Environmental Consultants

Matai Mining (Pty) Ltd Mining Right Application for Vanadium, Titanium and Iron Ore on various Farms within the Magisterial District of Mankwe, North West Province

Health Impact Assessment Report

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PROJECT DETAILS

PROJECT:	THE MATAI MINING PROJECT
Project Name	The development of the proposed Matai Mining Project in the Mankwe District, North West Province
Client:	Matai Mining (Pty) Ltd
Project Number	KIM03
Report Title	Health Impact Assessment Report for the Development of the Proposed Matai Mining Project in the Magisterial District of Mankwe, North West Province
Date Submitted	20 March 2019
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DISCLAIMER

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Specialist Declaration of Independence

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I Vumile Dlamini-Ribeiro, as duly authorised representative of Niara Environmental Consultants (Pty) Ltd., hereby confirm my independence and declare that I:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

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Executive Summary

Human health, the environment and development are intricately linked in that a negative impact in any one sphere would impact negatively on the remaining two spheres. For example, insufficient development of proper sanitation facilities would lead to unhygienic and unhealthy living conditions for humans as well as impact on the environment by causing pollution to water resources. Sustainable development requires that a development meets the needs of the present generation without compromising the future generations to meet their own needs and that the environmental, social and economic implications of any development project are considered to achieve development that is sustainable.

The use of Health Impact Assessments (HIAs) is a relatively new process in South Africa that is designed to ensure that often-overlooked or unanticipated health impacts are considered in proposed policies, programs, projects or plans. HIAs offer practical recommendations to minimise negative health risks and maximize health benefits, while addressing differential health impacts on vulnerable groups of people.

Health Impact Assessment

A HIA is a practical, multi-disciplinary process, combining a range of qualitative and quantitative evidence in a decision-making framework. A HIA seeks to identify and estimate the lasting or significant changes of different actions on the health status of a defined population. The methodology of this HIA was based on the Good Practice Note (GPN) for HIAs as supported by the International Finance Corporation (IFC). The IFC has published a set of Performance Standards (PS) for large Projects that will require international funding. PS4 which deals specifically with Community Health, Safety and Security, recognising that Project activities result in both positive and negative impacts to communities. The GPN has been developed specifically to provide guidance on community health for this Standard.

This approach was supported by a systematic and consistent approach to collecting and analysing baseline health data through the Environmental Health Areas (EHA) framework. Twelve different EHAs are described, which provide a linkage between mine-related activities and potential positive or negative community-level impacts. This incorporates a variety of biomedical and key social determinants of health. Through this integrated analysis, environmental and social conditions that contain significant health components are identified instead of focusing primarily on disease-specific conditions.

Specific Potentially Affected Communities (PACs) and health impacts related to different activities of the proposed Matai Mining Project have been described.

A HIA will:

- Provide a formal mechanism to engage the relevant stakeholders and key regulatory decision makers
- Review proposed project specifics
- Review the physical and general environmental setting of the proposed Matai Mining Project;
- Identify potentially affected communities (PACs)
- Analyse the sufficiency of baseline health
- Select key health impacts using both a set of defined Environmental Health Areas (EHAs) and input from stakeholder meetings
- Conduct qualitative impact rating and ranking analysis
- Propose a series of recommendations tied to potential impacts

Scoping Process

HIA uses a process known as "scoping" to obtain enough data and stakeholder input to identify the most important potential health impacts related to a project. Scoping can retrieve data through formal public health surveillance reports, census reports, socioeconomic studies, and cultural reports. The scoping process also includes the input of local residents who will experience the impacts of a potential project.

Stakeholder Engagement

The HIA Specialist gathered input through focus groups and invited written comments through the public participation process facilitated by Kimopax. Community Health Impact Assessment Consultants from Niara consulted a broad range of stakeholders. FGDs were conducted with local residents of Legogolwe, Lesobeng, Manamakgotheng, Mantserre, Mononono and Sefikile. The meetings started with a brief introduction to the purpose and process of conducting an HIA, and were followed by a questions and comments period. This stakeholder engagement process resulted in a wide-ranging list of perceived impacts which are discussed at length in Section 9 of the Report.

Baseline Data Collection

The HIA Specialist also reviewed baseline data from a variety of sources (e.g., District Health Barometer, Moses Kotane IDP, and South African 2011 Census, 2016 Community Survey etc.) and organized the information into 12 Environmental Health Areas (EHAs). The baseline health summary in Section 8 creates a point of reference regarding the health status of the potentially affected communities prior to development of the proposed Matai Mining Project; it also describes an overall health profile for the area. Decision-makers can use their knowledge

about the features of the proposed Matai Mining Project and the health profile of the region to better consider health in their deliberations.

Key Findings and Recommendations

Access to healthcare facilities did not seem to be a problem in the PACs as the healthcare facilities are within walking distance from most respondents' homes. Healthcare facilities have ambulances as well as mobile clinics that visit neighbouring communities weekly. Healthcare services are free as substantiated by 100% of respondents claiming not to pay for medical services.

In the light of healthcare services and infrastructure, the proposed Matai Mining Project impacts need to be considered as two separate/ opposing tangents. One, being a positive impact whereby there is the potential for the proposed Matai Mining Project to support the development of improved health services through direct and indirect interventions; and the second, being a negative impact whereby the proposed Matai Mining Project may stretch the already-burdened capacity of the Healthcare services in communities in the vicinity of the proposed Matai Mining Project area.

Respiratory tract infections from a viral and bacterial origin are important to consider. This can include seasonal influenza and other pandemic pathogenic strains to which the local communities may not have inherent immunity due to their lack of exposure to these diseases or strains. Vulnerable groups such as the elderly and children in these Project-affected communities, especially the elderly and those with underlying disease, are particularly susceptible as their immune systems are often weakened. Any plans by the proposed Matai Mining Project to manage respiratory diseases must thus consider community health as poor community health may affect business continuity and reputation, where the proposed Matai Mining Project runs the risk for being blamed for disease outbreaks especially as it may contribute to movements of people in and out of area.

An influx of people into the proposed Matai Mining Project area can be expected. The spontaneous migration and settlement of labourers and their families may introduce a wide range of concerns into the proposed Matai Mining Project area. These include:

- Increased use of and demand for already inadequate community housing, water, sanitation, food, and medical services can reduce the capacity to address health concerns adequately and contribute to new health challenges (with a likely increase in cost).
- Housing inflation and potential increase in communicable diseases like tuberculosis (TB) and Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS). This can, however, be

mitigated by Health Systems Strengthening (HSS)[1] to improve TB case detection and case management in local dispensaries; developing and maintaining site-based TB policies and programmes; as well as outbreak preparedness and response plans.

- An increased potential for accidents and injuries due to changes in road traffic in the area.
- An increase in accidents and the associated trauma will place added burdens on the health infrastructure such as emergency services that are already limited in the area.

Poverty and unemployment play a key role in local social challenges. The youth are especially at risk of succumbing to social ills such as alcoholism and drug abuse. These behaviours, in turn play a major role in domestic violence and high risk sexual behaviour.

A number of determinants/ interventions can influence (mitigate/reduce) the potential for an increase in HIV/AIDS in the proposed Matai Mining Project area. These are generally as an indirect influence of the proposed Matai Mining Project but some direct impacts from the workforce do exist. Develop a HIV/AIDS policy and programme that incorporates both the workplace and community considerations. Some mitigation measures to abate these include: developing a community-based HIV and Sexually Transmitted Illness (STI) strategy; HIV/AIDS education programmes; and implementing comprehensive HIV and STI management programmes in the workforce.

An influx of people during construction and the operational phases of the proposed Matai Mining Project may result in food inflation, increasing food deprivation and nutrition-related diseases. If long-term food inflation occurs, food deprivation may affect susceptible sub-populations such as children and marginalised groups. Poor food hygiene practices may also increase food-related illnesses. More consumption of fast food related to increased income may increase non-communicable (lifestyle) diseases such as obesity and diabetes (type 2). Education on lifestyle behaviours including eating habits, exercise, etc. would also lessen the health impacts related to obesity and diabetes. Matai Mining, together with the communities, can improve food security by assisting with school feeding programmes, including education on food gardens, nutrition, and good nutritional habits as well as sharing educational materials for use in local clinics.

The proposed Matai Mining Project may lead to increased traffic loads on primary and access roads and thus has the potential to increase the number of traffic accidents. This risk can be abated through improving road safety by collaborating with the district road-safety unit to establish and maintain pictorial road-safety signage near the site, as well as in a local language (Setswana) and English language (if needed); clearly demarcated pedestrian crossings in appropriate places etc. This could be achieved by establishing and implementing a Traffic Management Plan.

[1] HSS also contributes to the mitigation options.

While vector[2]-borne diseases are not common in the proposed Matai Mining Project Area, hence uncontrolled digging and the influx of people, coupled with poor environmental management may lead to establishment of vector breeding sites in the proposed Matai Mining Project Area. This situation may lead to the emergence and increase in prevalence of vector-borne diseases. Efficient environmental management of surface water is essential, particularly during construction. Coordination with the relevant government departments (i.e. Health and Social development) in establishing vector awareness programs is also essential.

With regards to the social determinants of health, the expected influx of people and increased income may result in illegal substances being available more freely. It is difficult to speculate whether the prevalence of tobacco smoking and/or substance abuse will increase due to the presence of the proposed Matai Mining Project. However, it is likely that it will increase as there will be an increase in the number of young people with decent incomes, who will be in a position to afford these commodities. Matai Mining may be in a position to conduct substance-abuse prevention education programs in the workplace and within the communities.

When discussing the exposure of people to potentially hazardous materials, noise and malodours, one needs to be cognisant of the in-migration of people. An influx of people into the area may increase domestic activities, including the use of domestic fuels. This may result in an increase in air pollution exposure, followed by associated increases in the prevalence of related respiratory illnesses. The clearing of the site (construction phase) and vehicular movement are the main activities and may have potential impacts on the ambient noise levels. Increased activity of vehicles and heavy machinery will contribute to the increased local noise levels. There is sufficient evidence that noise causes adverse health effects such as cardiovascular effects.

Identification of Health Impacts

The ultimate goal of an HIA is to identify the potential health impacts of the proposed Matai Mining Project or policy and use this information to maximise benefits and minimise adverse consequences to the public's health. Health impacts include positive and negative changes in specific health outcomes (e.g., asthma rates, gonorrhoea rates, motor vehicle fatality rates) and health determinants (e.g., access to health care, air and water quality, household income etc.).

Below is a list of the important potential health impacts (both positive [+] and negative [-]) identified in the HIA for the proposed Matai Mining Project:

- Change in morbidity and mortality data related to psychosocial distress such as depression, anxiety, substance abuse, and changes to family structure.

[2] Vectors are organisms that act as hosts and carriers of micro-organisms such as bacteria, viruses and parasites. They are generally unaffected themselves but spread the bacteria or viruses onto other species where they multiply to manifest as a full blown disease.

- Change in median household income
- Change in unemployment
- Change in the percentage of households living below poverty line
- Change in educational attainment data
- Change in morbidity and mortality data related to commercial motor vehicle
- (CMV) traffic on roadways related to the project and ore transport.
- Change in morbidity and mortality data related to non-commercial motor vehicle crashes.
- Change in morbidity and mortality data from poor air quality events (exceedances) through exacerbation of chronic obstructive pulmonary disease (COPD), asthma, cerebrovascular diseases, and cardiovascular diseases.
- Change in regional food costs expressed as a % of median household income
- Change in the rates of STI such as gonorrhoea, chlamydia, Hepatitis C, and HIV.
- Change in the rates of respiratory diseases such as influenza and pneumonia
- Change in morbidity and mortality for chronic diseases including cancer
- Change in % of households served with water and sanitation services
- Change in ratio of people to health care providers
- Change in time needed for emergency response for health issues

It is the specialist's opinion that due process has been followed. Where impacts have been assumed to be potentially significant, various mitigation measures to manage and monitor the impacts of the proposed mine development has been proposed. Adequate mitigation measures have been provided and are expected to reduce the significance of almost all negative impacts although not always to acceptable levels, while positive impacts will on average be significantly enhanced to maximise benefits to surrounding communities. The recommended mitigation measures must be implemented to minimise the impacts and ensuring compliance with current legislative requirements.

The implementation of appropriate mitigation measures should reduce the significance of the identified negative impacts, while positive impacts will be enhanced to maximise benefits to surrounding communities. The recommended measures must be implemented to manage the impacts and ensuring compliance with current legislative requirements. Lastly, it is recommended that Matai Mining establishes relationships with other institutions (e.g. government or NGOs) involved in local and regional healthcare development and social upliftment so as to maximise the benefits of its contribution to the overall health status of the community.

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Appendix A: Plans

Plan 1: Local Setting

Plan 2: Potentially Affected Communities

Plan 3: Healthcare Facilities

Appendix B: Focus Group Discussion Questionnaires

1. Introduction

Matai Mining is the holder of the prospecting right NW 30/5/1/1/2/11277 PR granted and issued in terms of Section 11(1) of the Mineral and Petroleum Resources Development Act 28 of 2002 as amended by Act 49 of 2008 ("MPRDA"). The primary right NW 30/5/1/1/2/2679 PR was originally granted to Rise Africa Mining and Exploration (Pty) Ltd on the 06 December 2011, which remained in force up until 5th of December 2013. Rise Africa Mining and Exploration (Pty) Ltd applied in terms of section 102 of the MPRDA to amend the granted right to include iron ore and titanium, the application was granted on the 8th of September 2013. Rise Africa Mining and Exploration (Pty) Ltd applied for renewal of the right on the 18th of October 2013 and was granted on the 26th of August 2015, with reference number: NW30/5/1/1/2/11277 PR. Rise Africa Mining and Exploration (Pty) Ltd applied for ministerial consent in terms of section 11 of the MPRDA of 2002, to cede the same right in favour of Matai Mining the consent was approved on the 3rd of November 2014. Matai Mining at the time owned by Yanbing Zhang -74% and Jayamma Zhang 26%. Matai Mining applied for ministerial consent in terms of section 11 of the MPRDA to have change in the shareholding by disposing all shares owned by Yangbing Zhang and transfer them to Camp Brave Limited; and consent was approved on the 09th of November 2015. Matai Mining hereby apply for a Mining right in terms of the Section 23 (a), (b) and (c) read together with regulation 11(1) (g) of the MPRDA (ACT 28 of 2002).

In addition to the MRA an application will also be submitted for environmental authorisation for the envisaged project activities. An Environmental Impact Assessment (ESIA) will be submitted in support of this application. This report is the outcome of the Social/ (Socio-economic) Impact Assessment (SIA), which is one of several specialist assessments that were undertaken as part of the EIA. The SIA Report forms part of the Environmental Impact Report (EIR). The EIR details the Impact Assessment Phase of the EIA process, which is aimed at investigating the potential impacts of the proposed Matai Mining Project on the receiving environment.

Kimopax (Pty) Ltd (hereafter, Kimopax), an independent consulting company, has been appointed to conduct a Scoping and Environmental Impact Assessment (S&EIA) as part of a Mining Right Application (MRA). The S&EIA is aimed at critically evaluating the potential environmental, social and economic impacts of the proposed Matai Mining Project (hereafter, the Proposed Matai Mining Project). Subsequently, Niara Environmental Consultants (hereafter, Niara) was appointed by Kimopax to undertake a Health Impact Assessment (HIA) for the proposed Matai Mining Project.

This document presents the results of the Health Impact Assessment (HIA) for the above-mentioned Project. The objective of the Study is to assess the human health impacts associated with the Project on the population of concern, with particular reference to vulnerable people, through the evaluation of various determinants of health, including those identified in the various specialist studies.

To ensure that environmental health becomes part of the Environmental Impact Assessment (EIA) decision making process, health will need to be integrated into the present process in a structured and systematic manner. This will ensure that human health issues, resulting from a listed activity, are addressed before the start of an activity.

This HIA Report is structured into various sections. The first few Sections determine which health effects, or indicators, ought to be considered. It takes into consideration all the relevant background information (in this case, environmental and health information) including laws, demographics of the affected population, health status, project details, etc., providing a complete characterisation of the current situation around the Project. Section 11 discusses how populations may be affected and to what degree (potential impacts).

1.1. Project Description

Matai Mining is applying for a mining right on the farms, certain portion of farm Magazynskraal 3 JQ, certain portion of farm Haakdoorn 6 JQ, the farm Wildebeestkuil 7 JQ, certain portion of the remaining extent of portion 1, certain parts of the remaining extent of portion 2, certain parts of the remaining extent of portion 5, certain parts of 6, portions 11, 12 and 13 (part of portion 2) and the remaining extent of the farm Syferkuil 9 JQ, the remaining extent of portion 1, portion 2, portion 3 (a portion of portion 1), the remaining extent of the farm Middelkuil 8 JQ.

A rollover, opencast mining method will be employed at the proposed project. This action entails the stripping of topsoil, softs and hard overburden, and storing these as close to the strip being mined as possible. As soon as a new strip is opened, the previous one is backfilled with the material, thereby employing concurrent rehabilitation. Furthermore, a three-stage crushing processing approach will be used, with primary crushing occurring in the pit. Conveyors will be used to transport the primary crushed material to the secondary crushers. A tripper conveyor will be used to stack ore onto the stockpile and ore will be removed by means of bottom extraction. Processed ore will be transported by truck, using the R510, to its final destination. Overall planned Life of Mine (LoM) is 31 years (Ukwazi Mining Studies, 2019).

1.2. Project Location

The Matai Mining Project is located in the Moses Kotane Municipality, Bojanala Platinum District Municipality, North West Province, South Africa. It lies about 13 km south-west of the closest town Northam, approximately, 70 km north of Rustenburg and 150 km north-west of Johannesburg. The Pilanesberg Nature Reserve lies approximately 13 km to the south of the proposed pit area. Other large sources of particulate matter in the area include the Union North and South Mines, the Pilanesberg Platinum mine, and the Dishaba Mine, all of which mine for platinum group minerals, and the Kalaka Mine which mines for limestone (Figure 1-1). Please also refer

to the Local Setting Plan –Plan 1, Appendix A. The mining right area is characterised by mining, rural communities, grazing areas and portions of cultivated land.

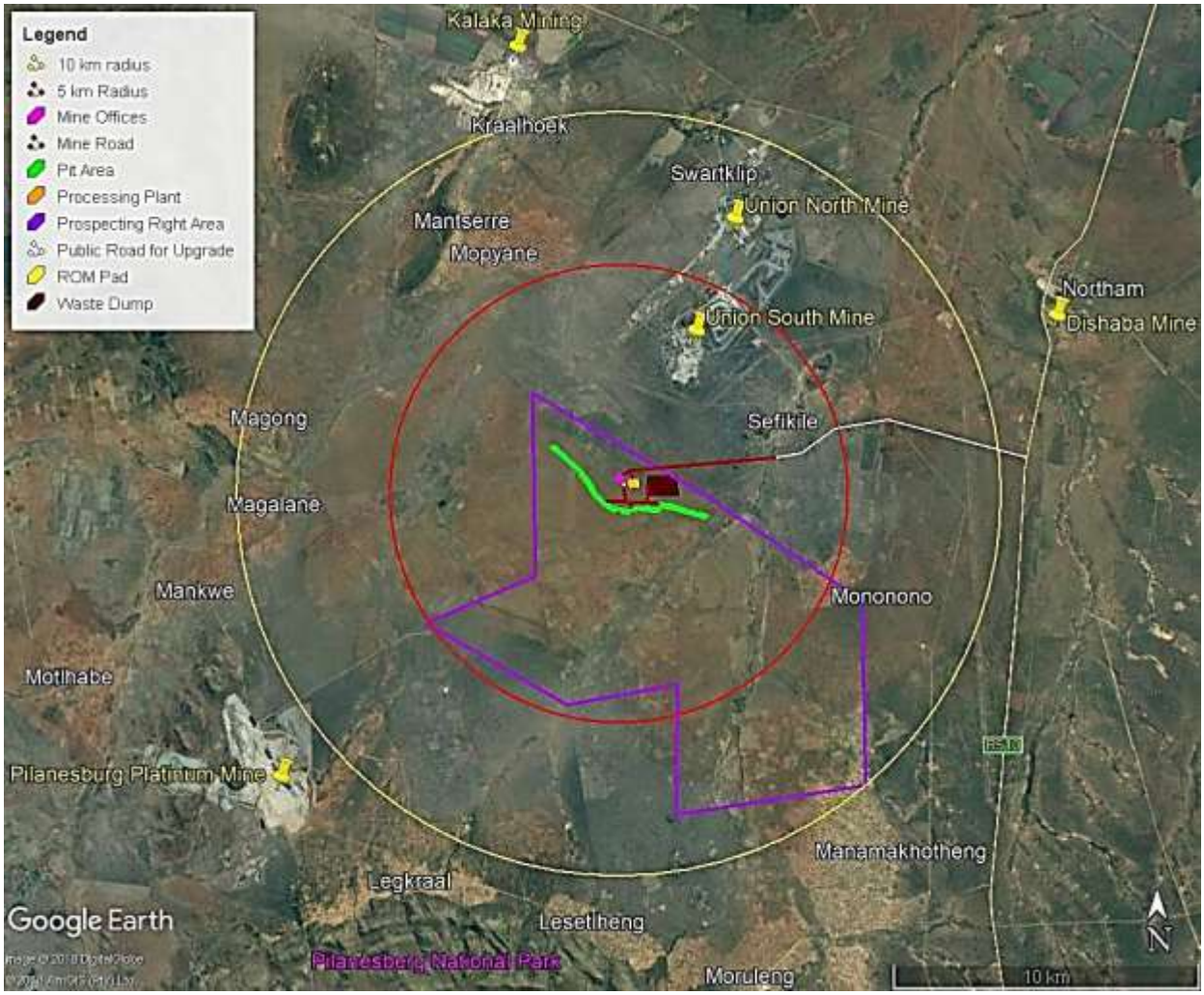


Figure 1-1: Location of the proposed Matai Mining Project.

Sensitive receptors within a 10 km range of the Matai Mining Project open pit area include the residential areas of Sefikile, Mantserre, Mopyane, Mononono, Magong, Magalane, Kraaihoek, Legogolwe and parts of Manamakhotheng. Plan 2 illustrates the Project's sensitive receptors –Potentially Affected Communities (PACs). The remainder of the land-use surrounding the mine is predominantly agricultural with a few farmsteads.

The topography immediately surrounding the site is gently undulating with no prominent topographic features in the project area. The Pilanesberg formation to the south, rises from the surrounding plains and consists of the crater of a long extinct volcano fringed by three concentric ridges or rings of hills.

1.3. Objective of the Specialist Study

The over-riding objective of a HIA is to maximise health gain and reduce health inequalities. The International Council of Mining and Metals (ICMM) indicate that health assessments 'help mining and metals managers and health and safety advisors address the public health impacts of their activities on the communities near their operations to better manage their responsibilities' (ICMM, 2010).

The overarching aim of the HIA was to provide decision-makers with a set of recommendations on health issues associated with the Project, so that health objectives may be considered at the same level as socio-economic and environmental objectives.

The objectives were:

- To predict the likely impacts the project may have on the health of surrounding communities; and
- To formulate mitigation measures to avoid or ameliorate negative community health impacts and to enhance positive ones.

1.4. Terms of Reference

Health is gaining prominence in public policies in accordance with its importance as a core value for population wellbeing and thus, as a driving force for sustainable human and social development. The assessment and management of community health is part of risk management and social responsibility of an operator.

The issues raised in the scoping phase of an EIA, which cannot be effectively addressed with the currently available information, form the basis for the terms of reference of specialist studies (DEAT, 2002).

The process included the following:

- A desktop review in to outline the country and community health profile and to determine any data gaps;
- A field visit by an experienced member of the Niara's health specialist team to:
  - Gather additional information that was not available in the public domain during the desktop review. This includes collection of information from health facilities, from the national health information management system, as well as from unpublished reports and documents;
  - Identify relevant stakeholders/informants. It is anticipated that the consultant will conduct interviews using a semi-structured questionnaire, with:
    - Relevant governmental/institutional personnel (e.g. representatives from ministry of health; officials responsible for water/sanitation, transport safety, STDs, disease control, alcohol prevention; personnel of local health services;

- Collect primary participatory data in the form of semi-structured focus group discussions with members the different potentially affected communities –please refer to the appended plan for an illustration of the identified potentially affected communities which were visited. It is anticipated that the focus groups will include men and women, as well as different age groups, in these discussions, and to conduct separate interviews with any vulnerable groups (e.g. women and/ elderly) as appropriate. Discussions will cover individual perceptions of health impacts, community lifestyles, and any traditional and local knowledge;
- Review the standards of the local health facilities and functionality of the health management information system; and
- Gain first-hand knowledge of the project setting and location of communities in relation to planned project activities.
- Review of other specialist studies conducted as part of the EIA to identify bio-physical or socio-economic impacts that may have health implications.

- Impact assessment process which involved:
  - Considering the potential future health impacts that the proposed Matai Mining Project may have on the health of the respective communities;
  - Determining the existing health needs of the community based on health strategies, infrastructure programs, service priorities, delivery plans and challenges;
  - Based on the existing evidence, rating the likelihood and consequence of different health impacts to outline their significance and prioritisation for mitigation; and
  - Considering recommendations for mitigation/management of priority impacts. Recommend measures to avoid/mitigate negative and enhance positive impacts resulting from the proposed Matai Mining Project at the relevant Project stage.

This HIA Report will form an appendix to the main EIA Report.

1.5. Details and Expertise of Specialist

Vumile Dlamini-Ribeiro is currently the Director of Environmental Management Services at Niara Environmental Consultants (Pty) Ltd. Vumile has 12 years of professional experience in Environmental Assessment and Management. Her roles include the executive management responsibilities of Niara Environmental Consultants, project management, client and business development, marketing and quality assurance as well as corporate compliance.

Having worked for a multi-disciplinary advisory firms and environmental consultancies, Vumile has a competent understanding of the work effort and cross collaboration required for a successful multidisciplinary organisation. Vumile has been involved in a number of Environmental Impact Assessments and has a particular interest in

health impacts assessments, water resource management, mining, energy and stakeholder engagement. Vumile has considerable experience across a range of community health and environmental sciences and has worked in South Africa, Mozambique, Sierra Leone and Liberia and is familiar with Regulatory Environmental Legislation in other parts of Africa.

Vumile is very well versed in the IFC Environmental and Social Performance Standards (including IFC PS 2012) and the associated Equator Principles, which have informed the approach and standard for a number of ESIA processes that she has been involved in. Vumile is skilled at organising and driving effective project teams at a scale relevant to the project's requirements. She has technical experience and is able to quickly identify the most pertinent issues of a particular project whilst focussing on driving project success by rigorously implementing project management tools.

Vumile has experience ranging over several aspects of social research, including the planning and execution of social surveys, participatory rural appraisal, sustainable livelihoods assessments, data management and statistical analysis, capturing and management of spatial data, stakeholder identification and community facilitation. She has acted as project manager and/or task leader on a number of social impact studies in Africa. Social impact studies included both mining development and linear projects.

2 Overview of the Matai Project Mining Process

Opencast mining starts with the stripping of usable soil and soft overburden material using a fleet of diesel trucks and shovels. This topsoil and overburden is stockpiled for use in the rehabilitation of the area once the mining is completed. A process of roll-over or strip mining is then followed in which the overburden of each strip is drilled and blasted and then placed in the excavation produced by the previous strip. This backfilling and rehabilitation will be undertaken as the mining progresses. The ore will be mined from the open pit using excavators, bulldozers, trucks, bowl scrapers and shovels.

Crushers will be used to reduce large rocks into smaller rocks, gravel, or rock dust. Three stages of crushing are planned. Trucks will deposit material into a receiving bin at the primary tip. A single jaw crusher will be used as the primary crusher. A static grizzly is placed at the primary tip to remove oversize material, with a vibrating grizzly placed before the crusher to screen off the fines before it enters the crusher. For the purposes of modelling for this report, it was assumed that this primary crushing will take place in the pit. From there, apron feeders will be utilised to extract ore from the bins and feed it to downstream equipment at a predetermined rate. Cone crushers or toothed roll crushers will be used for the secondary and tertiary crushing phases at the processing plant to reduce the size of the material to less than 32mm. Conveyors will also be used to transport the overburden (Kimopax, 2018).

A tripper conveyor will also be used to stack ore onto the stockpile. The ore will be removed from the stockpile by means of bottom extraction. This consists of a tunnel underneath the stockpile with a travelling rotary plough feeder and a conveyor (Kimopax, 2018). From the crushing plant, ore will be transported in trucks on a gravel road to the R510, and from there by tarred road to its final destination. The final void will be backfilled with the overburden from the initial boxcut.

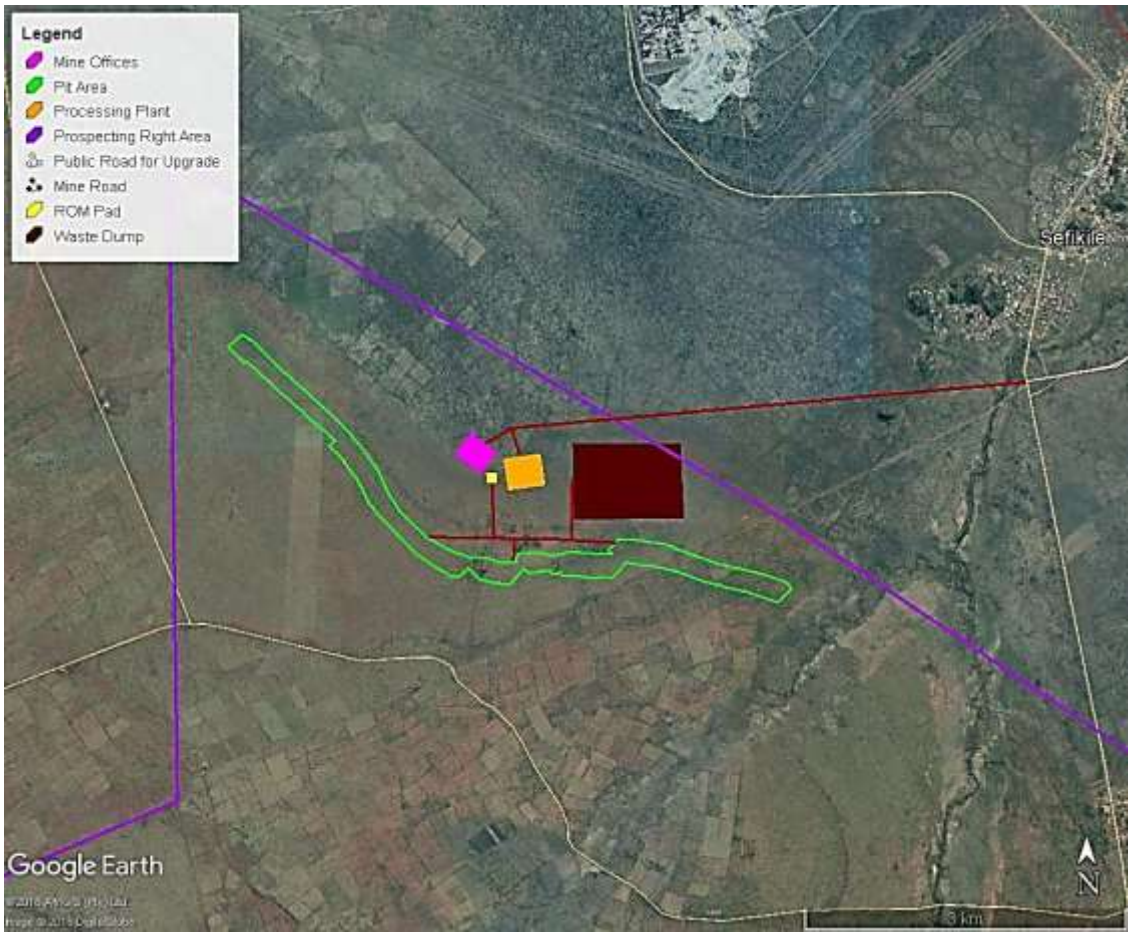


Figure 2-1: Proposed mine layout.

It is estimated that the mine infrastructure (offices and workshop facilities) will require an area of approximately 2 hectares ("Ha"). This is situated to the north of the mining operations, as shown in Figure 2-2. This was placed outside of the 500m blasting exclusion zone. The infrastructure area will be linked to the mining operation using a 15.5m wide haul road.

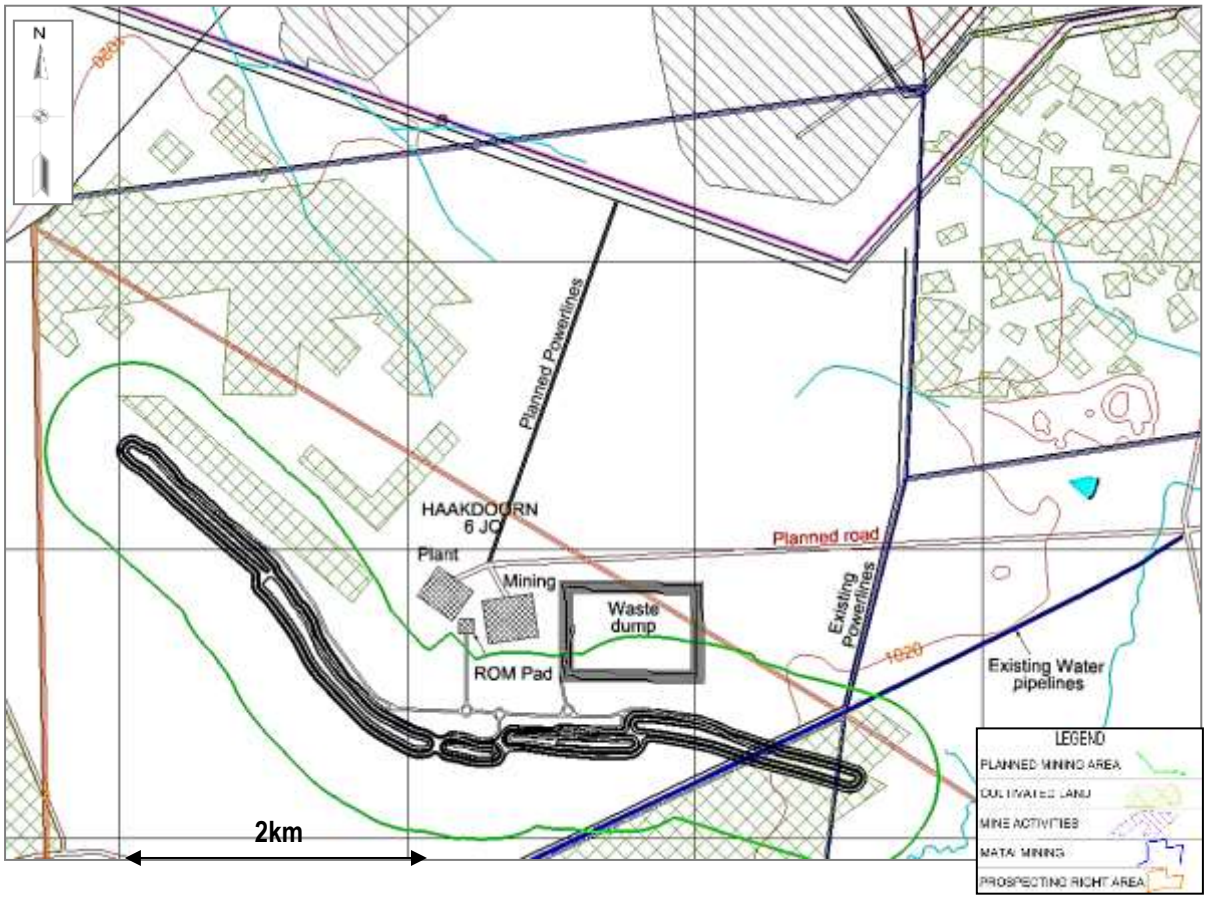


Figure 2-2: Surface mine layout

Electrical power is from the existing power line as part of the process plant infrastructure for workshops and office requirements. A site access road is required to link the site to the national road system. The nearest national road is the R510 which is approximately 15 kilometers (km) to the east of the site. The current gravel road (9km) requires upgrading at an estimated cost of R 0.3 million per kilometer and the remaining 6km requires a new road at a cost of R1 million per kilometer. In addition, the East portion of the pit mines through an existing power line and water pipe at the beginning of year 17. These will need to be re-routed at an estimated cost of R15 million.

3. South African Legislation Pertaining to Health

No new health-related primary legislation has been enacted since the 2015 amendment to the Medicines and Related Substances Act. Two Bills tabled in 2017 are still in the process of being dealt with by Parliament, while two Private Member's Bills have been ruled as undesirable and will therefore not be enacted. A further Private Member's Bill has been published for comment. Three draft Bills have been published for comment, dealing with tobacco control, the National Health Insurance Fund, and proposed amendments to medical schemes legislation. Other public health-oriented targets have included the proposal to raise the age limit for alcohol consumption

from 18 to 21 years, and the tax on sugar-sweetened beverages. Although the Minister's preference for inclusion of the new restrictions in the proposed Liquor Amendment Bill has been reported, this Bill has yet to be published for comment or tabled in Parliament. Only a minor change to the labelling requirement for alcoholic beverages has been issued, as a regulation in terms of the Foodstuffs, Cosmetics and Disinfectants Act.

3.1. Constitution of the Republic of South Africa (Act 108 of 1996)

The over-arching legislation is the Constitution of South Africa (Act 108 of 1996) (the Constitution), in particular Section 24, which places people and their needs at the forefront of environmental management. The Constitution provides a right to "an environment that is not harmful to [human] health or well-being" and to have the environment protected, for the benefit of present and future generations, through reasonable legislative measures. These measures include the prevention of pollution and ecological degradation, the promotion of conservation, the securing of ecologically sustainable development and the utilisation of natural resources while promoting justifiable economic and social development.

3.2. The National Health Act (Act 61 of 2003)

The National Health Act, 2003 (Act No. 61 of 2003) (NHA) provides a framework for a structured uniform health system in South Africa, taking into account the obligations with regard to health services imposed on the national, provincial and local governments by the Constitution and other laws. Any activity that gives rise to offensive/injurious conditions or is dangerous to health (e.g. accumulation of refuse) may have a negative impact on health and thus warrants being assessed in the EHIA (DOH, 2010). The Director General (DG) should issue and promote adherence to, norms and standards on health matters, including conditions that constitute a health hazard and facilitate the provision of indoor and outdoor environmental pollution control services. The Act also provides for environmental health investigations in Section 88.

3.3. National Ambient Air Quality Standards

The Department of Environmental Affairs (DEA) issued ambient air quality guidelines for several criteria pollutants, including particulates, sulfur dioxide, oxides of nitrogen, lead, ozone and carbon monoxide. The National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA) adopted these guidelines as National Ambient Air Quality Standards (NAAQS). On 2 June 2006, the Minister of Environmental Affairs and Tourism announced his intention of setting new ambient air quality standards in terms of Section 9(1)(a) and (b) of the NEM:AQA. The proposed new standards were published for public comment in the Government Gazette of 9 June 2006. Since then, updated draft National standards with allowable frequencies of exceedance and compliance timeframes have been proposed.

The prevailing legislation in the Republic of South Africa with regards to air quality is the NEM: AQA. The NEM: AQA serves to repeal the Atmospheric Pollution Prevention Act (Act no. 45 of 1965) (APPA).

The purpose of NEM: AQA is to set norms and standards that relate to:

- Institutional frameworks, roles and responsibilities;
- Air quality management planning;
- Air quality monitoring and information management;
- Air quality management measures; and
- General compliance and enforcement.

Guidelines provide a basis for protecting public health from adverse effects of air pollution and for eliminating, or reducing to a minimum, those contaminants of air that are known or likely to be hazardous to human health and well-being (WHO, 2000). Once the guidelines are adopted as standards, they become legally enforceable. These standards prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area. If the air quality guidelines/standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest.

Air quality legislation comprises primary standards which protect human health and secondary standards which protect property, vegetation, climate and aesthetic values. The development of new industries that increase air pollution through the emission of gases in the atmosphere should be managed. It should, however, be noted that no Air Quality Impact Assessment, inclusive of dispersion modelling was conducted at the time of this study.

3.4. National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended

The National Environmental Management Act (NEMA) provides the legislative framework for Integrated Environmental Management (IEM) in South Africa. Section 24 provides that all activities that may significantly affect the environment and require authorisation by law must be assessed prior to approval. NEMA also provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of the State and to provide for matters connected therewith. Section 2 of NEMA establishes a set of principles that apply to the activities of all organs of state that may significantly affect the environment.

These include the following:

- Development must be sustainable;

- Pollution must be avoided or minimised and remedied;
- Waste must be avoided or minimised, reused or recycled;
- Negative impacts must be minimised; and
- Responsibility for the environmental health and safety consequences of a policy, project, product or service exists throughout its life cycle.

These principles are taken into consideration when a government department exercises its powers, for example during the granting of permits and the enforcement of existing legislation or conditions of approval.

Section 28(1) of NEMA states that "every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring". If such pollution cannot be prevented, then appropriate measures must be taken to minimise or rectify such pollution. These measures may include:

- Assessing the impact on the environment;
- Informing and educating employees about the environmental risks of their work and ways of minimising these risks;
- Ceasing, modifying or controlling actions which cause pollution/degradation;
- Containing pollutants or preventing movement of pollutants;
- Eliminating the source of pollution; and
- Remedying the impacts of the pollution.

The authorities may direct an industry to rectify or remedy a potential or actual pollution problem. If such a directive is not complied with, the authorities may undertake the work and recover the costs from the responsible industry.

3.5. Other Relevant Legislation

Acts and Regulations pertaining to health and environmental, and health in particular, are indicated in Table 3-1

Table 3-1: Acts and Regulations relevant to Health and Environmental Health

National legislation	Relevance to HIA
Atmospheric Pollution Prevention Act (Act 45 of 1965)	Hazardous substances associated with air pollution affect human health. This Act has identified some of the activities for which authorization for emissions is required from the DEA (DOH, 2010).

National legislation	Relevance to HIA
National Environmental Management: Waste Act (Act 59 of 2008)	The objectives of this Act are to protect health, well-being and the environment; to ensure that people are aware of the impact of waste on their health, well-being and the environment; to provide for compliance with the measures set out in the Act and to give effect to Section 24 of the Constitution to secure an environment that is not harmful to health and well-being (DOH, 2010).
National Water Act (Act 36 of 1998)	The quality of water in domestic water sources impacts on human health. The Act provides for the protection of water quality for the benefit of human health and aquatic ecosystems through the concept of the reserve determination process (DOH, 2010).
Water Services Act (No. 108 of 1998)	Water services (water supply services and sanitation services) may impact on human health. Water service providers have an important role to play in this regard. Proposed activities may involve industrial use of water, which is covered under Section 7 of this Act (DOH, 2010)

3.6. International Management Standards

There are a number of international guidelines or best practice guidelines that refer to community health in development or industrial Projects. The World Bank Group's standards and norms, in particular those developed by its private sector arm, the International Finance Corporation (IFC), are generally considered as the benchmark. The IFC has published a set of Performance Standards for large projects that will require international funding. Performance Standard 4 (PS4): Community Health, Safety and Security, recognises that Project activities result in both positive and negative impacts to communities (IFC, 2012). The objectives of this PS4 are:

- To avoid or minimise risks to and impacts on the health and safety of the local community during the Project life cycle from both routine and non-routine circumstances; and
- To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimises risks to the community's safety and security.

IFC Performance Standard 4 "Community Health, Safety and Security" states that:

"The client will evaluate the risks and impacts to the health and safety of the Affected Communities during Project life-cycle and will establish preventive and control measures consistent with Good International Industry Practice (GIIP), such as in the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) or other internationally recognised sources. The client will identify risks and impacts and propose mitigation measures that are commensurate with their nature and magnitude. These measures will favour the prevention or avoidance of risks and impacts over minimization."

In addition to being considered the benchmark standards for major projects, the IFC's Performance Standards are applicable to projects seeking financing from either the IFC or other Equator Principles funding institutions.

Key requirements include:

- Evaluation of the risks and impacts of the affected community during the design, construction, operation and decommissioning of the Project;
- Where the Project poses risks to the health, safety and security of communities, an Action Plan will be disclosed on an on-going basis to enable the community to understand the risks and adverse impacts;
- The design, construction, operation and decommissioning of the Project will be in accordance with good international industry practice. Particular consideration will be given to potential exposure to natural hazards;
- Adverse impacts on soil and groundwater as a result of the proposed Matai Mining Project will also be avoided;
- The transmission of communicable diseases from temporary or permanent labour will be minimised;
- Risks and impacts from Project activities will be assessed and communicated in a culturally-appropriate manner. Emergency community situations shall be addressed; and
- Where employees or contractors are retained to provide security, the risks to those inside and outside the Project site will be assessed.

3.7. Other Policies with an Impact on the Health Sector

For the past five years, government has been reviewing the impact of pharmaceutical patents on high prices, and consequently the difficulty of ensuring access to medicines (Gray, 2017). Following on the publication of its Intellectual Property Consultative Framework in 2016, the Department of Trade and Industry released another policy document in 2017, the Draft Intellectual Property Policy of the Republic of South Africa Phase I 2017. In this phase of the development of the policy, the focus is on "IP and public health, coordination in international forums, and the implementation of commitments undertaken in international agreements". Phase 1 priorities have been identified on the basis of South Africa's development objectives, supplemented by research, analysis, and experience, as well as assessments of existing capacity to implement the measures outlined. While panned

by the pro-IP lobby, the policy has been lauded by other experts, and despite being approved by Cabinet in May 2018, no indication has yet been given of the process for amendment of the Patents Act (57 of 1978).

4. Health Impact Assessment Framework and Methodology

It is important that a distinction is made between HIA and Health Risk Assessment (HRA). HRA is concerned with the identification of hazards and risks to the workforce which relate to occupational health and safety and engineering design. Generally, HRA is "within the fence" while HIA is "outside the fence" but there are distinct overlaps with HIA often taking a central position as workplace activities can affect community health and existing community health needs or disease burdens can affect workplace health. HIA is used to evaluate the public health consequences of proposed decisions in non-health sectors (CDC), while HRA is about "quantitative, analytic process to estimate the nature and risk of adverse human health effects associated with exposure to specific chemical contaminants or other hazards in the environment, now or in the future (CDC). Results from HRA can be used within a HIA to predict human health effects of specific exposures. It is thus important that these assessments should not be placed into individual elements but integrated to support an overall strategic plan for the Project. Workplace health is specifically out of scope of the HIA; however it is important to understand which activities in the workplace can impact community health. This is important as the project activities can impart direct external influences on community health and the workforce also originates from the community and thus workplace activities and potential exposures must not be transferred back to the community at the end of shifts.

4.1. Environmental Health Areas

A World Bank analysis demonstrated that an almost 50% improvement in major health outcomes could be achieved by improvements in four sectors: (i) housing and urban development; (ii) water, food and sanitation; (iii) transportation; and (iv) communication. Building upon this sectoral analysis and incorporating a broad perspective on "environmental health" led to the development of a defined set of environmental health areas which have been adopted in the IFC Notes for PS4, the 2005 IPIECA (International Petroleum Industry Environmental Conservation Association) HIA guidelines and the IFC HIA GPN.

The IFC methodology uses twelve (12) Environmental Health Areas (EHAs) to support the systematic analysis of health considerations. These are summarized in

Table 4-2. The set of EHAs provides a linkage between project-related activities and potential positive or negative community-level impacts and incorporate a variety of biomedical and key social determinants of health. In this integrated analysis, cross-cutting environmental and social conditions that contain significant health components are identified instead of a HIA focusing primarily on disease-specific considerations – as is frequently done in many biomedical analyses of potential project-related public health impacts. The EHA framework is based on an analysis performed and published by the World Bank.

4.2. Potentially Affected Communities

To identify and quantify potential health impacts, an accurate population profile is required and it is important to distinguish between differences in exposure and susceptibility. Thus, besides a demographic profile of the at-risk population and the identification of the most vulnerable groups, it is crucial to understand how the development, construction and operational activities are likely to impact at both a household and community level. Impacts caused by resettlement, shifts in the social structures or influx triggered increases in population density are considered within the overall assessment.

The key aspects when considering the potential influence of the project to the Potentially Affected Communities (PACs) is the exposure pathway of the potential health determinant. The following key elements need to be considered:

- Whether there is a hazard;
- Who or what may be exposed to this hazard (pathway and rate of exposure to estimate the concentration/extent to which human receptors of concern may be exposed);
- The mode (air, water, food, vector, social determinants etc.) and route (inhalation, ingestion etc.) of exposure;
- The risk of exposure based on a likelihood and consequence analysis (magnitude, duration and length); and
- How sensitive or vulnerable the receptor is to the potential hazard or impact.

As part of the analysis, the relevant overall population is stratified into PACs. A PAC is a defined community within a clear geographical boundary where project-related health impacts may reasonably be expected to occur. PACs are inherently prospective and simply represent best professional judgments. PACs are likely to change over the course of project implementation; and there may be changes in the project design, thus its longer-term implications are not fully known. This implies that the definition of PACs may need further adaptation as the project moves ahead; therefore, the specification of a PAC should be viewed as time-dependent as it will evolve over the project cycle. Findings of social and economic assessments, resettlement plans and migration

management plans need to be carefully updated as this allows linkage between the PACs and key demographic determinants such as age structure and population numbers.

Mitigation strategies may also require specific considerations for the different PACs. On the one hand, not all the EHAs may be of concern for mitigation for the individual PACs. On the other hand, a separate risk analysis for a PAC may be indicated due to a particular susceptibility to a specific health impact. However, at this stage of the impact assessment only limited risk analysis will be carried out for different PACs based on the existing designs – refer to Plan 2 for an illustration of the PACs.

4.3. Introduction and Definition

A HIA is a practical, multi-disciplinary process, combining a range of qualitative and quantitative evidence in a decision-making framework. A HIA seeks to identify and estimate the lasting or significant changes of different actions on the health status of a defined population (Winkler *et al*., 2010). A HIA may be defined as "*a combination of procedures, methods and tools by which a Project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population*". The objective of a HIA is to deliver evidence-based recommendations to maximize potential positive health benefits and prevent or mitigate any detrimental health impacts that a Project may have on the potentially affected communities (PAC) (WHO/ECHP, 1999).

The WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. This is influenced through complex interaction of social, economic, genetic and environmental factors (WHO, 2010c).

The ultimate deliverable of a HIA is a Community Health Management Plan (CHMP) (Winkler *et al*., 2011). This plan would be based on evidence and stakeholder input, prioritised according to impacts and needs and having clear indicators to monitor and evaluate impacts and programs. The CHMP will also facilitate the development of social development programs linked to health.

The holistic model of health used in the HIA process acknowledges that the health status of a population is affected by factors known as health determinants (e.g. education, income level, health services, etc.). All of these are closely interlinked and differentials in their distribution lead to health inequalities. These include both biophysical and social determinants of health as well and not just purely health outcomes. The methodology allows HIA practitioners to consider how a Project affects these determinants of health, as well as health outcomes.

4.4. Determinants of Health

The driving concept behind HIA is that individual and community health is not simply determined by health services or biological factors (e.g., age). It is also shaped by wider social, economic and environmental influences and factors. These health determinants are the factors that lead to health outcomes and include:

- Physical environment factors (e.g., air quality, water quality, hazards)
- Built environment factors (e.g., buildings, public spaces, roads, bike lanes)
- Livelihood factors (e.g., income, employment)
- Social and community factors (e.g., social support, family structure, access to services)
- Lifestyle factors (e.g., diet, exercise, alcohol and tobacco use)

On the other hand, we have health-related outcomes. These health outcomes refer to the health status of both individuals and groups within a population or community and can include both positive and negative outcomes. The health determinants --as impacted by an activity--contribute to health outcomes in various ways, either directly or indirectly. Health outcomes can include things like morbidity rates (injuries), mortalities, asthma, diabetes, cardiovascular disease and other diseases. Both determinants of health as well as health outcomes will be assessed in this Report. This Report does however use a broader definition of health outcomes that includes the behaviours and contributing factors that contribute to an individual or community's health status. For example, while physical activity is not exactly a health outcome, it does have a notable effect on health outcomes and is therefore considered a health-related outcome.

4.5. Overview of the HIA Process

A standardised approach was considered for the HIA to ensure that evidence-based recommendations supported the impact assessment. To ensure compliance with the IFC performance standards, and especially PS4, the methodology outlined in the Good Practice Note for HIA from the IFC, was adopted (IFC, 2009). The main elements of this are illustrated in Figure 4-1. These are also discussed briefly below so that the context of the HIA is understood.

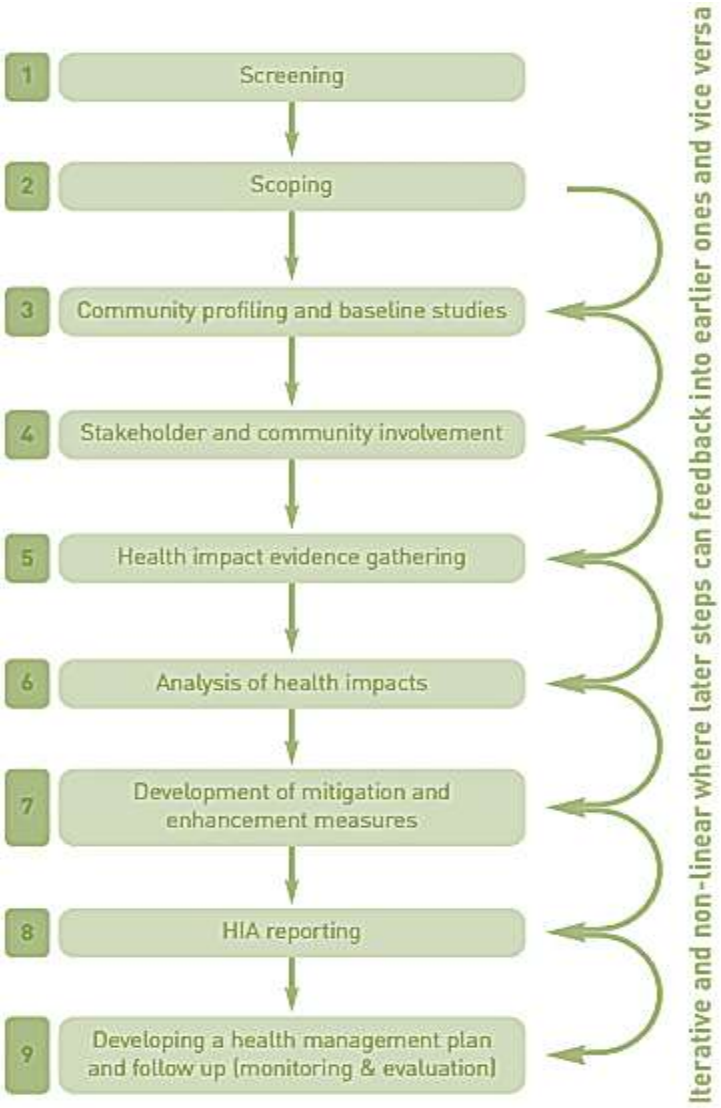


Figure 4-1: HIA Procedure

The framework that is commonly used for a HIA follows a 6-step process (IFC, 2009):

- Screening (preliminary evaluation to determine the necessity of a HIA);
- Scoping (identifying the range of potential Project-related health impacts and defining the terms of reference for the HIA, based on published literature, local data and broad stakeholder consultation and how these may be influenced by the Project);
- Risk assessment (qualitative and quantitative appraisal of the potential health impacts in relation to defined communities and the Project development, including stakeholder participation);
- Appraisal and mitigation (development of a CHMP) based on the findings of the risk assessment);
- Implementation and monitoring (realisation of the CHMP including monitoring activities that allow for adaptation); and

- Evaluation and verification of performance and effectiveness (key step to analyse the HIA process as a whole).

This HIA aims to influence design and inform the construction, operation and decommissioning phases of the Project. As HIAs are dynamic iterative processes they do require flexibility in their methodologies and tools, so that they can be fit for purpose for different Projects.

4.6. Benefits of HIA

Assessment and management of community health, safety and well-being impacts is increasingly considered part of the risk management and social responsibility of mining and metals operators. A range of industrial sectors e.g. oil and gas, chemical manufacturing and transportation are increasingly looking to embed HIA within their organizational and project management structures. For new mining projects and modifications, or acquisitions of existing projects, HIA can:

- Identify and maximize the positive community health and well-being impacts and opportunities that a mining project can bring.
- Identify, avoid and minimize, through changes to the project design and implementation, the unintended negative community health and well-being impacts that can arise.
- Identify existing community health problems, which could amplify the impact of a proposed project and affect its viability.
- Identify country-specific health regulations which may affect the proposed Matai Mining Project.
- Provide a process through which the project can work in partnership with local health, social care and welfare services to jointly alleviate these health problems.
- Form one part of a broader community and local stakeholder involvement and engagement process that can build trust, draw out any community concerns and generate a dialogue about the best ways that the project can benefit local communities.
- Help to make explicit the potential trade-offs between community health and well-being and other economic, environmental and social objectives of the proposed Matai Mining Project.
- Provide an equitable, transparent and evidence-based approach to planning and funding community health infrastructure and development activities to protect and enhance sustainable local livelihoods.
- Help to negotiate jointly those aspects of community health and well-being which are the responsibility of the project and those aspects which are the responsibility of local government and local public services.
- Help to manage project sustainability and obtain a long-term licence to operate.

A proactive approach to preventing ill health and maximizing health and well-being benefits can improve the financial performance of a project and parent company. Key bottom line benefits include:

- Speedier achievement of a mining project's licence to operate
- Lower planning and associated legal and consultancy costs
- Access to international funding
- Lower risk of disruptive protest or sabotage
- Lower risk of damage to a project and parent company's reputation
- Lower risk of future community-led liability and litigation
- Reduced absenteeism and health care costs for employees from local communities
- Improved general employee morale.

4.7. Determining the scale of the HIA

The level or scale of a HIA depends on the complexity of the Project, the magnitude of expected impacts, as well as the Project phase during which the HIA is undertaken. Various levels of HIA are defined in Table 4-1 below (IFC, 2012).

When gathering new field data for the HIA, the Project will require different levels of effort and needs. The key descriptive terms for these cases -- "comprehensive" and "rapid appraisal"--indicate the different depths of analysis and consultation required and whether the performance of the HIA involves collecting new field data.

A limited in-country HIA uses information that is readily accessible in the public domain. Data sources may include peer-reviewed scientific literature and "grey literature," that is, health department data. Although no specific new data collection is required, workshops or discussions with key internal and external stakeholders can provide useful health-related information. Limited in-country HIAs are appropriate for many expansion scenarios where new data collection is not crucial (IFC, 2009). The activities undertaken in the limited in-country HIA are highlighted in Table 4-1 and formed the basis for this study.

Table 4-1: Levels of HIA (IFC, 2009)

Level of HIA	Characteristics
Desktop HIA	- Provides a broad overview of possible health impacts; - Analysis of existing and accessible data; and - No new Project specific survey data collection.

Level of HIA	Characteristics
Scoping/Rapid Appraisal HIA	▪ Provides more detailed information of possible health impacts; ▪ Analysis of existing data; ▪ Stakeholder and key informant analysis; and ▪ No new Project-specific survey data collection.
Comprehensive HIA	▪ Provides a comprehensive assessment of potential health impacts; ▪ Robust definition of impacts; ▪ New Project specific survey data collection; and ▪ Participatory approaches involving stakeholders.

4.8. Baseline Data Collection

The data collection activities of the HIA included a desktop literature review, participatory data collection (stakeholder input – questionnaire and a Focus Group Discussion) and direct observation. This method allows for the triangulation of data and provides a robust description of data as shown in Figure 4-2 (Winkler *et al*., 2011).

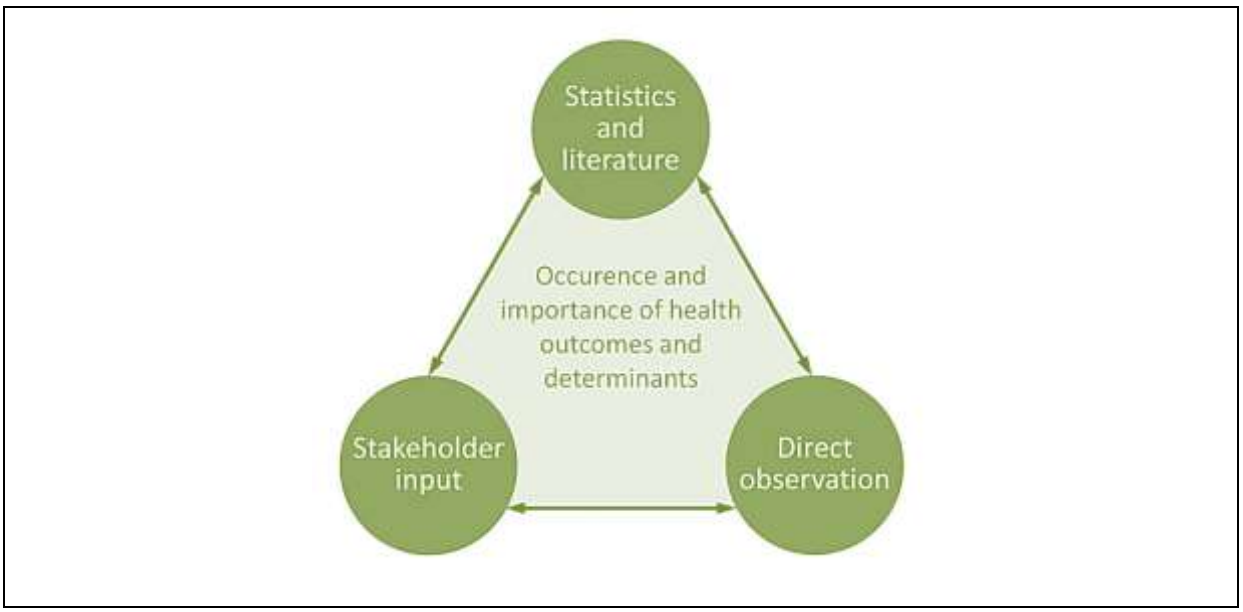


Figure 4-2: Triangulation of Data (Winkler *et al*., 2011)

4.8.1 Desktop Work

This involved a literature review of health-related data in the public domain as well as a review of existing Project documentation and related secondary data. The literature review was completed before the field visit so that data gaps could be identified and questioning routes and questionnaires could be developed. Priority was given to

topics that contributed the most towards the burden of disease in South Africa and the proposed Matai Mining Project site and also to health-related incidents related to mining.

The desktop work included an extensive literature review to inform the health profiling of the region and where possible the population in the proposed Matai Mining Project site. The desktop work described the broad health status of the population, based on a systematic review of the 12 EHAs. It must be noted that there is limited information in the public domain regarding the health profile in the North West Province, especially at the local level.

The outcomes of the literature review are presented in Section 6 and 7 of this Report and have been combined with the information that was acquired during the field visit (Section 8) and subsequent Project documentation review.

4.8.2 Questionnaire Design

Participatory tools were used in data collection. These tools included a questionnaire administered to community members through Focus Group Discussions (FGDs) (both males and females). The questionnaires were designed to assist in the identification of the major health concerns for the community, institutional issues (satisfaction or lack thereof with health facilities), socio-economic aspects and environmental concerns.

These questionnaires and discussions also sought to establish Knowledge, Attitudes, Practices, and Belief (KAPB) for specific diseases such as HIV/AIDS. The questionnaires used for the purpose of this study have been appended to this Report; see Appendix B for the Focus Group Discussion Questionnaire.

4.8.3 Field Visit

A field visit was undertaken to:

- Collect primary participatory data in the form of semi-structured focus group discussions with men and women in the different Project- affected communities;
- Gather additional information that was not available in the public domain during the desktop review. This includes collection of information from health facilities, from the national health information management system, as well as from unpublished reports and documents – qualitative and quantitative data;
- Identify key informants and expectantly conduct interviews using a semi-structured questionnaire;
- View the standards of the local health facilities and functionality of the health management information system; and
- Visualise the Project and location of communities in relation to planned Project activities.

The field work took place in February 2019. This was conducted by Vumile Ribeiro and a trainee on the HIA team. The field visit provided an opportunity to visualise and assess the prevailing situation in the communities and their relation to the proposed Matai Mining Project. This was important to understand the potential areas of influence of the Project and also the general living conditions in the communities living in close vicinity to the proposed Matai Mining Project site.

4.8.4 Key Informant Interviews

It was intended to conduct interviews with key Healthcare personnel from Healthcare facilities surrounding the Project area– refer to Plan 3 for an illustration of some of the healthcare facilities in and around the Project area. The objective of these interviews would have been to gain a better understanding of the structure and capacity of the local health system, to enquire what health statistics were available at the local level and where possible obtain authorised copies of statistics and reports. Due to hindrance of the HIA Specialist Team by the DoH, Key Informant Interviews could not be conducted in any of the targeted/ identified healthcare facilities.

4.8.5 Focus Group Discussions

In addition to visiting the local health facilities, FGDs were conducted in the immediate and wider proposed Matai Mining Project site – refer to Plan 2 for an illustration of the various PACs. The FGDs were held at the following communities:

- Legogolwe;
- Lesobeng;
- Manamakgotheng;
- Mantserre;
- Mononono; and
- Sefikile

Although women are generally considered to be the gatekeepers to family health and usually have a good understanding of critical issues that influence health at the community and household level, it was decided to include both men and women during FGDs. This allows for a high-level understanding of the health challenges, from both a biophysical and social health perspective. FGDs were conducted in English, with simultaneous translation into the local languages spoken (Setswana) in the community, through a local translator.

Figure 4-3: Assembling outside the school before the FGD at Mononono

4.9. Potential Impact Categorisation: Environmental Health Areas (EHAs) Framework

Potential community health impacts were identified on the basis of: (i) the available health data from the literature review; (ii) the information generated through stakeholder consultation; (iii) the knowledge of the Project context and developments; (iv) input from other specialist studies that inform the elements of the EIA; and (v) experience of previous HIAs in similar settings (Winkler *et al*., 2010).

The identified potential impacts were then categorised in terms of 12 Environmental Health Areas (EHAs) – a set of health-related factors and considerations defined by IFC methodology. These are summarised in

Table 4-2. The set of EHAs provides a linkage between Project-related activities and potential positive or negative community-level impacts and incorporates a variety of biomedical and key social determinants of health. In this integrated analysis, cross-cutting environmental and social conditions that contain significant health components are identified instead of a HIA focusing primarily on disease-specific considerations – as is frequently done in many biomedical analyses of potential Project-related public health impacts. The EHA framework is based on an analysis performed and published by the World Bank (IFC, 2009).

Table 4-2: Environmental Health Areas

Environmental Health Areas (EHAs)	
1.	**Vector-related diseases** – Mosquito, fly, tick and lice-related diseases (e.g. malaria, dengue, yellow fever, lymphatic filariasis, rift valley fever, etc.).
2.	**Acute respiratory infections and respiratory effects from housing** – Transmission of communicable diseases (e.g. acute respiratory infections, pneumonia, tuberculosis, meningitis, plague, leprosy, etc.) and respiratory infections.
3.	**Veterinary medicine and zoonotic issues** – Diseases affecting animals (e.g. bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g. rabies, brucellosis, Rift Valley fever, Lassa fever, leptospirosis, etc.).
4.	**Sexually-transmitted infections, including Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome (HIV/AIDS) –** Sexually-transmitted infections such as syphilis, gonorrhoea, chlamydia, hepatitis B and, most importantly, HIV/AIDS. Linkages of TB will be discussed where relevant under HIV, but often linked to EHA1.
5.	**Soil-, water- and waste-related diseases** – Diseases that are transmitted directly or indirectly through contaminated water, soil or non-hazardous waste (e.g. diarrheal diseases, schistosomiasis, hepatitis A and E, poliomyelitis, soil-transmitted helminthiases, etc.).
6.	**Food- and nutrition-related issues** – Adverse health effects such as malnutrition, anaemia or micronutrient deficiencies due to e.g. changes in agricultural and subsistence practices, or food inflation; gastroenteritis, food-borne trematodiases, etc. This will also consider feeding behaviours and practices.
7.	**Accidents/injuries** – Road traffic or work-related accidents and injuries (home and Project related); drowning.
8.	**Exposure to potentially hazardous materials, noise and malodours** – This considers the environmental health determinants linked to the Project and related activities. Noise, water and air pollution (indoor and outdoor) as well as visual impacts will be considered in this biophysical category. It can also include exposure to heavy metals and hazardous chemical substances and other compounds, solvents or spills and releases from road traffic and exposure to mal-odours. There is a significant overlap in the environmental impact assessment in this section. Ionizing radiation also falls into this category.
9.	**Social determinants of health** – Including psychosocial stress (due to e.g. resettlement, overcrowding, political or economic crisis), mental health, depression, gender issues, domestic violence, suicide, ethnic conflicts, security concerns, substance misuse (drug, alcohol, smoking), family planning, health seeking behaviours, etc. There is a significant overlap in the Social Impact Assessment (SIA) in this section.
10.	**Cultural health practices** – Role of traditional medical providers, indigenous medicines, and unique cultural health practices.

Environmental Health Areas (EHAs)	
11.	**Health systems issues** – Physical health infrastructure (e.g. capacity, equipment, staffing levels and competencies, future development plans); program management delivery systems (e.g., malaria-, TB-, HIV/AIDS-initiatives, maternal and child health, etc.).
12.	**Non-communicable diseases** – Cardiovascular diseases, cancer, diabetes, obesity, etc.

4.10. Direct versus Indirect and Cumulative Effects

The purpose of an HIA is to 'unravel the determinants of health, which include individual, social and environmental and institutional factors, that are directly or indirectly (representing underlying issues) and cumulatively affected by the proposed Matai Mining Project. Consideration of these aspects allows for better management of the risks associated with individual determinants' (IFC, 2009).

Numerous health determinants are affected by individual factors which may be genetic, biological, lifestyle or behavioural in nature and specific circumstances (IFC, 2009). These factors include indicators of vulnerability that describes individual exposure, susceptibility or the ability to cope. Examples include gender, age, dietary intake, exercise, alcohol and tobacco use, education, and employment. The relationship between a project and the individual determinants is complex and often controversial. 'The HIA is not a "social engineering" exercise; instead, the assessment aims to systematically analyse those potential direct, indirect (underlying) and cumulative community impacts that are predicted to occur due to the project' (IFC, 2009).

Activities identified for the project during the construction, commissioning, operational and decommissioning phases have been used to identify relevant generic key issues as recommended by the IFC HIA Guidelines (IFC, 2009). Associated EHAs and their implications in terms of the project activities were then used to guide the selection of potential positive and/or negative impacts.

4.11. Areas outside the Scope of the HIA

The study does not address classic occupational health concerns (e.g., physical hazards or environmental hazards encountered by workers), which are referred to as 'inside the fence' and are addressed by federally mandated health and safety protocols enforced by the department of Labour and Occupational Health and Safety Act 85 of 1993.

5. Impact Assessment Methodology

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact

characteristics, as defined above, used to evaluate impact significance. The methodology below will be used when determining the significance of impacts associated with the proposed Matai Mining Project.

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impact significance rating system is presented in Table 5-1, Table 5-2 and Table 5-3 and involves three parts:

1 **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/ population and duration;
2 **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and
3 **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from **Part B**) and the probability of occurrence.

5.1. Part A: Defining Consequence in Terms of Magnitude, Duration and Spatial Scale:

Use these definitions to define the consequence in Part B.

Table 5-1: Consequence Rating Methodology

Impact Characteristics	Definition	Criteria
Magnitude	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate -	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or threshold never exceeded

Impact Characteristics	Definition	Criteria
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
Spatial scale or population	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond
Duration	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years

5.2. Part B: Determining Consequence Rating:

Rate consequence based on definition of magnitude, spatial extent and duration.

Table 5-2: Consequence Rating Methodology

			Spatial Scale/ Population		
			Site or Local	**Regional**	**National/ International**
MAGNITUDE					
Minor	**DURATION**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	**DURATION**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	**DURATION**	**Long term**	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

5.3. Part C: Determining Significance Rating:

Rate significance based on consequence and probability.

Table 5-3: Significance Rating Methodology

		Consequence		
		Low	Medium	High
PROBABILITY (of exposure to impacts)	Definite	Medium	Medium	High
	Possible	Low	Medium	High
	Unlikely	Low	Low	Medium

5.4. Data Gaps and Limitations of the HIA Study

This HIA has focused on understanding the high-level health issues associated with the proposed Matai Mining Project site. The HIA also assessed health data gaps that may exist and determined whether additional information would be required to inform a more comprehensive health evidence-base.

The gap analysis included a critical appraisal of data quality of sources identified during the HIA process.

The following are the recognised limitations of the HIA study:

- The HIA specialist team was denied access into healthcare facilities (by the Department of Health) to conduct interviews with key informants at the time of field visit; and
- FGDs are normally based on respondents' self-declaration which may be prone to recall or response bias. Moreover, when it comes to questions on one's private life, study participants tend to be affected by a social desirability bias, where they may choose to give answers that are socially acceptable;
- As the proposed Matai Mining Project is still in the planning phase, many of the parameters required for the Air Quality Modelling were unavailable. Average values from the literature were used for many of the parameters, and in some cases, conservative estimates and 'worst-case' values were used in the model. Whilst care has been taken to assess the potential air pollution impact from the proposed mining activities, more accurate input data may result in different conclusions. For the emissions modelling, it was assumed that primary crushing will take place in the pit and that apron feeders and conveyors will be used to move all ore from the pit to the ROM pad (Ukwazi Mining Studies (Pty) Ltd, 2018a). For the mitigated scenario, it was assumed that all conveyor transfer points will be enclosed, resulting in a 70% mitigation efficiency.

This HIA must be viewed as a prospective / predictive study as the Project is still in the Environmental Application Phase.

6. Country Health Profile: South Africa

South Africa is a dynamic and complex country. A middle-income nation that has dedicated substantial resources to health and human capital investments, South Africa has a progressive Constitution that guarantees the right to health care and a vibrant civil society. National Health Insurance (NHI) is the central means by which the government aims to achieve universal coverage, under the principles of social solidarity and equity elaborated in the National Development Plan. To implement NHI, the government is revitalizing service delivery, changing the way that health services are financed, ensuring the provision of primary care, improving access to qualified human resources for health, and ensuring the availability of quality assured medical products.

Life expectancy has increased due to innovations and rapid scale-up of HIV/AIDs and Tuberculosis (TB) treatment and care, and expanded access to immunizations. Life expectancy which incorporates the impact of AIDS increased from 52.1 years in 2005 to 61.2 years in 2014 (Statistics South Africa, 2014). The estimated national HIV prevalence among the general population aged 15 – 49 years has remained 17.3% since 2005 (Department of Health Strategic Plan 2014/15-2018/9). Two in three TB patients also are HIV positive. South Africa has one of the highest TB incidence rates in the world (834 per 100,000 populations). The treatment success rate for new and relapse cases registered in 2013 is 78% (Global TB Report 2015).

South Africa also contributes about 10.4% of the global burden of reported Multi-drug Resistant Tuberculosis (MDR-TB) initiated on treatment. A National DRTB Survey to ascertain the burden of DR-TB was made available in the first quarter of 2016. Diagnosis and management of drug resistant cases account for nearly half of the TB budget, and treatment success rates are 49% for MDR-TB and 20% for XDR-TB (Global TB Report, 2015).

Progress in maternal and child health has been hindered by the HIV and tuberculosis epidemics, and the performance of the health system. Efforts to accelerate prevention interventions are underway, including the prevention of maternal to child transmission of HIV. Important reductions have occurred in under-five and neonatal mortality (42 and 14 per 1000 live births (2013/14)), although these rates are higher in comparison with other countries of similar socioeconomic status. Maternal mortality ratios remain high, estimated at 269 deaths per 100 000 live births. Immunization remains critical to improving child health. The government currently has eleven antigens on its national immunization schedule, including rotavirus and Pneumococcal Conjugate Vaccine, which has markedly reduced child morbidity and mortality. A national HPV campaign was launched in March 2014.

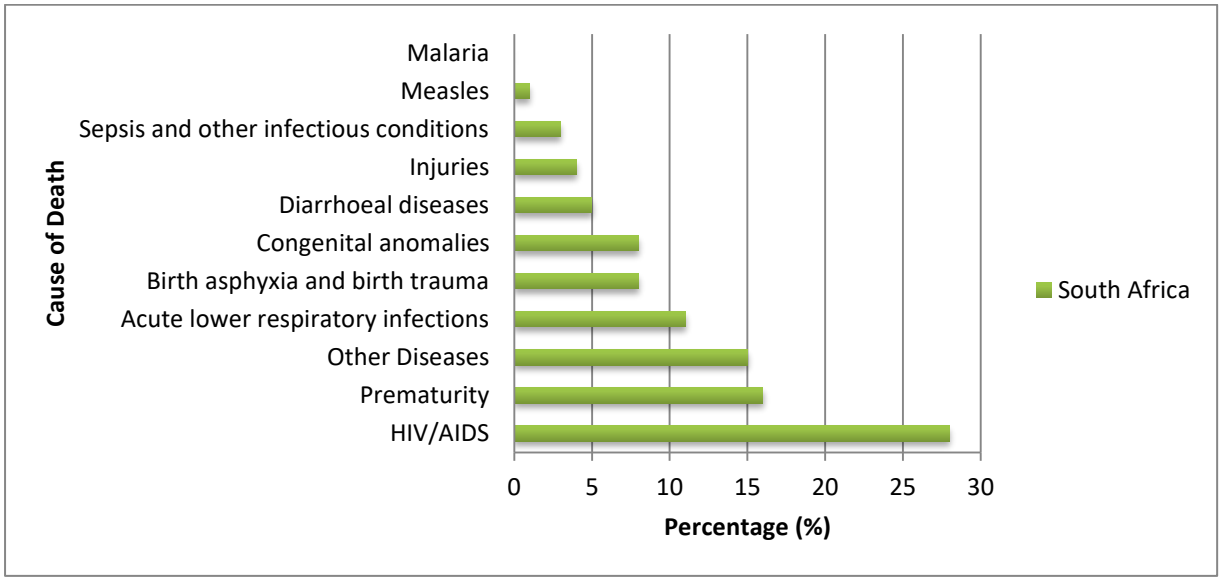


Figure 6-1: Distribution of causes of death among children aged under 5, % of totals in RSA

Approximately two in five deaths are attributable to non-communicable diseases. Some 40% of mortality from non-communicable conditions among men occurred before the age of 60 years - and is therefore considered premature. Second to non-communicable conditions is the burden of mortality and disability from violence and injuries. A rapid increase in motor vehicles has led to increases in road traffic accidents that now account for more than one-quarter of deaths due to injuries. For nearly two decades, tobacco-use declined because of strong legislation and policies to control tobacco consumption. The WHO FCTC was ratified in 2005. However, smoking rates are among the highest in the continent (21.5% in 2014). Harmful alcohol consumption is the third most important risk factor contributing to non-communicable diseases, injuries, and communicable diseases. Alcohol use is a major underlying factor in injuries and road traffic accidents. Patterns of harmful use exist among those who drink. Harmful and excessive alcohol consumption also contributes to non-communicable conditions, and can also accelerate the progression of infectious diseases.

Overweight and obesity pose major nutritional challenges. More than seven in ten women above 35 years old are overweight. A contributing factor is the rapidly increasing consumption of packaged foods high in calories, saturated fats, animal proteins, sugars, and salt. In addition, physical activity levels are low. Approximately half of adults are physically inactive, and two in five schoolchildren do not participate in sufficient physical activity. Improvement in the sustainable development sector has resulted in improved quality of life. Access to improved water sources is nearly universal. However, coal is used as a cheap source of energy for industry, and thus South Africa ranks as the highest greenhouse gas emitter in the continent. Climate change is one of the key priorities of Government, who views mitigation to ensure an internationally competitive lower carbon economy.

6.1. Public and Private Health Sector

South Africa has a large public sector and a smaller but fast growing private sector. The country's Healthcare system comprises a network of health facilities providing primary health care, supported by several higher levels of care. Healthcare in South Africa varies from the most basic primary healthcare, offered free by the state, to highly specialised, hi-tech health services available in both the public and private sector.

The public health sector is stretched and under-resourced in several places. While the state contributes about 40% of all expenditure on health, the public health sector is under pressure to deliver services to about 80% of the population. The private sector, on the other hand, is run largely on commercial lines and caters to middle- and high-income earners who tend to be members of medical schemes (South Africa Info, 2013). It also attracts most of the country's health professionals.

This two-tiered system is not only inequitable and inaccessible to a large portion of South Africans, but institutions in the public sector have suffered poor management, underfunding and deteriorating infrastructure. While access has improved, the quality of health care has fallen. The situation is compounded by public health challenges, including the burden of diseases such as HIV and Tuberculosis (TB), and a shortage of key medical personnel.

6.2. South African Health Care System

The South African government has been responding with a far-reaching reform plan to revitalise and restructure the South African health care system, including:

- Fast-tracking the implementation of a National Health Insurance scheme, which will eventually cover all South Africans;
- Strengthening the fight against HIV and TB, non-communicable diseases (NCDs), as well as injury and violence;
- Improving human-resource management at state hospitals and strengthening co- ordination between the public and private health sector;
- Deploying "health teams" to communities and schools;
- Regulating costs to make health care affordable to all; and
- Increasing life expectancy from 56.5 years in 2009 to 58.5 years in 2014.

6.3. Healthcare Facilities

There are 4 200 public health facilities in South Africa. The number of people per clinic as per figures from 2013, was 13 718, exceeding WHO guidelines of 10 000 per clinic. However, figures from March 2009 show that

people averaged 2.5 visits a year to public health facilities and the usable bed occupancy rates were between 65% and 77% at hospitals (South Africa Info, 2013).

Since 1994, more than 1 600 clinics have been built or upgraded. Free health care for children under the age of 6 and for pregnant or breastfeeding mothers was introduced in the mid-1990s (South Africa Info, 2013).

The National Health Laboratory Service (NHLS) is the largest pathology service in South Africa. It has 265 laboratories, serving 80% of South Africans. The laboratories provide diagnostic services as well as health-related research (South Africa Info, 2013).

6.4. Doctor Shortages

In March 2012, 165 371 qualified health practitioners in both public and private sectors were registered with the Health Professions Council of South Africa (HPCSA), the health practitioner watchdog body. This includes 38 236 doctors and 5 560 dentists (South Africa Info, 2013).

The doctor-to-population ratio is estimated to be 0.77 per 1 000. Due to the clear majority of General Practitioners – 73% – working in the private sector, there is approximately one practising doctor for every 4 219 people for public health care (South Africa Info, 2013). In response, the Department of Health (DoH) has introduced clinical health associates, midlevel health-care providers, to work in underserved rural areas.

Approximately 1 200 medical students graduate annually. In some communities, medical students provide health services at clinics under supervision (South Africa Info, 2013). Newly graduating doctors and pharmacists complete a year of compulsory community service in understaffed hospitals and clinics.

6.5. Quality of Services

Public health facilities in South Africa collectively scored less than 50% compliance with vital measures in two out of the six ministerial priority areas. These measures included: patient safety and security (34%) and positive and caring attitudes (30%) (DoH, 2012). The priority area waiting times scored the highest compliance to vital measures at 68%. Primary care facilities on average scored lower than hospitals in all priority areas. Overall, the facilities in Gauteng province obtained the highest compliance score on quality (69%) while the Northern Cape reflected the lowest (40%) (DoH, 2012).

6.6. Functionality of Services

In terms of performance in the five functional areas (Clinical Services, Infrastructure, Management, Patient Care, Support Services and Clinical Care), the compliance score obtained by the country's facilities is the lowest for Clinical Services (38%) (DoH, 2012). Within Clinical Services, the area of Health Technology recorded the lowest

compliance for both Primary Health Care (PHC) and hospital facilities followed by Pharmacy. This, and the low number of pharmacists working in public health facilities, needs urgent attention.

6.7. Mortality and causes of death 2015

A total of 460 236 deaths were recorded in South Africa in 2015, indicating a decline of 3,0% in deaths processed between 2015 and 2014 (474 659), this is according to the Mortality and causes of death, 2015 report released by Statistics South Africa. The three leading causes of natural deaths in 2014 were tuberculosis, diabetes mellitus and cerebrovascular diseases. Although tuberculosis maintained its rank as the number one leading cause of death in South Africa, non-communicable diseases continue their rise in the rankings of top 10 leading causes with diabetes mellitus moving from third position in 2014 to second position in 2015. Non-communicable diseases formed 60% of the ten leading underlying natural causes of death. In addition to diabetes mellitus; cerebrovascular diseases, other forms of heart disease, hypertensive diseases, chronic lower respiratory diseases and ischaemic heart diseases contributed to the rise in non-communicable diseases.

The continued rise in non-communicable diseases has been fuelled by males and females aged 65 and above. Females in this age group had nine out of ten non-communicable diseases in the leading causes, whilst men and eight of out ten as leading causes of natural deaths. Non-communicable diseases are accountable for 62,5% in the top 10 leading causes of death among females aged 65 and above, whereas among males in the same age group these constituted 48,0%. The second age group leading to a rise in deaths due to non-communicable diseases are those aged 45 to 64 years. For both males and females, six of the top ten leading causes of death were due to non-communicable diseases, accounting for 27,7% for females and 32,5% among males.

6.8. HIV/AIDS: Epidemics in Perspective

The country has made important gains in responding to the epidemics of HIV and TB and to STIs, but the national response needs to be accelerated if the country is to achieve the global health community goal of ending these as public health threats by 2030. Nearly one in five people living with HIV worldwide are in South Africa; tuberculosis (TB) is the leading cause of death in the country; and more than 1.1 million new cases of sexually transmitted infections (STIs) are treated each year.

More than 19% of adults (ages 15-49) in South Africa are living with HIV. The HIV burden varies widely by geography, age and gender and for key and vulnerable populations. New HIV infections declined from 360 000 in 2012 to 270 000 in 2016, with marked progress in preventing mother-to-child HIV transmission. Adolescent girls and young women as well as other key and vulnerable populations remain most heavily affected by the epidemic. South Africa has the world's largest HIV treatment programme, with 3.7 million people initiated on antiretroviral therapy as of December 2016, resulting in a sharp increase in national life expectancy from 58.3

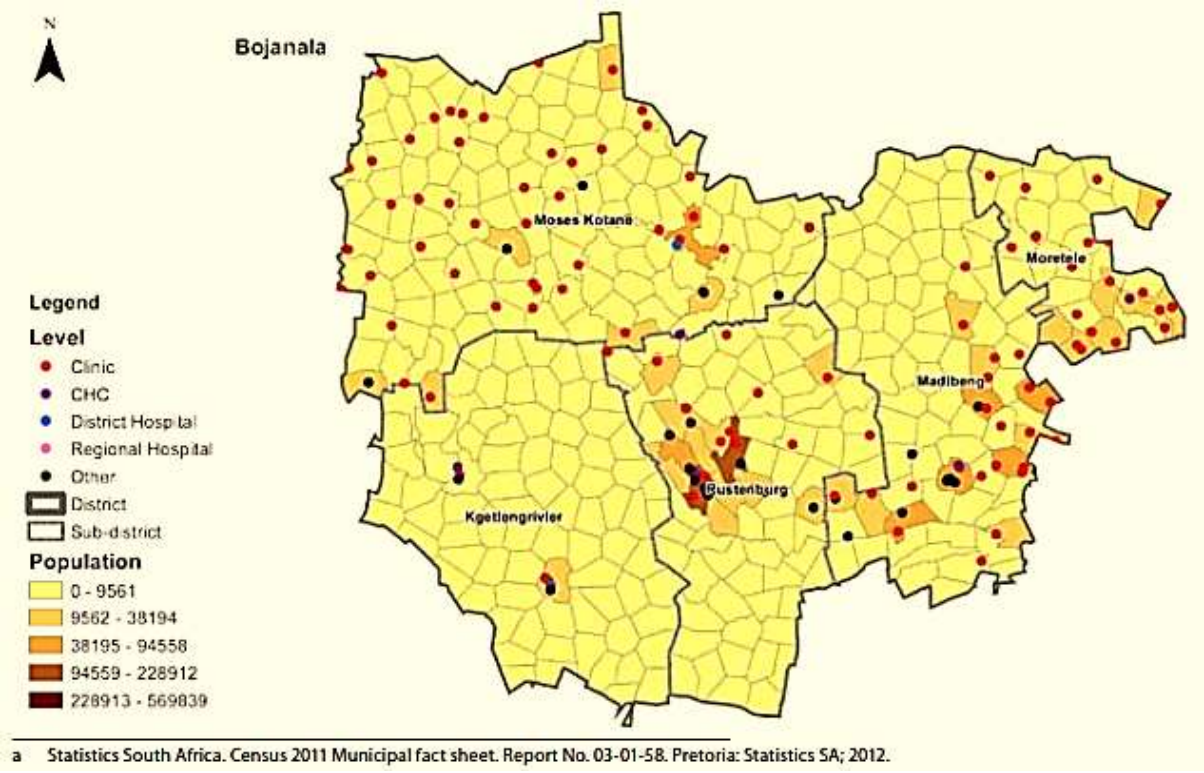
years in 2011 to 62.4 years in 2015. Although less detailed epidemiological information is available on STIs, the evidence underscores the seriousness as a public health problem and as a risk factor for HIV infection.

South Africa has the sixth highest TB incidence in the world, with more than 450 000 new cases diagnosed in 2015, 63% in people living with HIV. There has been only a modest decline in new cases since 2012. Multidrug-resistant TB (MDR-TB) is a growing problem; with the number of MDR-TB cases doubling from 2007 to 2012.

During 2012 -2016 South Africa advanced its efforts to address the needs of key and vulnerable populations and continued to address the social and structural drivers of HIV, TB and STIs, enhance human rights and reduce stigma, resource the response and provide effective leadership. However, the pace of impacting on the epidemics will need to be speeded up if we are to achieve the global targets signed up to and the national targets set. More of the same will not be enough.

7. District Health Profile: Bojanala District Municipality

Bojanala District is situated in North West Province and comprises five health sub-districts, namely Kgetlengrivier, Madibeng, Moses Kotane, Moretele and Rustenburg. The district has a population of 1 665 222, with a population density of 90.8 persons per km^2 and falls in the mid socio-economic quintile, Quintile 3. Estimated medical scheme coverage is 14. 6%.



a Statistics South Africa. Census 2011 Municipal fact sheet. Report No. 03-01-58. Pretoria: Statistics SA; 2012.

Figure 7-1: Population distribution sub-district boundaries and health facility locations

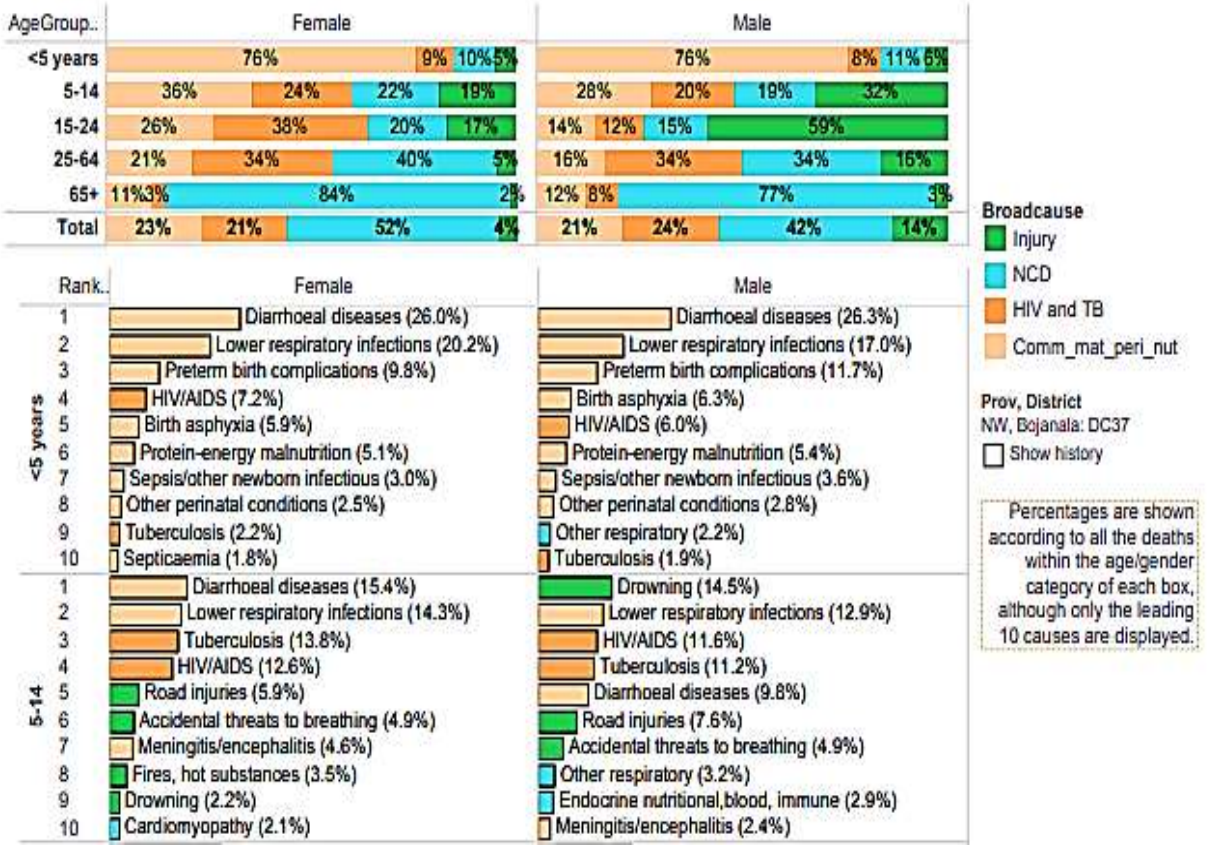
Table 7-1: Number of facilities by level, 2016/17

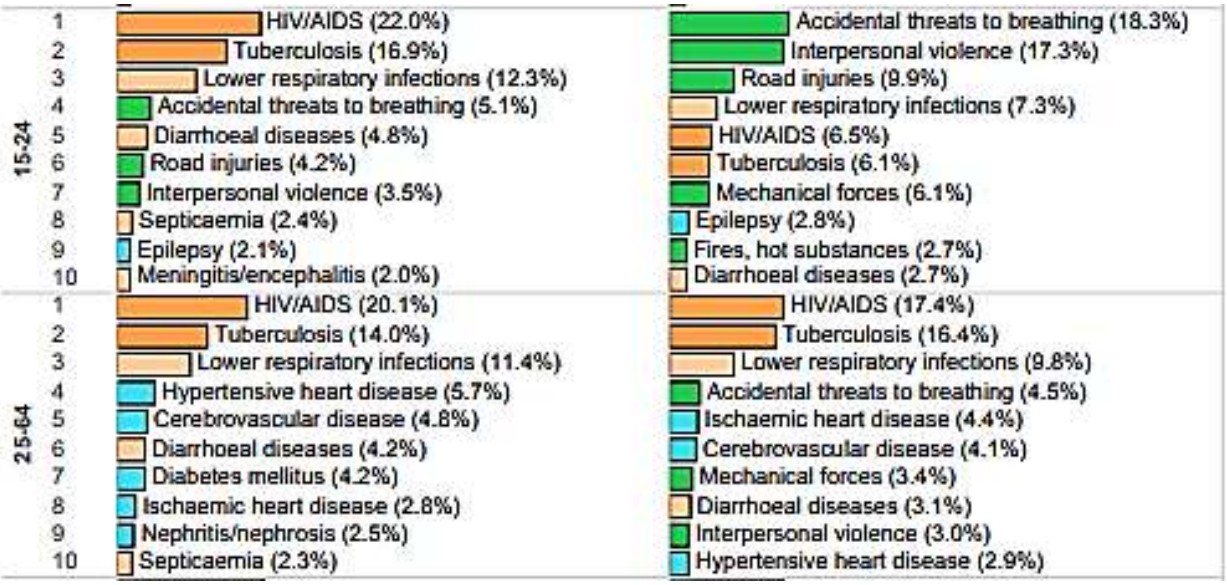
	Ward based outreach teams	Clinic	CHC	District Hospital	Regional Hospital	Central/ Tertiary Hospitals	Other Hospitals
Kgetleng Rivier SD	6	3	1	1	0	0	0
Madibeng SD	33	22	2	1	0	0	1
Moretele SD	30	22	0	0	0	0	0
Moses Kotane SD	34	47	3	1	0	0	0
Rustenburg SD	30	21	3	0	0	1	6
Bojanala	133	115	9	3	0	1	7

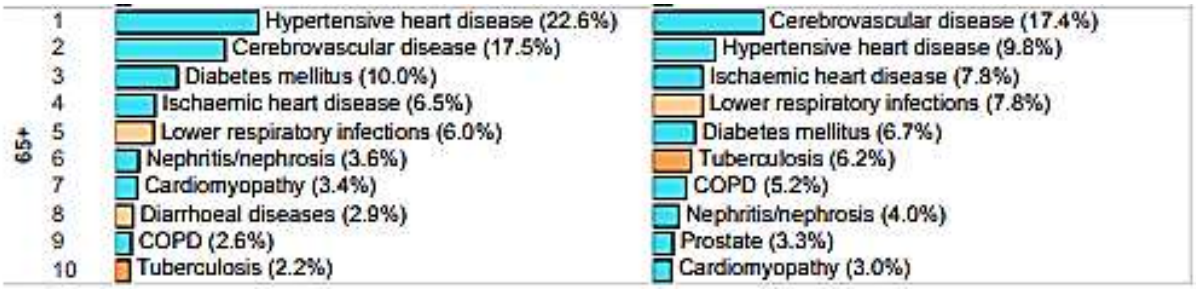
Source: DHIS.

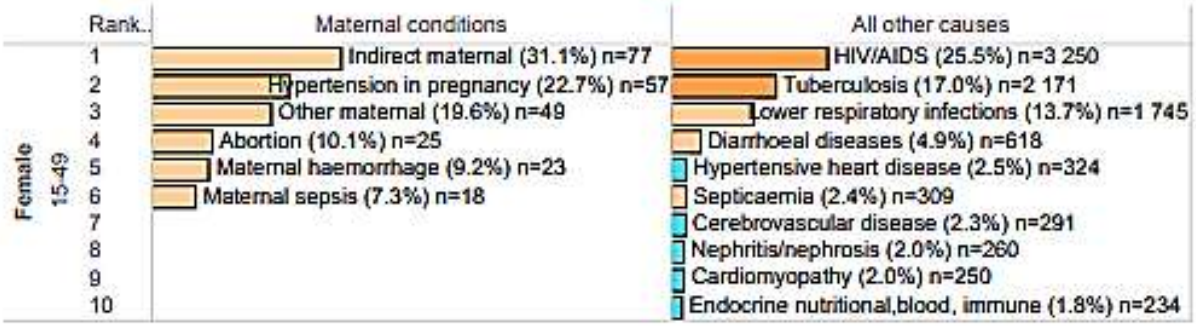
7.1. Burden of Disease Profile

For the percentage of deaths by broad cause, deaths are classified into four groups namely: (i) injuries; (ii) non-communicable diseases; (iii) HIV and TB; and (iv) communicable diseases together with maternal perinatal and nutritional conditions. Data are given by gender and age group for the period 2010–2015. The second part of the graph shows the 10 leading single causes of death within each age group (both genders) for 2010–2015 combined.









8. Baseline Health Status

The following section describes the baseline health status in the proposed Matai Mining Project area with reference to the EHAs. This is based on the national and regional baseline health data that was identified during the desktop review and during the site in February 2019. Data at the local level is based on the aforementioned FGDs that were carried out during the field visit.

8.1. EHA #1 Vector-Related Diseases

Vector-borne diseases are illnesses caused by pathogens and parasites in human populations. Distribution of these diseases is determined by a complex dynamic of environmental and social factors. Vector-related diseases may be present in the community, resulting from unmanaged water bodies and vectors drawn to waste, such as rats and mice.

While vector-borne diseases are not common in the study area, illegal dumping of waste and the influx of people coupled with poor environmental management may lead to establishment of vector breeding sites in the study area, a situation that may lead to emergence and increase in the prevalence of vector-borne diseases, e.g. toxoplasmosis.

8.2. EHA #2 Communicable Diseases Linked to Housing Design

Housing design is crucial because poor planning results in congestion, overcrowding of people and improper sanitation, all of which when combined form the fundamental requirements for the perfect breeding ground for many diseases. Research conducted in Sri Lanka, Costa Rica and Philippines showed a positive correlation between poorer housing and an increased death rate among children (Phillips, 1990).

Communicable diseases are spread from one person to another or from an animal to a person. The spread of such diseases often happens via airborne viruses or bacteria, but also through blood or other bodily fluid. The terms infectious and contagious are also used to describe communicable diseases.

To have “healthy housing” it is necessary that the following elements are adequately addressed: shelter, water supply, sanitation, solid waste, wastewater, overcrowding, indoor air pollution, food safety, vectors of disease, as well as aspects related to transport, and shopping facilities (WHO 1997). Coughs in children were identified as a common health problem in Sefikile, Manamakhotheng and Mononono.

Based on the key informant interview it was clear that most households live in a brick structure (some even almost squatter like housing) or traditional structures on individual properties (with more than one house on the respective property) or one house on a separate stand/property –please refer to Figure 8-1. As can be seen in these figures (below), most of the houses in the PACs are traditional brick or mud structures either with a tiled roof or corrugated iron roof. Based on observation in the field, overcrowding is not a matter of concern. According to the information collected from FGDs, TB and lower respiratory tract infections were reported as the most common respiratory diseases in the PACs. Lower respiratory infections include pneumonia (infection of the lung alveoli), as well as infections affecting the airways such as acute bronchitis and bronchiolitis, influenza and whooping cough.

Figure 8-1: Housing in Manamakhotheng

8.3. EHA #3 Veterinary Medicine and Zoonotic Issues

This EHA refers to diseases affecting animals (e.g. bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g. rabies, brucellosis, Lassa fever, leptospirosis, etc.). A zoonotic disease is a disease that can be passed between animals and humans. Zoonotic diseases can be caused by viruses, bacteria, parasites, and fungi. These infectious diseases of animals have different modes of transmission. In direct zoonosis the disease is directly transmitted from animals to humans through media such as air (influenza) or through bites and saliva (Rabies). In contrast, transmission can also occur via an intermediate species (referred to as a vector), which carry the disease pathogen without getting infected.

No zoonotic issues were identified during FGDs. It is however, important to remain cognizant that an increase in domestic animals may increase the risk for zoonotic diseases. Matai Mining would have to implement mitigation measures if these arose due to the Project.

8.4. EHA #4 Sexually-Transmitted Infections, Including HIV/AIDS

All respondents in the FGDs reported to having heard about HIV/AIDS. With numerous respondents across the PACs stating that HIV/AIDS is a serious problem in their communities it is clear to see that HIV/AIDS has affected all levels of these communities – from the youth to the elderly. All four interviewed healthcare personnel listed HIV/AIDS as one of the top five most common illnesses that they treat. All health facilities have the ability to diagnose HIV and stock ARVs.

Condoms are readily available within the communities. They are available for free at health facilities and they are also available in public toilets, shops, 'spazas', schools and shebeens. There is little stigma associated with buying condoms, although some women stated that they sometimes feel shy to take free condoms from public places and that it was the responsibility of the men to acquire condoms.

There are regular HIV awareness campaigns within the communities. It was observed that there is good knowledge of HIV transmission and prevention measures. Most members of the communities also have a good attitude towards people with HIV, none of the respondents voiced discriminatory attitudes towards HIV positive people. Information collected during focus group discussions shows that a large proportion of respondents know the two main ways to prevent HIV, namely condom use and having one uninfected sexual partner.

8.4.1 HIV/AIDS: Knowledge, Attitude and Behaviour

With numerous respondents across the PACs stating that HIV/AIDS is a serious problem in their communities it is clear to see that HIV/AIDS has affected all levels of these communities. While the others asserted that HIV/AIDS is not a serious problem in their communities as the DoH does an exceptional job educating the population about this disease, and therefore expect that everyone should have knowledge on this disease, results prove that the general levels of awareness and consistent knowledge on the disease and preventive behaviours is relatively poor.

There are low levels of stigma in the communities with associated discrimination as many individuals were willing to purchase food from someone who they knew was HIV positive. In addition, the majority of the respondents from the surveyed PACs would keep their HIV positive family member's status a secret. Apart from this being attributable to a general respect for their family member's privacy, part of this is due to the poor levels of knowledge and beliefs. Traditional, cultural and religious beliefs make it difficult to inform behavioural change information. It is felt that the more rural communities simply don't have access to adequate information about HIV and AIDS, and the high levels of illiteracy also makes behavioural change communication somewhat challenging.

Information collected during the FGDs shows that a large proportion of respondents know the two main ways to prevent HIV, namely condom use, abstaining and having one uninfected sexual partner (monogamy, that is, being faithful).

8.5. EHA #5 Soil-, Water- and Waste-Related Diseases

Adequate provision of water and sanitation services is a critical public health infrastructure. Safe drinking water and adequate sanitation is a necessity for good health, as households without safe water and proper sanitation systems are more vulnerable to water borne diseases. Government water schemes provide most households within the local study area with piped water; however, a considerable number of households still depend on groundwater resources for domestic and agricultural use. Communities are almost totally dependent on piped ground water abstracted from boreholes by pumps.

Moses Kotane Local Municipality, has limited resources with regard to raw water resources and finances to provide basic level of services (eradicate backlogs and sustain current and future plans). It is envisaged that all

upgrading of current services at RDP level, to above RDP level will be through a resource availability and infrastructure capacity assessment, in addition to a community participation process to ensure ability and willingness to pay for a higher level of service. MKLM is dependent on both surface and ground water sources though the majority of the villages are dependent on the ground water schemes. Access to basic sanitation remains a problem given a backlog of 70% compared to only 19% with basic sanitation facilities and 11% water borne systems. The 11% covers Madikwe and Mogwase townships as the only settlements with households connected to municipal sewer system. Households in other settlements are either on private septic tanks, +9VIPs provided by the municipality or Ordinary Pit Latrines

Data on ground water resources indicates that there are water shortages, especially during the dry season, in the area. Water scarcity in the area prevents local water supply schemes to provide sustainable and reliable water to most rural communities.

Safe drinking water is a basic necessity for good health, as unsafe drinking water can be a significant carrier of diseases such as trachoma, cholera and schistosomiasis. Drinking water can also be tainted with chemical, physical and radiological contaminants with harmful effects on human health. Results derived from the 2016 Community Survey indicates that most households throughout the MKLM have access to piped water inside or outside the yard (40% inside the yard). It is concerning that some households within the site-specific area has no access to piped water, and likely rely on municipal water tankers or water sourced from boreholes (CS, 2016).

	2016/17	2015/16	2014/15	2013/14	2012/13	2011/12
Water						
Blue Drop Score	n/a	n/a	n/a	55.87	n/a	68.59
Is the municipality responsible to provide?	Yes	Yes	Yes	Yes	Yes	Yes
Does the municipality have infrastructure to provide?	Yes	Yes	Yes	Yes	Yes	Yes
Does the municipality actually provide?	Yes	Yes	Yes	Yes	Yes	Yes
Is the service outsourced/commercialised?	No	No	No	No	No	No
Number of households and non-domestic customers to which provided	74 300	74 300	74 300	74 300	63 459	62 544
Number of domestic households/delivery points	74 059	74 059	74 059	74 059	62 966	62 051
Inside the yard	40 000	40 000	40 000	40 000	20 952	20 268
Less than 200m from yard	28 900	28 900	28 900	28 900	36 783	36 783
More than 200m from yard	5 159	5 159	5 159	5 159	5 231	5 000
Domestic households with access to free basic service	20 591	19 398	17 250	74 059	62 966	62 051

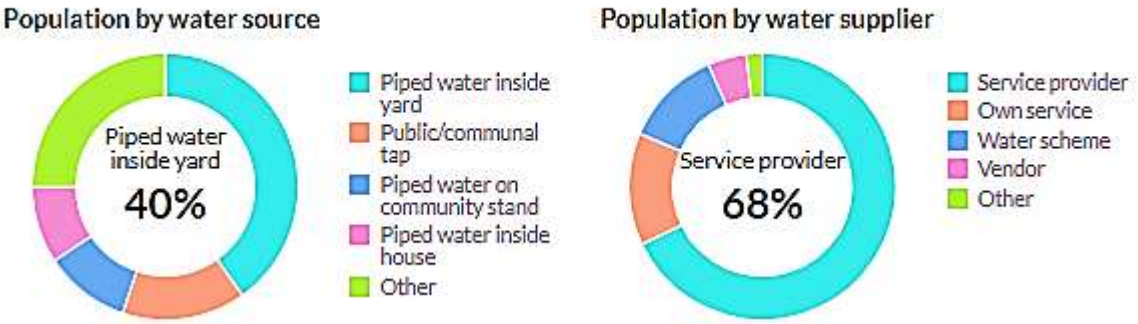


Figure 8-2: Population by water source and supplier

The availability of sanitation facilities not only improves the dignity of people, but also promotes their health. Areas without proper sanitation systems give rise to water-borne diseases like cholera and diarrhoea. . It is therefore important that as a municipality, prioritisation should be given to this service, particularly taking into account any backlogs. The field visit indicated that the majority of households do not have access to adequate sanitation services. Some residents of the surveyed PACs construct their own pit latrines, often of poor standard. In the FGDs the majority of the respondents used pit latrines and Ventilated Improved Pit-latrine (VIP) toilets in their own yards.

Sewerage and Sanitation						
Green Drop Score	n/a	n/a	n/a	n/a	0	0
Is the municipality responsible to provide?	Yes	Yes	Yes	Yes	Yes	Yes
Does the municipality have infrastructure to provide?	Yes	Yes	Yes	Yes	Yes	Yes
Does the municipality actually provide?	Yes	Yes	Yes	Yes	Yes	Yes
Is the service outsourced/commercialised?	No	No	No	No	No	No
Number of households and non-domestic customers to which provided	25 219	25 219	24 219	24 219	18 494	18 494
Number of households using:						
Flush toilet - public sewerage	6 793	6 793	6 793	6 793	6 793	6 793
Flush toilet - septic tank	0	0	0	0	0	0
Ventilated pit latrine	18 185	18 185	17 185	17 185	11 460	11 460
Bucket system	0	0	0	0	0	0
Other	0	0	0	0	0	0
Domestic households with access to free basic service	1 190	1 033	965	911	785	727

The following chart shows the sanitation facilities that are available in the MKLM. 79% of the households in MKLM mostly rely on pit latrines for sanitation purposes.

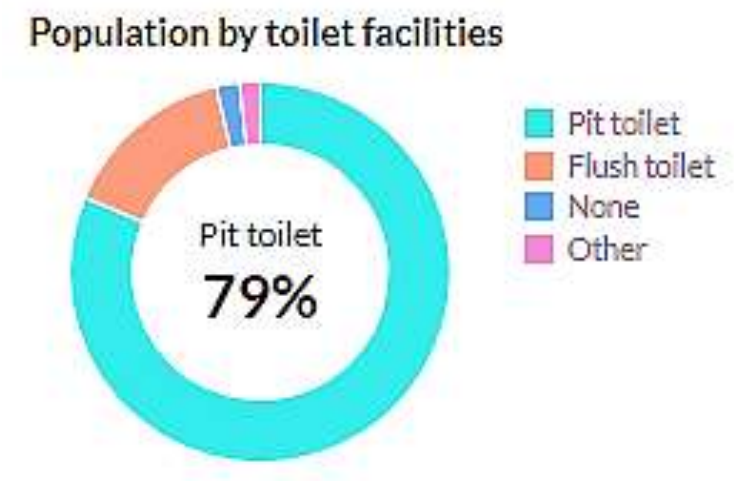


Figure 8-3:Population by toilet facilities

Figure 8-4: Homestead with VIP toilet in Magong

The most common types of poor sanitation related diseases include:

Diarrhoea is caused by a variety of micro-organisms including viruses, bacteria and protozoans. Diarrhoea causes a person to lose both water and electrolytes, which leads to dehydration and, in some cases, to death. Repeated episodes of diarrhoeal disease make children more vulnerable to other diseases and malnutrition. Diarrhoea is the most important public health problem directly related to water and sanitation. The simple act of

washing hands with soap and water can cut diarrhoeal disease by one-third. Next to providing adequate sanitation facilities, it is the key to preventing waterborne diseases.

Dysentery and diarrhoea are often used as similar terms. However, these two conditions are clinically different from each other. The most important difference between dysentery and diarrhoea relates to the affected area. While watery diarrhoea is a disease that affects the small bowel, dysentery affects the colon. The second difference between the two relates to the typical symptoms that are observed. Diarrhoea is presented as watery stool that may or may not be accompanied by cramps or a pain. However, in case of dysentery, the person suffers from a mucoid (resembling/ similar to mucin) stool that may be accompanied by blood. Dysentery is also accompanied by fever at times. Persons suffering from dysentery usually complain of cramps and pain in the lower abdominal area. It is interesting to note that four respondents listed abdominal pains/"stomach pain" as one of the most common illnesses affecting their villages, which could be a possible link to dysentery.

Cholera is an acute bacterial infection of the intestinal tract. It causes severe attacks of diarrhoea that, without treatment, can quickly lead to acute dehydration and death. Cholera is a world-wide problem, especially in emergency situations. It can be prevented by access to safe drinking water, sanitation and good hygiene behaviour (including food hygiene).

Trachoma is an eye infection spread mainly through poor hygiene caused by lack of adequate water supplies and unsafe environmental sanitation conditions. Intestinal worms, also known as Helminths, in an intestinal parasitic worms, which people come into contract with through contact with soil that has been contaminated with human faeces from an infected person, or by eating contaminated food. Depending upon the severity of the infection, it can lead to malnutrition, anaemia or retarded growth. Children are particularly susceptible and typically have the largest number of worms.

A hygienic environment, clean water and adequate sanitation are key factors in preventing opportunistic infections associated with HIV/AIDS, and in the quality of life of people living with the disease. AIDS-affected people are more susceptible to water-related diseases than healthy individuals, and they become sicker from these infections than people with healthy immune systems. Maintaining a healthy environment is essential to safeguarding the health, quality of life and productivity of people living with HIV/AIDS.

During FGDs, diarrhoea was identified as one of the diseases with a significant burden within the community, especially amongst children under five years of age. The disease is assumed to be especially common among children as they have higher chances of playing in contaminated or unclean water.

Figure 8-5: VIP toilets in Sefikile

No cases of cholera were reported during FGDs.

8.5.1 Surface Water

The proposed Matai Mining Project area falls within quaternary catchment No. A24E which forms part of the catchment of the Crocodile River which ultimately feeds into the Limpopo. Watercourses over the site are alikewise classified as non-perennials flowing only during the wet season or after rainfall events.

The surface water quality results were not available at the time of this Report compilation. This Section will be updated once the Surface Water Impact Assessment Report has been compiled and finalised. The author has however, in the interim, highlighted worst case scenarios in terms of surface water findings with potential impacts to human health. These are summarised below:

- If faecal coliforms exceed the guideline limit for irrigation at and of the sampling points, as well as the guideline limit for livestock watering: Faecal coliforms are bacterial indicators of faecal pollution from humans and warm blooded animals. They are primarily used to indicate the presence of bacterial pathogens such as Salmonella spp., Shigella spp. Vibrio cholerae, Campylobacter jejuni, Campylobacter coli, Yersinia enterocolitica and pathogenic E. coli.;
- If orthophosphate or manganese exceed the RQO limits at any sampling point: This is also likely to be from sewage from the nearby settlements.

8.5.1.1 What this could mean for Human Health

Coliforms are bacteria that are always present in the digestive tracts of animals, including humans, and are found in their wastes. They are also found in plant and soil material. The most basic test for bacterial contamination of

a water supply is the test for total coliform bacteria. Total coliform counts give a general indication of the sanitary condition of a water supply.

- Total coliforms include bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste.
- Fecal coliforms are the group of the total coliforms that are considered to be present specifically in the gut and feces of warm-blooded animals. Because the origins of fecal coliforms are more specific than the origins of the more general total coliform group of bacteria, fecal coliforms are considered a more accurate indication of animal or human waste than the total coliforms.
- Escherichia coli (E. coli) is the major species in the fecal coliform group. Of the five general groups of bacteria that comprise the total coliforms, only E. coli is generally not found growing and reproducing in the environment. Consequently, E. coli is considered to be the species of coliform bacteria that is the best indicator of faecal pollution and the possible presence of pathogens.

In general, increased levels of faecal coliforms provide a warning of failure in water treatment, a break in the integrity of the distribution system, possible contamination with pathogens. When levels are high there may be an elevated risk of waterborne gastroenteritis. As suggested in the Surface Water Report, the presence of faecal coliform in aquatic environments may indicate that the water has been contaminated with the faecal material of humans or other animals. Faecal coliform bacteria can enter rivers through direct discharge of waste from mammals and birds, from agricultural and storm runoff, and from human sewage (Doyle, 2006).

The health effects of exposure to disease-causing bacteria, viruses, and parasites in drinking water area varied. The most common symptoms of waterborne illness include nausea, vomiting, and diarrhoea. Infants, the elderly, and those with compromised immune systems may suffer more severe effects. In extreme cases some pathogens may infect the lungs, skin, eyes, nervous system, kidneys, or liver and the effects may be more severe, chronic, or even fatal (Brunswick, year unknown).

Other points to note are:

- Both calcium and magnesium are essential to human health. Inadequate intake of either nutrient can impair health. Recommended daily intakes of each element have been set at national and international levels.
- The palatability of drinking- water has been rated by panels of tasters in relation to its TDS level as follows: excellent, less than 300 mg/litre; good, between 300 and 600 mg/litre; fair, between 600 and 900 mg/litre; poor, between 900 and 1200 mg/litre; and unacceptable, greater than 1200 mg/litre. TDS is classified under the secondary standards, which are based on aesthetic factors such as colour and

staining properties of water rather than potentially harmful health effects. The standard in drinking water for TDS is 500 milligrams per liter (mg/l).

- The more dissolved solids in the water, the higher the hardness of the water/ the level of total dissolved solids in drinking water affect the taste of the water. Higher levels of TDS can make water taste bitter, salty or brackish. However, levels of total dissolved solids affect animals much more than humans.
- Fluoride may be an essential element for animals and humans. For humans, however, the essentiality has not been demonstrated unequivocally, and no data indicating the minimum nutritional requirement are available. Many epidemiological studies of possible adverse effects of the long-term ingestion of fluoride via drinking-water have been carried out. These studies clearly establish that fluoride primarily produces effects on skeletal tissues (bones and teeth). Low concentrations provide protection against dental caries, especially in children. Fluoride can also have an adverse effect on tooth enamel and may give rise to mild dental fluorosis (prevalence: 12–33%) at drinking-water concentrations between 0.9 and 1.2 mg/litre (Dean, 1942).
- In concentrations higher than 0.05 mg/l the manganese may become noticeable by impairing colour, odour, or taste to the water. However, according to the EPA health effects are not a concern until concentrations are approximately 10 times higher. Manganese can be consumed from our diet and in our drinking water.
- Iron overload can lead to hemochromatosis, which can lead to liver, heart and pancreatic damage, as well as diabetes. Early symptoms include fatigue, weight loss, and joint pain. Excessive iron is never recommended for digestion; it can lead to stomach problems, nausea, vomiting, and other issues. However, you could not drink enough water to consume toxic levels of iron. The EPA considers iron in well water as a secondary contaminant, which means it does not have a direct impact on health. It will not affect your health, but it will cause costly damage and other issues. Secondary drinking water contaminants do not pose health risks to humans at levels usually found in water. The drinking water standard for iron is 0.3 milli- grams per liter (mg/l), and the standard for manga- nese is 0.05 mg/l.

8.5.2 Groundwater

The Matai area is classified as having a moderate potential for groundwater occurrence with typical borehole yields between 0.5 and 2.0 L/s being reported. Higher-yielding boreholes are usually related to regional linear geological features like lineaments, fractures or faults.

According to the Surface and groundwater sections in the Scoping Report compiled by Kimopax (2018), there is no significant or irreversible groundwater impact expected, however, a potential risk of spillage of hydrocarbons from construction machines during the construction phase might occur. The water contamination may occur due to the runoff resulting from the contaminated surfaces within the dirty mine areas infiltrating into the surrounding

streams. This, if there are no measures that will be put in place to contain the dirty water. Due to the percentage of pyrite encountered in some of the geological logs, the exposed rock piles and discard dumps might have a potential to generate acid, the groundwater quality might be negatively impacted due leaching from exposed rock piles, discard dumps and Waste Rock Dumps (WRD). Mining activities will expose the pyrite to oxidising agents such as oxygen and ferric iron. This will lead to the formation of acidic conditions and the subsequent water quality deterioration due to heavy metal transport and salt loading, as the buffering capacity of the natural rock is utilised. Mine dewatering might result in lowering of the water table within the site. This can impact on water users in the area that rely on groundwater.

Although a hydrocensus was conducted across the proposed Matai MVT Mine mining area and included the proposed mining footprint areas and adjacent properties and concentrated on identifying existing boreholes to enhance the knowledge of the groundwater systems and current groundwater use, these findings from the Groundwater Impact Assessment for the proposed Matai Mining Project were not available at the time of Report compilation.

If any of the samples yield high concentrations of nitrates, this could potentially because of human and irrigation activity in the area. All samples with high nitrate concentrations should be checked for bacteriological contamination. This has acute health effects (SANS Drinking water standards). A source of nitrate in natural water results from the oxidation of plant and animal debris and of animal and human excrement.

Below is a summary of human health conditions that could arise from ingestion of water with high nitrate concentrations:

Methaemoglobinaemia: The toxicity of nitrate to humans is mainly attributable to its reduction to nitrite. The major biological effect of nitrite in humans is its involvement in the oxidation of normal Hb to metHb, which is unable to transport oxygen to the tissues. The reduced oxygen transport becomes clinically manifest when metHb concentrations reach 10% of normal Hb concentrations and above; the condition, called methaemoglobinaemia, causes cyanosis and, at higher concentrations, asphyxia. The normal metHb level in humans is less than 2%; in infants under 3 months of age, it is less than 3%.

Carcinogenicity: Nitrite was shown to react with nitrosatable compounds in the human stomach to form N-nitroso compounds. Many of these N-nitroso compounds have been found to be carcinogenic in all the animal species tested, although some of the most readily formed compounds, such as N-nitrosoproline, are not carcinogenic in humans. The Nnitroso compounds carcinogenic in animal species are probably also carcinogenic in humans. However, the data from a number of epidemiological studies are at most only suggestive. The endogenous formation of N-nitroso compounds is also observed in several animal species, if relatively high doses of both nitrite and nitrosatable compounds are administered simultaneously. Thus, a link between cancer risk and

endogenous nitrosation as a result of high intake of nitrate and/or nitrite and nitrosatable compounds is possible (Speijers et al., 1989; FAO/WHO, 1996, 2003a,b).

Several reviews of epidemiological studies have been published. No convincing evidence was found of an association between gastric cancer and the consumption of drinking-water in which nitrate concentrations of up to 45 mg/l were present. No firm evidence was found at higher levels either, but an association could not be excluded because of the inadequacy of the data available. Studies that have assessed the effect of nitrate from sources other than vegetables, such as the concentration in drinking water or occupational exposure to nitrate dusts, have not shown a protective effect against gastric cancer risk. For other types of cancer, there are no adequate data with which to establish any association with nitrite or nitrate intake (Gangolli et al., 1994; Möller, 1995; FAO/WHO, 1996).

Other effects: Congenital malformations have been related to high nitrate levels in drinking-water in Australia; however, these observations were not confirmed. Other studies also failed to demonstrate a relationship between congenital malformations and nitrate intake (WHO, 1985b; ECETOC, 1988; Manassaram et al., 2007).

Studies relating cardiovascular effects to nitrate levels in drinking-water gave inconsistent results (WHO, 1985b).

Possible relationships between nitrate intake and effects on the thyroid have also been studied. It is known that nitrate can competitively inhibit iodine uptake, as with similar anions. However, what is known to occur in the laboratory may not result in adverse effects in human populations under normal circumstances of exposure. In addition to effects of nitrate on the thyroid observed in experimental animal studies and in livestock, epidemiological studies revealed indications for an antithyroid effect of nitrate in humans. If dietary iodine is available at an adequate range (corresponding to a daily iodine excretion of 150–300 µg/day), the effect of nitrate is likely to be weak, with a tendency to zero. The nitrate effect on thyroid function may be strong if a nutritional iodine deficiency exists simultaneously (Höring, Nagel & Haerting, 1991; Höring, 1992).

Hettche (1956a,b) described an association between high nitrate concentrations in drinking-water and goitre incidence. As well, Höring & Schiller (1987), Sauerbrey & Andree (1988), Höring, Nagel & Haerting (1991), Höring (1992) and van Maanen et al. (1994) found that inorganic nitrate in drinking-water is associated with endemic goitre.

8.6. EHA #6 Food- and Nutrition-Related Issues

This category includes health outcomes and determinants related to food security, dietary choices, and the consumption of subsistence foods. The key health outcomes considered are nutrient levels, malnutrition or improvements in nutrient intake, and the subsequent increases or decreases in related diseases. The key determinants include diet composition, food security, and the consumption of subsistence foods.

Food security means having enough food to fully meet basic needs at all times. According to the Food and Agricultural Organization of the United Nations, "Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2001). At present, there are no known acute shortages of major dietary components (e.g., proteins, carbohydrates, grains, fruits, or vegetables) in any of the potentially affected communities. Food security is an important consideration in understanding potential health impact of development Projects. This EHA is affected by influx of people resulting in increased demand for food.

According to the results of the General Household Survey 2016, released by Statistics South Africa, the percentage of South African households with inadequate or severely inadequate access to food decreased from 23,9% in 2010 to 22,3% in 2016. The percentage of households that experienced hunger decreased from 23,8% to 11,8% while the percentage of individuals who experienced hunger decreased from 29,3% to 13,4% over the same period.

Mining projects can increase the range, quality and amount of food available, leading to improved nutrition and positive health and well-being impacts. However, projects can also reduce access to traditional food sources by, for example, using agricultural land for other purposes or increasing the demand, and therefore prices, of locally grown food. There may also be risks associated with increased availability and affordability of manufactured food products that are high in fat, salt and sugar. Obesity and micronutrient deficiencies can co-occur when calorie intake is high and the food eaten is low in essential vitamins and minerals.

Based on the FGDs, food shortage is not a serious problem in the area. A few respondents stated that malnutrition was a problem. This was for both children and also the elderly as vulnerable groups. Much of this was linked to poverty in the communities. Malnutrition is linked to poverty and food security issues, as the population cannot afford basic foodstuffs. Poor feeding practices related to poor education and illiteracy may worsen the existing situation.

Maize meal, porridge or mieliepap ('pap') was listed the most prominent staple food eaten in the PACs with all respondents mentioning this food as their staple diet. Beans, vegetables, rice, samp and meat were also listed as commonly consumed foods.

There were no reported deaths by malnutrition or other nutritional disorders in the PACs.

8.7. EHA #7 Accidents/ Injuries

This category contains health outcomes and determinants related to accidents and injuries. The key outcomes considered are increases and decreases in intentional and unintentional injuries with fatal and nonfatal results.

The key determinants in this category include items such as the presence of law enforcement, traffic patterns, alcohol involvement, distance to emergency services, and the presence of prevention programs.

Accidents and injuries were commonly reported in both FGDs. Road traffic accidents (RTA) are the not very common in the communities. Gender-based violence and crime related injuries such as assault are more common. There is a strong link to alcohol in domestic violence and motor vehicle accidents. RTA could increase even more with the further development of the proposed Matai Mining Project as the area is likely to see an increase in the number and size of vehicles travelling in and around the Project area (transport of goods and personnel). An increase of trucks would result in road degradation. The roadworthiness of the vehicles, the lack of driving skills will be a major hazard moving forward. At present domestic transport is mainly by taxi (microbus) and pedestrian. Some residents of the surveyed PACs have their own/ private vehicles.

8.7.1 Gender Based Violence

Gender-based violence and crime-related injuries such as assault are more common. There is a strong link to alcohol in domestic violence and motor vehicle accidents.

8.8. EHA #8 Exposure to Potentially Hazardous Materials, Noise and Malodours

During the field visit, it was apparent to the HIA Specialist that numerous households still use wood and coal (open fire) for cooking and heating that may cause a risk from indoor air pollution and associated respiratory health concerns. As waste removal from households also seems to be a challenge, some households burn waste that can emit harmful by products especially with plastics. Although no dumping sites were observed during the field visit, rural areas such as these often have illegal dump sites and those which are available can contaminate water supplies and present unhygienic conditions, further exacerbating the negative impacts of human health.

Dust generation in the Project area is principally a result of traffic of vehicles on unpaved roads in the area. It was also observed that the residents of PACs sweep their entire yards with grass/ straw brooms. This is done with no dust suppression and generates a lot of dust.

Both general and hazardous waste will be generated on the proposed Matai Mining Project site. These wastes will need to be handled, separated, stored and disposed of according to their classification.

8.8.1 Air Quality Findings

Gondwana Environmental Solutions International alongside Niara undertook an Air Quality Impact Assessment (AQIA) for the proposed construction and operational activities associated with the proposed Matai Mining Project. The main objective of the AQIA is to determine the potential impact of emissions from the construction

and operational activities associated with the proposed Matai Mining Project on ambient air quality in terms of the criteria air pollutants and dust fallout.

Heavy construction is a source of dust emissions that may have a substantial temporary impact on local air quality. Building and road construction are two examples of construction activities with high emissions potential. However, dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

Sensitive receptors within a 10 km range of the Matai Mining Project open pit area include the residential areas of Sefikile, Mantserre, Mopyane, Mononono, Magong, Magalane, Kraaihoek , Legogolwe and parts of Manamakhotheng. The most significant pollutant that is generated from open pit mining and related crushing and screening activities is particulate matter (PM). Particulate emissions will be generated from stripping of topsoil and overburden, materials handling operations, vehicle entrainment from roads, and crushing and screening activities on site. There will also be wind erosion of PM from ore, soil, waste and overburden stockpiles and from exposed areas of the site. Particulate matter with an aerodynamic diameter of less than 2.5 micrometers (µm) (PM2.5) and particulate matter with an aerodynamic diameter of less than 10µm (PM10) are criteria pollutants. Maximum permissible ambient air quality concentrations of these pollutants have been prescribed in the National Ambient Air Quality Standards (NAAQS) (Government Notice No. 1210, 2009; Government Notice No. 486, 2012). Ambient air pollutant concentrations are of significance in terms of their potential to impact human health and the broader environment.

Dispersion simulations were used to determine ambient air concentrations of PM10 and PM2.5 resulting from all operations at the proposed mine site including crushing and screening on site. For this purpose, AERMOD, the United States Environmental Protection Agency's preferred regulatory model for both simple and complex terrain was used. Three scenarios were selected for modelling – an uncontrolled scenario; a scenario taking into account emission reductions possible by implementing mitigation measures on all haul roads, conveyor transfer points and the processing plant; and a scenario with the added mitigation measure of tarring the access road off site. The predicted ambient air concentrations were then evaluated against the relevant NAAQS.

Sources that may contribute to ambient concentrations of PM10 and PM2.5 in the area include: the mining activities of the Rustenburg Platinum – Union Mines, the Pilanesberg Platinum mine, Kalaka Mining and Dishaba Mine; domestic fuel burning; vehicle entrainment from untarred road surfaces; biomass burning; and wind-blown dust from open areas and stockpiles.

8.8.2 Noise

Noise is also a factor to consider and the health impacts of noise are well described at both a physical and psycho-social level in the Noise Impact Assessment. Noise and vibration are noted as potential environmental risks due to the nature of the Project's operations. The WHO published a set of guidelines relating to community noise, including potential sources, quantification and potential effects (WHO 1999). Potential health effects identified include hearing loss or loss of hearing sensitivity, sleep disturbance, cardiovascular and physiological effects, mental health effects and behavioural effects, including poor performance by school children (Stansfield and Matheson 2003, WHO 1999, Health Evidence Bulletins 1999). Environmental noise has also been found to be responsible for interference with communication, cognitive performance and annoyance (Stansfield and Matheson 2003, WHO 1999). Stansfield and Matheson (2003) concluded that the effects of environmental noise are strongest for categories linked to quality of life (or the wider determinants of health in the context of HIA) as opposed to illness (or bio physical factors).

From an occupational health perspective, noise-induced hearing loss (NIHL) begins gradually and progressively gets worse. Problems with this disease include loss of the ability to communicate and reduced response to environmental and occupational noise and danger. In the mining environment, the effects of NIHL can be deadly in specific work situations. Bise (2001) listed several factors that influence occupational hearing loss. These factors include the following:

- Age of employee.
- Pre-employment hearing impairment.
- Diseases of the ear.
- Sound pressure level of the noise.
- Length of daily exposure.
- Duration of employment.
- Ambient conditions of the workplace.
- Employee lifestyle outside the workplace.

dBAcoustics was contracted by Kimopax to determine the potential noise impact on the surrounding environment due to the proposed Matai Mining Project. The physical effect of hearing loss and impairment due to noise exposure is not a community health risk but will certainly be an important workplace occupational health consideration. The noise levels required to induce hearing loss only occur at levels above 85 dB(A) which would be intolerable for any community. Noise annoyance can however lead to stress-related impacts on health and general well-being and may also have an influence on mood, performance, fatigue and cognition. Sleep can be disturbed by noise levels as low as 35 dB(A).

8.9. EHA #9 Social Determinants of Health

The social determinants of health refer to the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels (WHO, 2013). These circumstances are shaped by the distribution of money, power, access, and resources at global, national, state, regional, and local levels. The social determinants of health are mostly responsible for health inequities –the unfair and avoidable differences in health status seen within and between countries. This category reviews outcomes and determinants related to mental health, maternal and child health, substance use, social exclusion, psychosocial distress, historical trauma, family dynamics, economic status, educational status, social support systems, and employment status.

Mental health, or behavioural health, is considered a critical component of overall health and is linked to physical health and well-being for persons of all ages. Mental health includes reactions to stress and depression and problems with emotions. Substance misuse such as alcohol, tobacco or other drugs is not only an important health determinant but also closely linked to mental health (Prince et al., 2007). The use of the drug 'nyaope[3]' as well as marijuana which was reported (during the FGDs) have been linked to mental illness. These practices are also associated with crime, prostitution and domestic violence. Several respondents admitted that most members of their communities drink a lot of alcohol, especially during the weekends and at the end of the month when individuals have received their wages, salaries or social grants.

According to the Social Impact Assessment Report (Niara, 2019), the PACs have been encountering challenges which range from economic, environmental, social and spatial challenges. At a regional scale, like other with various lagging municipalities, North West Province is faced with developmental challenges coupled with socio-economic problems such as unemployment, job creation, education, HIV prevalence, basic service delivery, inequality, poverty, economic growth, sectorial dependency and economic distribution.

8.9.1 Health-seeking Behaviour

Individual health-related behaviour (manner in which people choose a health provider and at which stage of an illness) is influenced by many factors, including political, socio-cultural, economical, educational, personal and environmental. Each factor depends on various underlying variables, of which some weigh more than others. The collusion of all these variables will result in certain behaviour of a specific individual at a specific time point. Culture and spirituality influence health seeking behaviour. People may believe that western medicine may be

[3] Nyaope is a street drug that has allegedly come into widespread use in South Africa. It is famous for allegedly containing antiretroviral drugs for HIV.

effective in curing their ailments but their conviction is that mystical causes have also intervened; this obliges them to combine visits to the health care facilities with visits to traditional healers[4].-

There are two main types of health care-seeking behaviour studies. The first analyses barriers to care that lie between the patients and the services. According to MacKian (2003), the second type investigates the process of health care seeking. This involves identification of pathways to the formal health care system, often commencing with home care and traditional healers and extending to the formal system, pathways differing according to the presenting condition.

Several factors may influence health care use, including supply and demand. On the supply side, there is the availability of health care services, the cost of care, the technology and equipment available, the quality of management and the attitude of staff. On the demand side, there are the individual and household characteristics, perceptions and beliefs in the community, affordability (treatment, transport, and daily income), decision-making responsibility, accessibility and prioritisation. All these factors need to be considered as they may become barriers to utilisation of formal healthcare services. Without this understanding, any behavioural change efforts may not be effective.

Wilkinson (2001) reviewed health-seeking behaviour studies carried out in Cambodia in the 1990s for the WHO. He defined a number of concepts that are fundamental to the understanding of health-seeking behaviour:

- Access: determines whether patients are aware of services and are able to reach them within an acceptable time;
- Utilisation: refers to the rate and pattern of use of services;
- Demand for service: equates with health behaviour, that is, whether a patient becomes interested in using a service in the first place or adopts healthy practices;
- Perceptions of quality of care: can act as either a motivator or a barrier to service utilisation; closely linked to demand, access and utilisation; and
- Beliefs: provide a rationale for health-seeking behaviour. The widespread resort to ineffective, costly and apparently irrational health-seeking behaviour had to be set in the context of traditional belief systems about the aetiology[5] of disease and how one gets well.

Although it was reported that a number of households in the study area uses medicinal plants both for physical illnesses and spiritual purposes, traditional medicine did not play a major or an integral role in health seeking behaviour and also where choices are made as to preference for health care. The vast majority sought help from

[4] But see Section 8.10 below

[5] Aetiology refers to the study of causation, or origination. The word "aetiology" is mainly used in medicine, where it is the science that deals with the causes or origin of disease, the factors which produce or predispose toward a certain disease or disorder.

healthcare facilities as their first option. Numerous respondents stated that traditional medicine is often accessed after seeking care for a more western medical. It was difficult to establish whether some cultural traditions and religious beliefs of the local population in themselves pose a challenge in providing effective health services.

During FGDs, female respondents generally reported that they always take their children to a health facility whenever they have a recurring cough or fever. In addition, respondents claimed that all mothers take their children for vaccinations, as well as for regular weighing and measuring.

8.10. EHA #10 Cultural Health Practices

Culture and traditional values play a very important role in the local communities. The Tswana people place a large emphasis on traditional values and practices and this relates to health care and health-seeking behaviour. The community members' beliefs in their health as influenced by spiritual powers is an interesting notion of physical health and illness quite different from the Western perception hereof. It cannot be exclusively said how the respondents perceive physical and spiritual purposes of using the plants (i.e. whether physical illness is seen as physical irrespective of its cause).

Although one may be aware that medical pluralism, combining both biomedical and traditional medicine, is practiced in many South African households, a few respondents in the surveyed PACs did not want to comment much on personally using the services of sangomas[6], referred to as 'ngaka ya Setswana'.

In healthcare literature, religion and spirituality are most of the time used interchangeably, although they have quite different meanings (Miller & Thorensen, 2003). Spirituality is defined in individual terms, characterized by experiences involving meaning, connectedness, and transcendence, whereas religion is defined in communal terms, characterized by institutionalized practices and beliefs, membership and modes of organization (Pesut, Fowler, Taylor, Reimer-Kirkham & Sawatzky, 2008; Miller & Thorensen, 2003). Thus, whereas spirituality is understood at the level of the individual, religion is more of a social phenomenon, and as such is included in the more overarching concept of spirituality.

The difficulty in conceptualizing spirituality/religion comes from the multi-dimensionality of these concepts (Miller & Thorensen, 2003) and extends to the problem of how exactly spirituality/religion influence health. This, in turn, emphasizes the fact that there are multiple interpretations of how spirituality/religion influences health and a number of pathways through which this happens. Four most prominent such pathways have been proposed: health behaviours (through prescribing a certain diet and/or discouraging the abuse of alcoholic beverages, smoking, etc., religion can protect and promote a healthy lifestyle), social support (people can experience social

[6] Although sangoma is a Zulu term that is colloquially used to commonly describe all types of Southern African traditional healers, there are differences between practices: an inyanga is concerned mainly with medicines made from plants and animals, while a sangoma relies primarily on divination for healing purposes and might also be considered a type of fortune teller.

contact with co-religionists and have a web of social relations that can help and protect whenever the case), psychological states (religious people can experience a better mental health, more positive psychological states, more optimism and faith, which in turn can lead to a better physical state due to less stress) and 'psi' influences (supernatural laws that govern 'energies' not currently comprehended by science but possibly understandable at some point by science). It is because spirituality/religion influence health through these pathways, they act in an indirect way on health (Oman & Thorensen, 2002).

8.11. EHA #11 Health Systems Issues

This category considers health outcomes and determinants related to healthcare access and healthcare infrastructure. Important outcomes include the increase or decrease in the number of medical evacuations, clinics or hospital visit trends, health expenditures, and medication usage. Health determinants may include distance to health facilities, mobile clinics, the presence of community health workers, and the frequency of physician visits to the area/ clinics.

The health care infrastructure in the district and municipal area is relatively well served. The infrastructure was observed as sound. The majority of the respondents were unhappy with the quality of services they receive from their local clinics. They attributed their dissatisfaction to a lack of skilled staff to support the daily functioning of the facilities; the operating times of the facilities; a general disregard and lack of respect for patients (by the nurses); long waiting periods.

A respondent from Sefikile also mentioned a shortage of staff, especially in the form of doctors. This creates service delivery challenges and often results in long waits for patients, and places increased stress on the current medical staff. Staff shortages were also reported at the clinic level and this associated with equipment, consumables, mean that these services do not function optimally. No mobile clinics were observed during the field visit.

Figure 8-6: Front view of Mononono Clinic

Figure 8-7: Jojo tanks as well as pit latrine at Mononono Clinic

The Project relevant healthcare facilities are illustrated in Plan 3.

Towards strengthening PHC infrastructure and provision of equipment, the DoH increased both equipment budget provided to PHC and hospital facilities. However maintenance budget has been decreased and this has negatively affected the implementation of NHI. Total of 20 hospitals, 20 health centres as well as 78 clinics, reportedly, received their procured medical equipment.

8.11.1 Emergency Services

The Municipal Disaster Risk Management Plan is designed to establish the framework for implementation of the provisions of the Disaster Management Act, 57 of 2002, as well as the related provisions of the Municipal Systems Act, 32 of 2000.

The purpose of the Municipal DRM Plan is to outline policy and procedures for both the proactive hazard and risk assessment, followed by disaster prevention (if possible), risk reduction, preparedness and the re-active disaster response, relief and rehabilitation phases of Disaster Risk Management. Disaster Management is the function assigned to the district municipalities as per legislation (Disaster Management Act 57 of 2002). These are fairly effectively distributed throughout the municipal area, with the highest concentration of stations coinciding with the areas experiencing higher population densities, namely Mogwase.

These services are legislated under various pieces of legislation such as the Fire Services Act, Act 99 of 1987, National Veld and Forestry Fire Act, Act 101 of 1998, National Building Regulations and Building Standards Act, Act 103 of 1997, Hazardous Substances Act, Act 15 of 1973 as amended, Occupational Health and Safety Act, Act 85 of 1993 to highlight just a few.

The key issues facing the disaster management unit include the lack of fully operational disaster management centre and vast rural areas which make the provision of effective services difficult, concentration of industries surrounded by residential suburbs, climate change, large number of informal settlements and insufficient of safety awareness and education. In addition, climate change also presents a number of challenges which are linked to global impact such as increased temperatures, extreme weather events (flooding and drought) and climate vulnerability. The location of the municipality and its large manufacturing and mining sectors makes it vulnerable to various forms of disasters.

According to the District Municipality Spatial Development Framework, the challenges of improving the response time to emergency services are:

- Inadequate response vehicles and equipment.
- The review and development of disaster policy framework, disaster management plans and contingency plans for LMs.

The number of Fire Stations and/or Disaster Management Centres, in the district still needs to be determined.

8.12. EHA #12 Non-Communicable Diseases

Undoubtedly, NCDs (and communicable diseases) are playing an increasingly important role in defining South Africa's health profile, as they are attributable to environmental risk factors and they are an essential element to be taken into account in policy development and planning purposes at both national and local level.

Conditions in this broad class include cardiovascular and kidney disease, diabetes, chronic respiratory conditions, cancer, mental disorders, oral and eye pathologies, and musculoskeletal conditions. Today these conditions are among the top causes of death in South Africa. A common cause of death, across all age groups, is lower respiratory infections (DoH, 2016). NCDs include chronic medical conditions (asthmas and diabetes) and non-infectious diseases (stroke, heart attacks, cancer and depression). Unhealthy behaviours/circumstances/living conditions can lead to risk factors for NCDs and subsequent disease.

This category includes health outcomes and determinants related to chronic disease. Important outcomes include increases or decreases in mortality and morbidity rates of cancer, cardiovascular and cerebrovascular diseases, diabetes, respiratory diseases, and mental health disorders. Many NCDs can be prevented by reducing common risk factors such as tobacco use, harmful alcohol use, physical inactivity and eating unhealthy diets. Key determinants for chronic diseases may include smoking rates, rates of alcohol and drug abuse, physical activity levels, presence of recreation centres, as well as cancer screening rates.

The term NCDs refers to a group of conditions that are not mainly caused by an acute infection, result in long-term health consequences and often create a need for long-term treatment and care. These conditions include cancers, cardiovascular disease, diabetes and chronic lung illnesses. Many other important conditions are also considered NCDs, including injuries and mental health disorders.

The chief chronic conditions observed in the surveyed/ visited PACs include chronic diseases such as hypertension and diabetes. Several respondents in the surveyed PACs reported that hypertension and diabetes are very common in their communities.

8.12.1 Mental Health

Mental health refers to a broad array of activities directly or indirectly related to the mental well-being of a person. It is related to the promotion of well-being, the prevention of mental disorders, and the treatment and rehabilitation of people affected by mental disorders (WHO 2013). Mental health is a major consideration, as it relates to the community's perception of well-being and sense of place. FGD respondents reported that mental illnesses are not very prevalent in their communities as a whole.

Access to jobs, income, goods and services can enhance mental health and well-being and reduce stress. Having a sense of control over one's life is crucial for mental well-being, so mining and metals projects can improve mental health by reducing poverty, increasing self-esteem and empowering local communities. However, if not well managed, the disruption and uncertainty brought on by a new project can increase worry, stress, and feelings of powerlessness. If the price of local housing, food and other services increases as a result of the project, the financial stress on low income families can be great. The visual impact, especially to residents of Sefikile, on the environment and the lighting, odour and noise associated with mining and metals projects can also affect mood, heighten stress levels and lead to sleep disturbance. Lack of job security may also lead to stress amongst employees and dependants, particularly well-being when the project only provides short term employment contracts or when the project nears closure.

8.12.2 Physical Activity Levels

Consistent physical activity is an important indicator of future non-communicable diseases risk, particularly cardiovascular disease risk. Moderate physical activity is defined as some activity that causes an increase in breathing or heart rate (30 or more minutes a day, 5 or more days per week). Vigorous physical activity is defined as some activity that causes a large increase in breathing or heart rate (20 or more minutes a day, 3 times or more a week) (Newfields, 2014). All of the participating respondents in the surveyed PACs reported that they do not participate in leisure time physical activities such as jogging or exercise. Literature states that healthy lifestyles campaigns were established throughout the whole province. The DoH implemented the training strategy for health promotion. The DoH further organized promotional campaigns and events integrated with health programmes. The DoH maintained functional school health services in all the districts to strengthen health promoting schools. In strengthening youth structures six (6) sessions on life skills for the youth was conducted.

9. Stakeholder Engagement

HIA uses a process known as "Scoping" to obtain enough data and stakeholder input to identify the most important potential health impacts related to a project. Scoping can retrieve data through formal public health surveillance reports, census reports, socioeconomic studies, and cultural reports. The scoping process also includes the input of local residents who will experience the impacts of a potential project. Depending on the regulatory and geographical context, stakeholder input may be gathered by a variety of acceptable methods that include formal public scoping meetings, submission of written comments, or more informally in a small focus group format. In some cases, the HIA will employ all of these methods in a variety of formats.

The HIA Specialist gathered input through FGDs and invited written comments through the PPP administered by Kimopax. This process generated a list of potential benefits and concerns from stakeholders who are both

opposed to and in favour of the proposed Matai Mining Project. No community health related public comments from the PPP platform had been received at the time of compilation of this Report.

The FGDs were held in a variety of settings and used an open format with a brief introduction to the purpose and process of conducting an HIA, followed by a session for questions and comments. Community members were encouraged to notify their family members of the HIA Specialist's email address and the HIA Specialist would welcome their health concerns and respond as promptly as possible. No concerns, comments or issues were received via email.

9.1. Social Determinants of Health

- Psychological distress from worrying about increased contaminants and poisons in the water.
- Psychological distress over the potential for increased traffic accidents and poor highway conditions during operation due to mine trucks.
- Severe emotional distress about possibly being displaced (having to move) if the mine permit is granted, loss of a place to live.
- Psychological distress from blasting and living near industrial noise.
- Psychological distress from fears that residents will be exposed to unacceptable noise levels.
- Psychological distress from fears that noise from the mine will cause difficulty sleeping.
- Psychological distress from fears that mining would contaminate groundwater
- Authorising the mine would be beneficial because the PACs would have a sense of pride when there is a growth in mining.
- Authorising the Matai Mining Project would allow local employers to hire more people.
- Authorising the mine would increase employment and reduce the number of people facing food shortages due to financial constraints (If more people are employed, less people will go without meals).
- Authorising the Matai Mining Project would benefit the community's economy, employment levels, and educational resources for children.
- The proposed Matai MVT Mine could potentially increase the rate of increase alcohol and substance abuse rates in Mankwe, which will ultimately result in an increase in crime/ theft/ domestic violence/ sexual abuse/ child abuse/etc.
- Authorising the mine would strengthen the sense of community and if the community is strengthened, there will be productive things for children to do instead of loitering the streets which they currently do.
- Entire families will see benefits from there being a source of income and stability in the community.
- The potential of earning an income gives people something to strive for and decreases apathy.
- People will have money to buy things and will not have to steal it (Reduced crime).

9.2. Accidents and Injuries

- Increased accidents and injuries on the roadway for residents, motorcyclists and commuters.
- Increased accidents and injuries on the roadway for Emergency Medical/ Rescue/Fire Services to respond to in a timely manner.
- There may be more opportunity for intrusions; increased risk of injuries (assault) due to conflicts over personal property.
- Debris from crushing and washing may be carried into the residential area by high winds.
- Blasting may cause property damage.
- Mine and mine access would be close to residences.
- There may be fewer highway accidents/deaths of community members if people are employed closer to home.

9.3. Exposure to Potentially Hazardous Materials, Noise and Malodours

- Concern that baseline levels of air pollution will become higher
- Dust (from the mining operations) is dirty and seeps in everywhere causing many opportunities for exposure
- High winds will bring fugitive dust from the mine site to the residential area and other surrounding communities.
- The mine will increase levels of dust, which is of particular concern for respiratory health.
- The mine may not be able to control high levels of dust and other toxins from the mining process, which could affect the entire surrounding communities.
- Trucks and ancillary mine equipment will generate significant amounts of air pollution from dust and diesel fuel/ exhaust.
- The proposed Matai MVT Mine will require the transportation of large quantities of hazardous materials such as diesel fuel and oils for their equipment. Spills and leaks will expose the community to several health hazards.

9.4. Food and Nutrition

- There will be increased food security if more people are employed as a result of the mine.

9.5. Non-Communicable Diseases

- Childhood asthma will be increased for those who grow up near the mine.
- Exposure to mine dust may affect cardiovascular health and risk of respiratory disease.

- Living near an opencast mine may increases heart, lung, kidney disease and the death rate for adjacent communities.
- Vanadium, titanium and iron ore as well as mining related toxins are associated with cancer and other chronic illnesses.
- Diabetes rates will increase due to dietary changes from not having access to subsistence foods.
- High blood pressure, stroke, and rates of heart disease will increase due to increases in stress and other environmental exposures.
- Mining and ore transportation may increase respiratory distress and disease in the community for children and adults.

9.6. Health Systems: Services Infrastructure and Capacity

- Mines create jobs, which will allow more people to have access to medical aid and have the option to see private doctors.

10. Human Health Impacts from Mineral(s) to be mined

10.1 Magnetite/ Iron

Mineral prospecting and mining rarely result in a fully confined exposure to the target material being extracted from the environment. Where Iron Ore rock is not pure, and it rarely is pure, then Iron Ore dust is equally impure and thereby contains the impurities of which many are associated/ contaminated with 'heavy metals'[7]. Magnetite is the most commonly mined ore of iron. It is also the mineral with the highest iron content (72.4%).

Where the concentration of those other 'heavy metals' is not immediately commercially viable to be processed then those other heavy metals are routinely dumped upon an above ground waste rock dump where the concentrations can be accumulated to a commercial viability whilst the dust from those piles can be spread (blown and/or washed) across the environment. It is assumed the parting ore will either be stockpiled as a low grade ore or be sent to the waste rock dump, depending on its grade.

Some heavy metals (like iron) have been reported to be of bio-importance to man and their daily medicinal and dietary allowances had been recommended. Dietary iron can be found in meat, whole meal products, potatoes and vegetables. The human body absorbs iron in animal products faster than iron in plant products. Iron is an essential part of haemoglobin; the red colouring agent of the blood that transports oxygen through the human body. Iron is an essential nutrient for humans. A common problem for humans is iron deficiency, which leads to

[7] Heavy metals are those geological minerals with a metallic and metalloid character that are around 5 times the density of water and are poisonous at low concentration. Heavy metals include lead (Pb), cadmium (Cd), zinc.

anaemia. The average man needs an average daily intake of 7 mg of iron and, 11 mg for the average woman. A normal diet will generally provide all that is needed.

Iron may cause conjunctivitis, choroiditis, and retinitis if it contacts and remains in the tissue. Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in development of a benign pneumoconiosis, called siderosis, which is observable as an x-ray change. No physical impairment of lung function has been associated with siderosis.

Exposure to iron ore dust can cause metal fume fever. This is a flu-like illness with symptoms of metallic taste, fever and chills, chest tightness and cough. Prolonged or repeated contact can discolour the eyes causing permanent iron staining. Repeated exposure might cause changes seen on a chest x-ray. Silica being a common constituent of iron ore dust, prolonged exposure might cause silicosis and other related lung diseases (Keast, 1989).

10.2 Titanium

Although the area has vanadium, the current proposed Matai MVT mine will produce a crushed material that will smelted for titanium. There is no known biological role for titanium. There is a detectable amount of titanium in the human body and it has been estimated that we take in about 0.8 mg/day, but most passes through us without being adsorbed (Lenntech, 2017). It is not a poison metal and the human body can tolerate titanium in large dose.

Elemental titanium and titanium dioxide is of a low order of toxicity. Laboratory animals (rats) exposed to titanium dioxide via inhalation have developed small-localized areas of dark-coloured dust deposits in the lungs. Excessive exposure in humans may result in slight changes in the lungs –titanium has the ability to affect lung function causing lung diseases such as pleural disease, it can cause chest pain with tightness, breathing difficulties, coughing, irritation of the skin or eyes.

Effects of overexposure to titanium powder: Dust inhalation may cause tightness and pain in chest, coughing, and difficulty in breathing. Contact with skin or eyes may cause irritation. Routes of entry: Inhalation, skin contact, eye contact.

Carcinogenicity: The International Agency for Research on Cancer (IARC) has listed titanium dioxide within Group 3 (The agent is not classifiable as to its carcinogenicity to humans.)

10.3 Human Health Impacts of Vanadium

It is imperative to remain cognizant that although Matai Mining seeks to mine magnetite (the Project will only generate a magnetite concentrate), the end product is potentially titanium as the magnetite will be trucked and exported or alternatively sold to existing smelting operations. Due To the fact that the mine will only produce a magnetite concentrate, and not vanadium, the assessment of the potential health impacts of vanadium is not in the scope for the Project. The health impacts of vanadium have, however, been discussed in this subsection.

According to the WHO (2001), there is limited toxicokinetic information suggesting that vanadium is absorbed following inhalation (in humans) and is subsequently excreted via the urine with an initial rapid phase of elimination, followed by a slower phase, which presumably reflects the gradual release of vanadium from body tissue. Following oral administration, tetravalent vanadium is poorly absorbed from the gastrointestinal tract. There were no dermal studies available.

In inhalation and oral studies in laboratory animals, absorbed vanadium in either pentavalent or tetravalent states is distributed mainly to the bone, liver, kidney, and spleen, and it is also detected in the testicles (ibid.). The main route of vanadium excretion is via the urine. The pattern of vanadium distribution and excretion indicates that there is potential for accumulation and retention of absorbed vanadium, particularly in the bone. There is evidence that tetravalent vanadium has the ability to cross the placental barrier to the foetus.

The nature of the toxicity of vanadium pentoxide and other vanadium compounds is such that it is not possible to clearly identify the threshold level, for any route of exposure relevant to humans, below which there would be no concern for potential genotoxic activity.

A more recent study conducted by Lenntech Water Treatment Solutions (2014) states that insoluble vanadium compounds are not regarded as serious hazard, however, workers exposed to vanadium peroxide dust were found to suffer severe eye, nose and throat irritation. The uptake of vanadium by humans mainly takes place through foodstuffs, such as buckwheat, soya beans, olive oil, sunflower oil, apples and eggs. This same study asserts that vanadium can have a number of effects on human health, when the uptake is too high. When vanadium uptake takes places through air it can cause bronchitis and pneumonia (Lenntech, 2014).

The acute effects of vanadium are irritation of lungs, throat, eyes and nasal cavities. Other health effects of vanadium uptake are:

- Cardiac and vascular disease;
- Inflammation of stomach and intestines;
- Damage to the nervous system;
- Bleeding of livers and kidneys;

- Skin rashes;
- Severe trembling and paralyses;
- Nose bleeds and throat pains;
- Weakening;
- Sickness and headaches;
- Dizziness; and
- Behavioural changes

The health hazards associated with exposure to vanadium are dependent on its oxidation state. Magnetite contains elemental vanadium. Elemental vanadium could be oxidized to vanadium pentoxide during welding. The pentoxide form is more toxic than the elemental form. Chronic exposure to vanadium pentoxide dust and fumes may cause severe irritation of the eyes, skin, upper respiratory tract, persistent inflammations of the trachea and bronchi, pulmonary oedema, and systemic poisoning. Signs and symptoms of overexposure include; conjunctivitis, nasopharyngitis, cough, laboured breathing, rapid heartbeat, lung changes, chronic bronchitis, skin pallor, greenish-black tongue and an allergic skin rash.

11. Potential Health Impacts

The ultimate goal of an HIA is to identify whether there are potential health impacts and communicate these impacts to decision makers during the planning and permitting process. Health impacts are:

- Changes in health outcomes or determinants, not general changes in environmental conditions;
- Specific health outcomes or determinants, not general statements about health status; and
- Quantifiable, whenever possible.

All communities have existing health problems and health assets. Similarly, all development projects have the potential to generate positive and negative health and well-being impacts. It is within this wider context that the community health impacts of mining projects should be considered. Both positive and negative impacts occur because a project has the potential to change the economic, social, sanitary and natural environments within which communities live and work. Good design and management can help to maximize the positive health and safety impacts and avoid or minimize the negative ones.

A health impact is a positive or negative change in a specific health outcome or health determinant.

This section provides an analysis of the potential impacts associated with the proposed Matai Mining Project and has included the analysis of potential negative impacts and their mitigation measures, but also includes potential positive impacts and measures to enhance these. This is based on the evidence presented in the baseline health

description, the planned Project activities and information obtained from the other available specialist studies.

The key health impacts and needs have been described in the EHA framework. Project-specific determinants and comments will be described so as to inform the impact assessment. While it is recognised that some of these existing health needs will be inherited by the proposed Matai Mining Project and may be regarded as the responsibility of the government, they may influence the impacts and need to be considered for mitigation/management.

It is important to understand that assessing health impacts is often based on a broad range of factors. These can be influenced from a national or regional policy/program decision/intervention and thus may be extremely dynamic. The impact analysis considers the present state of health, based on the community profile, and impacts related to the existing plans and designs of the Project (Winkler et al., 2010).

It should be noted that only the impacts relevant to the Project have been assessed in the section below. In this instance, EHA #1 (vector-related diseases) and EHA #3 (veterinary medicine and zoonotic diseases) have been discussed but have not been evaluated and rated as, during the field visit and analysis, these EHAs were deemed immaterial in the PACs.

12.1. EHA #1: Vector-related Diseases

During active operational periods, the proposed Matai Mining Project may create new breeding sites for key mosquito vectors which would significantly increase the vector-borne disease risk. In addition, existing water bodies, such as surface-water environmental-control dams or new reservoirs, may become magnets for local community members and increase the risks of injury, including accidental drowning. In addition, water storage facilities require careful environmental engineering (for example, shoreline slopes and vegetation control) to prevent development of vector breeding sites. During construction and operations phases, tires, drums, and other containers may become significant breeding sites for mosquitoes. The consequences for this are:

- Potential new breeding sites for mosquito vectors
- Increase in the vector-borne disease risk

12.2. EHA #2: Acute Respiratory Infections and Respiratory Effects from Housing

Diseases that may be intensified due to mining include: conjunctivitis, respiratory tract diseases, vector borne diseases such as schistosomiasis and STDs such as HIV/AIDS. Acute conjunctivitis is attributed to high dust particles, smoke or chemical content in the air. With surface mining, dust and other chemicals are regularly dispersed in the air, which could lead to acute conjunctivitis. Similarly, respiratory tract diseases such as

tuberculosis (TB) and silicosis may spread more quickly in mining areas. Sneezing or coughing, the most common means of producing airborne TB bacilli, is common among miners as they are exposed to dust and chemicals in the air created by mining activities.

Tuberculosis is a contagious infection caused by Mycobacterium tuberculosis. Although all the organs in the human body are susceptible to TB, the lungs are the primary organs that are most commonly affected. Tuberculosis usually affects the young, poor and the immunocompromised individuals (those already suffering from diseases such as HIV/AIDS, which weakens the immune system). Since TB is spread through the air, it transmits easily in crowded environments. Miners work in close proximity to each other in an enclosed environment such as a mine, which allows the TB bacteria to spread easily.

11.2.1 Transmission of Communicable Diseases due to Overcrowding

An influx of large groups of workers can also lead to overcrowded conditions where air-borne diseases such as tuberculosis, influenza and meningitis can spread easily. This in-migration can also lead to the introduction of new infections to remote areas where local communities have little or no natural immunity to them.

About 70% of households live in formal dwelling/ house or brick/ concrete block structure within the municipality while 10% live in traditional dwelling or structure made of traditional matter. This 10% may be households living in rural areas. There is still, however, 4% living in informal settlements and a further 6% living in informal dwelling/ shack in the backyard.

The existing environmental health needs related to housing is based on observation and reports from the SIA. During the rainy season, cooking with wood is likely to occur indoors which can increase the incidence of respiratory infections, especially in children (WHO, 2011). Studies in some African countries have found the odds of developing Acute Respiratory Infections (ARIs) are more than twice likely if biomass fuels are burnt inside a household compared to using cleaner fuel. Moreover, studies have also shown that about half of the prevalence of active ARIs in adults aged over 20 years can be attributed to smoke from cooking fuels. In addition to this the general environmental health and sanitary conditions in most of the communities was poor as waste collection and management was inadequate. It can be assumed that personal hygiene is often lacking. While these are all existing social circumstances (generally related to poverty) that the proposed Matai Mining Project does not influence, these might play a synergistic (or indirect) role in influencing negative health impacts but also present an opportunity to measure improvements in the quality of life of residents.

Influx/in-migration to the area has been mentioned as a potential impact in the SIA. The project has the potential to attract outsiders and returning families. These factors need to be addressed in an influx management plan as monitoring of overcrowding will be important.

Respiratory tract infections, from a viral and bacterial origin are important to consider. This can include seasonal influenza and pandemic strains that the local communities may be unaware of due to their isolation. Vulnerable groups in these communities, especially the elderly and those with underlying disease, are particularly susceptible as their immune systems are often weakened. Any management plans for respiratory diseases by the proposed Matai Mining Project must consider community health as this may affect business continuity and reputation, where the project runs the risk for being blamed for disease outbreaks, especially with movements of people in and out of area.

The current capacity of the health care services to manage TB is efficient. The link with HIV is a growing problem nationally and might eventually have a project impact. This increases the challenge in monitoring for any negative impact related to increased transmission from the disease. The proposed Matai Mining Project will inherit this as well as the poor socioeconomic and housing conditions as described above.

TB has been described as a major concern in the surveyed communities. There are clear links between TB and silicosis from the workplace; however, this has mainly been reported from the underground mines in South Africa. There is however a potential for this type of exposure and it will thus need to be managed as part of the Project's occupational health and safety programme. Entrained dust from vehicles may pose a risk to communities in a similar way. TB may also present a major risk amongst workers who originate from areas where TB is more prevalent. The presence of the multidrug-resistant (MDR-TB) strain from these sources is also important as these can be introduced into communities that have not been exposed to these strains before. If the semi-skilled construction work-force is supported by third-country nationals then it will be vital to assess the burden of disease in these locations and the potential risks from the incoming workforce.

No skin diseases were reported from the FGDs.

Hostel accommodation and camps are commonly constructed to house project workers. This can bring with it a range of risks and opportunities in relation to health and wellbeing e.g. water supply, sanitary installations, ventilation and the control of infectious diseases – especially for FiFo (Fly in Fly out) operations. The influx of workers can also create pressures on existing housing leading to higher land and house prices, higher rents, housing shortages for existing residents, and overcrowding.

The proposed Matai Mining Project *per se* is unlikely to have a major impact related to communicable diseases if these are mitigated effectively.

11.2.2 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #2 by presenting the impact evaluation ratings for the three Project phases.

Table 11-1: Impact Evaluation –EHA #2

EHA #2 Communicable Diseases Linked to Housing Design		
	Impact Rating Without Mitigation	**Impact Rating With Mitigation**
Extent *(Local, Regional, International)*	Site or Local	Site or Local
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Moderate -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Medium**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes –impact can result in the loss of human life.	
Can impacts be enhanced: (Yes or No)	No	

Residual impacts

- Change in the rates of respiratory diseases such as influenza and pneumonia
- Influx during active operational periods of the Matai Mining Project may lead to an increase in prevalence of respiratory illnesses if household is overcrowded
- Loss of income due to retrenchment (during decommissioning phase of the Project may lead to loss of income may result in more people in a house, exacerbating the prevalence of respiratory diseases
- Increasing prevalence of respiratory health outcomes, including TB

Mitigation measures

- Collaborate with the DoH on awareness-creation around vaccinations to communicable diseases for vulnerable sub-populations such as children and old people;
- Labour policies should encourage hiring of local staff to avoid excessive job-seeking migrants. The Project should not hire at the “front gate” but consider a recruitment office at an off-site location. This will need to consider national recruitment and employment requirements;
- Reduce the prevalence of communicable diseases by collaborating with relevant government departments and schools for awareness creation and improved understanding of factors exacerbating communicable diseases, including coping strategies that result in behaviour change; and initiating competitions at schools for illustrating innovative ways to improve conditions at home - either by reducing exposure and susceptibility or increasing coping capability.
- Support community-based information campaigns related to TB symptoms and the need to seek care. The campaign should address the risk of co-infection between HIV and TB;
- Influx management and advice with regards to town planning to prevent overcrowding; and
- Develop partnerships to support the community-based TB control programs in conjunction with the DoH and any NGOs. This needs to include case detection, management and surveillance activities under the national TB program policy and strategy.

12.3. EHA #3: Veterinary Medicine and Zoonotic Issues

A zoonotic disease is a disease that can be passed between animals and humans. Zoonotic diseases can be caused by viruses, bacteria, parasites, and fungi. These infectious diseases of animals have different modes of transmission. In direct zoonosis the disease is directly transmitted from animals to humans through media such as air (influenza) or through bites and saliva (Rabies). In contrast, transmission can also occur via an intermediate species (referred to as a vector), which carry the disease pathogen without getting infected.

There may be several people with animals entering the area during influx. If people cannot afford preventative measures for animals, there may be an increase in the zoonotic disease risk such as rabies infections. No information on the current state of zoonotic diseases is available for the area. However, an influx of people who bring in animals, may lead to an increase in zoonotic diseases.

12.4. EHA #4: Sexually Transmitted Infections, including HIV/AIDS

11.4.1 Transmission of STIs and HIV/AIDS

HIV/AIDS and STI are existing public health challenges both nationally and within the immediate proposed Project area. The HIV prevalence in the proposed Matai Mining Project area is a public health concern. STIs, if present and untreated, have been found to increase the risk of transmission of HIV, if one partner is infected. HIV's link with TB and its importance has been discussed above.

Influx and/or movement of labour into the proposed Matai Mining Project area will pose an increased risk for STIs. There will be more disposable income, either as a direct or indirect consequence of the project. Although there will not be any accommodation on site as it is planned to use local labour, commercial sex workers are still likely to establish in Northam and other nearby towns, where newly employed men from the local community may be vulnerable to opportunistic sexual liaisons. The likely effect of the project employing a number of relatively well-paid employees may also increase the risk for transactional sex. Economic upliftment and settlement in the project area may also lead to the adoption of "urban" values and lifestyle changes, which may also play a role in casual sexual engagement.

The improved economic status of the area and the influx of new people, living away from their families, can also lead to an increased risk of sexually transmitted infections such as HIV/AIDS, gonorrhoea and chlamydia. Major outbreaks of infectious diseases can have a devastating effect not only on communities, but on the viability of a mining project such as the proposed Matai Mining Project.

Women and young girls are extremely vulnerable and have limited negotiating power for safe practices and family planning. Gender based sexual violence is not as common but there is very little support for any victims. It is important to recognise the role gender plays in sexuality and its effects on HIV transmission and prevention.

HIV/AIDS should be considered a major risk for the project and the community and interventions should be implemented on a broad base in the workforce and the community. Project Impact Mitigation

To stimulate the fight against the scourge of HIV/AIDS it will be important to strengthen the following factors:

- Awareness campaigns, to emphasise the big role that family plays in the fight against HIV.
- Restoration of values campaigns by encouraging church leaders, community leaders, traditional leaders and schools to play a role in the fight against the spread of HIV and AIDS.
- Condom distribution campaigns, working with taxi drivers, business owners and other departments to encourage and teach the proper use of condoms.
- Teen pregnancy campaigns through Motivational talks at schools and to different youth structures.
- Collaborating with Pastors fraternal and social partners the office shall organise the hosting of quarterly and annual Moral Regeneration events aimed at building moral fibre and positive values.
- Collaborating with sector departments, social partners, NGO's and CBO's in the fight against HIV/AIDs and related diseases

11.4.2 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #4 by presenting the impact evaluation ratings for the three project phases.

Table 11-2: Impact Evaluation –EHA #4

EHA #4: Sexually Transmitted Infections, including HIV/AIDS		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Regional	Regional
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Major -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**High**	**Medium**
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes –irreversible loss of human life.	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ Change in the rates of STI such as gonorrhoea, chlamydia, Hepatitis C, and HIV. ▪ Increasing the number of orphans and child headed households ▪ The likely effect of the project employing a number of relatively well-paid employees may also increase the risk for transactional sex ▪ Loss of income during closure and decommissioning phase of the Project may cause people to get involved in prostitution		
Mitigation measures ▪ Develop a HIV/AIDS policy that incorporates both the workplace and community considerations; ▪ Develop an integrated HIV management program that considers both the workplace and the community. TB and STI must be integrated into this; ▪ Support equal employment opportunities for women and establish livelihood programs to reduce risk for opportunistic sexual encounters and empower women and young girls to earn their own income to be in a position to provide for themselves without having to resort to sexual transactions; ▪ Support (financial or otherwise) NGO groups active in the area on gender-based sexual violence; and ▪ Support community-based condom distribution centres. These should be linked to other initiatives and not be run in isolation.		

12.5. EHA #5: Soil-, Water- and Waste-related Diseases

Mining projects can potentially change these exposures by adding or removing substances in the air, water and/or soil. Some of the substances that may be added can remain in the environment and/or the food chain for decades after the closure of a project (e.g. mercury, pesticides), and therefore may have transgenerational health impacts[8].

[8] According to the International Council on Mining and Metals (ICMM), Transgenerational impacts are those impacts which can affect future generations i.e. they lead to ill health in children and grandchildren even after a particular project has closed.

11.5.1 Water and Sanitation

Access to clean water and good sanitation are a fundamental determinant of health and can be positively or negatively affected by mining and metals projects. Projects can be heavy users of local water and can also release materials into existing water sources. Similarly, projects can place pressures on existing sanitation and water supply systems because of the increase in population in the area.

Influx may also play a role in availability of water due to increased demand, which may ultimately negatively affect water quality. Water-borne diseases such as diarrhoea are currently not very common but where it occurs, are linked to contaminated water and poor sanitary conditions. Water-washed diseases such as eye and skin infections are common. These are linked to poor hygiene.

Mining poses a significant threat to the integrity of aquifers, which may be hydrologically connected to other groundwater-dependent ecosystems including farm dams, bores and rivers. Water from mines must be disposed of and waste material is often held within the surface lease of a mine, introducing a risk of contamination of human food sources. Pollution of the environment can also occur through windblown dust during transportation, where the ore is washed and at export ports.

Although water is an essential requirement in the mine for various purposes, the use of it has the potential to affect the quality of surrounding resources. All mines are, therefore, required to contain, recycle and re-use dirty water within their operational systems, to avoid discharging contaminated water into the natural environment. Water contamination may occur as a result of runoff from contaminated surfaces and from any dirty water discharges including treated sewage effluent within the mine into the water course in proximity to the site.

The proposed Matai Mining Project might have the following direct impacts on water in the area:

- Potential contamination with hydrocarbons and chemicals during construction and operations.

The indirect impacts will be:

- In-migration into the PACs and neighbouring towns such as Northam. Pressure on existing limited services in terms of water supply and sanitation could dramatically increase the risk of water-related diseases; and
- Unplanned developments may influence environmental health conditions and further contaminate surface water bodies.

There is limited local data on basic water and sanitation practices or burden of disease linked to specific water and sanitation indicators. As the potential for the project to be accused of polluting the water bodies in the

surrounding communities from plant or domestic water exists, it is important to establish firm baselines for mitigation. Water and sanitation are significant existing needs in the communities and if Matai Mining supports any related initiatives they should be linked to specific indicators to measure impact.

Due to influx into the area and the indirect pressure it will cause on available sanitation services, the proposed Matai Mining Project is likely to have an impact on the sanitation situation in the area. However, improving the sanitation situation is likely to have major beneficial impacts in the communities and improve their overall quality of life.

During active construction periods, the Project may create new breeding sites for key mosquito vectors which would significantly increase the vector-borne disease risk. Water storage facilities require careful environmental engineering to prevent development of vector breeding sites. During construction and operation phases, tyres, drums, and other containers may become significant breeding sites for mosquitoes, with subsequent increased nuisance.

Groundwater quality may be impacted during construction as a result of localised hydrocarbon spills that may occur at workshops and yellow metal (earth moving equipment, named after the branded Caterpillar colour) parking areas, or hydrocarbon storage zones. Another potential risk to groundwater quality at the site is domestic waste generated by construction contractors and client staff.

An increase in income earned during construction and operational phases of the Project may improve the ability to afford basic environmental health services through increased access to such services and ability to pay for better services. This may result in a decline in cases of soil, water and sanitation-related diseases. However, with uncontrolled influx and human settlement, this may worsen over time.

11.5.2 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #5 by presenting the impact evaluation ratings for the three project phases.

Table 11-3: Impact Evaluation –EHA #5

EHA #5: Soil-, Water- and Waste-related Diseases		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Regional	Regional
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Major -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**High**	**Medium**
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ Influx of people may put a burden on water and sanitation infrastructure –change in % of households served with water and sanitation services ▪ Potential contamination with hydrocarbons and chemicals during construction and operations ▪ Unplanned developments may influence environmental health conditions and further contaminate surface water bodies ▪ Increase in income improves ability to afford basic environmental health services. This may result in a decline in cases of soil, water and sanitation-related diseases		
Mitigation measures ▪ Conduct baseline water and sanitation studies on communities based on accepted health indicators; ▪ Monitor for groundwater organics, bi-annually, including: Total Coliform, E. Coli and Heterotrophic plate count; ▪ Ensure proper disposal of human waste that is generated from the Project; ▪ Ensure proper waste management from Project generated waste according to waste management principles; ▪ Support the local authority in supporting and improving water and sanitation services, including the collection and disposal of waste in the communities; ▪ Establish water and sanitation committees in the communities to manage their own water and sanitation services. This will improve sustainability of any outreach support; ▪ Support information campaigns in the community on water use, hygiene and general ▪ sanitation; and ▪ Depending on the results of the baseline data gathering, support the government's school deworming programme in partnership with local authorities.		

12.6. EHA #6: Food and Nutrition-Related Issues

11.6.1 Changes in Income and Expenditure Consumption

New projects have significant potential to alter underlying levels of community and household income positively (IFC, 2009). These potential positive effects may have a profound impact on a variety of health performance indicators for all populations in a community (for example, children under age 5, women of reproductive age, elderly, and so on). Conversely, projects can trigger significant inflation, impacting both food and housing in surrounding communities. Significant food inflation can adversely impact existing vulnerable groups, with negative consequences on individual and community level health performance indicators.

Significant food inflation can make recruitment and retention of healthcare workers and teachers extremely difficult for local communities. Significant and sudden changes in income can have a marked effect on alcohol usage and subsequent gender violence. Workforce education and training are potential key mitigation activities.

Increased revenues coupled with careful planning and checks and balances have the potential to make significant contributions to the progressive realisation of internationally protected economic, social and cultural rights. However, without transparency, good governance including channels for complaints and remedies (grievance mechanisms), and plans for inclusive growth, large foreign investments into natural resources may translate into huge profits for a few and harmful impacts for local communities most directly affected.

The Project may influence nutritional indicators in the study area through the following direct and indirect (the majority) factors:

11.6.2 Water Quality and Quantity

The water-related impacts of the proposed Matai Mining Project are described in the above Section (EHA #5) and other specialist reports. Changes in flows and high levels of erosion may reduce the normal agricultural yields of the community. Mitigation measures are planned to address these impacts but the indirect effects of nutrition are very important to consider not only in the immediate Project area but also in larger rivers that are seasonally utilised for agricultural purposes. No significant changes in agricultural and subsistence practices are expected.

11.6.3 Influx

This can influence nutrition in a number of ways including:

- Lack of available land to cultivate food crops. There is a dependency on subsistence farming in the area and this is linked to access to land. Migrants settling in different areas may not have access to land which might influence food security.
- Unplanned developments in the area may limit the land available for agricultural purposes. Poor planning might lead to erosion which might eventually reduce the quality of soils and lead to poor crop yields.
- Supply and demand may create food inflation and make vulnerable groups more susceptible to escalating food prices in the Project area.

11.6.4 Change of Livelihoods and Practices

This can influence nutrition in a number of ways including:

- It is likely that youth in the area will abandon farming in search of alternative sources of employment, specifically with the Project. This impacts farming activities as the labour required to assist in the preparation and planting season is not available which can have a negative impact on agricultural production and exacerbate food shortages or surpluses that the family require to procure other services. This may also erode the practice of farming as the skills are not passed over the next generation which can further impact food security in the long term.
- As a result of economic upliftment, the community might move from a culture of growing food to buying food. These will most likely be refined products or the adoption of a more westernised diet. A reduction in physical exertion may also result as a result of changing livelihoods. Ironically, the final result could be an increased incidence of obesity and eventually non-communicable diseases (NCD).

11.6.5 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #6 by presenting the impact evaluation ratings for the three project phases.

Table 11-4: Impact Evaluation –EHA #6

EHA #6: Food and Nutrition-Related Issues		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Site or Local	Site or Local
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Moderate -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Medium**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Partially reversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ Change in regional food cost expressed as a % of median household income ▪ Influx of people may result in food inflation, increasing food deprivation, nutrition-related diseases ▪ Poor food hygiene and quality of food services may increase food-related illnesses ▪ Long-term food inflation may increase food deprivation, nutrition-related effects, affecting especially vulnerable groups such as children and marginalised groups ▪ More consumption of fast food related to increased income may increase non-communicable (lifestyle) diseases		
Mitigation measures ▪ Reduce project-related communicable diseases that may impact nutrition; ▪ Food inflation management as part of social program – meat, fruit and vegetables remain expensive items, but lower bread and cereal prices offer relief. Perhaps Matai Mining may assist in training selected individuals to bake bread on a semi-commercial scale and sell from their homes, or assist in the establishment community gardens growing fruits and vegetables; and ▪ Support local procurement of food items in combination with incentives to increase local production.		

12.7. EHA #7: Accidents/Injuries

The accidents and injuries health effect category describes changes to fatal and non-fatal injury statistics that can be either intentional (e.g., suicide, homicide, assault, and self-harm) or unintentional (e.g., motor vehicle crashes and falls).

11.7.1 Physical Injuries

The proposed Matai Mining Project may provide employment opportunities which are relatively safe and well-managed compared with other options available to many workers and can reduce work-related injuries in the population overall. However, project-related accidents, poorly controlled use of explosives or chemicals, equipment failure and truck movement can all potentially lead to physical injuries in local communities. If not well managed during decommissioning phase, the proposed Matai Mining Project may also pose injury risks, for example via falls, drowning, land slips and derelict buildings. The proposed Matai Mining Project may also affect injury rates indirectly through the social and economic changes they bring about. They may reduce the risk of violence in the community by providing gainful employment for young men, and by increasing the overall wealth of a community. However, the influx of large groups of, generally, male workers can sometimes lead to social unrest which may include violence and sexual assault.

Unfortunately, fatal and severe traumatic injuries continue to occur in mining and often have a profound impact on morale. Post-traumatic stress disorders sometimes develop in witnesses, colleagues and managers.

11.7.2 Road Traffic Accidents and Other Accidental Injuries

The impact of increased road traffic on air quality has already been discussed, but there are other potential health impacts associated with site related transport that may need to be considered. Higher volumes of traffic on rural roads may result in an increase in road traffic accidents an increase in traffic related noise and the potential for longer journey times for local people. This may also contribute to increased anxiety and stress, which, as previously discussed, is also detrimental to health. Whilst the individual health risks of air pollution are relatively small, the public health consequences are considerable (Kunzli et al 2000).

The proposed Matai Mining Project would increase the number of commercial motor vehicles (e.g., mine trucks and other vehicles) on the roads , which could potentially produce a small increase in accidents and injuries in the region. In general, changes in this health impact are expected to be negative, resulting in an increase in morbidity and mortality outcome data.

The proposed Matai Mining Project may lead to increased traffic loads on primary and access roads and has thus the potential to increase the number of traffic accidents. The proposed Matai Mining Project may influence accidents and injuries to other road users and pedestrians in the following direct ways:

- Transport of goods and personnel to service the needs of the proposed Matai Mining Project. This can include long-distance truck hauling and use of light duty vehicles. Sections of the roads have been destroyed by potholes. The roads are busy and un-roadworthy vehicles and poor driving practices are common;

- Transport of staff at shift changes in buses to their home in different communities; and
- Light vehicle traffic to support the general requirements of the proposed Matai Mining Project.

The proposed Matai Mining Project may influence accidents and injuries in the following indirect ways:

- Improvement in the local economy and the ability to buy motorised forms of transport. Use of safety devices and adherence to common road laws is likely to be inadequate/ not the norm with the potential for increased accidents;
- Social influences in the community. These may be associated with influx and a change in the social cohesion and traditional structures in the local communities. These have the potential to result in internal conflicts; and
- Increased use of alcohol and potentially drugs due to increased disposable income. This may also influence the social cohesion and may contribute to crime and violence.

11.7.3 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #7 by presenting the impact evaluation ratings for the three Project phases.

Table 11-5: Impact Evaluation –EHA #7

EHA#7: *Accidents/Injuries*		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Regional	Regional
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Major -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**High**	**Medium**
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes –irreversible loss of human life.	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ Change in morbidity and mortality data related to commercial motor vehicle (CMV) traffic on roadways related to the Matai Mining Project and ore transport. ▪ Change in morbidity and mortality data related to non-commercial motor vehicle crashes.		
Mitigation measures ▪ Engage the Local Municipality and interested and affected parties to assist with programmes targeted at improving traffic management and road safety in the study area; ▪ Develop a clear policy for the management of emergencies or accidents in the community as a direct result of the projects activities; ▪ Support with local safety and security as addressed in these specialist studies.		

12.8. EHA #8: Exposure to Potentially Hazardous Materials, Noise and Malodours

Local communities may already be exposed to low background levels of potentially hazardous materials (e.g. dust, particulate matter, heavy metals) that can be associated with health problems such as respiratory illnesses, skin diseases, organ damage, circulatory problems, birth defects, cancers and neurological disorders.

The negative health effects of ore mining in the Project Region are wide-ranging though not extensively documented. Many health effects can be directly correlated with toxic agents released into the soil, air, and groundwater by mining activity, but are also related to the social environment of North West Province, including limited economic opportunities.

Exposures and environmental health determinants as a result of the project will be covered in a number of specialist reports. These include air quality, water, noise and soil studies. Air quality and odours have been addressed in detail in the Air Quality Report.

11.8.1 Solid Waste (General and Hazardous)

Waste streams likely to be produced during the construction phase will include both general (non-hazardous) and hazardous wastes, and are expected to be similar in composition to the non-process wastes or co-products produced during the operational phase. The domestic waste stream will be comprised predominantly of non-hazardous waste types including paper, plastic, cloth and some food waste. In addition, relatively insignificant quantities of hazardous wastes may be included in this waste stream, including batteries, empty containers for cleaning chemicals, fluorescent light tubes, pesticide aerosol cans etc.

Waste storage drums that have industrial residues may adversely impact household water and food supplies, because these containers are often prized as inexpensive storage devices. The construction and rehabilitation activities will also result in the generation of hazardous wastes including chemicals associated with machine and vehicle maintenance, oily rags and filters, empty containers for hazardous chemicals (paints, solvents, lubricants, herbicides, pesticides / herbicides) and electrical and electronic equipment.

The uncontrolled storage of solid waste, in particular food waste, can attract vermin and pests including rodents, birds and flies. These vermin / pests may pose a nuisance to PACs closest to the site and may act as vectors for disease. The uncontrolled storage of solid waste can result in the release of unpleasant odours which may be regarded as a nuisance to adjacent land-users, particularly that downwind of the material. Odorous compounds are also released from relatively well-managed solid waste disposal facilities. The presence of large quantities of litter around the facility or at the proposed landfill may constitute a visual impact to employees and local communities.

11.8.2 Diesel Particulate Matter

Diesel particulate emissions are of special concern, particularly the size fraction up to 2.5 microns, known as $PM_{2.5}$. This size of particle is able to be respired deep into the lungs. PM2.5 from all sources has been implicated in numerous diseases ranging from cardiopulmonary disease to cognitive decline to cancer.

The deleterious impact on human health is incontrovertible (WA DOE 2008, California Air Resources Board 1998). Diesel engines are of particular concern as sources of particulate matter, as they typically produce $PM_{2.5}$ at a rate about twenty times greater than from gasoline (petrol) engines (WA DOE 2008, California Air Resources Board 1998).

11.8.2.1 Health Impacts of DPM: Cancer

Studies show an association between exposure to diesel exhaust and lung cancer (Bhatia, 1998), as well as cancers of the bladder and soft tissues (Guo et al., 2004). Several extensive and detailed reviews have been conducted on the body of literature relating long-term exposure to diesel exhaust particles and lung cancer (California EPA, 1998; USEPA, 2002; Cohen and Nikula, 1999). In addition, over forty studies conducted among those populations exposed to diesel exhaust have found increased rates of lung cancer associated with diesel exhaust particles exposure (as cited in Cohen and Nikula, 1999). Occupational studies conducted in railroad workers and truck drivers have consistently found increased lung cancer risk, even after adjusting for comorbidities such as smoking (Bofetta, 2001). The impact of DPM on cancer risk must be considered in the decision-making process for the proposed Matai Mining Project.

11.8.2.2 Health Impacts of DPM: Cardiac and Pulmonary

Although cancer risk is understandably of great concern to the public, cardiac and respiratory effects of diesel exposure have an even larger public health impact because they cause death and illness for a greater number of people. DPM can exacerbate asthma and emphysema, induce heart attacks and strokes, and has been associated with congenital heart abnormalities. According to a landmark study by Pope et al (2002), each 10 ug/m3 increase in DPM was associated with a 6% increase in cardiopulmonary mortality. In a follow-up to this study, Pope et al (2004) demonstrated that their previously observed increase in cardiopulmonary mortality was largely driven by increases in cardiovascular, as opposed to pulmonary mortality. In this follow-up study, a 10 ug/m3 increase in PM2.5 was associated with a 12% increase in mortality due to 'all cardiovascular disease plus diabetes' and an 18% increase in mortality due to 'ischemic heart disease'. Further epidemiological investigations have revealed that these estimates are likely largely underestimating the effect of $PM_{2.5}$ due to inadequate exposure characterization. Published in the New England Journal of Medicine, Miller et al. (2007) utilized a novel exposure characterization method and reported from the Women's Health Study that a 10 ug/m3 increase in $PM_{2.5}$ was associated with a 76% increase in death due to cardiovascular disease.

It is well understood that ambient air pollution and fine ambient particulate matter strongly contribute to disease burden and death, but it has been less clear as to how much an individual's living proximity to a major roadway or direct PM2.5 source influences health risks. An individual's exposure to $PM_{2.5}$ is dependent on where he/she lives and works and that this strongly influences health outcomes. Van Hee et al. (2009) demonstrated that living

close to a major roadway was a strongly associated with left ventricular hypertrophy, an important marker of cardiovascular disease and a strong predictor of heart failure and mortality. Additional work by this group has demonstrated an individual's exposure to PM2.5 impairs how well blood vessels dilate and how well the heart functions, providing a basis for our understanding of previously observed increases in mortality (Van Hee et al. 2011, Krishnan et al. 2012).

There are very specific physiological effects with DPM exposure. A recent study by Cosselman et al (2012) showed that diesel exhaust exposure, to healthy human volunteers, rapidly increases systolic blood pressure (SBP). In their study, SBP increased within 15 minutes of being exposed to dilute diesel exhaust and reached a maximum increase in SBP within one hour. Additional work utilising controlled diesel exhaust exposures to human volunteers has revealed that these acute exposures results in impairment in blood vessel function and alters blood coagulability[9], both of which are extremely deleterious effects and increase the risk of acute cardiovascular events such as heart attack and stroke (Mills et al. 2005, 2007, and Törnqvist et al. 2007). Fitting with these findings, epidemiological investigations have consistently demonstrated that acute increases in $PM_{2.5}$ result in an increased risk of heart attack (Peters et al. 2001).

In addition to cardiovascular risk, cerebrovascular effects and risk of stroke associated with $PM_{2.5}$ exposure has been investigated. Research published in the Archives of Internal Medicine (2012) examines, for the first time, the risk of acute, short term exposures to $PM_{2.5}$ as a key factor in triggering stroke, often within hours of exposure.

11.8.3 Noise

The impact assessment conducted by DbAcoustics used the noise emission characteristics of typical mining equipment, taking a precautionary approach to considering the worst-case scenarios. Conceptual noise propagation models were developed for various scenarios as described in the Noise Report. There are a number of receptors staying on, or very close to the proposed mining infrastructure, and it is assumed that these receptors will be relocated before mining starts. If they are not moved, this will result in a noise impact of high significance. The output of the modelling highlighted a potential for a noise impact of medium significance due to day and night-time construction activities. This is due to the number of occupied dwellings located within close vicinity from the proposed mining activity.

While there is a risk of a noise impact, the impact can be mitigated and reduced, with the magnitude of the reduction depending on the options selected as well as how the operation is managed. The proposed Matai Mining Project will not introduce potential fatal flaws in terms of acoustics. With the selection of the required

[9] Coagulation (also known as clotting) is the process by which blood changes from a liquid to a gel, forming a blood clot. It potentially results in haemostasis, the cessation of blood loss from a damaged vessel, followed by repair.

mitigation options, projected noise levels can be managed. If not mitigated, this will result in a noise impact of high significance during the operational phase. There is a potential noise impact of medium significance during the critical night-time operational phase. Measures are available and proposed that may assist in reducing noise levels and the probability of a noise impact occurring.

11.8.4 Blasting

Blast Management & Consulting (BM&C) was contracted as part of the EIA to perform an initial review of possible impacts with regards to blasting operations in the proposed Matai Mining Project.

11.8.4.1 Exposure to Noxious Fumes

Explosives used in the mining environment are required to be oxygen balanced. Oxygen balance refers to the stoichiometry of the chemical reaction and the nature of gases produced from the detonation of the explosives. The creation of poisonous fumes such as nitrous oxides and carbon monoxide are particular undesirable. These fumes present themselves as red brown cloud after the blast has detonated. It has been reported that 10 ppm to 20 ppm can be mildly irritating. Exposure to 150 ppm or more (no time period given) has been reported to cause death from pulmonary oedema. It has been predicted that 50% lethality would occur following exposure to 174 ppm for 1 hour. Anybody exposed must be taken to hospital for proper treatment.

Fumes, vapours, and gases are usually invisible. The effects of a toxic chemical on your body may be either acute or chronic. Acute (short-term) effects show up immediately or soon after exposure to the chemical. They may be minor, like nose or throat irritation, or they could be serious, like eye damage or passing out from chemical vapours. What all these effects have in common is that they happen right away. Chronic (long-term) effects may take years to show up. They are usually caused by regular exposure to a harmful substance over a long period of time. These effects are usually permanent. Factors contributing to undesirable fumes are typically: poor quality control on explosive manufacture, damage to explosive, lack of confinement, insufficient charge diameter, excessive sleep time, water in blast holes, incorrect product used or product not loaded properly and specific types of rock/geology can also contribute to fumes.

Symptoms and health effects of breathing carbon monoxide (CO) can cause headache, dizziness, vomiting, and nausea. If CO levels are high enough, you may become unconscious or die. Exposure to moderate and high levels of CO over long periods of time has also been linked with increased risk of heart disease. People who survive severe CO poisoning may suffer long-term health problems. Nitrous oxide is a gas with several legitimate uses, but when inhaled it can make people feel euphoric and relaxed. This happy feeling has led to it being nicknamed 'laughing gas'. Some people also experience hallucinations. However, there is a risk of death as a lack of oxygen can occur when using nitrous oxide.

11.8.5 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #8 by presenting the impact evaluation ratings for the three Project phases (overall potentially hazardous materials, noise and malodours).

Table 11-6: Impact Evaluation –EHA #8

EHA #8: Exposure to Potentially Hazardous Materials, Noise and Malodours		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Site or Local	Site or Local
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Moderate -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Medium**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ Change in morbidity and mortality data from poor air quality events (exceedances) through exacerbation of chronic respiratory diseases, or cardiovascular diseases ▪ Pollutants and emissions released by construction and operational activities may increase the prevalence of related respiratory illnesses and water related illnesses ▪ Influx of people into the area may increase domestic activities, including the use of domestic fuel, pesticides resulting in increased air pollution and associated Increases in the prevalence of related respiratory illnesses		
Mitigation measures ▪ Develop a dust management plan; Apply wetting agents, dust suppressant or binders on the exposed area; ▪ Vegetate, with grass or a gravel monolayer, the exposed areas; ▪ Reduce erosion loss by roughening slope surface - this dissipates energy of water or wind moving over the slope; ▪ Assess the angle of the slope, as maximum erosion occurs on slopes with angles between 30° and 35°; ▪ Improve upon the surface strength of a slope, which will lower the rate of erosion; ▪ Implement PM monitoring and continue with ongoing dust fallout monitoring; ▪ Collect data on a longitudinal basis from the local health centres on incidence of increased respiratory disease - especially respiratory tract infections that could be ascribed to dust. While these may not be specifically ascribed to the Project, the prevailing trends are useful to monitor so that any concerns could be addressed. This may require health systems strengthening to support recording; and ▪ Establish a monthly and annual reporting structure to appraise performance, compliance and complaints. ▪ A comprehensive, continuous air quality monitoring programme must be undertaken to ensure that mitigation measures are applied at all times to keep ambient air concentrations of PM10 and PM2.5 within the NAAQS over		

EHA #8: Exposure to Potentially Hazardous Materials, Noise and Malodours		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
residential areas; ▪ Mining related machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective; ▪ Environmental noise monitoring; ▪ Develop and implement a Storm Water Management Plan; ▪ Undertake groundwater and surface water monitoring; ▪ The management of waste rock will conform to the requirements of the IFC's EHS Guidelines for Mining (IFC, 2007); ▪ Limiting the size of the waste rock stockpiles by trucking to the waste rock dump as soon as possible and also careful selection of sites for stockpiling so as to minimise negative impacts to vegetation and water resource. In addition, seepage water should be channelled to a central collection point to avoid water resource contamination. ▪ As far as practical, the waste rock dump must be sited in a location such that in the event of failure, pollution of soil and water as well as physical risk to communities is minimised; ▪ The integrity of the waste rock dump must be inspected regularly by suitably qualified personnel throughout the LoM; ▪ Access to the waste rock dump should be restricted as far as practical and all local communities should be informed of the potential risks associated with these facilities through site notices and community meetings.		

11.8.6 Emergency Preparedness and Response

In addition to the emergency preparedness and response requirements already established at the proposed Matai Mining Project site, Matai Mining is advised to assist and collaborate with the PACs – especially local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to respond to such emergency situations. If local government agencies have little or no capacity to respond effectively, the client may have to play an active role in preparing for and responding to emergencies associated with the proposed Matai Mining Project. Matai Mining must document its emergency preparedness and response activities, resources, and responsibilities, and will disclose appropriate information to PACs, relevant government agencies, or other relevant parties.

12.9. EHA #9: Social Determinants of Health

11.9.1 Influx Management

When the proposed Matai Mining Project triggers significant migration (labourers, extended families, service providers, and so on) to the proposed Matai Mining Project area, it can pose potential significant impacts to surrounding communities. These impacts may occur, to varying degrees, across all phases of the proposed Matai Mining Project (preconstruction, construction, operations, and decommissioning). A strong interaction and mixing among local workers, imported specialty workers, and expatriates can facilitate the spread of respiratory disease, including the production of explosive epidemics that can pass back and forth between the proposed

Matai Mining Project and the community. In addition, food-borne epidemics are significant and can spread back and forth between the proposed Matai Mining Project worksite and the community via food handlers or petty traders.

The proposed Matai Mining Project faces the risk of unforced or voluntary migration, where it is assumed that migrants would be acting out of a rational self-interest as the motivating factor for moving. Often, if people are leaving behind adverse home conditions, they are migrating because of perceived opportunity rather than any specific guarantee of a job, particularly if a member of their extended family is already resident in the area (IFC, 2009). Migration is expected to yield positive benefits for the individual migrant (and his/her household), whether through remittance of incomes or settlement in the new location. In some circumstances, a significant migrant population may exist prior to project arrival, including artisanal and small-scale miners (IFC, 2009).

In-migration may have a wide range of negative impacts on the communities within close vicinity to the proposed Matai Mining Project site of influence. These negative impacts include including negative impacts on the environment; public infrastructure, services and utilities; the local and regional economy; livelihood strategies; public health; the social and cultural environment, and; legacy issues. These community-level impacts may directly and indirectly affect the proposed Matai Mining Project.

From a community health perspective, migrant workers introduce infectious diseases and social problems. These may be mitigated through pre-employment health checks and treatment. Implement HIV and TB control program.

The pattern of labour-based and economic in-migration typically follows project demand for labour (IFC, 2009). In the case of the proposed Matai Mining Project, the construction phase has the highest workforce requirements. As the proposed Matai Mining Project moves from construction to operational phase, and requires a smaller and more stable workforce, recently arrived migrants may move on as employment opportunities decrease and the disposable income of the local population declines.

Furthermore, the expected influx of people and increased income may result in illegal substances being available more freely. It is difficult to speculate whether the prevalence of tobacco smoking and or substance abuse may increase due to the presence of the proposed Matai Mining Project. However, it is likely that it will increase as there will be an increase in the number of young people with more than adequate incomes, who will be in a position to afford these commodities. Matai Mining may be in a position to conduct substance-abuse prevention education programs in the workplace and within the already affected (by alcohol) communities.

In-migration can generate a range of positive environmental, social, and health impacts, including:

- Increased links to mainstream economy

- Increased local skills-base
- Business-development opportunities
- Employment-creation
- Increased local labour pool
- Opening of new markets for local products and services
- Increased accessibility and availability of goods and services
- Alternative livelihood opportunities
- Improved local wage- and income-levels (including opportunities for local sourcing and higher prices obtainable for local products)
- Increased individual, household, and community-empowerment stemming from increased income and wealth
- Improved local training and skills-development opportunities
- Monetisation of remote rural economies, improving purchasing-power and increasing trade
- Opportunities to build community organizational structures
- Improved information and communication
- Improved water and sanitation
- Improved access to and expansion of infrastructure, public services and utilities (health, education, waste management, electricity, water supplies, telecommunications)
- Increased attention and input by government authorities, NGOs, etc.

Matai Mining could partner with government and NGO-services to prevent social problems; and ensure pro-social leisure opportunities are readily available e.g. football league, volunteer programs, invest in community events and festivals to promote cultural exchange, celebration of diversity etc.

11.9.2 Change in Number of Households Living Below the Poverty Line

Living below the poverty line is also an important determinant of health status. Poverty can be associated with decreased access to health care and increased disparities in health outcomes. In general, the mine would produce a positive impact on poverty status for a small number of people employed at the Matai Mining Project site. Like other social determinants of health, the overall health effects of this small change in unemployment would confer some health benefits. Positive social impacts include the increase in job opportunities and access to services.

11.9.3 Education Levels and Unemployment

The level of educational attainment in a household can influence community health. Economic status may create a powerful context for human health and improved income is generally thought to be associated with improved

community health outcomes. While there are many indicators used to assess economic status, the HIA reports median household income, employment, and the percentage of households living below poverty levels.

With mining being one of the major industries in the North West Province, it is expected that a sufficient number of the unemployed will have appropriate skills to qualify them for at least semi-skilled positions at the mine. Those that are less skilled may be more suited to manual labour such as earthworks and road construction. During the construction process potential candidates can also be identified to receive skills training for future (secondary economy) opportunities.

This means that local communities can potentially take maximum advantage of employment opportunities to be created by the proposed mine. However, it may not be possible to employ and train individuals from the local population in time for construction or operation, due to the level of skills required not being available locally. Matai Mining may be forced to make use of skilled migrant workers, as training required may be too complex and time-consuming. A situation like this may pose a risk of xenophobia as the local population may feel threatened.

11.9.4 Change in Educational Attainment

Higher levels of educational attainment are associated with positive health outcomes such longer lifespans and decreased risk for cardiovascular disease, cancer, and lung disease. In general, the proposed Matai Mining Project is expected to exert a positive change to this health impact. Economic influx into the area will likely draw families that can support local schools.

11.9.5 Gender-based Violence, Alcohol and Drugs

Gender-based violence occurs commonly and is often related to substance abuse. Substance abuse influences many health outcomes such as accidents and injuries. Substance abuse includes illegal drugs (e.g., marijuana, 'nyaope[10]' etc.), alcohol addiction, and binge drinking. Women and young girls are often the most vulnerable. Drug and alcohol abuse are currently a major problem and these have the potential to increase during the lifespan of the proposed Matai Mining Project.

Influx of people and increased income may result in illegal substances being available more freely. It is difficult to speculate whether the prevalence of tobacco smoking and or substance abuse will increase due to the presence of the proposed Matai Mining Project. However, it is likely that it will increase as there will be an increase in the number of young people with decent incomes, who will be able to afford these.

[10] Nyaope is a street drug that has allegedly come into widespread use in South Africa. It is famous for allegedly containing antiretroviral drugs for HIV

11.9.6 Social Cohesion and Well-being

There are a number of social challenges in the area. These are associated with culture, poverty, lifestyle practices, lack of opportunity and influence from past conflicts. However, perceptions of well-being are not likely to be as developed as those in the developed world in certain communities. Lifestyle is expected to be significantly affected. Subsistence farming and land tenure which are vital parts of the livelihood structure and an integral part of the culture may no longer remain so.

Alcohol-use was found to be common in the area with reports of drug abuse (especially marijuana) also reported. These lifestyle practices are often the root cause of social challenges.

It is not the intention of the HIA to address social issues in detail as this will be covered in more detail in the SIA. However, it is important to recognise the well-being and perceptions on quality of life have both a social and health basis. The proposed Matai Mining Project has the potential to maintain and create health impacts and inequalities that exist at the local level if these are not recognized. While these challenges were present at baseline and are generally the responsibility of the host government and local authorities, a number of factors related to the proposed Matai Mining Project's development should be considered.

11.9.6.1 Expectations from the proposed Matai Mining Project

The expectations of the proposed Matai Mining Project both from the local authorities and the community are high. Furthermore, the expectation for the proposed Matai Mining Project to support a range of social and development initiatives is significant.

11.9.6.2 Influx

This has the potential to alter the social fabric in the area and erode traditional values with a mixture of different cultures. Competing for limited resources may also have an impact on general health and well-being.

11.9.7 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #9 by presenting the impact evaluation ratings for the three project phases.

Table 11-7: Impact Evaluation –EHA #9

EHA #9: Social Determinants of Health		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Regional	Regional
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Major -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**High**	**Medium**
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Partially Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes	
Can impacts be enhanced: (Yes or No)	Positive impacts such as employment gain can be enhanced	
Residual impacts ▪ Change in morbidity and mortality data related to psychosocial distress such as depression, anxiety, substance abuse, and changes to family structure. ▪ Change in median household income ▪ Change in unemployment ▪ Change in the percentage of households living below poverty line ▪ Change in educational attainment ▪ Increase in xenophobia, violence, crime, prevalence of substance abuse and gender violence resulting from an influx of individuals without appropriate social infrastructure ▪ With the expected population growth and influx of job seekers, who may bring their families along, household size may increase resulting in overcrowding ▪ Construction workers and an influx of national and international people in search of economic opportunities are expected to put enormous pressure on the South African Police Services and immigration control ▪ Increase in psychosocial problems, including depression as a result of retrenchment at decommissioning phase ▪ A positive impact on poverty status for a small number of people employed at the Matai Mining Project site ▪ Influx of people and increased income may result in illegal substances being available more freely		
Mitigation measures ▪ Social management plans and recommendations as part of the SIA; ▪ Reduce substance-abuse and improve social cohesion by: ▪ Conducting substance-abuse prevention education programs in the schools within the communities; ▪ Providing recreational facilities for workers without families; ▪ Contributing to the establishment of appropriate community recreation facilities- considering needs and assets of the community; ▪ Collaborating with the relevant authorities to establish a system to monitor violence and community cohesion related to Project activities – provide technical skills; ▪ Participating in violence-prevention education programs, particularly focusing on gender violence and tribalism. ▪ Supporting education programs with a gender equity focus;		

EHA #9: Social Determinants of Health		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
▪ Plan for mine closure; ▪ Identify and support vulnerable groups; and ▪ Support graduate training programs for the youth in the community		

12.10. EHA #10: Cultural Health Practices

The potential influx of people may result in an increase in the existing number of unregistered medical practices. More people are practicing and using traditional medicine which may contribute to reducing the health burden if they are trained and knowledgeable.

Conversely, these practices may include traditional healers who may obtain plants in (possibly) contaminated areas. An increase in the prevalence of malpractice by traditional healers may occur if the burden of disease increases due to a lack of health facilities or if there are more people with an increased income. Unscrupulous practices may result in negative health impacts.

11.10.1 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #10 by presenting the impact evaluation ratings for the three project phases.

Table 11-8: Impact Evaluation –EHA #10

EHA #10: Cultural Health Practices		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Site or Local	Site or Local
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Moderate -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Medium**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	No	
Irreplaceable loss of resources: (Yes or No)	Yes – Unscrupulous practices by traditional healers may result in loss of human life.	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ More people are practicing and using traditional medicine which may contribute to reducing the health burden if they are trained and knowledgeable ▪ Negative health outcomes		
Mitigation measures ▪ Develop a disease-prevention plan that involves traditional healers and build onto indigenous knowledge, including assisting with disease-prevention through use of medicinal plants, home-based care, etc.		

12.11. EHA #11: Health Systems Issues

11.11.1 Health systems strengthening

There are several Healthcare facilities within the proposed Matai Mining Project area –refer to Plan 3 for an illustration of the healthcare facilities in the vicinity of the proposed Matai Mining area. However, the capacity of these facilities remains a challenge. There are also a few NGOs such as MSF Southern Africa which support health infrastructure and health system-strengthening programs. MSF supports the DOH in implementing the one-stop patient-centered model of care for survivors of sexual and gender-based violence which is called the Kgomotso Care Centre (KCC). The first Kgomotso Care Centre started operating in Boitekong clinic as a stand-alone structure from mid-2015 in Rustenburg. In the second half of 2016, MSF has extended support to two decentralized KCCs in Madibeng sub-district, which is Bapong and Letlhabile.

In terms of proposed Project impacts, influx may create increased demand for what is already a scarce resource. This has the potential to create tension.

Health information management is generally good in the health facilities that surround the proposed Matai Mining Project. This data is limited by the fact that diagnostics and human resource capacity is basic. However, it serves as the best form of health surveillance for the monitoring of health impacts if supported and managed well. Strategic investment in local health facilities can support this.

The proposed Matai Mining Project has the potential to impact on the national/local health service infrastructure and delivery mechanisms in the following ways:

11.11.1.1 In-migration

Additional in-migration into the PACs and ultimately, towns like Northam (Limpopo) are likely to significantly exceed the capacity of what are already limited facilities. There is minimal institutional capacity to support this potential growth either from a planning, budget or a delivery perspective. In-migration will be addressed in more detail in the SIA.

11.11.1.2 Health service delivery capacity and expectations on the proposed Matai Mining Project

There is minimal institutional capacity to support the local health service delivery. Therefore, the local health authorities will look to private partners or donors for assistance where possible, and as the proposed Matai Mining Project is so visible in the area, may look to it to plan, finance and even deliver health service on their behalf. Therefore it is essential that any interventions must be done in partnership with the local and national authorities so as not to be seen as a pure aid support package. The proposed Matai Mining Project must not assume the role of the government but deliver on its mandate to improve the quality of lives in the area.

For this reason, the proposed Matai Mining Project should see health as a key sector for strategic social investment and if this is conducted correctly, based on sustainability principles and in partnership with the local authorities it has the potential to enhance health systems and programmes and ultimately delivery in the area.

11.11.1.3 Healthcare funding

This extends into the element discussed above but also considers the potential inability to attract donor agency funding to the proposed Matai Mining Project area. As health needs extend to so many other areas of the country, there is a risk that donors and NGOs bypass the PACs in their budget and interventions due to the perception that the proposed Matai Mining Project will be in a position to fund and support any required programmes. This may reduce the potential to extend programmes and promote their sustainability.

11.11.1.4 Health service inequalities

There is a potential for inequalities between different communities as a result of Project supported health initiatives. It is logical that the proposed Matai Mining Project supports health services in the more impacted communities, but this has the potential to cause inequality in populations or communities who do not benefit.

The present and likely future medical service is likely to be the best equipped and staffed primary health care centre in the area for the foreseeable future.

11.11.2 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #11 by presenting the impact evaluation ratings for the three Project phases.

Table 11-9: Impact Evaluation –EHA #11

EHA #11: Health Systems Issues		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Site or Local	Site or Local
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Moderate -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Medium**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Partially reversible	
Irreplaceable loss of resources: (Yes or No)	Yes –increased pressure on infrastructure and services is expected to continue	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ Change in ratio of people to health care providers ▪ Change in time needed for emergency response ▪ Influx of people resulting in overburdened health facilities with inadequate health service ▪ Overburdened community health facilities, inadequate health service resulting from more people in the area		
Mitigation measures ▪ Influx management and supporting health facilities to cope with the increased population if related to project; and ▪ Support community volunteer programs through expansion of the community-based peer health educator group.		

12.12. EHA #12: Non-Communicable Diseases

The proposed Matai Mining Project may bring changes that affect people's lifestyles (e.g. diet, level of physical activity, smoking, alcohol and drug consumption) that increase or decrease their risk of chronic illnesses such as heart disease, diabetes, and cancer and can also affect the mental health status of the local population. This can be through increased incomes as well as the increased availability of tobacco, alcohol and narcotic drugs. Alongside infectious diseases, cardiovascular diseases (heart disease and strokes) are one of the leading causes of death, ill health and disability worldwide. Even small changes in these chronic disease risk factors can have significant long-term effects on local community health and well-being.

The potential increase in chronic disease risk factors may be at least partially minimized through support for NGOs and local health and social care services in delivering health promotion that emphasises moderation and the long-term adverse effects of substance abuse; and working with the local police service to regulate black market economies and what may be legally sold to workers.

The proposed Matai Mining Project will in all likelihood enhance the socio-economic conditions in the area, either through direct or cumulative benefits. As the proposed Matai Mining Project starts to improve health programs in the area through direct or indirect means, it is hoped that it will also contribute to increasing life expectancy in the area. The short-term effects may be an increased spending-ability and adoption of more western sedentary lifestyle and diet. With prosperity and an organised settlement may come a degree of urbanism with associated changes in values and behaviour, which predisposes the community to an increase in lifestyle-related diseases such as obesity, hypertension, diabetes, dental caries and some forms of cancers. This may place an additional burden on the local health care facilities that may not have an ability and capacity to diagnose and appropriately manage these conditions.

The proposed Matai Mining Project will employ a number of permanent and temporary workers. Diet and lifestyle will need to be monitored[11] in this sector as they will have access to increased incomes and potentially free meals on the proposed Matai Mining Project site. The following potential impacts from NCDs on the workforce will need to be considered:

- High costs associated with absenteeism due to ill health;
- Loss of trained or skilled people from the workforce as a result of disease. This will result in higher operational costs due to the need to retrain or recruit replacement staff; and
- Impact on the family unit with potential social and behavioural impacts.

[11] Diet and lifestyle monitoring can take place through education on nutrition and encouragement of 'self-monitoring'. Self-monitoring is a useful way to keep yourself on track with healthy eating and exercise habits. The goal is to help you become more aware of the behaviours that are holding you back from better health. Some common ways to self-monitor include keeping food diaries; exercise logs and regular self-weighing.

In terms of the significance of the proposed Matai Mining Project on surrounding communities, the following potential risk factors may have to be considered:

- Reduction in traditional lifestyle and values;
- Social and environmental factors that increase stress and unhealthy behaviours; and
- Increased pressure on existing health care facilities that only practice limited preventive health care.

These conditions are chronic in nature and difficult to predict at the local level. The cumulative impacts of the economic upliftment at the local-, county- and country-level will need to be considered and as such the impacts cannot solely be ascribed to the proposed Matai Mining Project. Mitigation and management at the local level is however important.

11.12.1 Project Impact Mitigation

The proposed Matai Mining Project impact mitigation for this EHA is listed below:

- Support health education programs as part of a community-based peer health educator program. These should focus on lifestyle risk factors such as diet, exercise, smoking and alcohol consumption.
- Support the local healthcare personnel with training on disease-management programs and the recognition of NCD symptoms and associated management. This should include integrated management to include proper management strategies for hypertension and high cholesterol; and
- Support with diagnostic medical hardware, where feasible.

11.12.2 Mental Health and Well-being

Many of the potential health impacts considered above have been environmentally related (particulates, dust, light pollution etc.). However, it must be recognised that all of these impacts have direct or indirect effects on the mental health and well-being of those they affect. Bio physical impacts aside, actual or perceived exposure to environmental risks can lead to a significant increase in anxiety and stress amongst affected populations. In addition, those members of communities involved in protesting against mining developments (and/or extensions to existing sites) may experience additional stress exacerbated by the process of protesting itself.

Many illnesses are related to stress (Brunner 1997) and correlations have been found between living in underprivileged areas and vulnerability to psychological or minor psychiatric problems (Harrison 1998). Frequent and prolonged activation of the 'fight or flight' response (such as that which may be produced by stress associated by proposed mining developments) has been found to be maladaptive and may prove to be central in understanding the social distribution of cardiovascular and other diseases and recent stressful life events have also been shown to increase to and severity of respiratory infections (Brunner 1997) and correlations have been

found between SES and frequency of environmental exposures to social or non-social hazards (Haan et al 1987, Kreiger 1997).

Social stress has also been found to have an effect on cell mediated immune function (Cohen et al 1992) and psychological distress as a factor in coronary heart disease as an increase in CHD cannot be explained solely by health behaviours, social isolation or work characteristics (Stansfield et al 2002). It has also been reported that disadvantaged areas make higher demands on primary care services and that many of the additional contacts related to psychological problems (Carlisle 1998), leading to the potential for increased GP consultations for mental health and well-being issues as a result of mining related anxiety and stress. Stress can be caused by many factors, including the psychosocial environment, and contribute to health inequalities between groups by raising levels of cortisol in the body and thus contributing to high blood pressure. There is limited and incomplete evidence but biological plausibility for the view that psychosocial factors may be important determinants of population health.

11.12.3 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #12 by presenting the impact evaluation ratings for the three project phases.

Table 11-10: Impact Evaluation –EHA #12

EHA #12: Non-Communicable Diseases		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent *(Local, Regional, International)*	Site or Local	Site or Local
Duration *(Short term, Medium term, Long term)*	Long Term > 5 years	Long Term > 5 years
Magnitude *(Major, Moderate, Minor)*	Moderate -	Minor -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Medium**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts ▪ Change in mortality and morbidity data due to non-communicable diseases. ▪ Influx of people with chronic diseases putting a burden on health service delivery ▪ Behavioural changes at the household level such as alcohol use, smoking, or dietary changes that may contribute to a rise in non-communicable disease outcomes affecting health service delivery ▪ Social and environmental factors that increase stress and unhealthy behaviours		
Mitigation measures ▪ Support health education programs as part of a community-based peer health educator program; ▪ Support the local healthcare personnel with training on disease-management programs and the recognition of NCD symptoms and management thereof; ▪ Support healthcare facilities with diagnostic medical hardware, where feasible.		

12. Cumulative Impacts[12]

Cumulative impacts are contextual and encompass a broad spectrum of impacts at different spatial and temporal scales (IFC, 2013) i.e. cumulative impacts can result from individually minor but collectively significant activities taking place over a period of time (Dutta, *et al*., 2012). These are not new types of impacts but recognition that impacts from individual projects and activities can combine together in time and space. In some cases, cumulative impacts occur because a series of projects of the same type are being developed. In other cases,

[12] The impacts which combine from different projects and which result in significance change, which is larger than the sum of all the impacts.

cumulative impacts occur from the combined effects over a given resource of a mix of different types of projects; for example, the development of a mine site, access roads, transmission lines, and other adjacent land uses.

The following cumulative impacts are expected:

- The cumulative impacts associated with the influx of job seekers include the long-term impacts on family structures and social networks of communities. In the case of HIV/AIDS or unwanted pregnancies the impacts might be permanent and have permanent cumulative impacts on the affected individuals, families and the community;
- An influx of workers (direct) and job-seekers (indirect) may lead to increased pressure on infrastructure and services and an increase in social pathologies. Matai Mining should make every effort to discourage influx by communicating early and widely that local residents will be given preference for employment. Matai Mining must ensure that it collaborates with the relevant local authorities and mining operations to identify and actively participate in initiatives/ projects to improve capacity where required. While the potential impacts linked to influx can have negative consequences, this is a common and anticipated phenomenon that cannot be a reason for preventing further development;
- An increase in direct project nuisance factors; namely, noise, air pollution, traffic and visual disturbances could further impact negatively on the sense of place for some receptors. Implementation of suitable mitigation measures has been proposed by the relevant specialist to reduce and manage these nuisance factors
- The other mines may contribute to the pollutant load on surface water systems. These changes may be substantial, affecting the regional water quality, though some mitigation is possible with practicable management systems. Changes in surface water quality impacts on the health various surface water users –drinking and recreational users. The development of the proposed Matai Mining Project may place pressures on existing sanitation and water supply systems because of the anticipated increase in population in the area.
- Ground water extraction at other mines may affect groundwater availability in the area. The change may be substantial, extend regionally, affect many people, and may be cumulative in nature causing an overall shortage of drinking water as majority of the healthcare facilities and settlements depend on borehole water.
- With regards to noise and vibration, some of the surrounding settlements s will be exposed to noise from the operations of various machines on the mine and trucks on the road. Extraction and transport operations of other mines will affect some the receptors. Though blasting will be carried out at other mines, the effects are not synergistic. With modern blasting technologies, the effects are likely to be small, localised, easy to mitigate, and non-cumulative.

- Changes in income level; education; health care; change in existing cultural pattern; alteration of location or distribution of human population in the area; change in housing.
- Potential health hazards; risk of accidents from explosion, release of oil, radioactive materials, toxic substances etc.

13. Monitoring and Evaluation

Monitoring is a crucial component of any study as it aims to ensure better operation and maintenance of any proposed project. It contributes significantly to preventing accidents.

Monitoring and Evaluation (M&E) plans should be based on appropriate, applicable and relevant Key Performance Indicators (KPIs) and therefore it is important to have a robust baseline with areas that can be measured based on impact management and interventions.

Numerous KPIs have been established for monitoring health performance indicators. These can be divided into three types (Mosse and Sontheimer, 1996):

- Structural - buildings, equipment, drugs, medical supplies, and vehicles; personnel; money; and organizational arrangements.
- Process - asses the effectiveness of the actions, and identify who is involved and whether the various programs are working.
- Outcome - measures the long-term effects of a program. The five D's (death, disease, disability, discomfort, and dissatisfaction) are typically considered outcome measures. The morbidity and mortality outcome indicators are calculated as rates.

Table 9 1 outlines the different health indicators that could be collected and used for monitoring by the proposed Matai Mining Project. It is important that a robust baseline is used to support these KPIs.

Based on the impact assessment there are a number of key data gaps that should be addressed to support a robust baseline and inform a surveillance program based on outcome indicators. It is recommended that quantitative data is collected from different potentially-affected communities to inform this monitoring program

Table 13-1: Health Monitoring Plan

Health Monitoring Plan			
Health Impact	**Structural indicators**	**Process indicators**	**Outcome indicators**
Transmission of communicable disease due to overcrowding	➢ Household size and no. of rooms/people; ➢ House-price inflation; and ➢ Effective project waste disposal services.	➢ Influx management; ➢ Local recruitment; ➢ Health education campaigns; ➢ TB policy and program.	➢ ARI indicators; and ➢ Any epidemics outbreak in community (e.g. meningitis).
Transmission of STIs and HIV/AIDS	➢ Health facility capacity on key HIV care and treatment principles; ➢ Effective management of STI and sexual partner follow up; ➢ Community based peer health educator activities; and ➢ Medical waste management.	➢ HIV policy implemented; ➢ HIV management program implemented with metrics; ➢ Health education programs; ➢ Commercial sex work activity; ➢ Reproductive health services for commercial sex workers; and ➢ Distribution of condoms.	➢ Health facility and district statistics; ➢ KAP survey and behaviour change measures; and ➢ HIV sero-prevalence studies.
Access to safe drinking water	➢ Proportion of households with access to improved water sources; and ➢ Equality of improved water supply.	➢ Health education programs; ➢ Influx management; and ➢ Water quality results.	➢ Diarrhoea, skin and eye disease rates from health facility; and ➢ End-user water quality results.
Sanitation and waste management	➢ Proportion of households with access to improved sanitation services; ➢ Equality of sanitation services; and ➢ Effectiveness of project sanitation services.	➢ Health education programs; ➢ Influx management; ➢ Support school-based deworming programs; and ➢ Agreements with local authorities.	➢ Schistosomiasis and soil-transmitted prevalence rates; and ➢ Health facility statistics for schistosomiasis, intestinal parasites and diarrhoea, skin and eye disease.
Malnutrition and food security	➢ Health facility capacity and reporting; and ➢ NGO agreements on nutritional programs.	➢ Access to land; ➢ Effectiveness of nutritional support	➢ Malnutrition statistics from health facility; ➢ Anthropometric measurements; and

Health Monitoring Plan			
Health Impact	**Structural indicators**	**Process indicators**	**Outcome indicators**
		programs; - Health education programs; and - Food inflation.	- Anaemia prevalence.
Accidents and injuries	- Health service support with improved trauma capability; - Emergency response ability; and - Emergency equipment and trained staff at site.	- Health and safety plans; - Emergency response plans and updates; - Drug and alcohol programs; - Transport-management plan; - Health education programs; - First aid training; and - Community grievances related to project activities.	- Police and health facility statistics; and - Workplace health and safety statistics.
Environmental health determinants	- Environmental and occupational hygiene monitoring-human resource, equipment; and - Change houses to prevent cross contamination from soiled clothing.	- Dust suppression activity; - Air quality monitoring; - Transport management plan; - Community grievances; and - Compliance to IFC PS3.	- Heavy metal testing at baseline; - Health facility statistics on respiratory infections; and - Water quality testing.
Social Determinants of health	- Equipment to screen for substance abuse. - Involvement in Rehabilitation centres	- Health education programs; - Workplace substance-abuse policy and program; - NGO support programs; - External stakeholder communication; and	- Reported cases of domestic violence; and - Reports on alcoholism and substance abuse.

Health Monitoring Plan			
Health Impact	**Structural indicators**	**Process indicators**	**Outcome indicators**
		➢ Grievance register linked to health.	
Health systems	➢ Health service capacity at workplace. Minimum standards adhered to in terms of stock, staff and equipment; and ➢ Community based peer health educator activities.	➢ Influx management; ➢ Support of local health facilities and monthly reports; ➢ NGO agreements; and ➢ Define dependent health care benefits and sign-off from labour organisation.	➢ Utilization and capacity of health facilities.
Non-communicable diseases	➢ Improved diagnostic services in health facilities; and ➢ Health management information system supports surveillance of NCD.	➢ Health education programs; and ➢ Training of health care personnel.	➢ Diabetes and hypertension statistics from health facility; ➢ Baseline health profile and risk mapping of different sectors of workforce; ➢ Cancer registry; and ➢ Spontaneous abortion registry.

14. Conclusion and Recommendations

In conclusion, Matai Mining needs to consider the existing health needs of the PACs they will be operating within as these existing health needs are present regardless of the proposed Matai Mining Project and represent the current health status of the community. The proposed Matai Mining Project will also need to consider the future health impacts that it (the proposed Matai Mining Project) may exert on these PACs.

This HIA has outlined the significant changes on the health status of the local communities that may be instigated by the proposed Matai Mining Project. An attempt has been made to give a comprehensive outlook of the baseline health status of the proposed Matai Mining Project site (where possible) and also to understand and prioritise future Project health impacts, based on the available evidence. Mitigation and management measures have been recommended and it is advised that these measures are incorporated into the overall environmental and social management plan for the proposed Matai Mining Project.

An impact assessment was undertaken, which employed both qualitative and quantitative research methods and incorporated consultation with and participation of PACs. It is the author's opinion that due process has been followed. Where impacts have been found to be potentially significant, various mitigation measures to manage and monitor the impacts of the proposed Matai Mining Project have been proposed.

Adequate mitigation measures are expected to reduce the significance of almost all negative impacts although not always to acceptable levels, while positive health effects can be created through the implementation of associated enhancement measures. The recommended mitigation measures must be implemented to manage the impacts and ensuring compliance with current legislative requirements. Lastly, it is recommended that Matai Mining inaugurates relationships with other institutions (e.g. government or NGOs) involved in local and regional healthcare development and social upliftment so as to maximise the benefits of its contribution to the overall health status of the community.

If the Project is granted environmental authorisation, it is recommended and advised that, on safety and health grounds, both the Project proponent and the competent authority should:

- prohibit or restrict the use of certain hazardous practices, processes or substances in the mine; or
- the applicant should provide advance notification and authorization before any such restricted practices, processes and substances are used; or
- specify categories of workers who, for reasons of safety and health, are not allowed to use specified processes or substances, or are allowed to use them but only under conditions prescribed in accordance with national laws or regulations.

It is recommended that the Project is allowed to proceed on the assumption that the environmental, social and health management commitments are adhered to.

15. Legal Requirements: Specialist Checklist

In terms of the NEMA 2014 EIA Regulations contained in GN R982 of 04 December 2014 all specialist studies must comply with Appendix 6 of the NEMA 2014 EIA Regulations (GN R982 of 04 December 2014). The table below show the requirements as indicated above.

Table 15-1: Specialist Checklist

EIA REGULATIONS 2017 GNR 327, 325 and 324 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Completed according to the EIA Regulations	Cross-reference in this scoping report
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	X	Page 2
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	X	Page 3
(c) an indication of the scope of, and the purpose for which, the report was prepared	X	Page 30
(CA) an indication of the quality and age of Base Data used for the specialist report	X	N/A
(CB) a description of existing impacts on the site, cumulative impacts of the proposed development and the levels of acceptable change	X	Page 119
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	X	Page 38
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	X	Page 30
(f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives.	X	Page 38
(g) an identification of any areas to be avoided, including buffers;	X	N/A
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	X	N/A

EIA REGULATIONS 2017 GNR 327, 325 and 324 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Completed according to the EIA Regulations	Cross-reference in this scoping report
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	X	Page 45
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	X	Page 80
(k) any mitigation measures for inclusion in the EMPr	X	Page 80
(l) any conditions for inclusion in the environmental authorisation;	X	Page 125
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	X	Page 114- 117
(n) a reasoned opinion— i. whether the proposed activity, activities or portions thereof should be authorised; and (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	X	Page 122
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	X	Page 80
(p) any other information requested by the competent authority	X	None requested

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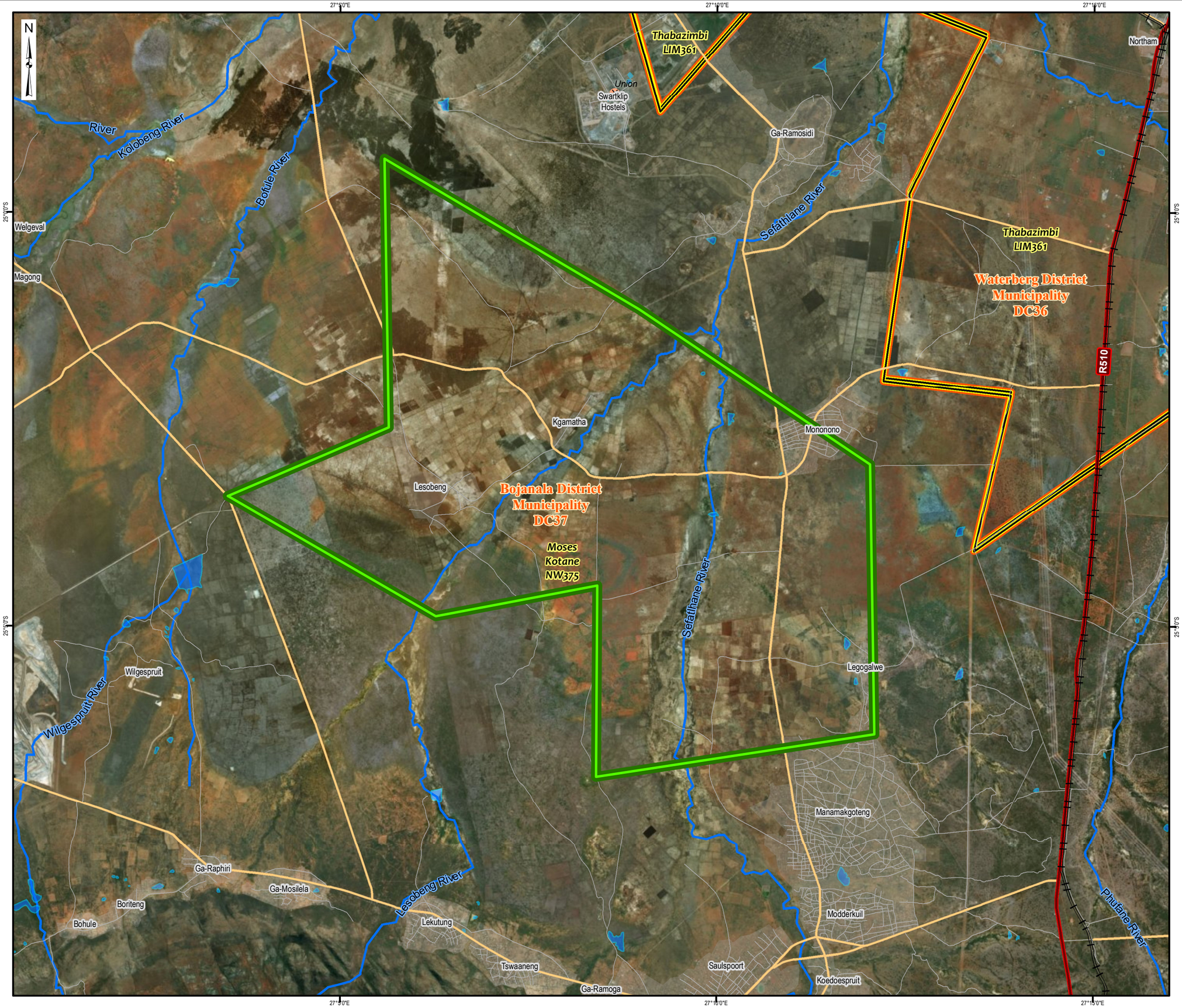
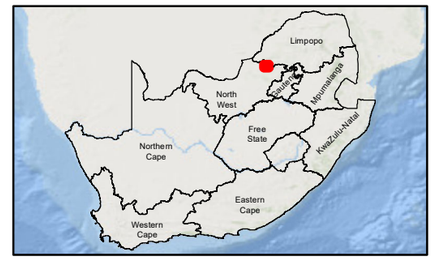
Appendix A: Plans





LEGEND

- Prospecting Right Area
- Local Municipalities
- District Municipalities
- Communities
- Dams
- NFEPA Rivers

Roads

- Main road
- Secondary road
- Street
- Railway

0 2.5 5
Kilometers

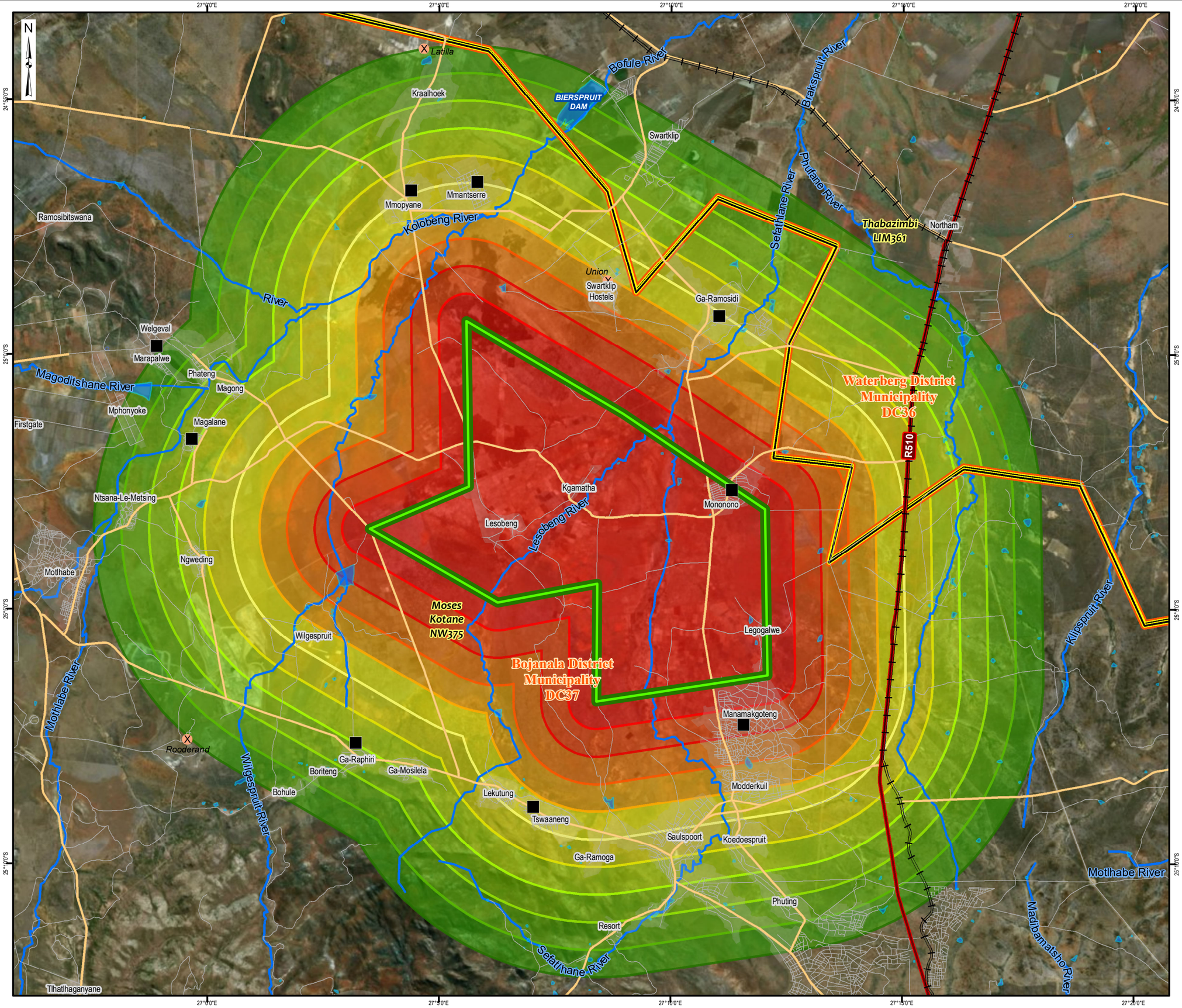
PROJECT
Community Health Impact Assessment for the Matai Mining Right Application, Magisterial District of Mankwe, North West Province

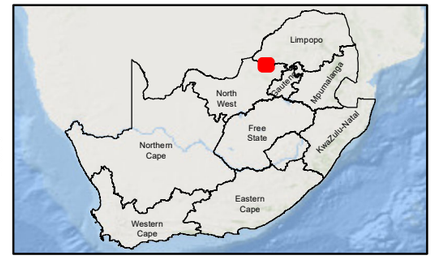
TITLE
Plan 1: Local Setting

Environmental Consultants

SCALE 1:80,000	REV. 0
DATE 30/01/2019	A3
REFERENCE: WGS Lo27	

Environmental Consultant: Vumile Ribeiro GIS: Cornette van Staden





LEGEND

- Prospecting Right Area
- Potenially Affected Communities

Roads

- Main road
- Secondary road
- Street
- Railway

- Communities
- Dams
- Pan
- NFEPA Rivers

10km PRA Concentric Buffer

- 1km PRA Buffer
- 2km PRA Buffer
- 3km PRA Buffer
- 4km PRA Buffer
- 5km PRA Buffer
- 6km PRA Buffer
- 7km PRA Buffer
- 8km PRA Buffer
- 9km PRA Buffer
- 10km PRA Buffer

0 4 8
Kilometers

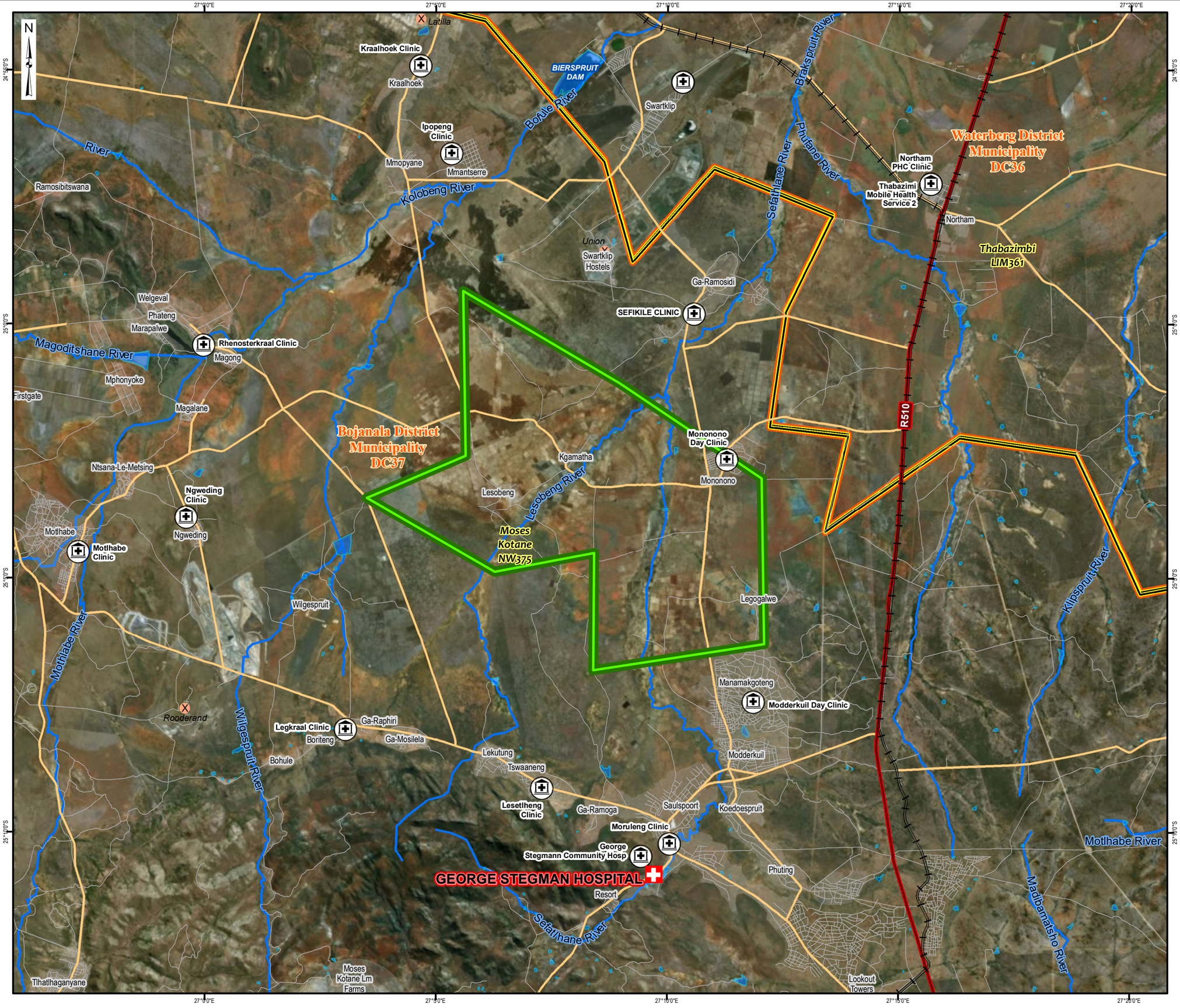
PROJECT
Community Health Impact Assessment for the Matai Mining Right Application, Magisterial District of Mankwe, North West Province

TITLE
Plan 2: Potentially Affected Communities

Environmental Consultants

SCALE 1:130,000	REV. 0
DATE 30/01/2019	A3
REFERENCE: WGS Lo27	

Environmental Consultant: Vumile Ribeiro GIS: Cornette van Staden



LEGEND

- Prospecting Right Area
- Hospitals
- Health Clinics

Roads

- Main road
- Secondary road
- Street
- Railway
- Communities
- Dams
- Pan
- NFEPA Rivers

0 4 8
Kilometers

PROJECT
Community Health Impact Assessment for the Matai Mining Right Application, Magisterial District of Mankwe, North West Province

TITLE
Plan 3: Healthcare Facilities

Environmental Consultants

SCALE 1:130,000	REV. 0
DATE 30/01/2019	A3
REFERENCE: WGS Lo27	

Environmental Consultant: Vumile Ribeiro GIS: Cornette van Staden

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Appendix B: Focus Group Discussion Questionnaires

Environmental Consultants

THE DEVELOPMENT OF THE PROPOSED MATAI MINING PROJECT, MANKWE MAGESTERIAL DISTRICT, NORTH WEST PROVINCE

POTENTIALLY AFFECTED COMMUNITIES QUESTIONNAIRE

Please may we ask a few questions related to health in your community? We will ask a number of questions related to health challenges you face in your community, the local health care services, the decision making in accessing the services and the general satisfaction of the available facilities. Please note that there are no right or wrong answers. Everyone's opinion is valued and important to us. Please let everyone speak and if you do not agree with a person then express this openly but without criticism as they are untitled to their opinion.

Please note that we do not represent Matai Mining (Pty) Ltd and thus cannot make commitments on their behalf. So questions related to requests or commitments that Matai Mining (Pty) Ltd may have made should not be discussed. If you have any questions for us please feel free to ask.

Location:

Date:

Interviewer:

Number of participants:

Niara Environmental Consultants, Registration no.: 2012/018290/07
59 Beaumont Road, Bluff, Durban, 4052
Cell: +27827872786; Fax: 0865314434

HEALTH SEEKING BEHAVIOUR	
Where did you go first the last time when your child had a fever/cough?	
If they usually do not go to the health facility, ask for the main reason for not doing so (Accessibility; Acceptability; Affordability)	
Where is the nearest health facility? (Also ask if there is any mobile clinic facility in the area and how frequently it comes to the community. Also inquire whether medical staff do home visits, e.g. during emergencies. Inquire about the presence of an ambulance) **How long does it take to walk there?** **How long does it take you to get there by car/ taxi?**	
Do you have to pay for medical services? (If yes) **How much do you pay?** (Find out if there is any community based health	

insurance scheme)	
Are you satisfied with the health care services you receive? **If not why?**	
How many traditional healers do you have in your community? **What sort of reasons will take you to the traditional healer?**	
Are there other health actors (e.g. NGOs) active in the communities? **If so what do they do?** (Note down active NGOs and what services they provide)	
MATERNAL AND CHILD HEALTH	
Do women in your community get antenatal care services? Where?	

Are you satisfied with the services you receive?	
Do all the new born children get vaccinations up to the age of one year? **Are there people in your community who do not take their children for vaccination?** (If yes) **Why?**	
Have your children under 5 been weighed and measured? **If so where? If not why?**	
Where do women normally deliver? **If at home, who assists?**	
Do women practice family planning in your community?	

(Discuss what methods they commonly use)	
EPIDEMIOLOGY OF DISEASE	
What are the 3 most important diseases in your community?	
Do many people have skin disease?	
HIV/AIDS	
Have you heard about the disease called HIV/AIDS? **What is it?** **Do you think it is a serious problem in your community?** (Why do they think it is/isn't such a serious problem?)	
When you hear the word protection/prevention- what does it mean to you? (Discuss methods of prevention)	

Do people use condoms? **Are they easily accessible?** **Why do people use/ not use them?**	
Is there much commercial sex? *These questions below are to guide the conversation* **What different kinds of commercial sex are there? Who are the sex workers and where do they work? Who are the clients and where do they work?**	
Are there categories of men who are known to have many sexual partners? *These questions below are to guide the conversation* **Which categories are these? Who do they have sex with and why? Are some categories of men**	

riskier than others and why?	
Are young people having sex? *These questions below are to guide the conversation* **If so, at what age? Who are their partners? Why are they having sex so early?**	
Is it possible for a healthy-looking person to have HIV/AIDS? **Would you buy food from somebody who you knew had HIV/AIDS?** **If someone in your family had HIV/AIDS would you keep it a secret?**	
SOIL AND WATER RELATED DISEASE	
What is the main source for <u>drinking</u> water in the community? (Record type of water source)	

Does every household have its own latrine? (Record types of sanitation facilities in the community)	
Do people swim in, or drink from open water bodies in the area?	
Do you consider your environment clean or dirty? **Why?**	
HOUSING	
Are there any challenges related to housing or accommodation in your community? **Is overcrowding a problem?**	
FOOD AND NUTRITION	
Do you have enough food in your community? (If there is a food shortage, find out why)	

Is malnutrition a problem in the community (especially in children)? Why (Bad feeding practices, food shortage)	
What food stuffs are most commonly consumed in the area?	
Do you use salt in your diet?	
SOCIAL DETERMINANTS OF HEALTH	
Do people in the community drink alcohol and smoke? (Discuss the extent of these vices)	
Do they use drugs?	
Is domestic violence common in your community?	
In general is there a feeling of wellbeing or state of hopelessness in your community?	
PROJECT AND COMMUNITY COHESION	

What are your general perceptions about the project?	
How do you think the project will influence your health and wellbeing?	
How do you think the project can help improve the community's health? **What can you as a community do to improve your own health?**	

THANK YOU