

HUMAN HEALTH IMPACT ASSESSMENT (HHIA)
FOR THE PROPOSED DEVELOPMENT OF THE SPITSVALE MINE
LIMPOPO, SOUTH AFRICA
FEBRUARY 2016
FINAL DRAFT

Prepared by

CSIR

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for



**SPECIALIST STUDY:
HUMAN HEALTH IMPACT ASSESSMENT**

**PREPARED BY:
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Photo from study area showing chromium –bearing ore.

Photo by Dr Richard Meissner CSIR

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DECLARATION

I hereby declare that I do:

- (a) have knowledge of and experience in conducting Human Health Impact specialist assessments, including knowledge of the National Environmental Management Act (Act 107 of 1998) and the Environmental Impact Assessment Regulations of 2010 that have relevance to the proposed activity;
- (b) 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 also declare that there is, to my knowledge, no information in my possession that reasonably has or may have the potential of influencing –

- (i) any decision to be taken with respect to the application in terms of the Act and its Regulations; or
- (ii) the objectivity of this report, plan or document prepared in terms of the Act and its Regulations.



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GLOSSARY

TERM	DEFINITION
CUMULATIVE IMPACTS	All impacts combined from different projects which result in significant change, and is larger than the sum of all the impacts.
DIRECTLY AFFECTED	Refers to the groups or individuals that will experience impacts as a direct result of the project.
DIRECT IMPACT	Impact of project that directly affects a particular area or aspect.
ECONOMICALLY ACTIVE	A person of working age (15–65 years) who is available for work, and is either employed or unemployed.
ENVIRONMENTAL HEALTH AREAS (EHA)	Areas to examine for potential project impacts.
EXPOSURE	Contact between an agent and a target, with contact taking place at an exposure surface over an exposure period; quantified as concentration integrated over time.
GENERIC KEY ISSUES	Issues or consequences that link the project activity to relevant EHAs.
HEALTH ACTION PLAN	Considers the rankings developed in the risk assessment and develops a written health action plan (HAP).
HOUSEHOLD	A group of persons who live together and provide themselves jointly with food and/or other essentials for living, or a single person who lives alone.
HUMAN DEVELOPMENT INDEX	Indication of life expectancy, education and income.
INFANT MORTALITY RATE	Probability of dying before age 1 per 1000 live births.
LABOUR FORCE	All persons of working age (15-65 years) who are employed or unemployed.
PROJECT SITE	The footprint area of the Spitsvale Mine.
IMPACT ASSESSMENT	Includes the key set of activities to investigate, to appraise, and to qualitatively or quantitatively rank the impacts the project is likely to have on the health of the defined communities.
LOCAL STUDY AREA	Land owners, farmers, settlements and people surrounding the project site.

TERM	DEFINITION
STUNTING	Refers to the number of children in the below 5 age group who have a low height for their age when measured or compared to the normal height for the same age group.
SUBPLACE	Small geographic area for which census data is available.
SUSCEPTIBILITY	A component of vulnerability that can be the result of internal factors (e.g. age, nutritional status, existing diseases).
UNDER 5 MORTALITY RATE	Probability of dying before age 5 per 1000 live births.
VULNERABILITY	Exposure and defenselessness – the exposure to the shocks, stress and risks and the lack of means to cope.
VULNERABLE POPULATION GROUPS	Determined by inherent factors, acquired environmental, social or behavioural factors, and elevated exposures.
YEARS OF LIFE LOST (YLL)	Year of Life Lost is a measure of premature mortality that takes into account both the frequency of deaths and the age at which death occurs.
DISABILITY ADJUSTED LIFE YEAR (DALY)	Disability Adjusted Life Year is one lost year of healthy life either through death or disability.

ABBREVIATIONS AND ACRONYMS

ARI	Acute Respiratory Illness
ART	Antiretroviral Therapy
AIDS	Acquired Immunodeficiency Syndrome
DALY	Disability Adjusted Life Year
DTP	Diphtheria, Tetanus and Pertussis
EHA	Environmental Health Area
EHS	Environmental Health and Safety
EP	Equator Principles
EPA	Environmental Protection Agency
GI	Gender Index
HAP	Health Action Plan
HDI	Human Development Index
HHIA	Human Health Impact Assessment
HIV	Human Immunodeficiency Virus
ICMM	International Council of Mining and Metals
IFC	International Finance Corporation
KPI	Key Priority Indicator
PAHs	Polycyclic Aromatic Hydrocarbons
PM₁₀	Particulate matter equal to or less than 10 micro metre in diameter
STIs	Sexually Transmitted Illness
TB	Tuberculosis
TPA	Tonnes Per Annum
WHO	World Health Organization

YLL

Years of Life Lost

1 EXECUTIVE SUMMARY

The Environmental Health determinants and associated impacts (both positive and negative) as a result of activities during the three phases of mining may be summarized as follows:

- Social determinants of health
 - Activities associated with different phases include an increase in male job seekers and workers during construction and an increase in women and children (vulnerable age group) during operation.
 - The use of local labour should have a positive impact on local businesses and thus the local economy. Identification of local capacity-building opportunities will be crucial to maximise employment opportunities.
 - The main estimated **negative** impacts associated with issues related to social determinants of health, before mitigation, include a change in social cohesion which has the potential to lead to acts of violence including xenophobia, crime, substance abuse, and interpersonal violence as well as an increase in psychosocial problems such as depression. The influx of jobseekers should thus be managed proactively to minimize social impacts on infrastructure and service delivery.
 - The change in land zoning status for future mining are regarded as **positive** as associated activities would likely ensure long-term social development support for the core communities and will create opportunities for job-creation in the secondary and tertiary economy sectors
 - The overall **nett-rating** for both the construction and operational phases are moderately-negative before mitigation and low-negative after mitigation, while the nett-rating for the decommissioning phase remains moderately-negative. A moderate **positive** impact is expected on the economic development during the construction and operational phases.
- Safety and security
 - Related activities which may have negative impacts on safety and security include an increase in social tension from the employment of outsiders, illegal business practices such as drug-dealing,
 - The overall **nett-rating** for the construction phase is moderately-negative before mitigation and low-negative after mitigation. For the operational phase it is moderately-negative before mitigation and although the rating is lower after mitigation, it remains moderately-negative. The nett-rating for the decommissioning phase is low to moderately-negative.

- Lifestyle
 - Related activities associated with lifestyle impacts an influx of – especially young people; increased trucking traffic; an increase in disposable income.
 - Although positive impacts may also result from increased income, negative impacts include an increased potential for increased substance abuse; sexually transmitted diseases (putting additional strain on the health system); and unhealthy lifestyles resulting in an increase in non-communicable diseases.
 - The overall nett-rating for the construction phase is moderately-negative before mitigation and low-negative after mitigation. For the operational phase it is moderately-negative before mitigation and although the rating is lower after mitigation, it remains moderately-negative. The nett-rating for the decommissioning phase is low-negative.
- Physical infrastructure
 - Related activities include again the influx of people, increased traffic loads,.
 - Associated impacts on the physical infrastructure include road deterioration, additional burden on the housing, school, water, sanitation, and electricity infrastructure which already experiences a backlog.
 - The nett-impact rating for this Environmental Health Area is high to moderately-negative before mitigation and after mitigation, moderate to low-negative for construction, and moderate negative for the operational and decommissioning phases.
- Health Management and Infrastructure
 - The main activity of concern again relates to the influx of people, especially those without medical aid. The reliance of the health infrastructure on mobile clinics, combined with an understaffed district hospital will increase the burden on clinics.
 - The nett-impact rating on health services, infrastructure and capacity before mitigation is moderately-negative during both the construction and operational phases. After mitigation the impact decreases to low-negative during construction but remains moderately-negative during the operational phase.
- Food and nutrition
 - Related activities of include the influx of people which will result in an increased demand for food. Unhygienic food practices will increase food-borne illnesses with diarrhoeal disease already being the main cause of death amongst those below 15 years of age. Increased disposable income may contribute to reducing food security and malnutrition but (specifically during the operational phase) for the unskilled and unemployed, food security may increase.

- The nett impact rating before mitigation for each of the phases is moderately-negative and low-negative after mitigation for the construction and decommissioning phases. For the operational phase the net-rating remains moderately-negative after mitigation. There is also a possible moderate positive impact in the affordability of food during the operational phase.
- Environmental pollution
 - Activities during all three phases will result in the emissions of particulate matter (dust). Although modelled concentrations were only predicted to exceed the standards on site, it must be kept in mind that there are people residing within the site boundaries near the haul road (RES, 2016) and it must be kept in mind that air pollution has no boundaries and small particles may travel far. Mitigation measures are therefore required.
 - Indoor air pollution levels are not currently known. If more people enter the area, informal housing and thus the use of domestic fuels for cooking and heating, are likely to increase.
 - Noise levels will be affected to various extents during the three phases. Noise, especially during blasting, during the construction and operation phase in the southern section of the Tubatse mining village may warrant the need for noise barriers.
 - Water-related activities include dewatering due to groundwater inflow into the open mine pit, which is not foreseen when the Klarinet and Tubatse koppies will be mined, but when the Spitskop flats are mined, inflow of groundwater is predicted.
 - The nett-impact for environmental pollution during construction is moderate-negative before and low-negative after mitigation. During the operational phase the nett-impact is moderately-negative (domestic and operational activities) to high-negative (vehicle emissions and noise). The nett-impact for the decommissioning phase is moderate-negative before mitigation and low-negative after mitigation

2 BACKGROUND

2.1 INTRODUCTION

South Africa produces more than 50% of the world's chromite (BCR Mining Right Application). The chromite resources in South Africa are situated within the Bushveld Complex which extends 400 km from east to west and the same distance north to south (BCR Working Plan) and which includes the Greater Tubatse Local Municipality (GTLM) in the Sekhukhune District Municipality (DM) within the Limpopo province (Figure 1).

BCR Minerals (Pty) Ltd is in the process of developing a chrome mine in the GTLM on portions 24, 25, 26 and 28 of the farm Spitskop (about 1600 hectares) and portions 8 and 22 of the farm Kennedy's Vale (about 600 hectares). The registered owners of the land are the Dithamaga Trust (Portions of Spitskop) and Rhodium Reefs, a mining company (BCR Working Plan).

The site of this proposed mine (Spitsvale) is about 17 km south-west of the town of Steelpoort (BCR Mining Right Application) (Figure 2).

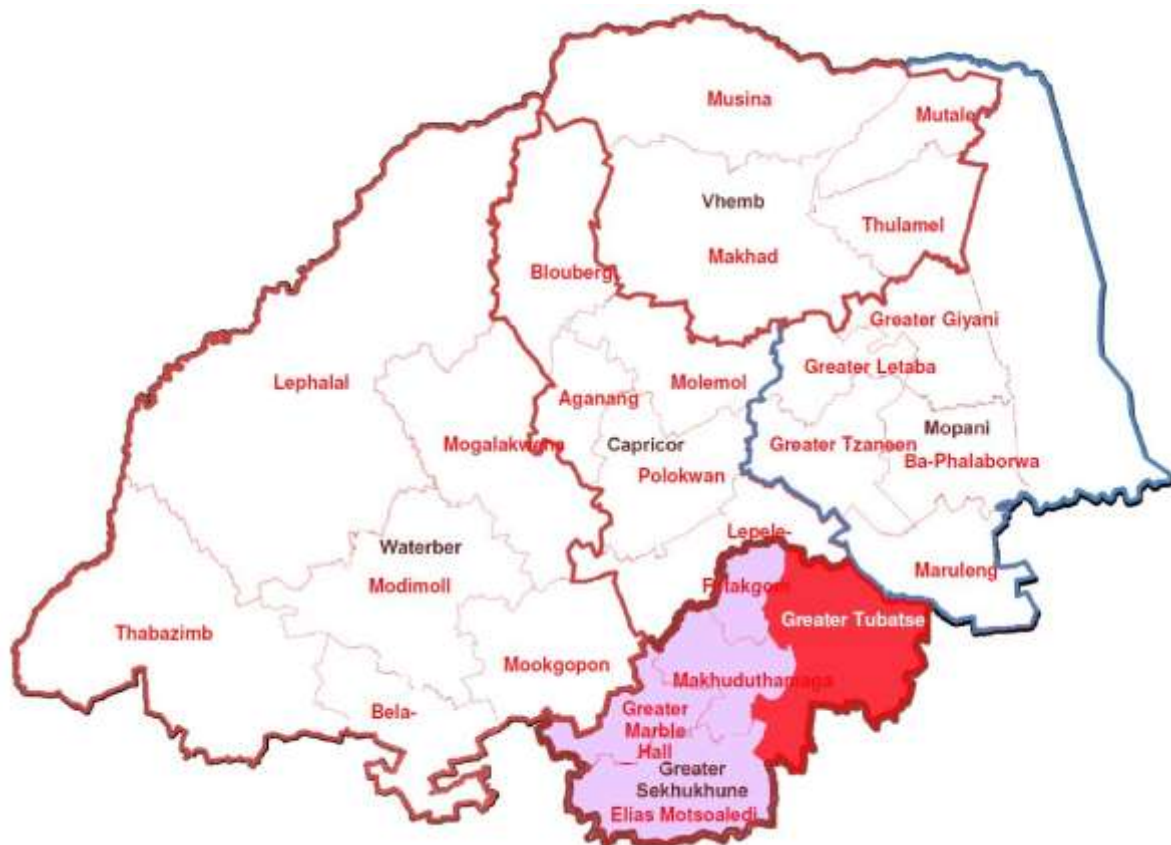


Figure 1. Limpopo Province, showing the Sekhukhune DM and Tubatse LM (red) (GTLM IDP 2014/15).

The residential areas closest to the mine are also depicted in Figure 2. The areas that were identified around the site that can be impacted by mine activities on site are:

Ga Mpuru sub-place
 Motate sub-place
 Ga Mampuru sub-place
 Tsakane sub-place
 Mahlagari sub-place
 Dithamaga Trust sub-place
 Havercroft mine
 Greater Tubatse non-urban area
 Anglo Platinum Twickenum mine
 Dilakong chrome mine
 Montrose mine
 Maandagshoek mine
 ECM Winterveld mine
 Eastern chrome mine 2
 Mapodi sub-place
 Ga Phasha sub-place

The Tubatse mine residential area, consists of Vuurpyl, Assegaai and Albezia (bordering the north-eastern fence line of the proposed development). It must be noted from the outset that no 2011 census data could be found for this residential area.

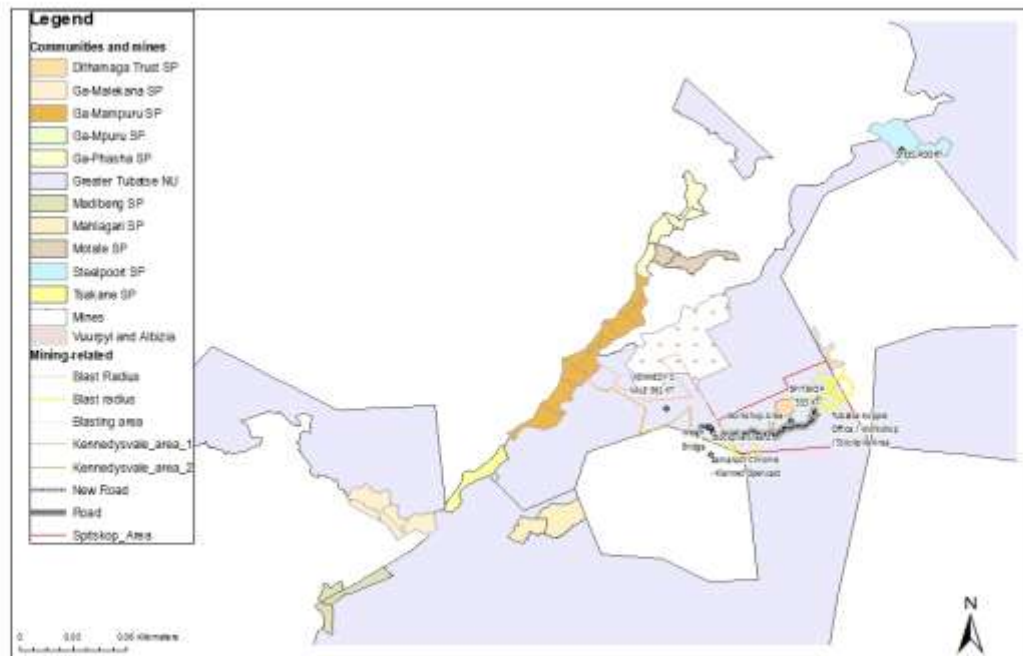


Figure 2. Site and surrounding residential areas of the appropriate mine.

An Environmental Impact Assessment (EIA) for the proposed Spitsvale mine is legally required and Environmental Management Assistance (PTY) Ltd, on behalf of BCR Minerals (PTY) Ltd, contracted the CSIR to conduct the Human Health Impact Assessment specialist study as part of the EIA.

This report presents the status quo (baseline) regarding aspects of human health of the communities of concern, and the possible impacts of the proposed Spitsvale mine on these aspects.

Where data for the specific communities of concern were not available, data applicable to the Greater Tubatse Local Municipality (GTLM) were used and if that could not be found, District Municipality data or provincial data were used. In some instances only national data could be obtained.

2.2 SCOPE OF PROJECT

The scope for the Human Health Impact Assessment is as follows:

The HHIA will evaluate the different types of evidence from the various specialist studies pertaining to this project, as well as from other readily available information, in order to assess the possible health impacts associated with the proposed development on the communities of concern. The combined effects of the issues or determinants of health and well-being identified in the specialist studies will form the basis for the HHIA. The project will adhere to the relevant provisions contained in the Equator Principles, the International Finance Corporation (IFC)'s Performance Standards.

2.2.1 Assumptions

- This assessment will be based on existing data sources and information supplied by the other specialist studies. Only readily available data will be considered for the assessment; that is, information which is accessible in electronic format, or else easily accessible.
- Major gaps in information will be identified.
- Occupational health and safety risks are excluded from this study.

2.3 METHODOLOGY

This Human Health Impact Assessment study evaluates the different types of evidence from the various specialist studies, as well as other readily available information, in order to assess the health impacts associated with the Spitsvale project on the population of concern. In so doing, the project aimed to adhere to the relevant provisions contained in the Equator Principles (IFC, 2006). These provisions had been derived from the principles themselves and the International

Finance Corporation (IFC)'s Performance Standards and Environmental Health and Safety (EHS) Guidelines.

Human Health Impact Assessment is a practical, multi-disciplinary process, combining a range of qualitative and quantitative evidence in a decision-making framework (Lock, 2000). The International Council of Mining and Metals (ICMM) indicated that HHIA's 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).

An HHIA generates recommendations to be used by decision-makers and stakeholders, with the purpose of maximizing a proposed development's positive health effects and minimizing a proposed development's negative health effects (WHO, 2011). The over-riding objective of an HHIA is therefore to maximise health gain and reduce health inequalities (Parry and Kemm, 2005).

The main steps in the HHIA as required by the IFC are indicated in Figure 3 (IFC, 2009).



Figure 3. The main steps in a Health Impact Assessment. (IFC, 2009).

The first steps in the HHIA process involve screening and scoping. In this process the area of concern is described as well as potential impacts to be assessed in the EIA. Scoping is followed by determining the status quo of human health in the proposed area where development is planned.

For the baseline assessment, the HHIA considered quantitative (where data and benchmarks were available) and/or qualitative evidence (such as opinions and expectations of affected people and other health determinants) where such information was readily available or could be easily acquired. The health determinants were compared to that of other areas and other levels to provide an indication of the potential health impacts of the proposed development on these communities.

Health impacts were then analysed systematically in a risk assessment to determine the range of potential impacts, their relative importance and where, when and how likely they were to occur.

A Health Action Plan, based on identified risks, their public health significance, and priorities determined by the community was finally developed to provide inputs to the mitigation strategy of the company. Identification of potential mitigation options was based on analysis of the significance of the potential health impacts. Indicators for monitoring and evaluation were recommended as part of this step. An important criterion for key performance indicators includes the availability of data to optimise monitoring and evaluation.

3 PROJECT DESCRIPTION

The proposed Spitsvale chrome mine will be developed in a mountainous area of the Greater Tubatse Local Municipality (GTLM). The area has a rural nature and consists mostly of scattered villages with Steelpoort about 17 km north-east, as the closest town and growth point. This area experiences summer rainfall with an average between 550 and 650 mm per annum. The evaporation is 1692 mm (Highlands Hydro, 2015). The prevailing wind is from the north east (RES, 2016)

It is envisioned that there will be three mining areas namely, Klarinet koppie, Spitskop flats and Tubutse koppie and that these areas will be mined separately from Klarinet to Tubatse over the life span (30 to 35 years) of the mine (RES, 2016). Ore mined (predicted to be 360 000 tonnes per annum (tpa)) will be excavated after drilling and blasting, then screened, using a mobile screener, transported to the on-site storing area where it will be stored until transported off-site by articulated trucks. It is envisioned that 1000 tonnes will be removed per day, which means between 30 and 40 truck-loads a day (ITS, 2015). Ore will be transported from the site to Maputo, about 480 km away.

Access to the proposed site will be from the existing access road from the D1261. The D1261 links the R555 and the R557 (ITS, 2015). Structures on site will be workshops, mobile administration offices, lighting of stockpile area and a Weigh Bridge (ITS, 2015)

Water needed at the mine for example for dust suppression and domestic use will be abstracted from bore holes and the Steelpoort River, a perennial river.

Electricity needed for activities at the mine will be generated using diesel generators.

There will not be a sewage plant on site. Alternatives to a septic tank are being investigated.

It is envisioned that about 80% of the workers (mainly unskilled and semi-skilled) will make use of public transport to and from the mine during all phases of the project, while the other 20% will use privately owned cars (ITS, 2015).

4 LEGAL AND REGULATORY REQUIREMENTS

4.1 MAIN ACTS RELEVANT TO ENVIRONMENTAL HEALTH

The Acts and Regulations that may have an impact on health, and environmental health in particular, are indicated in Table 1.

Table 1. Acts relevant to health and environmental health.

ACTS	RELEVANCE TO HHIA
CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA (ACT NUMBER 108 OF 1996)	The South African constitution states, "Everyone has the right: to an environment that is not harmful to their health or well- being (RSA, 1996)
NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT (ACT. 39 OF 2004)	Represents a distinct shift from exclusively source-based air pollution control to holistic and integrated effects-based air quality management. It focuses on the adverse impacts of air pollution on the ambient environment and sets health-based ambient standards to control ambient air pollution levels. At the same time it sets emission standards to minimise the amount of pollution that enters the environment (DoH, 2010).
NATIONAL ENVIRONMENTAL HEALTH POLICY	This policy document is intended as a 'broad guideline for the effective implementation and rendering of Environmental Health Services in South Africa'. It incorporates the philosophy of Environmental Health includes principles such as primary prevention, transparency, polluter pays, precautionary principle and cradle to grave. (http://cer.org.za/wp-content/uploads/2014/03/national-enviro-health-policy-dec-2013.pdf)
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 in order to secure an environment that is not harmful to health and well-being (DoH, 2010). "Amendments in 2014 to the Waste Act have put the regulation of mining residue deposits and residue stock piles under the Waste Act" (Tucker 2015).
HEALTH ACT (ACT 61 OF 2003)	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

ACTS	RELEVANCE TO HHIA
	HHIA (DoH, 2010).
MINE HEALTH AND SAFETY ACT (ACT.29 OF 1996)	Hazard identification and risk assessments should be conducted by every manager for the protection of the health of persons directly affected by mine activities (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).
MINERALS AND PETROLEUM RESOURCES DEVELOPMENT ACT, ACT NO 28 OF 2002	Require the compilation of a Scoping Report (Regulation 29) (Regulation 49 of GN R527) which needs to address the existing or pre-mining environmental status; anticipated environmental, social and cultural impacts, including the cumulative effects, where applicable.
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).
OCCUPATIONAL HEALTH AND SAFETY ACT (ACT 85 OF 1993) REGULATIONS: R1248	Although Occupational Health is excluded from the HIA, because it is addressed by the OHS Act, it is important to identify occupational health hazards that may affect the health of the community (DoH, 2010).

5 THE RECEIVING ENVIRONMENT

The environmental features in the receiving environment were addressed in terms of Environmental Health Areas (EHAs) as recommended by the IFC in "Introduction to Health Impact Assessment" (IFC, 2009). These areas take a broad view of environmental health, and as a result, encompass a wide spectrum of health determinants, including social and institutional issues. These determinants may render individuals more susceptible and result in direct, indirect and/or cumulative impacts. The EHAs define the types of health impacts and provides a structure for organising and analysing potential project impacts on the community. The EHAs should also capture those social and institutional factors that are most critical for the health impact analysis, for example, the "health services infrastructure and capacity" (IFC, 2009).

An EHA framework has been used as guide for defining potential health impacts associated with the different activities and phases of the project and to provide a structure for organising and analysing potential project impacts on the communities of concern (IFC, 2009). These EHAs, together with the related aspects of vulnerability are indicated in Table 2.

Table 2. Environmental Health Areas and potential project issues associated with exposure.

ENVIRONMENTAL HEALTH AREA (EHA)	EXAMPLES OF ISSUES POTENTIALLY RELEVANT TO THE PROJECT THAT MAY RESULT IN EXPOSURE
SOCIAL DETERMINANTS OF HEALTH	Population characteristics: age, gender, income, education, occupation and eco-social issues, changes to social cohesion
SAFETY, INCLUDING ACCIDENTS AND INJURIES, AND SECURITY AND ASSOCIATED IMPACTS	Road-traffic related, spills and releases, construction (home- and project-related) and drowning Gender issues, social class, race or ethnicity, security concerns, substance misuse
LIFESTYLE AND ASSOCIATED HEALTH IMPACTS	Social and health effects of drugs, alcohol abuse, physical activity levels, sexual behaviours and sexually transmitted diseases
PHYSICAL INFRASTRUCTURE, MANAGEMENT AND RELATED HEALTH IMPACTS (INCL, WATER, SANITATION, ROADS, RAILS, HOUSING)	Sewage and waste management, Impacts related to inadequate housing: overcrowding, communicable diseases, housing inflation

ENVIRONMENTAL HEALTH AREA (EHA)	EXAMPLES OF ISSUES POTENTIALLY RELEVANT TO THE PROJECT THAT MAY RESULT IN EXPOSURE
<p>HEALTH MANAGEMENT/INFRASTRUCTURE – INCLUDING PHYSICAL INFRASTRUCTURE, STAFFING; PROGRAM MANAGEMENT DELIVERY SYSTEMS; AND FUTURE DEVELOPMENT PLANS.</p> <p>TRADITIONAL KNOWLEDGE, CULTURAL HEALTH PRACTICES – INCLUDING ROLE OF TRADITIONAL MEDICAL PROVIDERS, INDIGENOUS MEDICINES</p>	<p>Availability and condition of health care facilities, personnel, health financing, mortality and morbidity (health status), traditional knowledge.</p>
<p>FOOD, NUTRITION AND ASSOCIATED HEALTH IMPACTS</p>	<p>Food inflation, changes in agricultural and subsistence hunting, fishing, and gathering practices, nutrition-related conditions</p>
<p>ENVIRONMENTAL POLLUTION, INCLUDING INDOOR AMBIENT AIR POLLUTION, SOIL, SURFACE AND GROUNDWATER POLLUTION, NOISE</p>	<p>Water access and quality, pesticides, fertilizers, road dust, air pollution (indoor and outdoor, related to vehicles, cooking, heating, or other forms of combustion or incineration), landfill refuse or incineration ash, and any other project-related release events. Related health outcomes: waterborne and airborne diseases, vector-related diseases.</p>

6 BASELINE ASSESSMENT

For the above EHAs, a baseline was determined followed by a “vulnerability rating”. Vulnerability refers to the susceptibility of an environmental feature to suffer harm or its inability to withstand the effects of a hostile environment before potential impacts are taken into account. The rating was done as follows:

VULNERABILITY RATING	CRITERIA
LOW	The environmental feature will be negligibly affected by the potential impact and has the ability to withstand negative effects without being adversely affected.
MEDIUM	The environmental feature will be moderately susceptible to suffer harm and will therefore be negatively impacted by the activity albeit not adversely.
HIGH	The environmental feature will be severely affected by the potential impact as it is highly susceptible to suffer harm and lacks the ability to withstand the negative effects of the activity.

6.1 ENVIRONMENTAL HEALTH AREA – SOCIAL DETERMINANTS OF HEALTH

A Human Health Impact Assessment includes the impact of social determinants of health, such as socio-economic factors including access to health care, employment status, etc. (WHO, 2013). There are general basic social issues that if addressed, will establish a community that functions well (Holtmann, 2010). Some of these are listed below:

- Adequate and quality educational opportunities
- Levels of crime and a sense of security
- Employment and business opportunities
- Functionality and affordability of healthcare services and facilities
- Governance and associated institutions
- Reliability and accessibility of community facilities and services

In this study the components included under Social Determinants of Health are comprised of:

Population characteristics, Education levels, Economic development, Employment status and Household income.

6.1.1 Baseline Assessment of Social Determinants of Health

6.1.1.1 Population characteristics

Where data for the specific communities of concern were not available, data applicable to the Greater Tubatse Local Municipality (GTLM) were used and if that could not be found, District Municipality data or provincial data were used. In some instances only national data could be obtained.

According to Census 2011 data as presented in StatsSA (2011a) "Local Municipality Fact Sheets", the GTLM had a population growth of 2.2% between 2001 and 2011, when it had a population of 335 676 (83 199 households), of which 52% were women and 48% were men. This data are exactly the same as the national average. The sex ratio (females/males x 100) in 2011 was 1.09, which means that for every 109 females, there were 100 males. The majority of the population (98%) in the LM are black Africans and in 56% of households the home language is Sepedi (GTLM IDP, 2015/16).

Most people in the 31 wards within the GTLM live in 180 scattered settlements in more rural areas, placing a burden on provision of services e.g. water, electricity, refuse removal etc. (GTLM IDP, 2014/15). Given the size (4550 km²) and population of the GTLM, it can be calculated that the LM has a population density of 74 /km². The Sekhukhune DM has a population density of 83/km², while Limpopo has a population density of 43/km² and Gauteng has a population density of 1500/km².

Of those communities of concern mentioned in Section 1, as the communities of concern, Ga Mampuru and the Greater Tubatse non-urban area had the largest populations, with 7500 and 6400 individuals respectively (StatsSA 2011a). The population in the other areas ranged between less than 50 (at the mines) to 3200 at Ga Phasha sub-place. In total these communities of concern, had a population of 41000 (12% of the GTLM population).

The age distribution of the communities of concern shows that, about 45% of the population are vulnerable (<15 and >60) ranging from 25% in the Greater Tubatse non-urban area to 55% in the Mapodi and Mapodi sub-place areas (StatsSA 2011a). This distribution is more or less the same as in 2011 in the GTLM, the Sekukhune DM as well as in the Limpopo province (all at 42%) (StatsSA 2011a).

The average household size in the Limpopo province as well as in the Sekukhune DM and the GTLM, is 4 people. In the communities of concern, this ranges from 3 in Maglagari and Greater Tubatse sub-place, to 5 in Ga Phasha and 6 in the Dithamaga trust.

It is known that female-headed households are more vulnerable in terms of coping, because they usually have less income than male-headed households. In South Africa, 51% of female headed households, compared to 30% of male headed households can be classified as poor (household with < R570 per capita income per month), (StatsSA, 2012). In Limpopo and in the GTLM, 50% and 47% of households respectively were headed by females in 2011, an improvement on the 57% in the GTLM in 2001 (StatsSA 2011).

In general, the communities of concern are not overcrowded. The average household size for the GTLM is 4, which is slightly higher than the national figure of 3.4. Overcrowding supports the distribution of infectious diseases. Households where more than four individuals shared a room were considered to be overcrowded in this study. The WHO considers more than 2.5 persons per room of the dwelling as being overcrowded (WHO, 2015). About 4% of the one room dwellings in the Greater Tubatse non-urban area and about 9% of the one room dwellings at the Maandagshoek mine and 2% of the two-room dwellings at Mahlagari may be considered overcrowded (StatsSA 2011a).

Dependency ratio is calculated as the number of people below 15 and above 64 years of age (those economically not active) as a percentage of the total population between 15 and 64 years of age. The dependency ratio in South Africa was 53% in 2011. This figure is lower than the GTLM dependency which was relatively high at 66% (StatsSA, 2011). Dependency ratio is calculated as the number of people below 15 and above 64 years of age (those economically **not** active) as a percentage of the total population between 15 and 64 years of age, as an indication of how many people are dependent on every one who is in the economically active age range.

6.1.1.2 Education levels

The Human Development Index (HDI), is an indication of how socio-economically developed a country is (based on factors such as life expectancy, literacy and gross domestic product per capita). The HDI was 0.63 for South Africa in 2012 (WHO, 2013a), which is lower than the global HDI of 0.68.

According to census 2011 data, 9% of South Africans above the age of 20 had no schooling in 2011, 28% had matric and 12% a higher education. At the same time in the GTLM 15% had no schooling, 23% had matric and 7% a higher education, thus the Local Municipality had a lower level of education than the country as a whole (StatsSA, 2011). The Spitsvale Social and Labour Plan (2015) stated even lower education levels for the LM. They found that only 4% of individuals above 21 years of age had matric.

6.1.1.3 Economic development

The relatively high dependency rate in the GTLM puts a burden on job creation in the area (Spitsvale Social and Labour Plan, 2015). The GTLM has a potential for economic development through mining and tourism. The current economy of the region has both the features of a formal and informal economy. On the one hand, it is characterised by mining, tourism and agricultural activities. On the other hand it is characterised by small stock farming and small businesses.

Several mining operations are located in the GTLM and mines provide 50% of jobs in the Local Municipality, followed by wholesale and retail with 16% and then community service and general government with 8% each. Agriculture provides 2% of jobs in the Local Municipality (Spitsvale Social and Labour Plan, 2015).

There is a potential to grow tourism in the GTLM, as there are underdeveloped tourist attractions, focussing on the Panorama route (GTLM IDP, 2015/16).

6.1.1.4 Employment status

The unemployment rate of South Africa in 2011 was 30% and that of Limpopo 39%, (highest of all provinces) while the unemployment rate for the GTLM was 50%. Despite this high rate, unemployment is less than the 2001 rate of 62% (StatsSA, 2011).

Considering only the economic active group (15 to 65) in the communities of concern in this study, then it is evident from census 2011 data that up to 82% were unemployed in the Dithamaga trust, 54% in Ga Mampuru, 47% in Mahlagari, 35% in Tsakane and 32% in Mapodi (StatsSA 2011a). At the Maandagshoek mine an unemployment rate of 49% was calculated. The reason is unknown (StatsSA 2011a).

6.1.1.5 Household income

Household income is generally low. According to the Spitsvale Social and Labour plan (2015), about 50% of individuals in the GTLM do not receive any form of income. From the 2011 census data it was calculated that the proportion of economically active individuals in the communities of concern without an income, ranges from 84% in the Dithamaga trust to more than 70% in Ga Mampuru, Montate, Tsekana, Ga Phasha and Mapodi sub-places and 60% in Mahlagari sub-place. It is evident that a high percentage of residents at some of the “mines” also have no income, for example 58% at the Maandagshoek mine. The reason for this discrepancy is not clear. On average about 53% of economically active individuals in the communities of concern are living below the poverty line (calculated from census data).

The sensitivities of the social determinants of health are assessed in Table 3.

Table 3. Social determinants of health related sensitivities

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Population characteristics	Individuals below 15 years and above 60 years of age more susceptible to environmental pollution. About 45% of the population in this category.	Medium	Additional mining activities will increase air pollution and thus potentially also respiratory diseases especially amongst the sensitive age groups.
Education levels	Individuals with low education levels are less able to cope with hazards, including environmental pollution. Education levels low in area.	High	Educational levels low, thus no guarantee that local individuals will be employed by the proposed mine.
Economic development	If there is no economic development in an area, people have fewer opportunities and it affects their ability to cope with hazards. Economic development strongly dependent on the mines.	Medium	An additional mine will further stimulate the economy which will be positive for the area.

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Employment status	<p>Individuals who are unemployed are less able to cope with hazards, including environmental pollution.</p> <p>Unemployment is relatively high in the area. A new mine will attract more job seekers.</p>	Medium to high	Influx of job seekers will further increase unemployment in the area.
Household income	<p>Individuals who have a low income are less able to cope with hazards.</p> <p>At least 50% of individuals in the area have no income and those with an income assumed to be low, due to low educational levels.</p>	High	The proposed mine may have a positive impact on the income of some local households if they are employed by the mine.

6.2 ENVIRONMENTAL HEALTH AREA – SAFETY AND SECURITY

In this study the components included under Safety and Security are comprised of:

Crime, Road accidents, and Injuries and Poisonings in the Home Environment.

6.2.1 Baseline Assessment of Safety and Security

The safety and security of an environment plays a role not only on physical health, but also on the psychosocial health of a community. Overcrowding and the stresses of urban life, such as unemployment, may contribute to increased substance abuse, mental illness and violent behaviour, factors that threaten the safety and psychosocial well-being of people in a community. Even indirect factors such as the state of public toilets may contribute to a safe environment (Holtmann, 2010).

6.2.1.1 Crime rates

There are five police stations and three satellite police stations within the GTM. The stations are in Burgersfort, Leboeng, Mecklenburg, Ohrigstad and Tubatse, while the satellite stations are in Penge, Driekop and Ga-Mapodile. Various types and degrees of crimes are reported at these stations such as rape, murder, armed robbery, and house breaking. Tubatse police station recorded the highest number of cases (3700) in 2013 and it was mostly business robberies. The crime rate in the Local Municipality is seen as one of the weaknesses in the GTLM that has to be addressed (GTLM IDP, 2015/16).

6.2.1.2 Road accidents

Vehicular deaths in Africa are expected to rise from 10th to 3rd place on the ladder of public health threats by 2019 (Cooke, 2009).

Speeding causes accidents and discourages walking on side-walks, leading to the impairment of quality of life. It is a problem particularly for children in socio-economically deprived areas who are especially vulnerable to accidents, as a result of a lack of open spaces for recreation (DH, 2008). Pedestrians are also vulnerable road users. In particular, the elderly are especially vulnerable to speeding incidents as they may not be able to react quickly to avoid accidents (DH, 2008).

The roadside environment (pavements, pedestrian crossings, and pedestrian lighting) has been identified as an important risk factor in pedestrian fatalities in South Africa (Albers et al., 2010). When the roadside is not in a good condition, pedestrians may be forced to walk on the roads. This is of particular concern where communities, especially informal communities, are found close to roads (Albers et al., 2010) as is the case in the area of the new development. Furthermore, poor road condition (including potholes, lack of markings and obstructions), may encourage dangerous driving behaviour which increases the risk to pedestrians (Albers et al., 2010). Roads in the area are in a fair condition (ITS, 2015).

South Africa has legislation in place on speed limits, drinking and driving, helmet use on motorcycles and seat belt use for vehicle occupants (WHO, 2015a).

In 2013 there were about 9 909 923 motor vehicles registered in South Africa (WHO, 2015a). Statistics show that between 2010 and 2011 motor vehicle accidents were responsible for 13 802 fatalities (76% men and 24% women) in the country, which relates to 25/100 000 of the population (WHO, 2015a). This fatality rate is about the same as in other African countries, but if compared to countries, such as The Netherlands or New Zealand (where it is 3.4 and 6 per 100 000 respectively), it is significantly higher. In Mexico the rate is also lower at 12.3 (WHO, 2015a). Of these fatalities, 38% were passengers, 33% pedestrians and 29% drivers (of 4-wheeled cars and light vehicles) (WHO, 2015a). Alcohol played a role in 58% of fatalities (WHO, 2015a). Although it is compulsory for drivers and passengers in South Africa to wear a seatbelt, only about one third of them do (WHO, 2015a). It must also be noted that vehicles sold in 80% of countries worldwide, fail to meet safety standards (WHO, 2015a).

Between 2011 and 2013 road injuries were responsible for 12% of deaths in children between 5 and 14 years and nearly 18% of deaths in individuals between 15 and 24 years and 5% in individuals between 25 and 64 years in the Sekhukhune DM (DHB, 2014/15). It is clear that it is mostly young, economically active people that are affected.

6.2.1.3 Injuries and poisonings in the home environment

Statistics on accidents, injuries and poisonings in the home environment for the study area were not readily available. In 2010, 4% of deaths in South Africa were due to injuries (not only those in the home environment) (WHO, 2012). A Year of Life Lost is a measure of premature mortality or living with a disability. In 2012 104 individuals per 100 000 of the population died as a result of injuries and injuries were responsible for 5017 Years of Life Lost (YLL) per 100 000 of the population (WHO, 2015b). A Year of Life Lost is a measure of premature mortality that takes into account both the frequency of deaths and the age at which death occurs. Injuries were also ranked 7th as cause of death in children younger than 5 years old (5th in the WHO African Region) (WHO, 2015b). Between 2011 and 2013, drownings were responsible for nearly 6% of deaths in children between 5 and 14 years in the Sekhukhune DM (DHB, 2014/15)

It is not known how many households in the study area use pesticides or paraffin as energy carrier. It is however, known that the use of these chemicals increases the risk of poisoning, especially among children. Between 2011 and 2013, poisonings were responsible for 2% of deaths in children below the age of 5 years in the Sekhukhune DM (DHB, 2014/15).

Table 4. Social determinants of health related sensitivities

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Crime	<p>Crime levels have an influence on the physical as well as the mental health of people.</p> <p>Crime in the study area is perceived to be relatively high.</p>	Medium	As more people move to the area as a result of mining, an increase in the crime rate is expected, especially if job seekers are not employed.
Road accidents	<p>Accidents have an influence on the physical health of people as well as on the economy.</p> <p>30% of deaths in those below 25 years of age in Sekhukhune DM are due to road accidents.</p>	Medium	More people and vehicles into the area will increase road traffic, deterioration of roads and thus increasing the risk of accidents.
Injuries and poisonings in the home environment	<p>Although statistics on accidents/poisonings in the home environment were not readily available, in SA it ranks 7th as cause of death among those <5 and in Sekhukhune DM 2% of deaths in those <5 years were due to poisonings.</p>	Medium	<p>An influx of people may cause an increase in violence and possibly xenophobia, which may cause an increase in injuries.</p> <p>More people in the area may increase the use of paraffin that may cause poisonings and fires.</p>

6.3 ENVIRONMENTAL HEALTH AREA – LIFE STYLE AND ASSOCIATED HEALTH IMPACTS

In this study the components included under Life Style and Associated Health Impacts are comprised of:

Substance abuse, Non-communicable diseases and Sexually Transmitted Illnesses (STIs).

6.3.1 Baseline Assessment of Life Style and Associated Health Impacts

6.3.1.1 Substance abuse

Substance abuse does not only cause adverse health effects but may also make individuals more susceptible to adverse health effects when exposed to environmental pollution. Moreover, addicts are often less productive and alert, which may affect their performance, also in the workplace.

Levels of substance abuse are generally higher amongst the unemployed as they become depressed and dismayed about their situation and turn to substance abuse as a way of escaping their reality.

Alcohol

In 2002, the WHO recorded an increase in alcohol consumption and prevalence of tobacco use in developing countries (WHO, 2002). At that stage, alcohol consumption had already been associated with 20 – 30% of the world's oesophageal cancers, liver diseases, epilepsy, motor vehicle accidents, homicides and other injuries (WHO, 2002).

Alcohol is the dominant substance that is abused in South Africa (Plüddemann et al., 2010). The average alcohol consumption among adults (≥ 15 years) in South Africa in 2005 was 7 l of pure alcohol per person per year, while the global median was 4.5 l (WHO, 2010). In 2010, this volume increased to 11 l while that for the WHO African region as well as the global median, was 6 l (WHO, 2015b). A study by the HSRC in 2008, found that in the general population (15 years and older) in South Africa, 41% of men and 17% of women were drinkers (SANHANES, 2013).

In a national nutrition study by the HSRC, published in 2013, it was found that 10% of households interviewed in Limpopo, perceived alcohol abuse in their households to be very serious issue and another 10% perceived it to be serious. Nationally alcohol abuse was found to be higher in urban informal areas (15% very serious and 13% serious) than in any other formal or informal areas (SANHANES, 2013). Rural formal areas reported the second highest prevalence (11% very serious and 7% serious). In rural informal areas, in which most of the study area may be classified as, it was

lower with 7% of households reported a very serious problem and 8% a serious alcohol problem (SANHANES, 2013).

According to South African Police statistics, about 80% of murders, 60% of attempted murders, 75% of rapes and 90% of all assault offenders were under the influence of alcohol when they committed the act of violence (SANHANES, 2013).

Drugs

In the Northern Region (NR) (Mpumalanga and Limpopo Provinces combined) 43% of patients attending specialist treatment centres during the second half of 2007 had alcohol as their primary drug of abuse. This percentage was higher than for the Eastern Cape, Western Cape and KwaZulu-Natal (Plüddemann et al., 2008). When compared to the figure for the second half of 2009 (38%), a 5% decrease in alcohol as the primary drug of abuse was evident in the NR, the only region that showed a decrease during this time period (2007 to 2009) (Plüddemann et al., 2010). However, the main drug of abuse in the NR was not alcohol, but cannabis (Plüddemann et al., 2008; Plüddemann et al., 2010).

Thirty-eight percent of patients in the NR attending specialist treatment centres during the second half of 2007 had cannabis as their primary drug of abuse, while 49% had cannabis as primary or secondary drug of abuse and 1% had the cannabis/Mandrax (methaqualone) combination or 'white-pipe' as their primary or secondary drug of abuse (Plüddemann et al., 2008). During the second half of 2009, cannabis as the primary drug of abuse in the NR increased to 44% of patients and cannabis as primary or secondary drug increased from 49% to 56% (both the 44% and 56% values are the highest of all treatment centres in South Africa). "White-pipe" as primary or secondary drug in the NR centres declined from 1% in 2007 to <1% in 2009 (Plüddemann et al., 2010).

For individuals below the age of 20 years admitted to any of the five treatment centres in the NR during 2007, the majority (73%) had cannabis as their primary drug of abuse, followed by alcohol (17%) (Plüddemann et al., 2008). The figures from six centres for the same period during 2009 were 62% for cannabis (11% decrease) and 18% for alcohol (1% increase) as primary drugs of abuse (Plüddemann et al., 2010). Seventy two percent of these patients were black Africans (Plüddemann et al., 2010).

Treatment admissions for Mandrax in South Africa decreased significantly from 2005 to 2007 (Plüddemann et al., 2008) and remained relatively low during 2009 (Plüddemann et al., 2010), while admissions for cocaine-related problems increased between 2005 and 2007 (Plüddemann et al., 2008) but declined in 2009 (Plüddemann et al., 2010). In the NR, 8% of admissions during the second half of 2007 were for cocaine as primary drug of abuse and 7% for heroine, while 0.4% was admitted for methamphetamine but no one for mandrax. Of those in the NR admitted for heroine, 58% were black Africans (Plüddemann et al., 2008). For the

second half of 2009, these figures changed to 4% admitted for cocaine as primary drug of abuse (thus a decrease), 11% for heroine (thus an increase) and no one for methamphetamine (a decrease) or mandrax (no change) (Plüddemann et al., 2010).

Although the prevalence of admissions for over-the-counter and prescribed medicines (overall about 5%) as well as for inhalation of solvents are nationally relatively low, these forms of drug abuse are an issue of concern in South Africa (Plüddemann et al., 2010).

Smoking

The prevalence of tobacco smoking in a country is an indication of what can be expected in the future regarding the burden of tobacco-related diseases (WHO, 2015b). In 2006, the prevalence of tobacco smoking among adults (≥ 15 years) in South Africa was 29.5% and 9.4% for men and women, respectively (global median: 33% and 9%) (WHO, 2010). In 2012, these figures were higher at 32% for men and lower at 7% for women, while the figures for the African Region were 24% for men and 2% for women and the global median was 34% for men and 9% for women (WHO, 2015b). The SANHANES study (2013) found the prevalence of ever smokers among those 15 years and older, in Limpopo, about 14% (lowest of all provinces), whereas the national prevalence was 21%.

6.3.1.2 Non-communicable diseases

A risk transition is being experienced in southern Africa (including South Africa (SANHANES, 2013)) moving towards an increase in non-communicable diseases (Cooke, 2009). Non-communicable diseases include the more chronic diseases such as diabetes, cancer and chronic respiratory diseases and cardiovascular disease. These diseases are mostly neglected in health budgets, as about 80% of the total health budget in Africa is allocated to infectious diseases. There is thus an urgent need to determine the extent of these diseases in Africa and to put systems in place to address them (Cooke, 2009).

In 2012, 711 per 100 000 deaths in South Africa were due to non-communicable diseases (18% from cardio-vascular diseases, 7% cancer, 3% chronic respiratory disease, 6% diabetes and 10% other non-communicable diseases (WHO, 2014), which was more than the median global figure of 570 per 100 000 deaths (WHO, 2015b). In South Africa 43% of deaths are due to non-communicable diseases and the probability for a South African to die between the ages of 30 and 70 years from one of the four non-communicable diseases is 27% (WHO, 2014). In the Sekhukhune DM 11% of deaths in the economically active group (25 to 64 years) were due to non-communicable diseases during the period 2011 to 2013 (DHB, 2014/15).

It is known that the prevalence of non-communicable diseases increases with increase in age (SANHANES, 2013). It is further known that physical inactivity, smoking

and alcohol abuse are among the risk factors for developing non-communicable diseases (SANHANES, 2013)

In the National Health and Nutrition Examination Study (2013), the self-reported prevalence of some non-communicable illnesses and conditions among participants (15 years and older) in Limpopo was as follows: (SANHANES, 2013).

Elevated blood pressure	7.4% (national 12%)
Heart disease	2.4% (national 1.5%)
Stroke	1.4% (national 1.7%)
High cholesterol	2.7% (national 1.9%)
High blood sugar/diabetes	2.8% (national 4.0%)

It is evident that in Limpopo the prevalence in Limpopo for these non-communicable illnesses and conditions is lower than the national prevalence, except for heart disease and high cholesterol.

The estimated YLL due to non-communicable diseases in South Africa in 2012 were 14 121 per 100 000 of the population, while the global median was 12 120 per 100 000 of the population (WHO, 2015b). When considering the top 20 factors responsible for the most YLL in the Sekhukhune DM, then the following non-communicable diseases ranked among the top 20: Cerebrovascular 6th, hypertensive heart disease 7th, diabetes 8th ischaemic heart disease 16th (DHB, 2014/15).

6.3.1.3 Sexually Transmitted diseases

Globally it is estimated that for every individual who starts HIV treatment, three to four individuals are newly infected. It is also of concern that there is an increase in resistance to antiretroviral drugs (Cooke, 2009).

Southern Africa has the highest HIV prevalence in the world (Cooke, 2009). The prevalence of HIV/AIDS in South Africa in 2009 was 11.2% (11236/100 000 people) and for the WHO African region it was 2.7% (2740/100 000 people) (WHO, 2012). In 2013 these figures increased to a prevalence of 11.9% (11888/100 000) for South Africa and remained the same 2.7% (2669/100 000) for the WHO African region (WHO, 2015b).

As far as incidence (new cases) of HIV/AIDS is concerned, 2009 recorded 773/100 000 people in South Africa and 217/100 000 for the WHO African region (WHO, 2012). The incidence of HIV/AIDS for 2013 in South Africa was 647/100 000 of the population, thus lower than during 2009 (WHO, 2015b). About 42% of those living with HIV were on antiretroviral medication in 2013 (WHO, 2015b).

A study by the HSRC determined that African females between the ages of 20 and 34 and African males between the ages of 25 and 49 years were at the highest risk of contracting HIV/AIDS. The prevalence of HIV among these groups was 32.7% and

23.7% respectively (HSRC, 2009). The study identified the risk factors for HIV infection to be the following:

- Early sexual debut
- Intergenerational sex or age mixing
- Multiple sexual partnerships
- Inconsistent and incorrect condom use

The HIV prevalence in Limpopo in 2008 was at 8.8%, the third lowest of the provinces. It was at the time also lower than the national figure of 10.9% (HSRC, 2009). The prevalence of HIV among children (2 to 14 years) in Limpopo decreased from 4.7% to 2.5% between 2005 and 2008, while the prevalence in the age group 15 to 24 years decreased from 7.4 to 3.9% during the same period. However, in the group older than 25 years, the prevalence in Limpopo increased from 11.4 to 16.7% between 2005 and 2008. For individuals between 15 and 49 years, the increase in the prevalence was from 11.0% to 13.7% (HSRC, 2009).

HIV/AIDS ranked number one in the top 20 factors responsible for the most Years of Life Lost (YLL) in the Sekhukhune DM (DHB, 2014/15). The prevalence of HIV/AIDS is seen as a threat in the GTLM (GTLM IDP, 2015/16).

Other Sexually Transmitted Illnesses (STI)

In 2010/11 the incidence of STI's in Sekhukhune DM was at 2.4% well below the national incidence of nearly 4%. It was also the lowest in the Limpopo Province (DHB, 2010/11).

The exact rates for the study area are not known. However, comparison to a study in a coal mining community in Mpumalanga showed that, in 2001, the prevalence of SDIs was the following (Hurkchand *et al.*, 2005):

- infection rate of *Chlamidia trachomatis* 7.90% and 12.86% for males and females, respectively;
- infection rate of *Neisseria gonorrhoea* 3.79% and 9.86% for males and females, respectively.

These results corresponded with the prevalence of the same diseases found in another study in 2000 in a gold mining area (Carletonville) in South Africa. In the Carletonville study the prevalence of chlamydia was 6.7% and the prevalence of gonorrhoea 8.1% (Hurkchand *et al.*, 2005).

Table 5. Lifestyle and associated health- related sensitivities

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Substance abuse	Alcohol use is a problem in South Africa. Alcohol use associated with violence, crimes and accidents.	Medium to High	An influx of people will increase the substance abuse problem with associated violence and injuries.
Non-communicable diseases	Non-communicable diseases are on the increase in SA. Statistics for the study area were not readily available, but for Limpopo showed slightly lower prevalence than national.	Medium	Influx of job seekers may increase the prevalence of risk factors for non-communicable diseases such as substance abuse (especially tobacco and alcohol).
Sexually transmitted diseases	Although statistics on the prevalence of sexually transmitted illnesses in the study area were not readily available, HIV relatively high in certain age groups. Incidence of STIs other than HIV in the DM is lower than provincial and national.	Medium	More people into the area will increase the risk for sexually transmitted illnesses; also if people earn salaries, they are in a position to pay for sex.

6.4 ENVIRONMENTAL HEALTH AREA – PHYSICAL INFRASTRUCTURES

In this study the components included under Physical Infrastructure, comprise of: Transport infrastructure, Housing access and condition, Water and sanitation (including solid waste) and Energy carriers.

6.4.1 Baseline Assessment of Physical Infrastructure

6.4.1.1 Transport Infrastructure

Increasing economic activities in an area may lead to rapid degrading of roads. It is envisaged that during construction at the mine, transportation of construction workers and the transportation of building materials will be needed. Materials like steel, cement and bricks will most probably have to be imported from various sources located outside of the study area.

During the operational phase the impact on the road infrastructure will be dependent on the routes and quantity of product that has to be transported by road. Workers will also have to be transported to and from the mine. During the decommissioning stage it is envisaged that traffic will decrease, but workers and equipment will most probably be transported to and from the site especially for rehabilitation of the site.

The main road (R555), like the other roads in the area, runs in valleys due to the mountainous topography. Settlements develop along these roads (GTLM IDP, 2015/16). The existing roads in the study area (R555, R557 and D1261) are paved with gravel sides and in a fair condition (ITS, 2015)). Roads in the villages are mainly gravel roads (GTLM IDP, 2015/16). The existing access road to the existing mines, off the D1261, will be used to access the new development (ITS, 2015).

The D1261 links the R555 and the R557 and provides access to the mines (ITS, 2015). The R555 (Steelpoort to Middelburg) carries 1000 vehicles per hour (vph) in peak time and the R557 (Steelpoort to Lydenburg) carries 1146 vph at peak times. Peak hours are from 06:00 to 07:00 in the mornings and from 15:15 to 16:15 in the afternoon. However, the existing traffic density is considered "desirable" in terms of control delay (in seconds) per vehicle at intersections (ITS, 2015).

In the GTLM transport is mostly either by rail or road and the latter is the transport used by the public in the LM. (Social and labour plan, 2015). The vehicles in the area are mainly light motor vehicles (82%) and the rest are mainly heavy vehicles (about 18%) (ITS, 2015). The 405 taxis and buses (18 from the Great North Transport and a number of smaller private companies) transport people in the LM, while raw materials (to and from the mines) and agricultural products are also transported via road (Social and labour plan, 2015). However, many of the taxis are not roadworthy and operate without the necessary permits (Social and Labour Plan, 2015).

6.4.1.2 Housing: access and conditions

A study in Nigeria (Fakunle, 2011) found the prevalence of acute respiratory infections in children under 5 years old was influenced among others, by household size, number of bedrooms, ventilation and the population density in the area. In order to have “healthy housing” it is assumed that the following elements are adequately addressed: shelter, water supply, sanitation, solid waste, overcrowding, indoor air pollution, food safety, vectors of disease, as well as aspects related to transport, and shopping facilities (WHO 1997).

A lack of any of these factors may result in “inadequate housing”, marked by among others, overcrowding (common in low socio-economic areas). Such conditions become fertile ground for spreading of disease, home accidents, spreading of fire, social tension and stress (DH, 2008).

In the GTLM, there is a housing backlog (especially of RDP houses) in most of the villages (GTLM IDP, 2015/16). About 83% of houses in the LM were considered formal in 2011, 54% were owned by the household and the average household size was 4 individuals (StatsSA, 2011). In the study area, Mahlagari had the highest percentage (53%) of informal houses, followed by the Dithamaga trust with 28% and the Greater Tubatse non-urban area with 25%. At the Twickenham mine 38% (7) of the 18 dwellings can be classified as informal (StatsSA 2011a).

As mentioned in Section 6.1.1.1, the communities are in general not overcrowded, although about 4% of the one room dwellings in the Greater Tubatse non-urban area may be considered overcrowded (>4 people/room) and about 9% of the one room dwellings at the Maandagshoek mine and 2% of the two-room dwellings at Mahlagari may also be considered overcrowded (StatsSA 2011a).

Burgersfort, the capital of the GTLM, is fast growing and a number of housing projects are planned there, which triggered business development as well as the development of informal settlements, resulting in a lack of schools. The population of Steelpoort (closest town to the study site) also increased by about 16% between 2010 and 2015 (IDP 2015/16). There is thus a huge need for service delivery and housing.

Provincially, 92% of learners in Limpopo and 82% in the Eastern Cape attended no-fee schools in 2014, compared to 41% of learners in the Western Cape and 45% of learners in Gauteng (StatsSA 2015).

There are 161 primary and 88 secondary schools with 114 723 learners and 3689 Educators (on average 31 learners per educator) in GTLM. In general there are more primary schools in the more rural areas, because many leave school before going to secondary school. Those who want to study further then attend schools in larger towns in or outside the LM (GTLM IDP 2015/16). A number of the schools are in a dilapidated condition and some others have a shortage of class rooms (IDP 2015/16).

6.4.1.2.1 Service delivery

There is a large backlog in service delivery (electricity, water, sanitation) affecting about 20% of households in the GTLM (GTLM IDP, 2015/16). The main reasons for the backlog are unplanned settlements, scattered villages over a large area, lack of infrastructure and the condition of existing infrastructure (GTLM IDP, 2015/16).

Water and sanitation

Infectious diseases may be reduced through measures such as infection control, but these measures often rely on basic standards of hygiene, including the provision of safe drinking water.

It is envisaged that by 2020 76 to 100 mega litre water per day will be necessary to satisfy the demand for mining (GTLM IDP, 2014/15). The GTLM experiences a 20 - 25% backlog in the delivery of services (water, sanitation, electricity) to the areas in the LM (GTLM IDP, 2015/16), indicating a need to increase the capacity at all water purification plants (Burgersfort, Steelpoort, Praktiseer and Penge) (GTLM IDP, 2014/15).

Surface and ground water

Access to piped water inside the house or yard in Limpopo in 2011, was at 52% the second lowest of all provinces. The Eastern Cape was the lowest with 49% (StatsSA 2012a). In the GTLM, about 10% of households had piped water inside the house in the same year (StatsSA, 2011). In most of the settlements along the main roads in the GTLM, water is provided through standpipes (IDP 2015/16).

The percentage of households in the communities of concern that had piped water inside the house in 2011, ranged from 0% in Dithamaga trust, 2% in Tsakane, 5% in Ga Mpuru, 12% at Maandagshoek mine (other mines had 100%), to 29% in Ga Phasha sub-place, 66% in the Greater Tubatse non-urban region, 72% in Mahlagari sub-place to between 90 and 100% at Motate and Mapodi sub-places (StatsSA 2011a).

Most households had water within 200 m. The worst off was Ga Phasha and Ga Mpuru that both had about 30% of households further than 200 m from the nearest water source (StatsSA 2011a). More than 80% of households in Ga Mpuru and Tskane indicated that they were using surface water for domestic use (StatsSA 2011a). It is not sure where this water is abstracted from.

The hydrological baseline study on surface water in the area reported on water quality from a dam close to the site as of "marginal quality-conditionally acceptable" and that of the Steelpoort River as of "poor quality, unsuitable for use without treatment", mainly based on turbidity (Hylands Hydrology, 2016). Surface water on site were also sampled as part of the geohydrological study and the chemical parameters measured were mostly below the limits set by the Department of Water Affairs (DWAF) in 1996, except for total dissolved solids and turbidity (Delta h, 2016)

As the mine is expected to impact on the chemical composition of the water and not on the microbiological composition, the water quality assessment focussed on the chemicals in the water and microbiological parameters such as *E coli* were not determined.

Previous studies by the CSIR on the microbiological quality of surface water in the Sehukhune DM, showed relatively high (>2000 most probable number (MPN)/100 ml) *E coli* counts (results unpublished).

The depth of groundwater at the site range between 5m and more than 50m (at the Tubatse and Klarinet koppies) (Delta h, 2015). Borehole water quality was assessed from bore holes on and around the site, of which some supplied communities (including a school) with drinking water. In general the ground water in the area can be classified as slightly alkaline with elevated levels of Total Dissolved Solids (TDS), which exceeded the Department of Water Affairs' 1996 limits for drinking water (Delta h, 2016). Some of the boreholes serving residents showed elevated levels (above health limits) of total dissolved solids, nitrate, chloride and arsenic. Some of these levels were high enough to cause acute health effects. Of special concern is the borehole serving the formal residential area (Tubatse mine residential area) bordering the eastern fence line of the proposed mining site (Delta h, 2016). The sources of these elevated chemical pollutants are unclear but may be natural.

Sanitation

In South Africa 63% of households had access to a flush or chemical toilet in 2011, while 23% of households in Limpopo (StatsSA, 2012a) and 6% in the GTLM had access to a flush or chemical toilet (StatsSA, 2011) while most households in the villages make use of self-made pit latrines (IDP, 2015/16).

In the study area only the households at the mines had access to a flush or chemical toilet for example the Eastern Chrome mines (Winterveld and ECM2) had 100% access (StatsSA 2011a), while 79% of households at the Havercroft mine had access. Maandagshoek mine with 10% access and Twickenham with 0% were the exceptions. Access of households in the other areas of concern ranged from 0% at Ga Mpuru and Dithamaga trust, between 1% and 3% at most of the other areas to 38% at the Greater Tubatse non-urban area and 50% at Mapodi (StatsSA 2011a). There were however, also a number of households (in some areas as much as 25%) without access to a toilet. In Ga Mpuru, Dithamaga trust and Mapodi about a quarter of households had no access to a toilet (StatsSA 2011a). From previous community studies done by the CSIR, it became clear that when a household do not have access to a toilet, they tend to relieve themselves in the veld, which may cause water and soil pollution and spread diseases. It was also mentioned in the final version of the GTLM IDP (2014/15) that the lack of sewage systems in the villages, leads to pollution of the rivers.

Waste

The 2011 census data indicated that Limpopo province with 22% of national households, had the lowest access to refuse removal of all provinces (StatsSA, 2012a). In the GTLM, 8% of households had access to weekly refuse removal in 2011 (StatsSA, 2011). The fact that most households are in scattered villages, puts a burden on service delivery.

In the communities of concern in the study area, Tsakane sub-place had more than 90% of households without access to refuse removal in 2011. Second highest was 30% at Ga Mpuru, Ga Mampuru and Ga Phasha (StatsSA 2011a). From previous studies done by the CSIR, it was evident that when households do not have access to regular refuse removal, they tend to dump it anywhere or burn it (data unpublished). Both these practices cause environmental pollution (water, soil and air).

In 2011, a tender was put out for the management of solid waste in the GTLM (TENDER NUMBER: GTM/V11/08/09). In that tender document it was stated that rural communities generated about 5 tonnes of waste per day, villages about 180 tonnes and informal settlements about 60 tonnes per day, while mines within the LM generated about 120 tonnes per day of general and domestic waste. Of the 725 tonnes of waste generated per day, 93% could not be accounted for in the Municipality's disposal system.

6.4.1.3 Energy carriers

In 2011, 87% of households in Limpopo used electricity for lighting, which indicates that at least 87% of households had access to electricity. However, only about 50% of households used electricity for cooking at the time, which was the lowest of all the provinces (StatsSA 2012a). This means that half of households in Limpopo used domestic fuel, which contributes to indoor and outdoor air pollution. In the same year (2011), 76% of households in the GTLM used electricity for lighting, indicating that 76% of households in this LM had access to electricity (StatsSA, 2011). In the study area, between 14% (Havercroft mine) and 96% (Dithamaga trust) of households did not use electricity for cooking or heating in 2011 (StatsSA 2011a), which is an indication of the proportion of households that may use domestic fuel.

Communities of concern identified to be amongst the most vulnerable, also to environmental pollution, were Ga Mampuru, Greater Tubatse non-urban and Ga Phasha sub-place.

Table 6. Physical Infrastructure health-related sensitivities

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Transport Infrastructure	Roads in fair condition but will have have to be upgraded to accommodate development.	Medium	Increase in traffic, especially heavy vehicles may deteriorate roads, contributing to accidents.
Housing and related Infrastructure	Existing housing backlog. Mainly primary schools only, of which a number are in a poor condition	High	People coming into the area due to development will increase demand for housing and schools. This may lead to an increase in unplanned settlements, informal houses and overcrowding.
Water and sanitation	There is a service delivery backlog and a need to increase capacity. Many households use surface and bore-hole water, of which the quality poses health risks. In some areas of concern 25% of households have no access to a toilet. Some areas up to 90% households no access to refuse removal	High	More people into the area will increase backlog as well as increasing the burden on service delivery, which will increase the backlog.
Energy carriers	Most households in the study area do not have access to electricity.	Medium	Mines have a high demand for energy. More people into the area will also increase energy demand.

6.5 ENVIRONMENTAL HEALTH AREA – HEALTH MANAGEMENT AND INFRASTRUCTURE

Access to health care provides a coping mechanism to vulnerable people. In this study the components included under Health management and Infrastructure, comprised of: Health infrastructure, Health workforce, Health financing and Health status.

6.5.1 Baseline Assessment of Health Management and Infrastructure

6.5.1.1 Health infrastructure

There are 0.7 hospitals and 22.7 psychiatric beds in South Africa for every 100 000 of the population, while the global median is 1.1 hospitals and 5.9 psychiatric beds and the figures for the WHO African region are 0.8 and 3.4 respectively (WHO, 2015b). South Africa is thus better off as far as psychiatric beds are concerned but not hospitals. When considering the population of 335676 in the LM and the four hospitals, then it can be calculated that there are 1.1 hospitals per 100 000 of the population, thus the same as the global median.

There are 11 medical facilities in the GTLM (mainly regional clinics), while mobile clinics are also in use. The Dilokong Hospital is the biggest hospital in the LM followed by Mecklenburg, HC Boshoff and Penge health centre. The clinics in Steelpoort, Ohrigstad and Burgersfort offer improved services, although specialist treatment is not available within the LM. Some of the scattered villages only have access to a mobile clinic once a week, while some are relatively far from a hospital and roads are not always accessible (GTLM IDP, 2015/16).

The four hospitals in the Greater Tubatse Local Municipality have a total of 376 beds (Tubatse Empowerment project, 2007), which relates to 1.1 beds per 1000 of the population in the LM. The Dilokong hospital, about 23 km (on Google maps) from the proposed development, is understaffed and often has a shortage of medication (GTLM IDP, 2015/16).

Bed utilisation rate is an indication of efficiency, as a low bed utilisation rate (significantly below 75%) is an indication that resources are wasted on empty beds (SAHR, 2014/15). In 2015/16 the bed utilisation rate (an indication of the efficiency) of district hospitals in Limpopo was at 69%, the third highest of the provinces and higher than the average of 66% for South Africa. The Sekhukhune DM however, was at 63%, below the national average (DHB, 14/15). The average stay in a hospital in the Sekhukhune DM is about four days (DHB, 2014/15).

6.5.1.2 Health workforce

Data for South Africa and the WHO African Region show that between 2007 and 2013, the health workforce per 10 000 of the population, was low, although better than in the WHO African Region. Distribution was as follows (WHO, 2015b):

Physicians	7.8 (SA)	2.1 (African Region)
Nurses & midwives	51.1 (SA)	12.4 (African Region)
Dentistry personnel	2.0 (SA)	0.5 (African Region)
Pharmaceutical	4.1 (SA)	0.8 (African Region)
Psychiatrists	<0.05 (SA)	<0.05 (African Region)

Furthermore the data show that 94% of births in South Africa were attended by skilled health personnel between 2007 and 2014, while the average for the WHO African Region was 51% (WHO, 2015b).

In the Sekhukhune DM, visits by a supervisor to a clinic (which is an indication of the quality of health care at a clinic) in 2014 was more than 80% (DHB, 2014/15). Dilokong hospital is considered to be understaffed (GTLM IDP, 2015/16).

6.5.1.3 Health financing

In general, an increase in the per capita total health expenditure is expected to improve life expectancy (WHO, 2010). The **total** governmental expenditure on health (per capita) in South Africa is R 1247, with Limpopo the highest of the provinces, at R 1667, while the amount for Sekhukhune DM was R 1407, thus also higher than the national average (DHB, 2015/16).

In South Africa about 18% of the population (24% of households) are covered by a medical aid, but in Limpopo this is only 8.9% (StatsSA, 2015). The expenditure per capita for that portion of the population that do **not** belong to a medical aid (uninsured) is on average R 897 for South Africa, R 756 for Limpopo (second lowest of all the provinces) and R 651 for the Sekhukhune DM (third lowest of all DMs in SA) (DHB, 2014/15).

The South African government spends about 13% of its total expenditure on health, while the global median is 11.6% and for the WHO African region it is 11.4% (WHO, 2015b).

6.5.1.4 Health status

Immunisation

In 2013 66% of children age one in South Africa, had been immunised against measles and 65% against diphtheria, tetanus and pertussis (DTP). For the WHO

African Region, 74% had been immunised against measles and 75% against DTP, while the global median for the same year was 80% in both cases (WHO, 2015b).

In 2014 76% of children age one, in the Sekhukhune DM had been immunised while 83% had their second measles immunisation (DHB, 2014/15), and thus better than the national and WHO African region figures.

Mortality and Morbidity

Life expectancy and mortality rates at birth are good indicators of population health (WHO, 2010). Although Africa has only 13% of the world's population, it carries 24% of the world's burden of disease (Cooke, 2009).

Mortality

Life expectancy at birth in 2013 was 60 (which mean when a baby is born, that baby is expected to live to at least the age of 60 years) for South Africa, which was better than the 58 for the WHO African Region (WHO, 2015b). The infant mortality rate (probability of dying before age 1 per 1000 live births) in South Africa was 32.8 in 2013, while the under-5 mortality rate (probability of dying before age 5 per 1000 live births) was 43.9. These rates, which are a good indication of the health status of a country, were higher (worse) than the global median infant mortality rate of 15.3 and under-5 mortality rate of 17.7 (WHO, 2015b) The figures for the WHO African Region for 2013 were however much higher at 59.9 and 90.1 respectively (WHO, 2015b).

Between 2011 and 2013, the main cause of death in Sekhukhune DM in children below the age of 5 years, was diarrhoeal diseases (30%), followed by lower respiratory infections (25%). Preterm complications, malnutrition and HIV/AIDS each contributed 6% (DHB, 2014/15)

Similarly the main cause of death in the DM among the age group 5 to 14 years was diarrhoeal diseases (24%), followed by lower respiratory infections (22%). This was followed by road injuries (12%), HIV/AIDS (8%), TB (7%) and drownings (6%) (DHB, 2014/15).

During the same time period (2011 to 2013) the main causes of mortality in those 15 to 24 years in the Sekhukhune DM, were road injuries (18%), lower respiratory infections (17%), HIV/AIDS (12%), diarrhoeal diseases (9%) and TB (8%) (DHB, 2014/15).

In the age group 25 to 64 years, HIV/AIDS became the number one cause of death (20%), followed by lower respiratory infections (18%), TB (13%), diarrhoeal diseases (8%) and road injuries (5%) (DHB, 2014/15).

Those 65 and above mostly died of lower respiratory infections (21%), followed by the non-communicable diseases: cerebrovascular (17%), hypertensive heart disease

(14%) and diabetes (6%), while diarrhoeal diseases were responsible for 8% of deaths (DHB, 2014/15).

It is thus evident that infectious diseases are playing a major role as the cause of mortality in the Sekhukhune DM. However, in those dying at an older age, non-communicable diseases become important contributors.

Morbidity

In South Africa the main causes of Years of Life Lost (YLL) in 2012 were communicable disease (62%), non-communicable diseases (28%) and injuries (10%). There was a 2% decrease in YLL due to communicable diseases and an increase of 2% in YLL due to non-communicable diseases since 2000 (WHO, 2013b).

TB

The global incidence of TB was 126 per 100 000 people and the global prevalence 159 per 100 000 people in 2013 (WHO, 2015b). The figures for the WHO African region for the same year were 280 (incidence per 100 000 people) and 300 (prevalence per 100 000 people). In South Africa the figures were significantly higher at an incidence of 860/100 000 and a prevalence of 715 per 100 000 people (WHO, 2015b).

The incidence rate of TB in the Sekhukhune DM was 264 per 100 000 of the population in 2014 (DHB, 2014/15), which is lower than the national incidence but higher than the global incidence. The treatment success rate in 2013 in the DM was 56% and the death rate 12% (DHB, 2014/15). TB is one of the five main causes of mortality among the economic active group in the Sekhukhune DM and TB ranked 4th in the top 20 factors responsible for the most YLL in the Sekhukhune DM (DHB, 2014/15).

Diarrhoea

Between 2007 and 2014, it was found that the global median for children below 5 years who had diarrhoea that needed rehydration, was 59% (WHO, 2015b), which is an indication of the severity of the cases. No data for South Africa were available for the same time period, but for the WHO African region, it was 49% (WHO, 2015b).

In 2013 about 7% of deaths among children below the age of 5 years in South Africa were due to diarrhoea. For the African region this was 10% and the global median was 4% (WHO, 2015b). As mentioned under mortality, the main cause of death (between 2011 and 2013), in Sekhukhune DM in children below the age of 5 years, was diarrhoeal diseases (30%) and diarrhoeal disease ranked 3rd in the top 20 factors responsible for YLL in this DM (DHB, 2014/15).

Other infectious diseases

In 2012 South Africa recorded 32 cases of measles, 6846 malaria, 15 leprosy, 2298 rubella and 323664 TB, while there were no data on cholera, diphtheria, meningitis, mumps, pertussis, polio, or yellow fever (WHO, 2014a).

Respiratory diseases

In 2013 16% of the deaths in children below 5 years of age in South Africa were due to acute respiratory infections, which were the same as that for the WHO African region, while the global median was lower at 12% (WHO, 2015b).

In the 2014 South African Household Survey, 53 000 individuals in Limpopo were found to have been diagnosed with asthma, which was the third lowest of all provinces in the country (StatsSA, 2015).

Considering the top 20 factors responsible for the most YLL in 2013, then lower respiratory infections ranked 2nd, chronic obstructive pulmonary disease (COPD) (either emphysema, chronic bronchitis or a combination of the two) 14th and asthma 17th in the Sekhukhune DM (DHB, 2014/15).

Disability

Results showed that 4,9% of South Africans aged 5 years and older were classified as disabled in 2014, of which there were more women than men. In Limpopo this figure was slightly lower at 4.6% (StatsSA, 2015).

According to census 2011 data, those individuals who were classified as disabled in the GTLM, were as follows:

Blind	1400
Deaf	404
Speech impairment	530
Physical needs	3143
Emotional needs	1003
Multiple disabilities	725

Considering a population of 335 676 in the GTLM in 2011 and a total of 6480 disabled individuals (not including those with multiple disabilities as to not do double counting), then 1.9% of the population was disabled in 2011.

Mental health

A recent study (published in 2016) by the Harvard Chan School of Public Health and which is discussed on the School's website, found that the global burden of mental illness is grossly underestimated. It was reported as 1.7% of DALYs but this study found

it is closer to 13% of DALYs (<http://www.hsph.harvard.edu/news/hsph-in-the-news/global-burden-of-mental-illness>).

The number of psychiatrists per portion of the population serves as a proxy for mental health system capacity and is a reliable indicator of the human resources available to mental health services (WHO, 2012). In South Africa there are 22.7 psychiatric beds for every 100 000 people and <0.05 psychiatrists per 10 000 people (WHO, 2015b).

From selected literature (1998, 2008 and 2014) the 12-month prevalence of mental disorders in South Africa are as follows (DHB, 2014/15):

Anxiety disorder	8.1%
Personality disorder	6.8%
Substance use disorder	5.8%
Major depressive disorder (two surveys)	4.8, 4.9%
Alcohol use disorders	4.5%
Post-traumatic stress disorder	0.6%

The national admission rate for patients with a mental disorder in 2014/15, was at 1.2%, exactly the same as the admission rate in the Sekhukhune DM (DHB, 2014/15).

Cultural practices

There is a wealth of often untapped indigenous knowledge and resources within many communities in a country, which may, if harnessed, improve health and well-being. Not much is currently known about such practices within the study area.

Table 7. Health Management and Infrastructure health-related sensitivities

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Health infrastructure	Some villages relatively far from clinics, some roads to health facilities inaccessible. Mobile clinics available only once a week.	Medium	Influx of people, will further increase need for more health facilities, including a hospital.
Health workforce	Health worker to population ratio is low.	High	Influx of people will increase need for health workers.
Health financing	Primary health care (PHC) financing per capita in Sekhukhune 3 rd lowest of all DM.	Medium to high	Influx of people, will increase demand for governmental per capita financing on health.
Health status	Morbidity and Mortality rates TB, diarrhea in children <5 years, lower respiratory infections a concern in the area	Medium	Will be dependent on the health status of individuals entering the area.

6.6 ENVIRONMENTAL HEALTH AREA – FOOD, NUTRITION AND ASSOCIATED HEALTH IMPACTS

Access to food provides a coping mechanism to vulnerable people. In this study the component, Child Growth are comprised of: Stunting, Wasting and Underweight, which provide an indication of nutritional status.

6.6.1 Baseline Assessment of Food, Nutrition and Associated Health Impacts

Food security includes a variety of aspects such as stability of the availability of food, as well as stability of access to and utilisation of food (SAHR, 2008). Nutritional status is determined by the degree of nourishment and is an indicator of food security. Under-nourishment means consumption is continuously below minimum dietary requirements (insufficient caloric intake) and may lead to poor health, to unproductivity and to a decrease in life expectancy.

Child growth is the most widely used indicator of nutritional status and children under 5 years of age may be classified according to three anthropogenic indices of nutritional status: height-for-age, weight-for-height and weight-for-age (SADHS, 2003). If children are classified as "stunted", it means they are below the median height for their age (reflecting chronic undernutrition), wasting means they are below the median weight for their height (reflecting acute undernutrition) and underweight is determined by their weight-for age ratio. The primary reason for stunting is poor nutrition, repeated infections, and inadequate feeding practices during the first 1000 days (WHO 2015c)

The Hunger Index (HI), (which is an index based on the proportion of people that are undernourished, the proportion of children under 5 years that are stunted or wasted and the child mortality rate) for South Africa was <5(low) in 2014 (WHO, 2016). To put this value into context, the HI (in 2014) for neighbouring countries was: Botswana 13.4, Namibia 16.9 and Zimbabwe 16.5 (all serious) while Eritrea (also in Africa) was 33.8 (alarming) (IFPRI, 2014).

South Africa is currently experiencing a "nutrition transition", because there are still relatively high levels of childhood stunting co-existing with increasing levels of obesity and overweight in older children and adults (SAHR, 2014/15).

Statistics from between 2007 and 2014 on stunting, wasting, underweight and overweight for South Africa, Limpopo and the WHO are presented below:

AREA	CHILDREN < 5 YEARS WHO WERE STUNTED	CHILDREN < 5 YEARS WHO WERE WASTED	CHILDREN < 5 YEARS WHO WERE UNDERWEIGHT	CHILDREN < 5 YEARS WHO WERE OVERWEIGHT	SOURCE
South Africa	23.9%%	4.7	8.7%	No data	WHO, 2015b
Limpopo	26.4% (<15)	No data	10.1% (<15)	17,5% (<15)	SAHR, 2014/15
WHO African region	39.4%	10.3%	24.9%%	6.2%	WHO, 2015b
Global median	24.0%	5.1%	11.5%	6.3%	WHO 2015b

It is evident from the data above that the nutritional status of children below the age of 5 years of age in South Africa is better than in the WHO African region as well as the global median. It must be noted that the data for Limpopo are for children below the age of 15 years of age (and not below 5 years). However, it does indicate that more than a quarter of children under the age of 15 years in Limpopo are stunted reflecting chronic undernutrition, which is a concern.

The South African National Health And Nutritional Examination (SANHANES, 2013, found the minority (46%) of the South African population is food secure (not at risk of hunger). About 28% were at risk of hunger, while 26% experienced hunger. Limpopo and the Eastern Cape were the only two provinces with a hunger prevalence of more than 30%.

Vitamin A

The SANHANE_1 study found the prevalence of Vitamin A deficiency in South Africa was about 44%. When considering South African women of reproductive age, the prevalence was 13%, which indicates a moderate public health problem according to the WHO. The prevalence in Limpopo was 20%. The WHO considers a prevalence above 20% as an indication of a severe problem of public health significance (SANHANES, 2013).

Table 8. Food and Nutrition health- related sensitivities

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Child Growth	Stunting	High	Development may reduce food insecurity and thus malnutrition that lead to stunting. For the unskilled and unemployed food insecurity may however, increase.
	Wasting	Medium	Development may reduce food insecurity and thus malnutrition that lead to wasting. For the unskilled and unemployed food insecurity may however, increase.
	Underweight	Medium	Development may reduce food insecurity and thus malnutrition that lead to underweight. For the unskilled and unemployed food insecurity may however, increase.

6.7 ENVIRONMENTAL HEALTH AREA – ENVIRONMENTAL POLLUTION

It is envisaged that air, water and soil will be affected by the proposed development. In this study the components included under Environmental Pollution, are comprised of: Ambient air, Indoor air, Noise and Water.

6.7.1 Baseline Assessment of Environmental Pollution

The South African constitution states, “Everyone has the right: to an environment that is not harmful to their health or well- being (RSA, 1996).

Ambient air pollution

Available air quality monitoring results pertaining to the study site, were limited to fall-out dust. It is therefore not known whether concentrations of inhalable or respirable particulate matter (PM₁₀ and PM_{2.5}) and or gases are currently exceeding health guidelines. Current sources of air pollution on and adjacent to the site are mainly human activities (burning of domestic fuel and waste), vehicles on unpaved roads and wind-blown dust, but also other industries such as mining and a smelting (adjacent to the site) (RES, 2016). These sources may all contribute to ambient air pollution (particulate matter and gases) in the communities. Hexavalent chromium is one pollutant expected to be emitted to ambient air by the adjacent chrome smelter.

Concentrations of fall-out dust during July, August and September 2015, which included the dry windy months, ranged between 57 mg/m²/day and 569 mg/m²/day. These concentrations fall within the residential standard of <600 mg/m²/day. The highest fall-out was measured next to the return road from the quarry (RES, 2016).

The prevailing wind direction is from the north-east to the south-west. Wind roses show the prevailing wind direction from midnight to 12:00 is from the south-west (RES, 2016). The closest (<400 m) communities north-east of the proposed development are Vuurpyl, Assegai and Albezia. From 12:00 to 23:00 the wind direction is mainly from the north-east (RES, 2016). There are no residential areas directly south-west from the proposed site.

The Dithamaga trust community is situated within the fence lines of the proposed Spitsvale development and is therefore the most vulnerable for impacts from environmental pollution. Proposed mining in the “Spitskop flats” will happen about one km west of this relatively small community (about 76 households and 450 people in 2011)

Indoor air pollution

The number of households in the communities of concern where indoor smoking is allowed is not known. However, in the SANHANES study (2013) it was found that the prevalence of ever smokers among those 15 years of age and older, in Limpopo, was about 14% (lowest of all provinces), whereas the national prevalence was 21%. It was also found in this study that rural informal areas had the lowest prevalence.

According to the census 2011 data, the majority of the households in the communities of concern do not use electricity for cooking or heating (up to 96% of households in Dithamaga trust). It is assumed that these households do use domestic fuel, resulting in indoor air pollution.

Noise

Noise is usually defined as “unwanted sound” (enHealth, 2004) and the WHO describes environmental noise or community noise as “noise that includes the primary sources of road, rail and air traffic, industries, construction and public works and the neighbourhood” (enHealth, 2004).

Certain parts of the study area have a rural character, while other parts are populated by settlements with a sub-urban atmosphere. No sources of ambient noise other than community noise could be identified within the fence line of the proposed mining site. The roads in the area were not considered to carry enough traffic to make a noise impact and the R555 is 8 km away (De Jager, 2015).

Water pollution

Most of the communities of concern in this study, have access to treated water through stand pipes, however, as mentioned in Section 6.4, More than 80% of households in Ga Mporu and Tskane indicated that they were using surface water for domestic use (StatsSA 2011a). It is not sure where this water is abstracted from.

The hydrological baseline study on surface water for the Spitsvale project reported on water quality from a dam close to the site as of “marginal quality-conditionally acceptable” and that of the Steelpoort River as of “poor quality, unsuitable for use without treatment”, mainly based on total dissolved solids and turbidity (Hylands Hydrology, 2016).

Boreholes serving some of the communities of concern, showed elevated levels (above health limits) of total dissolved solids, nitrate, chloride and arsenic (Delta h, 2015).

Microbiological parameters were not examined but when considering results from other studies in the GTLM done by CSIR, it can be concluded that surface water, especially the river, will be microbiologically polluted (by people and animals).

The permeability of the host rock is low, indicating that boreholes in these formations are likely to have a low yield unless intersecting a high permeability feature such as a fault or fracture zone (personal communication Mr Phill Hobbs, CSIR).

Table 9. Environmental pollution health-related sensitivities

COMPONENT	SENSITIVITY	VULNERABILITY	POTENTIAL IMPACT
Ambient air pollution	Existing fall-out dust concentrations comply to standard for a residential area. No data on fine Particulate matter or gases	Low (limited data)	Dust emissions expected to increase.
Indoor air pollution	Domestic fuel used for cooking and heating Assume tobacco smoking indoors	Medium	Influx of people may result in more informal houses using "dirty" fuels for cooking and heating, resulting in air pollution (particles and gases), both indoors and ambient.
Noise	Existing noise levels are considered to be below IFC residential guideline values for mining and industry as the only source identified was residential areas (community noise)	Low	Noise levels may increase from proposed mining activities and increase in traffic.
Water pollution	Some communities use surface water for domestic use and some use borehole water. Monitored data showed chemicals in some surface water sources and bore holes do not comply to standards for drinking water	Low to Medium	Geology in the area not conducive to acid mine drainage, based on low sulphide in ore-bearing strata from surrounding mines.

7 IMPACT ASSESSMENT

The project activities were categorised into three project phases: Construction, Operation and Decommissioning. Project activities were assessed according to their relevance to generic key issues (such as the influx of people as a result of the employment of people). These key issues have the potential to, in turn affect one of the seven Environmental Health Areas (see **Table 2**), resulting in either negative or positive health effects or environmental impacts.

7.1 IMPACT ASSESSMENT METHODOLOGY

The Impact Assessment methodology has been derived from the IFC Guideline for HHIA for assessing a range of environmental and socio-economic determinants of health and associated health impacts. Impacts may be estimated according to several criteria as presented in **Table 10**.

Table 10. Definitions of each of the criteria used to determine the significance of impacts

DESCRIPTION	
NATURE	Reviews the type of effect that the proposed activity will have on the relevant component of the environment and includes "what will be affected and how?"
EXTENT	Geographic area. Indicates whether the impact will be within a limited area (on site where construction is to take place); local (limited to within 25 km of the area); regional (limited to ~200km radius); national (limited to the borders of South Africa); or international (extending beyond South Africa's borders).
DURATION	Whether the impact will be temporary (during construction only), short term (2-5 years), medium term (5-15 years), long term (longer than 15 years, but will cease after operation) or permanent.
INTENSITY	Establishes whether the magnitude of the impact is destructive or innocuous and whether or not it exceeds set standards, and is described as none (no impact); low (where natural/ social environmental functions and processes are negligibly affected); medium (where the environment continues to function but in a noticeably modified manner); or high (where environmental functions and processes are altered such that they temporarily or permanently cease and/or exceed legal standards/requirements).
PROBABILITY	Considers the likelihood of the impact occurring and is described as

DESCRIPTION	
	very improbable, improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).
SIGNIFICANCE	Significance is given before and after mitigation. Low if the impact will not have an influence on the decision or require to be significantly accommodated in the project design, medium if the impact could have an influence on the environment which will require modification of the project design or alternative mitigation (the route can be used, but with deviations or mitigation). High where it could have a “no-go” implication regardless of any possible mitigation (an alternative route should be used).
STATUS OF THE IMPACT	A statement of whether the impact is positive (a benefit), negative (a cost), or neutral. Indicate in each case who is likely to benefit and who is likely to bear the costs of each impact.
DEGREE OF CONFIDENCE IN PREDICTIONS	Is based on the availability of specialist knowledge and other information.

Results of the impact assessment have been prioritised by an impact rating process. This process has been designed to provide a numerical rating of the various environmental and social determinants, as well as health impacts identified for various project activities. The significance rating process follows the established impact assessment formula:

Impact significance (pos. or neg.) = Impact intensity X Probability, where:

Impact intensity (pos. or neg.) = Intensity potential (magnitude) + extent + duration + frequency and

Probability = Likelihood of an impact occurring

The weights assigned to the various parameters that describe impacts in the formula are presented in **Tables 11 - 24**.

Table 11 indicates the extent or the geographic distance at which the impact will be experienced.

Table 11. Extent and rating of impact

EXTENT	RATING
Site only	1
Local (25 km radius of source)	2
Regional (~200km)	3
National (within South Africa's borders)	4
International (beyond South Africa's borders)	5

The length of time for which the impact may be prevalent is indicated by the duration (**Table 12**).

Table 12. Duration and rating of impact

TIMING AND DURATION	RATING
Temporary – during construction or decommissioning period	1
Short-term (2-5 years)	2
Medium-term (5-15 years)	3
Long term (longer than 15 years but end when operational period ends)	4
Permanent	5

The frequency indicates how often the envisaged impact is expected to occur, as shown in **Table 13**.

Table 13. Frequency and rating of impact

FREQUENCY	RATING
Highly infrequent	1
Infrequent	2
Regular	3
Continuous	4

The intensity potential is the rating of the magnitude of the impact if it occurred, as shown in **Table 14**. The magnitude or intensity potential of the potential health effect on the community incorporates the following considerations (IFC, 2009):

- Health hazard (toxicity or hazard potency)
- Exposure level (how often, how long, dose)
- Population at risk (number of people exposed, their degree of susceptibility)
- Probability that exposure occurs, and
- Any modifying factors (such as cultural, personal habits, availability of medical treatment, etc., (hazard-modifying influence: increase, neutral or decrease).

Table 14. Intensity potential (magnitude) and rating of impact

INTENSITY POTENTIAL (POSITIVE)	RATING	INTENSITY POTENTIAL (NEGATIVE)	RATING
None	1	None	1
Low	2	Low	2
Medium	3	Medium	3
High	4	High	4
Severe	5	Severe	5

The probability assigns a rating for the likelihood of the impact (consequence) manifesting, rated as shown in **Table 15**.

Table 15. Probability and rating of impact

PROBABILITY	RATING
Very improbable	1
Improbable	2
Probable	3
Highly probable	4
Definite	5

The overall impact intensity was determined by summing the individual scores. Health impacts have been rated by multiplying the consequences of the impact and the probability of occurrence. If an impact is unlikely to manifest then the probability will be negligible, in which case the intensity/consequence score will be reduced resulting in a reduced significance. The maximum possible score (worst-case), given a probability of 5, is 95. The impact significance matrix derived from the scoring process is indicated in **Table 16**.

Table 16. Impact significance matrix that was used to rate impacts

DEGREE OF IMPACT	INTERVAL	IMPACT SIGNIFICANCE RATING
Very high	76-100%	From 72 to 95 significance points
High	51-75%	From 49 and 71 significance points
Moderate	26-50%	From 25 to 48 significance points
Low	1-25%	From 1 to 24 significance points

The impact assessment considered potential health impacts (positive or negative) for project activities associated with construction, operation and decommissioning.

The impacts were assessed taking into consideration the technologies that will be implemented as well as assuming that best practices will be adhered to throughout the project. The assessment did not consider best practices as mitigation measures

but as a given. Significant impacts therefore, require mitigation over-and-above the implemented technologies. The criteria used to determine impact significance are indicated in **Table 17**.

Table 17. Determination of impact significance

DESCRIPTION	SCORE		RATING	
	NEG	POS	NEG	POS
Where the impact will have a negligible influence on the environment and no modifications or mitigations are necessary for the given development description. This would be allocated to impacts of any severity/ magnitude, if at a local scale/ extent and of temporary duration/time.	<25	<25	Low	Low
Where the impact could have an influence on the environment, which will require modification of the development design and/or alternative mitigation. This would be allocated to impacts of moderate severity/magnitude, locally to regionally, and in the short term.	25 – 48	25 – 48	Moderate	Moderate
Where the impact could have a significant influence on the environment and, in the event of a negative impact the activity(ies) causing it, should not be permitted (i.e. there could be a 'no-go' implication for the development, regardless of any possible mitigation). This would be allocated to impacts of high magnitude, locally for longer than a month, and/or of high magnitude regionally and beyond.	49 – 71	49 - 71	High	High
A very serious impact which, if negative, may be sufficient by itself to	72 - 95	72 - 95	Very High	Very High

DESCRIPTION	SCORE		RATING	
	NEG	POS	NEG	POS
prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects, or very beneficial effects.				

7.2 ASSESSMENT OF THE IMPACTS

The following sections discuss the potential positive and negative impacts relating to health that may occur during the three phases, namely construction, operation and decommissioning of the proposed Spitsvale mine. Risk analysis was used to evaluate impacts as they relate to each of the Environmental Health Areas (EHAs). Only EHAs considered relevant to the project were evaluated.

Factors that were regarded as significant in the baseline were also included in the assessment if it was anticipated that they may cumulatively impact health and well-being overall, even if they are not expected to be affected by the proposed mine in isolation.

The overall rating per EHA considered both the negative and positive impacts (nett impact).

7.2.1 Health Impacts as determined by Social Determinants of Health

7.2.1.1 Population characteristics

It is envisaged that job seekers will come to the area in addition to those who will be formally employed. This situation may have an influence on the household size and proportion of informal houses in the area.

The current situation may not change significantly as far as gender and age is concerned. However, during construction, more male workers are expected, presumably between 20 and 40 years of age, but during the operational phase when families of workers move into the area, the number of women and children may increase. With more children, the vulnerable population in terms of age will increase.

7.2.1.2 Education levels, Employment status and Household income.

A large sector of the required labour force will fall within the unskilled categories. Even though the study area is characterised by overall low educational/skill levels and high unemployment levels, it is anticipated that local labour could be used with subsequent economic benefits to the core communities. Trickle-down local effects would include increased spending due to the increased income and positive economic impacts on local businesses. Identification of potential for training and skills-building among the local communities therefore remain critical to maximise the employment opportunities, as highlighted in the Social and Labour Plan. It is possible that some outsiders would have to be employed for the highly skilled positions, although few of these positions are expected. These hires should be managed to prevent discontent from local job-seekers.

Although it is challenging to mitigate the influx of jobseekers and other outsiders, proactive measures should be put in place to limit the influx in favour of using of local labour. If construction workers or jobseekers from outside the area stay in the area after the construction phase, and without having found employment, there may be long term social consequences on infrastructure and service delivery.

A positive impact refers to the change in the zoning status of the land to be used for the future mining activities. As these activities would likely ensure long term social development support and possible financial benefits to the core communities, this impact was rated as positive. Opportunities for job-creation of locals in the secondary and tertiary economy should also be assessed as it may not only alleviate the unemployment situation but also strengthen the local economy.

The main estimated negative impacts associated with issues related to social determinants of health, before mitigation, include a change in social cohesion which has the potential to lead to acts of violence including xenophobia, crime, substance abuse, and interpersonal violence as well as an increase in psychosocial problems such as depression. A positive social impact is that there will be an increase in job opportunities and household income.

Table 18 gives the impact rating of activities associated with social determinants of health before and after mitigation. Mitigation mainly influences magnitude and probability but in some instances may also influence frequency. The overall nett-rating for both the construction and operational phases are moderately-negative before mitigation and low-negative after mitigation, while the nett-rating for the decommissioning phase remains moderately-negative.

Moderate positive impact is expected on the economic development during the construction and operational phases.

Table 18. Impacts associated with the Environmental Health Area: Social determinants of health

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEM ENT	POST- MITIGA- TION
	CONSTRUCTION PHASE									
INFLUX OF JOB SEEKERS	Unemployment increases, pop. profile and social cohesion changes, leading to social ills e.g. xenophobia, prostitution and drug abuse (negative) .	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	Employ locals or only from South Africa	Low (24)
ECONOMIC DEVELOP- MENT	Mine will stimulate the economy, household income will increase (positive) .	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	NA	NA
ECONOMIC DEVELOP-	Household income increase may lead to unhealthy	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (27)	Education Awareness	Low (24)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
MENT	lifestyle (negative).									
	OPERATIONAL PHASE									
INFLUX OF JOB SEEKERS	Unemployment increases, pop. profile and social cohesion changes, leading to social ills e.g. xenophobia, prostitution and drug abuse (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (48)	Employ locals or only from South Africa	Mod.(33)
ECONOMIC DEVELOPMENT	Mine will stimulate the economy, household income will increase (positive).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (48)	NA	NA
ECONOMIC DEVELOP-	Household income increase may lead	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (36)	Edu. Aware.	Mod. (33)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
MENT	to unhealthy lifestyle (fast food, sub. abuse) (negative).									
	DECOMMISSIONING PHASE									
TERMIN. OF EMPLOYMENT	Job losses - unemployment will increase (negative)	Local (2)	Temp. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	None	NA
ECONOMIC DEVELOPMENT	No stimulation of economy. Hh income decrease (negative).	Local (2)	Temp. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	None	NA

7.2.2 Impacts Affecting Safety and Security

In addition to rapid population growth, construction workers and an influx of people in search of economic opportunities are expected to put pressure on the Police Services. In the Financial Mail of 2 July 2015, the mayor of the Greater Tubatse said because of the mines, "communities have high expectations that their lives will be improved" and the group executive of corporate relations at two of the mines in the area said there had been incidents at the mines where mine property had been damaged partly due to job expectations

(<http://www.financialmail.co.za/features/2015/07/02/mining-benefits-and-trouble>)

Concern over personal safety impacts the commitment of people to their community as well as their morale

The main estimated negative impacts associated with issues related to safety and security in the study area before mitigation, include the following:

- Increase in social tension which may lead to, among others, xenophobic violence and crime. This is likely to occur should many outsiders be employed without catering for locals, either through skills development or through opportunities in the secondary economy.
- Illegal business practices e.g. drug dealing which may give rise to substance abuse and associated problems including interpersonal violence. Interpersonal violence is already one of the top 10 causes of death in the Sekhukhune DM among those 15 to 24 years of age (DHB, 2014/15)
- Increase in depression and other psychosocial conditions as a result of among others, breakdown in the social fabric and moral values and substance abuse, leading to interpersonal violence and injury. Such a situation will also likely lead to accidents including road traffic-related accidents and injuries.
- The increase in the population may also increase accidents and injuries at home (such as paraffin poisonings and burns).

The mine may work in collaboration with other stakeholders to establish and/or improve recreational facilities and other programmes targeted at the youth to curb substance abuse and other youth related social problems.

Table 19 gives a summary of the impact assessment of safety and security issues in the study area that may be associated with the mine before and after mitigation. The overall nett-rating for the construction phase is moderately-negative before mitigation and low-negative after mitigation. For the operational phase it is moderately-negative before mitigation and although the rating is lower after

mitigation, it remains moderately-negative. The nett-rating for the decommissioning phase is low to moderately-negative.

Table 19. Impacts associated with the environmental Health Area: Safety and security

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEMENT	POST- MITIGA- TION
	CONSTRUCTION PHASE									
INFLUX OF JOB SEEKERS	Increase in violence and crime (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	Employ locals or only from South Africa	Low (24)
INFLUX OF PEOPLE INTO THE AREAS	Increase in offsite (home) accidents/poison-ings (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (27)	Education Awareness campaign	Low (24)
INCREASE IN VEHICLES ON THE ROADS	Increase in road accidents (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	Education Awareness campaign	Low (24)
	OPERATIONAL PHASE									
INFLUX OF JOB SEEKERS	Increase in violence and crime (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (48)	Employ locals or only from South Africa only	Mod. (33)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
INFLUX OF PEOPLE INTO THE AREA	Increase in offsite (home) accidents/poisonings (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (36)	Education Awareness campaign	Mod. (33)
INCREASE IN VEHICLES ON THE ROAD	Increase in road accidents (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (36)	Education Awareness campaign	Mod. (33)
	DECOMMISSIONING PHASE									
INCREASE IN VEHICLES ON THE ROAD REMOVING EQUIPMENT	Increase in road accidents (negative)	Local (2)	Temp. Decom. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	Education Awareness campaign	Low (24)
TERM. OF EMPLOYMENT	Increase unemployment, crime (negative).	Local (2)	Temp. Decom. (1)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (27)	None	NA

7.2.3 Impacts relating to Lifestyle

Influx of people and increased income may result in alcohol and illegal substances being available more freely. It is difficult to speculate whether the prevalence of tobacco smoking (currently 14% among those above 15 years in Limpopo) and or substance abuse (alcohol abuse already a problem in the country) will increase due to the presence of the 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 products.

As a result of trucking traffic associated with the mine, there is potential for other changes in lifestyle of local communities such as a rise in prostitution. Mining towns are known to have high rates of prostitution which is also associated with sexually transmitted illnesses (STIs). Therefore, the potential for STIs including HIV/AIDS to increase is real in an area already perceived to have a problem. In addition, the influx of already infected people into the study area in search of better job opportunities will likely also increase the incidence of STIs. Such a situation would put an additional stress on the health system which already has a capacity issue.

The prevalence of non-communicable diseases is on the increase in South Africa. Already about 11% of mortalities in those economically active (25 to 64 years) in Sekhukhune DM are as a result of non-communicable diseases (DHB, 2014/15). Non-communicable diseases are associated with a life style of unhealthy eating, mostly of fast foods, leading to obesity, tobacco use, alcohol consumption and lack of exercise. An increase in the number of people with decent incomes may lead to an increase in individuals living an unhealthy lifestyle and as a result an increase in the prevalence of non-communicable diseases.

Table 20 gives a summary of the impact assessment of lifestyle issues in the study area that may be associated with the mine before and after mitigation. The overall nett-rating for the construction phase is moderately-negative before mitigation and low-negative after mitigation. For the operational phase it is moderately-negative before mitigation and although the rating is lower after mitigation, it remains moderately-negative. The nett-rating for the decommissioning phase is low-negative.

Table 20. Impacts associated with the Environmental Health Area: Lifestyle

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEMENT	POST- MITIGA- TION
	CONSTRUCTION PHASE									
INCREASE IN TRUCKING AND PEOPLE INTO THE AREA	Increase in the prevalence and incidence of STIs (negative) .	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (27)	Education Awareness campaigns	Low (24)
PEOPLE COMING INTO THE AREA -	Increase in prevalence of non-communicable diseases (negative) .	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (27)	Education Awareness campaigns Treatment	Low (24)
INCREASE IN PERSONAL INCOME	Increase in smoking and alcohol consumption, resulting in increase in incidence of non-communicable	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (27)	Education Awareness campaigns	Low (24)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
	diseases (negative).									
	OPERATIONAL PHASE									
INCREASE IN TRUCKING AND PEOPLE INTO THE AREA	Increase in the prevalence and incidence of STIs (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (36)	Education Awareness campaigns Testing and treatment	Low (24)
PEOPLE COMING INTO THE AREA-	Increase in prevalence of non-communicable diseases (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (36)	Education Awareness campaigns Treatment	Mod. (33)
INCREASE IN PERSONAL INCOME -	Increase in smoking and alcohol consumption, resulting in increase in incidence of non-communicable	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (36)	Education Awareness campaign	Mod. (33)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
	diseases (negative)									
	DECOMMISSIONING PHASE									
INCREASE IN TRUCKING	Increase in the prevalence and incidence of STIs (negative).	Local (2)	Temp. Decom. (1)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (27)	Education Awareness campaign	Low (24)
DECREASE IN PERSONAL INCOME	No decrease in smoking and alcohol use, continuing impacts of lifestyle (STIs, other lifestyle diseases) (negative).	Local (2)	Temp. Decom. (1)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (27)	Education Awareness campaign	Low (24)

7.2.4 Impacts relating to Physical Infrastructure

Components included under “Physical Infrastructure”, are comprised of: Transport infrastructure, Housing access and condition, Water and sanitation and Energy carriers.

The roads in the study area are currently in a fair condition, but development associated with the mine will increase traffic during all phases of the project at an expected rate of 2% per annum (ITS, 2015). Specifically traffic of heavy duty vehicles will increase, which will cause deterioration of the roads. This deterioration will not only be during construction, when all workers and materials will have to be transported to the site (estimated 20 heavy vehicles, 19 private vehicles and 4 mini busses a day) but will most probably be highest during the operational phase when workers and goods will be transported to and from the mine and ore from the mine. In particular, ore is expected to be transported to Maputo at 76 vehicle trips per day (estimated 40 heavy vehicles, 29 private vehicles and 6 mini busses) and 41 vehicle trips per hour (ITS, 2015). It is predicted that during the operational phase the traffic density in terms of control delay (in seconds) per vehicle at the R555/D1261 intersection will be “undesirable” and will have to be upgraded (ITS, 2015) During decommissioning vehicle traffic will decrease but materials will have to be transported away from the mine, although not necessarily to an international destination (estimated 15 heavy vehicles, 10 private vehicles and 2 mini busses (ITS, 2015)).

The mining development and people coming into the area as a result of the development, such as workers and job seekers, will overburden the current water, sanitation and electricity infrastructure, as there is already a backlog of about 20% of households in the Local Municipality.

As a result of the Spitsvle mine development, people, such as workers, their families as well as job seekers and others, will come into the area. These people will need houses, schools etc. There is no spare capacity to accommodate these people as far as housing is concerned as there is already a backlog in the supply of housing. This situation may lead to poorly constructed informal houses and or overcrowding. Overcrowding is conducive to the spread of communicable diseases.

Table 21 summarises the main impacts associated with physical infrastructure. The nett-impact rating for this Environmental Health Area is high to moderately-negative before mitigation and after mitigation, moderate to low-negative for construction, and moderate negative for the operational and decommissioning phases.

Table 21. Impacts associated with the Environmental Health Area: Physical infrastructure

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA-TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI-DENCE	SIGNIFICANCE		
								PRE-MITIGA-TION	MITIGA-TION/ ENHANCEMENT	POST-MITIGA-TION
	CONSTRUCTION PHASE									
INCREASE IN TRAFFIC, ESPECIALLY HEAVY DUTY VEHICLES	Road infrastructure deterioration (negative).	Local (2)	Temp. Constr. (1)	Cont. (4)	Medium (3)	Highly Probable (4)	High	Mod. (40)	Maintain roads	Mod. (30)
INCREASED DEMAND FOR WATER AND SANITATION AND ELECTRICITY	Overburden of service delivery infrastructure (water, sanitation and electricity) already a backlog (negative).	Local (2)	Temp. Constr. (1)	Cont. (4)	Medium (3)	Highly Probable (4)	High	Mod. (40)	Increase capacity in all sectors	Low. (24)
NEED FOR ADEQUATE HOUSING	Informal houses and overcrowding. Already backlog (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	Build houses and increase capacity of schools	Low (24)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEMENT	POST- MITIGA- TION
	OPERATIONAL PHASE									
INCREASE IN TRAFFIC, ESPECIALLY HEAVY DUTY VEHICLES	Road infrastructure deterioration (negative).	Inter National (ore to Maputo) (5)	Long term (4)	Con. (4)	Medium (3)	Highly Probable (4)	High	High (64)	Maintain and upgrade roads	Mod. (45)
INCREASED DEMAND FOR WATER AND SANITATION	Overburden of service delivery infrastructure (water, sanitation and electricity) Already backlog (negative).	Local (2)	Long term (4)	Cont. (4)	Medium (3)	Highly Probable (4)	High	High (52)	Increase capacity	Low (24)
NEED FOR ADEQUATE HOUSING -	Informal houses and overcrowding Already backlog (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Highly Probable (4)	Medium	Mod. (48)	Build houses; increase capacity of schools	Mod (33)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA-TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI-DENCE	SIGNIFICANCE		
								PRE-MITIGA-TION	MITIGA-TION/ ENHANCEMENT	POST-MITIGA-TION
	DECOMMISSIONING PHASE									
INCREASE IN TRAFFIC, - HEAVY DUTY VEHICLES	Road infrastructure deterioration (negative).	Local (2)	Temp. Decom. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Mod. (36)	Maintain roads	Moderate (27)

7.2.5 Impacts relating to Health Management and Infrastructure

Access to health care provides a coping mechanism to vulnerable people. Health management and infrastructure include health infrastructures, the health workforce, health financing and health status.

The health infrastructure (medical facilities) in the study area consists of mobile clinics once a week in many of the areas, with hospitals relatively far away and roads often inaccessible. The district hospital is understaffed (GTLM IDP, 2015/16). The expected influx of people to the area during construction and operation will increase the burden on health care services, and if the capacity is inadequate, the quality of service will decline.

As far as health financing is concerned, South Africa is on par or doing better compared with the other countries in the WHO African Region. The total health expenditure per capita in Limpopo is the highest of the provinces and the Sekhukhune DM higher than the South African average. However, for those without medical aid (uninsured), which forms about 80% of the population, the expenditure per capita for Limpopo is the lowest of all provinces and the Sekhukhune DM the third lowest for the District Municipalities.

The workforce at the public clinics in the study area is considered to be low and thus an influx of people into the area will increase the burden on the public clinics. However, the supervision rate at the clinics (an indication of the quality of health service) is 80%, but the bed utilisation rate, an indication of efficiency, is below the South African average.

Life expectancy, which is an indication of the health status of a population, is slightly higher for South Africa (60 in 2013) than for the WHO African region (58) but significantly lower than the global median (74) (WHO, 2015b).

The main cause of death in children under the age of 14 years was diarrhoeal diseases, indicating a hygiene problem. Poor sanitation may contribute to this issue.

The disease that ranked number one in the top 20 responsible for the highest number of DALYs in Sekhukhune DM was HIV/AIDS and so is assumed to be similar for the study area. An influx of people to the area, including contract workers, permanent workers, job seekers and some of these individual's families, will increase the prevalence and incidence of this disease of which the impact was assessed under impacts of lifestyle (**Table 20**).

It would serve Spitsvale mine well to work closely with the health department and other relevant stakeholders to address health issues particularly those concerning Spitsvale staff.

Table 22 indicates that the nett-impact rating on health services, infrastructure and capacity before mitigation is moderately-negative during both the construction and

operational phases. After mitigation the impact decreases to low-negative during construction but remains moderately-negative during the operational phase.

Table 22. Impacts associated with the Environmental Health Area: Health management and infrastructure

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEM ENT	POST- MITIGA- TION
	CONSTRUCTION PHASE									
INFLUX OF PEOPLE INTO THE AREA	Overburdened health facilities (ito capacity) with inadequate health service (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (27)	Increase capacity	Low (24)
INFLUX OF PEOPLE INTO THE AREA-	Inadequate infrastructure (not enough facilities such as clinics/hospitals) and/or poorly maintained infrastructure (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (27)	Build facilities	Low (24)
	OPERATIONAL PHASE									
INFLUX OF PEOPLE INTO THE AREA	Overburdened health facilities (ito capacity) with inadequate health service (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (36)	Increase capacity	Mod.(30)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEM ENT	POST- MITIGA- TION
INFLUX OF PEOPLE INTO THE AREA	Inadequate infrastructure (not enough facilities such as clinics/hospitals) and/or poorly maintained infrastructure (negative).	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (36)	Build facilities	Mod. (30)
	DECOMMISSIONING PHASE									
	NA									

7.2.6 Impacts relating to Food and Nutrition

Food security is an important consideration in understanding potential health impacts of development projects. The quality of food and types of food consumed have a direct bearing on people's susceptibility to environmental stressors including environmental pollution.

The national Hunger Index is low (<5). The number of stunted and underweight in children below 5 years of age in Limpopo is higher than the average for South Africa. However, the number of overweight children in South Africa was higher than the average for the WHO African region and the global median.

Development may reduce food insecurity and thus malnutrition that lead to underweight children, but on the other hand, for the unskilled and unemployed, food insecurity may increase.

Influx of people will lead to more street vendors selling unhygienic food causing foodborne illnesses in an area where diarrhoeal diseases are the main cause of death amongst those under the age of 15 years of age.

Table 23 which summarises the main impacts associated with food and nutrition-related issues, indicating that the nett-impact rating for this EHA is moderately-negative before mitigation for each of the phases and low-negative after mitigation for the construction and decommissioning phases. For the operational phase the net-rating remains moderately-negative after mitigation.

There is also a possible moderate positive impact in the affordability of food during the operational phase.

Table 23. Impacts associated with the Environmental Health Area: Food and nutrition

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEMENT	POST- MITIGA- TION
	CONSTRUCTION PHASE									
INCREASED DEMAND FOR FOOD	Food inflation, increasing food deprivation, nutrition-related diseases (negative) .	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (27)	School feeding schemes Communal vegetable gardens Nutritional awareness campaigns.	Low (24)
INCREASED DEMAND FOR FOOD-	Poor food hygiene and quality of food services may increase food-related illnesses (negative) .	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (27)	Food hygiene programmes	Low (24)
INCREASED HOUSEHOLD INCOME	Ability to afford healthier food and associated improved nutritional and health status (positive) .	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	Medium	Mod. (27)	NA	NA

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA- TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI- DENCE	SIGNIFICANCE		
								PRE- MITIGA- TION	MITIGA- TION/ ENHANCEMENT	POST- MITIGA- TION
	OPERATIONAL PHASE									
INCREASED DEMAND FOR FOOD	Food inflation, increasing food deprivation, nutrition-related diseases (negative) .	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (36)	School feeding schemes Comm. vegetable gardens Nutritional awareness campaign Subsidies	Mod. (33)
INCREASED DEMAND FOR FOOD	Poor food hygiene and quality of food services may increase food-related illnesses (negative) .	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (36)	Food hygiene pro-grammes	Mod. (33)
INCREASED HOUSEHOLD INCOME	Ability to afford healthier food - improve nutritional status (positive) .	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (36)	NA	NA
	DECOMMISSIONING PHASE									

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
INCREASED DEMAND FOR FOOD	Poor food hygiene and quality of food services may increase food-related illnesses (negative).	Local (2)	Temp. Decom (1)	Regular (3)	Medium (3)	Probable (3)	High	Mod. (27)	Food hygiene programmes	Low (24)

7.2.7 Impacts relating to Environmental Pollution

Ambient air

There are currently no industrial sources of air pollution at the proposed site. There is however, a community (Dithamaga) within the proposed development fence line at S 24.838413 E 30.160035. In this community 96% of households do not use electricity for cooking or heating and they do not have access to refuse removal. It is therefore assumed that they do use domestic fuels which will cause air pollution and will most probably burn waste which is also causing air pollution.

Emissions of particulate matter (dust) will be as a result of wind entrainment and activities during construction, operation and decommissioning. Activities during construction will include, amongst others, clearing of vegetation and an increase in vehicles transporting goods and people. During operations, emissions will result from blasting, trucking the ore to storage piles, dumping of ore at the storage piles, loading of ore to be transported to Maputo, and vehicles on haul roads. During decommissioning, emissions will be from activities such as dismantling and removal of structures and rehabilitation (vegetating) the area.

The only ambient air data currently readily available are concentrations of fall-out dust at the site, which fall within the residential standard of $<600 \text{ mg/m}^2/\text{day}$ (RES, 2016).

The prevailing wind direction is from the north-east to the south-west where there are no residential areas close to the proposed site. Wind roses show the prevailing wind direction from midnight to 12:00 is from the south-west (RES, 2016). The closest ($<400 \text{ m}$ from fence line) communities north-east of the proposed development are Vuurpyl, Assegai and Albezia and these areas are expected to be impacted on especially when the Tubatse koppie will be mined. From 12:00 to 23:00 the wind direction is mainly from the north-east (RES, 2016). There are no residential areas directly south and south-west from the proposed site. The other community expected to be impacted by the development, especially when the is the Dithamaga trust

The main pollutant expected to be emitted from activities at the mine through all phases of the project, is particulate matter. However, motor vehicles and the storage and handling of petroleum products will also emit gaseous pollutants such as sulphur dioxide, nitrogen dioxide and volatile organic pollutants (RES, 2016).

Modelled incremental (over and above the background) dust fallout rates did not exceed the residential standard of $600 \text{ mg/m}^2/\text{day}$ beyond the mine boundary. On the site the fall-out rate exceeded the industrial standard of $1200 \text{ mg/m}^2/\text{day}$ close to source during construction and although over a larger area during the operational phase, it was still on site (RES, 2016). From the Isopleths presented in the air quality impact report, it seems as if the dust fall-out residential standard will not be exceeded at the community on site (Dithamaga).

Modelled incremental PM₁₀ concentrations were in compliance with the national 24-h ambient standard (of 75 µg/m³) and the annual standard (of 40 µg/m³) beyond the mine boundary (RES, 2016). Exceedances of the daily and annual standards were confined to the site along the main haul route and near the mining areas (RES, 2016). Isopleths of the predicted PM₁₀ concentrations showed exceedance of the 24-h average standard in an area that may include at least part of the community on site. Exposure to concentrations of PM₁₀ above the 24-h standard may cause acute health effects such as respiratory effect.

Modelled incremental PM_{2.5} concentrations were in compliance with the national 24-h ambient standard (of 40 µg/m³) and the annual standard (of 20 µg/m³) beyond the mine boundary (RES, 2016). Exceedances of the daily and annual standards were confined to the site along the main haul route and near the mining areas but considering the isopleths of the predicted concentrations in the air quality impact report; it will be unlikely for the community on site to be affected (RES, 2016).

Although modelled concentrations were only predicted to exceed the standards on site, it must be kept in mind that there are people residing within the site boundaries near the haul road (RES, 2016) and it must be kept in mind that air pollution has no boundaries and small particles may travel far. Mitigation measures are therefore required.

Indoor air

Current pollutant concentrations in indoor air in the communities of concern in the study area are not known. Nonetheless, as the majority of households in the communities of concern do not use electricity for cooking or heating, the use of domestic fuel is assumed and its combustion leads to indoor air pollution.. Furthermore, about 14% of the population above 15 years in Limpopo are ever tobacco smokers. There will thus be households in the study area where people smoke indoors, thereby contributing to indoor air pollution.

When the mining development starts and more people come to the area, informal housing may increase and thus the use of domestic fuel for cooking and heating. If it is assumed that wood and paraffin will be used, then the pollutants emitted indoors will be particulate matter, carbon monoxide, nitrogen dioxide, sulphur dioxide and polycyclic aromatic hydrocarbons (PAHs).

From experience with other community studies done by the CSIR, it is assumed that pesticides are also being used indoors.

Noise

Current noise sources at the study area are mainly community activities and the area can be classified as suburban (De Jager, 2015). The noise impact of blasting was not assessed as it depends on many factors such as frequency of blasting and

materials and techniques used. Noise levels of up to 61 dBA at 750 m and 58.7dBA at one km (1000 m) are predicted for the construction phase. Sources of noise during the operational phase are envisaged to include the workshop, activities at the stockpiles and traffic on the haul roads. Noise levels of up to 55.4dBA at 300 m and 51.0dBA 500 m and 47.5dBA at 750 m are predicted for the operational phase. For the decommissioning phase it is expected that noise levels will decrease although rehabilitation activities create noise (De Jager, 2015).

The southern section of the Tubatse mining villiage (which includes Albezia) lies within the noise impact zone (medium-high significance) during construction and operation and noise barriers are recommended (De Jager, 2015). It seems as if the community within the fence line will fall outside of the noise impact zone.

Water

According to the Groundwater impact report (Delta h, 2015), dewatering due to groundwater inflow into the open mine pit, is not foreseen when the Klarinet and Tubatse koppies will be mined, as the ground water levels are considered to be deeper than the bottom of the pit. However, when the Spitskop flats will be mined, inflow of groundwater is predicted which will have to be removed at a rate of 2.8 litres per second, which relates to about 11 000 litres per hour or 240 000 litres a day. This process may have a dewatering effect on an area of about 1-1.5 km from the pit. There is thus a possibility that boreholes within this zone may be affected, i.e. a drawdown of the water table and a loss of yield. It is not known whether the boreholes, if any, used by the community on site, will fall within this impact zone.

The ore-bearing strata in the area are not known to be sulphide-rich (based on information of other mines in the area). It is therefore unlikely that acid mine drainage will be produced after decommissioning (Delta h, 2015).

Leachate from stockpiles is envisaged to be neutral to alkaline and may slightly elevate mineralisation of groundwater when compared with what is present in the ambient groundwater (DELTA h, 2015).

The nett-impact for environmental pollution during construction is moderate-negative before and low-negative after mitigation. During the operational phase the nett-impact is moderately-negative (domestic and operational activities) to high-negative (vehicle emissions and noise). The nett-impact for the decommissioning phase is moderately-negative before mitigation and low-negative after mitigation.

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Table 24. Impacts associated with the Environmental Health Area: Environmental pollution

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURA-TION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFI-DENCE	SIGNIFICANCE		
								PRE-MITIGA-TION	MITIGA-TION/ ENHANCE-MENT	POST-MITIGA-TION
	CONSTRUCTION PHASE									
INCREASE IN DOMESTIC ACTIVITIES DUE TO PEOPLE COMING INTO AREA	More people into the area will increase domestic activities, including the use of domestic fuel, pesticides resulting in increased air, soil and water pollution and associated increases in the prevalence of related health effects (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Probable (3)	High	Moderate (27)	Make people aware. about the risks.	Low (24)
SITE CLEARING AT THE MINE	Dust generated during construction activities at the mine, including site clearing and shaft sinking	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Moderate (36)	Dust control measures	Low (24)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
	(negative).									
INCREASE IN VEHICULAR ACTIVITIES	Air pollution generated by vehicular activities during construction phase (negative).	Local (2)	Temp. Constr. (1)	Regular (3)	Medium (3)	Highly Probable (4)	High	Moderate (36)	Maintain vehicles Dust control	Mod. (27)
MINING ACTIVITIES	Noise generated as result of activities related to the mine (negative).	Local (2)	Temp. Constr. (1)	Regular. (3)	Medium (3)	Highly Probable (4)	High	Moderate (36)	As per noise study: use acoustic barriers	Low (24)
	OPERATIONAL PHASE									
INCREASE IN DOMESTIC ACTIVITIES DUE TO PEOPLE COMING INTO AREA	Increase domestic activities, including the use of domestic fuel, pesticides resulting in increased air, soil and water pollution and associated	Local (2)	Long term (4)	Regular (3)	Medium (3)	Probable (3)	High	Moderate (36)	Risk awareness campaigns	Mod. (33)

POTENTIAL IMPACT	STATUS/ NATURE	EXTENT	DURATION	FREQ.	INTENSITY	PROB.	DEGREE OF CONFIDENCE	SIGNIFICANCE		
								PRE-MITIGATION	MITIGATION/ ENHANCEMENT	POST-MITIGATION
	increases in the prevalence of related health effects (negative) .									
OPERATIONAL ACTIVITIES AT THE MINES	Dust generated during operational activities at the mine (negative) .	Local (2)	Long term (4)	Cont. (4)	Medium (3)	Highly Probable (4)	High	Moderate (52)	Dust control measures	Mod. (36)
INCREASE IN VEHICULAR ACTIVITIES DUE TO THE MINE	Air pollution generated by all vehicular activities during operation (negative) .	International (5)	Long term (4)	Regular (3)	Medium (3)	Highly Probable (4)	Medium	High (60)	Maintain vehicles	Mod. (42)
MINING ACTIVITIES	Noise generated as result of activities related to the mine (negative) .	Local (2)	Long term (4)	Regular. (3)	Medium (3)	Highly Probable (4)	High	High (48)	As per noise study:use acoustic barriers	Mod. (33)
	DECOMMISSIONING PHASE									
VEGETATING THE AREA	Dust generated during activities to vegetate the area (negative) .	Local (2)	Temp. Decom. (1)	Regular. (3)	Medium (3)	Probable (3)	Medium	Moderate (27)	Dust suppression	Low. (24)

8 SPITSVALE HEALTH ACTION PLAN

As the significance of the assessed impacts indicated mostly moderately-negative risks, the focus of the Health Action Plan (HAP) (**Tables 25 to 31**) is one of the most significant aspects associated with the project activities. The plan includes the risks, recommended action(s), suggested responsibilities, key priority indicators (KPIs) and surveillance methods which include monitoring and evaluation.

Under each environmental health area, possible risks were addressed and for each risk specific actions are presented achieve an objective. For example, for the health area “environmental pollution” one of the risks is exposure to air pollution. The objective is to reduce exposure to air pollution and the action to suppress dust generation.

The main actions proposed in the HAP include:

- Various awareness raising campaigns
- Educational and training programmes
- Building/upgrading of health facility
- Building/upgrading of recreation facility
- Upgrading sanitation - provision of ablution facilities on site
- Dust suppression
- Vehicle fleet maintenance

Table 25. Health Action Plan related to Social Determinants of Health

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
RISK	CHANGES IN SOCIAL COHESION AS A RESULT OF INFLUX OF PEOPLE					
IMPROVE SOCIAL COHESION IN COMMUNITY	Collaborate with the authorities to establish a system to monitor violence and assess community cohesion related to project activities. (No extra costs, except time)	C → D	Spitsvale, Dept of Social Development Dept of Health	Other industries, NGOs, Police	Prevalence of violence-related activities	Violence-related statistics
	Conduct violence-prevention education programmes. (R 1200/h for skilled presenter plus advertising (R 1000/event) and hiring of community venue).	C→ D	Spitsvale, Dept of Social Development, Dept of Health	Other industries, NGOs, Police	Prevalence of violence-related activities	Violence-related statistics
IMPROVE FINANCIAL SKILLS IN EMPLOYEES AND EXTENDED FAMILIES, COMMUNITY	Conduct socio-economic education programmes, teaching financial skills. (R 1200/h for skilled presenter plus advertising (R 1000/event) and hiring of community venue).	C→ D	Spitsvale, Dept of Education/ educational institutions	Other industries Dept of Social Dev. Treasury	Prevalence under debt admin; bankruptcy	Data from Auditor-General, Treasury, Dept of Trade and Industry
	Conduct substance-abuse prevention education programmes.	C→ D	Spitsvale, Dept of Social	Dept. of Welfare,	Prevalence of substance	Survey data, rehabilitation centres, Police stats.

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
REDUCE SUBSTANCE-ABUSE, BAD MORAL CHOICES	(R 1200/h for skilled presenter plus advertising (R 1000/event) and hiring of community venue).		Development	Dept. of Edu. Community organizations, e.g. Churches	abuse	
	Establish appropriate recreation facilities, taking special cognisance of workers without families. (Contribute to building cost of multi-purpose community centre, revamp existing ones).	C→O	Spitsvale, Dept. of Sport	Communities, Other industries Municipality, Dept of Social Dev. Community organisations	Number of operational facilities	Record of local recreational and community building development projects; Site assessment

C=construction; O=operation; D=decommissioning. Possible cost implications in brackets under specific actions

Table 26. Health Action Plan related to Safety and Security

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
RISK	POTENTIAL INCREASE IN ACCIDENTS AND INJURIES, INCLUDING TRAFFIC- AND HOME-RELATED INCIDENTS					
IMPROVE ROAD SAFETY	Establish and maintain pictorial road-safety signage in local language and English language (if needed); clearly demarcated pedestrian crossings in appropriate places; descriptions along project roadways directly surrounding project facilities, including conveyor-belt routes if applicable, roadway rerouting areas, heavy-equipment crossing areas, etc. (Costs of a designer, an engineer, a translator and manufacturing and installation of signs).	C-->O	Spitsvåle, Dept of Transport	Region road-safety unit Dept of Education,	Prevalence of all accidents and injuries	Records of all accidents & injuries on-site and within community, records of training, hospital, clinic, fire dept records, Dept of Transport, Traffic Dept.
	Regular vehicle maintenance; adequately trained drivers; adherence to speed limit, tracking of vehicles. (Garages, workshops and technicians to maintain vehicles –	C-->D	Spitsvåle	Dept of Transport, Freight transport association	Prevalence of traffic-related accidents and injuries	Records of vehicle surveillance, service records of vehicles

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
	R 5.5 mil).					
INCREASE AWARENESS ON SAFETY, ALSO AT HOME	Awareness and education on safety risks potentially experienced by employees that are associated with overcrowding including, paraffin poisoning, fires, burns, road safety. Helpline with advice (R 1200/h for skilled presenter plus hiring of venue).	C-->D	Spitsvale, Dept of Education	Paraffin Association, other industries, Dept. of Health	Prevalence of all accidents and injuries	Records of all accidents & injuries on-site and within community, records of training, hospital, clinic, fire dept. records, Dept. of Transport, Traffic Dept.
	Involvement in awareness campaigns at schools about traffic-safety, paraffin, pesticide and domestic fuel-use safety. (R 1200/h for skilled presenter plus advertising (R 1000/event) and hiring of community venue).	C-->O	Spitsvale, Dept of Education	Paraffin Association, other industries, Dept. of Health	Prevalence of all accidents and injuries	Records of all accidents & injuries on-site and within community, records of training, hospital, clinic, fire dept. records, Dept. of Transport, Traffic Dept.
REDUCE INJURIES ON-SITE	Manage access control to site, including training of security personnel and those who enter, on safety issues. (Training of personnel at R 1200/h for skilled presenter and cost of surveillance cameras).	C-->D	Spitsvale	Dept of Labour	Surveillance cameras, security checks	Records of incidents

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
REDUCE OCCUPATIONAL SOURCES OF INJURIES AND ACCIDENTS	Training and regular refresher courses for employees on safety issues, including drivers. Adhere to the Occupational and Mine Health and Safety Acts. Safety and health forums to discuss success and failure. (R 1200/h for skilled presenter plus hiring of venue).	C-->D	Spitsvale	Dept of Labour Dept of Mining	Testing of employee knowledge and understanding	Records of incidents

C=construction; O=operation; D=decommissioning; Possible cost implications in brackets under specific actions.

Table 27. Health Action Plan related to Lifestyle

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
RISK	POTENTIAL INCREASE IN SEXUALLY TRANSMITTED DISEASES THAT IMPACT ON COMMUNITIES					
PREVENT TRANSMISSION, REDUCE PREVALENCE AND MITIGATE EFFECTS OF STDs	Develop Terms of Reference for STIs prevention programmes; targeting workers (No extra cost, except time).	C-->O	Spitsvale, Dept. of Health, Dept of Social Dev.	Environmental Health officers	Prevalence of STIs	Clinic data, medical records of occupational surveillance
	Include requirements for case-finding and treatment of curable STIs, peer educators programme, condom distribution, and Voluntary Counselling & Testing. (R 1200/h for skilled presenter in education programme).	C-->O	Spitsvale, Dept. Of Health, Dept of Social Dev.	Environmental Health officers	Prevalence of STIs	Clinic data, medical records of occupational surveillance
	Provide regular refresher courses for employees. (R 1200/h for skilled presenter plus advertising (R1000/event) and hiring of community venue).	C-->O	Spitsvale	Dept. of Health, Dept. of Labour, NGOs	Attendance of courses, testing of learning	Records of courses
RISK	POTENTIAL INCREASE IN LIFESTYLE-RELATED (NON-COMMUNICABLE) DISEASES DUE TO CHANGES IN LIFESTYLE					
INCREASE AWARENESS	Provide educational hand-outs for use in local clinics, schools.	C-->O	Spitsvale, Dept. of	Dept. of Education,	Prevalence of lifestyle-related	Clinic and hospital records, community surveys

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
ABOUT LIFESTYLE DISEASES	Competitions at schools. (Cost of pamphlets, judge of competition and competition prize(s)).		Health	other industries	diseases	
REDUCE ADVERSE IMPACTS OF NON-COMMUNICABLE DISEASES IN WORKFORCE	Programmes to support the psychosocial, emotional and mental health of workforce - screening for cancer, diabetes, high blood pressure, etc. Education on lifestyle behaviours including eating habits, exercise, responsible social choices. (R 1200/h for skilled presenter plus hiring of venue; Cost of medical materials necessary for screening for diseases at the mine clinic).	C-->O	Spitsvale	Dept. of Health, Dept of Edu.	Prevalence of lifestyle-related diseases in employees	Company records

C=construction; O=operation; D=decommissioning; Possible cost implications in brackets under specific actions.

Table 28. Health Action Plan related to Physical Infrastructure

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
RISK	TRANSMISSION OF COMMUNICABLE DISEASES DUE TO POOR HOUSING (INCLUDING OVERCROWDING) THAT MAY IMPACT ON THE COMMUNITY					
REDUCE OVERCROWDING	Collaborate with relevant departments on housing requirements i.e., total square meters vs. number of rooms, indoor cooking practices, etc. (No extra cost but time).	C-->D	Dept of Housing, Dept of Social Development	Spitsvale, Dept of Mining	No of people/hh	Community surveys, National surveys
IMPROVE VACCINATION COVERAGE	Collaborate with relevant departments on awareness creation around vaccinations to communicable diseases for vulnerable sub-populations such as children and old people. (No extra cost but time).	C-->D	Municipality, Dept. of Health	Spitsvale, NGOs	Prevalence of vaccinations	Clinic records
REDUCE THE PREVALENCE OF COMMUNICABLE DISEASES	Collaborate with relevant departments, schools for awareness creation and improved understanding of factors exacerbating communicable diseases, including coping strategies that result in behaviour	C-->D	Dept of Education, Dept. of Health	Spitsvale, NGOs	Prevalence of communicable diseases	Community surveys, National health surveys, notifiable disease register

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
	change. (No extra cost but time).					
	Initiate competitions at schools for illustrating innovative ways of improving conditions at home - either by reducing exposure, susceptibility or increasing coping capability. (No extra cost but time).	C-->O	Dept of Education	Spitsvale, Dept. of Health, NGOs, Env. Health officers	% uptake of innovative ideas in community, prevalence of communicable diseases	Community surveys (cell-phone-based), record of implemented ideas

C=construction; O=operation; D=decommissioning; Possible cost implications in brackets under specific actions.

Table 29. Health Action Plan related to Health Management and Infrastructure

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
RISK	INCREASED BURDEN ON EXISTING HEALTH SERVICES AS A RESULT OF INFLUX OF PEOPLE					
IMPROVE CAPACITY OF HEALTH SERVICES	Collaborate with clinics to identify opportunities for assisting with health services, specifically in terms of resources (including staff capacity) and maintenance issues. (No extra cost but time).	C -->D	Dept. of Health	Spitsvale, NGOs	Fully operational facilities/prop. of population, Doctor/patient and nurse/patient ratio, num. of beds/propor. of population, absenteeism	Health statistics, community surveys, staff training
	On-site health facility operational at the onset of construction. (Cost of establishing on-site health facility with skilled personnel).	C -->D	Spitsvale	Dept. of Health	Health services available to employees	Ratio Health workers/Employees Records (including nature of cases seen)
	Assist with the development of health-effect prevention plan to increase community resilience by improving coping capability, reducing exposure and reducing	C -->D	Dept. of Health	Spitsvale, All role players in area, community organisations	Prevalence of diseases	Health statistics, community surveys

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
	susceptibility of vulnerable sub-populations. (No extra cost but time).					

C=construction; O=operation; D=decommissioning; Possible cost implications in brackets under specific actions.

Table 30. Health Action Plan related to Food and Nutrition

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
RISK	INCREASE IN DEMAND FOR FOOD RESULTING FROM INFLUX OF PEOPLE INCREASING FOOD INFLATION					
IMPROVE NUTRITION	Collaborate with the Dept. of Health to conduct anthropometric monitoring (height, weight, age) within the potentially affected communities. (No extra cost but time).	C -->O	Dept. of Health	Spitsvale, NGOs	Prevalence of malnutrition as indicated by degree of stunting, underweight	Clinical records
	Assist with school feeding programmes, including education on food gardens, nutrition, and good nutritional habits. (No extra cost but time).	C -->O	Dept of Education, Dept of Social Development	Dept of Agriculture, Dept. of Health Spitsvale,	Prevalence of stunting, underweight etc at schools	Clinical records
	Competitions between schools on nutritional issues to create awareness. (Sponsor prize(s)).	C -->O	Spitsvale, Dept. of Health, Env. Health officers	Dept of Education	Prevalence of stunting, underweight etc at schools; degree of objectives achieved	Records of competition outcomes
	Temporary subsidising of basic foodstuffs, or assist local producers	C -->O	Dept Trade and Industry	Spitsvale, Dept. of	Prevalence of stunting,	Records of initiative outcomes

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
CURB FOOD INFLATION	with production of basic food in relief situations, assist with training of community care workers, assist with relief where necessary, also rehabilitation and development of affected vulnerable people. Assist and support local food producers (No extra cost but time).			Health, Env. Health officers	underweight etc at schools; degree of objectives achieved	
	Collaborate with local health-education services to provide materials (from food- and nutrition-related health-education programmes conducted for workers), to local health-education services and school programmes. (Cost of educational and awareness materials such as posters, pamphlets, board games and cost of graphic designer ± R 10 000).	C -->O	Spitsvale, Dept. of Health, Env. Health officers	Dept of Education,	Prevalence of malnutrition, % of population awareness of rollouts.	Clinic records, auditing of roll-outs
RISK	TRANSMISSION OF FOOD-BORNE DISEASES					
	Collaborate with local environmental health programmes	C -->O	Dept. of Health, Env.	Spitsvale	Prevalence of food poisoning	Notifiable disease records

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
REDUCE FOOD-BORNE DISEASES	to monitor food poisoning (No extra cost but time).		Health officers			
	Assist with food sanitation awareness materials to environmental health officers for educational sessions with food handlers, particularly vendors who sell food to workers. (Cost of educational and awareness materials such as posters, pamphlets, and cost of graphic designer ± R 10 000).	C -->O	Spitsvale, Dept. of Health, Env. Health officers	Dept of Education,	Prevalence of food poisoning, % of population awareness of rollouts	Clinic records, auditing of roll-outs, testing of food samples
	Food hygiene programmes: Building up of proper food handling facilities for food-handlers on and off-site (Cost of infrastructure for food handlers, including water and sanitation. Educating food handlers in safe handling of food (R 1200/h for skilled presenter plus materials such as pamphlets).	C -->O	Spitsvale, Dept. of Health, Dept. of Trade & Indus., Env. Health officers	Dept of Education,	% of population awareness of rollouts.	Clinic records, auditing of roll-outs

C=construction; O=operation; D=decommissioning; Possible cost implications in brackets under specific actions.

Table 31. Health Action Plan related to Environmental Pollution

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
RISK	POTENTIAL EXPOSURE TO AIR POLLUTION					
REDUCE EXPOSURE TO TRAFFIC-RELATED POLLUTION	Contribute to programmes to control vehicular pollution - emissions testing, specifications for optimal fuel efficiency. (Time and cost of emissions testing of mine fleet).	C-->D	Spitsvåle, Dept of Transport	Dept. of Health Dept. of Mining	Compliance to air quality guidelines	Concentrations of traffic-related air pollutants
	Programme to ensure proper company vehicle management. (No extra cost but time).	C-->D	Spitsvåle	Traffic Department.	% of maintained vehicles	Company fleet records
REDUCE EXPOSURE TO AIR POLLUTION	Collaborate with local health-education services to provide materials on issues of environmental exposure and how to prevent or reduce exposure. (Cost of educational and awareness materials such as posters, pamphlets, and cost of graphic designer ± R 10 000).	C-->O	Spitsvåle, Dept. of Environment	Dept of Education, Dept. of Health, Env. Health officers	Prevalence of illnesses of concern, achievement of objectives	Community surveys, focus group meetings,
	Manage particulate releases from dust roads and on-site dumps by	C-->D	Spitsvåle	Dept of Transport	Dust fallout measurements	Records

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
	spraying. (Cost of trucks, spraying materials and skilled drivers).					
	Assist efforts to create awareness about risks of exposure to domestic fuel use and implement cleaner fuel initiatives. (No extra cost but time).	C-->O	Municipality Department of Environment	Spitsvåle, Dept of Education, Dept. of Health, Env. Health officers, NGOs	Concentrations of related air pollutants, community surveys	Records, survey results
RISK	TRANSMISSION OF WATER-RELATED DISEASES (CHOLERA, ETC.), WORMS, RODENT- AND FLY-RELATED DISEASES AND EXPOSURE TO SEWAGE OUTFALL					
REDUCE RELEASES INTO SOIL, SURFACE WATER AND GROUNDWATER	Provide adequate ablution facilities (toilets) for workers at each work site and ensure the safe disposal of for example waste from chemical toilets. (Cost of ablution facilities: construction and maintenance of these facilities).	C	Spitsvåle		Number of employees per toilet; Condition of the toilet; Frequency of waste removal	Visual assessment; evaluation of service provider records
	Ensure that waste is stored appropriately and collected	C--> D	Spitsvåle	Municipality	Number and volume of	Records of internal log. Waste removal sign-in

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
	regularly. (Cost of developing and control of an appropriate waste management plan).				removals at specified intervals.	records, visual assessment
REDUCE IMPACT OF POLLUTION AT COMMUNITY LEVEL	Implement non-hazardous waste plans, including awareness and education in affected communities in collaboration with local waste management. (No extra costs but time).	C--> O	Management at Municipal level	Spitsvåle	Monitoring of issues to be implemented according to pre-set criteria	Implementation plan
	Awareness campaigns, School, competitions. (Time to assist with programmes and cost of sponsoring competition prize(s)).	C--> O	Dept. Of Environment, Municipality	Spitsvåle, Dept. of Health, Education, Community	Volume of solid waste recovered	Recycler survey
	Conduct health education programmes for workers regarding hygiene, housing, nutrition, soil, water and sanitation issues and related diseases. (R 1200/h for skilled presenter and hiring of venue).	C--> O	Spitsvåle, Dept. of Health	Dept of Education, NGOs	Prevalence of nutritional illnesses, nutrition-related diseases, water and sanitation-related diseases	Community surveys (cell phone-based), focus group discussions with leaders in community, minutes of meetings

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
	In collaboration with regulatory authorities, put in place plans for management of solid and liquid mine waste.(No extra cost but time).	O-->D	Spitsvæle, Municipality,	Dept. of Mining, Dept. of Environment	Surface and ground water quality parameters	Monitoring records and evaluation reports
RISK	INCREASED RATE OF VECTOR AND INSECT-RELATED DISEASES					
DECREASE/ PREVENT VECTOR-RELATED DISEASES	Manage the flow of the contours on site to prevent accumulation of standing water; manage potential sources on-site such as water and waste bodies (Cost of services of landscaper).	C -->O	Spitsvæle	Dept. of Health, Town Planning	Prevalence of vector-borne diseases	Notifiable disease records, hospital and clinic data, community surveys
	Conduct on-going survey programmes for vector-carriers such as rats, mosquitoes in potential affected communities (No extra cost but time).	C -->O	Dept. of Health, Municipality	Spitsvæle	Prevalence of vector-borne diseases, prevalence of vectors	Notifiable disease records, hospital and clinic data, community surveys
	Education, awareness of community on the sources of vector-borne diseases such as rats, mosquitoes and others, as well as the prevention and treatment	C -->O	Dept. of Health, clinics, Dept of Education, Dept. of	Spitsvæle	Prevalence of vector-borne diseases, prevalence of vectors	Notifiable disease records, hospital and clinic data, community surveys

OBJECTIVE	SPECIFIC ACTION	TIMING	RESPONSIBLE	POT. COLLABORATORS	KPI	SURVEILLANCE METHOD
	thereof (No extra cost but time).		Environment			

C=construction; O=operation; D=decommissioning; Possible cost implications in brackets under specific actions.

9 MONITORING AND EVALUATION (M&E)

The baseline assessment of the community's health and wellbeing provides a baseline from which the monitoring programme can judge whether the project or other factors are causing beneficial or harmful effects on local communities (ICMM, 2010). The IFC guidelines suggest that a company's mitigation strategy and health action plan should include both a long term community health monitoring (surveillance) and evaluation plan, as well as a verification programme (IFC, 2009). Such programmes are designed to 1) review progress on the project; 2) provide early warning of population level problems, whether at the single or cumulative effects levels, by identifying problems in planning and/or implementation; and 3) make adjustments in order to address unanticipated effects. As a result, an M&E programme requires clear key performance indicators in order to capture early unanticipated consequences, to institute remedial actions and to evaluate progress made on the objectives of the Health Action Plan.

It will be of value to form a group of different stakeholders that have the potential to be involved in establishing a coordinated data collection process. Inclusion of local government departments such as environment, health and others will help to understand and assist with improving the status of the local health information systems, including the reliability of the data accessibility in a timely manner so that early warnings of population-level issues may be raised. Community organisations should be included and community members could be employed as infopreneurs (an entrepreneur who specialises in information, thereby providing, promoting, and distributing knowledge) (Van Rensburg, 2008). Inclusion of other industries is important in order to avoid duplication of monitoring efforts. Such a group may also be able to provide more frequent informal data, even though it may be more qualitative assessments.

Verification

The verification process should start after 6-12 months' worth of information on the KPIs have been collected (IFC, 2009). Formal external verification for health performance should be done at selected time intervals, but should be creating a platform for more frequent community stakeholder involvement. Input may provide a continuous informal assessment process whereby issues relating to the indicators can be identified in good time.

Table 32. Key Performance Indicators (KPIs) for monitoring and evaluation of the Spitsvale Health Action Plan

KPI	TYPE OF HEALTH DETERMINANT	INDICATOR	MEASURE OF INDICATOR	TYPE OF ASSESSMENT	FREQ. OF ASSESSMENT	SOURCE OF INFORMATION
Structural Indicators	Access to adequate housing	Average household size, Average no of rooms per household	Household size, number of rooms	Community surveys at specified time intervals	Biennially	Dept of Housing, Municipality
	Population density	Change in population density	Number of households/people per square metre	Community surveys at specified time intervals	Biennially	Dept of Housing, Municipality
	Access to and use of health facilities	Change in health facilities per community (ratio); medical supplies	Number of clinics, medical practices, hospitals/per community or population	Community surveys at specified time intervals	Annually	Dept of Health, Municipality
Process indicators	Access to adequate sanitation	Change in the no of households/toilets	No of households/toilets	Community surveys at specified time intervals	Biennially	Dept of Environment
	Access to adequate water supply	Households with no running water in house or yard.	Number of households that has to fetch water further than 200 m from their home.	Community surveys at specified time intervals	Annually	Municipality

KPI	TYPE OF HEALTH DETERMINANT	INDICATOR	MEASURE OF INDICATOR	TYPE OF ASSESSMENT	FREQ. OF ASSESSMENT	SOURCE OF INFORMATION
	Access to secure water supply	Changes in access to secure water supply relative to baseline	No of households with more than 2-3 consecutive days without water	Community surveys at specified time intervals	Biennially	Dept of Environment Municipality
	Access to health care	Access to relevant health services relative to baseline	Maternal health child services and family planning	Community surveys at specified time intervals	Annually	Health data from Health information services
	Access to knowledge	Awareness and training on environment, health and safety; HIV/AIDS awareness and public health	Knowledge, attitudes, practices, beliefs on prevalent diseases	Community surveys at specified time intervals	Biennially	Dept of Social Development
Outcomes indicators	Death (mortality)	Rate of mortality relative to baseline	Mother and child mortality rates	Community/hospital surveys at specified time intervals	Annually	Death Register
	Diseases	Rate/prevalence of diseases of concern relative to baseline Appearance of new diseases	Rate of respiratory diseases, non-communicable diseases, communicable diseases, notifiable diseases.	Community surveys at specified time intervals	Annually	Health information systems, notifiable disease register

KPI	TYPE OF HEALTH DETERMINANT	INDICATOR	MEASURE OF INDICATOR	TYPE OF ASSESSMENT	FREQ. OF ASSESSMENT	SOURCE OF INFORMATION
		Anthropometric measures relative to baseline	Weight for age; height for age; height for weight	Surveys at clinics	Annually	Dept of Health, clinics
	Disability	Rate/prevalence of disability relative to baseline	Accidents Substance abuse	Community surveys at specified time intervals	Annually	Dept of Transport, Dept of Social Development,
	Dissatisfaction	Rate of dissatisfaction relative to baseline	Crime rates Pollution levels including noise	Helpline	Annually	Municipality, Police, Depts. of Environment, Housing
Verification	Review of progress	All aspect of the project	Progress on indicators related to various aspect of project	Stakeholder meetings. Ensure collected information is available on time.	Biannual, but also as required.	'Monitoring group'

Evaluation

In addition to evaluating KPIs relating to the different determinants of health, it is important to do a public health evaluation of the project, thereby asking whether 'the project achieved its overall aims and objectives in a way that protected and enhanced the health and well-being of local communities (ICMM, 2010). Such an evaluation should be taken at regular intervals (possibly every three years) by an independent agency. Mitigation and enhancement measures should be evidence-based when possible and developed in consultation with affected communities, NGOs, local government and local health and social care agencies (ICMM, 2010). An advisory group which includes a range of stakeholders within the area may enhance the value of such an evaluation.

Three aspects of the project may be evaluated, namely:

Process evaluation assesses the effectiveness of the programmes and programme actions and identifies who is involved. For Spitsvale it will involve design and implementation of the project and whether the following key values were considered:

- Transparency
- Democracy
- Equity
- Inclusivity
- Concern for the health and well-being of the community

Impact evaluation assesses structural aspects of the project such as buildings, equipment, medical supplies, vehicles, personnel, organisational arrangements. This will involve evaluation of the immediate effects or impacts of the mine on various structural components associated with the project during all phases. It will also evaluate whether recommendations from the HIA and feedback from the affected communities were used to modify and enhance project impacts on the local communities.

Outcome evaluation assesses the long-term effects of the various programmes within the project concerning death, disease, disability, discomfort and dissatisfaction. For Spitsvale the longer term effects and impacts of the mine over the lifetime of the project should be evaluated. Direct measurement of health outcomes may require establishing a wide range of demographic surveillance systems, preferably in collaboration with other relevant stakeholders such as local government and other business or industrial sectors.

Costs of Monitoring and Evaluation

Costs involved in the monitoring and evaluation as presented in Table 32 will be minimal, as information and secondary data may be sourced from other departments, municipalities and clinics. Should Spitsvale have a community survey done by an independent agency to obtain primary data, such a survey could cost in the order of R 600 000.

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