guarantees a real reflection and application of the considered variables in practice. It, therefore, yields more comprehensive evidence than a single method could produce (Du Plessis & Majam, 2010, pp. 456, 459, 464; Van Dijk, 2015, pp. 30-31). The collection of both quantitative and qualitative data is therefore used to gain greater clarity on the correlation between questions of the interviews, focus groups and questionnaires.

The data collection methods included interviews, focus group discussions, and the use of key informants, researcher observations and questionnaires. The interviews were conducted with household members, community members and focus groups within communities, such as the Riverlea Community Forum (RCF), church congregations, the Catholic Commission for Justice and Peace, Lawyers for Human Rights (LHR), and mine representatives, as well as government officials, such as representatives of City Parks in Johannesburg, Department of Mineral Resources (DMR) officials, the South African Police Services (SAPS), the Metro Police and others.

The research team chose the communities of Riverlea, Diepkloof, Meadowlands, and Snake Park as focus communities because they are located where the mine waste belt ends. Davidsonville, a small ‘coloured’ community to the North-West of Soweto, was also included because the people in that community live in the shadow of immense mine waste dumps and, as this report will show, with dire consequences. The Davidsonville community successfully took a transgressing mining community to court and was included not for reporting processes but for what the Bench Marks Foundation and the monitoring school could learn from their experience (Nelson, 26 November 2010). The team chose the Community of Danville in Mafikeng as a control study because Danville is a township with housing that has asbestos roofs and in all ways approximates Riverlea, Diepkloof, Meadowlands, Snake Park and Davidsonville, except that there is no mining near Danville.

The interviews with community members were semi-structured, based on a list of topics related to the interaction between mining companies and communities; in particular, the environmental, cultural, socioeconomic, political and health impacts of mining on the selected communities were investigated. A degree of flexibility was allowed in the interviews
to assist the interviewer(s) to probe deeper when it was felt that more relevant information could be obtained through further questioning. The questions and topics were not necessarily asked in the same order each time because this depended on the way the interview developed. This allowed the person being interviewed a degree of freedom to voice concerns and to participate in directing the flow of the conversation. These in-depth interviews assisted in clarifying what themes and topics were important, what the major concerns of individuals and communities were and the relationships between different strata within communities, such as local workers and migrants.

Focus groups (of eight to 12 people) and interviewees were selected purposely to take into account gender, race, migrant or local status, age and specific interest groups (e.g. people with health conditions). Some of the focus groups, however, had a ‘mixed’ composition. To enhance the scientific nature of the study, the researchers (interviewers) were drawn from the local communities. Notes were taken of interviews, and some interviews/focus group sessions were tape recorded. Several individuals in different areas were also used as key informants, such as a local pastor and several selected males and females who lived in the areas. Patton (2002, p. 321) describes key informants as “[...] people who are particularly knowledgeable about the inquiry setting and are articulate about their knowledge – people whose insights can prove particularly useful in helping an observer understand what is happening and why”. Participatory observation was also used to gather information. Several observations (e.g. unemployment, poor service delivery and housing, employer/employee dynamics, air and dust pollution, etc.) were made by participants that gave insight into the research settings.

The Household Health Survey Questionnaire, based on the World Health Organisation’s (WHO) World Health Survey Guide, was used (WHO, 2002) to obtain empirical information. The research was also guided by the Bench Marks Framework, Principles for Global Corporate Responsibility: Bench Marks for Measuring Business Performance (Bench Marks Foundation, 2003). The Bench Marks Framework is considered one of the four leading corporate responsibility measuring tools globally. Notably, this document forms the framework for research, measurement and action on corporate behaviour. The questionnaires (see Appendix 1) were administered to 400 households: 100 in Riverlea, 100 in Diepkloof, 100 in Meadowlands and 100 in Doornkop (an informal settlement in Snake Park). An additional 50 households were surveyed in Davidsonville, a small ‘coloured’ community to the North-West of Soweto. The communities were selected for their proximity to current, derelict, abandoned or ownerless mines along the northern edge of Soweto, parallel to Main Reef Road. The households were selected by using random sampling, which meant everyone in the community had the same chance of being selected (e.g. by visiting every fifth house in a certain geographical area to request that the inhabitants complete a questionnaire).
Over a week-long period in August 2016 the questionnaires were administered, and the interviews and focus groups conducted. The empirical data was gathered by Charles van der Merwe (Riverlea); Rapule Moiloa (Diepkloof); Israel Mosala (Meadowlands); Theodore Tiny Dlamini (Doornkop/Snake Park); and Celeste van Rensburg (Davidsonville). Data was collected in the control group in Danville, Mafikeng by Chris Molebatsi, who used the same questionnaire. The interviewers were all competent in English and spoke the dominant languages of the communities in which they administered the questionnaires.

The data collectors attended a workshop, presented by the Bench Marks Centre for CSR at the North-West University (NWU), which was facilitated by the NWU’s Prof Freek Cronjé, Ms Suzanne Reyneke and Prof Eddie Bain, as well as Mr David van Wyk and Mr Brown Motsau of the Bench Marks Foundation. The purpose was to provide training for the selected field workers. They were educated on the methodology of field research (random and non-random sampling, the completion of the questionnaires and conducting interviews), as well as the way in which the prospective respondents needed to be approached and dealt with, both while completing questionnaires and during interviews. They were also taught the ethical requirements relevant to such research (for example, stating the purpose of the research, completion of a consent form, voluntariness, not to influence the respondents in answering the questionnaire, anonymity, and freedom to participate and withdraw at any time).

3.3 Data analysis

The interviews with the respondents were translated, where necessary, and transcribed. The content of the data was then analysed using a conceptual (thematic) analysis. A preliminary thematic analysis at the end of the fieldwork period(s) also provided the structure in which this report is being presented.

According to Palmquist et al. (2005), the process of conceptual analysis comprises eight steps, namely:

- Deciding on the level of analysis;
- Deciding on how many concepts to code for;
- Deciding whether to code for the existence or frequency of a concept;
- Deciding how to distinguish among the concepts;
- Developing rules for the coding of texts;
- Deciding what to do with irrelevant information;
- Coding of texts; and
- Analysing results.
A more theoretical (in contrast to a practical) approach, that is, the interpretation of written sources (literature control; also see literature review) was used as the basic point of departure for the analysis and interpretation of the results.

The quantitative data was used as a verification of the qualitative data by illustrating the opinions of respondents in a quantified manner. Quantitative data analysis was done by manually analysing information obtained from the questionnaires. The questionnaires were analysed by the Statistical Consultations Services of the NWU, Potchefstroom Campus.

3.4 Ethical considerations

The following ethical considerations were always kept in mind while conducting the research:

- **Voluntary participation:** no participant was forced to participate in the research, and they were free to withdraw from the research at any stage.
- **No harm to participants:** the researcher ensured that no physical or psychological harm was done to the participants because of the study.
- **Anonymity and confidentiality:** all the information gathered during the study was dealt with confidentially, and permission obtained from the participants for all information to be shared publicly. Permission was also obtained from all individuals who were photographed to use these photographs where required.
- **Not deceiving the subjects:** participants were informed concerning the aim, the purpose and the procedures of the study, and were not deceived in any way.

The research project received an ethics approval certificate from the NWU. The ethics approval certificate number is NWU-00279-16-A7. The project report was subjected to critical review and reading processes (see Acknowledgements) towards the end of the project so as to enhance the scientific quality of the research.

The research results will be disseminated in the following ways:

- They will be communicated to all the affected mining corporations for their comment prior to the results being made public;
- They will also be sent to the relevant government departments and Constitutional/Chapter 9 Institutions;
- They will be presented at a launch of the research in August 2017, at which representatives of all the stakeholders will be present;
- They will be shared at community workshops in the researched communities and with community monitors to empower them to understand and use the research results in their engagement with mining concerns;
They will be published in scientific publications, outlined in academic addresses, and made known via popular media and the internet.

3.5 Limitations of the research

The researchers experienced difficulties engaging with the mining companies and to get members of mine management to respond to correspondence directed through, for example, the Riverlea Community Forum (RCF) – an exercise requiring several follow-up telephone calls and e-mails.

In principle, the Bench Marks Foundation prefers to engage with corporations with and through communities about the issues that are of concern to communities, thereby assisting communities to develop the confidence to engage with power and stand up for their constitutional and legal rights. This is also to avoid a dependency situation developing between the community and the non-governmental organisation (NGO). The research process thereby becomes a vehicle for community self-discovery, organisation and advocacy. To this end, we attach examples of communication between community structures and the corporations involved, the state and other role players in Appendix 2. Not all the communities were equally well organised. The RCF is composed of well educated, middle class, salaried individuals who have access to the internet and the latest communication tools. In Diepkloof, we interacted with the Voices of the Poor Concerned Residents (VPCR), who are also fairly well organised. However, there is no formal resident organisation in Meadowlands, while in Doornkop informal settlement, the community is only starting to coalesce around Tiny Dlamini (key informant and data collector). This is a matter that Bench Marks Foundation will have to address after the report is published through the monitoring school.

Photo 1: Voices of the Poor Concerned Residents meeting in Diepkloof
The research subjects in the area were generally cooperative, although a number were extremely fearful of perceived security and economic consequences for their families and themselves should they in any way be identifiable from the research.

The household health survey provided us with community members’ perceptions and information regarding their health, health services and the perceived impacts of mining on their health. However, it would require a proper epidemiological study to determine a direct correlation between tailings\(^1\) dust and respiratory problems in these communities, such as blood tests, to determine the presence or otherwise of toxic substances that might also be present in the mine waste. Unfortunately, the Bench Marks Foundation does not have the capacity or technology to carry out such a study.

4. HISTORICAL OVERVIEW

What is Soweto known for today? As the place where Nelson and Winnie Mandela had a modest house in the early 1960s? As a place where two Nobel Peace Prize winners, Nelson Mandela and Desmond Tutu, lived in the same street, namely Vilakazi Street?

\(^1\)“Tailings, also called mine dumps, culm dumps, slimes, tails, refuse, leach residue or slickens, are the materials left over after the process of separating the valuable fraction from the uneconomic fraction (gangue) of an ore. Tailings are distinct from overburden, which is the waste rock or other material that overlies an ore or mineral body and is displaced during mining without being processed. The amount of tailings can be large, ranging from 90% – 98% for some copper ores to 20% – 50% of the other (less valuable) minerals. The extraction of minerals from ore can be done two ways: placer mining, which uses water and gravity to concentrate the valuable minerals, or hard rock mining, which pulverizes the rock containing the ore and then relies on chemical reactions to concentrate the sought-after material. In the latter, the extraction of minerals from ore requires comminution, i.e., grinding the ore into fine particles to facilitate extraction of the target element(s). Because of this comminution, tailings consist of a slurry of fine particles, ranging from the size of a grain of sand to a few micrometres. Mine tailings are usually produced from the mill in slurry form, which is a mixture of fine mineral particles and water” (Wikipedia, 2017).
As the place where there was a student uprising in 1976? (The Museum of this uprising is now a tourist attraction) As the place where Regina Mundi Church, an iconic site in the struggle against apartheid, is located? As the place where the Freedom Charter was signed in 1955 in the suburb of Kliptown? Or as a romanticised tourist attraction for foreign tourists? Few people bother about why it was created in the first place, or when it started, and what its relationship was to mining activity on the Witwatersrand main reef, which forms the northern border of the township. Hardly anyone knows about the underground architecture and map of Soweto. No one cares that it served as a dormitory to house millions of black South Africans who were, and still are, the subaltern working population in Johannesburg and its lush suburbs.

The history, health and welfare of Soweto and its people are inextricably linked to the history of gold mining, colonialism and apartheid yet little research has been done into the history of the ‘location’ prior to the forced removals of black people from Sophiatown and other parts of ‘white’ Johannesburg in the 1950s and early 1960s (Phillips, 2014). Although ‘health’ and ‘hygiene’ concerns about the City of Johannesburg (COJ) was used to stereotype and then to justify the earliest forced removals of black people from Johannesburg to Kliptown as early as 1904-1906 (Kennedy, 1984, p. 46), very little historical research has been done on the development of, and the current health status of communities in Soweto, or about the location of Soweto in relation to the ‘Reef’ and gold mining. It is for this reason that Bench Marks Foundation, with the assistance of Christian Aid, decided to take on this mammoth task.

The task at hand required the research team to delve into geology, geography, meteorology, nuclear sciences, chemistry, health sciences, anthropology, sociology, economics, mining, history and economic history.

4.1 Geological history

The geological history is described by referring to the basin (geological depression) where gold was discovered and its early developments, the importance of water in gold mining, the ‘sister’ heavy metals of gold and their influence on adjacent communities, as well as dust and radioactivity.

4.1.1 Basin, drain, inland sea

A basin is a geological depression, but might also be referred to as a zinc (sink) in South Africa. A kitchen zinc in particular. Most South Africans have been exposed to black women portrayed as domestic workers, derogatorily referred to as ‘nannies’, ‘meide’, ‘kitchen girls’,...
‘house-helps’ etc. These are the location or township women who come to the suburbs of Johannesburg daily to clean the living spaces of the suburban middle classes and the wealthy madams. Many of them travel from Soweto, situated in a basin below the Witwatersrand, into which both the sewage and mine waste of Johannesburg drains. No amount of dishwashing liquid or scrubbing will cleanse the ‘locations’ they come from. They come from places such as Diepkloof, Pimville, Kliptown, Meadowlands, Snake Park Orlando, etc. Their mothers and grandmothers were ‘cleansed’ out of Sophiatown, Doornfontein, Emmarentia and other parts of Johannesburg and washed and rinsed by colonialism, racism and apartheid into the basin that is Soweto. Considered not to be clean enough, hygienic enough or ‘civilised’ enough to take up residence in town, but hard working enough to clean, make hygienic and spruce up the City of Johannesburg and its suburbs daily. Such is the intersection of the socio-geology and political geography and economy of Soweto.

Millions of years ago, gold drained into this basin, carried there by rivers, and settled along the northern and western edges/beaches of an inland sea. C. Biccard Jeppe’s (1946) description of the location and topography of the Witwatersrand remains one of the best available to us:

The western and central portions of the Witwatersrand goldfields lie to the south of a series of parallel ridges, which form abrupt escarpments on their northern side; from there the name ‘Witwatersrand’ (“The Ridge of White Waters”) has been derived […]. These ridges, extending over a distance of some 35 miles (with one two-mile break), and several miles in width, form a watershed between the tributaries of the Limpopo and Crocodile Rivers to the North (flowing into the Indian Ocean) and those of the Vaal and Orange Rivers (which flow into the Atlantic Ocean) to the south […]. The mines of the Central Rand lie in a depression, with ridges and hills further to the South and South-West. (Jeppe, 1946, p. 35)

Soweto lies in a basin to the South and South-West and directly below the mines of the Central Rand, from Langlaagte and Crown Mines in the East through to Durban Roodepoort Deep (DRD) and Doornkop in the West. This location means that much of the runoff from the Vaal River watershed runs down off the Witwatersrand ridge, and past the mines and mine waste (forming a chain stretching from the North-East of Soweto to the North-West of the ‘location’) through Soweto.

The topographical elevation map below shows the steep drop from the ridge that comprises the Witwatersrand to the basin that is Soweto. It is a flood risk map but also shows that the rivers flow down from the Reef through Soweto and towards the Vaal River.

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2 ‘Townships’ in South Africa denotes urban locations allocated to the housing black workers.
Significantly, after an outbreak of the plague in Johannesburg in 1903-1904, the authorities decided to shut down ‘Kaffir Locations’, as it was called, situated to the West of Johannesburg, and to relocate the Asian and African populations to Kliptown (later to become Lenasia and Soweto). Klipspruit was also targeted to become the sewage works of Johannesburg, which it now is (Kennedy, 1984, p. 46).

The words ‘Meide’, ‘Coolie’ and ‘Kaffir’ are derogatory words that do not reflect the views of the authors of this paper, but rather the racism of the time.
Geologists tell us that millions of years ago the interior of South Africa was covered by an inland sea, the edge of which stretched from where Nigel is now, on the Far East Rand, through the South of Springs, Brakpan, Boksburg, Germiston, Johannesburg, Roodepoort, Randfontein, Carletonville, Stilfontein, Potchefstroom, Klerksdorp, Orkney, Allanridge, Odendaalsrus and Welkom in the South. This sea filled a vast inland basin, and rivers and streams flowed into it from surrounding highlands, depositing pebbles, sand and gold all along the edge or beach of this sea. This layer of gold, the so-called ‘Reef’ was covered, over many millennia, by layers of mud which, in turn, became layers of sedimentary rock or shale measuring thousands of meters thick. The impact of a meteorite that struck the earth’s surface at Vredefort Dome and movements of geological plates pushed parts of the ‘Reef’ to the surface. These parts are referred to as ‘outcrops’ composed of shale and mixed layers of sediment known as ‘bankets’ or conglomerates of pebbles (Truswell, 1970, pp. 27-40) and sand which contain a ‘bouquet’ of minerals, including gold, silver, copper, iron, uranium, lead and arsenic.

Map 2: Soweto in relation to South Africa’s goldfields

Source: Macnab, 1987

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4 Reportedly named after a grainy Dutch biscuit, similar to a chocolate chip cookie.
Map 3: Discovery sites of gold in the Witwatersrand region from 1874-1886

Source: Cairncross & Dickson, 1999, p. 33

Map 4: Gold mines were established further afield after the discovery of gold on the Witwatersrand (1886)

Source: Cairncross & Dickson, 1999, p. 33
The Witwatersrand Basin is the largest known gold producing area in the world and the deposits have now been worked for well over 100 years and are believed to have produced about 98% of South Africa's gold. Gold is produced from seven goldfields within the basin, mainly from conglomerate horizons of the Witwatersrand, Ventersdorp and Transvaal Supergroups.

The Witwatersrand Basin is located on the Kaapvaal Craton in South Africa and is an oval-shaped basin, covering an area of some 400 km NE-SW and some 180 km NW-SE, of which approximately 84 000 km² consist of outcrop and an often deeply buried subgroup of the Witwatersrand Supergroup sedimentary and sub-ordinate volcanic sequences.

The Witwatersrand Supergroup is underlain by an Archaean granite-greenstone basement more than 3.1 billion years old and the Dominion Group, which is about 3.074 to 3.086 billion years old. It is unconformably overlain by rocks of the Ventersdorp (2.7 billion years old), Transvaal (2.6 billion years old) and Karoo (302 to 180 million years ago) supergroups.

The area within the basin is composed of the generally non-mineralized West Rand Group (also known as the Lower Witwatersrand Supergroup) covering an area of some 54 000 km², and the Central Rand Group (also known as the Upper Witwatersrand Supergroup) consisting of gold and uranium rich terrains over an area of some 30 000 km², in which are the major producing gold and uranium mines of South Africa.

The origin of gold mineralization in the Witwatersrand Basin has been debated for at least 100 years. The debate has been divided between the synergenetic or placer and the epigenetic or hydrothermal models. The most widely accepted model currently appears to be the 'modified placer model' in which grains of placer gold have been remobilized after burial.

The goldfields are therefore considered to represent major, diachronous entry points of coarse-grained sediments into the basin and appear to be laterally coalesced fluvial braid-planes, where gold was concentrated within the conglomerates developed primarily on unconformities.

Deposition in the Witwatersrand Basin is considered to have taken place along the interface between a fluvial system and a major body of still water or an inland sea, with the source of the gold postulated to be a northerly Archaean Greenstone belt in which plate interactions caused the development of mineralizing hydrothermal activity and generated sedimentary environments where gold-bearing deposition could occur. The basin is filled with approximately 14 000 m of sedimentary and subordinate volcanic rocks, which have folded along a South-West to North-East axis into an asymmetrical syncline (Superior Mining, 2016).

### 4.1.2 The official beginning and early development of gold mining

Before 1886, when the district of Heidelberg in the Transvaal, or Zuid Afrikaansche Republiek, came into existence, three districts, namely Potchefstroom, Pretoria and Rustenburg, surrounding villages of the same names, contained certain farms that lay within the area known as the Witwatersrand ('the ridge with white waters'). Contrary to the view that this
was a dry arid flat area, it was “well-watered, well defined, stood out prominently from a
distance and it is not surprising to find that physical features were described with regard to
this distinctive geographical feature” (Gray, 1937, p. 74).

Johannesburg came into existence in 1886 when President Paul Kruger of the Zuid
Afrikaansche Republiek proclaimed the following farms to be public gold diggings during
September and October 1886. In September 1886 the Zuid Afrikaansche Republiek (ZAR, later, Transvaal) government declared the farm Langlaagte and eight others – all of which
were in Afrikaner farmers’ possession – officially open as public diggings, which led to the
establishment of the biggest gold-mining operations in the world. A translated version of the
Government Gazette (Staats Courant) of September 8, 1886, referred to as the ‘birth notice’
of the Rand, reads as follows (Jacobsson, 1936, pp. 17-18):

“Whereas it appears to the Government of the South African Republic that it is advisable
that the farms named Driefontein, Elandsfontein, southern portion Doornfontein, Turffontein, Government farm Randjeslaagte, Langlaagte, Paardekraal, Vogelstruisfontein and Roodepoort, all situate in the Witwatersrand, district Heidelberg, be declared a public
digging.

Now, therefore, I STEPHANUS, JOHANNES PAULUS KRUGER, State President of the South
African Republic, in terms of Article 5 of Law No. 8, 1885, do proclaim the abovementioned
farms a Public Digging in the following order and from the following dates respectively, namely:
• The farms Driefontein and Elandsfontein on Monday, 20th September, 1886;
• The southern portion of the farm Doornfontein and the farm Turffontein on Monday,
27th September, 1886;
• The piece of Government ground named Randjeslaagte and the farm Langlaagte on
Monday, 4th October, 1886; and
• The farms named Paardekraal and Vogelstruisfontein and Roodepoort on Monday, 11th
October 1886, in so far as the same have not been beaconed off by owners or lessees
for ‘Mynpacht-brieven’ or according to Article 20 of Law 8, 1885 as reserved cultivated
lands, gardens, agricultural lands and water leadings, in the vicinity thereof.

GOD PRESERVE LAND AND PEOPLE
Given under my hand at the Government Offices at Pretoria, on this, the 8th day of
September, A.D. 1886.
(Sgd.) S.J.P. KRUGER, State President.
(Sgd.) W. EDUARD BOK, State Secretary.”

Gold prospecting was, therefore, happening on several farms in the district. However, the
farm on which the first gold-rich conglomerates were discovered was Langlaagte, Ward
Kliprivier and District Heidelberg, about 250m north of the modern ‘coloured’ township of
Riverlea.
“The discovery in 1886 of the auriferous conglomerates of the Witwatersrand Main Reef Series was regarded by the Government as a new discovery of payable gold in a new era and its obligation was discharged according to the Gold Law by allowing (George) Harrison and (George) Walker each to work a discoverer’s claim given to them by Gerhardus Cornelius Oosthuizen without payment of claim licence.” (Gray, p. 82) They paid the government in Pretoria for the licence instead. Johannesburg started its existence as an informal settlement, as the Transvaal Chamber of Mines noted in 1927: “Johannesburg commenced as many other mining camps have done. It was a mere collection of iron shanties [and tents and wagons]; there were no well-defined roads and the suburbs of the town which are today populated by thousands of people were at that time considered to be right out in the veld.” (Transvaal Chamber of Mines, 1927, p. 11)

*Photo 3: Settlement of tents and wagons*

Source: Jacobsson, 1936

*Photo 4: Digging for gold on the Witwatersrand (1886)*

Source: Cameron & Spies, 1986, p. 187
The effect of the discovery was massive: it helped to lift the entire country out of the depression of the 1880s and into a new phase of growth. This growth was the result of the development of gold mining on the Witwatersrand and was achieved by the combined operation and influence of the following:

- Uniformity and extent of the gold-bearing deposits;
- Improvements and adaptations of the mechanical and chemical processes of gold mining;
- Proximity of valuable coal deposits;
- Ability to attract a large amount of foreign capital; and
- Cheap unskilled labour (De Kock, 1924, p. 243).

4.1.3 Water and gold (fountains, fissures and aquifers)

The role that water played in depositing gold along the ‘reef’ or edge of the inland sea at the centre of what is now South Africa, was discussed above. However, there are other important links between water and gold that must be mentioned, for these links will have an important role in the political economy, spatial arrangements and history of Johannesburg and Soweto.

In the undisturbed, natural environment, minerals and water coexist. The natural erosion of rock outcrops allows the naturally required amounts of minerals to be released into rivers and streams in quantities required for sustaining plants and animals, yet, when mining occurs, that natural balance is disturbed, with disastrous consequences.
If one looks at a map and the names of towns that sprang up all along the gold reef, one cannot help but notice the references to sources of water in these place names, such as Springs, Brakpan (brackish pan), Turffontein (Peat fountain), Braamfontein (Braam fountain), Randfontein (Rand fountain) etc. These names do not only refer to the farms that existed before the towns sprang up along the reef, but also to the fact that, although the area in which Johannesburg evolved has relatively low annual rainfall, it was rich in springs and fountains, indicating an abundance of groundwater before mining started. In fact, naturally eroding minerals into water systems are healthy and provide living organisms with the minerals they require for a healthy existence.

Water is essential to life in our country and the planet. A prerequisite for sustainable human development must be to ensure uncontaminated streams, rivers, lakes and oceans. After the recent three-year (2014-2017) drought and water restrictions, there is growing public concern about the condition of our water resources in and around Johannesburg and South Africa as a whole. South Africa is a water-scarce country and ranks as one of the 30 driest countries in the world, with an average rainfall of about 40% less than the annual world average rainfall. South Africa has an average annual rainfall of less than 500mm, while that of the world is about 850mm (South African Government, 2015). The public is becoming increasingly aware of the ways in which mining affects fresh water through the heavy use of water in processing ore, and through water pollution from discharged mine effluent and seepage from tailings and waste rock (material not containing commercial quantities of target material) impoundments.

Mining is increasingly threatening the water sources on which we all depend, and we become concerned when the National Department of Water Affairs (DWAF) issues directives against the use of borehole and stream water, because of contamination (Cloete, 2008). According to James Lyon of the Mineral Policy Centre in Washington, water is “mining’s most common casualty” (Safe Drinking Water Foundation, 2017). There is growing awareness of the environmental legacy of mining activities that have been undertaken with little concern for the environment.

The price South Africans have paid for attracting foreign investment through mining corporations and the export of our minerals has been very high. Mining by its very nature consumes, diverts and can seriously pollute water, air and soil resources. Negative impacts can vary from the sedimentation caused by poorly built roads during exploration to the disturbance of water during mine construction. Water pollution from mine waste rock and tailings might need to be managed for decades, if not centuries, after a mine’s closure. In South Africa in general, and Gauteng in particular, abandonment rather than responsible closure seems to have been the norm, given that there are 6 000 ownerless, derelict and abandoned mines nationwide and some 600 in Gauteng alone (Council for Geoscience, 2017).
These impacts depend on a variety of factors, such as the sensitivity of local terrain, the composition of the minerals mined, the types of technology employed, the skill, knowledge and environmental commitment of the company and, finally, the ability of the government to monitor and enforce compliance with environmental regulations. One of the problems is that mining has become more mechanised and therefore able to handle more rock and ore material than ever before. In Johannesburg, the gold found in a conglomerate layer of pebbles and sand has always been low grade – a ton of rock is mined to obtain an ounce of gold. This means that over a period of about 130 years an enormous amount of waste has been generated. South Africa is responsible for about 86% of all the waste in Africa as a whole (Institute of Waste Management Southern Africa, 2017).
Therefore, mine waste has multiplied enormously. As mine technologies are developed to make it more profitable to mine low-grade ore, even more waste will be generated in the future. Waste from the mining of processed ore is mineralised rock containing the gold. Ultra-deep level mining involves the excavation of large quantities of waste rock (material not containing the target mineral) to extract the desired mineral ore. The ore is then crushed into finely ground tailings for processing with cyanide and separating processes to extract the final product. Almost three tonnes of ore (waste) is needed to produce enough gold for one typical wedding ring. According to AngloGold Ashanti (2004): “As at 1997, South Africa produced an estimated 468 million tons of mineral waste per annum (DWAF, 2001). Gold mining waste was estimated to account for 221 million tons or 47% of all mineral waste produced in South Africa, making it the largest, single source of waste and pollution (DWAF, 2001). There are more than 270 tailings dams in the Witwatersrand Basin, covering approximately 400km² in surface area (AngloGold Ashanti, 2004). These dams are mostly unlined, and many are not vegetated, providing a source of extensive dust, as well as soil and water (surface and groundwater) pollution...” (Oelofse et al., 2007, p. 617). The dust and water from the tailings waste contain chemicals, minerals and heavy metals that are poisonous, such as arsenic, cyanide, mercury, lead and uranium.

*Figure 2: Uses of gold*

![Pie chart showing the uses of gold.](source)


Over 42 million cubic metres of general waste is generated every year across the country, with the largest proportion coming from Gauteng province (42%). In addition, more than 5 million cubic metres of hazardous waste is produced every year, mostly in Mpumalanga and KwaZulu-Natal (due to the concentration of mining activities and fertiliser production in these provinces). By far the biggest contributor to the solid waste stream is mining waste (77%), followed by pulverised fuel ash (8%), agricultural waste (6%), urban waste (5%) and sewage sludge (4%) (Institute of Waste Management Southern Africa, 2017).
There are five main types of mining impacts on water quality:

i. Acid Mine Drainage (AMD)/Acid Rock Drainage (ARD). ARD is a natural process whereby sulphuric acid is produced when sulphides and pyrites in rocks are exposed to air and water. AMD is essentially the same process, greatly magnified. When large quantities of rock containing sulphide minerals are excavated from an open pit or exposed in an underground mine, it reacts with water and oxygen to create sulphuric acid. When the water reaches a certain level of acidity, a naturally occurring type of bacteria called Thiobacillus ferrooxidans can become active, accelerating the oxidation and acidification processes, leaching even more trace metals from the wastes. The acid will leach from the rock if its source rock is exposed to air and water and until the sulphides and pyrites are leached out – a process that can last hundreds, even thousands of years. Acid is carried off the mine site by rainwater or surface drainage and deposited into nearby streams, rivers, lakes and groundwater. AMD severely degrades water quality and can kill aquatic life and make water virtually unusable (Safe Drinking Water Foundation, 2017);

To begin to address the very real problems posed by AMD, the government must:

- prevent future loss of aquatic habitat to AMD;
- record and clean up existing acid-generating mine sites;
- improve public access to information on monitoring and enforcement of AMD treatment and reclamation; and
• prevent future AMD by improving environmental risk assessment and adopting a liability prevention approach to future AMD mine assessments.

ii. Heavy metal contamination and leaching. Heavy metal pollution is caused when metals such as arsenic, cobalt, copper, cadmium, lead, silver and zinc contained in excavated rock or exposed in an underground mine encounter water. Metals are leached out and carried downstream as water washes over the rock surface. Although metals can become mobile in neutral pH conditions, leaching is particularly accelerated in the low pH conditions, such as those created by AMD (UIS Sediba Laboratory, 2017);

iii. Processing chemicals pollution. This kind of pollution occurs when chemical agents (such as cyanide or sulphuric acid used by mining companies to separate the target mineral from the ore) spill, leak, or leach from the mine site into nearby water bodies. These chemicals can be highly toxic to humans and wildlife (UIS Sediba Laboratory, 2017);

iv. Erosion and sedimentation. Mineral development disturbs soil and rock during constructing and maintaining roads, open pits and waste impoundments. In the absence of adequate prevention and control strategies, erosion of the exposed earth can result in substantial amounts of sediment being carried into streams, rivers and lakes. Excessive sediment can clog riverbeds and smother watershed vegetation, wildlife habitats and aquatic organisms. Water Quantity Mining can deplete surface and groundwater supplies. Groundwater withdrawals can also damage or destroy streamside habitat many miles from the actual mine site (UIS Sediba Laboratory, 2017); and

v. Water and aquifers. Johannesburg is a major city in one of the driest countries on the planet; we receive 50% less rainfall than the global average, yet the mining industry has systematically destroyed crucial sources of underground water occurring in aquifers and fissures. Underlying much of Gauteng, North-West and Limpopo provinces is the so-called South African Transvaal Aquifer. This is a massive body of water containing dolomitic formation (Buchanan, 2013). The presence of this water formation poses a serious obstacle to both platinum and gold mining and has done so since the discovery of gold on the Witwatersrand in 1886. Thus, we read in the published papers and discussion documents of the Association of Mine Managers for 1931 – 1936 (Bok, 1938, pp. 171-173) that East Rand Property Mines (ERPM) pumped enormous amounts of water to its mines on the East Rand: “the average amount of 2,200,000 gallons (8,360,000 litres) per day pumped from all natural sources, roughly 1,800,000 gallons is the constant inflow, and the balance of 400,000 per day is the measure of the drainage of the zones” (Bok, 1938).
Roy MacNab, in his history of the Gold Fields of South Africa mining company, notes regarding Venterspost mine in 1934: “Water was the last big hurdle. They had found the reefs, the gold was there but Nature, as if to protect it from the intruder, had put dolomite in the way. Through the dolomitic caverns filled with water, the shafts would have to go to reach the reef and the gold.” (Macnab, 1987, p. 145). Water was a common problem for the mines on the Rand and elsewhere, and millions of litres of water were pumped out per day from various mines over the 130 years of mining on the Witwatersrand.

The fissures, aquifers and groundwater resources were all part of the natural formation of water, filling up during the rainy season and reducing in the dry season. Impermeable granitic dykes interspersed the gently sloping permeable conglomerates, shales and dolomitic layers. Rainwater, being slightly acidic, carved out caverns that filled with water, while dykes determined the flow. Mining disturbed the natural flow of ground water by perforating the dykes and creating new flow opportunities, causing water to flow in different directions from the natural flow. This impacted the springs/fountains, wells and boreholes used by the population on the surface.

The different basins, East, Central and West, which comprised the areas in which mining was concentrated, are all rapidly filling up with water because no one is pumping out the water anymore. The natural flow and direction of the water has been disturbed by mining. Natural aquifers have been ‘cemented’, i.e., filled with concrete to neutralise the danger they posed.
to men working in shafts and tunnels underground. Dykes that naturally contained groundwater flow and direction have been perforated by mine tunnels, allowing water to flow freely in whatever direction the dykes were perforated, spewing out acid and heavy metal-contaminated water wherever the ground water breaks through to the surface in springs and streams. Land subsidence and sinkholes in the great dolomitic belts that underlay most of the South African gold fields act as drains and sinks in the underground water, leaving the current and future generations with a massive, dangerous and expensive environmental challenge – the surface has been undermined by the underground.

A lot of handwringing is done by the business, academic and political elite about the environmental, ecological and hydrological (water) impact of mining in general and the abandoned, derelict and ownerless mines in particular. Thus, the Centre for Scientific and Industrial Research (CSIR) held a workshop on 16 and 17 March 2015 on the South African Mining-Related Landscape Rehabilitation Status Quo: Identifying Research Work Required to Close Knowledge Gaps (De Klerk & Claassen, 2015). Seminars, workshops, committees, indabas (meetings), etc. around the destructive impact of abandoned, ownerless and derelict mines have become an industry for consultants and academics, as has the generation of guidelines, tools, models, plans and blueprints for resolving the matter. The above workshop identified 72 guidelines, tools, models, plans, etc. that have been developed in recent years to mitigate the problem. It has also inspired many academic papers, journals and books.

Map 7: Watershed, mine dumps and sewage works in relation to Soweto

Source: McCarthy et al., 2007, p.392
This brings us back to the question of basins. Riverlea, Diepkloof, Meadowlands and the Doornkop informal settlement in Snake Park all fall within the Central Basin (there being three basins south of Main Reef Road: Eastern, Central and Western). This was the prognosis of the environmental experts in 2010:

In the largest basin, the Central Basin, the water level has been rising at an average rate of 0.59 metres per day (m/d) since July 2009, varying seasonally between 0.3 and 0.9 m/d. By end-November 2010, the mine water level reached an elevation of ~1155 metres above mean sea level (mamsl), measured in Catlin Shaft at Simmer & Jack Mine. This is ~510 m below surface (mbs) at this location. Linear extrapolation of the longer water level graph for the South-West Vertical Shaft at East Rand Proprietary Mines (ERPM) predicts that the rising water level will reach the surface by March 2013. This will be updated as more monitoring data is collected. By this time, however, it will have sterilised still exploitable gold reserves located at a depth of less than 400 mbs. Of even greater consequence is that it will not only have flooded the shallower underground tourist facilities at Gold Reef City, but also compromised the shallow groundwater resource associated with the dolomitic strata located to the South-East of Johannesburg. (Water Research Commission, 2010, p. vi)

This can lead to subsidence and sinkholes, which are already very common throughout the West Rand, and poses a potential danger to residents of Soweto.

*Map 8: Largely undermined dolomitic belts of South Africa*

While laws and regulations exist and existed in the past, failure by previous and current governments to enforce the laws and regulations has caused the problem to spiral out of control. Not only did mining consume and waste huge quantities of water in the past, but
abandoned, ownerless and derelict mines continue to poison water in the present and will continue to do so in the future. Decanting of toxic, radioactive acid water has started occurring all over the Witwatersrand.

*Photo 6: Acid water decanting in children’s park - Davidsonville*

Without standards being enforced, communities are faced with decreased corporate accountability and increased ecological liability. According to Young, “we can pay now or pay later, and history has shown us that, especially with mining, cleanup is always more expensive than prevention. Good companies understand this concept, but the laws are not there for the good guys” (Safe Drinking Water Foundation, 2017). Deregulation, which is favoured by the industry, would further reduce accountability, consistency and transparency with respect to protecting clean water. Without an effective regulatory base, voluntary measures have not and will not deliver reliable, consistent safeguards and environmental performance improvements, as is shown by the number of ownerless, derelict and abandoned mines in South Africa.

Given the fact that we are one of the most water-scarce countries in the world and for the sake of current and future generations, we need to safeguard the purity and quantity of our water against irresponsible mineral development. We need to ensure the best pollution prevention strategies are employed in cases where the risks can be managed. We also need to recognise that in some places mining should not be allowed to proceed because the identified risks to other resources, such as water, are too great. In the right place – and with conscientious companies, new technologies and good planning – many of the potential impacts are avoidable. In fact, most mine pollution arises from negligence, not necessity.

**4.1.4 Gold and its sisters: uranium, arsenic, lead, copper, iron, silver, chrome – the implications for community health**

In 1886, gold was first discovered much farther West, in the area known as the Witwatersrand. A long time elapsed before the importance of this discovery was fully realised, but over the years the low-grade gold uranium deposits of the Witwatersrand System, which fill the Witwatersrand Basin and cover thousands of square kilometres in the Transvaal and Orange
Free State, have become the best-known mineral region in the world, both for size and wealth. (Liebenberg, 1972, pp. 354-355)

Liebenberg’s reference to the “gold uranium deposits of the Witwatersrand System” indicates the close association between uranium and gold in South Africa. The implications of which became apparent during the Second World War and the race to build the first atom bomb, as well as in the post-war world characterised by the Cold War and the proliferation of nuclear weapons. In this context, South Africa became a major supplier of very cheap uranium. Uranium from South Africa had a competitive edge in that it was a by-product of established gold mining production and required no new investment in the start-up of mines. An abundance of uranium was also already present in the mountains of yellow waste (tailings) all over the southern parts of the City of Johannesburg.

A.P. Cartwright (1962) traces the history of uranium in South Africa, referring to a paper delivered by Dr A.W. Rogers, the director of the Geological Survey of South Africa, to the Geological Society in 1915. Robert Kotze, the Government Mining Engineer, responded to the paper as follows: “In addition to the valuable scientific results obtained from such radioactive elements, results that appear to be likely in the course of time to revolutionize chemistry as well as the production of energy and indeed possibly the whole fabric of our present day civilization, the application of these elements in medicine is of extreme interest and value.” (Cartwright, 1962, pp. 285-286).

The next time mention is made of the presence of uranium in South African gold mines was in 1923, when R.A. Cooper, a metallurgist employed by the Corner House group, delivered a paper to the Chemical, Metallurgical and Mining Society of South Africa, in which he reported that “among the heaviest concentrates on many mines of the group, extending from the Boksburg Fault to the Central Rand, was uraninite” (Cartwright, 1962, p. 287). By World War 2 it was clear that the “Rand may be one of the biggest low-grade uranium fields in the world” (Cartwright, 1962, p. 289).

The presence of uranium and other heavy metals in the mine waste of Johannesburg is now an accepted fact (Truswell, 1970, pp. 38-39). Less well known are the health impacts of radiation on near mine communities. Radiation risks in Johannesburg in general and Soweto find expression in:

i) unfenced and unsecured mine waste, particularly slimes/tailings accessible to the unknowing public;

ii) informal settlers residing on abandoned mine sites;

iii) people stripping radioactive materials from abandoned mine sites and uranium processing plants and selling this to scrap metal dealers;

iv) people using tailings sand as a building mix for concrete, cement and plaster to build houses;
v) dust blown into the air from slimes/tailings dams and people inhaling or ingesting the dust;
vi) runoff of mine water from tailings dams, or seepage into groundwater;
vii) plants absorb radioactive substances from the soil on which they grow. If fruits, vegetables or other plants that have been grown in such soil are consumed as food, they also get into the human body; and
viii) the breaking down of naturally occurring and mine deposited uranium into radon gas getting into houses and buildings.

The health implications associated with such a large concentration of people living virtually on top of the largest concentration of uranium on the planet are immense.

*Photo 7: Geiger readings in Riverlea, Diepkloof, Meadowlands and Doornkop*

*Figure 4: Decomposing uranium breaks down as radon gas*

*Source: Ismail, 2016*
Radon gas is the second largest cause of lung cancer on the planet after smoking. According to the WHO/International Atomic Energy Agency (IAEA), the worldwide average annual radiation dose from exposure due to naturally occurring radiation sources, including radon, is 2.4 milliSievert (mSv). In any large population, about 65% would be expected to have annual doses of between 1 and 3 mSv. About 25% of the population would be expected to have annual doses of less than 1 mSv, and about 10% would be expected to have annual doses greater than 3 mSv (IAEA, 2014).

Table 1: Radiation risks

<table>
<thead>
<tr>
<th>mSv/h</th>
<th>µSv/h</th>
<th>Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>10,000,000</td>
<td>Organ failure and death within hours</td>
</tr>
<tr>
<td>1,000</td>
<td>1,000,000</td>
<td>Severe: Vomiting / 1:20 risk of cancer</td>
</tr>
<tr>
<td>100</td>
<td>100,000</td>
<td>Severe: Radiation poisoning</td>
</tr>
<tr>
<td>1</td>
<td>1,000</td>
<td>High danger: Evacuate immediately</td>
</tr>
<tr>
<td>0.1</td>
<td>100</td>
<td>High danger: Heightened sickness risk</td>
</tr>
<tr>
<td>0.02</td>
<td>20</td>
<td>High danger: Sickness risk</td>
</tr>
<tr>
<td>0.01</td>
<td>10</td>
<td>Danger: Relocate now</td>
</tr>
<tr>
<td>0.005</td>
<td>5</td>
<td>Elevated risk: Relocate as soon as possible</td>
</tr>
<tr>
<td>0.002</td>
<td>2</td>
<td>Elevated risk: Take safety precautions</td>
</tr>
<tr>
<td>0.001</td>
<td>1</td>
<td>Safe: Short-term habitation only</td>
</tr>
<tr>
<td>0.0005</td>
<td>0.5</td>
<td>Safe: Medium to long term habitation</td>
</tr>
<tr>
<td>0.0002</td>
<td>0.2</td>
<td>Safe: Long-term habitation (normal levels)</td>
</tr>
</tbody>
</table>

Source: Before it’s News, 2013

Figure 5: Effects of radiation on the human body

Source: Apex, 2017

According to Liebenberg, “gold and uranite appear to vary sympathetically, i.e., although they occur in individual grains, they tend to occur together and to be distributed together […] This manner of distribution is also true for other heavy minerals, such as zircon, chromite,
monazite, and ilmenite (now changed to Leucoxene), which tend to follow the gold and uranite in their distribution.” He notes the following correlations: “[…] a very close correlation between gold and silver; a close correlation between gold, silver, and uranium; and a significant correlation between uranium and zirconium, uranium and chromium […]” (Liebenberg, 1972, pp. 372-374).

In the refining of gold, “any matte or slag formed is crushed and sampled separately. In addition to assaying materials for gold and silver, certain chemical components are determined, particularly those which are important to subsequent furnace operations. Among them are silica, iron, lead, alumina, calcium oxide, copper, zinc, sulphur and arsenic.” (Rubidge, 1972, pp. 178-255) Other by-products of gold are sulphur, copper, iron, lead, platinum group metals and arsenic (Rubidge, 1972).

Before 1950, when the first uranium processing plants were set up, most of the uranite found its way into tailings waste dumps, as did most of the arsenic and some of the lead, copper, iron and silica. R.J. Adamson, while discussing the disposal of mine residues (waste), states:

In the early days of gold mining in South Africa, the disposal of waste rock cyanide sand and slime, surplus mine water and discarded solutions presented little if any difficulty, there being more than sufficient unused land near the reduction works to accommodate these residues and effluents. However, the outlook has since altered considerably owing to the establishment of industrial zones in the neighbourhood of many mines and of agricultural development in other mining districts. It is, therefore, necessary not only to secure adequate disposal areas to cover the requirements of each mine for its full life but also ensure that suitable measures are taken to prevent residues from encroaching beyond the limits set and also to prevent pollution by dissolved solids in any run-off from the mine. While it is obviously advantageous to have the sites as close as possible to the treatment plant to minimise pumping costs, it is obviously necessary to move further afield either owing to lack of suitable terrain adjacent to the plant or to the proximity of townships, industrial zones, water courses, roadways or electric power lines. Also, preference should be extended to the utilisation of poor farming ground rather than highly cultivated land. However, it is a sine qua non that sufficient surface area for dumps and dams must be made available, and at economical rates, if the mine is to fulfil its function as a gold producer. (Adamson, 1972, p. 152)

The current researchers found:

• The calculated geographical location of ‘townships’ near mine waste facilities such as tailings dams, or alternatively the deliberate siting of tailings dams near townships;
• The deliberate location of industrial zones near mine waste facilities;
• The deliberate location of mine waste near rivers and water sources, and lately the allocation of mining licences for catchment areas of important rivers;
• Extensive spillage from mining operations and mine waste facilities into streams, wetlands and rivers; and
• The allocation of mining licences for areas in which a 500m exclusion zone would be impossible, such as near major roads, railway lines, housing, a school, electric power lines, and petroleum and water pipelines. In fact, Meadowlands, Riverlea, Davidsonville, Reigerpark, and Delmorpark are all townships where housing is located without any regard for exclusion zones.

Clearly, the mining industry and government have scant regard for the dangers mentioned as early as 1972 by Mr Adamson of the Chamber of Mines.

4.1.5 Proximity of human settlements to tailings in Soweto and mining consultation

The proximity of human settlements to tailings in Soweto is a recurring theme in this research. The following is a pictorial summary showing this proximity. The tailings are coloured in yellow. Tailings 1 is 140m, tailings 3 is also 140m, and tailings 5 is 240m away from the residential areas, showing a complete disregard for the prescribed exclusion zone of 500m. A more detailed exposition of the proximity of human settlements to tailings is provided below.

Map 9: Proximity of human settlements to tailings in Soweto

Source: NWU, Potchefstroom Campus, Centre for Environmental Management (CEM), 2014
Maps 10 and 11: Tailings measurements of exclusion zones - Diepkloof and Riverlea

Source: NWU, Potchefstroom Campus, CEM, 2014
4.1.6 Mining consultation, dust, ‘security’, radioactivity and the consequences of keeping the public in the dark

It is common that mine tailings waste facilities (TWF) are unguarded, unfenced and not properly signposted. When there are warning signs, these are often inadequate and misleading. There is also no attempt to educate near-mine communities about the dangers posed by derelict, abandoned and ownerless mines. The following graphs depict the frequencies of how often the mines consult with the researched communities and an indication of how important the community residents feel that this communication is.

**Graph 2: How often do the mines consult the community?**

**Graph 3: How important is it for the mine to consult with communities?**

The Soweto campus of the Johannesburg College of Education is nestled in between two major tailings dams, both of which belonged to the once most productive and profitable mine in the world, Crown Mines.
Photo 8: A typical dust bucket, Riverlea

The college took over some of the buildings and housing that once belonged to Shaft 17, Crown Mines. Less than a decade later, the National Nuclear Regulator (NNR) condemned the establishment of the college in an area that is too radioactive. Both dumps contain large quantities of uranium and other heavy metals. To live and learn there poses a health risk.

At the entrance, just past the security gate, there is a dust bucket on a pole. A dust bucket serves to accumulate dust for the purposes of analysis to determine air quality near its location. The researchers asked the security guard about the dust bucket. They asked, “Do you know what the bucket is for?” “Yes!” he answered confidently, “These white people are very clever. They put that bucket there, and it catches all the dust from these dumps so that no dust will reach us!”

At Robinson Lake a few years ago, a TV crew asked the security guard if he knew what the ‘Radioactive’ sign meant. He responded on air: “It means that I am in radio contact with my control room!”

Photo 9: Dust storm sweeping through Diepkloof (October 2015)

A mine worker was asked if he knew what the “toxic do not drink” water sign meant. He responded that it was not OK to drink the water using a cup. Levels of illiteracy among mine workers remain high. Mine signage, which is supposed to protect employees and members of the community, often serves only to confuse them, as illustrated above. Health and safety education provided by corporations leave a
lot to be desired, and workers in mines work in radioactive environments without protective gear and no education about radioactivity.

A former employee who worked for a subcontractor on the Mooifontein tailings disclosed in an interview that they were not informed about the presence of uranium, arsenic, lead, cadmium, copper, sulphur, mercury or cyanide in the mine waste they were working on and the protective gear was wholly inadequate. Negative mine impacts do not end at the fence because the wind blows mine dust through the fence and into neighbouring communities and neighbouring farmers.

*Photo 10: No entry signage*

The sign above is found where mine seepage flows into the Booysens River. The Bench Marks Foundation research team regularly tests water for Total Dissolved Solids (TDS) and acidity, noting that the United States Environmental Protection Agency (EPA) sets the upper limit for safe drinkable water at 500 parts per million. At all the testing points, the team regularly found the TDS levels to be much higher than this upper limit, and often higher than 2500ppm.

*Photo 11: Metered reading for total dissolved solids*

This measurement was taken where mine seepage flows into the Booysens River, showing 3470ppm.
The Bench Marks Foundation research team has on numerous occasions found children, youth and adults, swimming in tailings evaporation ponds, playing on tailings, quad-biking on tailings, stripping hijacked cars at abandoned tailings, or worshipping on or near tailings. Tailings facilities, even though they contain uranium and other heavy metals, are generally unmaintained, unsecured, unfenced and not signposted. The mining best practice rule of exclusion zones of 500m is generally ignored. This rule is insisted on by environmentalists, health practitioners and mining experts, with some recommending a distance of 2 000 meters as acceptable (Gauteng Province Agricultural and Rural Development Department, 2012, p. 30).

Photo 12: Teenagers playing on the Diepkloof tailings dam
The above photographs indicate the various recreational activities that take place on and around the tailings. At a meeting with managers in the scrap metal industry on 14 September 2011 at the Killarney Club in Houghton, the NNR defined the responsibilities of licence holders of nuclear waste facilities:

As a principle, the South African Regulatory Framework requires that the primary responsibility for ensuring radiological protection of the health and safety of the workers, members of the public as well protection of the environment rests entirely with the holders [of] or applicants for a nuclear authorisation and extends in an unbroken chain through management to the workers of that facility. (NNR, 2011, p. 12)

The NNR, those who abandoned radioactive dumps, and local governments and property developers, therefore, seem to be currently (and historically) remiss for locating low-cost housing near radioactive mine-waste facilities. However, it turns out that the licence or certificate of registration applies only to mine waste ‘on site’ and not waste ‘off-site’. It
appears that the Department of Energy and the DMR now recognise that the concept of ownerless abandoned mine tailings is not adequately covered by legislation, and in this regard, legislation is in the process of being passed. The biggest contributor to the solid waste stream in South Africa is mining waste (77%), followed by pulverised fuel ash (8%), agricultural waste (6%), urban waste (5%) and sewage sludge (4%) (Institute of Waste Management Southern Africa, 2017). As has been seen in the past, good legislation that is not applied through effective control and regulation is not worth the paper it is printed on. According to the same presentation, the radioactive materials, processes and sites monitored by the NNR include:

Material (irrespective of whether processed or not)
- that contains no significant amounts of radionuclides other than naturally occurring radionuclides; and
- is designated by national law or by a regulatory body as being subject to regulatory control because of its radioactivity.

Note:
- Regulatory control as a practice includes the option of exemption.
- Regulatory control may also mean control of an existing exposure situation.

While NNR regulatory activities include:
- Prospecting, mining and processing of uranium, thorium, gold, copper, heavy minerals, phosphate rock and fertilisers production;
- Clearance of sites contaminated with Naturally Occurring Radioactive Material (NORM) residue;
- Recycling of scrap material (i.e., ferrous and nonferrous metals, plastic, stainless steel, etc.) that is contaminated with NORM residues;
- Conducting tests in laboratories on small quantities of NORM samples for verification of proposed and existing actions, (including samples from prospecting activities).
- Some service providers authorised to clean-up (sic) identified sites contaminated with NORM residue.

To this end the NNR is responsible for the following authorisations:
- Mining and mineral processing facilities;
- Scrap processors;
- Scrap smelters;
- Fertiliser manufacturing;
- Service providers; and
- Small users (NNR, 2011).

In 2005 the DMR undertook that:

Government shall within five years following approval of this policy, establish a Radioactive Waste Management Fund (RWMF) by statute. The funds paid into the RWMF shall not be
subject to tax. In keeping with the *polluter pays principle*, the contributions to the fund will be from the generators of radioactive waste. The contributions shall be managed equitably without cross-subsidisation and amongst others, be based on classification of the waste as well as the volumes. The purpose of the fund shall be to ensure that there are sufficient provisions for the long-term management options for the various waste forms. (Department of Minerals and Energy, 2005, p. 22)

In the National Radioactive Waste Disposal Institute Act, 53 of 2008, mention is made in Section 21 of an RWFM in terms of which an Act must be promulgated. Funds of Institute 21:

The funds of the Institute consist of:

- money received from waste generators on a cost recovery basis for services rendered in terms of this Act;
- money appropriated by Parliament; and
- money transferred to the Institute from the RWMF that must be established by an Act of Parliament.

It is unclear whether this fund ever came into existence through a motion adopted by an Act of Parliament.

4.1.7 Waiting to inhale... asbestos fibres, radioactive dust and arsenic

Black township housing development has historically comprised the erection of low-cost housing. The white minority was not ‘comfortable’ with the black majority becoming urbanised during colonialism and apartheid. This meant that township or location development always occurred on the least economically viable, most compromised land and that only the cheapest building materials were used. The cheapest building materials included mine tailings for mixing cement and asbestos sheet roofing. It was observed during the course of this research that most of the houses in Riverlea, and many in Meadowlands and Diepkloof, have asbestos roofing. Only the Doornkop informal settlement in Snake Park does not have an abundance of asbestos.

It was also found that respiratory problems such as coughing, asthma, sinusitis and hay fever cumulatively represent the biggest health challenge in the households surveyed. This could be attributable to mine dust containing arsenic, silica and uranium. It could also be the asbestos roofing or the fact that many houses are simply constructed in flood plains and swamps, meaning that they are constantly damp and freezing in winter. Thus, in Riverlea Extension (also referred to as ‘Zombie’) many residents live on oxygen machines, and in houses that are damp because of the nearby Booyens Spruit, which in the rainy season floods right up and across Sand Street to people’s front doors. The area is also dusty because of the windblown tailings dust from Mooifontein tailings. The asbestos roofs of their houses could also be part of the problem.
DRD/ERGO claims that the residents burn coal and paraffin, but all the houses in Riverlea have had electricity since 1984 and the current researchers found the negligible use of paraffin or coal in Riverlea.

The above graph shows the predominance of electricity use over coal and paraffin in Soweto households. On 11 October 2000, some five years before the total ban on asbestos, the Land and Environmental Affairs Select Committee of Parliament, and the National Council of Provinces hosted a “Briefing by the Asbestos User Group and Environmental Quality and Protections (Department of Environmental Affairs and Tourism)”, at which Ms R A Ndzanga
ANC Gauteng) mentioned that during a visit to Botswana she was told that all houses roofed with asbestos products had to be replaced, but all the houses in Soweto still had their asbestos roofs. Mr Gibson, on behalf of the Asbestos User Group, then added that:

The Summit did recommend a ban be put on all asbestos and asbestos-based products except white asbestos, and this ban was immediately implemented. This ban becomes problematic however when low-density applications of asbestos (i.e., those collected and reused from dumps) are removed because the act of removal releases asbestos dust which causes more harm than the product itself. He stipulated that high-density applications of asbestos, which are used in townships [...] cause no risk to occupants. (NCOP User Group and Environmental Quality and Protections, 2000, p. 1)

This begs the question of why it was not widely used to roof houses in white suburbs during apartheid. Mr Gibson made the following startling admission, saying: “Everite knew the risks associated with asbestos in the mid-1960s but did not develop a program dealing with education, dust control, health surveillance and research/development until the mid-1970s.” (NCOP User Group and Environmental Quality and Protections, 2000, p. 2) There is a global agreement that no asbestos, regardless of colour, is good asbestos. The only countries that, until recently, tried to sell the idea that white asbestos was better than blue asbestos were Zimbabwe, Canada and South Africa.

Dangers in the dust: Inside the global asbestos trade

“Dr Vincent Cogliano, of the WHO's International Agency for Research on Cancer says: ‘My own personal view is that these risks are extremely high. They are as high as just about any known carcinogen that we have seen, except, perhaps, for tobacco smoke. Any exposure is going to prolong the asbestos epidemic - continued export and continued use of chrysotile will increase the incidence of lung cancer and mesothelioma for many decades to come’, he said.”

“At Janice’s hospital in Montreal, Dr Dick Menzies has signed a letter telling the government there is an 'overwhelming scientific consensus' that white asbestos use must end. He is just one of many prominent physicians, academics and others who have besieged the federal and provincial governments with letters of protest.”

“The WHO says 125 million people encounter white asbestos in the workplace, and the International Labour Organization (ILO) estimates that 100,000 workers die each year from all asbestos-related diseases.” (Morris, 2010)

The authorities and industry were, therefore, aware of the risks of asbestos in the 1960s but continued using asbestos extensively in townships. Riverlea came into existence in 1964, and Riverlea extension, surveyed in this report, still has 97% asbestos roofs in 2017, Diepkloof has 66.3%, and Meadowlands 53.3%, thirteen years after the use of asbestos was totally banned in 2005. Could this be ascribed to an economic system that values life by class and race, and
the need for cheap labour and the maximising of profits? Surely, residents of these communities have room for litigation against the asbestos industry and authorities for failing their Constitutional right to a healthy and safe environment?

In 1987 the South African Labour Development Research Unit (SALDRU) wrote: “In South Africa and other countries workers are still being exposed to asbestos at levels which have been scientifically demonstrated to be unsafe. The current position in the scientific community and in governments like that of the United Kingdom (UK) is that there is no safe threshold for asbestos exposure where lung cancer excess is preventable.” (Aron & Myers, 1987, p. 5)

*Figure 6: The workplace hazards of dust*

Source: Hazards Magazine, 2011
The problem in South Africa is that, even after banning asbestos in 2005, there are still authors who argue that the asbestos exposure in Soweto is ‘not so bad’. “The airborne asbestos fibre concentration in and around Soweto is low (the methodology included ‘61 houses that were chosen by convenience sampling’)” (Philips et al., 2007, p. 3). Or, as the 1987 SALDRU paper so accurately puts it, in support of the notion that there is no safe level of asbestos exposure:

Many people worked at high exposures for short periods only, or at low exposures for long periods. Their doses of asbestos have been close to, and generally lower than, those doses permitted by current standards regulating exposure to asbestos in the advanced countries. Despite this low level of exposure which is assumed by the industry to be safe, these people have already been shown to have developed excess asbestos related disease after sufficient time had elapsed for the effect of the latency period had come into operation. (Aron & Myers, 1987, p. 9)

The same principles apply to residents in dwellings with asbestos roofs. Accepting the principle that no exposure to asbestos is acceptable, Philips et al. (2007) would have been better advised to investigate the health profiles of the residents occupying the houses in and around areas where the asbestos fibres were ‘low’.

Many scientists argue that there is no such a thing as safe radiation exposure. The other unfortunate fate to befall the African majority, which also happens to make up the bulk of the labour force in Gauteng and the Witwatersrand, is that they had no say in the location of their housing and had, due to colonialism and apartheid, lived in racially segregated locations and townships. These were, as in the case of Soweto, often located near toxic, radioactive mine waste and dumps. All the arguments made about asbestos above might be made in relation to uranium and uranium-containing mine dumps. So, the challenge for any household survey is to determine which of the many possible variables are responsible for the poor health status of residents.

Coming to the question of radioactive mine waste, David Fig asks: “How should the government respond when most of the old gold mining companies have left or gone out of business without dealing with their pollution legacy?” (Fig, 2011, p. 1) It is an interesting question, given that the regulatory guide *Interim Guidance on the Management of NORM Tailings and Waste Rock* developed by the NNR does not once mention the words “exclusion zones” or “safety zones”. Nowhere in the NNR document does it make any recommendations or suggestions about the location of tailings or rock waste facilities in relation to housing, infrastructure, schools, social facilities, etc. The document does refer to the fact that “the controls should include: monitoring, surveillance, remedial work (if necessary), water diversion and treatment, maintenance of fences, controlling land use and erecting sign postings and warnings” (NNR, 2015, p. 11). However, this research team has yet to find a
single tailings waste facility that is secured, fenced off, properly signposted or even monitored along the mine waste belt that rings Soweto to the West, North and East.

Elna Fourie notes that the International Commission on Radiological Protection (ICRP) defines the justification of a ‘practice’ by stating that “no practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes” (Fourie, 2009, p. 3). It is not clear what benefit the residents of Soweto derive from the radioactive mine dumps on their doorstep.

“\textit{The gold ores of the Witwatersrand contain appreciable concentrations of uranium and its radioactivity progeny. Mining has resulted in the dispersal of radioactive progeny. Mining has resulted in the dispersal of radioactive material into the environment via windblown dust, waterborne sediment and the sorption a precipitation of radioactivity from water into sediment bodies.}” (Department of Minerals and Energy, 2008)

As noted above, uranium breaks down into radon gas. In the United States (US), radon gas is the second highest cause of lung cancer. In America and Europe people regularly test their houses for radon exposure, but this is not the case in South Africa. Long-term exposure to radon can lead to lung cancer, which is the only cancer proven to be associated with inhaling radon, according to a health specialist at the Cancer Association of South Africa, Professor Michael Herbst (Ismael, 2016).

Radon was classified as a human carcinogen by the International Agency for Research on Cancer in 1988 (IARC, 1988) after several studies found that miners occupationally exposed to radon, usually at high concentrations, demonstrated a notably increased risk of lung cancer. According to Herbst, recent research had focused on specifying the effect of residential radon on lung cancer risk. In these studies, scientists measured radon levels in the homes of people who had lung cancer and compared them to the levels of radon in the homes of people who had not developed lung cancer. Despite the location of thousands of low-cost township and location houses near and sometimes on mine waste, radon is never measured in these houses (Ismael, 2016).

5. **HISTORY OF SOWETO – THE FLIPSIDE OF THE HISTORY OF JOHANNESBURG**

This section of the history of Soweto includes the interface of geology, health, economics, politics and mining in the development of a township (mining and the location of townships – the geopolitics of colonialism and apartheid). The following comment was made by Ambrose Pratt, an Australian journalist, after visiting Johannesburg in 1910:
There are classes in South Africa, but amongst the whites at least there are no masses. The caste system which has replaced the older institution of slavery has effectually compelled even the poorest of wage earning whites to join forces with the plutocrats in a tacit conspiracy of cooperation to maintain their pride of race and to prevent the social elevation and political emancipation of the blacks. [...] Millionaires and mechanics view the Negro through cognate sets of spectacles. The millionaire wants plenty of unskilled cheap labour. The mechanic wants a monopoly of the skilled labour market and, being lazy, he also wants cheap black industrial valets to perform the rougher portions of his work.

5.1 Early discovery of gold in South Africa and on the Rand

Among members of the public, there is the mistaken view that mining in South Africa commenced with the ‘discovery’ of diamonds at what became Kimberley in 1869 and gold on the Rand in 1886. Contrary to this belief, the country is replete with archaeological evidence that mining occurred here as far back as 1800 years ago. Apart from numerous mines, some of which were being successfully reworked, ruins of stone buildings have been found in several hundred distinct places. Few of these have been explored systematically, but investigations in 1905, though confined to a small number of sites, determined at least the main questions of date and origin (Pike, 2017).

The fanciful theories of popular writers, who had ascribed these ruined Iron Age cities to remote antiquity, and had even been so audacious as to identify their founders with the subjects of King Solomon or of his contemporary, the queen of Sheba, were seen to be untenable. The book by J.T. Bent, Ruined Cities of Mashonaland (1892), was by then interesting only for its illustrations; his theories regarding King Solomon were obsolete. Positive archaeological evidence demonstrated that the ‘Great Zimbabwe’, the most famous and the most imposing of the misnamed ‘Ruined Cities’, was not built before medieval times (Pike, 2017).

The Iron Age archaeological sites of Mapungubwe, K2, Leokwe and the Schroda site in the Mapungubwe National Park in South Africa, and the Mmamagwe site in Botswana are among the best-studied Iron Age sites in southern Africa. They represent the Zhizo, K2 and Mapungubwe Iron Age cultures that existed in this region roughly between 600 and 1300 AD. Small Iron Age sites post-dating this period have also been recorded in the area, including stonewalled sites on hilltops and Khami-type ruins (Pike, 2017). Mapungubwe is renowned for its golden rhino and is believed to be the precursor of Great Zimbabwe, the most remarkable Iron Age site in southern Africa. The Mapungubwe landscape was proclaimed a World Heritage Site in July 2003. Other important archaeological sites are at Toutswe Mogala and Mmamagwe in Botswana. Several sites are also situated on Sentinel Ranch and Mapela Hill in Zimbabwe.
At several archaeological sites, such as Mapungubwe and Thulamela in the Limpopo Valley, there is evidence of sophisticated political and material cultures, based partly on contact with the East African trading economy. These cultures, which were part of a broader African civilisation, predate European encroachment by several centuries. Settlement patterns varied from the dispersed homesteads of the fertile coastal regions in the East to the concentrated towns of the desert fringes in the west. The farmers did not, however, extend their settlement into the western desert or the winter rainfall region in the south-west. These regions remained the preserve of the Khoisan until Europeans put down roots at the Cape of Good Hope. Currently, aided by modern science in uncovering the continent’s history, which forms part of the African Renaissance, South Africa is gaining a greater understanding of its rich pre-colonial past (Pike, 2017).

Even before the 1886 discovery of gold on the farm Langlaagte, attributed to George Harrison and George Walker, there had been extensive prospecting and panning for gold around the Witwatersrand. In fact, the history of mining by European colonists and settlers can be traced back to 1853 (Gray, 1937, p. 15). However, the pre-colonial residents who resided on Melville Koppie (hill) and those who lived in the hills to the South of Alberton, where Meyersdal is located, mined and smelted iron possibly for several centuries prior to 1886.

Photo 15: Ruins of Iron Age Settlement South-East of Alberton

The area indicated above received no protection from the South African Heritage Association when property developers decided to create a gated golf estate. In 2004 this area was summarily bulldozed and turned into a gated complex for the rich with the approval of the ruling party and government of South Africa, with the full complicity of the South African Heritage Association. Like black lives, black history does not count for much in South Africa – both are trumped by profits.
5.2 The gradual evolution of Soweto, a matter of ‘civilisation’, ‘hygiene’, ‘cleanliness’, cheap labour and profits

The history of Soweto is closely associated with the demands of the South African economy for cheap labour and the racial division of labour, which evolved because of the evolution of colonialism and apartheid. The white population of South Africa practised slavery from 1652 to 1834 (Watson, 1990) and then, as the Voortrekkers (the people who trekked from the Cape to the North of the country) moved into the interior, they practised forms of servitude approximating slavery. The labour needs of mining towns such as Johannesburg meant a dependence on cheap black labour.

The Mining Industry in the Transvaal is built upon the basis of cheap native labour for unskilled work. If European workmen on the mines refuse to support that policy, they will be cutting their own throats, because good wages to European workers on the Witwatersrand for skilled supervision work, and reasonable wages for semi-skilled work at which a man can learn to become a skilled miner, have been possible only because the rough unskilled work has been done by imported indentured native labour and local black labour. (Transvaal Chamber of Mines, 1927, p. 58)

The racial division of labour would lead to the racial segregation of living spaces and eventually the evolution of Soweto. Thus, even before the discovery of gold in Johannesburg in 1886, the municipal ordinances of the town of Potchefstroom in 1884 determined that the town council was obliged to build a location for the black population (Shorten, 1966). The western area (West Rand) of what was to become Johannesburg and the Witwatersrand, fell under the magisterial district of Potchefstroom, while the area that would become the East Rand fell under the Heidelberg District (Gray, 1937).

In October 1887, less than a year after the discovery of ‘payable gold’, mine bosses complained about the shortage of black labourers, who earned eight shillings per week on the Rand. This complaint was repeated endlessly in one report after the other. The various means through which labour was attracted to the Rand gold mines, where they were housed in compounds in often primitive conditions (Shorten, 1966), included hut tax, poll tax and labour tax. One government report in 1903 openly said that the taxes were specially designed to “force Natives to work in the towns and on the mines” (Callinicos, 1980, p. 28). Later the Pass Laws and the 1913 Land Act added to the pressure.

Before 1897, the responsibility for the control of “natives in the streets” was the responsibility of the Sanitary Committee, the precursor of today’s City Council. Initially, no provision was made to accommodate ‘natives’. In 1897 the wages of African mine workers fell dramatically, forcing many to move into the ghetto areas of Johannesburg. A year later the Anglo Boer War broke out, causing many African workers to leave the Rand (Van Onselen, 1976, pp. 86-87), and few returned after the occupation of Transvaal by the British army. The
wages of African workers fell even further, leading to a shortage of unskilled labour on the mines. Indentured Chinese labour was imported briefly to meet the demand for labour (Walker & Weinbren, 1961, pp. 16-17).

After 1897, the local government was empowered to make provision for the accommodation of black South Africans. To finance the housing for the ‘native’ population, blacks were required to pay head or hut tax. However, the collection of the taxes was inefficient, with the consequence that the housing development lagged. In the early town planning for Johannesburg, plots were set aside for so-called ‘Coolies and Arabs’ to the West of the central business district. Blacks soon settled in between the coloured and Indian Communities. Soon the area set aside was deemed unhygienic. Overpopulation, slum conditions and disease soon became commonplace in the area, which is now known as Newtown. The population of the area was composed of all races but was predominantly black African (Shorten, 1966, p. 755).

Map 12: Johannesburg ‘Kaffir’ and ‘Coolie’ locations (1898)

Source: Kennedy, 1984, p.34

Because of the 2\textsuperscript{nd} Anglo-Boer War, many blacks left the Witwatersrand, and the ensuing shortage of labour led to the import of indentured Chinese labour in the boom that followed the war (Special Committee, 1906, pp. 11-12). The Chinese workers were viewed with great suspicion by local farmers and traders and were accommodated in concentration camp-like conditions (Special Committee, 1906, pp. 11-12). The Special Commission appointed to inquire into the control of Chinese indentured labour in the Witwatersrand district found that:
the main factors in the matter of control of labourers under the Labour Importation Ordinance of 1904, the Labour Importation Amendment Ordinance, 1905 and the Regulations issued thereunder:- (1) The provision, according to law, that labourers cannot be transported from one importer to the other without the consent of the Lieutenant-Governor being first had and obtained; (2) the provision that every labourer should carry on his person the document known as the ‘Identification Passport’ (metal ticket); (3) the provision that labourers should reside on the mine premises on which they are employed, and that they should not be allowed to trade, or acquire, lease or hold land; (4) the provision that the labourers must be provided with permits to be issued by the importer or his representative in case they are absent from the said mine premises; (5) policing and (6) mine supervision and control. (Special Committee, 1906, p. 4)

These restrictive controls on ‘foreign’ mine labour would eventually be generalised to turn even ‘native’ South Africans into foreigners in their own land as the system evolved towards apartheid. Africans were needed in the towns and cities for their labour, but they were not wanted as co-inhabitants, given the racial attitudes of the white ‘European’ populations of these towns and cities.

The Chamber of Mines was formed for the purpose of controlling and setting African labour wages, and to end the competitive wage environment by creating a monopolistic employer organisation that would set wages and stop the free movement of labour between different mining companies based on wages and competition for cheap labour.

One of the main problems that necessitated an organization like the Chamber of Mines was the supply of native labour to the mines. This problem became one of the initial aims of the organisation...The periodic shortages every year introduced strong competition between companies resulting in increased costs, and in 1898 the average wage spiralled to 15/- [fifteen shillings – fifteen Rand in today’s currency] per week. Managers now saw the need for cooperation in native labour conditions. (Malan, 1970, p. 27)

The Chamber set up a Native Labour Department in 1892, which in turn gave rise to the ‘Witwatersrand Native Labour Association’ (WNLA). Apart from legislation and taxes, alcohol was a powerful tool in the recruitment and retention strategies of the WNLA, as F. Perry, a former chairman, noted about Mozambican mine workers in 1906 (quoted in Van Onselen):

They brew themselves many kinds of native spirits, and the potent liquors of European manufacture threw open to them new vistas of enjoyment. A few of them had found their way to the diamond fields. To the Witwatersrand goldfields, which were nearer to them they came in great numbers, especially after the construction of the Delagoa Bay Railway. Their earnings were not spent on cattle but on whisky and gin. Thus, a period of work, instead of supplying them with the means of settling down, only gave them a period of drink and idleness. Afterwards, they had to return to work to earn the coin wherewith to gratify their cultivated
taste. In this way, they have become nearer than any other South African races to supplying the material of an industrial, as distinguished from an agricultural population. (Van Onselen, 1976, p. 95)

Perry seems to have suggested that a typical industrial working class is one that is addicted to alcohol. In 1893 the Sanitary Superintendent of Johannesburg expressed his alarm about the increasing numbers of patients with sexually transmitted diseases, citing “several bad cases of syphilis which, owing to the absence of any place to which they could be sent, could not be isolated or treated”. Kennedy writes: “In a hard drinking town like Johannesburg, with its scores of bars and hotels, prostitution was naturally rife; probably, too, the compounds of conscripted labourers soon constituted a large reservoir of untreated syphilis [...] In any event, blacks manifested the disease in severe and acute ways to the dismay of mine doctors and municipal officials.” (Kennedy, 1984, p. 42)

African mine workers at the time had no access to public hospitals and were treated in buildings in the compounds. There were 62 such compound medical facilities on the Rand. There were no beds or nurses. The patients slept on the floor on strips of felt or hessian sacks and were attended to by male orderlies. “The hospital superintendent as often as not was an ex-non-commissioned officer of the British Army.” (Cartwright, 1962, p. 173) Black mineworkers perished in their thousands from pneumonia because they were not provided with protective clothing and often went underground half naked (Callinicos, 1987, p. 78). Emerging from the hot and stuffy, dusty underground shafts into the cold, dry winter air of the Rand made them even more prone to lung and respiratory diseases, including tuberculosis (TB) and ‘miner’s phthisis’.

Jock McCulloch writes: “In the last decade of the nineteenth-century pneumatic drills were introduced into South Africa’s gold mines. Power drills were highly efficient and increased the productivity of labour. They also generated clouds of dust, and with dust came silicosis. Drilling was a white job, and as a result, many Europeans died. Rock drillers had an average working life of only seven years and a life expectancy of barely 30.” (McCulloch, 2002, p. 117)

The complete disregard for black lives at the time was also reflected in how Africans were treated in death. L.E. Neame sketches out the circumstances surrounding the burial of black people: “Natives and coloured people were buried anywhere.” The Star newspaper, in a leading article on December 14, 1888, said:

If close upon one thousand Europeans, Americans and Australians have been laid beneath the veld at Braamfontein, how many dark-skinned corpses must have been consigned their last resting places in and around Johannesburg? It is a lamentable fact that nobody seems to know when or how these burials have taken place. Ask any of the public officials whose duty one would suppose it to be to have full knowledge of these circumstances, and he will tell you, ‘Oh,
somewhere beyond the claims on the South side of the town’; but as to the exact spot, or what name, he knows nothing. (Neame, 1958, p. 45)

Segregated space was eventually afforded to Africans in the already segregated cemetery of Braamfontein. The racial hierarchy was further entrenched through petty by-laws prohibiting Africans from walking on the pavements, and the introduction of the pass system,

[...] forcing a Native to carry a pass giving his name, trade, the name of employer, and the latter’s address, was inaugurated in 1890. The price of each pass was two shillings per month, and the object of the system at first was two-fold: (1) the money raised each month was to be utilized for the Johannesburg Central Hospital [...] (2) A check could be kept on the many Natives coming to the town, and their movements controlled. A Native found without a pass could be fined and deported. [...] The pass system with its fingerprint registration, and the compound system are likely to be a part of Johannesburg’s life as long as gold mining is done and Native labour is required. (Leyds, 1964, pp. 290-291)

*Map 13: Segregated cemetery of Braamfontein*

Local government was re-established in Johannesburg in 1902 and tasked with the administration of ‘native’ housing. However, government policy was vague, and the council’s responsibilities in this regard were poorly defined. At the time, the black African population was small and a non-permanent feature of the urban environment in Johannesburg. The council had a degree of control over the ‘health and welfare of natives’ (Shorten, 1966, p. 755). The 1904 outbreak of the ‘plague’ or typhoid fever killed off nearly 2 000 people in Johannesburg. “The Medical Officer of Health reported that this disease, too, bred more
easily where there was ‘pollution of soil and air by the present bucket system, extensive soil pollution by slops and by natives promiscuously defecating in outlying districts’.” (Callinicos, 1987, p. 79) The outbreak of typhoid was used to justify the cordoning off of the Malay and ‘Kaffir’ locations and the relocation of their populations to Kliptown (Pimville). Both locations were burnt to the ground. In part, the housing challenge presented by black mine workers was overcome by developing a

range of measures to keep unwilling recruits in bondage and to extract most work for the least pay, food and accommodation. The compound system and all its accompanying institutions of mine ‘police’, physical violence and social control, became crucial. In collaboration with the State, a sophisticated ‘pass’ system was developed to prevent and detect ‘desertion.’ Laws such as the Masters and Servants Act were effectively used to suppress work stoppages and other forms of worker resistance. On many mines, workers were systematically cheated of their wages and forced to stay longer than the periods for which they had contracted. (Moroney, 1978, p. 32)

These measures were directly related to the policies applied to Chinese indentured labour. In the early years of Johannesburg’s history, African mine workers died in their thousands from pneumonia (Callinicos, 1987, p. 78). No one in Johannesburg was aware of the presence of uranium in the gold mines at the time, and most commentaries attributed the deaths to temperature differences in the underground workings and the surface when workers changed shifts, or to the tropical origins of central and East African migrants, or to the scanty clothing these workers wore while at work during this time (Cartwright, 1968). This is despite the fact that the US Naval Medical Research Institute had identified pneumonia as a possible symptom of radiation exposure.

The policy for the management of black residents and workers in urban areas took shape at this time with Lord Alfred Milner as High Commissioner presiding over South Africa until the establishment of the Union of South Africa in 1910. In 1905 Howard Pim, one of Milner’s key advisors on ‘native’ administration and urban planning, summarised the thinking of the time that would give rise to the racially informed urban division of space in colonial and apartheid cities:

Let us assume [...] that the white man does turn the native out of one or more of his reserves [...] the native must live somewhere. We will suppose that he is moved into locations attached to the large industrial centres – a theory of native management which receives much support. [...] In the location he is more closely huddled together than he would be in his own country and finds [...] himself in surroundings in which his native customs have no place, and he is compelled to purchase from the white man food which in his own country he raised for himself. What the white man gains, therefore, is little more than the labour required for the food which under natural conditions the native raised for himself. For a time, the location consists of able-bodied people, but they grow older, they become ill, they become disabled – who is to support them? They commit offences – who is to control them? The reserve is a sanatorium where they can
recruit; if they are disabled, they remain there. Their own tribal system keeps them under discipline, and if they become criminals there is not the slightest difficulty in bringing them to justice [...] (Marks & Trapido, 1979, pp. 71 - 72)

The objective spelt out here was to keep the ‘native’ population out of the ‘white’ cities as far as possible, except as labour, and to externalise the cost of moving ‘native’ labour to rural ‘reserves’ or the later homeland/Bantustans. A part of this process would be to make the cities as inhospitable as possible by denying the black population access to land/property, decent housing, a living wage or economic opportunities other than labour. Lord Milner, in 1903, summed up the unfolding policy as follows:

Our welfare depends upon increasing the quantity of our white population, but not at the expense of its quality. We do not want a white proletariat in this country. The position of the whites among the more numerous black population requires that even their lowest ranks should be able to maintain a standard of living far above that of the poorest section of the population of a purely white country. [...] However, you look at the matter, you always come back to the same root principle – the urgency of that development which alone can make this a white man’s country [...] one in which a largely increased white population can live in decency and comfort. That development requires capital, but it also requires a large amount of rough labour. And that labour cannot to any extent, be white [...] (Marks & Trapido, 1979, p. 66)

Among other things, a “life of decency and comfort” no doubt meant that the white population of Johannesburg could not live downwind of the mine slimes/tailings, or downstream of the water pollution emanating from the mines, or the sewage from the city; hence the black townships of Johannesburg were all located topographically lower than the white city and its lush suburbs, downwind from the mine tailings and the ensuing toxic dust and downstream from the mine-polluted rivers flowing off the ‘Rand’.

In Johannesburg, the evolving policy received a push with the outbreak of the plague in 1903, and in the ensuing panic, it was argued that preventative measures against the plague would require the eradication of rats from the city, which would have been impossible without erasing the slum areas. Consequently, a zinc fence was erected around Newtown and the area was burnt to the ground. Most of the Newtown residents were relocated to temporary housing in Klipspruit (Pimville), where the Johannesburg City Council erected wood and zinc shacks, thus creating the conditions for a new slum (Kennedy, 1984).

J. Howard Pim, the deputy mayor of Johannesburg in 1905 epitomised white attitudes towards the black population at the time. He declared: “The simple truth is that there is going on, side by side in the negro people, a minimum progress with a maximum regress; or, in other words, an awakening in the minority of them, with an increasing degradation of the majority [...] the best of the Whites and the best of the Negroes seldom live in anything like close proximity.” Pim then claimed that it was the duty and responsibility of the white man to
discipline and teach “the savage […] as a child is taught” the virtues of civilized existence through “technical education, forced labour, slavery […] it seems to me the only hope” (Kennedy, 1984). Thus, Pim justified the forced removal and relocation of blacks on the grounds that they were a bad influence on poor whites, and that he was repelled by the prospect of racial mixing and the consequent moral degradation.

The overcrowded and underserviced, poverty-stricken conditions the African workers found themselves in in Johannesburg left them weak and vulnerable to disease. When the great flu epidemic from Europe hit South Africa in 1918, thousands of people, especially black working-class South Africans perished. Whites in the middle-class suburbs of Johannesburg panicked and responded, demanding the removal of slums from the city and further racial segregation (Callinicos, 1987, pp. 79-80). Instead of dealing with overcrowding in the city, overcrowding was shifted to new high density (overcrowded) townships, which would later amalgamate into Soweto.

From 1910 to 1920, the black population of Soweto increased threefold, from the 96 000 (approximately 92 000 men and 4 000 women) of 1910. Slum conditions rapidly spread, with the flu epidemic of 1918 adding further stimulus to segregationist policies and the establishment of the Western Bantu Township between 1918 and 1921 with the erection of 300 houses. However, the segregation occurred at a ‘snail’s pace’ because the colonial government made black workers pay for the ‘sub-economic’ housing in the townships through hut and poll tax.

In 1923 the Native Urban Areas Act came into force, giving local governments the power to launch housing schemes for black workers. At the time, the Johannesburg Council applied for a loan of £200 000 to build houses for whites. The Housing Board argued that the urgency for subsidised housing for whites was insignificant in comparison with the urgent need to segregate and house blacks properly. The city health inspector, Dr Charles Porter, inveighed with the council to eradicate the slums in the city, adding that public health would be greatly improved if location housing was provided for blacks, thereby separating them from the suburbs in which poor whites were residing.

The pace at which sub-economic housing for blacks in segregated locations was built was extremely slow. In the 26 years between 1901 and 1927, only 1 585 houses were built. According to estimations at the time, 80 000 black workers were without housing in 1927. One reason for which the pace was so slow was because the law, in the form of the evolving ‘Colour Bar’ (Davenport, 1991, p. 510), prohibited black workers from the building trades and bricklaying. There were only allowed to mix cement. The Johannesburg housing schemes for black residents occurred under contracts that required skilled labour that could be carried out only by high wage white workers. This drove up the cost of housing for blacks and, moreover, inflated the monthly rentals paid by black household heads.
In terms of the original legislation (the law was frequently amended), Africans could be forced to reside in locations or compounds, but the councils had to provide the land where Africans who were ‘legitimately’ in the area of the council’s jurisdiction could settle (Shorten, 1966, p. 390).

The Johannesburg council began forcibly removing Africans from the city but suffered a setback when the High Court ruled that Africans could not be forcibly evicted from houses that they resided in before alternative, approved housing was made available to them. Given the prevailing racist attitudes of the time, the city council made available only the worst and least valuable land for the purposes of African and coloured housing, that is, the land closest to and downwind of the mine waste dumps along Main Reef Road. The city created and expanded the Wemmerpan ‘Bantu Hostel’ for African men and created the ‘Eastern Bantu Location’ while expanding the ‘Western Bantu Location’.

On 1 May 1927, the City of Johannesburg created a Department of ‘Native Affairs’, which built 850 houses in the next two years in the Western and Eastern ‘Bantu’ Locations. One of the aims of the Native Urban Areas Act of 1923 was to “control the flood of Africans into the cities”. This objective failed because the council could not keep up with the demand for housing and by 1930 informal settlements in Sophiatown, Newclare, Martindale, Prospect and the Muslim location were regarded as health risks by the city council (Shorten, 1966, p. 390).

Although Pimville had been established in the first decade of the 20th Century, in the 1920s the city council decided to create a ‘model township’, 18km South-West of Johannesburg that would accommodate 80 000 people. The ambitious plans included shopping centres, a community hall, a hospital, a police station, a central post office, a fire station, 10 schools and 10 churches.

Building started in 1931, and four years later 3 000 houses had been completed. In 1936 another 4 000 houses followed. Between 1933 and 1939, 135 000 rural peasants, driven by the pressure of land shortages and the tax demands of the colonial government, sought work in the mines. This represented a 50% increase in African labour in the industry. With white men enlisting to fight in World War 2, many other African workers, deterred by low mining wages, were attracted to the rapidly expanding industrial sector. Wages consequently increased by more than 50% during the war (Pallister et al., 1987, p. 38).

Despite the claims by the city officials that the removals of blacks from the suburbs of Johannesburg was to eliminate slum conditions, the conditions in the townships where they were moved to left a lot to be desired, as the following table taken from the report of the manager of the Johannesburg Native Affairs Department in 1940 shows:
Table 3: Infant deaths - Pimville, Orlando and Western Township (1940)

<table>
<thead>
<tr>
<th></th>
<th>Pimville Klipspruit</th>
<th>Western Township</th>
<th>Orlando</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official Population</td>
<td>15 000</td>
<td>15 000</td>
<td>35 000</td>
</tr>
<tr>
<td>Number of drains</td>
<td>36</td>
<td>2 295</td>
<td>117</td>
</tr>
<tr>
<td>Bins</td>
<td>230</td>
<td>220</td>
<td>204</td>
</tr>
<tr>
<td>Taps</td>
<td>63</td>
<td>2 322</td>
<td>204</td>
</tr>
<tr>
<td>Houses</td>
<td>2 392</td>
<td>2 322</td>
<td>2 524</td>
</tr>
<tr>
<td>Average number of people per house</td>
<td>16</td>
<td>15.5</td>
<td>16.7</td>
</tr>
<tr>
<td>Deaths of children under 5 years old</td>
<td>210</td>
<td>68</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Per 15 000</td>
</tr>
</tbody>
</table>

Source: Callinicos, 1987

The table above shows that 210 Pimville babies died before they were one year old. In 1940, there were 229 registered births. If this figure was accurate, it meant that out of a possible 229 babies only 19 lived to see their first birthday. The main causes of infant death were pneumonia, enteritis or diarrhoea and TB. These illnesses are associated with lack of proper shelter and heating, an unclean environment and lack of potable water, overcrowding and malnourishment (Callinicos, 1987, p. 188).

Between 1939 and 1946 only 1 000 new houses were constructed because of a shortage of labour and building materials due to the war. However, the shortage of labour caused massive inward migration, causing the black population to increase to 395 231. Many informal settlements sprung up near Orlando West, Pimville and Alexandra in 1944. The ‘squatter movement’, was considered to be a major ‘health’ threat to parts of Johannesburg. The informal settlements lacked potable water, sanitation or services (Shorten, 1966, p. 792).

Meanwhile, the mines of the Witwatersrand made huge profits for their international, mainly British, shareholders, as the following table (Table 3) demonstrates. South Africa could indeed have been a wealthy country providing all its citizens with a decent standard of living had some of these ‘returns’ stayed in the country. The working population whose sweat, muscles and blood produced these results found themselves without political or labour rights, without freedom of choice or movement, and without sufficient housing.

Table 4: Crown Mines’ returns on investment (1934 – 1940)

<table>
<thead>
<tr>
<th>Year</th>
<th>1934</th>
<th>1935</th>
<th>1936</th>
<th>1937</th>
<th>1938</th>
<th>1939</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown Mines’ returns on investment</td>
<td>170%</td>
<td>170%</td>
<td>190%</td>
<td>190%</td>
<td>190%</td>
<td>190%</td>
<td>185%</td>
</tr>
</tbody>
</table>

Source: Cartwright, 1968, p. 211
A ‘controlled’ informal settlement was established in Moroka in Soweto to address the housing crisis, providing building space for 12,000 households and 68,000 people. The development included communal taps, clinics, beer halls and rubbish removal. Between 1947 and 1951 a further 5,233 houses were built (Shorten, 1966, p. 391).

By 1951 the newly-elected apartheid Parliament, finally realising that the labour Colour Bar acted as a brake on building houses in segregated areas for blacks, passed the Native Building Workers Act, with the twofold result of reducing the shortage of labour to build houses and reducing the costs of construction of the same houses (Shorten, 1966, p. 793). The Act made it legal for African workers to lay bricks and do skilled building work in designated ‘black’ areas, locations and townships.

Another factor that eased the supply of housing construction as far as the city council was concerned was the passing of the Native Services Levy Act of 1952. This law determined that employers of African labourers had to contribute a weekly levy for every African labourer for whom no housing provision was made. In this manner, £720,000 per annum became available to affect the racial and class segregation of the City of Johannesburg.

After 1954 the City of Johannesburg could construct 3,000 houses per annum in Pimville, Dube, Orlando and Meadowlands. While this kept up with the inflow of Africans into the city, it did not deal with the existing shortfall of 35,000 houses. The National Housing Commission and later the Native Housing Board sped up housing construction loans to the City of Johannesburg. In the decade between 1949 and 1959, £5,909,000 was allocated to the Johannesburg council.

The mining corporations stepped in to assist the apartheid government with the racial and class segregation of the city, following the example set by Ernest Oppenheimer of Anglo American, who in 1956 contributed £3 million towards the clearing of ‘black spots’ or slum areas occupied by Africans from ‘white areas.’ Rand Mines, Gold Fields of South Africa, Union Corporation, the Johannesburg Consolidated Investment Company, General Mining and Finance Corporation, the Anglo-American Corporation and Anglo Transvaal Consolidated Investment Company all followed suite (Shorten, 1966, p. 392). The main beneficiary of the enforced segregation and relocation of South Africa’s black African population from the suburbs of Johannesburg into Soweto was the asbestos mining industry which formed, through Gencor, the platform through which Afrikaner capital penetrated the mining sector. All the houses constructed in Soweto had roofs composed of asbestos sheeting.

Large corporations that were close to the NP at that stage included Gencor, Sanlam, Nasionale Pers, Rembrandt and others. At the same time, there was a noticeable rapprochement between the NP and the English business establishment. It was during this time that people such as J.F. Klopper, the leader of the Broederbond, and Nico Diedrichs, the Minister of Finance and later
leader of the Broederbond, and some of the staunchest Afrikaner (national) socialists became
darlings of the Chamber of Mines when the creation of an ‘Afrikaner’ mining group, Gencor, was
accepted as a payoff for not nationalising the other ‘English’ mines. (Van Vuuren, 2006, p. 23)

In a recent article on the same topic, Sipho Dube wrote:

And when the small-time Afrikaner-dominated mining company Federale Mynbou took control
of General Mining, it was Anglo American, led by Harry Oppenheimer, that lent a ‘helping hand’. 
[...] Much has been written to the effect that this was Oppenheimer’s way of heading off the
Afrikaner-led government policy of separating white English-speaking people from the
Afrikaners, but some historians contend that it was the government, in unison with the
Afrikaner business community, that forced him to part with a chunk of Anglo’s wealth. (Dube,
2017)

Basically, the health of the black population in the townships was compromised in a deal that
retained the private ownership of mines in South Africa in return for a share in mining for
Afrikaner capital.

In 1957 and 1958, 13 000 more houses were constructed, while in Dube and Nancefield,
hostels to accommodate 10 128 single men were erected. Under the Native Resettlement
Act of 1954, the Government moved the African residents of the western suburbs of
Johannesburg to Meadowlands. Sophiatown was rezoned for whites only and renamed
Triomf (triumph) in 1956, while the southern part of the area was set aside for coloured
ownership and occupation in 1957. “The removals were carried out with the precision of a
military operation, and left over a thousand ‘unlawful’ residents of Johannesburg homeless.”
(Davenport, 1991, p. 344)

The majority of the African population of South Africa lost all control over its lives in this
period of seeming corporate largesse, charitable gestures and racist paternalism. They were
deprived of having any choice of where they could live, were denied the right to own housing
in urban areas (cities and towns, where they could only rent), had no say in the shape, size or
colour of the houses, or the size of the stands on which the houses were constructed. They
also had no say in the building materials used to construct the houses, which often included
cement mixed with radioactive mine tailings sand and asbestos roofing. This would have
significant health impacts on generations of Sowetans. Redress in this regard should include
an investigation into the entire supply chain that benefitted from the sale of building
materials in the construction of the low-cost housing that comprises Soweto.

Having dealt with the small problem of the law, the apartheid government moved rapidly to
forcibly remove large numbers of black working-class South Africans out of ‘white’ suburbs
and municipal areas. The national government became directly involved in the process in
1954. The Bantu Resettlement Committee was established with the aim of resettling the
black population to the South West of the city centre, where they would no longer fall under
the control of the Johannesburg City Council but under that of the Department of Non-White
Affairs at local government level and the Department of Bantu Administration nationally.
Thus, black South Africans were removed from Sophiatown, Martindale and Newclare, and
resettled in ‘matchbox’ houses in Meadowlands, right under the tailings/slimes dams of DRD,
Crown Mines, Randfontein Estates, West Rand Consolidated, Consolidated Main Reef and
other mines. Most black, Indian and coloured townships were established South of the
mining belt, and its attendant mine waste, and tailings and slimes dams. This is shown on
Map 14 below, in which mines 28 to 35 form the northern border of Soweto. Most of these
mines are currently abandoned, derelict or ownerless, and many are occupied by informal
settlers, while some are operated by small scale, survivalist artisanal miners (Zama Zamas),
deemed ‘illegal’ by the DMR.

Map 14: Mines along the Northern boundary of Soweto (1962)

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Mine</th>
<th>Subsidiary of</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A subsidiary of Harmony Gold. Doornkop, of which the tailings North of Snake Park is part, was originally a Randfontein Estates operation</td>
</tr>
<tr>
<td>29</td>
<td>West Rand Consolidated Mines Ltd</td>
<td>General Mining and Finance Corporation Ltd.</td>
<td>Now owned by Harmony Gold</td>
</tr>
<tr>
<td>30</td>
<td>Luipaardsvlei Estate and Gold Mining Co. Ltd.</td>
<td>Gold Fields of South Africa Limited</td>
<td>Mintails</td>
</tr>
<tr>
<td>31</td>
<td>East Champ d’Or Gold Mining Company Ltd</td>
<td>Johannesburg Consolidated Investment Company Limited</td>
<td>Wes Wits, a joint venture between Mintails and DRD</td>
</tr>
<tr>
<td>No</td>
<td>Name of Mine</td>
<td>Subsidiary of</td>
<td>Current Status</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------------</td>
<td>---------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>32</td>
<td>Durban Roodepoort Deep Limited</td>
<td>Rand Mines Ltd</td>
<td>DRD/ERGO</td>
</tr>
<tr>
<td>33</td>
<td>Rand Leases (Vogelstruisfontein) Gold Mining Company</td>
<td>Anglo Transvaal Consolidated Investment Company Ltd.</td>
<td>Wes Wits Mining Rand Leases Vogelstruisfontein Gold Mining Company</td>
</tr>
<tr>
<td>34</td>
<td>Consolidated Main Reef Mines Limited</td>
<td>Rand Mines Ltd</td>
<td>Central Rand Gold</td>
</tr>
<tr>
<td>35</td>
<td>Crown Mines</td>
<td>Rand Mines Ltd</td>
<td>Central Rand Gold, DRD (ERGO), Confusion about licence</td>
</tr>
</tbody>
</table>

**Map 15: The wealth divide**

This Google Earth Map above was adapted by the Bench Marks Research Team. It shows the flows of wealth and poverty, environmental degradation and waste.

### 5.3 Main Reef Road and the segregation of labour by race, ethnicity and class

The geographical distribution of the population by race and class coincided with the distribution of wealth and waste. The two groups were separated by Main Reef Road. Poverty and waste flowed south of Main Reef Road, while opulence and leafy urban and suburban development flowed north of Main Reef Road. The indigenous African population found itself trapped in the polluted south against its will, located in between mine waste dumps by legislative force and physical removal from the north.
The Federation for a Sustainable Environment (FSE) summarises the challenges facing the Witwatersrand (Gauteng) in the following manner:

- The Witwatersrand has been mined for more than a century.
- It is the world’s largest gold and uranium mining basin with the extraction, from more than 120 mines, of 43 500 tons of gold in one century and 73 000 tons of uranium between 1953 and 1995.
- The basin covers an area of 1 600km$^2$ and led to a legacy of some 400km$^2$ of mine tailings dams and 6 billion tons of pyrite tailings containing 600 000 tons of uranium.

The FSE is one of the leading civil society voices regarding the environmental challenges facing South Africa because of the legacy of mining (Liefferink, 2016).
6. SOCIAL, ECONOMIC, ENVIRONMENTAL, HEALTH AND SAFETY IMPACTS ON MINING COMMUNITIES

6.1. Riverlea

6.1.1 History and demography of Riverlea

The National Housing Commission approved a loan of almost R1 million for a housing scheme to accommodate 623 ‘coloured’ households in Riverlea in 1963. The project was completed in 1964. It was expanded in 1965 to 788 households in total (Shorten, 1966, p. 393). This saw coloured communities moved out of ‘white’ suburbs into places such as Riverlea, Davidsonville, Reigerpark and Delmorpark along the Witwatersrand, invariably squeezed unto dubious land in between mine waste facilities.

Photo 16: Mooifontein tailings South of Riverlea

The Mooifontein tailings South of Riverlea, shown above, rise 10 storeys high. Riverlea covers an area of 3.4km², cut through the middle by the Johannesburg-Soweto passenger railway line. South of the line is Riverlea Extension, or ‘Zombie’, which is generally poorer than Riverlea proper, which is north of the line. Riverlea has a population of 16 226 people, with a population density of 4 771, which adds up to 91 people per square kilometre, and comprises 4 208 households. Women make up 51.47% of the population and men 48.53%. The research team did a household health survey involving 100 households randomly selected in Riverlea.

5 ‘Coloureds’ in South Africa refers to ‘mixed race communities’, a colonial and Apartheid designation imposed on a diverse community, many of whom, especially in the Northern and Western Cape, would define themselves as ‘San’, ‘Khoisan’ or ‘Malay’.
Extension. The predominant language in Riverlea is Afrikaans. The population composition by race is shown in the table below.

**Table 5: Riverlea population by race**

<table>
<thead>
<tr>
<th>Population group</th>
<th>People</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coloured</td>
<td>10 917</td>
<td>67.28%</td>
</tr>
<tr>
<td>Black African</td>
<td>4 794</td>
<td>29.55%</td>
</tr>
<tr>
<td>Indian or Asian</td>
<td>269</td>
<td>1.66%</td>
</tr>
<tr>
<td>Other</td>
<td>212</td>
<td>1.31%</td>
</tr>
<tr>
<td>White</td>
<td>33</td>
<td>0.20%</td>
</tr>
</tbody>
</table>

Source: Census, 2011

All the respondents to the household questionnaire had been born in Riverlea and had lived there all their lives. 51% of the respondents were female. Of the households surveyed, 87% had between four and six people living in the home. Nearly half (43%) of the respondents were between the ages of 40 and 49 years of age, 28% were between 50 and 59, while 20% were between 30 and 39 years of age. This indicates a settled population and community.

6.1.2 Most common illnesses in Riverlea households

The most common ailments affecting the Riverlea households surveyed are indicated in the graph below.

**Graph 6: Reasons for seeking healthcare in Riverlea**

The most persistent ailment identified by the respondents is coughing (31.6%), followed by asthma (14.3%), eczema (9.2%), other ailments (9.2%), heart disease (8.2%) and sinusitis (7.1%). If respiratory ailments are added together (a cough, sinus, asthma and TB) it comes to a total of 56.1%. The respondents also reported eye problems (4.1%).
The respiratory problems might be associated with dust (from the surrounding mine operations and tailings), asbestos roofs and/or smoking. Almost all the surveyed houses in Riverlea had asbestos roofs (97%), 574 cigarettes were smoked per day by various members of households (fathers, mothers, uncles, aunts, etc.), but 92% of the respondents believed their health problems were caused by the surrounding mines. All the respondents thought that the surrounding mining operations and mine waste facilities polluted the air in their community. Their respiratory problems were not caused by the burning of coal, paraffin, or wood, as some mine studies of the community’s health claimed, given that 99% of the households had access to electricity, which was installed as long ago as 1988.

Nkosi et al. (2015) suggest that there is a link between the respiratory problems among the elderly living in or near mining communities in Gauteng and mine waste facilities. They note that exposed communities have a higher prevalence of chronic respiratory symptoms and diseases such as asthma (17.3%), chronic bronchitis (13.4%), chronic cough (26.6%), emphysema (5.6%), pneumonia (17.1%) and wheeze (24.7%), compared to unexposed communities. Residing in exposed communities, current smoking, ex-smoking and use of paraffin or gas as the main residential cooking/heating fuel emerged as independent significant risk factors for chronic respiratory symptoms and diseases. While there is a strong coincidence between the findings of Nkosi et al. (2015) and those of the Bench Marks’ household survey, we can simply not ascribe the respiratory problems of the community to paraffin, coal or wood for energy use by residents, because 99% of the households surveyed reported using only electricity in their homes.

Despite ongoing research to ascertain the health implications of tailings dust in the Witwatersrand region, previous studies have confirmed increased hospital admissions, emergency room visits and mortality among patients with respiratory ailments. Many epidemiological studies have linked levels of ambient particulate matter (PM) with a variety of human health problems, such as silicosis, pneumoconiosis and increased risk of TB, lung cancer, scleroderma, and systemic lupus erythematosus. Specifically, exposure to gold mine dust, that is, rich in silica, has been linked to the development of chronic bronchitis, emphysema, and air flow obstruction. (Oguntoke et al., 2013, pp. 2, 9-10)

The residents of Riverlea, just like residents in other communities on the West Rand, are therefore not amiss in associating their respiratory problems with mine dust from the surrounding mine dumps and mining operations (Wright et al., 2014). As Wright et al. (2014) note,

the gold mine dumps and tailings dams [an industrial waste dam for mining waste or the materials left after the fraction that has any value has been removed] were and still are sources of air pollution, as many of them are not covered. Communities such as Davidsonville, Kagiso and Krugersdorp in the Witwatersrand area (Gauteng Province) live alongside these gold mine dumps and tailings dams. Many of these communities comprise historically marginalised ethnic
groups living in government-funded houses, informal settlements and retirement homes. Evidence suggests that these mine dumps and tailings dams are a dust nuisance for the local communities during periods of high winds. This suggests multiple exposure pathways (i.e., breathing, drinking, eating and dermal contact) for local communities who complain of the general deterioration of their health. Respiratory problems are a major concern.

Of the households surveyed in Riverlea, 55.1% had access to a medical doctor, while 40.8% utilised the services of the local public nurses at the clinic. We found many Riverlea Extension residents of all ages living on oxygen machines and who complained that their respiratory problems were worsened by the dust from the mine dumps, especially on windy days. The research period stretched over three years, from 2014 to 2017, and coincided with one of the worst droughts in recent memory across the whole of South Africa. The 2015 - 2016 dust season was not restricted to the normal August to September period, but went on from August 2015 right through to September/October 2017.

*Photo 17: During and after dust storm - view from Riverlea*

The photographs above show a dust storm blocking out the Sentech Tower, as seen from Riverlea (1 January 2016).

*Map 16: Prevailing winds blowing into Riverlea and Soweto*
Photo 18: One-year old from 'Zombie' on oxygen machine

Photo 19: Aunt Rose with her oxygen machine

Photo 20: Pennielope Paulsen passed away on 1 February 2017
6.1.3 Comparing Riverlea to the control community of Danville

Graph 7: Reasons for seeking healthcare in Danville

Comparing the health status of Riverlea with that of Danville makes for interesting reading. A total of 31.6% of Riverlea residents complained about coughing, while only 14% of the Danville residents complained of the same problem. A total of 7.1% of households in Riverlea complained about sinusitis, whereas only 2.3% of households in Danville complained of the same. While 14.3% of households in Riverlea complained about asthma, only 5.8% of households in Danville complained about this particular ailment. Levels of TB are more or less the same in the two communities. However, 9.2% of Riverlea households report eczema to be a problem, compared to 1.2% of households in Danville. Cumulatively, only 25.6% of households in Danville suffer from respiratory problems (cough, sinus, asthma and TB), whereas the respiratory ailments in Riverlea affect 56.1% of households. These two communities are similar in all ways, except for two factors: firstly, in Danville, only 52.6% of households reported having asbestos roofs, whereas almost 100% of those surveyed in Riverlea reported having asbestos roofs. Secondly, Danville has no mine dumps.

6.1.4 Dust in Riverlea

The mining operations around Riverlea do not take dust pollution seriously. The research team observed that there were very few dust sampling buckets in Riverlea (four in total, according to DRD). There was one dust sampling bucket next to the community centre under a tree, put there by Central Rand Gold (CRG). It was removed soon after the Bench Marks Foundation posted comments regarding the shortcomings of placing a bucket under a tree on Facebook. There was a second dust sampling bucket in Sand Street, managed by SGS and DRD/ERGO. The residents complained that it seemed as if the dust samples were hardly ever collected and when they were the companies responsible for the dust buckets hardly ever
provided the communities affected by the dust with any feedback. There was a third dust bucket at the Johannesburg College of Education, next to Shaft 17, in between the Mooifontein and Shaft 17 tailings dumps.

*Photo 21: Central Rand Gold dust bucket - Riverlea Community Centre*

The dust bucket above tells a story. Instead of using the latest model of dust samplers, the companies operating around Riverlea and Soweto are using a sampler design dating back to 1970. It is not a very efficient design.

*Diagram 1: The D1739-70, 1970 dust sampler*

Source: (Annegarn, 2015, p. 11)

The efficiency, or lack thereof, of this dust sampler, is demonstrated by the following chart.
Graph 8: Notional efficiency of the 1970 dust sampler

The graph above shows that the higher the wind speed, the lower the levels of efficiency of the dust sampler. Residents tell us that during the windy season they must clean their houses two or three times per day. Perhaps the ‘scientists’ should simply consider collecting dust samples for analysis from the homes of Riverlea and Soweto residents! The latest approved sampler, approved in 2004, is the ASTM Standard D1739-98, 1998 model that was reapproved in 2004.


Annegarn (2015) notes that this model marginally improves efficiency; however, in the three years that the Bench Marks team worked in Riverlea and Soweto while conducting the research, it never came across the ASTM D1739-98 model. Annegarn (2015) concludes that dust buckets, if properly set up, allow for good spatial coverage with low precision, and that intervention response time will make no difference (Annegarn, 2015). In other words, they are just a public placebo.
The image above shows an SGS/DRD employee collecting dust buckets in Riverlea on 12 April 2017. There are alternative, more accurate electronic means of measuring dust fall out with detection devices. Ecotech, an Australian firm with offices in South Africa, offers fence-line monitoring of dust and gas emissions products.

Fence-line monitoring allows mine operators to monitor dust and gas emissions but, more importantly, it enables them to pinpoint the sources of this pollution and reduce its impact on surrounding areas. Fence-line monitoring includes:

- Wind speed and direction sensors;
- Real-time dust and gas monitoring linked to wind sensors; and
- Powerful software that maps pollution concentrations, direction and distance (to source).

Station data integration allows data from multiple locations to be combined, processed and presented in easy-to-understand reports (Mining Technology, 2017). The question then, is why do we find bucket systems, instead of more accurate electronic systems, deployed in densely populated, poor and marginalised communities, living in and around mine dumps in South Africa? The industry will claim that the electronic systems are too expensive. However, the Bench Marks Foundation would venture other reasons for this, such as the following:

- As the silicosis battle between mine workers and the industry has shown, the industry does not seem to care for the plight of its employees;
- Profitability always seems to come before responsibility in the industry; therefore it seems as if it will always go for the cheapest options when it comes to community health and the environment;
- These are poor, marginalised and voiceless communities dumped between Johannesburg’s sewage works and mine waste, treated by colonialism; and
• Apartheid as human waste, has seemingly been forgotten by the current government.

Annegarn (2015) is the ‘independent consultant’ for DRD/ERGO, which means that he is paid by the corporation, and serves on the Crown Mines or ERGO Gold Dust Monitoring Forum as the chairperson. The ERGO Gold Dust Monitoring Forum is composed of the following people:

**Table 6: ERGO Gold Dust Monitoring Forum**

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Gender</th>
<th>Race</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harold Annegarn (chairman)</td>
<td>‘Independent Consultant’</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Ruth Adora</td>
<td>SGS Environment</td>
<td>Female</td>
<td>?</td>
</tr>
<tr>
<td>Nondumiso Songo</td>
<td></td>
<td>Female</td>
<td>Black</td>
</tr>
<tr>
<td>Kerusha Naidoo</td>
<td></td>
<td>Female</td>
<td>Black</td>
</tr>
<tr>
<td>Sharon Banks</td>
<td></td>
<td>Female</td>
<td>White</td>
</tr>
<tr>
<td>Greg Ovens</td>
<td>ERGO Mining</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Dave Rhodes</td>
<td></td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Louis Kleynhans</td>
<td></td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Geof Pollock</td>
<td></td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Piet de Vries</td>
<td>I-PROP</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Ian van Niekerk</td>
<td>I-CAT</td>
<td>Male</td>
<td>White</td>
</tr>
<tr>
<td>Phatu Raphalalani</td>
<td>Department of the Environment</td>
<td>Male</td>
<td>Black</td>
</tr>
<tr>
<td>Victor Loate</td>
<td></td>
<td>Male</td>
<td>Black</td>
</tr>
<tr>
<td>Justice Netshandama</td>
<td>COJ</td>
<td>Male</td>
<td>Black</td>
</tr>
<tr>
<td>Lebo Molefe</td>
<td></td>
<td>?</td>
<td>Black</td>
</tr>
<tr>
<td>Godfrey Makomene</td>
<td>FSE</td>
<td>Male</td>
<td>Black</td>
</tr>
<tr>
<td>Nemamgaya Michael</td>
<td>Gauteng Department of Economic and Rural Development (GDARD)</td>
<td>Male</td>
<td>Black</td>
</tr>
<tr>
<td>Judith Taylor</td>
<td>Earth Life Africa</td>
<td>Female</td>
<td>White</td>
</tr>
<tr>
<td>Hannes Venter</td>
<td>National Arts, Sport, Recreational and Expo Centre (NASREC)</td>
<td>Male</td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td>DMR Gauteng Regional Manager</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: SGS/ERGO Dust Monitoring Forum, 2016

From the attendance register and apologies tendered, it would seem that no community organisation members are on this forum. Most of those present represent corporate interests. Interesting also is that DRD/ERGO is represented only by white males, possibly a reflection of the lack of transformation of this mining outfit at management level. The Bench Marks Foundation believes any consultants paid for by a mining corporation, be they auditors or environmentalists, cannot be considered ‘independent’. The representatives from Earth Life Africa and FSE are positive about the developments; however, they cannot speak on behalf of communities.
6.1.5 Specific community concerns of mining companies operating around Riverlea

6.1.5.1 Central Rand Gold

Photo 23: Central Rand Gold operation behind T.C. Esterhuysen Primary School

Photo 24: Collapsed access road
The image above shows the collapsed access road to T.C. Esterhuysen Primary School, due to the open cast operation of CRG. It was taken on 3 February 2017. The RCF is a very active structure in the community. It meets every Monday in either the Catholic Church or in the Community Centre. It regularly engages with the Bench Marks Foundation, LHR, the Legal Resources Centre (LRC), the FSE, the DMR, SAPS, the Metro Police and the Management of DRD/ERGO and CRG. It has laid charges of illegal dumping against CRG. The RCF has kept meticulous files of the minutes of its own meetings, as well as meetings with other affected parties, the mining companies, government departments, etc. It has also kept files of all its correspondence with and from the mining companies.

The RCF raises the following concerns about the CRG operation behind T.C. Esterhuysen Primary School:

- Somehow, despite easily observable irregularities, the CRG has a province-wide mining licence, DMR Reference Number: GP30/5/1/2/3/2/1(140) EM;
- The Environmental Impact Assessments (EIA), in so far as they are publicly available, for CRG operations show a single plan for multiple province-wide operations. This, the RCF suggests, is illegal and in contravention of the National Environmental Management Act (NEMA), the regulations associated with radioactive waste as per the requirements of the NNR, and the Minerals and Petroleum Resources Development Act (MPRDA);
- It is not clear that the operation has an approved Environmental Management Plan (EMP), as required by law;
- It is not clear whether the operation has a water use licence, as required by the DWAF and the National Water Act (Act 36 of 1998);
- The RCF alleges that CRG illegally used the water supply of the T.C. Esterhuysen Primary School for its operations;
- There is no safety exclusion zone, as required by mining best practice, between the mine and a National Heritage Site (George Harrison Park), a primary school catering for six to 12-year-old children (T.C. Esterhuysen Primary School), two campuses of a technical college (The Johannesburg College of Education), a gasworks and a South African State Oil Company (SASOL) gas pipeline, Eskom power lines, two major roads (Nasrec Road and Main Reef Road) and a railway line. The whole operation was undertaken with no regard for the safety of the public, including small children and the youth. The only safe access road to the school was compromised – it is collapsing into the open cast hole and children must share this road with heavy mine vehicles;
- The mine does not seem to have a proper mine closure plan, as required by the MPRDA, given that no satisfactory document to this effect could be produced despite numerous written enquiries by the RCF. It does not appear as if adequate funding has been set aside for the closure of the mine. The community laid charges of illegal dumping after the CRG seemingly attempted to turn the pit into an illegal waste
dump with waste from the South African National Roads Agency (SANRAL) maintenance and expansion operation on the M1 highway;

- The mine attempted to pay the RCF to close the open cast pit. The community rejected this because the paltry sum involved would not even have covered the cost of a single grader;

- The RCF is complaining about the fact that the company that eventually received the closure contract was not registered with the Department of Trade and Industry (DTI) at the time of it being awarded. The website of the company portrayed it as being involved in tourism, and as a courier services provider;

- The operation was never secured with proper fencing, proper berms or signposts, which are appalling safety and security standards;

- The mine does not seem to have operation-specific Social and Labour Plans (SLPs), but again a single province-wide plan. The community alleges that no employment was created for residents of the community, that no SLPs were ever discussed with the community, and that the community never derived any benefits from the operation. Johannesburg Parks claims that they were promised R1.5 million, given that the operation happened on Parks land, and that this payment never materialised. Johannesburg Parks never consulted the community about the alienation of recreational land for use as an opencast mining operation;

- The operation has compromised the Constitutional Right to health and safety of primary school children and students;

- The operation represents a risk and threat to infrastructure: major roads, railway, gas works, Eskom power and Johannesburg water;

- In the presentation made by CRG to the DMR to obtain a mining licence, no attempt at an operation-specific licence was made, and Riverlea is mentioned in only one sentence, which is fairly meaningless: “Not affecting urban development especially in key projects and focus areas established through the mining land areas.” (sic) (CRG South Africa (Pty) Ltd, 2007, p. 36); and

- Failure to stick to its SLPs or to honour the Mining Charter and abide by the MPRDA.
Our engagement with the Riverlea Community Forum (RCF) and residents of Riverlea indicated that DRD fared only marginally better than CRG when it came to responding to the concerns of the Riverlea Community. The Centre for Environmental Rights (CER) notes that DRD is a gold producing company specialising in the re-mining of gold tailings or slimes dams. DRD's primary listing is on the Johannesburg Stock Exchange (JSE), while its secondary listing is on the New York Stock Exchange. DRD's assets are held through its interests in ERGO Mining Operations (Pty) Ltd (EMO), which owns 100% of ERGO Mining (Pty) Ltd and ERPM. In 2014, DRD had 2,329 employees, including 989 permanent employees (CER, 2016, p. 67).

CER has found that DRD operates without a water licence. This is probably because it has a province-wide mining licence instead of having separate licences for each of its operations. Over the three-year period, the Bench Marks Research Team found that:

- The dust blowing from the Mooifontein Dump onto which DRD is depositing reworked tailings from other dumps in the area is a major problem, according to Riverlea community residents. They perceive it to be a contributor to the poor air quality in this community. CER reports that DRD is frequently guilty of exceedances in terms of dust control and clean air regulations (CER, 2016).
As seen above, a dust storm over Riverlea completely obscures Mooifontein tailings dam.

People with respiratory problems in Riverlea fear the dry, windy month of August. The 2010 DRD Annual Report stated that there had been a 20% decrease (to 115) in the number of instances in which levels of dust exceeded the South African National Standards (SANS) Standard 9. This, of course, still leaves many exceedances and many DRD operations that are in very close proximity to residential areas. Nine complaints about dust were received by Crown Mines during 2010. In 2011, DRD reported that dust levels also exceeded the SANS standard on 18 occasions and complaints were received relating to dust. There were 155
instances in which dust levels exceeded the SANS standard in 2012. The increase from 2011 was said to be due to the decommissioning of the Crown Mines’ tailings facility, which led to the dust drying out when deposition stopped. It was stated that this was only a temporary situation. There were 51 dust level exceedances of the SANS standard in the 2012-2013 financial year (CER, 2016, pp. 70-71).

- There are frequent breaches of its tailings evaporation and holding ponds, causing spills into the Booysens River. These spills contain elevated total dissolved solids (TDS) levels and are highly acidic.

*Photo 27: Total dissolved solids measurement at the Booysens River*

The above measurement, TDS 3240 ppm (the EPA upper limit for TDS is 500ppm), was taken where tailings and operational spill and the Booysens River meet.

*Photo 28: Measuring acidity and total dissolved solids at the Booysens River*
Seen above is a community monitor checking the water for acidity and TDS at the point where the Booysens River and mine pollution meets.

*Photo 29: Durban Roodepoort Deep operation in Riverlea spraying the re-mined dump*

The above photograph shows a DRD operation in Riverlea in which the re-mined dump is being sprayed. Allegedly, DRD did not have a water licence in 2012 when this photograph was taken. CER reports that in 2009 there was also one ‘reportable incident’ involving DRD when spillage control dams were breached at the Crown plant. This breach resulted in 600 tonnes of slime flowing into the Russell stream, which affected an area 30m long. It was stated that the area was in the process of being cleaned up (CER, 2016, p. 70). In the 2010 Annual Report of DRD, it was stated that during the reporting period there had been one reportable environmental incident. It was stated that vandalism to a pipe resulted in the spillage of 1 500 tonnes of slime (CER, 2016, p. 70). In the 2011 financial year, the company reported 16 environmental incidents. These included water pollution caused by burst pipes and stormwater runoff, dust-related incidents and radiation incidents (CER, 2016). There were two spillages at Crown Mines’ operations and three at ERGO during the year, but the 2012 report is unclear as to whether these were the same five water pollution incidents reported to the DWAF (CER, 2016). In a response to a parliamentary question, the minister of water and sanitation stated that, as at 25 July 2014, ‘Crown Gold Recoveries’ and ‘Crown Mine: ERGO Mine Knights’, both DRD operations, were operating without water licences, and no applications for authorisation had been received by the Department of Water and Sanitation. The application for authorisation submitted by a mining operation called ‘Knights Gold’ in Gauteng was reportedly in process, as was that of another unnamed DRD mine (CER, 2016, p. 71).
• There are frequent pipe bursts into the Booysens River, causing spills. We have photographic evidence of this.

*Photo 30: Burst mine pipe spilling into Booysens River*

In the image above, taken on 25 May 2015, the contents of a burst mine pipe containing water from a tailings dam can be seen spilling into the Booysens River. The pipe remained in a state of disrepair for 10 days.

*Photo 31: The Booysens River and Klipspruit silted up with white tailings sand*

Johannesburg’s natural soil colour is red. The Booysens River and Klipspruit are both silted up with white tailings sand, as seen in the above photograph taken on 25 May 2016.

• The Booysens River below the Mooifontein dump is completely silted up with tailings sand.
• The DRD operations are not properly secured, fenced or signposted; they are openly accessible to the public, including children.

6.1.6 The Riverlea community’s perception of the mining operations

Given the above, it is not surprising that the Riverlea community views mining with a high degree of hostility.

Photo 32: Riverlea community residents blocking off an access road to Durban Roodepoort Deep operations

Seen above are Riverlea community residents blocking off an access road to DRD operations, due West of the community to prevent further mining activity (11 April 2017).

What do the people of Riverlea think about mining?
• When asked whether they thought that mining activities around the community affected their health, 92% of Riverlea community residents answered in the affirmative;
• All those questioned believed that mining activities polluted the air;
• The community were in 100% agreement that mining polluted the water;
• They all complained that mining brought migrant workers, while 85% thought that mining might contribute to xenophobia. This happens particularly when mining companies promise the community residents jobs before operations start, only to disappoint them by importing trained labour from elsewhere to save costs;
• Most of the community residents questioned (97%) did not believe that mines created jobs for local communities;
• Most of the community residents (96%) did not believe that mines closed and rehabilitated their operations properly;
• Of the Riverlea community residents surveyed, 84% believed that formal mining operations would bring in ‘illegal’ ‘Zama Zama’ operators;
• All the Riverlea residents interviewed believed that the mine operations around their community caused traffic jams; and
• Almost all the Riverlea community residents surveyed (98%) did not think that the mine was a good neighbour.

The households of Riverlea have had a very negative experience and perception of mining. If one studies old maps of the area, the loss of recreational space and facilities for the residents of Johannesburg in general, and Riverlea and Diepkloof in particular is obvious. Shareworld, Atwell Gardens, Library Gardens and Booysens Reserve were all destroyed by uncontrolled and poorly regulated mining.

Map 17: Mine waste facilities on Atwell Gardens, Shareworld recreational area and Library Gardens

Source: Adapted from a map at the Langlaagte Police Station

The map above shows the encroachment of mine waste facilities on Atwell Gardens, Shareworld recreational area and Library Gardens. Recreational dams and streams have also been destroyed, including the Russell Dam, Booysens Spruit and New Canada Dam. Russell Dam has been turned into an evaporation pond and the stream into a containment channel. Booysens Spruit is clogged up with tailings waste, and the New Canada Dam is a toxic pond.

6.2 Diepkloof

6.2.1 History and demography of Diepkloof

Diepkloof is squeezed in between the Diepkloof tailings to the North and the Shaft 17 tailings to the East. The attention of the research team was focused on Diepkloof Zone 3, just South of the Diepkloof tailings, and Zone 4, just across from the N1 highway, which is dwarfed by the Crown Mines Shaft 17 dump.
According to Census 2011, the area of Diepkloof Zone 3 covers 0.91 km$^2$ and has a population of 9,897 people living in 2,401 households. Of the population, 51.4% are female, while 48.6% are male. Black Africans comprise 99.71% of the population. Diepkloof Zone 4, according to the 2011 Census, covers an area of 1.39 km$^2$ and has a population of 20,029 who live in 5,443 households. Women make up 50.95% of the population and men 49.05%. Black Africans form 99.35% of the population.

Photo 33: Diepkloof, in the valley below the mine tailings storage facility

The numbers of people per household in Diepkloof varies greatly, with 52.8% of households having between five and more than seven people per household, compared to Riverlea, where 87% of households had between four and six people per household.

6.2.2 Most common illnesses in Diepkloof households

Graph 9: Reasons for seeking healthcare in Diepkloof
Coughing affects 32.4% of the residents surveyed, followed by ‘other’ ailments at 20.3%, fever and sinus at 8.1% and optical problems at 6.8%. Asthma affects 5.4% of the surveyed residents, and TB, eczema, arthritis and heart disease each affect 2.7%. In Diepkloof, 53.3% of households have asbestos roofs, compared to the 97% in Riverlea.

Respiratory problems combined (cough, sinus, asthma and TB) make up 48.6% of the health problems of people living in Diepkloof, as compared to the 56.1% in Riverlea. Why is there this 7.5% difference? Asthma in Riverlea exceeds that in Diepkloof by 8.9% in the households surveyed. Is it because there are fewer asbestos roofs in the Diepkloof communities surveyed? People in the households surveyed in Diepkloof also smoke much less than those in Riverlea. According to those surveyed, the households in Riverlea smoke 574 cigarettes per day, while households in Diepkloof smoke only 49 cigarettes per day.

6.2.3 Comparing Diepkloof to the control community of Danville

Graph 10: Reasons for seeking healthcare in Danville

Comparing the health status of Diepkloof with that of Danville makes for interesting reading. A total of 32.4% of Diepkloof residents complained about coughing, while only 14% of Danville residents complained of the same problem. A total of 8.1% of households in Diepkloof complained about sinusitis, whereas only 2.3% of households in Danville complained of the same. While 5.4% of households in Diepkloof complained about asthma, 5.8% of households in Danville complained about this particular ailment. The levels of TB are more or less the same. However, in Diepkloof 2.7% of the households reported that eczema was a problem, but it affected only 1.2% of households in Danville. Cumulatively, only 25.6% of the households suffered from respiratory problems (cough, sinus, asthma and TB) in Danville, whereas the respiratory ailments in Diepkloof households affected 48.6% of households. In Diepkloof 53.3% of households had asbestos roofs, only slightly more than
Danville, where 52.6% of households reported having asbestos roofs. The main difference is that Diepkloof is surrounded by mine dumps on the East and North. In response to being asked about HIV/AIDS, the respondents returned a 0% positive response. Researchers have found that people in Soweto households say that “one cannot speak about HIV/AIDS; to do so is to invite it into your home”.

6.2.4 Dust and tailings dams in Diepkloof

High levels of coughing, sinus and optical problems might indicate a dust problem. Residents spoke of opening their front doors when they returned from work in the afternoons and “finding a yellow carpet of sand running down the passage”, while others complained of having to constantly sweep out dust from their homes.

Photo 34: Dust storm over Diepkloof

The photograph above shows a dust storm over Diepkloof taken on 29 September 2017. Kneen et al. (2015) did a study of urban encroachment into exclusion zones around mines between 1951 and 2011 and concluded that

encroachment of housing onto land close to tailings storage facilities (TSFs), i.e. areas rendered marginal because of the dust hazard and risk of structural failure, has continued unabated for decades, intensifying human exposure to windblown mineral dust. Recent research indicates that the finer milling used for modern gold extraction results in aeolian dust emanating from the TSFs, which contributes to a higher proportion of inhalable particles in the source material. Air quality dispersion modelling, validated by ambient aerosol monitoring campaigns, indicates that episodic dust events generate PM$_{10}$ and, specifically, quartz dust concentrations that are unhealthy at distances of up to 2km downwind of TSFs.

Kneen et al. (2015, 142) documented residential development from 1952 to 2011 (using historical aerial photographs, census data from 2001 and 2011 and ancillary information) to determine the population exposed to dust emanations from the TSFs. Using the images, land use was classified into residential areas, TSF footprints and open areas, onto which a series of
500m buffer zone contours were superimposed. The resulting statistics were used to assess the populations exposed to dust hazards within the defined buffer zones.

The data shows that housing development had experienced a growth of approximately 700% since 1952, at a rate of 14% per year. Analysis of recent monitoring campaign data has confirmed multiple occurrences of quartz-rich inhalable dust in residential settings, at levels that exceed occupational health standards, extrapolated to values for population exposure.

Wright et al. (2014) notes that “by 2010 there were nearly 300 tailings dams in the Witwatersrand area. Gold mine tailings generally comprise heavy metals, such as zinc, copper, lead and arsenic, as well as chemicals used during the milling processes and other toxic material, including cyanide and radioactive uranium. Heavy metals are associated with neurological, cardiovascular and respiratory effects, while uranium is associated with kidney damage” (Wright et al., 2014). The Diepkloof tailings overshadow Zone 4 to the North.

Kneen et al. (2015) confirm that, “while international standard practice and local mining regulations prohibit or avoid locating residential areas closer than 500m from TSFs, the earliest aerial photographic images of the areas within that distance around Johannesburg’s TSFs clearly show that housing development has been continuing despite the recent data on the emerging increase in health risks for residents” (2015, p. 142). They also agree that ‘dormitory’ towns sprang up near the dumps because of deliberate government forced removals, in which Black African people were moved out of the white suburbs of Johannesburg. After the lifting of the Group Areas Act and the re-establishment of freedom of movement, people flooded into Gauteng in search of jobs. Instead of challenging the spatial arrangements of apartheid, the new government continued to funnel people into the already crowded dormitory towns by building Reconstruction and Development Programme (RDP) housing there and allowing property developers to build houses inside exclusion zones, in flood zones and on dangerous undermined dolomitic belts. The neo-liberal dispensation after 1994 meant that the market dictated housing provision, which simply translated into political apartheid being replaced by economic apartheid – low wage earners continued to be located, by the market, in low-cost housing on low-cost land. One of their focus areas is the Crown Mines complex that divides Riverlea from Diepkloof.

Kneen et al. (2015) make the following important observations:

It is obvious that there was no (enforced) policy in place in Johannesburg to prevent human settlements close to these tailings facilities. Since these facilities were created, buffer zones around the TSFs, as prescribed under mining regulations, have not been enforced. After more than half a century of mining and mine tailings in the city, Johannesburg’s residents were confident [that] they could live in the shadow of the TSFs. Since 1952, for over 50 years, this has been true. While dust was a constant presence in these areas during spring (August, September and October), that dust was mainly coarse, settleable particles which were not inhaled and
remained primarily a nuisance. Since 2002, finer milling and generation of inhalable dust have transformed this nuisance into a health hazard. This contributes to the current need to invest in dust suppression and the importance of educating the local population about not damaging or disturbing the dust mitigation measures (water sprays and vegetation on TSF surfaces). (Kneen et al., 2015)

Photo 35: Crown Mine Complex in relation to Riverlea and Diepkloof Zones 3 and 4

Kneen et al. (2015) concluded that:

- Government and property developers ignored and continue to ignore mining regulations concerning exclusion zones around TSFs;
- After more than half a century of mining and mine tailings in the city, Johannesburg’s residents were confident they could live in the shadow of the TSFs. Since 1952, for over 50 years, this has been true; and
- Early on, the coarser dust did not represent a health challenge, but finer inhalable dust resulting from new milling processes transformed the dust nuisance into a health hazard.

However, Bench Marks Foundation would like to challenge some of the assumptions above as being only partially correct, and to point out that Kneen et al. (2015) missed some important points:

- Black South Africans never became “confident [that] they could live in the shadow” of TWFS. They were forced to live there through forced removals and racial segregation associated with apartheid and colonialism;
• Bench Marks Foundation prefers the term TWFs, to the term TSFs, especially given that corporations simply abandon mine waste facilities, as a rule, after exploitation;
• The Chamber of Mines had a ‘tailings maintenance unit’ that saw to it that the tailings were grassed and vegetated during apartheid. This unit, like many other important units at the Chamber of Mines, simply fell away after 1994; and
• Unmaintained and unsecured TWFs erode and break down, and at times also encroach on residential areas.

Both the Shaft 17 tailings and the Diepkloof tailings impact negatively on surface water streams in Diepkloof. These tailings are operated and maintained by DRD/ERGO. Bench Marks Foundation has identified several spillage points from storm water channels, evaporation and holding ponds into adjacent streams, affecting the pH and levels of TDS in these streams.

*Photo 36: Tailings spillage point*

In the above image, a tailings spillage point is seen below the Diepkloof tailings, into a stream between Zone 3 and a TWF.

*Photo 37: Cattle grazing and drinking at the polluted Klipspruit*
Photo 38: Sulphur-encrusted grass

In the image above, sulphur-encrusted grass can be seen in the stream below the Diepkloof tailings in Zone 3.

Photo 39: Total dissolved solids and pH measurements near Diepkloof

In the photograph above, a researcher is measuring the TDS and pH levels of water in a stream running parallel to Zone 4, Diepkloof, below the N1 Highway and Shaft 17 tailings.

Photo 40: Low pH in stream below Shaft 17 tailings
The measurements obtained from the stream below Shaft 17 tailings, next to the N1 highway, parallel to Diepkloof Zone 4, shows a low pH, which indicates that the water is extremely acidic.

*Photo 41: High total dissolved solids reading*

The photograph above shows a high TDS reading from a stream below Shaft 17 tailings in Diepkloof Zone 4.

6.2.5 **Specific community concerns of mining companies operating around Diepkloof**

In focus group discussions in Diepkloof, the residents complained that no one from the mining operations nearby had ever bothered to meet with them to explain the implications of the mine dumps or mine operations near their homes. Those in Zone 4, closest to the N1 highway and the Shaft 17 TWF, suffer a constant dust problem during the dry winter months and flooding, damp walls and seepage during the rainy summer months.

*Photo 42: Focus group discussion in Diepkloof Zone 4*
The residents complained about skin rashes, eczema and coughing, while one resident complained of having repeated miscarriages of grotesquely deformed foetuses. “One time the nurses ran out of the room because they had never seen anything like it!” There are no government or mine-sponsored education programmes for communities living near mine operations or mine waste facilities. Toxic streams are not secured, fenced or signposted, and there is evidence of frequent breaches of storm water containment channels, containment and evaporation ponds. During school holidays and weekends children play in and around the streams.

Of concern is a youth correctional facility (prison) situated below and very close to the southwestern corner of the Diepkloof TWF, West of Zone 3. The staff, under the condition of anonymity, informed the researchers that water was seeping up through the floors and that the walls are all damp. The buildings are located within the stream flood plain, and well inside the 500m exclusion zone. The facility is in direct contravention of the Constitutional right of the inmates and staff to a healthy and safe environment.

*Photo 43: Albertina Sisulu Youth Correctional Facility*

The photograph above shows the Albertina Sisulu Youth Correctional Facility, the location of which is in contravention of the staff and inmates’ right to a healthy and safe environment.

6.2.6 The Diepkloof residents’ perception of the mining operations

Given the above information, it is not surprising that the community expressed the following:

- Of the responding households, 57.3% thought that their health problems stemmed from mining activities in close proximity to their homes;
• Many respondents (77%) thought that mining contributed to air pollution in Diepkloof;
• Most respondents (74%) agreed that mining caused water pollution;
• Some respondents (43%) believed that mining brought in migrant workers;
• Only 16% thought that mining contributed to xenophobia;
• Of the surveyed respondents, 65% did not think that mining brought any jobs to their community;
• Many respondents (69%) agreed that mine owners did not rehabilitate their worked-out mines properly;
• Only 10% of Diepkloof residents thought that ‘Zama Zamas’ practised formal mining;
• Only 14% thought that mining operations caused traffic problems; and
• Many residents (83%) thought that mines were bad neighbours.

6.3 Meadowlands

6.3.1 History and demography of Meadowlands

Of the surveyed respondents of the Bench Marks health survey, 55.9% were male, while 44.1% were female. Most of the respondents (93.8%) had lived in Meadowlands all their lives, and 83.3% homes had three or more bedrooms, with 14.6% having only two bedrooms. Of the surveyed households, 77.7% had more than five people residing in there.

*Photo 44: Meadowlands in the shadow of Vogelstruisfontein mine waste*
6.3.2 Most common illnesses in Meadowlands households

In Meadowlands, 28.6% of the respondents selected the ‘other’ category to indicate their reason for seeking the help of health services. Coughing affected 14.3% of people, fever, 12.7%, asthma 11.1%, sinus 7.9%, TB 6.3%, eye problems 6.3% and HIV/AIDS 4.8%. Cumulative respiratory problems (cough, sinus, asthma and TB) affected 39.6% of the population. Meadowlands’ households surveyed smoked 324 cigarettes per day. Of the households surveyed in Meadowlands, 94% used electricity. Only 33.7% of the households had asbestos roofs.

Graph 11: Reasons for seeking healthcare in Meadowlands

6.3.3 Comparing Meadowlands to the control community of Danville

Graph 12: Reasons for seeking healthcare in Danville

When comparing the health status of Meadowlands with that of Danville, it was found that a total of 14.3% of Meadowlands residents complained about coughing, while a slightly lower 14% of Danville residents complained of the same problem.
A total of 7.9% of households in Meadowlands complained about sinusitis, whereas only 2.3% of households in Danville complained of the same. While 11.1% of households in Meadowlands complained about asthma, only 5.8% of households in Danville complained about this particular ailment. The levels of TB were more or less the same. However, in Meadowlands, 3.2% of households reported that eczema was a problem. It affected only 1.2% of households in Danville. Cumulatively, only 25.6% of households suffered from respiratory problems (cough, sinus, asthma and TB) in Danville, whereas the respiratory ailments in Meadowlands households affect 39.6% of households. In Meadowlands, 33.7% of the homes had asbestos roofs, significantly less than Danville, where 52.6% of the households reported that they had asbestos roofs. The two significant differences between Danville and Meadowlands are that Meadowlands has tailings waste on its Northern Border (though better grasses than the dumps in Riverlea and Diepkloof), and Meadowlands has significantly fewer asbestos roofs.

6.3.4 Dust and tailings dams in Meadowlands

Generally, the TWFs that stretch along the northern boundary of Meadowlands are better grassed and maintained. Nonetheless, the residents complained about dust during the dry season. It is also concerning that there are many schools and education facilities (eight schools in total) in the last blocks before the TWFs. The houses in the last blocks before the tailings are well within the 500m exclusion zone, which was simply ignored by both the government and property developers.

Photo 45: Dust bucket in Meadowlands
The image above shows Meadowlands residential blocks constructed within the 500m exclusion zone of TWFs. According to Module 3: Toxicology (Section 10: Other Heavy Metals), arsenic is produced as a by-product of mining or the smelting of copper and other non-ferrous metal ores, including gold. Arsenic is absorbed by ingestion, skin absorption or inhalation (School of Public Health and Family Medicine, 2017). In a seminal paper on the subject, Martin et al. write:

Arsenic in dust and aerosol generated by mining, mineral processing and metallurgical extraction industries is a serious threat to human populations throughout the world. Major sources of contamination include smelting operations, coal combustion, hard rock mining, as well as their associated waste products, including fly ash, mine wastes and tailings. The number of uncontained arsenic-rich mine waste sites throughout the world is of growing concern, as is the number of people at risk of exposure. Inhalation exposures to arsenic-bearing dust and aerosol, in both occupational and environmental settings, have been definitively linked to increased systemic uptake, as well as carcinogenic and noncancerous health outcomes. It is, therefore, becoming increasingly important to identify human populations and sensitive subpopulations at risk of exposure and to better understand the modes of action for pulmonary arsenic toxicity and carcinogenesis. (Martin et al., 2014, p. 127)

While it is well-documented that mine tailings represent major sources of arsenic-contaminated dust throughout the world, the contribution by these sources to total global atmospheric arsenic fluxes is yet to be assessed (Martin et al., 2014, p. 131).
Figure 9: Dangers of lead and arsenic poisoning

Eczema seems very common in near mine communities. In Meadowlands, the research team encountered Tebogo Dikobe\(^6\), a nine-year-old child with severe eczema. Tebogo’s grandmother was at her wit’s end. The public clinics lacked the medicines to help the child, while the public hospitals kept referring him back to the clinics. After the research team relayed his story on public media, a Muslim doctor offered to help the child free of charge. After treating Tebogo continuously for three months with little success, the doctor asked questions about his home environment. After learning that Tebogo lived in the shadow of TWFs in Meadowlands, the doctor suggested that he relocated to live with his paternal grandmother instead. The doctor believed Tebogo suffered from arsenate eczema of hyperkeratosis (scaling skin). We found several similar cases in Riverlea and Snake Park.

\(^6\) Not his real name
As seen in the above photographs, Tebogo is suffering from a severe skin condition, which could be caused by arsenic, lead or uranium exposure. We noted in section 4.1.4 above that arsenic is very common in gold-containing conglomerates that make up the gold reefs of South Africa. Various studies also show that it is present in TWFs and is therefore likely to be in tailings dust (Corriveau et al., 2011). Residents living in the shadow of gold tailings could ingest arsenic, lead or uranium through dust blowing into the kitchen and onto eating utensils and into cooking pots. It could also be absorbed from dust blowing onto washing that is drying on outside washing lines, inhaled when walking in the streets, or inhaled due to dust accumulating in their houses during dust storms.

Using a Smart Geiger device, the research team obtained some rather disturbing radioactivity readings in the blocks closest to the tailings, North of Meadowlands on 27 January 2017.

In 2016, the NNR finally conceded that there were no legislation or regulations to measure and control indoor radon emissions. It further conceded that if mine waste was not being properly managed, housing development in South Africa has and continues to take place in high-risk radioactive exposure areas. Currently, the NNR Act and Regulations are being revised to include existing exposures, as well as indoor radon. In future, the NNR will advise the government to include mandatory radon measurements in housing regulations and building codes (Pule & Speelman, 2016, p. 22). This is after 100 years of gold mining and the deliberate situation of low-cost housing for the black working class near toxic, radioactive mine waste, from 1904 to the present.

Photo 48: Radioactivity readings obtained in Meadowlands

The radioactivity reading shown above is a major cause for concern.

6.3.5 Past and present mining activities in Meadowlands

Given that the DMR seems to have allocated province-wide rather than operation-specific mining licences, and approved province-wide rather than operation-specific EIAs and management plans, it has come to the attention of the Bench Marks Foundation that there is
a degree of confusion over which old, derelict mines now belong to the new DRD, CRG or West Wits operations. From the websites of these companies, we see overlapping and confusing maps. This impacts the public responsibility and accountability of these mines.

**Map 18: Original mines to the North of Meadowlands**

The map above indicates the original mines to the north of Meadowlands, which were: Consolidated Main Reef Mines, Rand Leases (Vogelstruisfontein) and DRD Ltd.

**Map 19: West Wits Project, north and north-west of Soweto**

Source: Wes Wits
The map above indicates Central Rand and DRD rights, yet DRD is operating the Crown Mines Complex. Adding to this confusion, it is not clear whether the EIA and EMP approvals were given to the DMR, according to which, for example, CRG has approval for Vogelstruisfontein 231 IQ, Mooifontein 225 IQ, Randskou 324 IQ, Ormonde 99 IR, and Diepkloof 319 IQ. The
Bench Marks Foundation has established that Mooifontein, Randskou, Ormonde and Diepkloof are actually operated by DRD and not CRG.

**Figure 10: Undated Environmental Management Programme approval for Central Rand Gold operations**

6.3.6 Meadowlands’ perception of the mining operations

The Meadowlands community does not have the same level of community organisation as their counterparts in Diepkloof and Riverlea, but expressed the following:

- Of the Meadowlands residents surveyed, 43% think that their health problems are associated with mining, and 35.5% of them are not sure;
- Most of the surveyed households (83%) believe that mining pollutes the air;
- Only 11% of the Meadowlands residents consider that mining pollutes water;
- Few people (27%) believe mining brings in migrant labour; and
- Only 10% hold the view that mining leads to xenophobia.
6.4 Doornkop Informal Settlement in Snake Park

6.4.1 History and demography of Doornkop

The demographic statistics for Doornkop are not to be found on the pages of Statistics South Africa because they are subsumed into the statistics of Dobsonville. It is estimated that Doornkop has a population of some 2,500 people living in shacks, near the Doornkop tailings. Some have now been accommodated in RDP housing within the flood plain of one of the tributaries of the Klipspruit.

Photos 49: Doornkop informal settlement

Harmony’s Doornkop Gold Mine is to the west of Snake Park, and the old unmaintained Doornkop tailings are to the north. Of the respondents to the household health survey, 73.3% were women, and 43.3% had lived in Snake Park all their lives, while another 43.3% had lived there for more than 10 years. Unlike the other communities surveyed, 63.3% of the respondents lived in shacks, while only 26.6% lived in RDP houses. Many of the RDP houses were in the swampy floodplain of a stream that is fed from runoff from the Doornkop tailings dam.

6.4.2 Most common illnesses in Doornkop (in Snake Park) households

Doornkop is the exact opposite of Riverlea when it comes to asbestos, because only 6.5% of the dwellings have asbestos roofing in this community, compared to 97% in Riverlea. The household health complaints were dominated by coughing, which affected 50.7% of the respondents, followed by fever (24.6%). Asthma and TB followed at 5.8% and sinus problems at 4.3%. The cumulative respiratory problems (cough, sinus, asthma and TB) added up to
66.6% of health complaints in this community. All the households were connected to electricity, although many connections were ‘illegal’ and we observed that electricity supply was often disrupted by load shedding; thus coal, paraffin and wood would be the only factors affecting respiratory problems in the community during times of load shedding. Smoking in households in the Doornkop households surveyed in Snake Park was low compared to the households surveyed in other communities; about 179 cigarettes are smoked per day here.

Graph 13: Reasons for seeking healthcare in Doornkop (Snake Park)

Of the surveyed residents, 59.6% had required healthcare in the 30 days previous to being questioned, while another 21.1% had sought medical attention in the previous year. A few people (5.4%) indicated that there was only one healthcare provider (the local public clinic) in the area in which they lived. In Snake Park, 95.3% of the households received their treatment from a public nurse, and only 2.3% accessed a medical doctor. A key informant and monitor in the community found eight children aged between nine and 11 years with both mental and physical challenges. Researchers suspect either arsenate or lead poisoning, or exposure to radioactivity during the mothers’ pregnancies.
Radioactivity, Cerebral Palsy and other Birth Deformities

Uranium poisoning in Punjab first made news in March 2009, when a South African Board-Certified Candidate Clinical Metal Toxicologist, Carin Smit, visiting Faridkot city in Punjab, India, was instrumental in having hair and urine samples taken (2008/09) from 149/53 children respectively, who were affected with birth abnormalities, including physical deformities, and neurological and mental disorders. These samples were shipped to Microtrace Mineral Lab, Germany.

At the onset of the action research project, it was expected that heavy metal toxicity might be implicated as the reason for which these children were so badly affected. Surprisingly, high levels of uranium were found in 88% of the samples and in the case of one child the levels were more than 60 times the maximum safe limit.

A study, carried out among mentally retarded children in the Malwa region of Punjab revealed that 87% of children below 12 years and 82% beyond that age had uranium levels high enough to cause diseases. Uranium levels in samples of three children from Kotkapura and Faridkot were also 62, 44 and 27 times higher than normal.

Subsequently, the Baba Farid Centre for Special Children, Faridkot, sent samples of five children from the worst-affected village, Teja Rohela near Fazilka, which has over 100 children who are congenitally mentally and physically challenged, to the same lab.

Since 2009, Micro Trace Minerals of Germany has continued testing cancer patients living in the Malwa Region of Punjab, the area known for having the highest cancer rate in India. Patient evaluation and the collection of nail samples were carried out with the help of Prof. Chander Parkash of the Technical University of Punjab. As with previous studies, high uranium was found in nearly all the test persons. The work was published in the British Journal of Medicine and Medical Research in 2015.

Source: (Wikipedia, 2016)

Photo 50: Two physically and mentally challenged children - Doornkop

The images above show two of many severely physically and mentally challenged children found in Doornkop Informal Settlement and Snake Park. The exceptionally high Geiger reading was obtained on 17 November 2016 in the presence of an SABC television crew. In a
report published by the DWAF in 2003 on levels of radioactivity in the water in the Klip River catchment, it is reported that “two of the sites showed marginal radioactivity status for infants, namely the Klip River at Durban Deep mine downstream from the discharge from No 5 shaft, which needs closer monitoring, and the Russel stream at New Canada road. At both sites care should be taken that the water is not used by infants under one year of age.” (Kempster et al., 2003, p. 31) The readings obtained in the study at these points ranged from 1mSv/a to 10mSv/a. It is therefore only logical to deduce from this that the water referred to would be harmful to the unborn foetus, should pregnant mothers consume it. We also found other children with the same condition in other near-mine communities, including Riverlea and Reigerpark.

*Figure 11: Impact of radiation on the unborn foetus*

The figure above explains the impact of radiation on the unborn foetus. The health effects of radiation on the foetus can be severe, even at radiation doses too low to make the mother sick.
The Bench Marks Foundation notes several shortcomings in the study:

- It did not measure the water in the tailings evaporation ponds;
- It did not measure the water at spill points where tailings water flows directly into the Booysens Spruit, the Russel stream or the Klipspruit;
- It did not note that children from near tailings communities swim in this water;
- It does not mention that there are some communities who, prior to being linked to the Rand Water grid, possibly consumed water directly from tailings facilities along the edge of Soweto;
- It failed to look at seepage into RDP houses built in stream flood plains, or the artificial wetlands that result from tailings ground water plumes; and
- It confuses Russel Stream with Booysens Spruit. Russel Stream goes nowhere near New Canada Road.

**Figure 12: Prenatal radiation exposure**

- It is especially important that pregnant women follow instructions from emergency officials and seek medical attention as soon as emergency officials say it is safe to do so after a radiation emergency.
  - A developing foetus is highly susceptible to health effects from radiation exposure because of the rapid rate of cell division.
- Prenatal radiation exposure occurs when the mother’s abdomen is exposed to radiation from outside her body.
  - A pregnant woman who accidentally swallows or breathes in radioactive materials could absorb them into her bloodstream. From the mother’s blood, radioactive materials might pass through the umbilical cord to the foetus or concentrate in areas of the mother’s body near the womb (such as the urinary bladder) and expose the foetus to radiation.
- The possibility of severe health effects depends on the gestational age of the foetus at the time of exposure and the amount of radiation it is exposed to.
  - Foetuses are particularly sensitive to radiation during their early development, namely between weeks 2 and 18 of pregnancy.
    - The health effects to the foetus can be severe, even at radiation doses too low to make the mother sick.
    - These can include stunted growth, deformities, abnormal brain function, or cancer that might develop sometime later in life.
- Women have an increased risk of fatal miscarriages. Foetuses are less sensitive to radiation during the later stages of pregnancy (after 18 weeks).
- Since the foetus is shielded by the mother’s abdomen, it is partially protected in the womb from radioactive sources outside the mother’s body. This means that the radiation dose to the foetus is lower than the dose to the mother for most radiation exposure events.

Source: Centre for Disease Control and Prevention, 2017
6.4.3 Comparing Doornkop (Snake Park) to the control community of Danville

A total of 32.4% of Diepkloof residents complained about coughing, while only 14% of Danville residents complained of the same problem. A total of 8.1% of households in Diepkloof complained about sinusitis, whereas only 2.3% of the households in Danville complained of the same. While 5.4% of the households in Diepkloof complained about asthma, 5.8% of households in Danville complained about this particular ailment. The levels of TB were more or less the same. However, in Doornkop 2.9% of the households reported that eczema was a problem; it affected only 1.2% of the households in Danville. Cumulatively, only 25.6% of the households suffered from respiratory problems (cough, sinus, asthma and TB) in Danville, whereas the respiratory ailments in the Doornkop households affected 66.6% of the households. These two communities are similar in all ways. In Diepkloof 53.3% of the homes have asbestos roofs, only slightly more than Danville, where 52.6% of households reported that they had asbestos roofs. The main difference is that Diepkloof is surrounded by mine dumps on the East and North.

Graph 14: Reasons for seeking healthcare in Danville

Doornkop is part informal settlement, part RDP housing, of which many of the houses are located within the annual floodplain of a river that is fed straight from the Doornkop tailings. A total of 50.7% of Doornkop residents complained about coughing, while only 14% of the Danville residents complained of the same problem. A total of 4.3% of households in Doornkop households complained about sinusitis, whereas only 2.3% of households in Danville complained of the same. In Doornkop, 5.8% of households complained about asthma, as did the households in Danville. The levels of TB were also more or less the same. However, in Doornkop 2.9% of households reported that eczema was a problem which affected only 1.2% of the households in Danville. Cumulatively, only 25.6% of the households
suffered from respiratory problems (cough, sinus, asthma and TB) in Danville, whereas the respiratory ailments in Doornkop households affected 66.6% of the households. These two communities are different in that asbestos does not feature at all in Doornkop, while 52.6% of the households reported having asbestos roofs in Danville. Another difference is that Doornkop is located in the shadow of the abandoned Doornkop tailings, which lacks plant cover and maintenance.

6.4.4 Dust and tailings dams in Doornkop

*Photo 51: Doornkop tailings and surrounding communities*

During visits by the Bench Marks research team to Snake Park during the summer months, children were frequently found swimming in the tailings’ evaporation ponds. This is of great concern, given that the tailings are acidic and contain heavy metals such as uranium, arsenic and lead.

*Photo 52: Children swimming in tailings water below the Doornkop tailings waste facility*
The tailings pictured above are entirely accessible to the public; there are no guards, no fences and no warning signs. Children are swimming in the acidic, toxic tailings water below the Doornkop TWF. According to informants, the City of Johannesburg and the Department of Agriculture are encouraging people to invade the 500m exclusion zone around the tailings to take up farming. This is without prior research regarding the suitability of this land, given that it is covered in tailings dust fallout and tailings water seepage and spills. These farmers do not have piped water, and it is almost certain that their livestock is watered with tailings water. Seen in the photograph below is tailings mud flooding into land from Doornkop TWFs, occupied by small scale informal farmers (January 2017).

*Photo 53: Tailings mud flooding into land from Doornkop tailings waste facility*

![Photo 53](image3.png)

*Photo 54: Breach in the wall of evaporation/holding pond*

![Photo 54](image2.png)

A clear breach in the wall of the evaporation/holding pond below Doornkop TWF is evident in the photograph taken in January 2017. In the photograph below, tailings water streaming
through a breach in the tailings pond wall below the Doornkop TWF can be seen (January 2017).

*Photo 55: Tailings water streaming through breach in tailings pond wall*

![Image of tailings water streaming through breach in tailings pond wall](image)

*Photo 56: Farming in a tailings wasteland below Doornkop tailings waste facility*

![Image of farming in a tailings wasteland below Doornkop tailings waste facility](image)

The residents of the Doornkop informal settlement, be they in shacks or in RDP housing, also suffer the inconvenience of tailings-polluted water bubbling up through their floors during the rainy season, because they are living within the floodplain of a stream, into which runoff from the Doornkop tailings is spilling.
6.4.5 What do the Doornkop (Snake Park) people think of having a mine as a neighbour?

It should be mentioned that the perception of the Doornkop community, according to the survey results, is remarkably different from the other communities. This community seems to be indifferent to mining in the area.

- When asked whether they thought that mining activities around the community affected their health, only 5.6% of Doornkop community residents answered in the affirmative; and
- Only 40.5% of the interviewees in the community thought that the mine was not a good neighbour, although 100% of them believed that the mine was responsible for air pollution and 98.1% believed that the mine caused water pollution.

Although the Doornkop residents admitted that mining activities in the area polluted the air and water, brought migrant workers to the community (93.5%) and did not rehabilitate their operations (76%), they did not link these issues to poor health and well-being.

7. CONCLUSION

This report provided a socio-geological and historical overview, answering key questions about popular international and national perceptions about Soweto and the fact that,
although the first forced resettlements of people to Kliptown (a township in Soweto) took place between 1904 and 1906, Soweto’s recorded history seems to start only with the student uprisings of 1976.

The report proceeded to give an account of the geological history of the Witwatersrand in general and the basin in which Soweto, as a collection of townships, evolved. This geological history is important because many of the positive and negative impacts of mining from the longest-lasting gold reef in the world derive from it. These impacts are those on water, air, soil, ecosystems, and human health and well-being. Hydrology and meteorology were also investigated because, on the Rand, the predominant directions of the wind will determine ‘who eats dust’, and in which direction sewage and waste flows.

The history of Soweto followed, showing how it was shaped by concerns for the health and well-being of Johannesburg’s ‘white European’ population and their racial attitudes towards the ‘black African’ population. The dependence of the ‘white’ population, and that of the mining industry on the cheap labour supplied by the black population, led to an overdeveloped suburban society on the northern side of the ridge that separates Johannesburg from the underdeveloped, poverty stricken Soweto, in which Johannesburg’s black working class was accommodated in cheap dormitory housing. This separation of races was central to apartheid, which had a political dimension, an economic/class dimension, a physical-geographical dimension, as well as an ecological dimension. The role of successive governments and of mining interests in the evolution of Soweto was carefully traced. The tragedy of post-apartheid South Africa is that authorities have done nothing to change the spatial/geographical arrangements of apartheid – the poor continue to be black, working class, marginalised and trapped on the worst land in Gauteng, and living in substandard housing.

Finally, the results of household health surveys done in five Soweto communities, namely Riverlea, Diepkloof, Meadowlands, and the Doornkop informal settlements of Snake Park and Davidsonville, were shared. These communities were then compared to the results of a control group in Danville, Mafikeng. These results raise issues regarding ill-health and their possible origins in the impacts of mining along the eastern, northern and north-western rim of Soweto. Of concern here is the preponderance of respiratory problems in Soweto households. Also worrying is the complete disregard for legislative and regulatory requirements concerning TWFs, whether they are in the process of being re-mined, abandoned, ownerless or derelict. It is disturbing that safety exclusion zones around mine waste facilities have not been maintained, having instead been invaded by both formal property developers and informal settlers. Clearly, local government, the banks and property developers have little concern for the Constitutional right of citizens to a healthy and safe environment.
8. FINDINGS AND RECOMMENDATIONS

The research team focused on a very specific area in South Africa. Consequently, some of the recommendations relate specifically to the area studied, but the problems which have been uncovered are not unique to these communities. Therefore the recommendations to local, provincial and national government are not applicable to these communities only, but to mine impacted communities nationally.

Drawing on the research results the following findings and recommendations are made:

8.1 Government

8.1.1 Departments of Mineral Resources, Environmental Affairs, and Water and Sanitation

8.1.1.1 Summary of findings on Acid Mine Drainage

The research has shown that AMD is a real threat to the well-being of the inhabitants of all the townships adjacent to mining activities, be they active operations, or ownerless, derelict or abandoned mines. AMD threatens communities, farmers and water consumers who bear the brunt downstream, but the danger is not limited to liquid waste from mining activities entering the natural water sources in and around Soweto, but also comes from sewage, industrial and municipal waste.

Bench Marks Foundation recommendations regarding Acid Mine Drainage

To begin to address the very real problems posed by AMD, the government must:

- Prevent the future loss of aquatic habitat to AMD;
- Record and clean up existing acid-generating mine sites;
- Improve public access to information on monitoring and enforcement of AMD treatment and reclamation; and
- Prevent future AMD by improving environmental risk assessment and adopting a liability prevention approach to future AMD mine assessments.

8.1.1.2 Summary of findings on the regulatory framework

While laws and regulations exist and existed in the past, failure by previous and current governments to enforce the laws and regulations has caused the problems associated with mining to spiral out of control. Not only did mining consume and waste huge quantities of water in the past (and continues to do so at present), but abandoned, ownerless and derelict mines continue to poison water and will continue to do so in the future unless this situation is addressed.
Regarding residential exposure to radon, Herbst’s recent research was focused on specifying the effect of residential radon on lung cancer risk. In these studies, scientists measure radon levels in the homes of people who have lung cancer and compare them to the levels of radon in the homes of people who have not developed lung cancer. Despite the location of thousands of low-cost township and location houses near and sometimes on mine waste, radon is never measured in or outside these houses by the relevant government authorities (Ismael, 2016). Radon measurements of mine waste and in houses must be monitored by the government, and be successfully minimised to comply with international requirements.

**Bench Marks Foundation recommendations on the regulatory framework governing mining**

The above matters fall within the purview of the departments of Water and Sanitation, the Environment and Mineral Resources, and must be dealt with on a short-, medium- and long-term remedial basis.

**8.1.2 National Nuclear Regulator (NNR), Department of Health, Department of Human Settlements and National Institute for Occupational Health (NIOH)**

**8.1.2.1 Summary of findings on the need for radon regulations**

South Africa lacks adequate radon regulations for the building industry and residential property development. Our research has found that building contractors and residents frequently load toxic and radioactive tailings sand, which is retailed and used in the cement mix to construct or extend houses in Soweto. Radon is the second highest cause of lung cancer after smoking. The impact of radon on the residents of low-cost township housing in Soweto has been ignored, and this criminal neglect must be set right.

**Bench Marks Foundation recommendations on radon regulations**

- Given that quartz-rich inhalable dust in residential settings are occurring at levels that exceed occupational health standards, the Bench Marks Foundation believes that government and mine owners should be obliged to compensate residents living in the proximity of TWFs for compromising their health.
- We call on the NNR and the Department of Health to undertake an epidemiological study on the impacts of mining on the health of communities in the areas we have studied, focusing particularly on the respiratory illnesses caused by the dust from the mine dumps. This must include the impacts of radioactive mine waste, particularly uranium, which produces radon when it decays.
- The NNR should immediately draft concept legislation for tabling in parliament, and after the requisite consultation, the bill should be passed into legislation. Such legislation should not include any exclusionary clauses.
• The NNR, the Department of Health and NIOH should do proper epidemiological research into the impact of Radon on Riverlea, Diepkloof, Meadowlands, Doornkop/Snake Park and Davidsonville.

8.1.3 South African Human Rights Commission (SAHRC)

8.1.3.1 Summary of findings on human rights violations

Regarding the impacts of waste from or at ownerless and derelict mines, this study revealed severe violations of human rights through the decisions made about destructive industrial, environmental and health impacts on the lives of the inhabitants of the researched townships. The people of Riverlea and Soweto did not choose to live where they are. These communities have also been kept in the dark about the dangers posed by surrounding mine waste polluting water and impacting air quality (dust through poor waste management and ongoing waste from reclamation operations). Community representatives are seemingly excluded by design from pollution-monitoring committees. In addition, the mining TWFs are all unguarded, unfenced and poorly managed, posing a serious risk of illnesses and disease in the researched communities.

Bench Marks Foundation recommendations to the South African Human Rights Commission

The SAHRC must investigate the pollution legacy, including the denial of, or the violations of the Constitutional right of the residents of these communities to a healthy and safe environment, as well as the right of people to represent themselves in matters affecting them. The communities would surely welcome public hearings in the affected areas.

8.1.4 The Green Scorpions (Department of the Environment Special Investigations Unit)

8.1.4.1 Summary of findings regarding environmental transgressions

Both legacy and current, in some instances, repeated transgressions of environmental laws and serious instances of life-threatening pollution were identified in this report.

Bench Marks Foundation recommendations to the Green Scorpions

We recommend that the Green Scorpions and the Department of Environmental Affairs investigate the ever-worsening environmental health situation facing the communities of Riverlea, Diepkloof, Meadowlands and Snake Park. Such an investigation must seek redress and reparation from the following groups:

• Former owners of abandoned, ownerless and derelict mines, as well as the Chamber of Mines;
• Department of Mineral Resources;
• Department of Environmental Affairs;
• Department of Health;
• City of Johannesburg; and
• NNR.

8.2 Parliament

8.2.1 Summary of findings concerning the prevalence of asbestos

Asbestos is still extensively present in Soweto and Riverlea, affecting both air quality and soil, even though the use of all asbestos was banned in South Africa in March 2008.

Bench Marks recommendations to Parliament on the issue of asbestos

• Parliament, through its Portfolio Committee for Environmental Affairs, based on its experience in convening national asbestos summits, should investigate why so many communities, such as Riverlea, remain exposed to asbestos, despite the complete banning of all use of this building material on March 28, 2008.

• We accordingly call upon Parliament to establish a National Parliamentary Inquiry into compensation and other remedial systems to make necessary changes to bring to an end the impacts of asbestos on Soweto and Riverlea communities. Furthermore, the proposed inquiry should investigate how communities can have a direct say in the Multidisciplinary Asbestos Advisory Group (MAAG) that was to have been set up following the 1998 Asbestos National Summit.

8.2.2 Summary of findings on inclusive health and the right to a healthy and safe environment

The research report shows that communities are not properly consulted before mining licences are issued and that their right to free, prior and informed consent and their right to say no to mining are serially ignored. Communities are also excluded from the Environmental Impact Assessments and Social and Labour Plan processes. This situation emanates from weak legislation and the subversion of existing laws and regulations by mining companies, often with the collusion of government officials.
Bench Marks Foundation recommendations to Parliament on inclusive health and the right to a healthy and safe environment

It is recommended that Parliament, particularly the relevant portfolio committees of Mineral Resources and Environmental Affairs, urgently intervene to remedy the legislative and policy (political) exclusion of mining communities or communities affected by mining. This will mean urgently working to amend the Mine Health and Safety Act 29 of 1996, as well as the National Health Laboratory Service Act No. 37 of 2000, not excluding the National Water Amendment Act 27 of 2014 and the Mineral and Petroleum Resources Development Act No. 28 of 2002 to include mining and mining-affected communities. This will go a long way towards fulfilling the Constitutional guarantees to the right to a healthy and safe environment, which requires the state to take legislative and other measures to achieve the progressive realisation of these rights.

8.2.3 Summary of findings on abandoned, ownerless and derelict mines

There are as many as 6 000 abandoned, ownerless and derelict mines in South Africa, with an estimated 600 in Gauteng alone. These mines pose serious health and safety risks for near-mine communities. The Bench Marks Foundation notes that the mine closure fund located in the DMR stands at R50 billion, with the fund for Gauteng standing at R10 billion.

Bench Marks Foundation recommendations to Parliament on abandoned, ownerless and derelict mines

Parliament should pass laws for the creation of a special investigative unit, with mining community participation and oversight, also involving civil society organisations, to trace and find the owners of these so-called ownerless and derelict mines, with the aim of holding these polluters accountable in line with the ‘polluter pays’ principle recognised in the National Environmental Management Act.

Furthermore, it needs to be ensured that all the relevant authorities are empowered to ensure proper closure of mines and that the real and true costs of such closures are kept in accounts by Treasury. The BMF believes that prevention and strong regulations are better cures than after-the-fact responses.

8.3 Metro and Local Governments

8.3.1 Summary of findings on the geographical setting of townships and industrial areas

On the geographical setting of townships/industrial areas, and the allocation of mining licences, during our research we observed:
• The calculated geographical location of townships near mine TWFs such as tailings dams or, alternatively, the deliberate siting of tailings dams near townships, disregarding the common norm of not building within the 500m exclusion zones around mine waste facilities;
• The deliberate location of industrial zones near mine waste facilities;
• The deliberate location of mine waste near rivers and water sources, and lately the allocation of mining licences for the catchment areas of important rivers;
• Extensive spillage from mining operations and mine TWFs into streams, wetlands and rivers; and
• The allocation of mining licences for areas in which 500m exclusion zones are common in Gauteng and which are disasters waiting to happen. Mines within 500 meters from major roads, railway lines, housing, schools, electric power lines, and petroleum and water pipelines are shortsighted and not in the interest of public health and safety. In fact, Meadowlands, Riverlea, Davidsonville, Reigerpark and Delmorpark are all townships in which housing is located without any attention to exclusion zones.

**Bench Marks Foundation recommendations to Metro and Local Governments**

The above matters require the urgent attention from all three spheres of government to, among others, provide the following:

• Better protection of heritage sites, e.g. George Harrison Park and TC Esterhuysen School;
• Better protection in terms of the Constitutional right to a healthy and safe environment, e.g. TC Esterhuysen School and Johannesburg College and all near mine communities;
• Stricter enforcement of building laws and regulations that prohibit building in flood plains, such as in Diepkloof and Doornkop;
• Stricter enforcement of waste management laws and regulations, and of the 500m exclusion zones. The Bench Marks Foundation insists that exclusion zones of between 500 and 2000 meters become law instead of just being a rule of thumb norm.
• Stricter enforcement of SLPs and the Mining Charter; and
• Effective monitoring and implementation of remedial steps to be taken by government (local government sphere), and the DMR.
8.4 National Cancer Association of South Africa (CANSA) and the National Institute for Occupational Health (NIOH)

8.4.1 Summary of findings on dust

The research has shown that dust levels from mine waste downwind into communities pose a constant irritation and threat to the health and well-being of the inhabitants of the adjacent townships.

Bench Marks Foundation recommendations to CANSA and NIOH regarding dust

The Bench Marks Foundation calls on the National Cancer Association of South Africa and on the NIOH to do the necessary research into the dust levels in the researched communities, especially because research has found that the levels in these communities in some cases exceed that which is considered the upper limit in the workplace.

8.5 Department of Mineral Resources and Mining Companies

8.5.1 Summary of findings on mining activities

- Mining voids filling up with water (see Item 4.1.3). Heavy metal contamination and leaching heavy metal pollution is caused when metals such as arsenic, cobalt, copper, cadmium, lead, silver, uranium and zinc contained in excavated rock or exposed in an underground mine come into contact with water.

- Processing chemicals pollution. This kind of pollution occurs when chemical agents (such as cyanide or sulphuric acid used by mining companies to separate the target mineral from the ore) spill, leak, or leach from the mine site into nearby water bodies.

- Land subsidence and sinkholes in the great dolomitic belts that underlie most of the South African goldfields caused by mining act as drains and sinks into which the underground water flows, leaving the current and future generations with a massive, dangerous and expensive environmental challenge.

- Mine TWFs: It is common that TWFs are unguarded, unfenced and not properly signposted. Where there are warning signs, these are often inadequate and downright misleading. There is also no attempt to educate near-mine communities about the dangers posed by derelict, abandoned and ownerless mines;

- Adjacent communities: The presence of uranium and other heavy metals in the mine waste of Johannesburg is now an accepted fact (Truswell, 1970, pp. 38-39). Less well-known are the health impacts of radiation on near-mine communities;

- There are 6 000 ownerless, derelict and abandoned mines nationwide and some 600 in the province alone (Council for Geoscience, 2017), and the biggest contributor to...
the solid waste stream in South Africa is mining waste (77%), followed by pulverised fuel ash (8%), agricultural waste (6%), urban waste (5%) and sewage sludge (4%) (Institute of Waste Management Southern Africa, 2017);

- Legacy issue. The problem in South Africa is that even after banning asbestos in 2008, various authors are still arguing that the asbestos exposure in Soweto is ‘not so bad’ and ‘low’; and
- In the case of dust surveillance, the question arises: why do we find bucket systems, instead of more accurate electronic systems deployed in densely populated, poor and marginalised communities living in and around mine dumps in South Africa? The industry will claim that the electronic systems are too expensive, but such systems are recommended for the proper collection of data.

Bench Marks Foundation recommendations to the Department of Mineral Resources and Mining Companies regarding water, waste and asbestos

The following must be monitored and corrected by mining companies and, where necessary, assisted by government:

- Unfenced, un-signposted and unsecured mine waste, particularly slimes/tailings accessible to the unknowing public;
- Informal settlers residing on abandoned mine sites;
- People stripping radioactive materials from abandoned mine sites and uranium processing plants and selling them to scrap metal dealers;
- People using tailings sand as a building mix for concrete, cement and plaster to build houses;
- Dust blown into the air from slimes/tailings dams and people inhaling or ingesting the dust;
- Runoff of mine water from tailings dams or seepage into ground water;
- All plants can absorb radioactive substances from the soil in which they grew. If fruits, vegetables or other plants are consumed as food, they also get into the human body;
- Decay of naturally occurring and mine deposited uranium into radon gas in houses and buildings.
- All ownerless, derelict and abandoned mines adjacent to the researched townships must be identified, and the owners should be held responsible for tailings, dust, radiation and water pollution;
- Effective remedial steps must be taken by mining companies to contain and ameliorate the effects of the solid waste stream. Local government needs to monitor sewage disposal by mines and to implement corrective action;
- Oversights regarding the management of mining TWFs must be corrected by mining companies, and public awareness projects must be instituted and presented by them;
- Asbestos that was used in the construction of buildings must be replaced with government-agreed upon cladding; and
• Electronic dust surveillance systems should be installed by mines for the proper measuring of dust emissions in the researched townships.

8.6 Communities, Civil Society, Education and Faith-Based Organisations

8.6.1 Summary of findings on community awareness

The research has found that, except for Riverlea, community awareness is low and that structures for raising awareness are limited. Furthermore, the larger parts of the communities are ignorant about the hazards associated with mining.

Bench Marks Foundation recommendations regarding education and awareness programmes to communities, civil society, education and faith-based organisations

That awareness raising programmes based on the findings of this research be facilitated by the community monitors of the Bench Marks Foundation.

8.7 The Media

Bench Marks Foundation recommendations to public and private media
We call on all media to cover mine impact, health and safety stories diligently and to report truthfully about the true cost of mining, in particular, its impact on poor mining communities. National water sovereignty and security and the health and well-being of residents living in near mine communities depend on media scrutiny and public awareness from such scrutiny.
LIST OF REFERENCES


## APPENDIX 1: SOWETO HEALTH STUDY QUESTIONNAIRE

### Question 1: How old are you?

<table>
<thead>
<tr>
<th>Age</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger than 20</td>
<td>1</td>
</tr>
<tr>
<td>20–29</td>
<td>2</td>
</tr>
<tr>
<td>30–39</td>
<td>3</td>
</tr>
<tr>
<td>40–49</td>
<td>4</td>
</tr>
<tr>
<td>50–59</td>
<td>5</td>
</tr>
<tr>
<td>60–69</td>
<td>6</td>
</tr>
<tr>
<td>70 and older</td>
<td>7</td>
</tr>
</tbody>
</table>

### Question 2: What is your gender?

<table>
<thead>
<tr>
<th>Gender</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1</td>
</tr>
<tr>
<td>Female</td>
<td>2</td>
</tr>
</tbody>
</table>

### Question 3: In which area are you residing?

<table>
<thead>
<tr>
<th>AREA</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diepkloof</td>
<td>1</td>
</tr>
<tr>
<td>Meadowlands</td>
<td>2</td>
</tr>
<tr>
<td>Riverlea</td>
<td>3</td>
</tr>
<tr>
<td>Snake Park</td>
<td>4</td>
</tr>
</tbody>
</table>

### Question 4: How long have you lived in this area?

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 years</td>
<td>1</td>
</tr>
<tr>
<td>5–9 years</td>
<td>2</td>
</tr>
<tr>
<td>10–20 years</td>
<td>3</td>
</tr>
<tr>
<td>All your life</td>
<td>4</td>
</tr>
</tbody>
</table>

### Question 5: How would you describe your dwelling?

<table>
<thead>
<tr>
<th>TYPE OF DWELLING</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shack/Zozo</td>
<td>1</td>
</tr>
<tr>
<td>Backyard room</td>
<td>2</td>
</tr>
<tr>
<td>RDP House</td>
<td>3</td>
</tr>
<tr>
<td>Two Roomed House</td>
<td>4</td>
</tr>
<tr>
<td>Three or more roomed house</td>
<td>5</td>
</tr>
</tbody>
</table>

### Question 6: Does your house have an asbestos roof?

<table>
<thead>
<tr>
<th></th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
</tr>
</tbody>
</table>

### Question 7: How many people live in your household?

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 person</td>
<td>1</td>
</tr>
<tr>
<td>2 persons</td>
<td>2</td>
</tr>
<tr>
<td>3 persons</td>
<td>3</td>
</tr>
<tr>
<td>4 persons</td>
<td>4</td>
</tr>
</tbody>
</table>
Question 8: When was the last time that either you as an adult or anyone else in your household needed healthcare?

<table>
<thead>
<tr>
<th>WHEN</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last 30 days</td>
<td>1</td>
</tr>
<tr>
<td>Between 1 month and less than 1 year ago</td>
<td>2</td>
</tr>
<tr>
<td>Between 1 year and less than 2 years ago</td>
<td>3</td>
</tr>
<tr>
<td>Between 2 years and less than 3 years ago</td>
<td>4</td>
</tr>
<tr>
<td>Between 3 years and less than 5 years ago</td>
<td>5</td>
</tr>
<tr>
<td>More than 5 years ago</td>
<td>6</td>
</tr>
</tbody>
</table>

Question 9: Who was the last person who needed healthcare in your household?

<table>
<thead>
<tr>
<th>WHO</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yourself</td>
<td>1</td>
</tr>
<tr>
<td>Your husband/wife</td>
<td>2</td>
</tr>
<tr>
<td>Your mother</td>
<td>3</td>
</tr>
<tr>
<td>Your father</td>
<td>4</td>
</tr>
<tr>
<td>Your sister</td>
<td>5</td>
</tr>
<tr>
<td>Your brother</td>
<td>6</td>
</tr>
<tr>
<td>Your son</td>
<td>7</td>
</tr>
<tr>
<td>Your daughter</td>
<td>8</td>
</tr>
<tr>
<td>Your aunt</td>
<td>9</td>
</tr>
<tr>
<td>Your uncle</td>
<td>10</td>
</tr>
<tr>
<td>Your grandfather</td>
<td>11</td>
</tr>
<tr>
<td>Your grandmother</td>
<td>12</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
</tr>
</tbody>
</table>

Question 10: Thinking of the last time you [or someone in your household] needed to see a healthcare provider who could treat your condition, how many healthcare providers are there around in your area who you could choose from?

(Number)

Question 11: Which reason best describes why you [or someone from your household] last needed healthcare?

<table>
<thead>
<tr>
<th>REASON</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>High fever</td>
<td>1</td>
</tr>
<tr>
<td>Severe diarrhoea</td>
<td>2</td>
</tr>
<tr>
<td>Cough</td>
<td>3</td>
</tr>
<tr>
<td>Sinusitis</td>
<td>4</td>
</tr>
<tr>
<td>Asthma</td>
<td>5</td>
</tr>
<tr>
<td>Tuberculosis (TB)</td>
<td>6</td>
</tr>
<tr>
<td>Silicosis</td>
<td>7</td>
</tr>
<tr>
<td>Cancer</td>
<td>8</td>
</tr>
<tr>
<td>HIV/Aids</td>
<td>9</td>
</tr>
<tr>
<td>Sexually Transmitted Infections (STI)</td>
<td>10</td>
</tr>
<tr>
<td>Eczema (Skin lesions/Itching)</td>
<td>11</td>
</tr>
</tbody>
</table>
**Question 12:** Which reason best describes why you [or someone from your household] needs healthcare?

<table>
<thead>
<tr>
<th>REASON</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical (Eye problems)</td>
<td>12</td>
</tr>
<tr>
<td>Immunization</td>
<td>13</td>
</tr>
<tr>
<td>Antenatal consultation</td>
<td>14</td>
</tr>
<tr>
<td>Family planning</td>
<td>15</td>
</tr>
<tr>
<td>Childbirth</td>
<td>16</td>
</tr>
<tr>
<td>Dental care</td>
<td>17</td>
</tr>
<tr>
<td>Arthritis</td>
<td>18</td>
</tr>
<tr>
<td>Heart disease</td>
<td>19</td>
</tr>
<tr>
<td>Bodily injury</td>
<td>20</td>
</tr>
<tr>
<td>Minor surgery</td>
<td>21</td>
</tr>
<tr>
<td>Other (Specify)</td>
<td>22</td>
</tr>
</tbody>
</table>

**Question 13:** Generally, do you think that any of the above mentioned conditions affected you or members of your household, are caused by mining activities (past or present)?

- Yes 1
- No 2
- Not Sure 3

**Question 14:** In your experience of the mining activities, near or around your area, do they

<table>
<thead>
<tr>
<th>Do they...</th>
<th>Not at all</th>
<th>Maybe</th>
<th>Definitely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollute the air</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Pollute the water</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Bring in migrant workers</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Contribute to xenophobia 1 2 3
Provide jobs for local people 1 2 3
Rehabilitate its operations 1 2 3
Bring in Zama-Zamas 1 2 3
Cause traffic problems 1 2 3
The mine is a good neighbour 1 2 3

Question 15: Do you or any members of your household smoke?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Question 15: If you or anyone else in your household smokes, how many cigarettes are smoked in a day?

____________________

Question 16: Do you use any of the following forms of energy in your household?

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Electricity</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2.Coal</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3.Wood</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4.Paraaffin</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Question 17: The last time you, or any member of your household, needed healthcare, did you get healthcare?

<table>
<thead>
<tr>
<th></th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
</tr>
</tbody>
</table>

Question 18: If your answer was no to Question 17, which reasons best explain why you, or your household member, did not get healthcare? (You may choose more than one option)

<table>
<thead>
<tr>
<th>REASON</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Could not afford the cost of the visit</td>
<td></td>
</tr>
<tr>
<td>2.No transport</td>
<td></td>
</tr>
<tr>
<td>3.Could not afford the cost of transport</td>
<td></td>
</tr>
<tr>
<td>4.The healthcare provider's drugs or equipment are inadequate</td>
<td></td>
</tr>
<tr>
<td>5.The healthcare provider's skills are inadequate</td>
<td></td>
</tr>
<tr>
<td>6.You were previously badly treated</td>
<td></td>
</tr>
<tr>
<td>7.Could not take time off work or had other commitments</td>
<td></td>
</tr>
<tr>
<td>8.You did not know where to go</td>
<td></td>
</tr>
<tr>
<td>9.You thought you were not sick enough</td>
<td></td>
</tr>
<tr>
<td>10.You tried but were denied healthcare</td>
<td></td>
</tr>
<tr>
<td>11.Other (Specify)</td>
<td></td>
</tr>
</tbody>
</table>

Question 19: When you last needed healthcare, where did you get care?

<table>
<thead>
<tr>
<th>WHERE</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>At a public clinic, excluding an overnight stay</td>
<td>1</td>
</tr>
<tr>
<td>At a public hospital where you stayed overnight</td>
<td>2</td>
</tr>
<tr>
<td>At a mine hospital where you stayed overnight</td>
<td>3</td>
</tr>
<tr>
<td>At a mine clinic, excluding an overnight stay</td>
<td>4</td>
</tr>
<tr>
<td>At a private hospital where you stayed overnight</td>
<td>5</td>
</tr>
</tbody>
</table>
**WHERE**

<table>
<thead>
<tr>
<th>Where</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>At private clinic where you stayed overnight</td>
<td>6</td>
</tr>
<tr>
<td>At Home</td>
<td>7</td>
</tr>
</tbody>
</table>

**Question 20:** Who provided you with the healthcare that you required? (Choose one option only).

<table>
<thead>
<tr>
<th>Type</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Doctor</td>
<td>1</td>
</tr>
<tr>
<td>Psychiatrist</td>
<td>2</td>
</tr>
<tr>
<td>Nurse</td>
<td>3</td>
</tr>
<tr>
<td>Midwife</td>
<td>4</td>
</tr>
<tr>
<td>Dentist</td>
<td>5</td>
</tr>
<tr>
<td>Optician</td>
<td>6</td>
</tr>
<tr>
<td>Physiotherapist</td>
<td>7</td>
</tr>
<tr>
<td>Traditional healer</td>
<td>8</td>
</tr>
<tr>
<td>Other (Specify)</td>
<td>9</td>
</tr>
</tbody>
</table>

**Question 21:** The last time you, or a household member, sought medical care, did the healthcare provider prescribe any medicine for you or a household member?

<table>
<thead>
<tr>
<th>X</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
</tr>
</tbody>
</table>

**Question 22:** If the answer to Question 22 was yes, of the medicines that were prescribed for you or a household member, how many of them were you able to get?

<table>
<thead>
<tr>
<th>Amount</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of them</td>
<td>1</td>
</tr>
<tr>
<td>Most</td>
<td>2</td>
</tr>
<tr>
<td>Some</td>
<td>3</td>
</tr>
<tr>
<td>Very few</td>
<td>4</td>
</tr>
<tr>
<td>None of them</td>
<td>5</td>
</tr>
</tbody>
</table>

**Question 23:** Which reason best explains why you, or the household member, did not get all the medicines you were prescribed?

<table>
<thead>
<tr>
<th>Reason</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Could not afford</td>
<td>1</td>
</tr>
<tr>
<td>Could not find all medicines</td>
<td>2</td>
</tr>
<tr>
<td>Did not believe all the medicines were needed</td>
<td>3</td>
</tr>
<tr>
<td>Started to feel better</td>
<td>4</td>
</tr>
<tr>
<td>Already had some medicines at home</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
</tr>
</tbody>
</table>

**Question 24:** How would you rate the way healthcare in your town involves you in deciding what services it provides and where it provides them?

<table>
<thead>
<tr>
<th>Rating</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>1</td>
</tr>
<tr>
<td>Good</td>
<td>2</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>3</td>
</tr>
<tr>
<td>Poor</td>
<td>4</td>
</tr>
<tr>
<td>Don’t know</td>
<td>5</td>
</tr>
</tbody>
</table>
Question 25: Are you, or any member of your household disabled?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
</tr>
</tbody>
</table>

Question 26: If your answer was yes to Question 25, who is disabled?

<table>
<thead>
<tr>
<th>WHO</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yourself</td>
<td>1</td>
</tr>
<tr>
<td>Your Husband/Wife</td>
<td>2</td>
</tr>
<tr>
<td>Your Mother</td>
<td>3</td>
</tr>
<tr>
<td>Your Father</td>
<td>4</td>
</tr>
<tr>
<td>Your Sister</td>
<td>5</td>
</tr>
<tr>
<td>Your Brother</td>
<td>6</td>
</tr>
<tr>
<td>Your Son</td>
<td>7</td>
</tr>
<tr>
<td>Your Daughter</td>
<td>8</td>
</tr>
<tr>
<td>Your Aunt</td>
<td>9</td>
</tr>
<tr>
<td>Your Uncle</td>
<td>10</td>
</tr>
<tr>
<td>Your Grandfather</td>
<td>11</td>
</tr>
<tr>
<td>Your Grandmother</td>
<td>12</td>
</tr>
<tr>
<td>Other (Specify)</td>
<td>13</td>
</tr>
</tbody>
</table>

Question 27: During the past year, did you provide help to a relative or friend (adult or child), because this person has a long-term physical or mental illness or disability or is getting old and weak?

<table>
<thead>
<tr>
<th>Who</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, for a person living in the same household</td>
<td>1</td>
</tr>
<tr>
<td>Yes, for a person living in a separate household</td>
<td>2</td>
</tr>
<tr>
<td>No one</td>
<td>3</td>
</tr>
</tbody>
</table>

Question 28: Please tell me the kind of care you provided to this person(s)?

<table>
<thead>
<tr>
<th>How did you help?</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. You helped with personal care, such as going to the toilet, washing, getting dressed, or eating</td>
<td></td>
</tr>
<tr>
<td>2. You helped with medical care, like changing bandages and giving medicines</td>
<td></td>
</tr>
<tr>
<td>3. You helped with household activities such as meal preparation, shopping, cleaning, laundry</td>
<td></td>
</tr>
<tr>
<td>4. You watched over them since their behaviour can be upsetting or dangerous to themselves or others</td>
<td></td>
</tr>
<tr>
<td>5. You helped them to get around outside the home</td>
<td></td>
</tr>
</tbody>
</table>

Question 29: How important is "respectful treatment" for you at a medical facility by staff towards you?

<table>
<thead>
<tr>
<th>Would you say it is:</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely important</td>
<td>1</td>
</tr>
<tr>
<td>Very important</td>
<td>2</td>
</tr>
<tr>
<td>Moderately important</td>
<td>3</td>
</tr>
<tr>
<td>A little important</td>
<td>4</td>
</tr>
<tr>
<td>Not important at all</td>
<td>5</td>
</tr>
</tbody>
</table>
Question 30: How important is “respectful treatment” to you by the mining corporations operating near or around your community?

<table>
<thead>
<tr>
<th>Would you say it is:</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely important</td>
<td>1</td>
</tr>
<tr>
<td>Very important</td>
<td>2</td>
</tr>
<tr>
<td>Moderately important</td>
<td>3</td>
</tr>
<tr>
<td>A little important</td>
<td>4</td>
</tr>
<tr>
<td>Not important at all</td>
<td>5</td>
</tr>
</tbody>
</table>

Question 31: How important is consultation with you and your community by the mining corporations operating near or around your community?

<table>
<thead>
<tr>
<th>Would you say it is:</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely important</td>
<td>1</td>
</tr>
<tr>
<td>Very important</td>
<td>2</td>
</tr>
<tr>
<td>Moderately important</td>
<td>3</td>
</tr>
<tr>
<td>A little important</td>
<td>4</td>
</tr>
<tr>
<td>Not important at all</td>
<td>5</td>
</tr>
</tbody>
</table>

Question 32: How often do the mining companies near or around your communities consult with you and your community

<table>
<thead>
<tr>
<th>Always</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not so often</td>
<td>1</td>
</tr>
<tr>
<td>Sometimes</td>
<td>3</td>
</tr>
<tr>
<td>Never</td>
<td>4</td>
</tr>
</tbody>
</table>

Question 33: How important is “involvement in decision making” about you or your community to you?

<table>
<thead>
<tr>
<th>Would you say it is:</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely important</td>
<td>1</td>
</tr>
<tr>
<td>Very important</td>
<td>2</td>
</tr>
<tr>
<td>Moderately important</td>
<td>3</td>
</tr>
<tr>
<td>A little important</td>
<td>4</td>
</tr>
<tr>
<td>Not important at all</td>
<td>5</td>
</tr>
</tbody>
</table>

Question 34: How important is a clean, healthy and safe environment to you?

<table>
<thead>
<tr>
<th>Would you say it is:</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely important</td>
<td>1</td>
</tr>
<tr>
<td>Very important</td>
<td>2</td>
</tr>
<tr>
<td>Moderately important</td>
<td>3</td>
</tr>
<tr>
<td>A little important</td>
<td>4</td>
</tr>
<tr>
<td>Not important at all</td>
<td>5</td>
</tr>
</tbody>
</table>

Question 35: How important is “clear/understandable, transparent and honest communication” to you?

<table>
<thead>
<tr>
<th>Would you say it is:</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely important</td>
<td>1</td>
</tr>
<tr>
<td>Very important</td>
<td>2</td>
</tr>
<tr>
<td>Moderately important</td>
<td>3</td>
</tr>
<tr>
<td>A little important</td>
<td>4</td>
</tr>
<tr>
<td>Not important at all</td>
<td>5</td>
</tr>
</tbody>
</table>

LETTER 1: CENTRAL RAND GOLD

CENTRAL RAND GOLD (PTY) LTD
ATTENTION: BHEKI MDAKANE & TRACEY GEDDES

Dear Sir and Madam,

RE: MINING RELATED MATTERS IN THE RIVERLEA AREA WHERE MINING IS CURRENTLY BEING CARRIED OUT BY CRG UNDER MINING RIGHT GP 30/5/1/2 (140) MR

We refer to the above.

1. Subsequent to the community meeting we were placed in possession of your Social and Labour Plan. We have studied the document, and it is apparent that the document does not address the Riverlea community. Please confirm this.
   • We are advised that the mine was required to produce a SLP for each and every mining operation that it conducts in the respective areas and are in the process of seeking legal advice on your failure to include Riverlea in the SLP and not one blanket SLP covering all operations in Gauteng.

2. It has recently come to our attention that CRG is in the process of selling its local assets to Hiria Group Co. Media reports indicate that a memorandum of understanding has been concluded and the parties sought to conclude the sale by 31 March 2015. Please confirm whether this sale has in fact proceeded and if so the effective date of the sale. Note that the Hina Group cannot proceed with operations without community consultation.
   • We trust that any sale of the business agreement would disclose the issues relating to the Riverlea community and the mining operations therein.

3. We require confirmation that the mining operations in Riverlea will cease to commence. If so, please advise if you have prepared a Mine Closure Plan. If there is indeed a closure plan, the community needs to have access to it as it directly affects our safety and well-being.

4. As you are aware, we are concerned about the environmental impact of the mining. To this end, please provide us with a copy of the Environmental Impact Assessment as well as the Environmental Management Plan and any other environmental assessments conducted in relation to the mining in Riverlea.

5. We were further advised that CRG would attend to the rehabilitation of the area. Kindly confirm by way of a written report; the manner in which the rehabilitation would take place and period when it would be completed.
6. It has further come to our attention that the use of water for the mining operations may have been illegal. Kindly provide us with a copy of the water license issued in respect of the mining operations and/or agreement concluded with the school for use of their water use. Kindly also provide us with a copy of your waste management plan and license as these are also legal requirements for any mining operation.

7. Please note we are concerned with the presence of illegal miners at the mine shafts previously operated by you. There is no visible security and the illegal miners have taken advantage of same.
   - We demanded you place adequate security to prevent the illegal mining. We have addressed a letter to the local police and we request that your private security firm work in conjunction with SAPS to prevent the illegal mining.
   - You will appreciate that the illegal mining places the community at risk. There are many reports of violent conduct by the illegal miners above the fact that their conduct is illegal.
   - Please advise when we expect more stringent security measures to be put in place.

8. We previously advised that the failure to properly secure the mining area has exposed danger to the learners of the primary school.
   - You have not acceded to our request to have additional measures put in place to ensure the safety of the learners. If we do not receive an adequate action we will address the matter with the Department of Education.

Kindly respond as a matter of urgency to the issues raised herein.

Thank you very much

_________________________
RIVERLEA COMMUNITY FORUM
MINING COMMITTEE
(CHAIRMAN)
14th May 2015
MINUTES OF DRD MEETING WITH COMMUNITY:

<table>
<thead>
<tr>
<th>To:</th>
<th>Wayne Swanepoel</th>
<th>Date:</th>
<th>05 November 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>From:</td>
<td>Nestus Bredenhann</td>
<td>Proj#:</td>
<td>ERG3619</td>
</tr>
<tr>
<td>RE:</td>
<td>Meeting Minutes for the Riverlea Community Forum Date: Tuesday, 22 September 2015 Time: 17:00 – 19:00 Venue: Ergo Crown</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Attendees
Stakeholder attendance is set out below in Table 1.

Table 1: Stakeholder attendance

<table>
<thead>
<tr>
<th>NAME</th>
<th>DESIGNATION</th>
<th>COMPANY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reece Rosenberg (RR)</td>
<td>Chairperson</td>
<td>Riverlea Community Forum</td>
</tr>
<tr>
<td>Robin Wheatley (RW)</td>
<td>Member</td>
<td>Riverlea Community Forum</td>
</tr>
<tr>
<td>Charles van der Merwe (CM)</td>
<td>Member</td>
<td>Riverlea Community Forum</td>
</tr>
<tr>
<td>Mark Kayter (MK)</td>
<td>Member</td>
<td>Riverlea Community Forum</td>
</tr>
<tr>
<td>Wayne Swanepoel (WS)</td>
<td>SM: H&amp;SE</td>
<td>Ergo Mining</td>
</tr>
<tr>
<td>AbiotKekana (AK)</td>
<td>Transformation</td>
<td>Ergo Mining</td>
</tr>
<tr>
<td>Louis Kleynhans (LK)</td>
<td>Environmental</td>
<td>Ergo Mining</td>
</tr>
<tr>
<td>Greg Ovens (GO)</td>
<td>Environmental</td>
<td>Ergo Mining</td>
</tr>
<tr>
<td>Nestus Bredenhann (NB)</td>
<td>Consultant</td>
<td>Digby Wells Environmental</td>
</tr>
</tbody>
</table>

Welcome, Introduction and Presentation

The Riverlea Community Forum (RCF) meeting was formally started at approximately 17:15 by the facilitator, WS Swanepoel (WS). Attendance was kept in the form of a signed attendance register. All attendees had the opportunity to introduce themselves together with declaring their designation and/or role.

As introduction to the formal presentation WS provided an overview of the activities leading up to this RCF meeting being undertaken. He also stipulated that a good working relationship needs to continue between Ergo Mining (Ergo) and the RCF, hence continued engagement needs to be formalised.

GO Ovens (GO) continued with a formal presentation, providing information on: summary of actions requested for by RCF; location of the Crown Mining Right GP 184 MR; exiting environmental licences; mitigation measures currently being implemented at operations; and social initiatives underway and/or planned. The meeting was closed by WS and adjourned at approximately 18:30.
<table>
<thead>
<tr>
<th>NAME</th>
<th>COMMENT</th>
<th>ACTION</th>
</tr>
</thead>
</table>
| WS   | ▪ Ergo has a good working relationship Cllr Douglas and we work together from time to time on various matters.  
      ▪ Ergo is prepared to share information, show good faith, and do not want to be measured according to other mines in the area.  
      ▪ Ergo has worked in good faith with the RCF and has been transparent when dealing with the RCF. | LK / WS  
LK / WS |
| RR   | ▪ Thanked everyone for having the RCF at the meeting.  
      ▪ RCF requested to view various documents more than once from Ergo; asking this from the DMR does not work.  
      ▪ RCF acts on behalf of community (had meeting yesterday also). | |
| WS   | ▪ Quick introductions of new people as done (GO and NB).  
      ▪ Went through objectives of the meeting.  
      ▪ Ergo seeks to sustain the RCF relationship through open dialogue and address requests where possible.  
      ▪ Information provided to RCF is done in good faith (not wanting to see that it is used against Ergo).  
      ▪ Ergo provide copy of the PowerPoint to RCF.  
      ▪ Ergo has an open door policy for engagement and it is considered to undertake a quarterly meeting. | LK / WS  
LK / WS |
| RR   | ▪ Will appreciate to set a date for such meetings going forward. | LK / WS |
| GO   | ▪ Provided content on the map of Riverlea and associated mining rights.  
      ▪ Dump 382 almost completely mined.  
      ▪ Mining is completed at the Mooifontein dump. | |
| MK   | ▪ Who does the “mined-out” property belong to? | I-prop. |
| GO   | ▪ Which sections will be mined by Central Rand Gold (CRG)? | |
| RR   | ▪ Provided content of the various licences / EMPs. | |
| WS   | ▪ Can we have the sampling data?  
      ▪ Yes. Meeting is undertaken in good faith and transparency is required. Information provided can’t be used against Ergo, and certain information can only be made available through the regulators.  
      ▪ What will the information be used for? | LK / GO |
| RR   | ▪ Bench Marks is assisting RCF to understand the documents and associated information; we don’t have the required knowledge to do so by ourselves.  
      ▪ We can possibly have a number of meetings until the data is understood.  
      ▪ Ergo can also assist by explaining how monitoring is done e.g., dust buckets placed within the area. | |
| GO   | ▪ Some audits, as required by regulations, are required to be done every second year, but Ergo does them every year as good practice.  
      ▪ Independent consultants conduct the audits or assist to get these done. | |
<table>
<thead>
<tr>
<th>NAME</th>
<th>COMMENT</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR</td>
<td>Some reports deemed for the DMR are quarterly; the last one was June 2015, when is the next report?</td>
<td>GO</td>
</tr>
<tr>
<td>GO</td>
<td>Explained the various Air Quality mitigation measures.</td>
<td>RR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GO</td>
</tr>
<tr>
<td>RR</td>
<td>Are the sprayers made of metal; are you still having issues with theft?</td>
<td>LK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LK</td>
<td></td>
<td>RR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS</td>
<td>Netting is done by Soweto community members – sections are being done between communities, since Ergo can’t do everything for everyone.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WS</td>
</tr>
<tr>
<td>AK</td>
<td>In some areas the communities mobilize to get the work done quicker which has an impact on the allocated budget (more people work on the job).</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>The community questions the RCF since people are directly affected, especially those living close to the TSFs.</td>
<td></td>
</tr>
<tr>
<td>GO</td>
<td>Will vegetation grow back if it is burnt down?</td>
<td>RR</td>
</tr>
<tr>
<td></td>
<td>Yes, it is self-sustainable and water is required for 18 months as part of the process.</td>
<td>LK</td>
</tr>
<tr>
<td></td>
<td>Has TSFs been vegetated with plants or seeds?</td>
<td>MK</td>
</tr>
<tr>
<td></td>
<td>Vegetation has all been planted as seeds.</td>
<td>GO</td>
</tr>
<tr>
<td>NAME</td>
<td>COMMENT</td>
<td>ACTION</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>RR</td>
<td>Some TSF areas are very green. Yes, what Ergo uses to vegetate the TSFs is self-sustainable.</td>
<td>GO</td>
</tr>
<tr>
<td>GO</td>
<td>Provided information on the dust monitoring results and data that was done.</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Last year near Soccer City there was a white blanket of dust and this affected Riverlea.</td>
<td>GO</td>
</tr>
<tr>
<td>GO</td>
<td>Ergo is investigating to utilise cleaned water from Goudkoppies for rehabilitation. Water is a very scarce resource since it is being used for communities as well. Pipelines run within existing servitudes and will not affect communities.</td>
<td></td>
</tr>
<tr>
<td>WS</td>
<td>Provided details on Corporate Social Investment (CSI) initiatives already undertaken and also what is intended to be done e.g. to reestablish the Gas shack initiative (which could have been done better).</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>When were these initiatives done?</td>
<td>AK</td>
</tr>
<tr>
<td>AK</td>
<td>They were done last year.</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Were schools in Riverlea earmarked for the school uniforms project?</td>
<td></td>
</tr>
<tr>
<td>AK</td>
<td>Yes, Ergo also targeted some schools in Soweto for this project.</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>We had challenges last year with the Department of Social Development and the initiative had to be stopped.</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Is Westbury close to Riverlea? (for the refurbishing of the computer facility).</td>
<td>WS</td>
</tr>
<tr>
<td>WS</td>
<td>For the Secondary School – isn’t this done by the Department of Education? Ergo rather targets CSI projects that will remain sustainable.</td>
<td></td>
</tr>
<tr>
<td>MK</td>
<td>Is the facility maintained by Ergo?</td>
<td>WS</td>
</tr>
<tr>
<td>WS</td>
<td>No, Ergo handed over everything to the community since it is important to do the right thing and it is challenging to find the correct people.</td>
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<tr>
<td>RR</td>
<td>Some people are greedy and take money earmarked for development; it needs to be maintained. The approach to these needs to be to mitigate corruption.</td>
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<tr>
<td>AK</td>
<td>Unfortunately, not all requests can be adhered to; Ergo have to select those that can be representative of communities.</td>
<td></td>
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<tr>
<td>RR</td>
<td>Not sure why the Council were involved with the “Fun Day” and not the Coloured Foundation. Ergo does not want to create a divide between or within communities; harmony needs to be created rather. Requests are being looked at and are considered e.g. Ergo is currently considering a request from Council for benches and tables. Ergo wants to re-establish the Gas Shack initiative to change people’s lives through empowerment and train people on how to manage a new business (with the support of the RCF). Also, to provide gas bottles.</td>
<td>WS</td>
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<tr>
<td>NAME</td>
<td>COMMENT</td>
<td>ACTION</td>
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<td></td>
<td>Ergo will ensure there is a transparent process in place. In addition, Ergo wants to undertake a feasibility study to understand if the concept will be feasible (the information will be shared with RCF).</td>
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<tr>
<td>RR</td>
<td>Agrees that the Gas Shack initiative originally was done incorrectly and created an incorrect perception of the project’s intention.</td>
<td>RR</td>
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<td></td>
<td>There are many households and illegal structures that will benefit, but the misperception created challenges; at a previous public meeting people felt “no” for the initiative to continue.</td>
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<tr>
<td>WS</td>
<td>The survey done previously was done incorrectly and Ergo wants to do this correctly this time around in order to allocate gas bottles and stoves to the correct people (not as a free handout, but rather to change the lives of people).</td>
<td></td>
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<tr>
<td>RR</td>
<td>Not all Riverlea people can afford the gas bottles and stoves because of poverty or unemployment. We will speak to the community again to gauge acceptance levels and will provide feedback to Ergo. We want to get the correct people for the Gas Shack initiative.</td>
<td>RR</td>
</tr>
<tr>
<td>WS</td>
<td>Ergo wants to manage the Gas Shack initiative in consultation with community.</td>
<td></td>
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<tr>
<td>MK</td>
<td>Sludge from TSFs; where is it taken to?</td>
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<tr>
<td>GO</td>
<td>It is taken to the super dump in Brakpan.</td>
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<tr>
<td>RR</td>
<td>Why don’t Ergo pump the sludge back into the underground compartments?</td>
<td></td>
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<tr>
<td>GO</td>
<td>It is difficult to determine the impact since the majority of underground mines in Johannesburg are interconnected.</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>The property underneath the TSF is almost ready, what will be done with it?</td>
<td></td>
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<tr>
<td>GO</td>
<td>The relevant authorities need to come together and decide on the preferred approach for the land use.</td>
<td></td>
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<tr>
<td>RR</td>
<td>What is the responsibility of Ergo, since they contaminated the land?</td>
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<tr>
<td>GO</td>
<td>It is not contaminated; Ergo needs to get a closure certificate from the DMR. Thereafter the local municipality will need to rezone area and determine the subsequent land use.</td>
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</tr>
<tr>
<td>MK</td>
<td>RCF also wants to be open and transparent, and yet we don’t understand mining and the associated legislation. We need to answer to the community and want to do so with sufficient information.</td>
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<tr>
<td>RR</td>
<td>Thank you for being willing to talk to the RCF.</td>
<td>WS</td>
</tr>
<tr>
<td>WS</td>
<td>Can ongoing meetings be undertaken Riverlea? (since we want to all RCF representatives present) and having the proposed meeting at 6pm will be better than 5pm.</td>
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<tr>
<td>WS</td>
<td>Yes, this can be investigated and agreed upon.</td>
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<td></td>
<td>Will we get a copy of the notes of the meeting?</td>
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<tr>
<td></td>
<td>Yes, this will be provided.</td>
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</tbody>
</table>
8 March 2016

DEPARTMENT OF MINERAL RESOURCES: REGIONAL OFFICE, GAUTENG
Mineralia Building, Cnr De Korte and De Beer Street, BRAAMFONTEIN, 2017

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Dear Madams and Sirs,  

URGENT

VIOLATION OF NUMEROUS ACTS OF PARLIAMENT AND FAILURE TO IMPLEMENT THE SOCIAL LABOUR PLAN AND OTHER KEY REQUIREMENTS FOR A MINING LICENCE UNDER MINING RIGHT GP 30/5/1/2 (140) MR

1. The above-captioned matter refers.
2. We require your office’s assistance to launch an investigation into the mining operations conducted by Central Rand Gold Ltd (“CRG”) in the Riverlea area.
3. Whilst our Forum does not consist of mining experts, it is abundantly clear that CRG has violated the law in respect of the mining operations in Riverlea.
4. Firstly, the community of Riverlea has not benefitted or is even included in the Social and Labour Plan (“SLP”) submitted by CRG when applying for the license. The SLP does not even mention the area in which the mining activities take place.
5. Secondly, the mining operations proximity to the primary school is questionable. The distance between the mining operations and the school is less than that prescribed by legislation.
6. Thirdly, you will note on inspection that there are insufficient safety mechanisms to prevent the learners from injuring themselves. There is no private security in the area employed by CRG.
7. Fourthly, CRG utilized the primary school’s water during its operation without obtaining the necessary permits for water use.
8. Fifthly, the mining has caused damage to George Harrison Memorial Park which is a heritage site. The site is destroyed as a result of CRG’s conduct.
9. The surrounding area has become a dumping site due to the state in which CRG abandoned the area.
10. We have requested CRG to provide us with the Mine Closure Plan however they have failed to provide same.
11. Needless to say that there is health issues arising from the dust created by the mining.
12. We are aware of a High Court application launched by CRG in September 2011 to set aside the decision by the DMR to cancel CRG’s mining rights.
13. We are further aware that the matter was settled in December 2011. We respectfully submit that if an investigation is conducted into the mining affairs of CRG, it will be determined that nothing has changed since that date.
14. In fact we submit that there are further contraventions by CRG.
15. The conduct by CRG clearly takes advantage of the poor and seemingly powerless community of Riverlea. Their disregard for the law and the surrounding area is indicative of their lack of compassion and respect for the Riverlea Community.
16. At all material times CRG has sought to evade its responsibilities in terms of the law.
17. In the circumstances, we humbly request that your local office commence an urgent investigation into the conduct of CRG regarding the mining operations in Riverlea.
18. It is further of utmost importance that CRG provide the DMR and the Riverlea with a written undertaking that it will rehabilitate the land in the near future.
19. Kindly advise as a matter of urgency whether you require any further information to commence the investigation against CRG.
20. Should you require any further information regarding the above, kindly contact the writer hereof.

Thank you very much.

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