

Community Health Impact Assessment Study for the proposed Ferroalloys Plant, Coal Wash Plant-Coke Plant near MMSEZ, Limpopo

Prepared for

Gudani Consulting (Pty) Ltd



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0	Nolwazi Dlamini	Vumile Ribeiro	19 June 2025	

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Specialist Information

Title of Specialist Study:	Community Health Impact Assessment Study for the proposed Ferroalloys Plant, Coal Wash Plant-Coke Plant near MMSEZ, Limpopo
Specialist Company Name:	Niara Environmental Consultants (Pty) Ltd
Specialist Name:	Nolwazi Dlamini
Specialist Qualifications:	• BSocSc. (Geography and Environmental Management) University of KwaZulu Natal (2020); • Bsc Hons. (Geography) University of Witwatersrand (2021)
Professional Affiliation/Registration:	Environmental Assessment Practitioners Association of South Africa (EAPASA) EAPASA Reg. 2022/5249
Physical Address:	Office 1 Palm Place Office Park, 22 Bram Fischer Drive, Linden, Johannesburg, 2195
Postal Address:	Office 1 Palm Place Office Park, 22 Bram Fischer Drive, Linden, Johannesburg, 2195
Telephone Number:	+27 82 767 2786
Cellphone Number:	+ 27 83 690 9515
E-mail:	nolwazi@niara.co.za
Title of Specialist Study:	Community Health Impact Assessment Study for the proposed Ferroalloys Plant, Coal Wash Plant-Coke Plant near MMSEZ, Limpopo
Specialist Company Name:	Niara Environmental Consultants (Pty) Ltd
Specialist Name:	Vumile Ribeiro
Specialist Qualifications:	• BSocSc. (Geography and Environmental Management) University of KwaZulu Natal (2007); • BSocSc. Hons. (Environmental Analysis and Management) University of Pretoria (2011); • MPhil. (Environmental Law) University of Pretoria (current);
Professional Affiliation/Registration:	• Environmental Assessment Practitioners Association of South Africa (EAPASA Reg : 22019/1183).

Physical Address:	Office 1 Palm Place Office Park, 22 Bram Fischer Drive, Linden, Johannesburg, 2195
Postal Address:	Office 1 Palm Place Office Park, 22 Bram Fischer Drive, Linden, Johannesburg, 2195
Telephone Number:	+27 82 767 2786
Cellphone Number:	+27 82 767 2786
E-mail:	vumile@niara.co.za

Declaration by the Specialist

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

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing:
 - any decision to be taken with respect to the application by the competent authority; and
 - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.

Name of Specialist:	Nolwazi Dlamini
Signature of the Specialist:	
Name of Specialist:	Vumile Ribeiro
Signature of Specialist:	V. Ribeiro
Name of Company:	Niara Environmental Consultants
Date:	19 June 2025

Undertaking under Oath/Affirmation

I Nolwazi Dlamini and Vumile Ribeiro, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Name of Specialist:	Nolwazi Dlamini
Signature of the Specialist:	
Name of Specialist:	Vumile Ribeiro
Signature of Specialist:	V. Ribeiro
Name of Company:	Niara environmental Consultants
Date:	19 June 2025

Specialist Checklist

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

EIA REGULATIONS 2017 GNR 327, 325 and 324 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	In accordance with the EIA Regulations	Cross reference in this Report
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	✓	vi
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	✓	vi
(c) an indication of the scope of, and the purpose for which, the report was prepared	✓	vi
(cA) an indication of the quality and age of Base Data used for the specialist report	✓	79
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and the levels of acceptable change	✓	79
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	✓	38
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	✓	41
(f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives.	✓	107
(g) an identification of any areas to be avoided, including buffers;	✓	107
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	✓	Figure 3
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	✓	47
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	✓	79 - 152
(k) any mitigation measures for inclusion in the EMPr	✓	79 - 152
(l) any conditions for inclusion in the environmental authorisation;	✓	154
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	✓	154
(n) a reasoned opinion— i. whether the proposed activity, activities or portions thereof should be authorised; and (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	✓	157
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	✓	N/A
(p) any other information requested by the competent authority	✓	154

Executive Summary

Introduction

Designated by the Department of Trade and Industry in July 2016, the Musina-Makhado Special Economic Zone (MMSEZ) comprises two sites. The southern site, situated approximately 34 km from the northern site, is a Greenfield site earmarked for the development of energy and a metallurgical cluster for the production of high-grade steel. The southern site, which is the focus of this Health Impact Assessment (HIA), spans eight farms that straddle the border between the Makhado and Musina local municipalities within the Vhembe District Municipality (Department of Trade and Industry, 2016). The MMSEZ is envisioned as a catalyst for heavy industrial development within the Trans-Limpopo Spatial Development Initiative, aimed at attracting both foreign and domestic direct investment. Alongside the energy and metallurgical complex, the MMSEZ will include supporting infrastructure such as light industries, intermodal facilities, housing, retail centres, business hubs, community facilities, and telecommunication services (National Planning Commission, 2019).

Human health, the environment, and development are inherently interconnected, with changes in one sphere influencing the others. For instance, inadequate sanitation infrastructure can lead to public health crises and environmental degradation through water pollution (World Health Organization, 2021). Sustainable development demands that present needs be met without compromising the ability of future generations to meet their own, ensuring that environmental, social, and economic implications are carefully assessed (Brundtland Commission, 1987). The use of Health Impact Assessments (HIAs) is a relatively new process in South Africa, designed to ensure that often-overlooked health consequences are integrated into policy, program, and project planning. HIAs provide evidence-based recommendations to mitigate adverse health effects, enhance health benefits, and address disproportionate health impacts on vulnerable communities (Quigley et al., 2006).

This HIA evaluates the potential health implications of the proposed ferrochrome plant and provides mitigation measures to minimize adverse effects.

One of the primary concerns is air quality and respiratory health risks. The ferrochrome production process is associated with emissions of particulate matter, sulfur dioxide, and hexavalent chromium (Cr(VI)), all of which pose significant respiratory health risks (International Agency for Research on Cancer, 2018). Exposure to these pollutants may increase the prevalence of chronic respiratory conditions such as asthma, bronchitis, and lung cancer among workers and nearby communities (South African National Institute for Occupational Health, 2020).

Water quality and contamination risks also pose a significant threat. The plant's operations may lead to contamination of local water sources with heavy metals and other hazardous substances (Department of Water and Sanitation, 2019). Chronic exposure to pollutants such as chromium, lead, and other toxic elements could result in long-term health effects, including kidney and liver damage (Agency for Toxic Substances and Disease Registry, 2020).

Occupational health and safety hazards are another major concern. Employees working in high-temperature environments will be at risk of heat stress, burns, and chemical exposure (South African Department of Labour, 2021). Strict occupational safety measures, including the use of personal protective equipment (PPE) and routine medical screenings, will be essential in protecting worker health.

Noise pollution and its mental health effects must also be considered. Continuous industrial operations and heavy machinery use will contribute to significant noise pollution, which can result in hearing impairment, increased stress levels, and sleep disturbances among workers and nearby residents (World Health Organization, 2018).

Socioeconomic and community health impacts are also critical. While the project is expected to create employment opportunities and drive economic growth within the region, rapid industrialization and an influx of workers may strain existing public health services and infrastructure, leading to increased demand for healthcare, housing, and sanitation services (Statistics South Africa, 2020). Additionally, disruptions to traditional lifestyles and social structures may contribute to psychological and social stress within the affected communities (Department of Environmental Affairs, 2021).

To minimize the identified health risks, several mitigation strategies are recommended. Air quality management measures should be implemented, including advanced emissions control technologies and continuous monitoring of air pollutants (South African Air Quality Information System, 2020). Strict wastewater treatment protocols and routine monitoring should be established to prevent water source contamination (Department of Water and Sanitation, 2022).

Occupational health and safety programs should be strengthened, incorporating worker training, PPE distribution, and medical surveillance (International Labour Organization, 2019). Noise reduction measures such as soundproofing of facilities and operational scheduling to limit noise exposure should be adopted. Additionally, investment in local healthcare infrastructure is necessary to accommodate increased demand, alongside community health awareness initiatives (South African Health Review, 2021).

Ongoing stakeholder engagement will also be crucial in addressing community concerns and ensuring sustainable development. Transparency and continued dialogue between project developers, government authorities, and local communities will help mitigate adverse health impacts and foster long-term benefits for all stakeholders involved (Public Participation Guidelines for Environmental Impact Assessment, 2020).

The proposed ferrochrome plant within the MMSEZ presents significant economic opportunities but also poses potential health risks that must be addressed through proactive mitigation strategies. A commitment to stringent regulatory compliance, environmental stewardship, and community engagement will be essential in ensuring that industrial development proceeds sustainably while safeguarding public health. Continuous monitoring and adaptive management will be critical in maintaining a balance between economic growth and health protection in the region.

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

generations to meet their own needs and that the environmental, social and economic implications of any development project are considered to achieve development that is sustainable.

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

Methodology

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

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

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

Activities

The specific activities of the cHIA included:

- A desktop literature review outlining the host country and its community health profile;
- Collecting primary data by participatory means with the use of semi-structured questionnaires and key informant interviews with relevant stakeholders;
- Collecting additional secondary information that was not available in the public domain that is available in published and grey data ;
- Understanding the mine design, present and planned work activities, and location of PACs;
- Considering the potential human health impacts that the proposed mine development will have on the health of the respective communities;

- Determining the existing health needs of the community based on health strategies, infrastructure, programs, service priorities, delivery plans and challenges; and
- Developing evidence-based recommendations to avoid/mitigate negative and enhance positive impacts resulting from the proposed development.
- Health Impact Assessment Consultants from Niara consulted with medical personnel at a local health facility as well as local residents.

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

Conclusion and recommendations and Recommendations

The Musina-Makhado Special Economic Zone (MMSEZ) represents a significant strategic initiative aimed at promoting industrialisation, enhancing regional trade, and driving economic growth. While the development of the zone is expected to yield considerable economic and employment benefits, it also presents a range of potential public health risks, particularly for communities located within and around the project area.

This Community Health Impact Assessment (cHIA) has identified several priority health concerns, including air and water pollution, occupational health hazards, vector-borne diseases, increased traffic accidents, and pressure on existing health infrastructure. If left unaddressed, these risks could negatively impact the health and well-being of both workers and surrounding populations.

Nevertheless, the assessment demonstrates that these risks can be effectively managed through adequate planning and the implementation of appropriate mitigation measures. A detailed Health Monitoring Plan has been developed to support ongoing surveillance, facilitate timely intervention, and ensure accountability. The proposed health impacts, associated risks, and corresponding mitigation strategies are presented in Sections 13 to 15 of this report.

Based on the findings of this cHIA, the following conclusions and recommendations are presented:

- The project may proceed, provided that the identified mitigation measures and the Health Monitoring Plan are implemented in full and in a timely manner.
- These measures should be formally integrated into the Environmental Management Programme (EMPR) to ensure that they are regularly monitored, enforced, and reported on transparently.

- Public health considerations should be incorporated into every stage of the project lifecycle, including planning, design, construction, and operation. This requires close collaboration between project developers, government departments, health authorities, and local communities.
- Stakeholder engagement and health risk communication should be maintained continuously to promote awareness, community participation, and informed decision-making.
- The Health Monitoring Plan should be reviewed and updated periodically, taking into account data from ongoing monitoring activities, newly identified risks, and any changes in project scope or community health conditions.
- The project should also contribute to strengthening local health systems through investment in health infrastructure, personnel, and services as part of its broader commitment to sustainable development and social responsibility.

In conclusion, the MMSEZ has the potential to serve as a catalyst for regional development. However, its long-term success should not be measured by economic performance alone, but also by its ability to protect and promote the health of affected communities. By adopting a proactive, inclusive, and evidence-based approach, and by adhering to the recommendations outlined in this cHIA, the MMSEZ can achieve its development objectives while ensuring that public health is safeguarded and enhanced.

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List of Abbreviations and Acronyms

AIDS	Acquired Immunodeficiency Syndrome
ARC	Annualised Rate Of Change
ART	Antiretroviral Drug Therapy
CO₂	Carbon Dioxide
CO	Carbon Monoxide
CBD	Central Business District
CDC	Centres For Disease Control and Prevention
cHIA	Community Health Impact Assessment
CHMP	Community Health Management Plan
CV	Curriculum Vitae
DFFE	Department Of Forestry, Fisheries and The Environment
DMRE	Department of Mineral Resources and Energy
DoH	Department Of Health
DPM	Diesel Particulate Matter
e.g	Example
EMPR	Environmental Management Programme
EAP	Environmental Assessment Practitioner
EHS	Environmental, Health and Safety
EHA	Environmental Health Areas
EIA	Environmental Impact Assessment
GBD	Global Burden Of Disease
GWMF	General Waste Management Facility
GCL	Geosynthetic Clay Layer
GPN	Good Practice Note
GHGs	Greenhouse Gases
HIA	Health Impact Assessments
HRA	Health Risk Assessment
HIV	Human Immunodeficiency Virus)
HPV	Human Papillomavirus
IDP	Integrated Development Plan
IFC	International Finance Corporation

IPIECA	International Petroleum Industry Environmental Conservation Association
KII	Key Informant Interview
MRF	Material Recovery Facility
MMR	Maternal Mortality Ratio
CH₄	Methane
MPRDA	Mineral And Resources Development Act
MR	Mining Right
MDR-TB	Multi-Drug Resistant Tuberculosis
NEMA	National Environmental Management Act
NEM: AQA	National Environmental Management: Air Quality Act
NEM:WA	National Environmental Management: Waste Act
NHI	National Health Insurance
NHLS	National Health Laboratory Service
NO_x	Nitrogen Oxide
NCD	Non-Communicable Disease
PM;	Particulate Matter
PAC	Potentially Affected Communities
PS	Performance Standards
PHC	Primary Health Care
PPP	Public Participation Process
SADC	Southern African Development Community
SO₂	Sulphur Dioxide
SDG	Sustainable Development Goal
TMP	Traditional Medical Practitioners
TB	Tuberculosis
WML	Waste Management Licence
WHO	World Health Organization
U5MR	Under-5 Mortality Rates
UN SDGs	United Nations Sustainable Development Goals
VOCs	Volatile Organic Compounds
YLDs	Years Lived With Disability

1 Introduction

The proposed Musina-Makhado Special Economic Zone (MMSEZ) is located within the Makhado and Musina local municipalities under the jurisdiction of the Vhembe District Municipality in Limpopo Province. The primary strategic objective of the Limpopo Economic Development Agency (LEDA) is to accelerate industrial diversification through targeted economic development initiatives. The metallurgical cluster of the MMSEZ is primarily focused on mineral beneficiation within the Vhembe District and surrounding regions. This includes the processing of coking coal and other essential minerals, which are critical inputs for steel and iron production, aligning with South Africa's national industrialisation objectives and mineral beneficiation strategy (LEDA, 2020). Additionally, the MMSEZ is envisioned to support complementary land uses such as bulk infrastructure, light industries, intermodal facilities, housing, retail centres, business hubs, community facilities, and telecommunication services (Department of Trade and Industry, 2016). The zone is expected to generate employment opportunities for both skilled and semi-skilled workers, fostering economic growth in the region (Statistics South Africa, 2020).

In accordance with the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), a Scoping and Environmental Impact Assessment (EIA) process is mandated to obtain environmental authorisation for the MMSEZ development (Department of Environmental Affairs, 2021). To ensure that environmental health considerations are integrated into the EIA decision-making process, human health impacts must be assessed systematically before any project activities commence. Niara Environmental Consultants (hereafter, Niara) has been appointed by Gudani Consulting (Pty) Ltd to conduct a Health Impact Assessment (HIA) for the proposed MMSEZ project.

This HIA aims to evaluate the potential human health impacts of the project, particularly focusing on vulnerable populations, through an assessment of key health determinants identified in various specialist studies. The report is structured into multiple sections, including an analysis of health-related laws, the demographic profile of affected communities, existing health conditions, and a detailed evaluation of the project's potential impacts. Additionally, it presents mitigation measures to minimise adverse effects and enhance health outcomes (World Health Organization, 2021). The findings will contribute to informed decision-making, ensuring that the development of the MMSEZ proceeds in a sustainable manner that safeguards public health and well-being.

This HIA evaluates the potential health implications of the proposed ferrochrome plant and provides mitigation measures to minimize adverse effects.

One of the primary concerns is air quality and respiratory health risks. The ferrochrome production process is associated with emissions of particulate matter, sulfur dioxide, and hexavalent chromium (Cr(VI)), all of which pose significant respiratory health risks (International Agency for Research on Cancer, 2018). Exposure to these pollutants may increase the prevalence of chronic respiratory conditions such as asthma, bronchitis, and lung cancer among workers and nearby communities (South African National Institute for Occupational Health, 2020).

Water quality and contamination risks also pose a significant threat. The plant's operations may lead to contamination of local water sources with heavy metals and other hazardous substances (Department of Water and Sanitation, 2019). Chronic exposure to

pollutants such as chromium, lead, and other toxic elements could result in long-term health effects, including kidney and liver damage (Agency for Toxic Substances and Disease Registry, 2020).

Occupational health and safety hazards are another major concern. Employees working in high-temperature environments will be at risk of heat stress, burns, and chemical exposure (South African Department of Labour, 2021). Strict occupational safety measures, including the use of personal protective equipment (PPE) and routine medical screenings, will be essential in protecting worker health.

Noise pollution and its mental health effects must also be considered. Continuous industrial operations and heavy machinery use will contribute to significant noise pollution, which can result in hearing impairment, increased stress levels, and sleep disturbances among workers and nearby residents (World Health Organization, 2018).

Socioeconomic and community health impacts are also critical. While the project is expected to create employment opportunities and drive economic growth within the region, rapid industrialization and an influx of workers may strain existing public health services and infrastructure, leading to increased demand for healthcare, housing, and sanitation services (Statistics South Africa, 2020). Additionally, disruptions to traditional lifestyles and social structures may contribute to psychological and social stress within the affected communities (Department of Environmental Affairs, 2021).

To minimize the identified health risks, several mitigation strategies are recommended. Air quality management measures should be implemented, including advanced emissions control technologies and continuous monitoring of air pollutants (South African Air Quality Information System, 2020). Strict wastewater treatment protocols and routine monitoring should be established to prevent water source contamination (Department of Water and Sanitation, 2022).

Occupational health and safety programs should be strengthened, incorporating worker training, PPE distribution, and medical surveillance (International Labour Organization, 2019). Noise reduction measures such as soundproofing of facilities and operational scheduling to limit noise exposure should be adopted. Additionally, investment in local healthcare infrastructure is necessary to accommodate increased demand, alongside community health awareness initiatives (South African Health Review, 2021).

Ongoing stakeholder engagement will also be crucial in addressing community concerns and ensuring sustainable development. Transparency and continued dialogue between project developers, government authorities, and local communities will help mitigate adverse health impacts and foster long-term benefits for all stakeholders involved (Public Participation Guidelines for Environmental Impact Assessment, 2020).

The proposed ferrochrome plant within the MMSEZ presents significant economic opportunities but also poses potential health risks that must be addressed through proactive mitigation strategies. A commitment to stringent regulatory compliance, environmental stewardship, and community engagement will be essential in ensuring that industrial development proceeds sustainably while safeguarding public health. Continuous monitoring and adaptive management will be critical in maintaining a balance between economic growth and health protection in the region.

1.1 Project Locality

The Musina-Makhado Special Economic Zone (MMSEZ) is strategically located in the northern part of the Limpopo province, South Africa, offering significant advantages due to its proximity to key transport routes, raw material sources, and regional markets. The MMSEZ consists of two primary sites—Site 1 located in Antonvilla, Musina, and Site 2 situated approximately 50 km to the south of Musina, in the Makhado/Bokmakierie region. These sites are strategically positioned to maximize industrial growth, particularly in the metallurgical and logistics sectors, with additional potential for the future development of a petrochemical cluster.

Site 1 is situated in Antonvilla, Musina, an area well-connected to major transport routes, including the N1 national road that forms part of the North-South Corridor. This corridor is crucial for trade between South Africa and Southern African Development Community (SADC) countries, offering seamless access to regional markets. The strategic location of Site 1 near the Zimbabwean border further enhances its importance as a logistics and manufacturing hub, facilitating the movement of goods and services both within South Africa and across the SADC region.

Site 2, located approximately 50 km south of Musina in the Makhado/Bokmakierie area, is designated for the metallurgical cluster of the MMSEZ. The site's proximity to abundant raw materials, particularly in the mining and mineral processing industries, positions it as an ideal location for establishing a sustainable metallurgical hub. This area's rich resource base provides the foundation for mineral beneficiation processes that will support the broader South African industrialisation agenda.

Both sites are well-positioned to support the objectives of the MMSEZ, benefiting from excellent access to essential infrastructure, including transportation, electricity, and water services. The locality of the MMSEZ not only supports the movement of goods but also facilitates regional economic integration, ensuring that the zone can leverage its strategic position for industrialisation and economic growth in Limpopo and beyond.

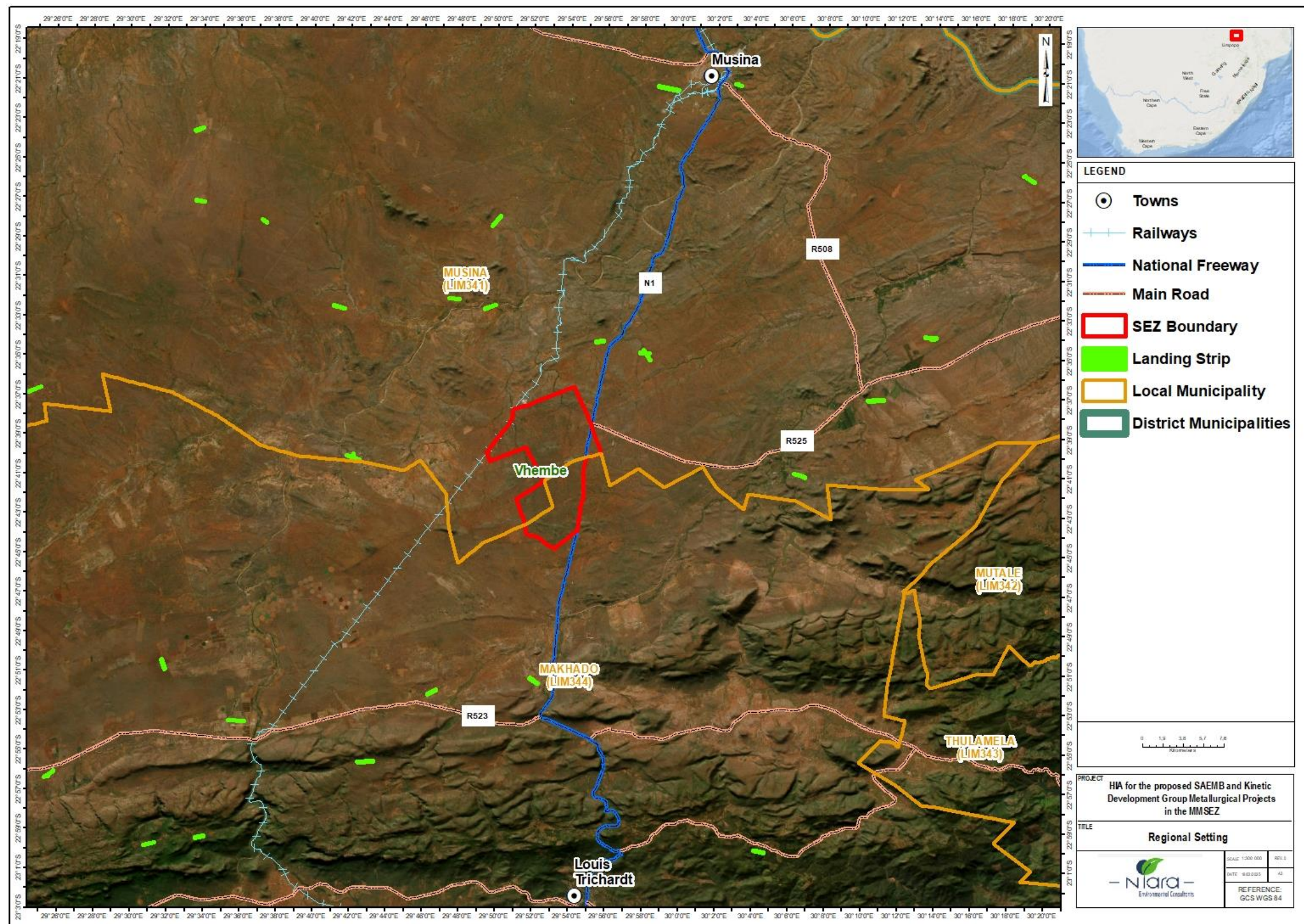


Figure 1 - Regional Setting

1.2 Property Description

The Musina-Makhado Special Economic Zone (MMSEZ) is strategically located in the northern part of the Limpopo province, South Africa, offering significant advantages due to its proximity to key transport routes, raw material sources, and regional markets. The MMSEZ consists of two primary sites:

- Site 1 is situated in Antonvilla, Musina, an area well-connected to major transport routes, including the N1 national road that forms part of the North-South Corridor. This corridor is crucial for trade between South Africa and Southern African Development Community (SADC) countries, offering seamless access to regional markets. The strategic location of Site 1 near the Zimbabwean border further enhances its importance as a logistics and manufacturing hub, facilitating the movement of goods and services both within South Africa and across the SADC region.
- Site 2, located approximately 50 km south of Musina in the Makhado/Bokmakierie area, is designated for the metallurgical cluster of the MMSEZ. The site's proximity to abundant raw materials, particularly in the mining and mineral processing industries, positions it as an ideal location for establishing a sustainable metallurgical hub. This area's rich resource base provides the foundation for mineral beneficiation processes that will support the broader South African industrialisation agenda.

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Table 1-1: Property Details

Farm Name	Portion 0 of ANTROBUS 566 MS Portion 0 of VAN DER BIJL 528 MS Portion 0 of SOMME 611 MS Portion 0 of LEKKERLAG 580 MS Portion 0 of STEENBOK 565 MS Portion 0 of WITKOP 617 MS Portion 1 of JOFFRE 584 MS Portion 0 of BATTLE 585 MS Portion 0 of DREYER 526 MS
Magisterial district	Vhembe District Municipality
Distance and direction from nearest town	50 km south of Musina
21-digit Surveyor General Code for each farm portion	TOMS00000000056600000

	T0MS00000000052800000
	T0MS00000000061100000
	T0MS00000000058000000
	T0MS00000000056500000
	T0MS00000000061700000
	T0MS00000000058400000
	T0MS00000000058500000
	T0MS00000000052600000

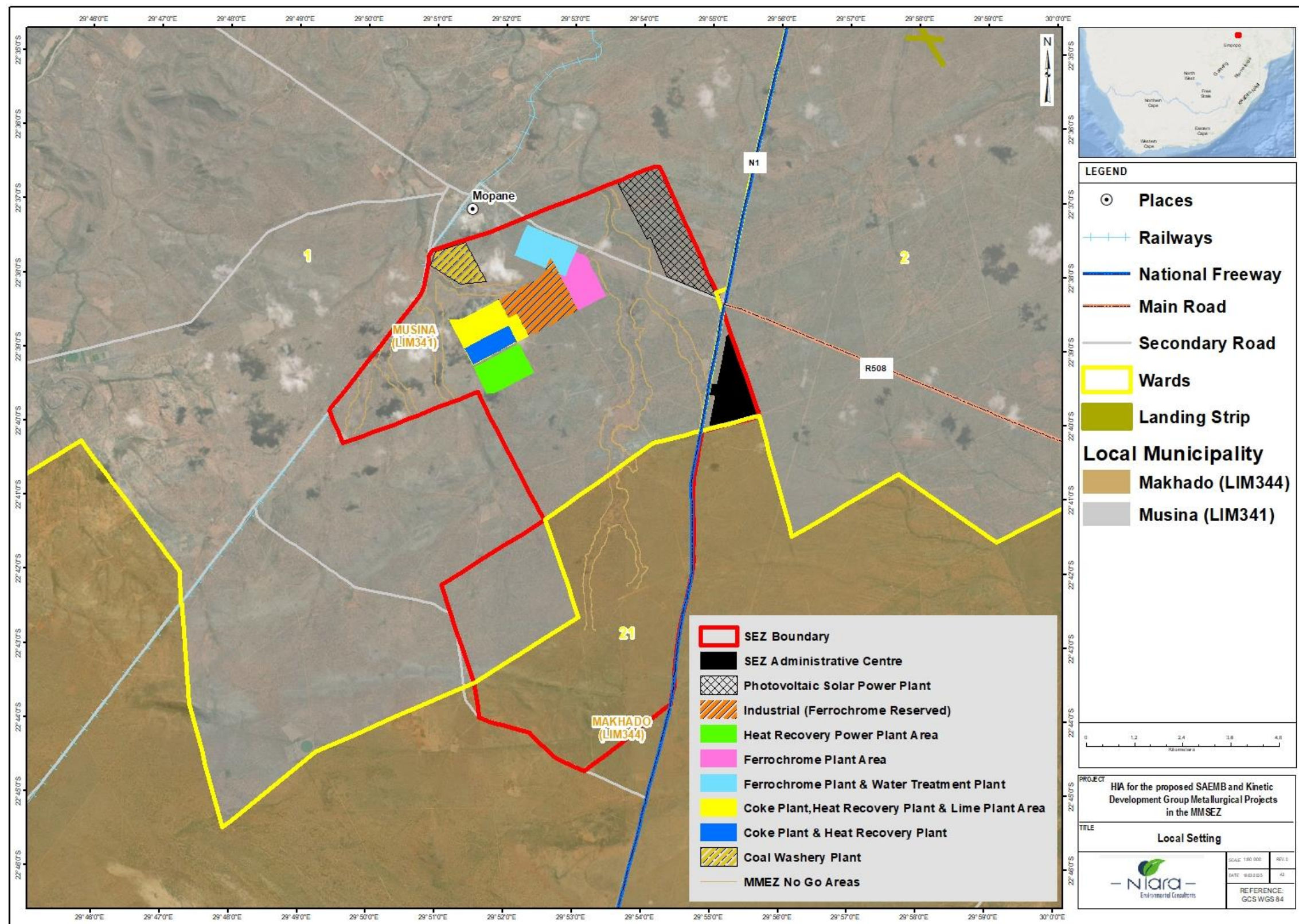


Figure 2: Local Setting

2 Project Description

The MMSEZ spans two primary sites, each chosen for its strategic location and suitability for industrial development. The total land area dedicated to the MMSEZ includes both Phase 1 and Phase 2 land allocations, with clear distinctions between the logistics and manufacturing hub at Site 1 and the metallurgical cluster at Site 2.

Site 1 covers an area of 375 hectares and has already been secured for Phase 1 of the MMSEZ development. This site is intended for the logistics and manufacturing components of the zone, with its location in Antonvilla offering easy access to key infrastructure, including the N1 national road. This site's proximity to the Musina town centre ensures efficient access to local services and amenities, while its location near regional transport corridors supports trade within South Africa and across the SADC region.

The site is well-equipped with essential infrastructure, including water, electricity, and transportation networks, which are essential for facilitating industrial activities. The established infrastructure and excellent connectivity make Site 1 an ideal location for the development of the MMSEZ's logistics and manufacturing sectors.

Site 2, located approximately 50 km south of Musina, spans 6,000 hectares and is designated for the metallurgical cluster of the MMSEZ. The site's proximity to key mineral resources, such as coal and iron ore, makes it an ideal location for mineral beneficiation activities. The land is owned by the Community Property Owner's Association (CPA), and 2,000 hectares have been allocated for Phase 1 of the development, with the remaining land set aside for future expansion.

The Makhado/Bokmakierie region is rich in natural resources, which will support the establishment of a metallurgical hub within the MMSEZ. The site also benefits from established infrastructure, including roads, power, and water supply, making it conducive to industrial operations. Furthermore, the area has a growing industrial base and access to skilled labour from nearby communities, ensuring that Site 2 can support long-term industrial development.

The land for Phase 1 of Site 1 is owned by the Musina Municipality, while Site 2 is owned by the CPA. The 3,150 hectares allocated for Phase 2 of Site 1 are in the process of being transferred from the Department of Public Works (DPW) to the Musina Municipality. This transfer process is expected to be completed in the near future. The ownership structure of the land ensures a legally sound and sustainable development process, with clear rights and responsibilities for all parties involved.

In summary, the MMSEZ covers a total area of 6,375 hectares for Phase 1 and an additional 3,150 hectares for Phase 2. The land is strategically located with access to key infrastructure and resources, providing a solid foundation for the development of logistics, manufacturing, and metallurgical industries. These properties, with their strategic location and available infrastructure, are ideal for supporting the growth and industrialisation of the region and the broader Southern African economy.

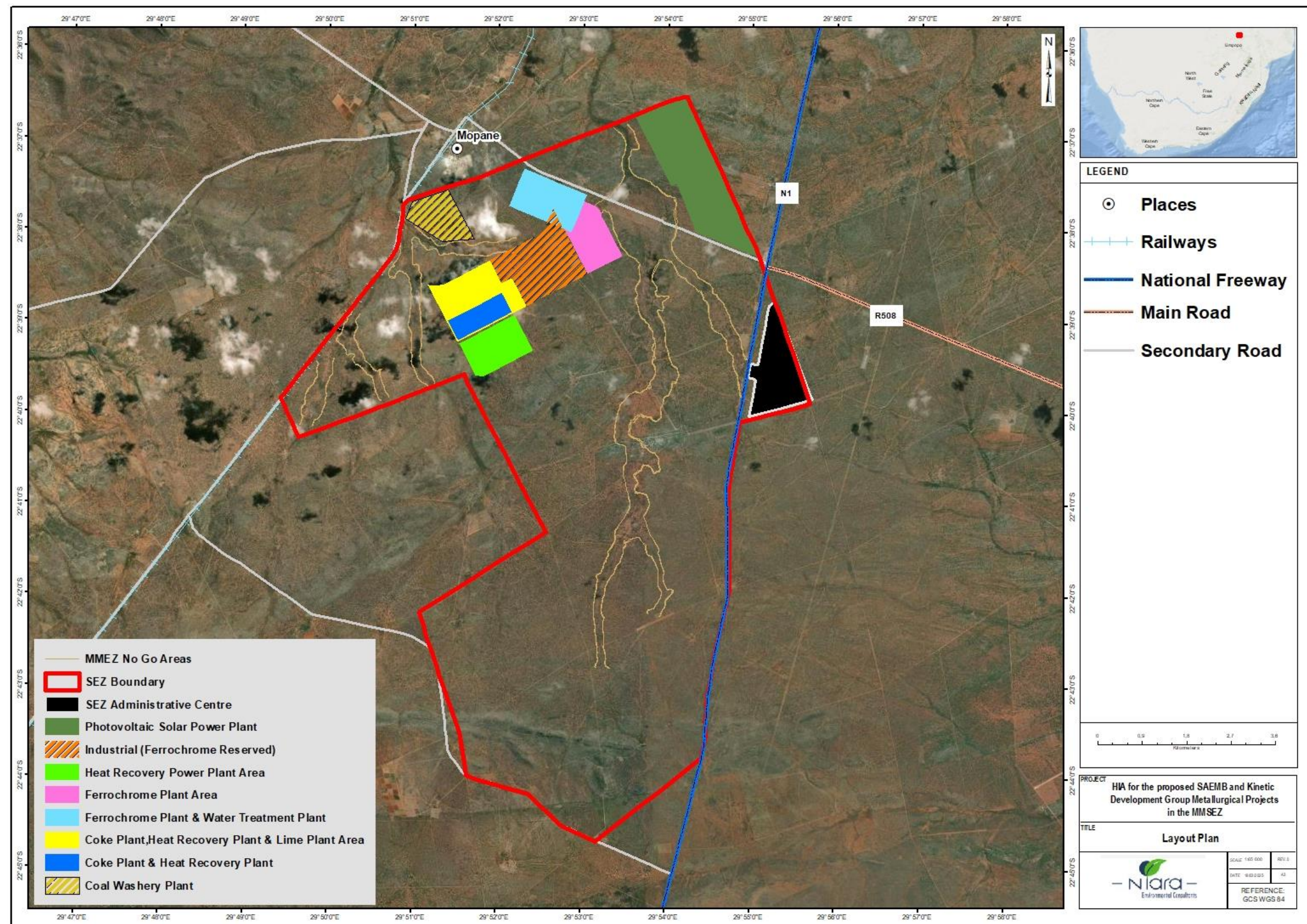


Figure 3 – Layout Plan

3 Terms of Reference

The purpose of this Health Impact Assessment (HIA) is to assess potential health related impacts associated with the proposed Musina-Makhado SEZ Project. It can be used to inform key Gudani decision makers, relevant South African Government authorities, other relevant stakeholders and to provide the Applicant with information to help identify management and mitigation measures. These mitigation measures aim to avoid, minimise and reduce potential health impacts.

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

The Terms of Reference for the cHIA comprised the following:

- A desktop review in order to outline the country and community health profile and to determine any data gaps;
- A field visit by an experienced member of the Niara's community health specialist team to:
 - Gather additional information that was not available in the public domain during the desktop review. This includes collection of information from health facilities, from the national health information management system, as well as from unpublished reports and documents;
 - Identify relevant stakeholders/informants and collect primary participatory data in the form of Focus Group Discussions with members of the potentially affected community. These individuals included both men and women, as well as different age groups, in these discussions. Discussions covered individual perceptions of health impacts, community lifestyles, and any traditional and local knowledge;
 - Review the standards of the local health facilities and functionality of the health management information system;
 - Gain first-hand knowledge of the Project setting and location of communities and farmsteads in relation to planned project activities; and
 - Review of other specialist studies conducted as part of the EIA to identify bio-physical impacts that may have health implications. Examples of such impacts include groundwater, since contamination of groundwater resources could affect the health of communities that rely on such resources.
- An impact assessment process which involved:
 - Considering the potential future health impacts that the proposed project will have on the health of the respective communities;
 - Determining the existing health needs of the community based on health strategies, infrastructure programs, service priorities, delivery plans and challenges;

- Based on the existing evidence, rating the likelihood and consequence of different health impacts to outline their significance and prioritisation for mitigation; and
- Considering recommendations for mitigation/management of priority impacts. Recommend measures to avoid/mitigate negative and enhance positive impacts resulting from the proposed Project at the relevant project stage.

Although the EI/ EMPr is framed in accordance with the Environmental Impact Assessment Regulations, 2014 (the EIA 2014 Regulations), this study has considered in addition the relevant provisions contained in the Equator Principles. These provisions had been derived from the principles themselves and the International Finance Corporation (IFC)'s Performance Standards and the Environmental Health and Safety (EHS) Guidelines. The Report has evaluated the different types of evidence from readily available information, to assess the health impacts associated with the proposed SEZ Project on the population of concern.

3.1 Inclusion of Future Industrial Waste Site

In South Africa, the burden of disease is significantly linked to environmental risk factors, with hazardous waste being identified as one of the top three major contributors. The management of both domestic and hazardous waste is a particular concern, especially in the context of large industrial developments, such as the proposed Musina-Makhado Special Economic Zone (MMSEZ). The Internal Master Plan for the MMSEZ, developed by iX Engineers (2019), recommends the establishment of a centralized Waste Management Area (WMA) to handle general waste and low volumes of hazardous waste. Additionally, the plan suggests the development of a separate hazardous waste management facility for the treatment and disposal of hazardous waste outside the MMSEZ complex.

The proposed Internal Master Plan has identified a potential site for an industrial and hazardous waste disposal facility near the MMSEZ, close to the community of Mopane. This proximity to a residential area raises concerns about potential health risks to the local population.

From a community health perspective, it is essential to conduct a thorough investigation into the most viable and financially feasible solutions for managing hazardous waste generated within the MMSEZ. These options include the transportation of hazardous waste to disposal facilities in Gauteng or the development of a local hazardous waste disposal facility near the MMSEZ. Several key health risks associated with waste disposal must be carefully considered, including:

- Organic domestic waste, which, if improperly managed, can ferment and create conditions that promote the growth of harmful microbial pathogens, posing a significant public health risk.
- Exposure to hazardous waste, which can have serious health effects, with children being particularly vulnerable to pollutants such as heavy metals and chemicals.
- Industrial waste, which can expose communities to chemical and radioactive hazards, especially when co-disposed with municipal waste.

- Medical waste, which requires careful handling and disposal due to the potential for transmitting infectious diseases and creating various health risks.

To mitigate these risks, stringent and careful waste disposal methods must be employed to ensure that hazardous waste does not pose a threat to the health of the Mopane community and the surrounding farming areas. In November 2020, Niara conducted a follow-up site visit to update baseline data and perform a systematic review of the health impact evidence regarding exposure to hazardous waste among those living near the proposed hazardous waste site, particularly the Mopane community and local farmers. This review included additional consultations with the affected community in Mopane. However, due to a lack of communication from the Project Manager, surrounding farmers were not consulted during this update, and feedback regarding human health was not received. Consequently, these comments have not been addressed in the report. Despite these limitations, the potential adverse health effects from exposure to hazardous waste have been comprehensively evaluated, providing critical insights for decision-making and community health protection.

3.2 Objective of the Specialist Study

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

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

The objectives were:

- To predict the likely impacts the proposed Project may have on the health of surrounding communities such as the Community and other surrounding land users; and
- To formulate mitigation measures to avoid or ameliorate negative community health impacts and to enhance positive ones.

This was achieved through:

- Evaluating various determinants of health, including those identified in the various specialist studies;
- Reviewing and assessing comments as received during the stakeholder engagement process; and
- Desktop and literature reviews.

4 Details and Expertise of Specialist

Nolwazi Dlamini is an experienced Environmental Consultant at Niara Environmental Consultants (Pty) Ltd, with three years of expertise in Geographic Information Systems (GIS), Water Use Licensing, Environmental Impact Assessments (EIA), and Air Emission Licensing (AEL), particularly within the mineral resources and energy sectors.

She has spent over two years as an Environmental Assessment Practitioner (EAP) in the mining industry, where she conducted various environmental assessments, including environmental audits, financial provision assessments, and Waste Management Licence (WML) applications. Her responsibilities also included Water Use Licence Applications (WULA), Basic Assessment Reports (BAR), Scoping and Environmental Impact Assessments (S&EIA), Community Health Impact Assessments, and the development of Environmental Management Programmes (EMPr).

Additionally, she has one year of experience as an Environmental Consultant in the petroleum industry, where she worked under an air quality specialist. In this role, she was responsible for environmental compliance monitoring for Engen depots and retail sites, EIA gap closure monitoring for retail and commercial sites, and ensuring compliance with Air Emission Licences (AEL) and Water Use Licences (WUL). She also contributed to the development of internal environmental procedures covering air emissions, waste management, and environmental safety.

Nolwazi is a skilled Environmental Assessment Practitioner with a deep understanding of the environmental and social impacts of various activities across different sectors. Her core competencies include research and report writing, specialist report review, and conducting comprehensive environmental impact assessments

Vumile Ribeiro is the Director of Environmental Management Services at Niara Environmental Consultants (Pty) Ltd. Vumile has fifteen (15) years of professional and international experience in Environmental Assessment and Management primarily in the Mineral resources and energy sector. Her roles include the operational management responsibilities of Niara Environmental Consultants, project management, report writing, client liaison, as well as business development.

Having worked for a multi-disciplinary advisory firms and environmental consultancies, Vumile has a competent understanding of the work effort and cross collaboration required for a successful multidisciplinary organisation. Vumile has been involved in a number of Environmental Impact Assessments and has a particular interest in health impacts assessments, water resource management, mining, energy and stakeholder engagement. Vumile has considerable experience across a range of developmental and environmental sciences and has worked in South Africa, Mozambique, Sierra Leone and Liberia and is familiar with Regulatory Environmental Legislation in other parts of Africa.

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

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

5 Overview of the Musina Makhado SEZ Project

Special Economic Zones (SEZs) are designated geographic areas within a country that are reserved for specific economic activities. These zones benefit from tailored arrangements, including legal frameworks and systems, which often differ from those governing the rest of the country.

The Musina-Makhado SEZ will feature a diverse mix of land uses and infrastructure to facilitate optimal manufacturing operations within the zone. The development is expected to include a comprehensive energy and metallurgical complex, incorporating various manufacturing plants, as detailed in the figure below.

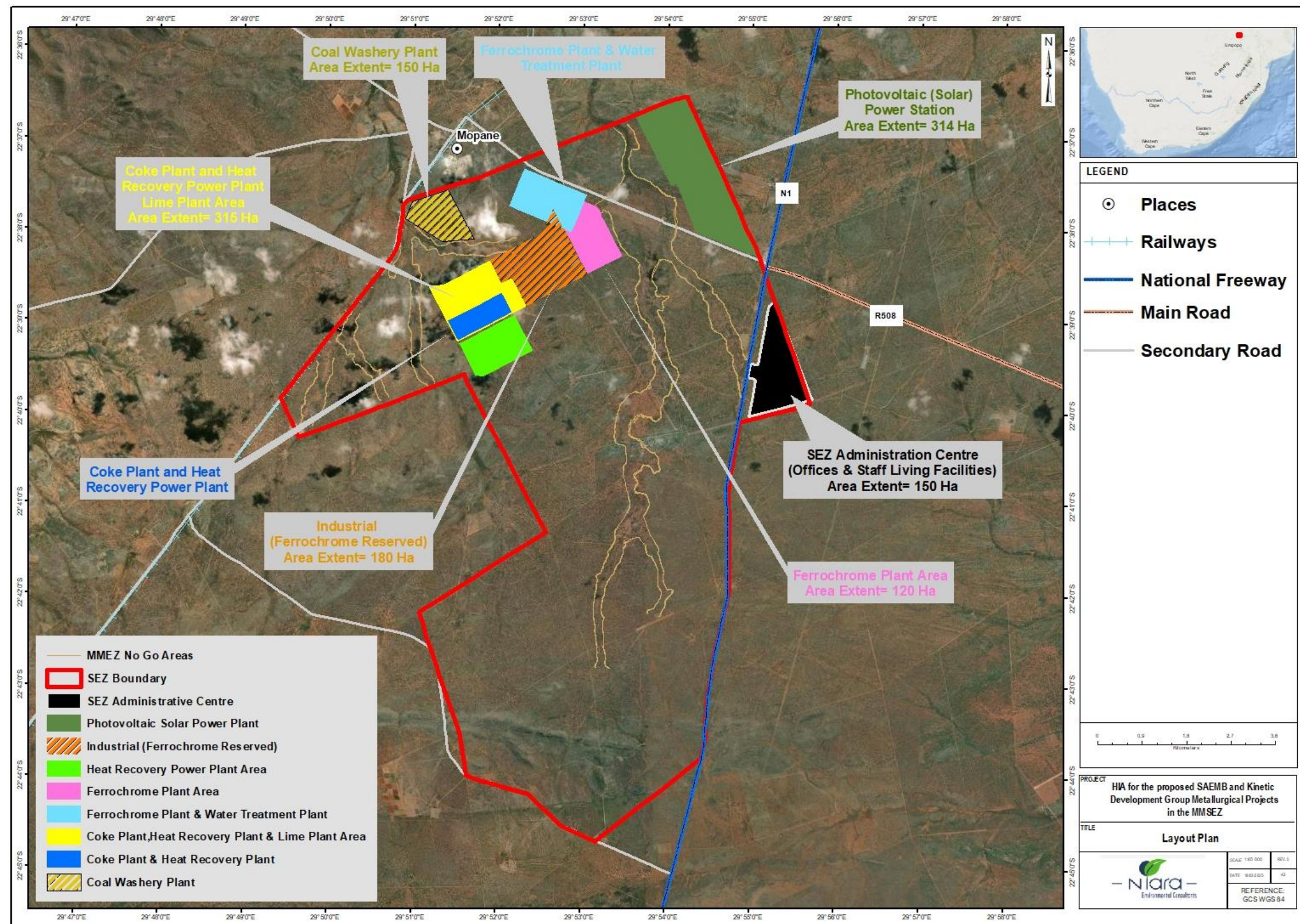


Figure 4 – Manufacturing Plants

6 South African Legislation Pertaining to Health

6.1 Constitution of the Republic of South Africa (Act 108 of 1996)

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

6.2 The National Health Act (Act 61 of 2003)

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

6.3 National Ambient Air Quality Standards

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

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

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

- Institutional frameworks, roles and responsibilities;
- Air quality management planning;

- Air quality monitoring and information management;
- Air quality management measures; and
- General compliance and enforcement.

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

Table 6-1: National Ambient Air Quality Standards for Criteria Pollutants

POLLUTANT	AVERAGING PERIOD	CONCENTRATION ($\mu\text{g}/\text{m}^3$)	FREQUENCY OF EXCEEDANCE ⁽³⁾
Sulphur dioxide (SO_2)	10 minutes	500 (191)	526
	1 hour	350 (134)	88
	24 hours	125 (48)	4
	1 year	50 (19)	0
Nitrogen dioxide (NO_2)	1 hour	200 (106)	88
	1 year	40 (21)	0
Particulate Matter (PM_{10})	24 hours	75	4
	1 year	40	0
Particulate Matter ($\text{PM}_{2.5}$)	24 hours	40 ⁽¹⁾	0
		25 ⁽²⁾	
	1 year	20 ⁽¹⁾	0
		15 ⁽²⁾	
Ozone (O_3)	8 hours (running)	120 (61)	11
Benzene (C_6H_6)	1 year	5 (1.6)	0
Lead (Pb)	1 year	0.5	0
Carbon monoxide (CO)	1 hour	30 000 (26 000)	88
	8 hours (calculated on 1 hourly averages)	10 000 (8 700)	11

Notes:

*Values indicated in blue are expressed in part per billion (ppb)

(1) Compliance required by 1 January 2016 – 31 December 2029.

(2) Compliance required by 1 January 2030.

(3) Frequency of exceedance refers to the number of times an exceedance is allowed within a calendar year.

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

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

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

These include the following:

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

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

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

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

- Remedying the impacts of the pollution.

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

6.5 GHG Emissions

On 14 March 2014, the following six greenhouse gases were declared as priority air pollutants in South Africa:

- Carbon dioxide (CO₂);
- Methane (CH₄);
- Nitrous Oxide (N₂O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF₆)

National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), were published by the DEA (now known as DEFF). A person identified as a Category A data provider in terms Annexure 1 of these regulations, must register their facilities by filling in the form under Annexure 2 of these regulations and must submit a GHG emissions inventory and activity data in the required format given under Annexure 3 of these regulations on an annual basis. All data must be provided annually, by the 31 March of the following year. Data providers are required to register on the NAEIS and report on their direct GHG emissions on an annual basis and comply with the reporting requirements as detailed in the National GHG Emission Reporting Regulations.

National Pollution Prevention Plan Regulations (Gazette No. 40996) were published on 21 July 2017 by the DEA (now known as DEFF). A Pollution Prevention Plan will be required should the development do the following:

- Undertake any of the following activities identified in Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents (CO_{2-eq}); or
- Undertake any of the following activities identified in Annexure A of the National Pollution Prevention Plan Regulations (Gazette No. 40996 of 21 July 2017) as a primary activity, which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents (CO_{2-eq});

Annexure A activities in terms of the National Pollution Prevention Plan Regulations include:

- Coal mining
- Production and /or refining of crude oil
- Production and/or processing of natural gas
- Production of liquid fuels from coal or gas
- Cement production
- Glass production
- Ammonia production
- Carbon black production
- Iron & steel production
- Ferro-alloys production
- Aluminium production
- Polymers production
- Pulp and paper production
- Electricity production
- Nitric acid production

6.6 Other Relevant Legislation

Following the 2019 General Election, a number of health-related Bills have lapsed. The National Health Laboratory Service Amendment Bill, first introduced in 2017, was passed by Parliament in February 2019, and assented to by the President as Act No. 5 of 2019. However, the linked National Public Health Institute of South Africa Bill, also introduced in 2017, which passed its Second Reading in the National Assembly in August 2018 and was referred to the National Council of Provinces, has not progressed further.

Acts and Regulations pertaining to health and environmental, and health in particular, are indicated in Table 6-2 below.

Table 6-2: Acts and Regulations relevant to Health and Environmental Health

National legislation	Relevance to cHIA
Atmospheric Pollution Prevention Act (Act 45 of 1965)	Hazardous substances associated with air pollution affect human health. This Act has identified some of the activities for which authorization for emissions is required from the DEA (DOH, 2010).
National Environmental Management: Waste Act (Act 59 of 2008)	The objectives of this Act are to protect health, well-being and the environment; to ensure that people are aware of the impact of waste on their health, well-being and the environment; to provide for compliance with the measures set out in the Act and to give effect to Section 24 of the Constitution to secure an environment that is not harmful to health and well-being (DOH, 2010).
National Water Act (Act 36 of 1998)	The quality of water in domestic water sources impacts on human health. The Act provides for the protection of water quality for the benefit of human health and aquatic ecosystems through the concept of the reserve determination process (DOH, 2010).

National legislation	Relevance to cHIA
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)

6.7 International Management Standards

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

The objectives of this PS4 are:

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

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

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

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

Key requirements include:

- Evaluation of the risks and impacts of the affected community during the design, construction, operation and decommissioning of the Project;
- Where the Project poses risks to the health, safety and security of communities, an Action Plan will be disclosed on an on-going basis to enable the community to understand the risks and adverse impacts;
- The design, construction, operation and decommissioning of the Project will be in accordance with good international industry practice. Particular consideration will be given to potential exposure to natural hazards;

- Adverse impacts on soil and groundwater as a result of the proposed Project will also be avoided;
- The transmission of communicable diseases from temporary or permanent labour will be minimised;
- Risks and impacts from Project activities will be assessed and communicated in a culturally-appropriate manner. Emergency community situations shall be addressed; and
- Where employees or contractors are retained to provide security, the risks to those inside and outside the Project site will be assessed.

The IFC Environmental, Health, and Safety Guidelines include community health, safety and security aspects.

The Guidelines address aspects related to:

- Water quality and availability – preventing adverse impacts to the quality and availability of groundwater and surface water resources, and protecting drinking water sources, whether public or private, at all times;
- Structural safety of Project infrastructure – reducing potential hazards posed to the public while accessing Project facilities, and undertaking hazard analysis to identify opportunities to reduce the consequences of a failure or accident;
- Life and fire safety – design, construction and operation of all new buildings accessible to the public in accordance with building codes, fire regulations, legal/insurance requirements, and an internationally accepted Life and Fire Safety (L&FS) standard. Fire prevention, means of egress (design measures that facilitate safe evacuation in case of an emergency), detection and alarm systems, and an emergency response plan are important elements of the life and fire safety provisions;
- Traffic safety – preventing traffic accidents and promoting traffic safety by all Project personnel;
- Transport of hazardous materials – establishing procedures to ensure compliance with local laws and international requirements applicable to the transportation of hazardous materials, as well as measures presented for preventing or minimizing the consequences of catastrophic releases of hazardous materials;
- Disease prevention – preventing the occurrence and spread of communicable;
- Diseases, including surveillance, active screening and treatment of workers, undertaking health awareness and education initiatives in local communities, and providing health services; and
- Emergency preparedness and response – preparing Emergency Preparedness and Response plans commensurate with the risks of the facility, including provisions for communication systems, community notification, media and agency relations, medical services, etc.

6.7.1 The Polluter Pays Principle

“Polluter pays principle” (PPP) requires the producers or generators of pollution to pay for the costs of avoiding pollution or of cleaning up or remedying its effects. The polluter pays principle is an important cornerstone of environmental law and is generally accepted

as an economic principle aimed at consumer protection. Therefore, any pollution generated by a process must be paid for from within the cost structure of production. The polluter pays principle may also be applied to impose sanctions for wrongful conduct, or to require correct measures to restore a given environmental asset to its pre-damage condition. This Principle is a very effective way followed by public authorities and countries in respective to encourage rational use of scarce environmental resources (UNCED, 1992).

Pressure on industry to reduce wastage comes from both internal and external economic drivers. Producer responsibility initiatives – already in place or proposed for a range of goods from batteries and packaging to vehicles and electronic equipment – make industry responsible for its products after use, and should result in fewer harmful components, as well as, design decisions which will make disassembly and recycling easier.

National Environmental Management Act (Act 107 of 1998): Framework legislation -overall template of environmental law in the country and provides guidance to sectoral legislation. Section 4(p) states that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

6.8 Company Management Standards

The Applicant does not yet have a specific management standard that addresses community health or supports the use of HIA as a tool. However, as part of the Applicant's commitment to work with communities within which it operates, community healthcare is a key focus. The Applicant is committed to providing a safe, injury free and healthy place to live and work – the health and safety of the residents, employees and contract workers in their respective homes and adjoining communities is a key priority.

7 Health Impact Assessment Framework and Methodology

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

7.1 Environmental Health Areas

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

The IFC methodology uses twelve (12) Environmental Health Areas (EHAs) to support the systematic analysis of health considerations. These are summarised in Table 7-2.

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

7.2 Potentially Affected Communities

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

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

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

As part of the analysis, the relevant overall population is stratified into PACs. A PAC is a defined community within a clear geographical boundary where project-related health impacts may reasonably be expected to occur. PACs are inherently prospective and simply represent best professional judgments. PACs are likely to change over the course of project implementation; and there

may be changes in the project design, and thus its longer-term implications are not fully known. This implies that the definition of PACs may need further adaptation as the project moves ahead; therefore, the specification of a PAC should be viewed as time-dependent as it will evolve over the project cycle. Findings of social and economic assessments, resettlement plans and migration management plans need to be carefully updated as this allows linkage between the PACs and key demographic determinants such as age structure and population numbers.

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

The properties adjacent to the proposed Project is mainly wilderness and agriculture, with significant mining activities in the larger area. There are dispersed dwellings in the area associated with agricultural activities. Makhado is another important town in close proximity to the MMSEZ and could be impacted by the development of industrial activities in the region.

7.3 Introduction and Definition

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

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

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

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

7.4 Determinants of Health

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

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

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

Figure 5 illustrates the general relationship between an activity, the impacts activities can have on health determinants, and the resulting influences and changes to health-related outcomes. These determinants of health encompass all 12 EHAs.



Figure 5: Activity Impacts, Health Determinants and Health-Related Outcomes

7.5 Overview of the cHIA Process

A standardised approach was considered for the cHIA to ensure that evidence-based recommendations supported the impact assessment. To ensure compliance with the IFC performance standards, and especially PS4, the methodology outlined in the Good Practice Note for cHIA from the IFC, was adopted (IFC, 2009). The main elements of this are illustrated in Figure 6. These are also discussed briefly below so that the context of the cHIA is understood.

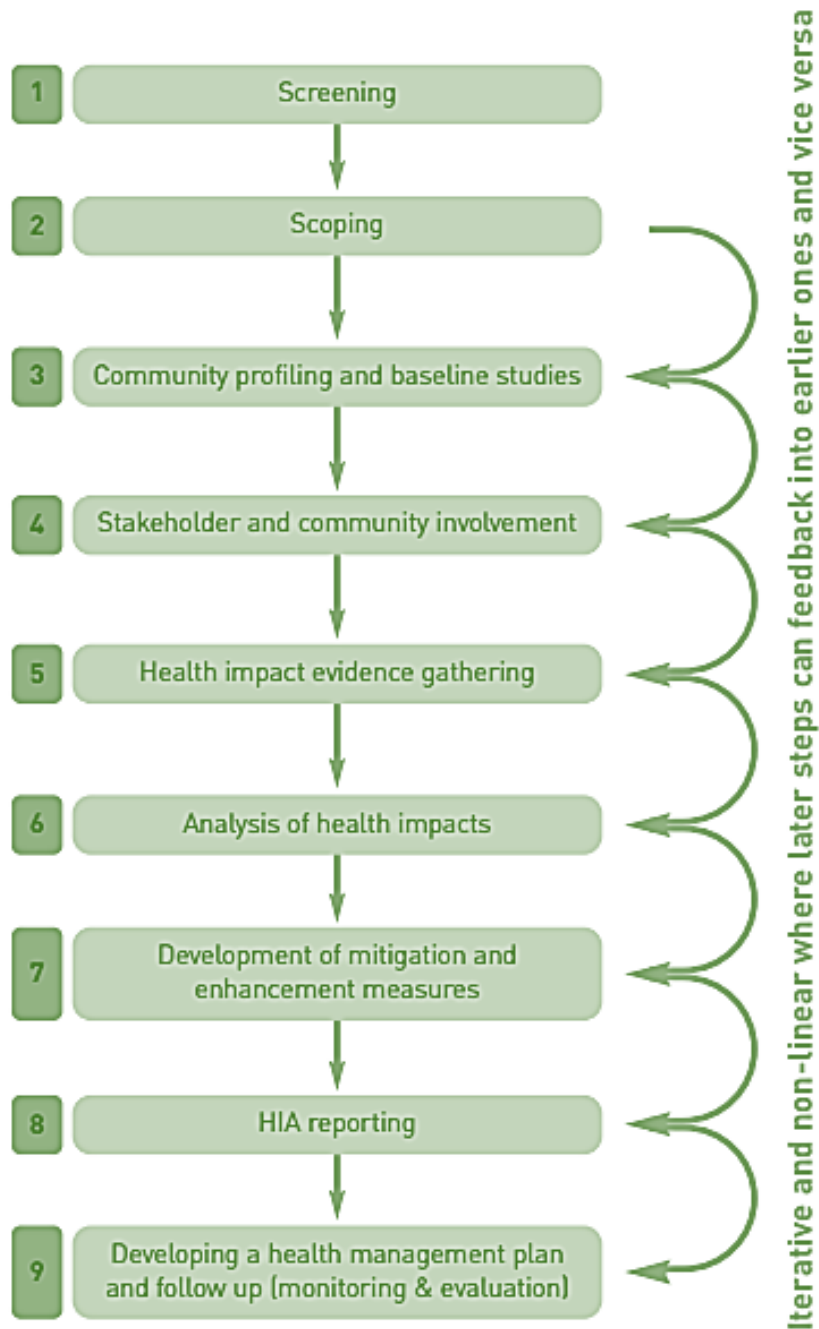


Figure 6: cHIA Procedure

Source: CMM, 2010

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

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

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

Figure 7 shows a decision-flow diagram outlining the decision steps, and the key questions to consider, from screening to a rapid in-house cHIA and onto a more formal rapid or in-depth cHIA.

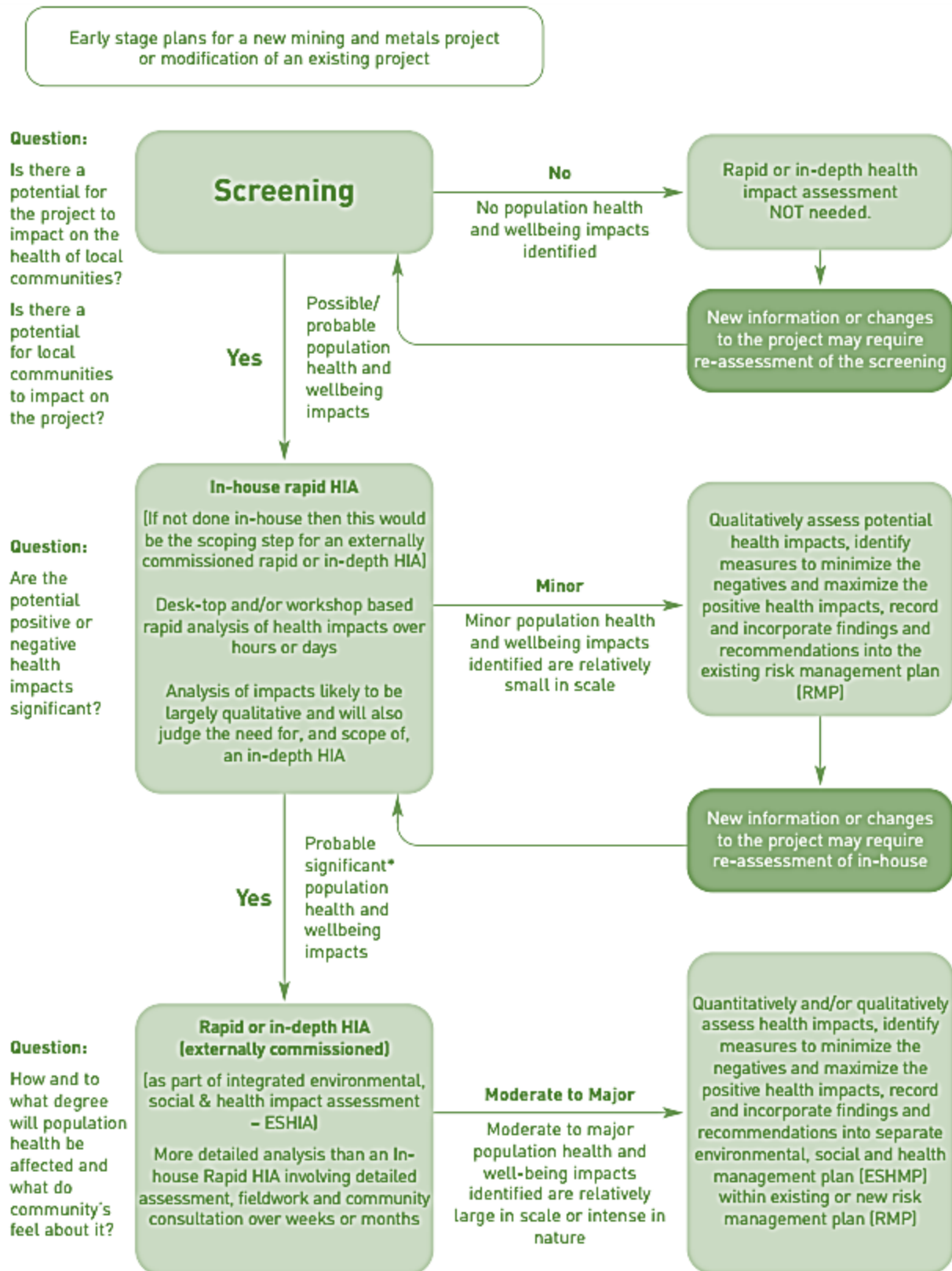


Figure 7: Decision tree for Health Impact Assessment

7.6 Benefits of cHIA

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

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

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

- Speedier achievement of a mining project's licence to operate;
- Lower planning and associated legal and consultancy costs;
- Access to international funding;
- Lower risk of disruptive protest or sabotage;

- Lower risk of damage to a project and parent company's reputation;
- Lower risk of future community-led liability and litigation;
- Reduced absenteeism and health care costs for employees from local communities; and
- Improved general employee morale.

7.7 HIA and Project Timeline

Ideally a cHIA should be undertaken as early as possible in a project's design, iteratively and in parallel with project planning, with cHIA results timed to inform key decisions. At the initial concept stages of planning, when details are sketchy, an in-house rapid cHIA can be useful. Rapid cHIAs are 'first look' desk-based analyses that take hours, days or sometimes a few weeks to carry out. They aim to provide a quick overview of the potentially important impacts so that emerging community health issues can inform the early project design and planning process. They generally do this by undertaking a rapid community profile and review of the health impact research literature; and by using existing community feedback.

As the project plan is developed in more detail, a more formal rapid or in-depth cHIA should be completed with the help of relevant specialists either as a standalone assessment or as part of an integrated environmental, social and health impact assessment (ESHIA). Figure 8 shows a timeline of when key assessments can be undertaken during the lifecycle of a mining project and how they can feed into each other.

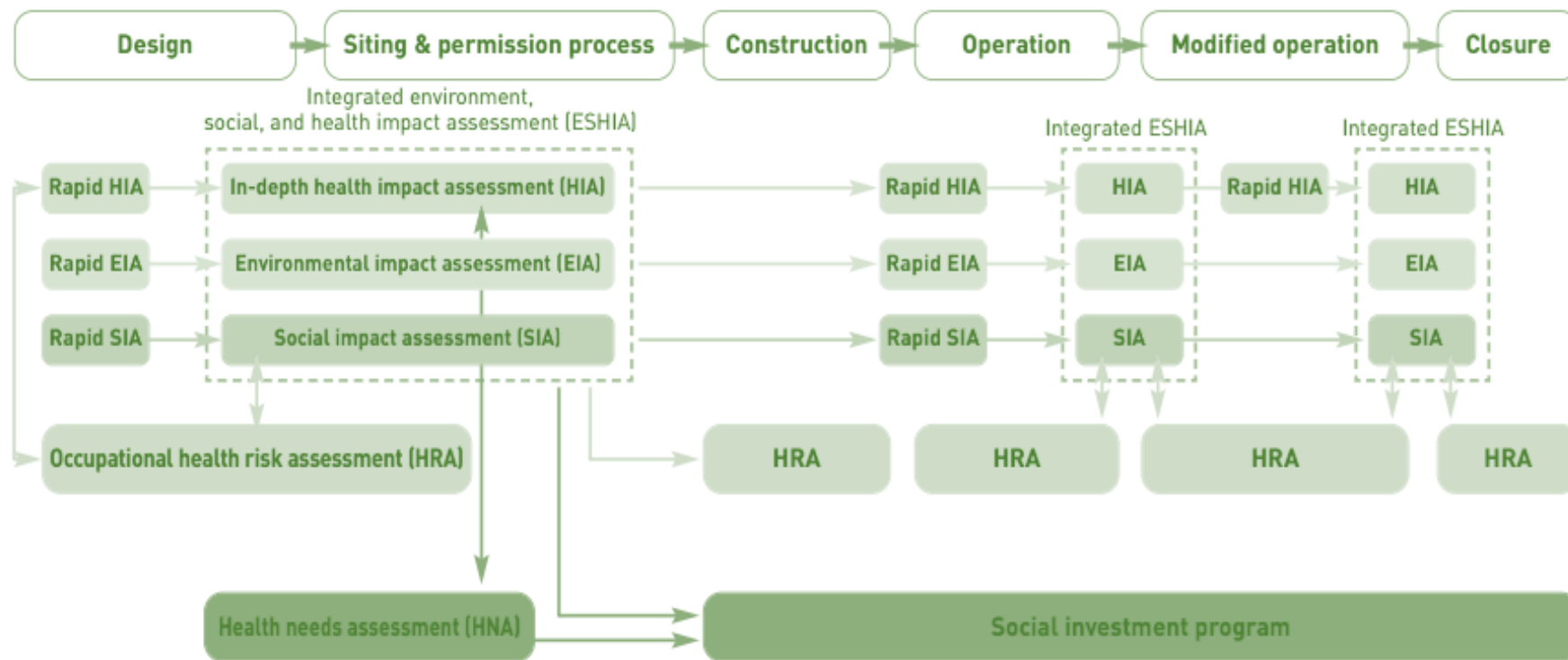


Figure 8: Project Timeline showing when cHIA, EIA, SIA, Occupational Health Risk Assessment (HRA) and Health Needs Assessment (HNA) can be undertaken during a Project's Lifecycle

Source: CMM, 2010

7.8 Determining the scale of the cHIA

The level or scale of a cHIA depends on the complexity of the Project, the magnitude of expected impacts, as well as the Project phase during which the cHIA is undertaken. Various levels of cHIA are defined in Table 7-1.

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

In Figure 9, the ‘potential health impact’ axis considers health issues in the Project location, such as:

- Hazardous materials exposure—how the mine will operate, and what the exposures to physical, biological, and chemical agents will be;
- Endemic disease profile;
- HIV/AIDS, tuberculosis, schistosomiasis, etc.;
- Health systems and infrastructure—poor or non-existent health infrastructures; and
- Stakeholder concerns—critical community issues, such as water quality or access, increased road traffic and accidents.

The ‘social sensitivity’ axis in Figure 9 covers a broad range of issues, many of which are typically addressed within the social analysis of the potentially affected communities (for example, conflict, resettlement, political factors, vulnerable communities, human rights, and equity concerns). The vulnerable status includes factors such as gender, ethnicity, culture, sickness, physical or mental disability, poverty or economic disadvantage, and dependence on unique natural resources (IFC, 2012).

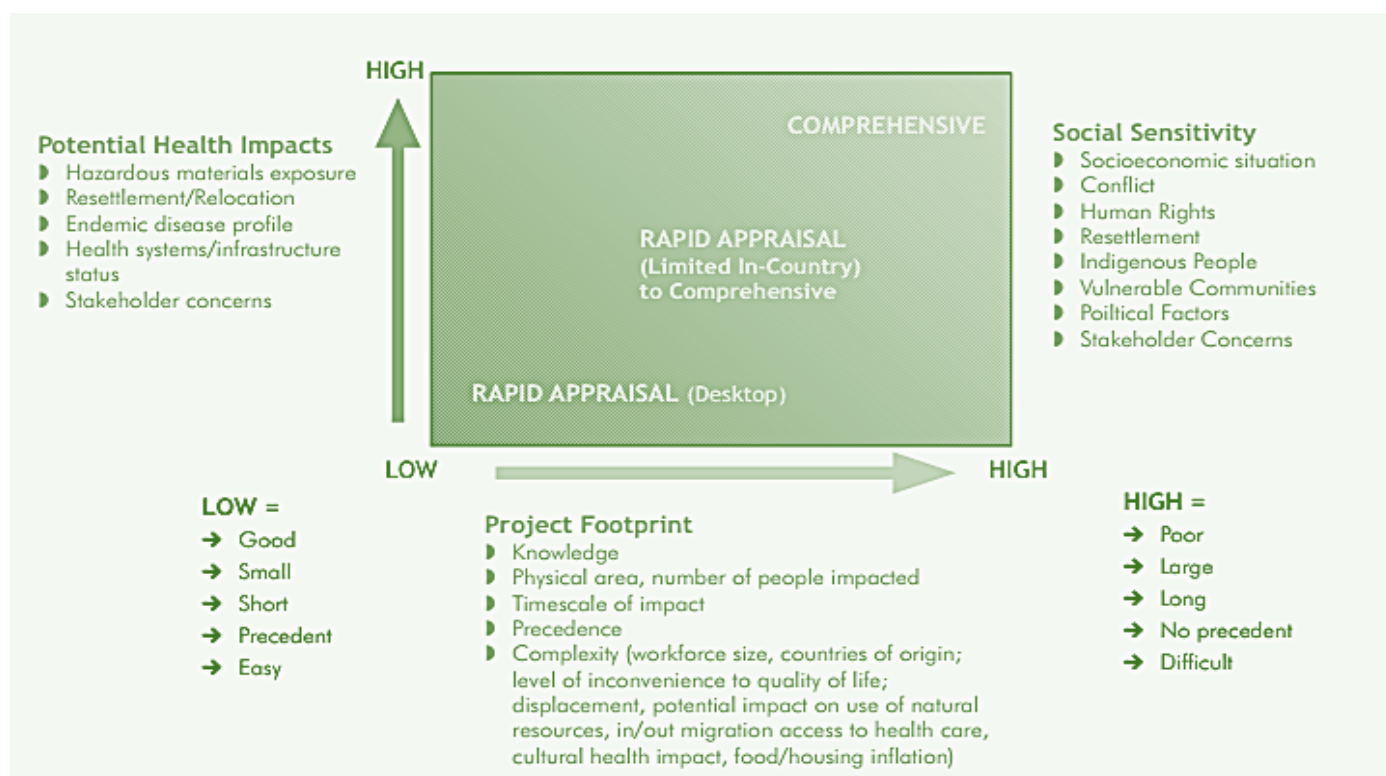


Figure 9: Selecting a cHIA Type

Source: CMM, 2010

Since the Project is a relatively big and an influx of new residents (however few) is expected, a Comprehensive HIA was deemed necessary, as opposed to Rapid Appraisal or Desktop HIA. An essential element of the comprehensive HIA is the need for some type of new data collection in potentially affected communities, and for helping to predict changes in health determinants, the associated risks, and health outcomes.

A Limited In-Country HIA uses information that is readily accessible in the public domain. Data sources may include peer-reviewed scientific literature and “grey literature,” that is, health department data. Although no specific new data collection is required, workshops or discussions with key internal and external stakeholders can provide useful health-related information. Limited in-country HIAs are appropriate for many expansion scenarios where new data collection is not crucial (IFC, 2009). The activities undertaken in the limited in-country HIA are highlighted in Table 7-1 and formed the basis for this study.

Table 7-1: Levels of cHIA

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

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

Source: IFC, 2009

7.9 Stakeholder Analysis

Stakeholders are vitally important throughout the entire cHIA process. The experience and expertise of a wide range of stakeholders and key decision makers are necessary as it aids in identifying potential concerns and hazards surrounding human health. Public participation ensures that community concerns are noted and addressed. Stakeholders include some of the following:

- Community representatives;
- Proponent of development project;
- Specialists;
- NGOs; and
- Representatives from various authorities ranging from local to national government.

7.10 Baseline Data Collection

The data collection activities of the cHIA included a desktop literature review, participatory data collection (stakeholder input – informal, randomly selected discussions) and direct observation. This method allows for the triangulation of data and provides a robust description of data as shown in Figure 10.

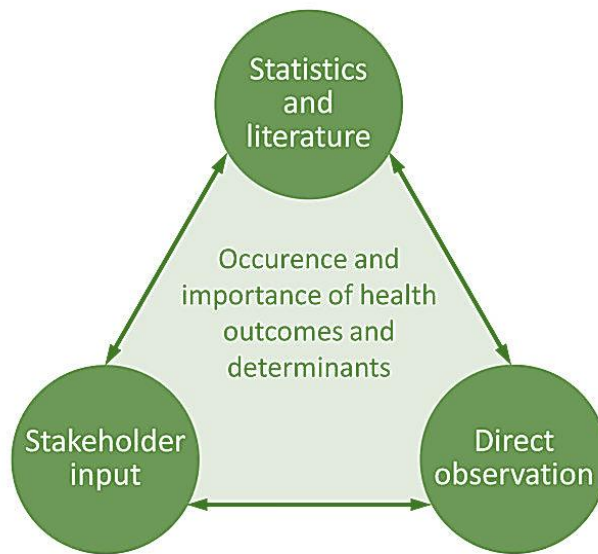


Figure 10: Triangulation of Data

Source: Winkler et al., 2011

7.10.1 Desktop Work

This involved a literature review of health-related data in the public domain as well as a review of existing Project documentation and related secondary data. The literature review was completed before the field visit so that data gaps could be identified and questioning routes for Key Informant Interviews (KII) and questionnaires could be developed. Priority was given to topics that contributed the most towards the burden of disease in South Africa and the proposed Project site and also to health-related incidents related to mining.

The desktop work included an extensive literature review to inform the health profiling of the region and where possible the population surrounding the proposed Project site. The desktop work described the broad health status of the population, based on a systematic review of the 12 EHAs.

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

7.10.2 Questionnaire Design

Participatory tools were used in data collection. These tools included a semi-structured interview with four key informants, and a questionnaire administered to community members through informal interviews and discussions (both males and females). It was decided to only include women groups during the discussions as they are generally considered to be the gatekeepers to family health and usually have a good understanding of critical issues that influence health at the community and household level. The questionnaires were designed to assist in the identification of the major health concerns for the community, institutional issues (satisfaction or lack thereof with health facilities), socio-economic aspects and environmental concerns.

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

7.10.3 Field Visit

A field visit was undertaken to:

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

A site visit was undertaken by Olebogeng Modibane in April 2025 .The field visits provided an opportunity to visualise and assess the prevailing situation in the communities and their relation to the proposed SEZ Project and additional industrial hazardous waste dump near the Mopane community. This was important to understand the potential areas of influence of the Project and also the general living conditions in the communities living in close vicinity to the proposed SEZ Project site.

7.10.4 Exposure Analysis

Potential sources of exposures and pathways to sensitive/ community receptors that could give rise to health risks as a result of activities at, or associated with, the proposed SEZ activities have been identified. This should not be confused with Human biomonitoring (HBM), which is a technique in common for both workplace and community assessments. HBM can be defined as the method for assessing human exposure to chemicals or their effects by measuring these chemicals, their metabolites or reaction products in human specimens (CDC, 2012; NRC, 2006). Biomonitoring involves measurements of biomarkers in bodily fluids, such as blood, urine, saliva, breast milk, sweat, and other specimens, such as faeces, hair, teeth, and nails. Biomonitoring data directly reflect the total body burden or biological effect resulting from all routes of exposure, and interindividual variability in exposure levels, metabolism and excretion rates. HBM is not part of the scope for this study.

Recommendations for appropriate mitigation measures to reduce potential health impacts as well as future occupational and environmental monitoring needs have been made.

7.10.5 Key Informant Interview

It was intended to conduct interviews with key Healthcare personnel from Healthcare facilities surrounding the Project area. The objective of these interviews would have been to gain a better understanding of the structure and capacity of the local health system, to enquire what health statistics were available at the local level and where possible obtain authorised copies of statistics and reports. Due to hindrance of the HIA Specialist Team by the Department of Health (DoH), Key Informant Interviews could not be conducted in any of the targeted/ identified healthcare facilities. An 'offline' visit to Mudimeli Clinic was however conducted.

7.10.6 Discussions

The entire community living in Mopane is affected by the operations of the SEZ including people living on farms to in and surrounding the proposed Project area. In addition to visiting the local health facilities, informal discussions were conducted in the immediate and wider proposed Project site. The informal discussions were held with randomly selected individuals at the following communities:

- Maaname;
- Manyii;
- Tshikuwi
- Mopane; and
- Mudimel.

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

7.11 Potential Impact Categorisation: Environmental Health Areas (EHAs) Framework

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

The identified potential impacts were then categorised in terms of 12 Environmental Health Areas (EHAs) – a set of health-related factors and considerations defined by IFC methodology. These are summarised in the table below. The set of EHAs provides a linkage between Project-related activities and potential positive or negative community-level impacts and incorporates a variety of biomedical and key social determinants of health. In this integrated analysis, cross-cutting environmental and social conditions that contain significant health components are identified instead of a cHIA focusing primarily on disease-specific considerations – as is frequently done in many biomedical analyses of potential Project-related public health impacts. The EHA framework is based on an analysis performed and published by the World Bank.

Table 7-2: Environmental Health Areas

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

7.12 Direct versus Indirect and Cumulative Effects

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

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

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

8 Impact Assessment Methodology

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

Table 8-1 Impact Rating Methodology

Magnitude		Quantitative Score
The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it has a significant, moderate or insignificant		
(VL) Very Low	The impact alters the affected environment in such a way that the natural processes or functions are not affected.	1
(L) Low	The impact alters the affected environment in such a way that the natural processes or functions are not affected significantly.	2
(M) Medium	The affected environment is altered, but functions and processes continue, albeit in a modified way.	3
(H) High	Function or process of the affected environment is disturbed to the extent where it temporarily ceases.	4
(VH) Very High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.	5

Extent		
Classification of the physical and spatial aspect of the impact		
(F) Footprint	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1
(S) Site	The impact could affect the whole, or a significant portion of the site.	2
(R) Regional	The impact could affect the area including the neighbouring Farms, the transport routes and the adjoining towns.	3
(N) National	The impact could have an effect that expands throughout the country (South Africa).	4
(I) International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.	5
Reversibility		
This describes the degree to which the impact can be managed following mitigation. The classes are rated as follows:		
Reversible	Can be avoided, managed or mitigated in such a way that natural processes are not affected and returned to natural state	1
Recoverable	Can be avoided, managed or mitigated to the degree that functions and processes continue in a modified way)	3
Irreversible	Irreversible impact (may cause irreplaceable loss of resources). Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.	5
Duration		
The lifetime of the impact, that is measure in relation to the lifetime of the proposed development.		
(S) Short Term	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.	1
(SM) Short - Medium Term	The impact will be relevant through to the end of a construction phase.	2
(M) Medium	The impact will last up to the end of the development phases, where after it will be entirely negated.	3
(L) Long Term	The impact will continue or last for the entire operational lifetime (i.e. exceed 20years) of the development, but will be mitigated by direct human action or by natural processes thereafter.	4
(P) Permanent	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.	5
Probability		
This describes the likelihood of the impact actually occurring. The impact may occur for any length of time during the life cycle of the activity. The classes are rated as follows:		

(U) Unlikely	The possibility of the Impact occurring is none, due to the circumstances or design. The chance of this Impact occurring is zero (0%)	1
(P) Possible	The possibility of the Impact occurring is very low, due either to the circumstances or design. The chance of this Impact occurring is defined as 25% or less	2
(L) Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of Impact occurring is defined as 50%	3
(H) Highly Likely	It is most likely that the Impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75 %.	4
(D) Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100 %.	5

Weighting Factor

Subjective score assigned by Impact Assessor to give the relative importance of a particular environmental component based on project knowledge and previous experience. Simply, such a weighting factor is indicative of the importance of the impact in terms of the potential effect that it could have on the surrounding environment. Therefore, the aspects considered to have a relatively high value will score a relatively higher weighting than that which is of lower importance

(L) Low	1
(LM) Low - Medium	2
(M) Medium	3
(MH) Medium - High	4
(H) High	5

Mitigation Measures and Mitigation Efficiency

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures

Mitigation measures were recommended to enhance benefits and minimise negative impacts and address the following:

Mitigation objectives: what level of mitigation must be aimed at: For each identified impact, the specialist must provide mitigation objectives (tolerance limits) which would result in measurable reduction in impact. Where limited knowledge or expertise exists on such tolerance limits, the specialist must make "educated guesses" based on professional experience;

Recommended mitigation measures: For each impact the specialist must recommend practicable mitigation actions that can measurably affect the significance rating. The specialist must also identify management actions, which could enhance the condition of the environment. Where no mitigation is considered feasible, this must be stated and reasons provided;

Effectiveness of mitigation measures: The specialist must provide quantifiable standards (performance criteria) for reviewing or tracking the effectiveness of the proposed mitigation actions, where possible; and

Recommended monitoring and evaluation programme: The specialist is required to recommend an appropriate monitoring and review programme, which can track the efficacy of the mitigation objectives. Each environmental impact is to be assessed before and after mitigation measures have been implemented.

The management objectives, design standards, etc., which, if achieved, can eliminate, minimise or enhance potential impacts or benefits. National standards or criteria are examples, which can be stated as mitigation objectives.

Negligible	The impact will be mitigated to the point where it is of limited importance	<=20
Low	The impact is of importance, however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels	<=40
Moderate	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw	<=60
High	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.	>60

Table 8-2 Impact Rating Methodology

Magnitude	Weight
Very Low	1
Low	2
Medium	3
High	4
Very High	5

Extent	Weight
Footprint	1
Site	2
Regional	3
National	4
International	5

Reversibility	Weight
---------------	--------

Reversible	1
Recoverable	3
Irreversible	5

Duration	Weight
Short term	1
Short-Medium term	2
Medium term	3
Long term	4
Permanent	5

8.1 Direct versus Indirect and Cumulative Effects

Social impacts can be categorized into direct, indirect, and cumulative effects:

- Direct Effects:** These are the immediate and primary impacts of the proposed Newcastle Coal Mine Project on the surrounding communities, cultures, and societies. They are usually tangible and can be directly attributed to the project activities. Examples include:
 - Displacement of households or communities due to land acquisition.
 - Changes in local employment opportunities and income levels.
 - Physical changes to the landscape and natural environment.
 - Impacts on local infrastructure such as roads, water supply, and health facilities.
- Indirect Effects:** These are the secondary impacts that result from the direct effects of the proposed Project. They are often less immediate and may be more diffuse, making them harder to predict and assess. Examples include:
 - Changes in the local economy due to increased demand for goods and services.
 - Changes in social dynamics, including migration patterns and community cohesion.
 - Changes in land use patterns and access to natural resources.
 - Changes in local markets and prices of goods and services.
- Cumulative Effects:** These are the combined impacts of the proposed Newcastle Coal Mine Project along with other existing and potential future projects, activities, and developments in the area. Cumulative effects take into account the

synergistic or additive impacts that multiple stressors may have on the social fabric of the community and the environment. Examples include:

- Increased pressure on local infrastructure and services due to multiple projects.
- Cumulative environmental degradation, such as loss of biodiversity and water pollution.
- Cumulative social changes, including shifts in cultural practices and community identity.
- Cumulative economic impacts, such as changes in land values and employment patterns.

Assessing direct, indirect, and cumulative effects requires a comprehensive understanding of the context, stakeholder perspectives, and potential pathways of impact.

8.2 Impact Variables to be Assessed

The following are usually assessed within a cHIA:

- Population impacts, including population change (ethnic composition, size, etc.); inflow or outflow of temporary workers; presence of seasonal residents; and relocation of individuals and families.
- Socio-economic impacts, including job creation, enhanced economic equity; change in employment equity; impacts on women and possible economic and social vulnerabilities as a result of the Project; and changes in the industrial/commercial focus of the community.
- Individual and family level impacts, including disruption in daily living and movement patterns; disruption in social networks; introduction of new social classes and tourism and leisure impacts.
- Community/institutional arrangements, such as attitude formation; interest group activity; and alteration in size and structure of local government.
- Public health, safety and security impacts.
- Community infrastructure, including changes in community infrastructure; land acquisition and disposal; and effects on known cultural, historical and archaeological sites.
- Intrusion impacts, including noise pollution, air pollution and malodour pollution.

Only impacts relevant to this proposed Project have been analysed. Additional impacts that emerge during the PPP and consultation phases will be included.

8.3 Limitations and Assumptions

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

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

The following are the recognised limitations of the HIA study:

- As the proposed SEZ Project is still in the planning phase, several parameters required for the air quality modelling (conducted by Gondwana) were unavailable. Average values from the literature were used for many of the parameters, and in some cases, conservative estimates and 'worst case' values were used in their model.
- The HIA study often refers to local level data which has some limitations that need to be understood and respected. Recording and reporting of the health data within the visited Healthcare facilities is completed manually, and it is likely that the recording may lack required accuracy. However, this information is invaluable in understanding the health challenges in the area, although the limitation must be considered when evaluating information, as its ability to be used as a robust baseline and to monitor relevant health impacts is limited; and
- Interviews and any other discussions are normally based on respondents' self-declaration which may be prone to recall or response bias. Moreover, when it comes to questions on one's private life, study participants tend to be affected by a social desirability bias, where they may choose to give answers that are socially acceptable.

This HIA must be viewed as a prospective / predictive study as there has as yet been no initiation of any construction activities on the proposed site.

9 Health Opportunities and Risks associated with Special Economic Zones

The nature of SEZs can hold unique health risks for both workers and communities. These zones tend to be located outside of capital regions, and, as such, infrastructure, services and knowledge, and attitudes and practices around health are generally less developed than in urban settings (ADB, 2018). In addition, the Musina-Makhado SEZ is strategically placed to take advantage of cross-border collaboration, and subsequently, transient migrant populations are to be expected. This may place added pressure on existing health as well as social infrastructure. The proposed SEZ is expected to be a culturally diverse location, and, in taking into consideration all of the above, the proposed SEZ Project may also hold risks to local communities and workers if left unidentified and unmanaged.

In a well-functioning SEZ , health opportunities can stem from:

- Meeting of basic essential needs (clean water, shelter, sanitation, security, and food safety are accessible);

- Proper zoning of residential and commercial, recreation, and industrial areas;
- The capacity of the emergency preparedness and response sector to respond to both industrial and community incidents;
- Industrial traffic having designated routes and road infrastructure in good, safe condition;
- Strategic resettlement of households, when required, with infrastructure complete and in excellent condition;
- Separate and safe industrial and public waste management;
- Safe worker behavior on- and off-site;
- Peaceful cohabitation of workers and community members;
- Strategic location and good condition of worker accommodations; and
- Protection of cultural and spiritual sites.

In a poorly functioning SEZ, health risks can stem from:

- Mixing of residential and industrial uses of land (the lack of appropriate buffer zones);
- Environmental issues such as airborne emissions, water pollution, noise, light, and vibration;
- Inadequate health services for mobile and migrant workers and community members;
- Inability of emergency preparedness and response sector to respond appropriately to
- Industrial and community incidents;
- Conflicts between local residents and projects;
- Lack of cohesion between community members and workers;
- Resettlement that happens multiple times and infrastructure that remains unfinished;
- Worker accommodation that is in poor condition;
- Nonexistent waste management strategies;
- Disorganized and chaotic traffic;
- Workers not being equipped with safe working conditions or provided the basics to
- Be safe on- and off-site;
- Poor coping and personal health practices, such as alcohol and drug abuse;
- Human trafficking;
- Impoverishment; and

- Lack of basic needs being met including access to safe water, sanitation, shelter, security, and safe food.

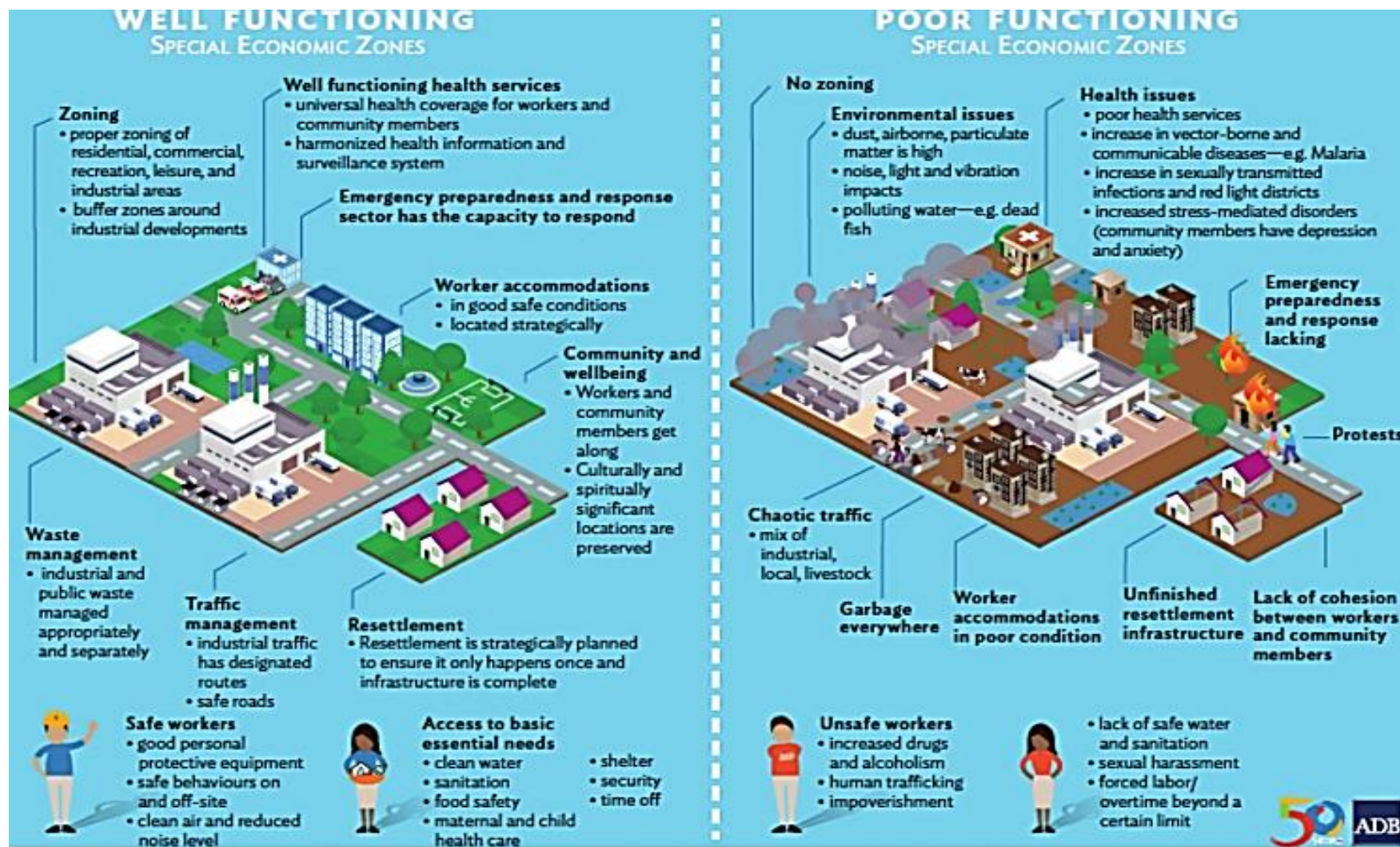


Figure 11: Typical Health Opportunities and Risks Associated with Special Economic Zone Development

10 Country Health Profile: South Africa

Since the end of apartheid in 1994, South Africa has experienced notable changes in population health. The first years of post-apartheid South Africa were characterised by economic growth and noteworthy steps towards reducing inequalities in health and high levels of mortality from infectious and maternal causes. Unfortunately, the emergence of the HIV/AIDS epidemic during the early 2000s, prior to the rollout of antiretroviral drug therapy (ART), resulted in massive shocks to the health system and reversed many previous gains in health. Concerted efforts by successive administrations, coupled with international support, have stabilised the epidemic and have begun to shift health policy towards longer-term strategies and goals that now include a wider range of priorities such as non-communicable disease (NCD) prevention and National Health Insurance (NHI)—South Africa's approach to achieving universal health coverage (ibid).

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

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

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

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

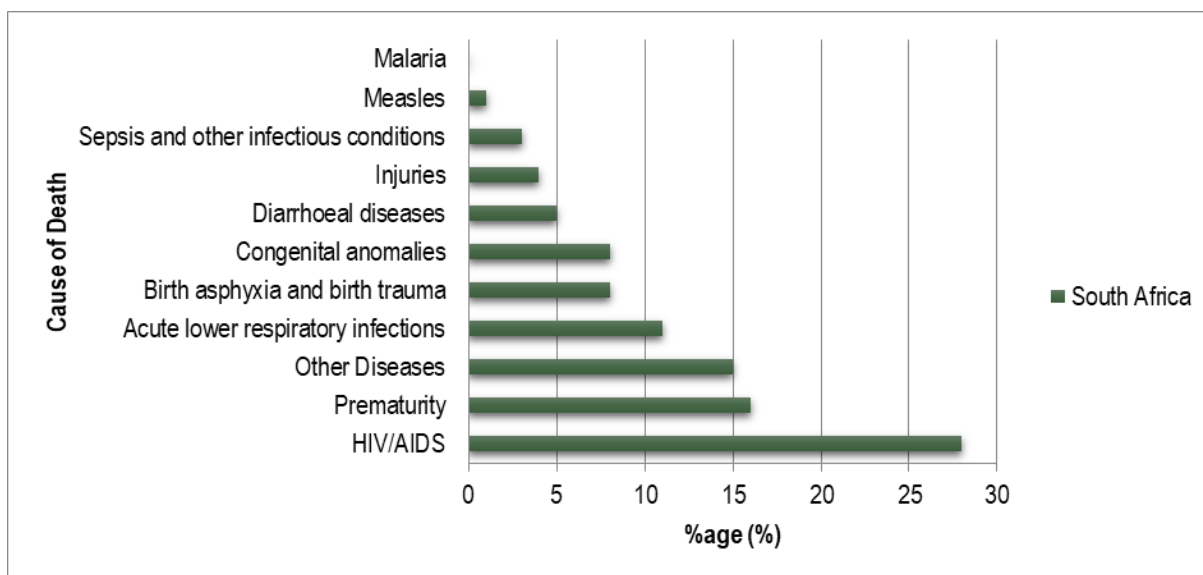


Figure 12: Distribution of causes of death among children aged under 5, % of totals in RSA

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

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

10.1 Burden of Disease

GBD 2019 estimated the incidence and prevalence of a range of disease, injuries, and sequelae, summarised here in YLDs. Population growth and ageing were key drivers of nonfatal disease burden: the total number of YLDs nationwide increased from 3.59 (95% UI 2.67–4.61) million in 1990 to 6.50 (4.86–8.37) million in 2019, while age-standardised YLD rates increased from 11 587

(8677–14 796) per 100 000 in 1990 to 12 053 YLDs (9046–15 474) per 100 000 in 2019. Trends in YLDs by province for specific causes of disability are illustrated in the Figure below. Aside from YLDs due to HIV/AIDS and its sequelae (including tuberculosis), which increased several orders of magnitude, the largest increases among leading causes of YLDs were from diabetes, chronic kidney disease, neonatal disorders and other musculoskeletal disorders.

The 21 leading causes of YLDs in 2019 (in descending order) are shown here, except for HIV/AIDS, which had annualised per cent change values that exceeded the scale of this figure by orders of magnitude. (A) Change over 1990–2007. (B) Change over 2007–2019. YLDs, years lived with disability.

All provinces except for North-West experienced a considerable increase in YLDs from NCDs between 2007 and 2019 from the combined effects of demographic change and rising age-specific prevalence of NCDs such as diabetes and chronic kidney disease. The largest increase in YLDs from NCDs was in Northern Cape at 3.8% (+3.5 to +4.0%) per year, while YLDs in North-West decreased at –0.6% (–0.4% to –0.8%). Due to their high prevalence, mental disorders as a group contributed to the largest total number of YLDs in all provinces, though their rate of increase between 1990 and 2019 was less pronounced than for other NCDs. Injuries accounted for about 4.6% of total YLDs in Limpopo and Northern Cape (the highest two provinces), as compared with 3.2% and 3.7% of total YLDs in KwaZulu-Natal and Mpumalanga (the lowest two provinces).

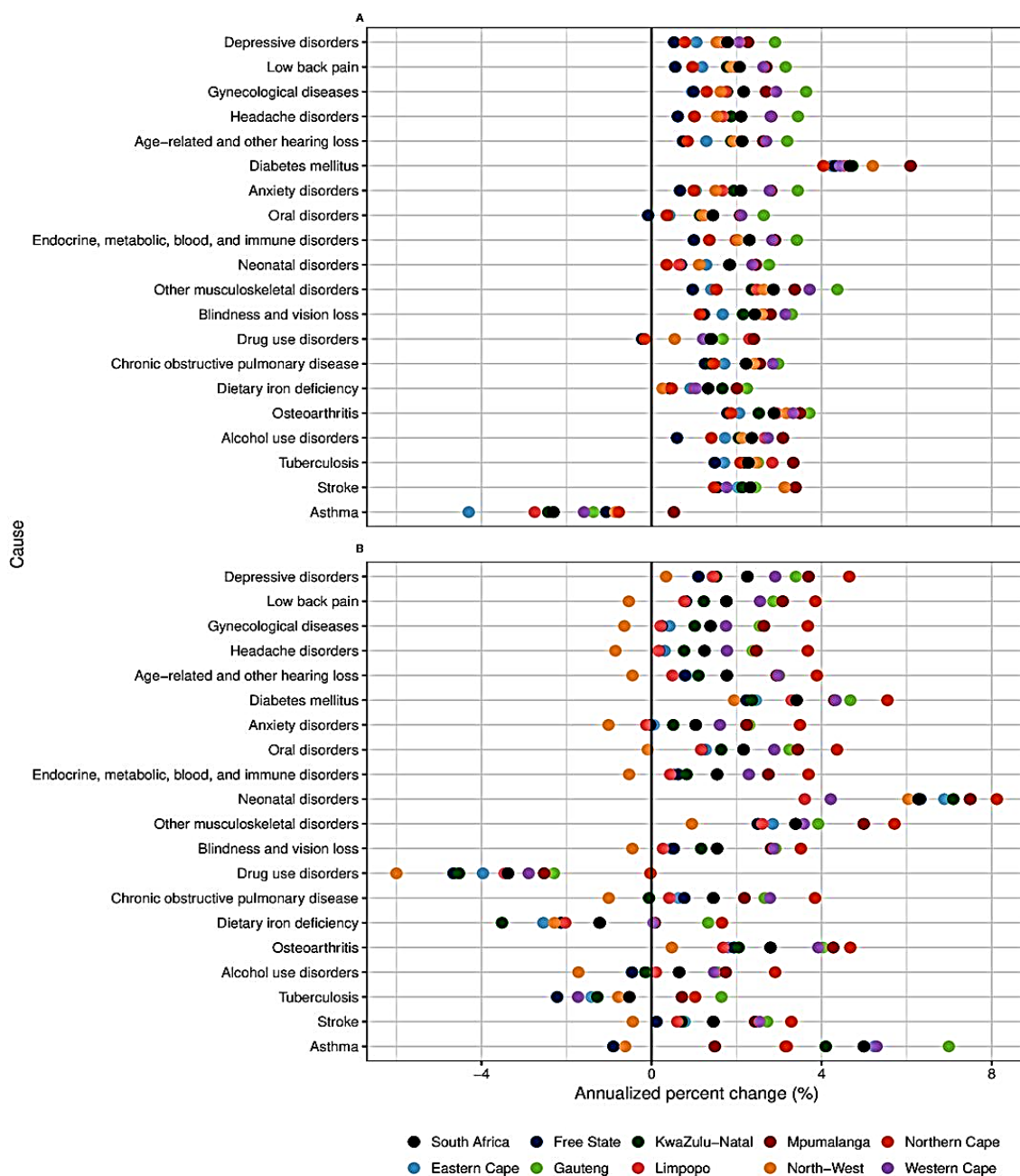


Figure 13: Annualised per cent change in YLDs (all ages, both sexes) by province, 1990–2019

10.2 Mortality Levels and Trends

Statistics South Africa has published a report on the top 10 leading causes of mortality in South Africa, based on all death notification forms maintained by the Department of Home Affairs.

The report, published on Tuesday (15 June), does not include deaths due to Covid-19 as these will be published after the 2020 processing cycle, the statistics body said.

The data shows that mortality levels are declining in the country as seen by the downward trend in the number of registered deaths since 2007.

The 65-69 age group had the highest proportion of deaths in 2018 at 8.4%, followed closely by the 60-64 age group at 8.3%.

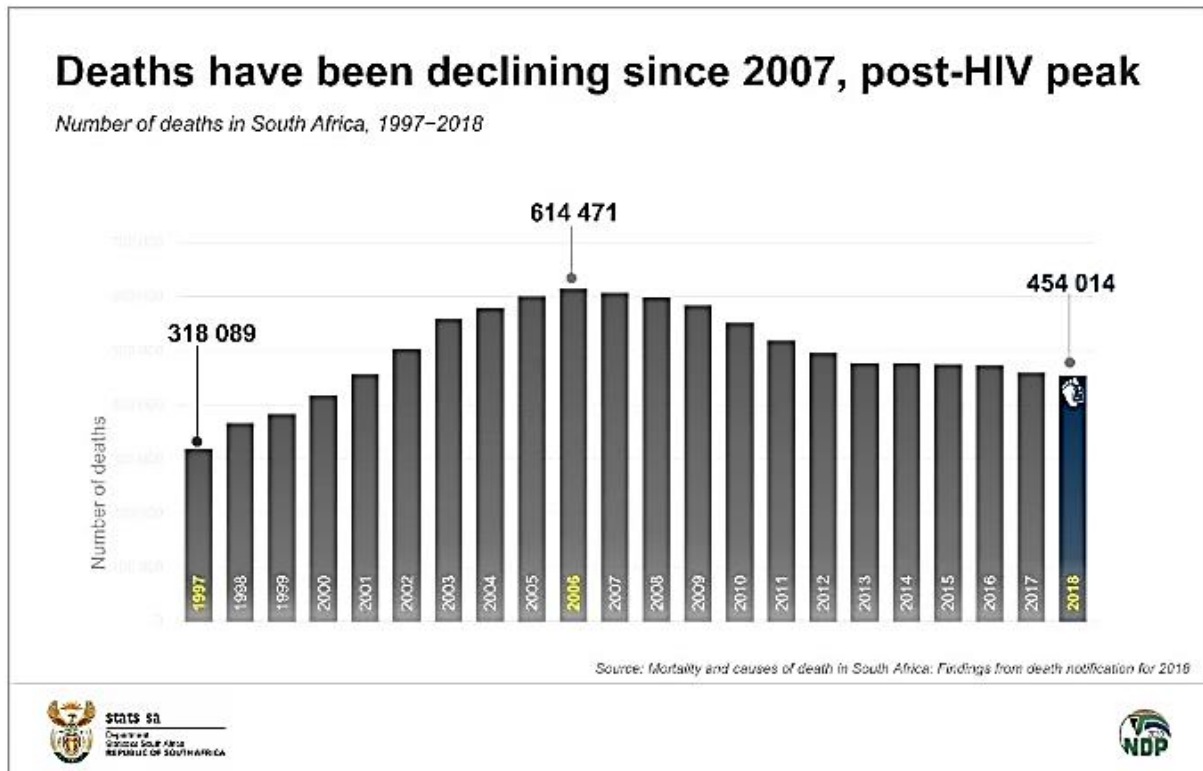


Figure 14: Mortality Levels and Trends

10.3 Natural Deaths

The top 10 leading underlying natural causes of death for the reporting period were:

- Tuberculosis;
- Diabetes mellitus;
- Cerebrovascular diseases;
- Other forms of heart disease;
- Human immunodeficiency virus (HIV) disease;
- Hypertensive diseases;
- Influenza and pneumonia;
- Ischaemic heart diseases;

- Chronic lower respiratory diseases; and
- Malignant neoplasms of digestive organs.

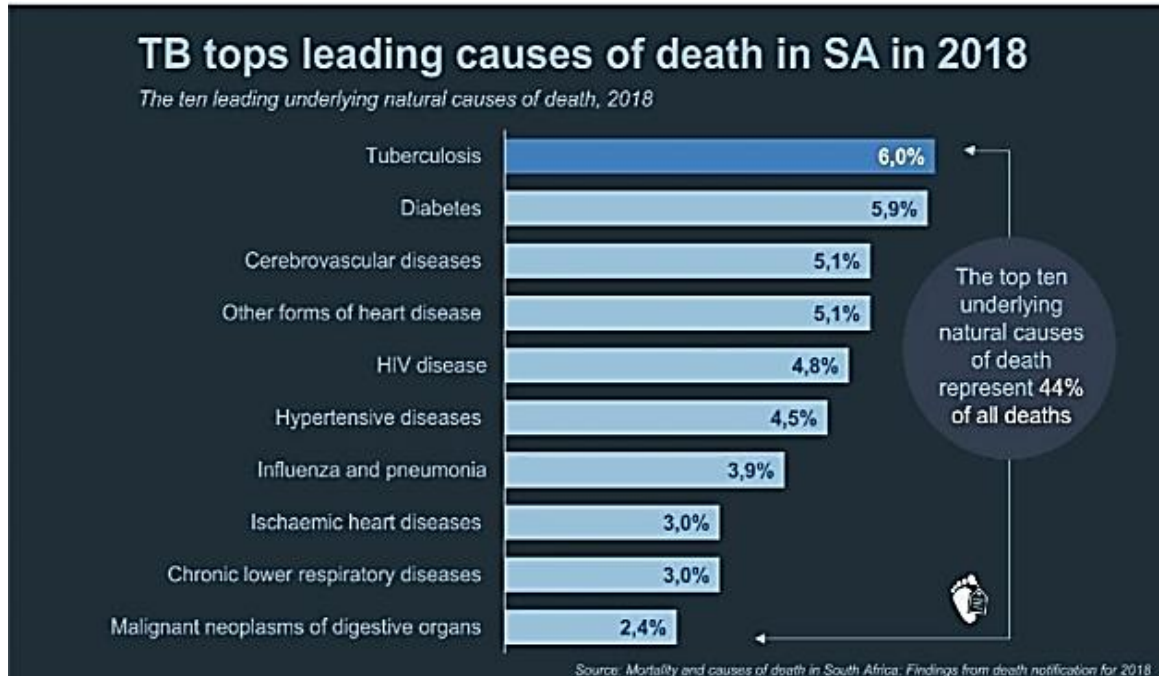


Figure 15: Top 10 underlying natural causes of death in SA in 2018

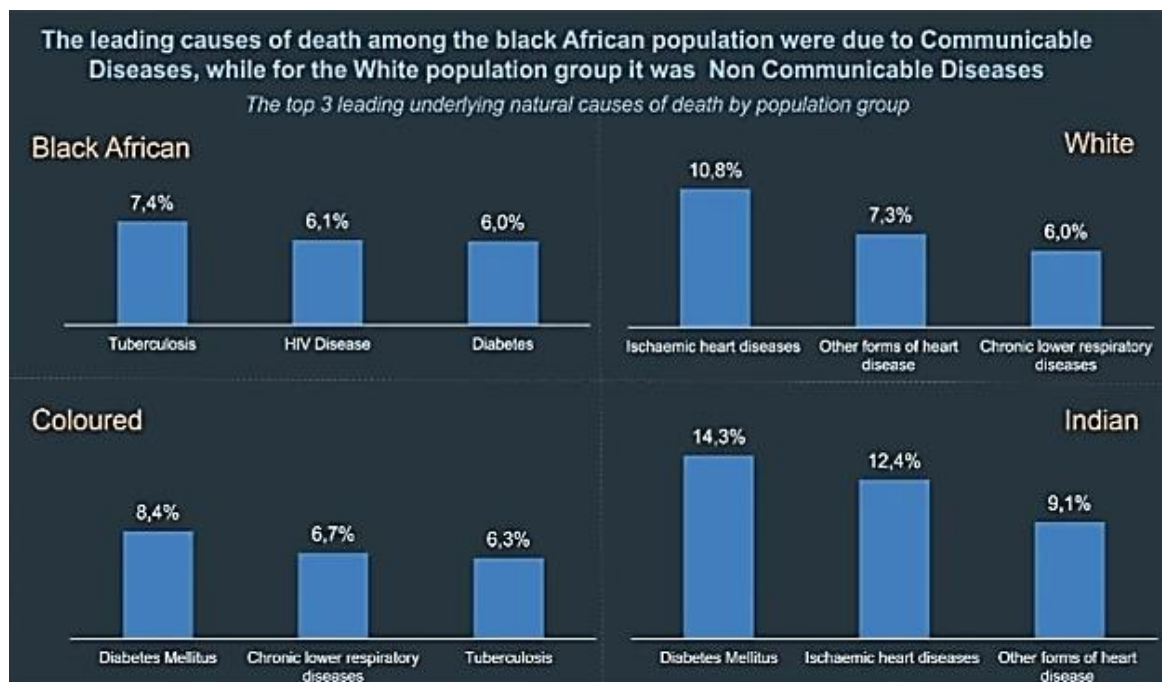


Figure 16: Leading causes of death among different races

10.4 Non-Natural Deaths

Although the number of deaths due to natural causes was higher than the number of deaths due to non-natural causes, the proportion of deaths due to non-natural cause have been on a slight increase in the recent years.

Between 2010 and 2018, a consistent increase in the proportions of deaths due to non-natural causes was noted from 9% in 2010 to 11.9% in 2018.

The age groups most affected by non-natural causes of death in 2018 were 20-24 years and 15-19, accounting for 49.2% and 42.5%, respectively.

Males had higher proportions of deaths due to non-natural causes compared to females, with a wider difference observed at age group 15-29 where as much as 58.1% of male deaths resulted from non-natural causes compared to 19.8% of female deaths in the same age group.

The main cause of non-natural deaths are:

- Accidental injury (68.3%);
- Assault (14%); and
- Transport accidents (11.4%).

In total, KwaZulu-Natal had the highest proportion of deaths due to non-natural causes (13.5%), followed closely by Cape Town (13%).

10.5 Public and Private Health Sector

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

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

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

10.6 South African Health Care System

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

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

10.7 Traditional Medicine

Traditional medicines are widely used in South Africa where, despite the influx of western treatments, around 27 million South Africans continue to use indigenous medicine (Cocks and Møller, 2002). The use of shrubs, herbs and trees for medicinal purposes is an ancient practice with long-standing importance to people from all levels of society.

The use of traditional healthcare comprising of plant-based medicines is not just with natural illnesses, but also for afflictions believed to be caused by the supernatural. In fact, a study of a South African village has shown that approximately one-third of the wild plants used served cultural and spiritual needs rather than basic utilitarian purposes (Cocks et al., 2008). In South Africa there are an estimated 200 000 registered healers (Summerton, 2006) whose extensive knowledge and reported ability to connect with ancestors are in continuous demand. Furthermore, self-medication remains popular amongst the general public, especially for minor ailments such as coughing and diarrhoea (Dahlberg and Trygger, 2009).

The WHO observes that it is difficult to assign one definition to the broad range of characteristics and elements of traditional medicine, but that a working definition is essential. It thus concludes that traditional medicines: “[Include] diverse health practices, approaches, knowledge and beliefs incorporating plant, animal and/or mineral-based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to maintain well-being, as well as to treat, diagnose or prevent illness” (WHO, 2002).

Traditional healers are generally divided into two categories – those that serve the role of diviner-diagnostician (or diviner-mediums) and those who are healers (or herbalists). The diviner provides a diagnosis usually through spiritual means, while the herbalist chooses and applies relevant remedies.

The WHO estimates that up to 80% of the population in Africa makes use of traditional medicine. In Sub-Saharan Africa, the ratio of traditional healers to the population is approximately 1:500, while medical doctors have a 1:40 000 ratio to the rest of the population (Abdool-Karim, 2002). It is clear that traditional healers play an influential role in the lives of African people and have the potential to

serve as crucial components of a comprehensive health care strategy. The Medical Research Council (MRC) founded a traditional medicines research unit in 1997 to introduce modern research methodologies around the use of traditional medicines. It has also aimed to develop a series of patents for promising new entities derived from medicinal plants.

10.8 Healthcare System Performance

Literature compares HAQ Index values for the year 1990 and 2019 across all nine provinces and with the other 15 SADC member countries (figure 5; online supplemental figure S5). In terms of overall performance, South Africa ranked third in 1990 and fourth in 2019, surpassed only by Mauritius and Seychelles in both years. However, HAQ Index values varied considerably between provinces, with the highest values in 2019 for Western Cape and KwaZulu-Natal (similar to Mauritius in 1990), and the lowest values for Free State, Northern Cape, and Eastern Cape (between Eswatini and Namibia in 2019). These three provinces also had the smallest improvements over time. By contrast, the largest improvements in HAQ Index were in KwaZulu-Natal, Mpumalanga and Gauteng; the only SADC neighbours that had a larger improvement than KwaZulu-Natal were Seychelles, Zambia, Botswana, Angola and Namibia.

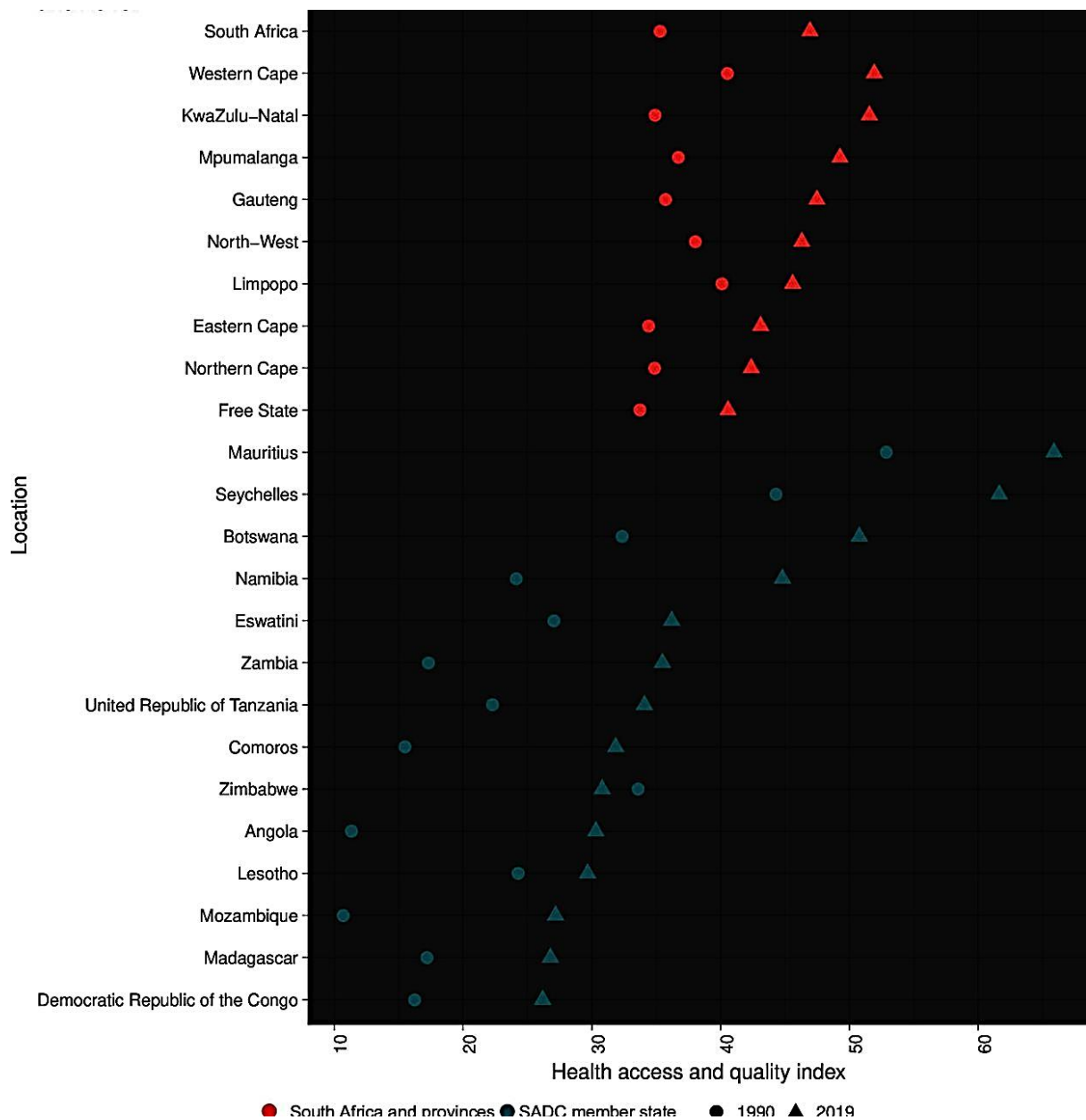


Figure 17: GBD Healthcare Access and Quality Index Values for South Africa and Provinces compared with Southern African Development Community Member States, 1990 and 2019

The GBD healthcare access and quality index is a summary measure of health system performance that incorporates estimates of age-standardised and risk-standardised mortality rates for 32 causes that are amenable to healthcare. The index scale ranges from 0 to 100, with higher values indicating better performance. GBD, Global Burden of Disease; SADC, Southern African Development Community.

10.9 Healthcare Facilities

There are 4 200 public health facilities in South Africa. The number of people per clinic as per figures from 2013, was 13 718, exceeding WHO guidelines of 10 000 per clinic. However, figures from March 2009 show that people averaged 2.5 visits a year to public health facilities and the usable bed occupancy rates were between 65% and 77% at hospitals (South Africa Info, 2013).

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

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

10.10 Doctor Shortages

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

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

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

10.11 Quality of Services

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

10.12 Functionality of Services

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

hospital facilities followed by Pharmacy. This, and the low number of pharmacists working in public health facilities, needs urgent attention.

10.13 HIV/AIDS: Epidemics in Perspective

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

More than 19% of adults (ages 15-49) in South Africa are living with HIV. The HIV burden varies widely by geography, age and gender and for key and vulnerable populations. New HIV infections declined from 360 000 in 2012 to 270 000 in 2016, with marked progress in preventing mother-to-child HIV transmission. Adolescent girls and young women as well as other key and vulnerable populations remain most heavily affected by the epidemic. South Africa has the world's largest HIV treatment programme, with 3.7 million people initiated on antiretroviral therapy as of December 2016, resulting in a sharp increase in national life expectancy from 58.3 years in 2011 to 62.4 years in 2015. Although less detailed epidemiological information is available on STIs, the evidence underscores the seriousness as a public health problem and as a risk factor for HIV infection.

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

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

10.14 Health-related Sustainable Development Goal Targets

Health has been recognised as central to international development for more than 20 years, and major efforts have been made to reduce morbidity and mortality either universally, or through a focus on specific population subgroups (e.g., "the poor", "women and children") (World Bank, 1993).

The United Nations Sustainable Development Goals (UN SDGs, also known as the Global Goals) are 17 goals with 169 targets that all UN Member States have agreed to work towards achieving by the year 2030. They set out a vision for a world free from poverty, hunger and disease. Health has a central place in SDG 3 "Ensure healthy lives and promote well-being for all at all ages", underpinned by 13 targets that cover a wide spectrum of WHO's work. Almost all of the other 16 goals are related to health or their achievement will contribute to health indirectly.

Table 10-1: Summary of Key Sustainable Development Goals That Affect Health Determinants

SDG	Summary
6	Ensure availability and sustainable management of water and sanitation for all
7	Ensure access to affordable, reliable, sustainable and modern energy for all
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
11	Make cities and human settlement inclusive, safe, resilient and sustainable
12	Ensure sustainable consumption and production patterns
13	Take urgent action to combat climate change and its impacts
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Source: United Nations. Sustainable Development Knowledge Platform. New York

Sustainable Development Goal 3 (SDG 3 or Global Goal 3), regarding "Good Health and Well-being" targets, indicators and progress include:

- Target 3.1: Reduce maternal mortality;
- Target 3.2: End all preventable deaths under five years of age;
- Target 3.3: Fight communicable diseases;
- Target 3.4: Reduce mortality from non-communicable diseases and promote mental health;
- Target 3.5: Prevent and treat substance abuse;
- Target 3.6: Reduce road injuries and deaths;
- Target 3.7: Universal access to sexual and reproductive care, family planning and education;
- Target 3.8: Achieve universal health coverage;
- Target 3.9: Reduce illnesses and deaths from hazardous chemicals and pollution;
- Target 3.a: Implement the WHO framework convention on tobacco control;
- Target 3.b: Support research, development and universal access to affordable vaccines and medicines;
- Target 3.c: Increase health financing and support health workforce in developing countries; and
- Target 3.d: Improve early warning systems for global health risks.

MMSEZ is committed to environmentally sustainable growth and regional integration. Infrastructure development cannot be sustainable if human health is damaged. Conversely, development that includes health gains is likely to be more sustainable. MMSEZ is also committed to supporting the SDGs.



Figure 18: Sustainable Development Goals

Figure 19 plots the observed average annualised rate of change (ARC) (2015–2019) in key quantitative SDG-3 targets by province and compares these to the rate of change that is needed to achieve the target. The Global Burden of Disease estimates that all nine provinces are currently on track to achieve the NCD target, and five are on track to achieve the under-5 mortality rates (U5MR) target. Two provinces at most are currently on track to achieve neonatal mortality and maternal mortality ratio (MMR) targets, respectively. HIV incidence declined quite slowly over 2015–2019, and tuberculosis incidence increased, suggesting these targets will be very challenging to achieve.

This analysis adds to the literature on mortality in South Africa and represents the largest systematic effort to date to quantify levels and long-term trends in nonfatal outcomes, risk-attributable burden, and comparative healthcare system performance in South Africa and its provinces. As in other countries, a subnational lens on health progress is important in South Africa because of considerable health inequalities and decentralisation of health planning and policy. South Africa is committed to achieving the health-related SDGs. Achieving SDG targets necessitates monitoring of health outcomes and associated risks, as well as inequality in health infrastructure and inequitable access to services. One practical use of these subnational estimates is to identify which provinces are on track to achieve specific SDG targets to provide opportunities to share best practices and shore up disease-specific programmes in provinces that are off-track. It was found that most health indicators varied greatly by province, with poorer and more rural provinces generally showing lower levels of health and less progress since 1990.

While all provinces have made progress on HAQ since 1990, economically advantaged provinces have generally progressed at a faster rate, and performance in disadvantaged provinces has lagged behind neighbouring middle-income SADC countries. Many of the inequalities within and across provinces in South Africa are also due to the fragmented nature of the health system, with an under-resourced public health sector serving most of the people and a well-resourced private sector serving a minority of the population. The NHI provides a vital opportunity to close these gaps by integrating the public and private sector financing. In addition, the COVID-19 pandemic has stressed a fragile healthcare system and has highlighted the ‘syndemic’ nature of South Africa’s quadruple burden of disease by exposing the dominant role of shared risk factors (like harmful alcohol use) and social-structural vulnerabilities in driving disease and injury trends. Further, significant contraction of the local and regional economies is expected to exacerbate inequities in access to healthcare for the most vulnerable. Findings suggest that a doubling-down on investments in key health programmes is needed in nearly all provinces, especially the least advantaged—and these investments are particularly urgent in the wake of COVID-19-related health service disruptions.

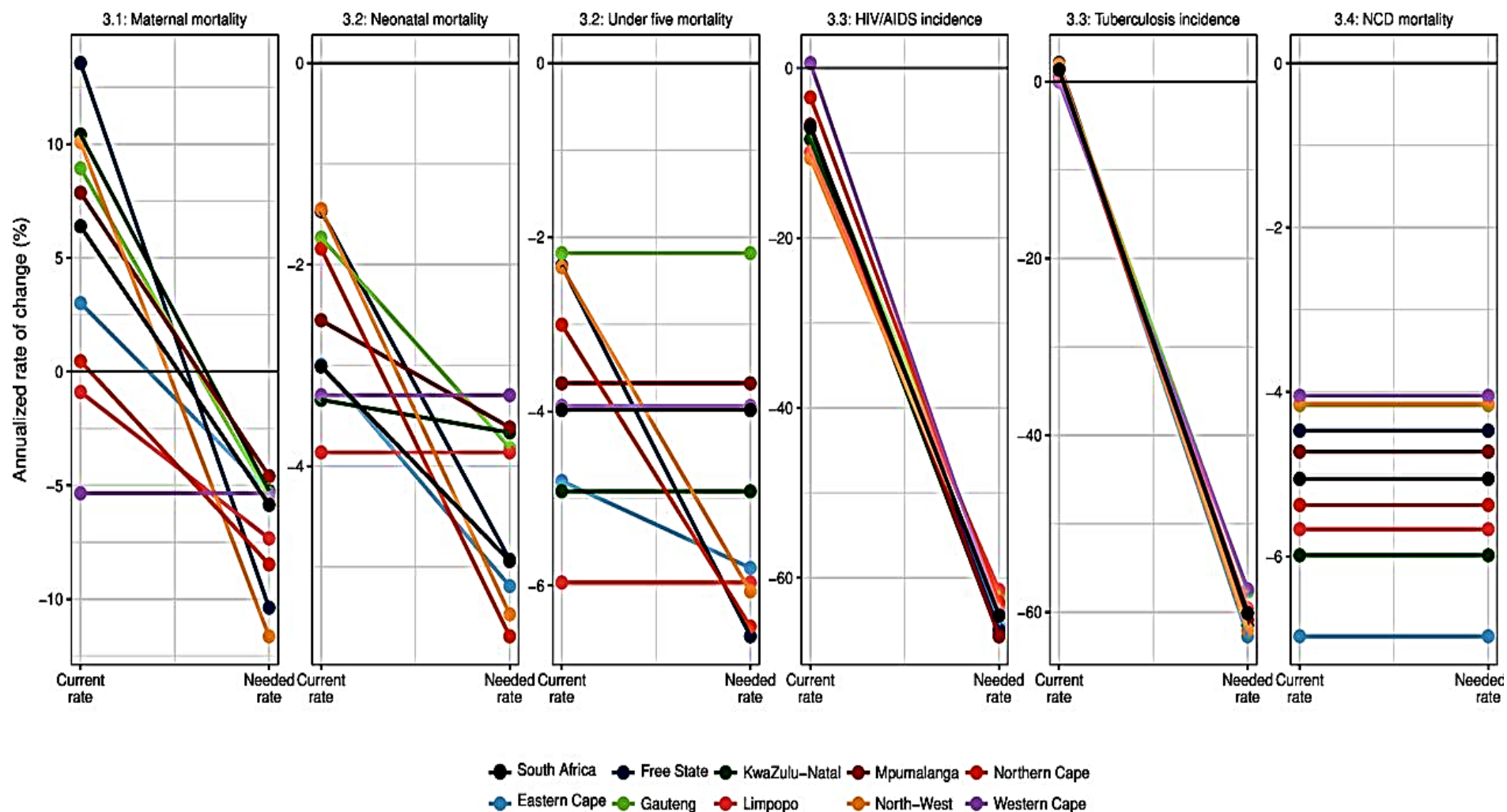


Figure 19: Progress towards Achievement of Key Health-related Sustainable Development Goal Targets in South Africa and Provinces

Unsurprisingly, the impact of HIV/AIDS and concurrent tuberculosis still dominate much of the quadruple burden of disease in South Africa and remain major drivers of changes in population health. The national response to HIV/AIDS after 2007, including the rollout of ART, significantly improved life expectancy thereafter. It was also found an increase in the burden of HIV/AIDS and tuberculosis among adolescents, suggesting that more intensive, integrated efforts are needed for prevention and treatment in this age group. Given the rapid rises in NCDs and associated risk factors, integrated care for adolescents should also have a strong emphasis on NCD prevention. Furthermore, while significant progress has been made in controlling tuberculosis among people living with HIV, in part because of expanded ART, limited progress has been made in controlling tuberculosis in HIV-negative populations. This further supports the need for strategies targeting other non-HIV risk factors associated with tuberculosis that are increasingly prevalent, such as diabetes and alcohol abuse. The COVID-19 response in South Africa will need to ensure greater support for people living with HIV and that the HIV care continuum is not significantly disrupted and intensify efforts to prevent a resurgence in tuberculosis in 2021 and beyond.

Maternal and child survival has been an area of success since 1990, though most provinces do not appear to be on track to meet the SDG targets. To some extent, recent progress reflects the rollout of ART, including prevention of mother-to-child transmission, coupled with increased coverage of core Expanded Programme on Immunisation vaccines and, more recently, pneumococcal conjugate and rotavirus vaccines.^{27 28} Crucially, stay-at-home orders that have been implemented to limit the spread of COVID-19 could significantly disrupt immunisation activities, thus increasing the risk of children contracting other infectious diseases, as documented in Pakistan, for example. A recent modelling study found that the risk of COVID-19 death in the context of receiving immunisation services was far outweighed by the risk of death from a vaccine-preventable disease that resulted from not receiving these services. To prevent increases in child mortality from vaccine-preventable diseases, the Department of Health will need to assess where provincial and sub-provincial immunisation services have been most disrupted and redirect resources to targeted, mop-up campaigns.

Injuries, especially from interpersonal violence, have been a consistent feature of the South African landscape over the past 25 years. Evidence suggests that violence can increase during and in the aftermath of disease pandemics, as has been observed in the context of COVID-19-related lockdown/stay-at-home orders, suggesting a nuanced approach to COVID-19 mitigation will be required to balance direct and indirect health effects.³⁰ The single most important risk factor for injuries in South Africa is a high prevalence of harmful use of alcohol. While WHO and others acknowledge alcohol taxes and regulations as 'best buys' in terms of their population health impact, practical challenges remain in implementing these policies in the South African context.

Alcohol consumption remains a primary form of recreation for many and is strongly linked to perceptions of masculinity; a large local alcohol industry also ensures easy access. Past efforts to reduce alcohol and drug abuse locally have generally failed to combine interventions targeting high-risk persons and groups with population-wide approaches to reduce per-capita consumption. Further, alcohol policies may have limited impact without concurrent efforts to address firearm possession and use, or to de-link heavy drinking from gender norms. Integrated alcohol and firearm control policies, combined with sustained public campaigns addressing drinking culture, will be necessary to reduce interpersonal violence, and they could generate extensive social and economic benefits.

The image also illustrates a rapid increase in nonfatal disease burden and NCD risk factors in all provinces, despite notable progress on reducing age-specific NCD death rates. These increases, driven by prevalent conditions like diabetes, have implications for health planning and resource allocation at the provincial level. Health promotion and prevention efforts are urgently needed in order to prevent a resurgence in NCD mortality and reduce fiscal pressures on NHI.³⁵ Tobacco control was an early success story for South Africa, but more recently tobacco use as a risk factor has been replaced by obesity and physical inactivity. Dietary policies (including taxes, subsidies and regulations) and efforts to promote exercise through the built environment will probably have an outsized role in the intersectoral agenda in the coming years. In addition, a critical gap in the South African health system is the lack of integrated care for mental disorders at the primary level, a highly-specific, evidence-based, best-buy intervention were almost 27 million cases globally and almost 900 000 deaths, with virtually all countries affected. At this point, North and South America and Southeast Asia had the largest number of people infected with the virus.

10.15 The Impact of Covid-19

Coronavirus disease 2019 is a contagious disease caused by a virus, the severe acute respiratory syndrome coronavirus 2. The first known case was identified in Wuhan, China, in December 2019. The disease has since spread worldwide, leading to an ongoing pandemic (WHO, 2021).

The first case of COVID-19 was reported to the World Health Organization (WHO) in December 2019 from Wuhan City, Hubei Province in China, and in January 2020 the WHO declared the COVID-19 outbreak a public health emergency of international concern. The first case of COVID-19 in South Africa was detection on the 5th March 2020, and the announcement was made by the WHO on 11 March 2020 characterising COVID-19 as a pandemic, the President of South Africa declared the pandemic to be a national disaster on 15 March 2020.

The pandemic has had devastating socio-economic costs; an estimated 2.8 million South Africans have lost their jobs. South Africa's budgetary and Public Finance Management systems channelled the allocation of more than R20 billion to the health sector COVID-19 response and an additional R100 billion has been spent on income support through new social grants.

COVID-19 has placed an even greater strain on South Africa's overburdened and under-resourced health system and has stymied the progress the country has made in strengthening health systems towards achieving universal health coverage. It has also disrupted access to health care for chronic conditions, including non-communicable diseases, testing, treatment initiation, and continuity of care for HIV and TB, as well as for sexual and reproductive health services, due to both travel restrictions and the re-orientation of healthcare services to respond to the pandemic.

Overall, findings show that the COVID-19 pandemic placed an additional burden on already resource-constrained healthcare facilities, with nurses enduring shortages of basic resources, rapid depletion and delayed restocking of COVID-19-related equipment, and additional strain due to staff shortages. Healthcare workers also experienced daily dilemmas and internal conflicts associated with the pandemic, which affected their health and well-being, and their ability to deliver services.

When it comes to children, the overall the reporting rate of children infected by COVID-19, at the time of this report, has remained low. However, a number of factors including the social and economic impact of the national lockdown, poor implementation of infection prevention and control strategies and the fear of being infected at health facilities had an overall negative impact on routine child health services. The PHC system has been key in addressing preventative and promotive aspects of health for children and PHC clinic utilisation data indicates that the national average of 2.1 visits per annum in 2019 decreased to 1,6 in April 2020. There was a 25% decrease in coverage of most vaccines, raising the possibility of measles outbreaks.

Child nutrition, which has a major impact on morbidity and mortality in children, was also affected by the COVID-19 pandemic, with a decrease in the coverage for of vitamin A dispensing and an increase in the SAM CFR, particularly in KwaZulu-Natal, Western Cape and North-West Provinces. The Integrated School Health Program (ISHP) collapsed completely when the schools were closed during the lockdown. However the recovery of the services occurred sooner in PHC than in hospital or community-based services. The longer-term impact of the socio-economic effects of the downturn in the economy, the increase in unemployment rates and decrease in food security in the country is significantly impacting on children and is likely to have a longer-term effect on child health in the country.

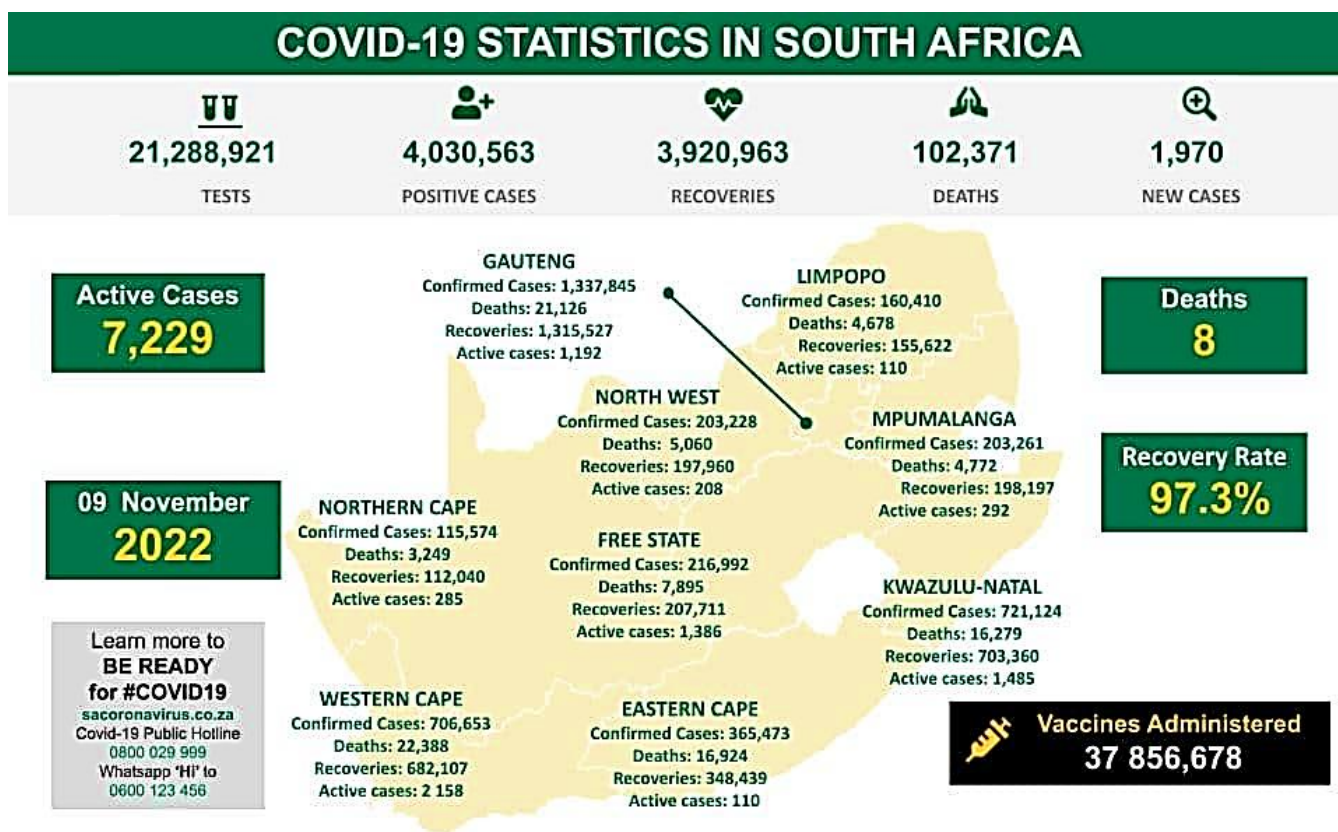


Figure 20: Update on Covid-19 (Wednesday, 16 November 2022)

11 Baseline Health Profile: Vhembe District

Vhembe District is located in the Northern part of Limpopo Province South Africa boarded by Capricorn District in the South-West and Mopani in the East. Vhembe District shares land port borders with Zimbabwe and Botswana on the North-West through Limpopo River and Mozambique South-East through the Kruger National Park. Vhembe District is comprised of four (4) Municipalities as District Municipality thirty-four (34). It is comprised of 4 municipalities districts named after the municipality i.e. Collins Chabane, Makhado, Musina, and Thulamela. The district has a population of 1 367 186, with a population density of 53.4 people per km² and falls in socio-economic Quintile 2, among the poorer districts, and has an estimated medical scheme coverage of 7.2%. Vhembe is one of the 11 National Health Insurance (NHI) pilot districts.

The Vhembe District has 6 District Hospitals, 1 specialized, 1 regional Hospital, 115 fixed Primary Health Care facilities, 8 Community Health Centres and 18 mobile clinics. District hospitals provides secondary level of care whiles specialized hospital provides mental health services and regional hospital acts as a referral facility for the district hospitals. Fixed Primary Health Care facilities, Community Health Centres (CHC) render comprehensive health services whereas mobile clinics render Primary health care in areas more than 5 kilometres away from the clinic.

Makhado Sub district in Makhado Municipality situated on the western side of Vhembe District boarded by Capricorn on the south-east with an estimated population of 458778. The sub district has 36 fixed PHC clinics, 3 District Hospitals and 2 CHC and 5 mobile clinics.

The Musina Sub District in Musina Local Municipality is situated on the north boarded by Capricorn District on the North-west side of Vhembe District 'sharing borders with Zimbabwe on the North and Botswana on the West with an estimated population of 120452. Although the population appears to be little compared with other sub districts there is high rate of external and internal migrants utilizing Primary health care services. Musina sub district is comprised of 1 district hospital, 10 fixed PHC clinics and 2 mobile clinics and Port health clinic In Beit bridge boarder post 2 of the 10 clinics are less than 5 km apart. Half of the area of Musina Municipality Majority of the area it's visited by Mobile clinic with estimated visiting points. Musina sub-district has fewer health facilities as compared to the rest of the sub-district. This has a negative impact on health service delivery with regard to accessibility of health service by the community.

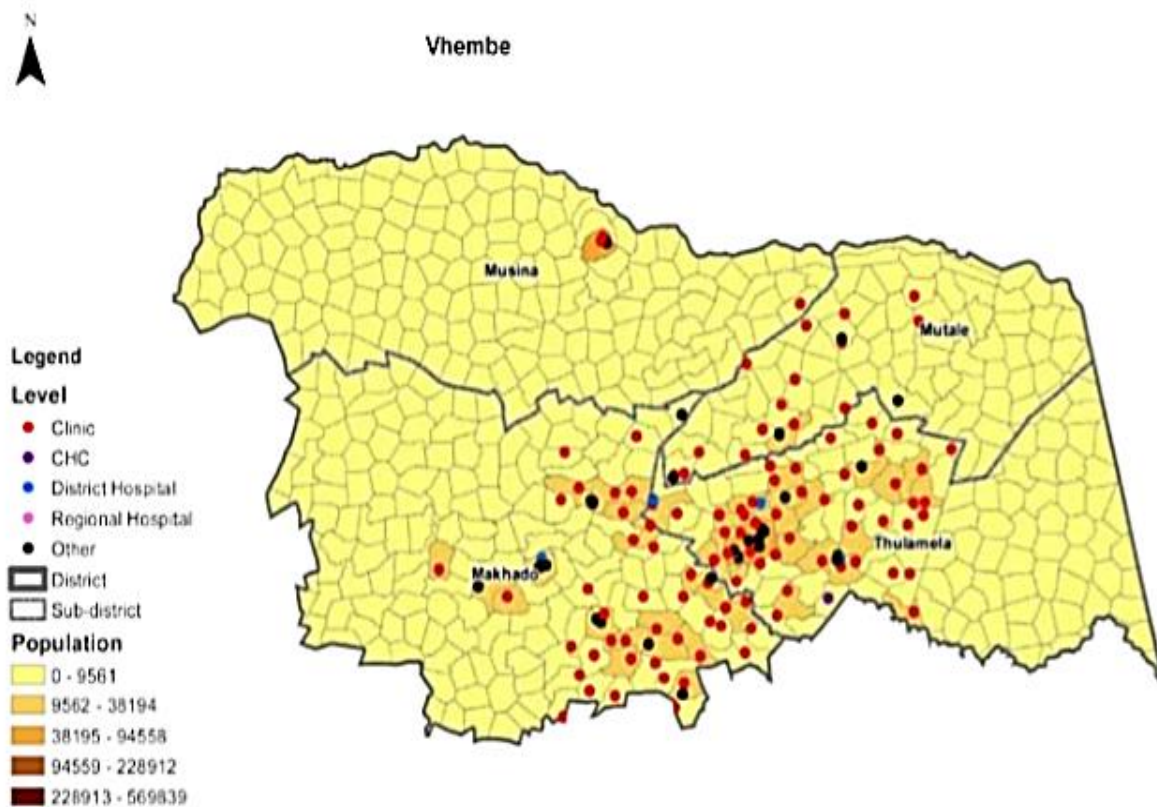
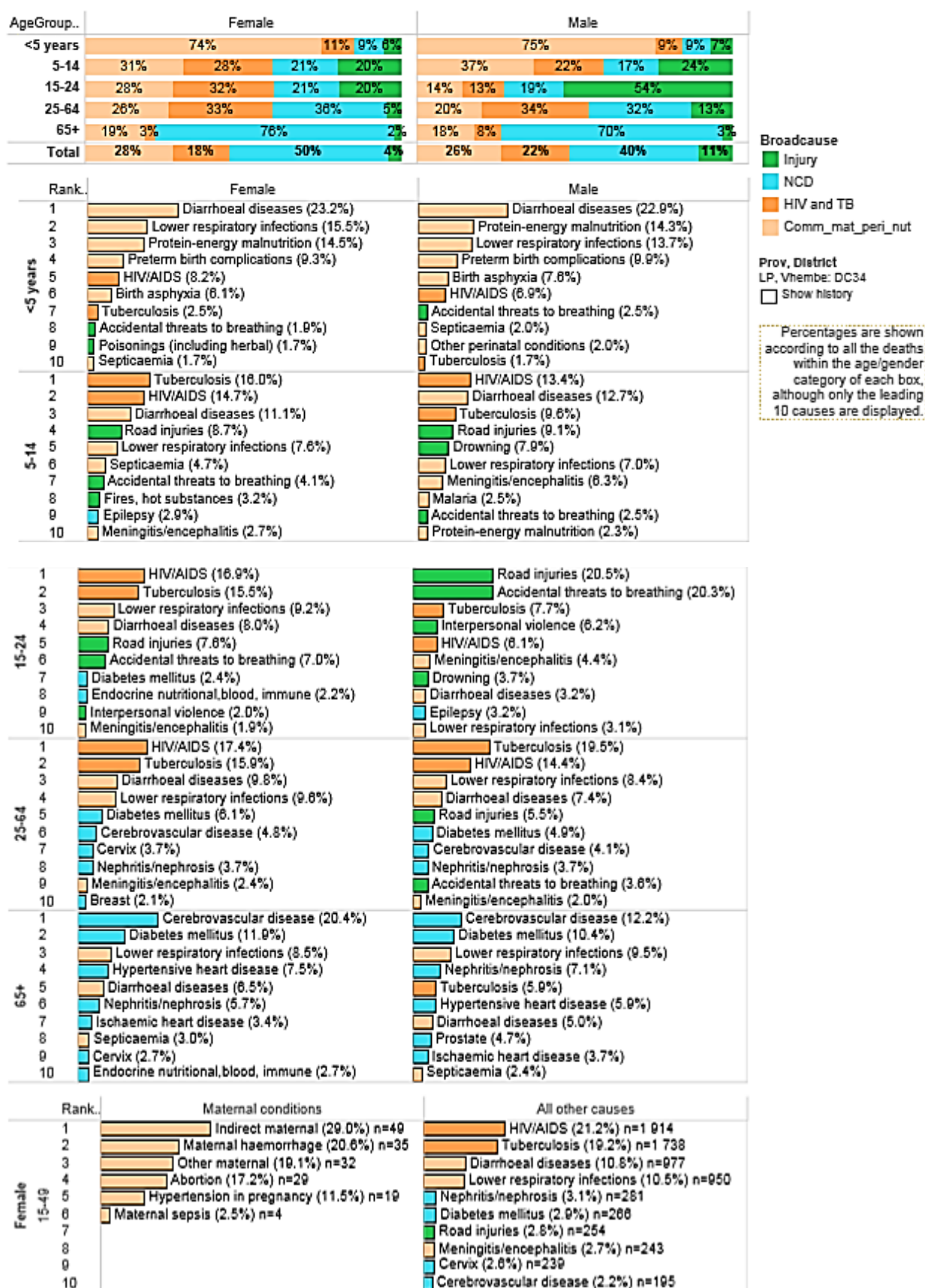


Figure 21: Population distribution sub-district boundaries and health facility locations

11.1 Burden of Disease Profile

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



11.2 Makhado Local Municipality

The Municipality is located in the northern parts of Limpopo Province (coordinates 23° 00' 00'' S 29° 45' 00'' E) approximately 100km from the Zimbabwean border along the N1 Route. (See Locality Map below). The municipal area is 7605,06 km² (or 760506 Hectares) in size and strategically located on a macro scale along a major passage between South Africa and the rest of the African continent. Approximately 416 728 people currently reside within the Municipality and based on the vastness of the rural populace the municipality can be classified as predominately rural.

11.3 Musina Local Municipality

Musina Local Municipality falls within the Vhembe District Municipality, which is made up of four local municipalities, namely Musina, Makhado, Thulamela and LIM 345, of which Musina Local Municipality is bounded by Makhado Local Municipality to the South and Thulamela local Municipality to the east. Musina is also bounded in the South West by the Local Municipality of Blouberg which falls within the Capricorn District Municipality. Musina Local Municipality is located in the very North of the Limpopo Province, bordering Mozambique, Botswana and Zimbabwe. Musina Local Municipality covers an area of approximately 1 129 740.773 hectares, 11 297.41 km² and the coordinates is 23° 20' 17'' S 30° 02' 30'' E that extends from the confluence of the Mogalakwena and Limpopo rivers in the West to the confluence of the Nwanedi and Limpopo rivers in the East and from Tshipise and Mopane in the South to Botswana/Zimbabwe borders in the North and Mozambique in the eastern side of Kruger National Park.

11.4 Mopane

Mopane is located in Musina local municipality, within the province of Limpopo. (GPS coordinates: 22.6204 S, 29.8576 E). A unique feature of the proposed Project area is that the small village of Mopane is the only human settlement (with the exclusion of farm houses) in the vicinity of the proposed SEZ site and future industrial waste site. Musina Local Municipality is in the process of preparing a master plan for the development of 1,000 new residential sites at the small settlement of Mopane.

Access to health care facilities is a major problem in Mopane, which is further exacerbated due to limited public transport. During the field visits to Mopane, it was evident that the community's biggest infrastructure challenge is roads and refuse disposal. Profiles on water and sanitation, as well as on electricity, are provided below.

Brick houses comprise almost 70% of all current dwelling in Mopane. Though the buildings and houses in Mopane are dated and dilapidated, there are currently no informal dwellings in the project footprint area at all. Historical evidence also indicates that work seekers tend to form a squatter camp as close as possible to the construction or development site. These squatter camps are often the focal point for xenophobic attacks (proximity to Zimbabwean border) and violent social unrest.

11.4.1 Human Settlements

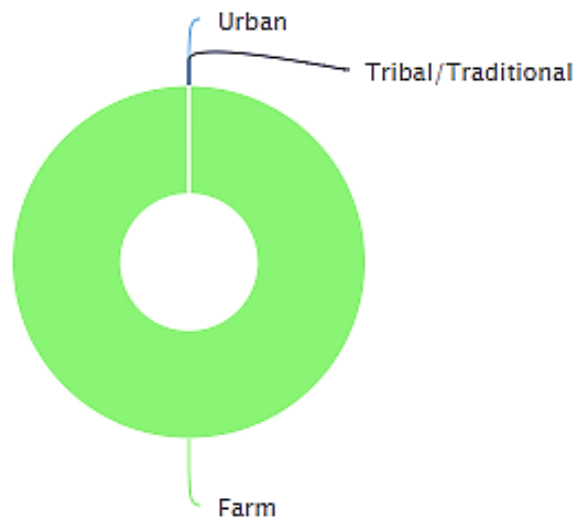


Figure 22: Settlement type in Mopane

There is a proposed development next to the Mopane town for the development of 1 000 erven proposed by the Municipality. This development obtained Environmental Authorisation in 2013.

11.5 Service Delivery

11.5.1 Electricity

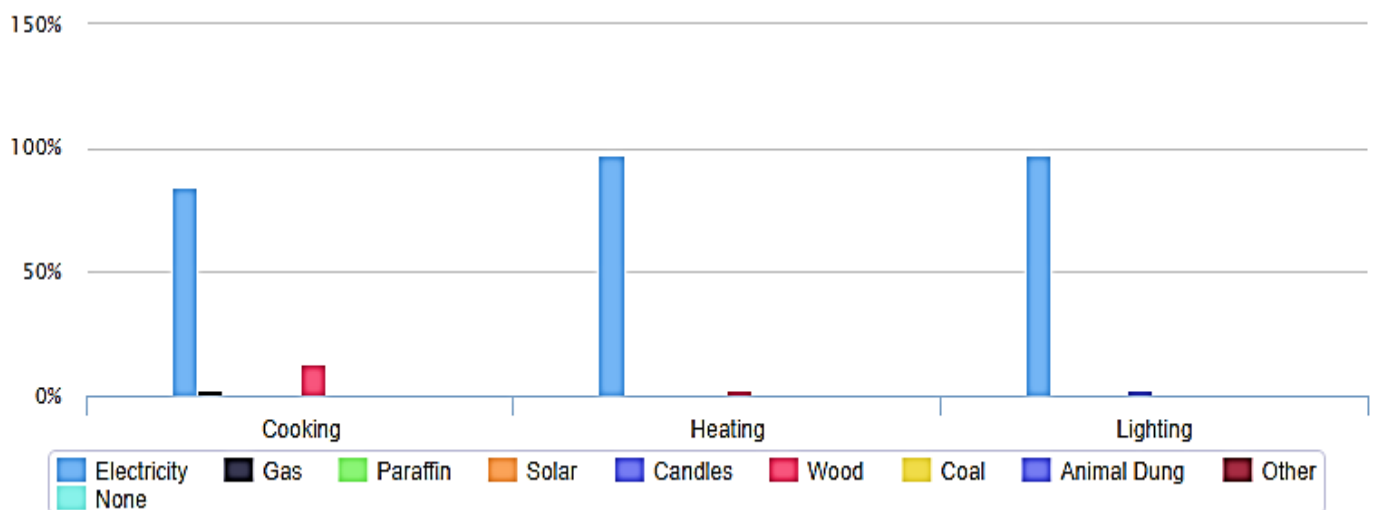


Figure 23: Energy or fuel for cooking, heating and lighting

11.5.2 Water and sanitation

Households are generally well serviced as far as electricity and water are concerned.

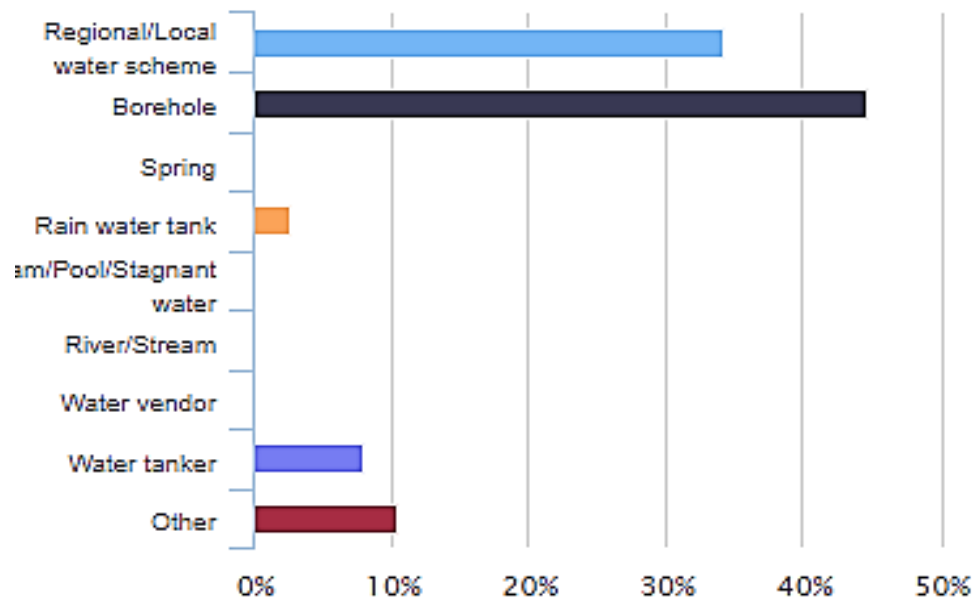


Figure 24: Source of water

11.5.3 Waste Management

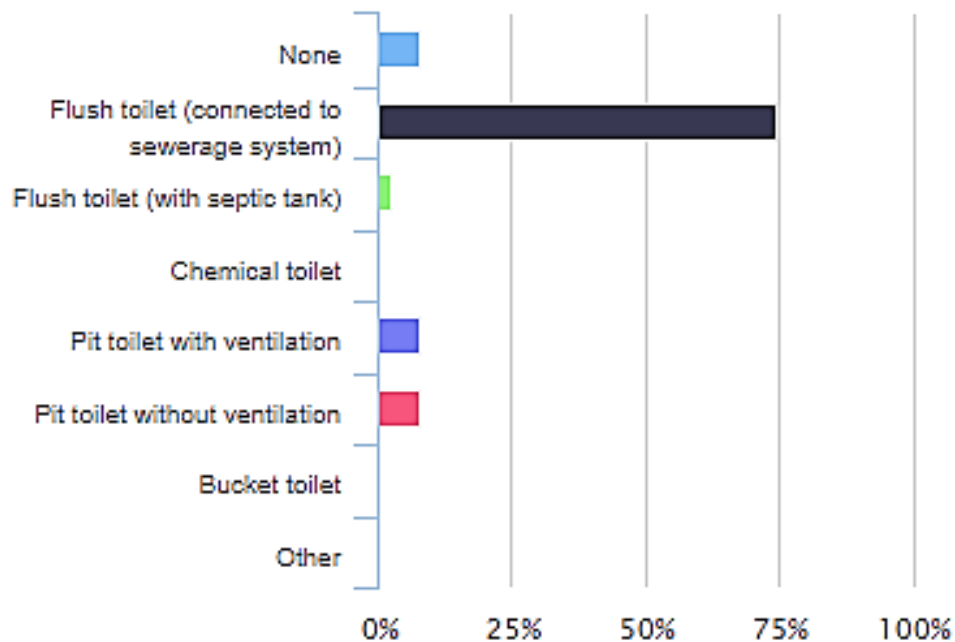


Figure 25: Toilet facilities

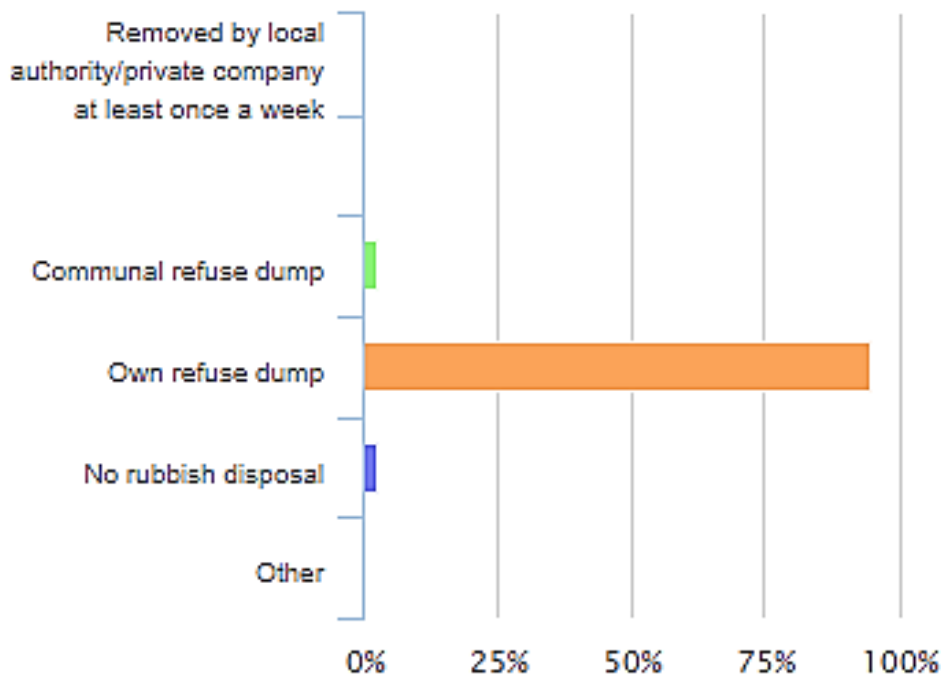


Figure 26: Refuse disposal

12 Health Profile: Local Municipality and Ward

12.1 Infrastructure and Service Delivery

The Constitution of the Republic of South Africa (Act 108 of 1996) provides all South Africans with basic human rights, which includes the rights to access basic infrastructure and services. Free Basic Municipal Services (FBS) are provided by the government to those South African households who cannot afford these services. These services are assumed to be sufficient to cater for the basic needs of a poor household.

12.1.1 Water

Safe drinking water is a basic necessity for good health, as unsafe drinking water can be a significant carrier of diseases such as trachoma, cholera and schistosomiasis. Drinking water can also be tainted with chemical, physical and radiological contaminants with harmful effects on human health.

Safe drinking water is a basic necessity for good health, as unsafe drinking water can be a significant carrier of diseases such as trachoma, cholera and schistosomiasis. Drinking water can also be tainted with chemical, physical and radiological contaminants with harmful effects on human health.

The majority (97.7%) of the population get water from a regional or local service provider, 50% have access to piped water in their yard and 47% have access to water in their houses. Only 1% of the population rely on communal taps and 1% of the population get their water from a communal stand.

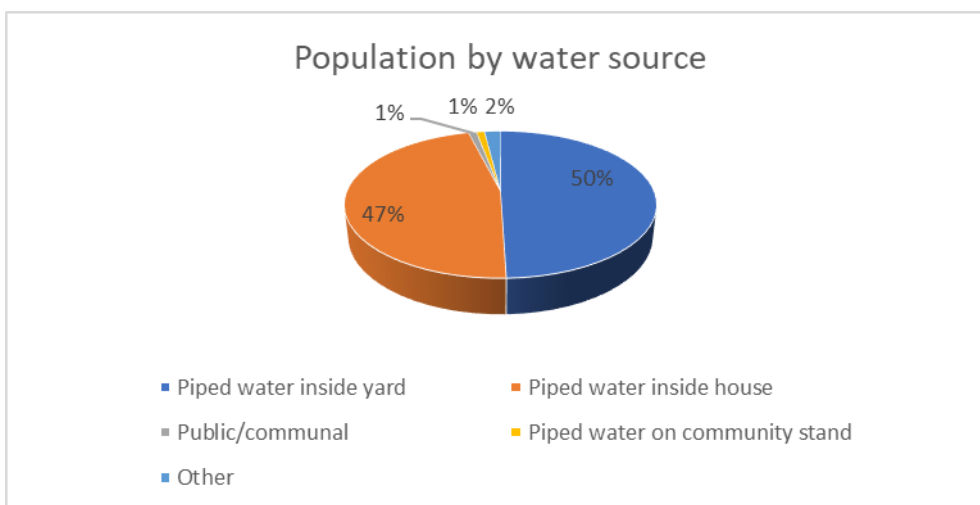


Figure 27: Population by Water Source

Source Community survey, 2016

12.1.2 Sanitation

The availability of sanitation facilities not only improves the dignity of people, but also promotes their health. Areas without proper sanitation systems give rise to water borne diseases like cholera, diarrhoea, and typhoid. It is therefore important that as a municipality, prioritisation should be given to this service, particularly considering any backlogs.

95.5% of the households have access to flush or chemical toilets, which is slightly higher compared to district level. Some households mainly within the informal settlement do not have access to flush or chemical toilets facilities.

12.1.3 Electricity

The supply of electricity to households throughout the country is central to the governments' aim of improving quality of life (SA Handbook, 2011). The cost of energy in South Africa is amongst the lowest in the world (as a result of a heavy reliance on coal power); however, the demand is growing due to increase in macro-economic activities and industrialisation (SA Handbook, 2011). Electricity services in South Africa are at crossroads. National economic growth has outstripped available generation capacity, while the regulatory uncertainty has undermined effective management of distribution assets at the municipal level.

76% of the households have access to electricity, this percentage has been gradually growing since 2001. Electrified households use electricity for lighting, heating and cooking. Although 76% of the households are electrified, the IDP 2018/2019 indicates that are challenges with electricity provision in some wards, there are challenges with trapping of electricity during the winter. Approximately 4.3% of the households do not have access to electricity. These households rely on other forms of energy such as candles, paraffin and firewood.

12.1.4 Refuse Removal

South Africa generates 19 million tons of waste per year and this is often harmful to the environment and people's health. According to Section 24 of the national constitution, all South Africans have the right to an environment that is not harmful to a person's health and wellbeing. The pollution and Waste Management Act gives the local municipalities the responsibility on waste removal.

86% of the households in Govan Mbeki Local Municipality get refuse disposal from a local authority, private company or community members at least once a month. In some areas it was reported that there seems to be a lack of consistent refuse removal resulting in the public dumping their domestic waste next to the roads. This poses significant consequences for environmental health and the visual state of the environment.

12.1.5 Housing

According to the Community Survey 2016, there are approximately 108 892 households in Govan Mbeki. A total of 63% of the households live in formal houses, whilst 20.4% live in shacks and 10.6% live in a flat in the backyard. Only 2.1% of the population live in traditional houses. The IDP (2018-2019) has reported that the municipality is experiencing shortages of houses.

12.1.6 Transport and Roads

In terms of road provision, the IDP states that some areas the roads infrastructure and maintenance are poor, roads are in a dilapidated condition, have potholes and some tar roads need patching (SDF, 2014-2034). With regards to infrastructure the SDF (2014-2034) indicates that the most common challenges which relate to infrastructure and services can be summarised as follows:

- Sewage spillage;
- Dumping / pollution – landfill site / inadequate refuse removal;
- Road maintenance; and
- Informal settlements.

13 Baseline Health Status in the Primary Zone: MMSEZ

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

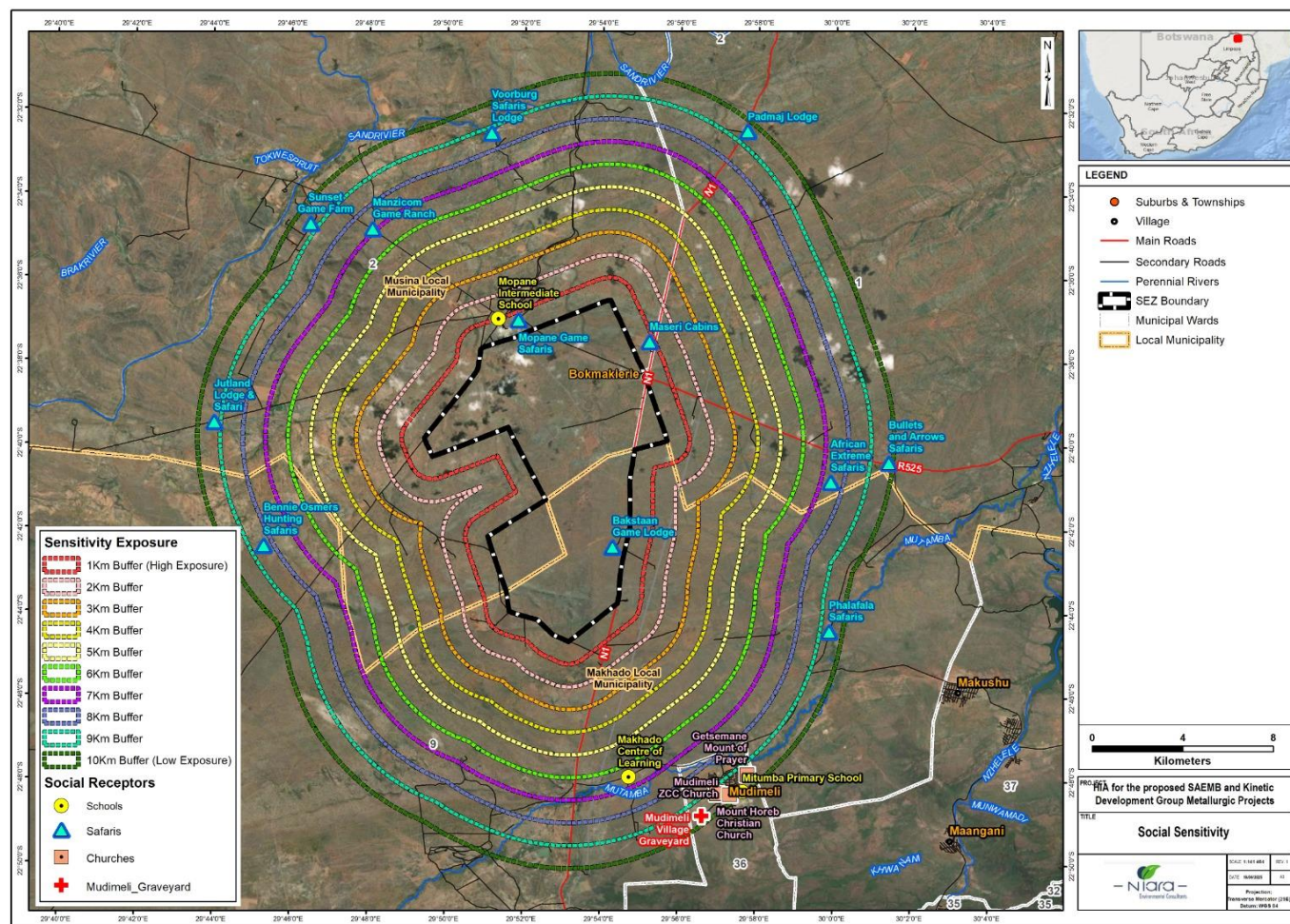


Figure 28: Social Sensitivity Plan

13.1 EHA #1: Vector-related Diseases

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

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

Uncollected refuse was seen in the streets of Musina town, which can have negative health impacts on the communities of concern, including but not limited to diarrhoea, eye and skin infections. Makhado is comparatively cleaner than Musina.

13.1.1 Malaria burden

Malaria may not be the most significant public health threat and cause of mortality in the proposed Project area, but media and literature reports to having had a recent outbreak of malaria in the area. However, there is good knowledge and understanding of malaria transmission and prevention. Ownership of Insecticide-Treated Nets (ITNs) is not good, and the few who own them might not be using them properly. However, there are good diagnostic mechanisms in the area, with consistent use of Rapid Diagnostic Tests (RDTs) to diagnose malaria.

The Limpopo health department has started with the process of fumigation in the lowveld regions, including the Vhembe district. Limpopo's health department is aiming at significantly reducing malaria cases in 2019. The province has seen a number of people dying due to the deadly endemic in the last few years. The department has started with the process of fumigation in the lowveld regions, including the Vhembe district.

Thousands of malaria cases were reported in the province in 2018 and over 130 cases were detected earlier in 2019 (SABC News, 2019). About 400 seasonal sprayers have been deployed across malaria-prone regions. MEC for health in Limpopo, Dr Phophi Ramathuba, says that they have been able to reduce the number of malaria cases in the province. "We have been able to provisionally reduce the number of cases of malaria from over 18 000 in the previous year to just a mere 6 000. So that tells that indeed we can be able to move forward if you also look at the number of deaths that we reduced from 160 to just 38." The department is continuing using the much-criticised DDT pesticide. DDT became infamous after experts warned of its potentially harmful environmental impact.

Very little is described on the entomology in the area. This includes the vector complexes, their breeding preferences and behaviour (resting and feeding), as well as susceptibility patterns to different classes of insecticide. This is vitally important for the proposed Project to describe as it will influence the type of mitigation measures required from a source reduction and control perspective.

13.2 EHA #2: Acute Respiratory Infections and Respiratory Effects from Housing

Housing design is crucial because poor planning results in congestion, overcrowding of people and improper sanitation, all of which when combined form the fundamental requirements for the perfect breeding ground for many diseases. Research conducted in Sri

Lanka, Costa Rica and Philippines showed a positive correlation between poorer housing and an increased death rate among children (Phillips, 1990).

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

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

Based on the key informant interview it was clear that most households live in a brick structure or traditional structures on individual properties (with more than one house on the respective property) or one house on a separate stand/property. According to data derived from 2011 census there is not an extreme need for housing throughout the province as 88.7% of people in Limpopo reside in formal housing (Stats SA, 2011). It was confirmed during the field visit that much of the population within the PACs has some kind of formal residence. Houses were traditional brick or mud structures either with a thatch or corrugated iron roof.



Figure 29: Housing structure in Mopane



Figure 30: Settlement just off the R525



Figure 31: Street view of Mudimeli



Figure 32: Entrance into small informal settlement along the R545 towards Mopane

Based on observation and informal discussions with several respondents, overcrowding was not seen as a problem. Houses are basic and sufficient. Squatter areas do not appear to be a problem. The majority of households within the local study area have access to electricity for lighting purposes. With regards to cooking and heating there seems to be a greater reliance on alternative energy sources, especially wood. It is reasonable to argue that wood is sourced from areas surrounding rural communities. This would have an adverse impact on human respiratory health. According to literature, TB is the most common respiratory disease in the LMs.

13.3 EHA #3 Veterinary Medicine and Zoonotic Issues

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

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

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

There was, generally, good knowledge about HIV and how it is contracted. Mudimeli Clinic, which was the one healthcare facility visited, has the ability to diagnose HIV and stock ARVs.

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

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

13.4.1 HIV/AIDS: Knowledge, Attitude and Behaviour

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

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

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

13.5 EHA #5 Soil-, Water- and Waste-Related Diseases

The two main sources of water in the area are the Limpopo River (and the alluvial aquifer under the riverbed) and the Nzhelele Dam. The Nzhelele Dam is situated on the Nzhelele River, approximately 50 km north- east of Makhado. The Sand River a perennial

stream that is often dry in the winter and flows to the west, 10 km north of the SEZ site. The Mutamba/ Nzhelele Rivers with perennial flow in a south-east direction, 20 km east of the SEZ site.



Figure 33: Surface water within the study area

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

The availability of sanitation facilities not only improves the dignity of people, but also promotes their health. Areas without proper sanitation systems give rise to water-borne diseases like cholera and diarrhoea. The field visit indicated that the majority of households do not have access to adequate sanitation services. Some residents of the surveyed communities construct their own pit latrines, often of poor standard. The majority of the respondents used pit latrines and Ventilated Improved Pit-latrines (VIP) toilets in their own yards/ homes.

13.5.1 Diarrhoea

Diarrhoea is usually a symptom of gastrointestinal infection and can be caused by a variety of bacterial, viral and parasitic organisms. Diarrhoea control and prevention takes place at different levels, including vaccination against rotavirus and measles, early and exclusive breastfeeding for at least the first 6 months (preferably 2 years), vitamin A supplementation, hand washing with soap, improved water quality and sanitation.

Diarrhoea was identified as one of the diseases with a significant burden within both Mudimeli and Mopane communities, especially amongst children under five years of age. The disease is said to be especially common among children in the surveyed communities as they have higher chances of playing in contaminated or unclean water. No cases of cholera were reported during interviews and discussions. The image below was taken in Mudimeli.



Figure 34: Pit latrine in Mudimeli



Figure 35: Jojo tank used by small community on the R525 between Mopane and Bokmakirie

13.6 EHA #6 Food- and Nutrition-Related Issues

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

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

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

Maize meal, porridge or mieliepap ('pap') was listed the most prominent staple food eaten in the PACs with all respondents mentioning this food as their staple diet. Beans, cabbage, potatoes, wild spinach, pumpkin, rice, samp, chicken and tinned fish were also listed as commonly consumed foods.

There were no reported deaths by malnutrition or other nutritional disorders in the surveyed communities or the neighbouring settlements.

13.7 EHA #7: Accidents/Injuries

This category contains health outcomes and determinants related to accidents and injuries. The key outcomes considered are increases and decreases in intentional and unintentional injuries with fatal and nonfatal results. The key determinants in this category include items such as the presence of law enforcement, traffic patterns, alcohol involvement, distance to emergency services, and the presence of prevention programs.

13.7.1 Road Traffic Accidents

The SEZ is strategically located along the N1 north-south route into the Southern African Development Community (SADC), very close to the border between South Africa and Zimbabwe. It forms part of the Trans-Limpopo Spatial Development Initiative and has been developed as part of greater regional plans to unlock investment and economic growth, and to address the development of skills and employment.

As stated above, the proposed Musina-Makhado SEZ southern site is located adjacent to the N1 which is the major link motorway between Pretoria and Beitbridge Land Port of Entry to Zimbabwe and the R525 road which traverses and crosses the SEZ. The N1 is a single carriageway in both directions. The R525 is a paved, tarred road and is also a single carriageway in both directions which connects Mopani Railway Station in the west with Pafuri Gate for the northern most entrance gate to the Kruger National Park in the east. The southern section of the SEZ is planned to provide access from the south to the SEZ, namely the Huntleigh Road leading to Huntleigh Railway Station. This project area is located within an area with existing road networks. Road traffic accidents (RTA) are not very common in the communities. Table 9 1 indicates accidents hotspots in the district municipality.

Table 13-1: Hazardous locations/accident hotspots

MUNICIPALITY	AREA
Makhado	R524 : from Makhado to Tshakhuma N1 : next to Mampakuil R578 : Njakanjaka village
Musina	N1 : Ha-Mavhele, Bokmakier and Heitleigh

Gender-based violence and crime related injuries such as assault are more common. There is a strong link to alcohol in domestic violence and motor vehicle accidents. RTA could increase even more with the further development of the proposed Project as the

area is likely to see an increase in the number and size of vehicles travelling in and around the Project area (transport of goods and personnel). An increase of trucks would result in road degradation.

13.7.2 Gender Based Violence

Gender-based violence and crime-related injuries such as assault are not very common in the surveyed communities common. There is a strong link to alcohol in domestic violence and motor vehicle accidents.

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

During the field visit, it was apparent to the HIA Specialist that numerous households still use wood and coal (open fire) for cooking and heating that may cause a risk from indoor air pollution and associated respiratory health concerns in the surveyed communities. As waste removal from households also seems to be a challenge, many households burn waste that can emit harmful by products especially with plastics. The figure below illustrates refuse which according to respondents had been sitting there for over two days. “The municipality is always on strike and they leave the dirt here for us” said one of the respondents. Just on the outskirts of the surveyed communities are illegal and uncontrolled dump sites which can contaminate water supplies and present unhygienic conditions –please refer to.

Wind erosion is a major cause of both loss and dispersion of pollutants from the proposed Project site. Such dust dispersion is not only a nuisance but also a potential health hazard to inhabitants in close proximity and can also cause soil and water pollution. The main pollutant of concern during the Project will be PM including PM and PM_{2.5}. A detailed Air Quality Impact Assessment Report was not available to the author at the time of Report compilation. This has been identified as a significant gap.

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

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

13.8.1 Air Quality

Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by the Applicant to compile the air quality specialist study as part of the authorisation process. The main objective of this study was to establish baseline/pre-development air quality in the study area and to quantify the extent to which ambient pollutant levels will change as a result of the proposed Project. Due to the lack of available operating information and detailed maps on the individual plants, the fugitive PM emission sources could not be quantified adequately. The simulated results discussed in this section (for PM₁₀ and PM_{2.5}) are an underprediction of what is expected to occur as a result of the SEZ operations; mainly to the north, north-east and east of the SEZ boundary.

The main sources of air pollution emissions have been identified as the following (Airshed, 2018):

- Railway transport;

- Vehicles travelling on paved roads;
- Road transport exhaust;
- Material transfer points;
- Storage facilities;
- Power production;
- Coal cleaning;
- Coke production;
- High vanadium steel production;
- Manganese steel production;
- Ferromanganese production;
- Silicon manganese alloy production;
- Domestic waste handling;
- Cement production;
- Refractories production;
- Stainless steel production;
- Ferrochrome production;
- Vanadium titanium magnetite plant;
- Sewage treatment plant; and
- Water treatment plant.

13.8.2 Noise

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

and Matheson (2003) concluded that the effects of environmental noise are strongest for categories linked to quality of life (or the wider determinants of health in the context of HIA) as opposed to illness (or bio physical factors).

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

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

Gudani Consulting and Enviro-Acoustic Research cc (GC/EARES) have undertaken the study to determine the potential noise impact on the surrounding environment due to the development of the proposed Musina-Makhado SEZ Project.

Ambient (background) sound levels were measured during the day and night of 7 March 2019, augmented with the results of longer-term ambient sound level measurements collected during previous site visits. Measurements were sufficient to characterise the ambient sound level character and, together with measurements done in the area for other projects there is a very high confidence in the typical rating level determined for the area. Considering the ambient sound levels measured onsite as well as the developmental character of the area, the acceptable zone rating level would be typical of a rural area (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008 for most of the area.

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

13.9 EHA #9 Social Determinants of Health

The social determinants of health refer to the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels (WHO, 2013). These circumstances

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

Mental health, or behavioural health, is considered a critical component of overall health and is linked to physical health and well-being for persons of all ages. Mental health includes reactions to stress and depression and problems with emotions. Substance misuse such as alcohol, tobacco or other drugs is not only an important health determinant but also closely linked to mental health (Prince et al., 2007). These practices are also associated with crime, prostitution and domestic violence. It was observed that several men on Mopane members of their communities drink a lot of alcohol, especially during the weekends and at the end of the month when individuals have received their wages, salaries or social grants. The key health personnel validated this by asserting that alcohol and drug abuse was a definite contributor of disease.



Figure 36: Bottle store and 'shebeen' in Mopane/ Mopane

The respective local municipalities are faced with developmental challenges coupled with socio-economic problems such as unemployment, job creation, education, HIV prevalence, basic service delivery, inequality, poverty, economic growth, sectorial dependency and economic distribution.

13.9.1 Health-seeking Behaviour

Individual health-related behaviour (manner in which people choose a health provider and at which stage of an illness) is influenced by many factors, including political, socio-cultural, economical, educational, personal and environmental. Each factor depends on

various underlying variables, of which some weigh more than others. The collusion of all these variables will result in certain behaviour of a specific individual at a specific time point. Culture and spirituality influence health seeking behaviour. People may believe that western medicine may be effective in curing their ailments but their conviction is that mystical causes have also intervened; this obliges them to combine visits to the health care facilities with visits to traditional healers.

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

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

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

- Access: determines whether patients are aware of services and are able to reach them within an acceptable time;
- Utilisation: refers to the rate and pattern of use of services;
- Demand for service: equates with health behaviour, that is, whether a patient becomes interested in using a service in the first place or adopts healthy practices;
- Perceptions of quality of care can act as either a motivator or a barrier to service utilisation; closely linked to demand, access and utilisation; and
- Beliefs: provide a rationale for health-seeking behaviour. The widespread resort to ineffective, costly and apparently irrational health-seeking behaviour had to be set in the context of traditional belief systems about the aetiology¹ of disease and how one gets well.

There is good health-seeking behaviour in the Project area. None of the respondents from either the surveyed communities admitted to consulting with traditional healers. Distance to healthcare facilities was not listed as an issue as the surveyed communities Clinic

¹ Aetiology refers to the study of causation, or origination. The word "aetiology" is mainly used in medicine, where it is the science that deals with the causes or origin of disease, the factors which produce or predispose toward a certain disease or disorder.

is within walking distance from each corner of the surveyed communities. Affordability is not an issue as all public health services are free – patients do not have to pay for medical services, consultation or for medicine.

13.10 EHA #10 Cultural Health Practices

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

Although one may be aware that medical pluralism, combining both biomedical and traditional medicine, is practiced in many South African households, respondents in the surveyed communities did not want to comment much on personally using the services of sangomas².

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

The difficulty in conceptualizing spirituality/religion comes from the multi-dimensionality of these concepts (Miller & Thorensen, 2003) and extends to the problem of how exactly spirituality/religion influence health. This, in turn, emphasizes the fact that there are multiple interpretations of how spirituality/religion influences health and a number of pathways through which this happens. Four most prominent such pathways have been proposed: health behaviours (through prescribing a certain diet and/or discouraging the abuse of alcoholic beverages, smoking, etc., religion can protect and promote a healthy lifestyle), social support (people can experience social contact with co-religionists and have a web of social relations that can help and protect whenever the case), psychological states (religious people can experience a better mental health, more positive psychological states, more optimism and faith, which in turn can lead to a better physical state due to less stress) and 'psi' influences (supernatural laws that govern 'energies' not currently comprehended by science but possibly understandable at some point by science). It is because spirituality/religion influence health through these pathways, they act in an indirect way on health (Oman & Thorensen, 2002).

² Although sangoma is a Zulu term that is colloquially used to commonly describe all types of Southern African traditional healers, there are differences between practices: an inyanga is concerned mainly with medicines made from plants and animals, while a sangoma relies primarily on divination for healing purposes and might also be considered a type of fortune teller.

No collaboration between healthcare facilities and traditional healers was noted.

13.11 EHA #11 Health Systems Issues

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

The health care infrastructure in the district and municipal area is relatively well served. The infrastructure was observed as sound. All respondents were happy with the quality of services they receive from the surveyed communities Clinic. There were no complaints of a lack of skilled staff to support the daily functioning of the facilities; the operating times of the facilities; long queues or overcrowding.

Key health personnel mentioned a shortage of staff, in the form of both professional nurses as well as doctors. This creates service delivery challenges and often results in long waits for patients, and places increased stress on the current medical staff. Staff shortages were also reported at the clinic level and this associated with equipment, consumables and limited documentation storage/filing methods, mean that these services do not function optimally.



Figure 37: Mudimeli Clinic

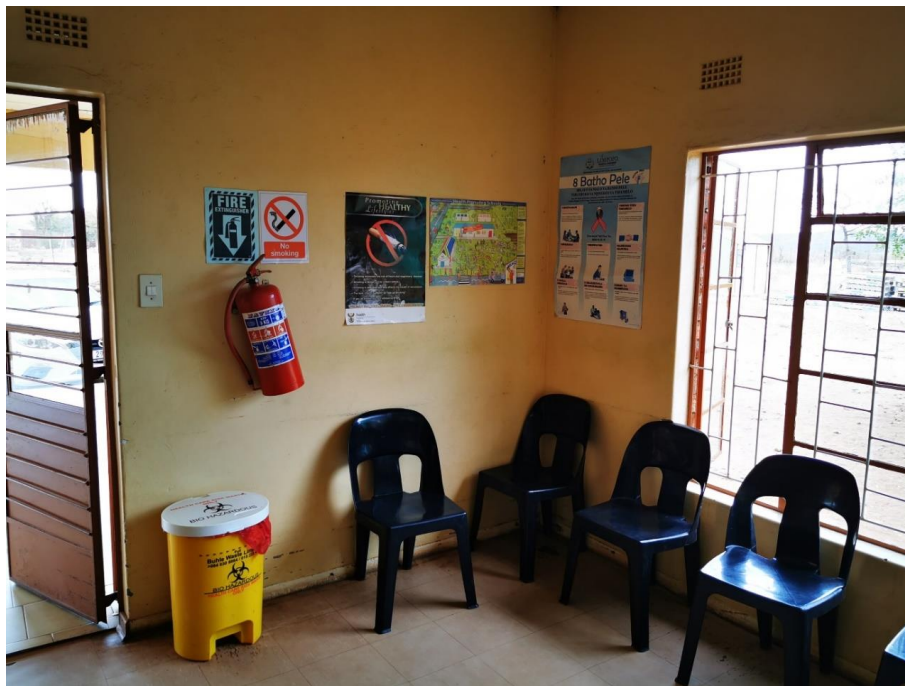


Figure 38: Mudimeli Clinic waiting area

13.12 EHA #12 Non-Communicable Diseases

ACTIVITIES FOR 2019			
DATE	ACTIVITY	TARGET GROUP	VENUE
FEBRUARY 2019	TEENAGE PREGNANCY	TEENAGERS AT SCHOOLS	MUDIMELI SECONDARY SCHOOL
MAY 2019	NO TOBACCO AND SUBSTANCE ABUSE	COMMUNITY	MUDIMELI CLINIC
JULY 2019	MENTAL HEALTH AWARENESS	COMMUNITY AND MENTAL HEALTH CARE USER	MUDIMELI CLINIC
AUGUST 2019	CERVICAL SCREENING AWARENESS	WOMEN AND COMMUNITY	MUDIMELI CLINIC
DECEMBER 2019	WORLD AIDS DAY	COMMUNITY	MUDIMELI CLINIC

Figure 39: Mudimeli Clinic activities for 2019

13.12.1 Emergency Services and Disaster Management

The Municipal Disaster Risk Management Plan is designed to establish the framework for implementation of the provisions of the Disaster Management Act, 57 of 2002, as well as the related provisions of the Municipal Systems Act, 32 of 2000. The purpose of the Municipal DRM Plan is to outline policy and procedures for both the proactive hazard and risk assessment, followed by disaster prevention (if possible), risk reduction, preparedness and the re-active disaster response, relief and rehabilitation phases of Disaster Risk Management. Disaster Management is the function assigned to the district municipalities as per legislation (Disaster Management Act 57 of 2002). There are currently Disaster Management Framework Plans for both the Makhado and Musina Local Municipalities. It is estimated that the District is served by 37 police stations. These are fairly effectively distributed throughout the municipal area, with the highest concentration of stations coinciding with the areas experiencing higher population densities.

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

The provincial emergency medical services (EMS) and planned patient transport (PPT) systems in places like Mudimeli are characterised by long waiting times, a lack of reliability, and indignity. The current failure of the EMS system impacts disproportionately on the vulnerable poor, often residing in rural settings, such as the surveyed communities. The unavailability of ambulances either in emergencies or for planned patient transport means that many people are forced to make substantial, often not budgeted for, payments to access health services at facilities (TAC, 2018). For those who are unable to pay for these services, they have no option than to wait for an ambulance which often take hours to arrive, or does not arrive at all.

13.13 EHA #12 Non-Communicable Diseases

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

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

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

13.13.1 Mental Health

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

Access to jobs, income, goods and services can enhance mental health and well-being and reduce stress. Having a sense of control over one's life is crucial for mental well-being, so manufacturing, power generation and metals projects can improve mental health by reducing poverty, increasing self-esteem and empowering local communities. However, if not well managed, the disruption and uncertainty brought on by a new project can increase worry, stress, and feelings of powerlessness. If the price of local housing, food

and other services increases as a result of the project, the financial stress on low income families can be great. The visual impact on the environment and the lighting, odour and noise associated with heavy industrial projects can also affect mood, heighten stress levels and lead to sleep disturbance. Lack of job security may also lead to stress amongst employees and dependants, particularly well-being when the project only provides short term employment contracts or when the project nears closure.

13.13.2 Physical Activity Levels

Consistent physical activity is an important indicator of future non-communicable diseases risk, particularly cardiovascular disease risk. Moderate physical activity is defined as some activity that causes an increase in breathing or heart rate (30 or more minutes a day, 5 or more days per week). Vigorous physical activity is defined as some activity that causes a large increase in breathing or heart rate (20 or more minutes a day, 3 times or more a week) (Newfields, 2014). Residents of the surveyed communities reported that they do not participate in leisure time physical activities such as jogging or exercise.

14 Anticipated Health Impacts of the various Manufacturing Plants

14.1 Thermal Power Plant

A thermal power station is a power plant in which heat energy is converted to electric power. In most of the places in the world the turbine is steam-driven. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator.

Due to its high energy generation potential, coal is widely used in power generation in different countries. Although, the presence of carbon, hydrogen and sulphur in coal facilitates the energy generation in coal combustion, some pollutants including CO_x, SO_x, NO_x, particulate matter (PM) and heavy metals are accumulated in air and water and lead to severe environmental and health impacts as a result of leaching, volatilization, melting, decomposition, oxidation, hydration and other chemical reactions. In addition, fly ash, in both wet and dry forms, is mobilized and induces severe impacts including bone deformities and kidney dysfunction, particularly with exposure of radionuclides (Munawer, 2018).

The burning of coal leads to the emission of poisonous gases with underlying health impacts and environmental problems (Clancy et al.; Katsouyanni et al., 2001, Gent et al., 2003). In coal combustion, the carbon, sulphur, and nitrogen react with oxygen and produce their respective oxides: carbon dioxide (CO₂) and carbon monoxide (CO), sulphur dioxide (SO₂) and sulphur trioxide (SO₃), and nitrogen dioxide (NO₂) and nitric oxide (NO), respectively. The emission of these gases has been correlated with many health problems directly and indirectly, including skin, cardiovascular, brain, blood and lung diseases, and different cancers (Badman and Jaffé, 1996, Cornell, 2016, Bascom et al., 1996, Kelsall et al., 1997, Health effects of outdoor air pollution. Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society, 1996, Pope et al., 1995). For example, CO enters into the blood stream and reacts with haemoglobin and reduces the formation of oxy-haemoglobin complex by decreasing its ability for O₂ transformation (Badman & Jaffé, 1996). Hence, the CO can alter biological functions at the cellular level and cause many abnormalities including slow reflexes, and coagulation confusion or disorders. Both CO and CO₂ cumulatively have harmful impacts on the environment in the form of global warming and greenhouse gases (GHG) emission. The CO₂ emission from coal combustion, during power generation, also leads to the interaction of CO₂ with particulate matter (PM 2.5), which thereby changes

the air quality and leads to increased asthma attacks and other respiratory and cardiovascular diseases with underlying poor life expectancy rates. Inhaling particulate matters may cause some dangerous diseases, including chronic obstructive pulmonary disease (COPD) and lung cancer (Cornell, 2016).

The sulphur, in coal, oxidizes upon combustion and pollutes the air, water, and land by releasing SO_x (SO₂, SO₃, SO₃²⁻ and H₂SO₄). The formation of the poisonous SO₂ gas, a major pollutant in air, may accelerate the rate of diseases and decrease life expectancy around power plants (Bascom et al., 1996, Kelsall et al., 1997, Health effects of outdoor air pollution. High exposure to SO₂ causes suffocation, wheezing, coughing, and reductions in lung function by affecting mucous and cellular mucins (Kelsall et al., 1997, Health effects of outdoor air pollution. Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society, 1996, Pope et al., 1995, Bascom et al., 1996). NO₂ forms the most important part of acid rain, as nitrous acid HNO₂ and nitric acid HNO₃, which causes a large number of skin diseases (Singh & Agrawal, 2007). The entrance of SO_x and NO_x air pollutants into the blood stream and cells destabilizes normal heart beats (rhythms) and culminates in heart attacks and other heart related problems (Peters, PerzDöring, Stieber, Koenig, & Wichmann, 1999). In addition, high levels of NO₂ (>1500 mg/m³) in the air causes a reduction in the pulmonary function in humans (Li *et al.*, 2001, Health effects of outdoor air pollution. The ozone gas formed as a result of NO₂ reaction with the volatile organic compounds in the air causes ozone-related asthma exacerbations in infants (Gent *et al.*, 2003).

PM level, individually and in combination with NO₂ in air, increases the concentration of free radical based reactive oxygen species (ROS) and contributes to DNA mutation, and damage of protein and lipids which may constitutively activate membrane proteins which leads to the development of some serious diseases, including lung cancer, cardiovascular diseases and reproductive disorders (Hussain et al., 2016a, Valko et al., 2007, Miller et al., 2007; Clancy et al.; Katsouyanni et al., 2001).

Figure 40 illustrates the coal combustion associated health and environmental risks. Process A) shows how the emission of CO_x, SO_x and NO_x from a coal combustion plant is hydrated in rain water and converted into respective acids (H₂CO₃, H₂SO₄, and HNO₃) to cause many environment and health impacts by disturbing all kingdoms of life including eukarya, archaea and bacteria. CO and CO₂ emission from a coal combustion power plant into air hugely contributes to global warming and damages the food-web, and increases the spreading of malaria, cardiovascular diseases and respiratory diseases like asthma. During coal combustion, sulphur emission first oxidizes to form sulphur dioxide (SO₂), and further oxidizes to form SO₃ that forms sulphuric acid (H₂SO₄) upon hydration in rain. Acid rain comprised of H₂CO₃, H₂SO₄, and HNO₃ leads to dangerous diseases including cancers of skin and various skin diseases in animals. NO_x regulates pulmonary dysfunction by free radical mechanism. Process B) conveys the cumulative effect of PM with NO_x and CO_x causes cellular stress and respiratory diseases. PM, together with CO_x and NO_x impacts the cellular DNA and respiratory canal epithelial lining, and SO_x reacts with mucous lining to regulate the SO₃-derivatives of glycoproteins (e.g. mucins) to regulate various diseases.

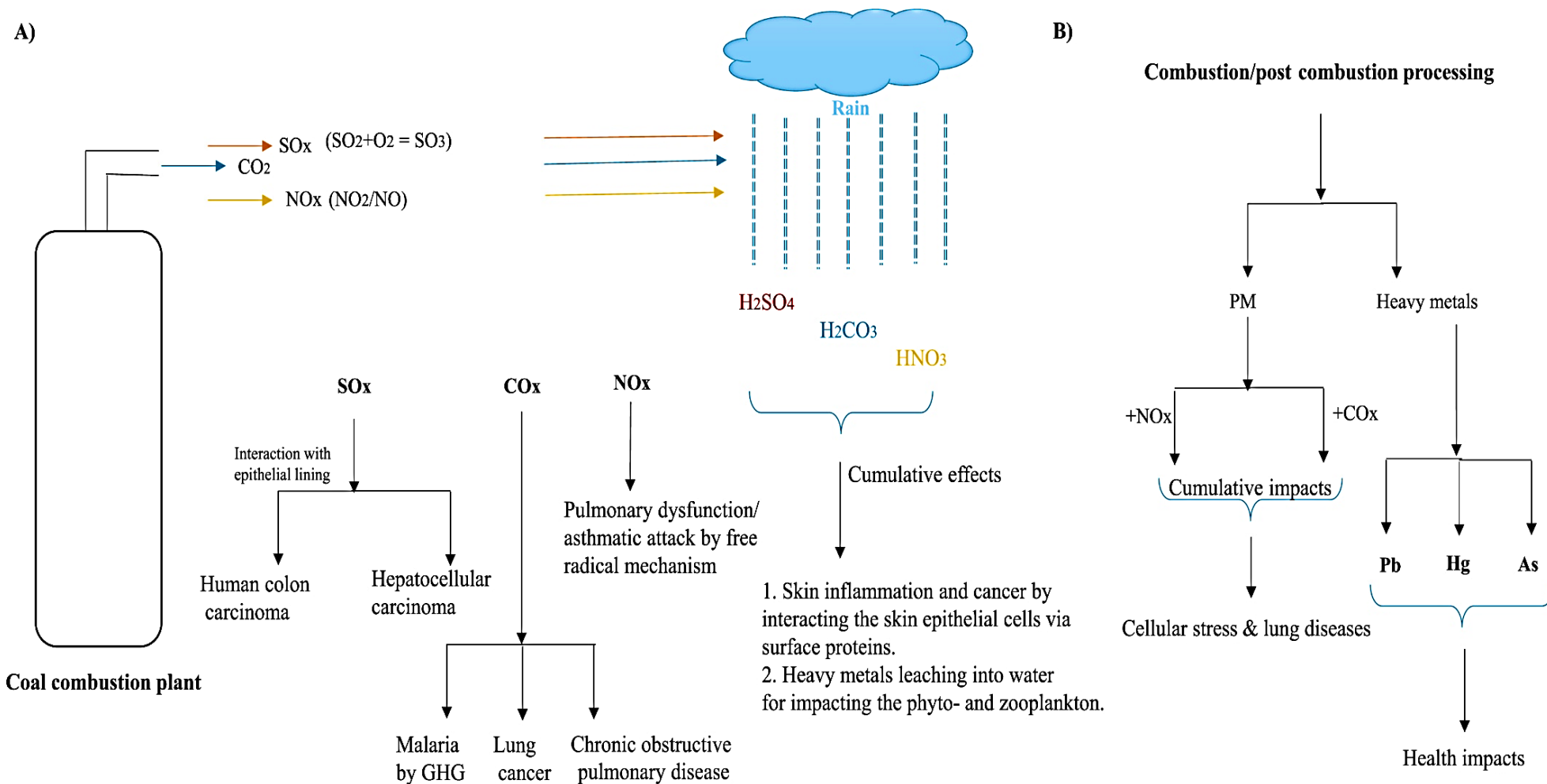


Figure 40: Coal combustion related health and environmental risks

14.2 Coke Plant

Coke for smelting of iron ore in the blast furnace must meet particular specifications as to its physical qualities and composition and is especially produced in the coke oven plant from carefully selected types of bituminous coal (Wesley and Hermon, 2012).

Modern processes filter out pollutants, typically include:

- Atmospheric Emissions:
 - Particulate matter (dust)
 - Sulphur dioxide (SO₂)
 - Nitrogen Oxides (NO_x)
 - Fugitive emissions in volatile compounds (e.g. poly-aromatic hydrocarbons, dioxins), carbon monoxide emissions).
- Hazardous waste:
 - Sludge not used in ovens.

These pollutants and their anticipated human health impacts have been discussed in Section 15 of this Report.

14.3 Ferrochromium Plant

Ferrochrome (FeCr) is an iron-chromium alloy which is used to make stainless steel. Soil, sediment, water and air can all become contaminated with chromium through industrial activities. Dust from industry operations such as mining and smelting settles out of the air, polluting soils and surface water. Most soluble chromium eventually settles onto sediment. Contamination of soil, surface and groundwater can also occur through release of industrial wastewater and leaching of soluble Cr compounds from wastes such as waste rock, dust and slag piles. Ferrochrome production creates air pollution, dust, slag (waste produced during ferrochrome separation from other ore elements) and process water. These waste materials have the potential to be contaminated with chromium and other heavy metals and chemicals of concern.

Ferrochrome production emits air pollutants such as nitrogen oxides, carbon oxides and sulphur oxides (NO_x, CO_x, SO_x) and particulate dusts that contain heavy metals such as chromium, zinc, lead, nickel and cadmium. During the high temperature smelting of chromite ore, some Cr-III is converted to toxic Cr-VI, contaminating the dust.

Inhalation: High concentrations of dusts or fumes may cause irritation. Repeated or prolonged exposure to various chromium compounds has been reported to result in ulceration and perforation of the nasal septum, irritation of the throat and lower respiratory tract, less commonly in gastrointestinal disturbances, blood changes, pulmonary sensitization, pulmonary pneumoconiosis or fibrosis, and rarely liver effects.

Skin Contact: Contact with dusts or powder may cause irritation. Repeated or prolonged exposure to various chromium compounds has been reported to cause various types of dermatitis, including eczema, “chrome holes”, sensitization, and, in contact with damaged skin, kidney damage. These effects have not been reported from exposure to the metal per se.

Eye Contact: Contact with dusts or powders may cause irritation. Repeated or prolonged exposure to some chromium compounds may cause conjunctivitis and lacrimation³. These effects have not been reported from exposure to the metal per se.

Ingestion: Chromium metal is poorly absorbed by the intestinal tract. Absorption of sufficient amounts of some chromium compounds may result in dizziness, intense thirst, abdominal pain, vomiting, shock, oliguria⁴ or anuria⁵, and uraemia⁶, which may be fatal.

14.4 Ferromanganese Plant

Standard ferromanganese, also known as high-carbon ferromanganese, is one of the manganese ferroalloys smelted directly from manganese ores. In general, it is produced either by a blast furnace or a submerged arc furnace. The alloy is smelted either by high-manganese slag or discard slag practices. Lime is used to keep the manganese content low in slag.

Ferromanganese causes skin and eye irritation. It may also cause allergy or asthma symptoms or breathing difficulties if inhaled, cancer, may damage fertility or the unborn child. Causes damage to the immune system and nervous system through prolonged or repeated exposure. In contact with water releases flammable gas.

Acute exposure to manganese: Dust or fumes may be irritating to the mucous membranes. Occupational exposure to dust or fumes has been reported to cause upper respiratory tract problems, black mucous membrane discharge from the nose, and neurological damage. Metal fume fever, an influenza-like illness, may occur due to the inhalation of freshly formed metal oxide particles sized below 1.5 microns and usually between 0.02-0.05 microns (DLA, 2015). Other symptoms may include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Fever, chills, muscular pain, mild to severe headache, nausea, occasional vomiting, exaggerated mental activity, profuse sweating, excessive urination, diarrhoea and prostration may also occur.

Acute Exposure (Carbon): Inhalation of dust may cause slight mucous membrane irritation. If sufficient quantities of manganese dust or fumes are inhaled and absorbed, systemic poisoning known as "manganism", a Parkinsonian-like syndrome may occur. It is characterized initially by anorexia, asthenia, headache, insomnia or somnolence, irritability, restlessness, and spasm or pain in the

³ Shedding tears, or shedding more tears than is normal.

⁴ Oliguria refers to low urine output.

⁵ Anuria is defined as absence of any urine output.

⁶ Uraemia is a clinical syndrome marked by elevated concentrations of urea in the blood and associated with fluid, electrolyte, and hormone imbalances and metabolic abnormalities, which develop in parallel with deterioration of renal function.

muscles. Manganese psychosis may follow with uncontrollable behaviour, unaccountable laughing or crying, visual hallucinations, confusion and euphoria. Sexual excitement followed by impotence may occur (DLA, 2015).

Adolescents living in communities with ferromanganese alloy plant activity have been shown to exhibit deficits in olfactory and fine motor function. Household dust may serve as an important manganese (Mn) exposure pathway to children, though dust Mn concentrations have not previously been measured to assess household contamination from ferromanganese alloy plant emissions (Lucas *et al.*, 2019). Given the evidence associating elevated Mn exposure with neurological impairments in children from various literature, it becomes apparent that dust Mn levels should be reduced in contaminated environments to protect the health of resident children.

14.5 Pig Iron Plant

Iron is a lustrous, ductile, malleable, silver-grey metal (group VIII of the periodic table). It is known to exist in four distinct crystalline forms. Iron rusts in damp air, but not in dry air. It dissolves readily in dilute acids. Iron is chemically active and forms two major series of chemical compounds, the bivalent iron (II), or ferrous, compounds and the trivalent iron (III), or ferric, compounds.

Iron may cause conjunctivitis, choroiditis, and retinitis if it contacts and remains in the tissues. Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in development of a benign pneumoconiosis, called siderosis, which is observable as an x-ray change. No physical impairment of lung function has been associated with siderosis. Inhalation of excessive concentrations of iron oxide may enhance the risk of lung cancer development in workers exposed to pulmonary carcinogens. LD50 (oral, rat) =30 gm/kg. (LD50: Lethal dose 50. Single dose of a substance that causes the death of 50% of an animal population from exposure to the substance by any route other than inhalation. Usually expressed as milligrams or grams of material per kilogram of animal weight (mg/kg or g/kg)) (Lenntech, 2018).

Pig iron is used for making steel and pure iron units. It has very high carbon content along with silica and another constituent of dross. Pig iron made from smelting iron indulges with the high amount of carbon for further processing steps.

14.6 Stainless-Steel Plant

The main difference between stainless steel and carbon steel is the amount of chromium present. Unprotected carbon steel rusts readily when exposed to air and moisture. This iron oxide film (rust) is active and accelerates corrosion by making it easier for more iron oxide to form (Delta, 2019).

Pollutants are typically including:

- Carbon Dioxide (CO₂)
- Traces of elements not fully removed by the stack gas scrubbers:
 - Sulphur dioxide (SO₂)
 - Nitrogen Oxides (NO_x)

- Trace elements like Mercury, Cadmium and Lead.

These potential human health impacts of these pollutants have been discussed in Section 15 of this Report.

14.7 Lime Plant

The word 'lime' refers to products derived from heating (calcining) limestone. Lime is a calcium-containing inorganic material in which carbonates, oxides, and hydroxides predominate. In the strict sense of the term, lime is calcium oxide or calcium hydroxide (Delta, 2019).

The lime industry is a significant carbon dioxide and dust emitter. These pollutants and their anticipated human health impacts have been discussed in Section 15 of this Report.

14.8 Calcium Carbide Plant

Calcium carbide, also known as calcium acetylide, is a chemical compound with the chemical formula of CaC_2 . Its main use industrially is in the production of acetylene and calcium cyanamide (Patnaik, 2003). Calcium carbide is produced industrially in an electric arc furnace from a mixture of lime and coke at approximately 2,200 °C.

The figure below presents the material flow chart of the production. The process can be seen as starting with the drying of coke and production of lime from limestone. After that these substances are mixed and fed into the electrical oven, where they under high temperatures react to form calcium carbide. The calcium carbide is then cooled by the surrounding air and after that crushed and sorted. Finally, the carbide is packaged in containers of various sizes for different types of consumers or fed directly into for example PVC production. China is the only major country using calcium carbide to produce PVC plastics (Harriman, 2005). This is done through the so called "acetylene route", where calcium carbide and water becomes acetylene and calcium hydroxide.

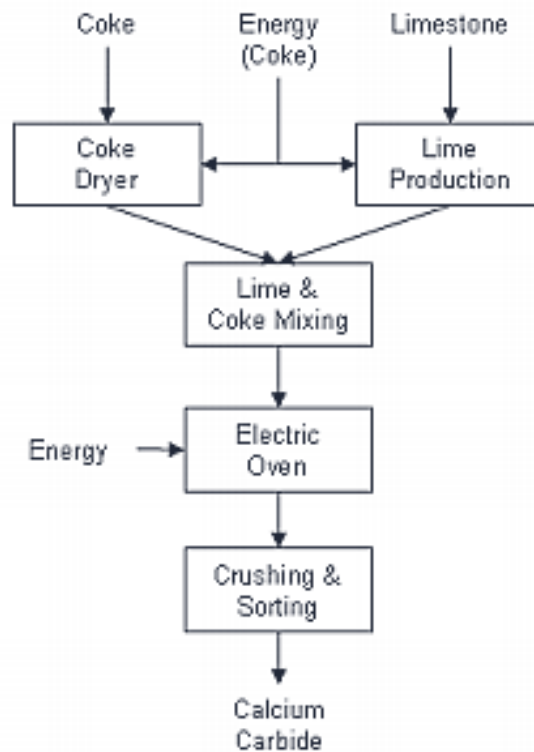


Figure 41: Flow chart of calcium carbide production

The reaction of calcium carbide with water, producing acetylene and calcium hydroxide, was discovered by Friedrich Wöhler in 1862. This reaction was the basis of the industrial manufacture of acetylene, and is the major industrial use of calcium carbide (Greenwood et al, 1997). In China, acetylene derived from calcium carbide remains a raw material for the chemical industry, in particular for the production of polyvinyl chloride. Locally produced acetylene may be more economical than using imported oil. Calcium carbide reacts with nitrogen at high temperature to form calcium cyanamide. Commonly known as nitrolime, calcium cyanamide is used as fertilizer. It is hydrolysed to cyanamide, H_2NCN .

By adding calcium carbide during the steel production, the amount of slag and sulphur can be reduced, resulting in less impurity (China Chemical Reporter, IV, 2003).

Calcium carbide is used:

- In the desulfurization of iron (pig iron, cast iron and steel);
- As a fuel in steelmaking to extend the scrap ratio to liquid iron, depending on economics; and
- As a powerful deoxidizer at ladle treatment facilities.

Calcium carbide is sometimes used as source of acetylene gas, which is a ripening agent similar to ethylene. However, this is illegal in some countries as, in the production of acetylene from calcium carbide, contamination often leads to trace production of phosphine and arsine.

Calcium carbide causes various health hazards like, headache, dizziness, mood disturbances, sleepiness, mental confusion, memory loss, cerebral oedema and seizures. These results indicate that fruit treatment with calcium salts not only affects the ripening process but also influences the aroma of the fruits.

14.8.1 Cancer

Calcium carbide has the potential to cause cancer and contains traces of phosphorus hydride and arsenic. Some early symptoms of arsenic or phosphorus include diarrhoea with or without blood, vomiting, thirst, weakness, burning sensation of chest and abdomen, irritation or burning in the eye, difficulty in swallowing, permanent eye damage, sore throat, ulcers on the skin, cough and shortness of breath.

Stomach Upset: Carbide has an alkaline substance, an irritant which has the potential to erode mucosal tissues inside the stomach. This can disrupt intestinal functions significantly.

Disruption of Neurological System: It has been found that carbide imitates acetylene gas, which can drastically impair the neurological system by inducing hypoxia for a prolonged period. Hypoxia is a condition that prompts low oxygen supply to the blood as well as tissues. Some of the symptoms of this condition include dizziness, headache, sleepiness, mood disturbances, memory loss, sleepiness, cerebral oedema, mental confusion and seizure.

Cement is produced by mixing concrete, mortar and grout made of sand and water. Studies show that calcium carbide residue can successfully be used for the production of cement without major property changes of the cement.

15 Potential Health Impact Assessment

The ultimate goal of a cHIA is to identify whether there are potential health impacts and communicate these impacts to decision makers during the planning and permitting process. The potential impacts during the construction phase will be similar with a lower significance than the busier long-term operational phase. Health impacts include:

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

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

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

This section provides an analysis of the potential impacts associated with the proposed Project and has included the analysis of potential negative impacts and their mitigation measures, but also includes potential positive impacts and measures to enhance these. This is based on the evidence presented in the baseline health description, the planned Project activities and information obtained from the other available specialist studies.

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

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

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

The assessment of impacts due to risks to the health and safety of people and the safety of the environment is based on acts and regulations on buildings and structures; fire safety and other safety regulations; and documents on natural hazards. SEZ workers (including those who are involved in the construction of the SEZ and associated facilities) are a critical population within the area supporting SEZ development. The safety, security, and fair treatment of workers are fundamental toward maximizing economic growth, income generation, and health opportunities in SEZs. For this reason, occupational health related mitigation measures have also been included in this section.

15.1 EHA #1: Vector-related Diseases

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

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

15.1.1 Malaria burden

The proposed Project does have the potential to impact malaria transmission. This will require mitigation; interventions may differ based on seasonal and land use practices. Modification of the environment often changes the habitat for mosquitoes to breed in. In this regard, the presence of a dam in the proposed Project area strongly increases the malaria risk during the rainy season.

Influx of individuals may also play a role in increased disease transmission. More people from outside the area may increase the naturally-occurring parasite pool and changes in land use may also alter the environment. This is challenging for the proposed Project to manage as their responsibility, as it is already part of the baseline conditions.

The health of the workforce also needs to be considered, especially as some of the workforce may come from the local community. The risk of the disease could have significant health and economic impacts to the proposed Project if not mitigated properly. Malaria can have the following impacts at the workplace level:

- **Absenteeism** through repeated infections: This will have a significant impact on productivity and increased costs. It is estimated that an expatriate non-immune employee will take 5-7 days to reach optimal productivity after an uncomplicated case of malaria and a semi-immune local employee 2-3 days.
- **Health and safety risks:** It is important to note here that malaria is not contagious and you can't catch it from physical contact with someone who has it. The malaria parasite is not in an infected person's saliva and it is not passed on from one person to another. The only way you can catch malaria from a person is through blood transfusions or organ transplants. The effects of the disease and the treatment drugs may decrease alertness thus endangering fellow employees and themselves (patients). The medications may also reduce hearing sensitivity.
- **Increase cost of overall health care:** The cost of malaria management through large case-loads can become significant even if managed at the local site medical service. An uncomplicated case of malaria may cost about \$15 to manage, without considering human resource and capital expenses (Asante and Asenso-Okyere, 2003). The impact of a complicated case of malaria, that may require medical evacuation and extended hospitalisation in an Intensive Care Unit (ICU), can be very costly, and may run into hundreds or thousands of dollars.
- **Increased burden on the medical service:** High case-loads of malaria will take a significant amount of time in the medical service and limit the effectiveness of other health programs, such as occupational health.
- **Employee turnover and attractiveness:** The risk of contracting malaria may decrease the ability to attract skilled staff to work in the area. Repeat infections and decreased morale from the risks related to the disease may also increase employee turnover.
- **Employer liability:** The risk exists for an employer to be held liable for complications that may arise from an infection, especially if mitigation measures have not been implemented.

In summary, the way malaria transmission will be influenced by the proposed Project will depend on determinants such as the epidemiological setting, local vector behaviour and management, change in land use related to vector activity, socio-economic conditions and health-seeking behaviours. The highly endemic nature of the disease means that the proposed Project is unlikely to significantly add to the already high disease burden of the community during the wet season. However, during the dry season, the increased potential for breeding sites will play a major role and change the normal epidemiology of the disease vectors. The behaviour of the vector is not known and may need to be described and understood to determine if the dam and land use will alter the behaviour and lifecycles of the vectors. In spite of these potential unknown factors, mitigation measures are warranted and are likely to play a significant beneficial role to the community if well-planned and executed.

15.1.2 Project Impact Mitigation

The Project impact mitigation for this EHA is listed below:

- Partner with existing initiatives (such as local health authorities and NGOs) to provide education and improve awareness so that people know how to protect themselves and their communities from mosquitoes, ticks, bugs, flies and other vectors – e.g. support malaria awareness campaigns in the communities;
- Ensure Project designs reduce the potential for sources of vector breeding. This includes both construction and operational considerations;
- Develop community-based programs in partnership with the local authorities and based on the strategy of the national malaria control program. Where programmes exist but are ineffective, consider options to assist in improving their effectiveness (e.g. ITN distribution and use); and
- Any workplace malaria and vector control program should include measures for mitigating the potential increase in vector densities, thus decreasing disease transmission in the communities.

15.1.3 Occupational Health and Safety

- Maintain and extend the current workplace malaria and vector control programme as construction initiates. This will require an extension of the human resource element and skill. It is recommended that a skilled entomologist is employed at least for the duration of construction and the initial operation phase. Source reduction, environmental management and larvaciding will be crucial elements. The programme must have clear objectives and measurable indicators;
- Entomological surveillance in the work areas and temporary work camps;
- Planning of temporary work or accommodation camps considering the following:
 - adequate drainage to prevent pooling of water;
 - reduction of vegetation around accommodation units;

- appropriate accommodation units to promote bite prevention including i) screened windows and doors; ii) air conditioners or fans and iii) provision of an ITN that fits the bed appropriately and is easy to use.
- Aggressive case-surveillance to determine the likely origin of and root cause of malaria cases;
- Appropriate education programmes in the workforce that occur prior to secondment and are on-going at site, especially for expatriate staff. These can be supported by serial KAP studies to determine effectiveness of programmes and actual behaviour change.
- Maintain a long sleeve-shirt policy and encourage use of malaria chemoprophylaxis for staff living on site (and particularly for expatriates).
- Include malaria risk as criteria for fitness to work in pre-assignment medical examinations in non-immune employees.

15.1.4 Impact Evaluation

The table below considers the scale of the specific predicted impacts related to EHA #1 by presenting the impact evaluation ratings for the three Project phases.

Table 15-1: Impact Evaluation –EHA # 1

EHA #1: Vector-related Diseases		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Regional (3)	Local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Major (4)	Minor (2)
Probability (Definite, Possible, Unlikely)	Possible (2)	Possible (2)
Calculated Significance Rating (Low, Medium, High)	Low (-32)	Low (-26)
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Irreversible (5)	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts		
• Influx of people may put a burden on water and sanitation infrastructure –change in % of households served with water and sanitation services • Potential contamination with hydrocarbons and chemicals during construction and operations • Unplanned developments may influence environmental health conditions and further contaminate surface water bodies • Increase in income improves ability to afford basic environmental health services. This may result in a decline in cases of soil, water and sanitation-related diseases		

EHA #1: Vector-related Diseases

Mitigation measures

- Groundwater and surface water quality must be monitored;
- Restrict access to project-created water bodies;
- Conduct baseline water and sanitation studies;
- Ensure proper disposal of human waste generated from the project; and
- Ensure proper waste management.

15.2 EHA #2: Acute Respiratory Infections and Respiratory Effects from Housing

Diseases that may be intensified due to heavy industrial activities include: conjunctivitis, respiratory tract diseases, vector borne diseases such as schistosomiasis and STDs such as HIV/AIDS. Acute conjunctivitis is attributed to high dust particles, smoke or chemical content in the air. With steel plants, dust and other chemicals are regularly dispersed in the air, which could lead to acute conjunctivitis. Similarly, respiratory tract diseases such as tuberculosis (TB) and silicosis **may** spread more quickly in these areas. Sneezing or coughing, the most common means of producing airborne TB bacilli, is common among industrial workers as they are exposed to dust and chemicals in the air created by certain industrial activities.

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

15.2.1 Transmission of Communicable Diseases due to Overcrowding

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

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

The existing environmental health needs related to housing is based on observation and reports from the SIA. During the rainy season, cooking with wood is likely to occur indoors which can increase the incidence of respiratory infections, especially in children (WHO, 2011). Studies in some African countries have found the odds of developing Acute Respiratory Infections (ARIs) are more than twice likely if biomass fuels are burnt inside a household compared to using cleaner fuel. Moreover, studies have also shown

that about half of the prevalence of active ARIs in adults aged over 20 years can be attributed to smoke from cooking fuels. In addition to this the general environmental health and sanitary conditions in most of the communities was poor as waste collection and management was inadequate. It can be assumed that personal hygiene is often lacking. While these are all existing social circumstances (generally related to poverty) that the proposed SEZ Project does not influence, these might play a synergistic (or indirect) role in influencing negative health impacts but also present an opportunity to measure improvements in the quality of life of residents.

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

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

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

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

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

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

15.2.2 Occupational Health Risks

- Develop a site-based TB management policy and programme for the workforce (including contractors and short-term labourers) that incorporates screening as well as education campaigns. This must be integrated into the Project's HIV policy as required. Develop programmes with clear objectives and measurable indicators so that effectiveness can be established. It is vital that these programmes are functional prior to the mobilisation of the main construction workforce;
- Screen employees at recruitment for TB and provide adequate referral and support on-going treatment programmes from the workplace medical service. These should be part of the contractor management plan;
- Evaluate the origin of any incoming construction workforce and understand TB and MDR-TB risks in this group. Ensure effective TB screening in this group prior to final appointment and mobilisation. These should be part of the contractor management plan;
- Ensure that adequate housing is available (especially during construction) to accommodate employees so that overcrowding does not occur. The Oil and Gas standard for temporary labour camps as defined by IPIECA can be used as a guide and includes the following:
 - Each room used for sleeping purposes contains at least 4.6 m² of floor space for each occupant;
 - Single beds are not closer than 1 m, both laterally and end to end;
 - Beds are elevated at least 0.3 m from the floor;
 - Double-decked beds are spaced not less than 1.2 m both laterally and end to end, and the clear space between the lower and upper bunk is at least 0.68 meters. Triple bunks are not acceptable; and
 - At least 2.1 m ceilings are provided.
- Ensure Project facilities have adequate waste disposal and sanitation services; and
- Determine if respirable crystalline silica is present and whether it poses a workplace health risk. Once these risks have been determined and the risk-to-workplace-health assessed, a basic modelling or risk assessment must be undertaken to determine the risk to community health. This should inform the development of appropriate control and monitoring programmes based on exposure and risk.

15.2.3 Impact Evaluation

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

Table 15-2: Impact Evaluation –EHA #2

EHA #2 Acute Respiratory Infections and Respiratory Effects from Housing		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Site or Local (2)	Site or Local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Medium (3)	Low (2)
Probability (Definite, Possible, Unlikely)	Possible (2)	Possible (2)
Calculated Significance Rating (Low, Medium, High)	Low (-28)	Low (-26)
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible, Recoverable or Irreversible)	Irreversible (5)	
Irreplaceable loss of resources: (Yes or No)	Yes –impact can result in the loss of human life.	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts: • Change in the rates of respiratory diseases such as influenza and pneumonia • Population influx may lead to an increase in prevalence of respiratory illnesses if household is overcrowded • Loss of income due to retrenchment (during decommissioning phase of the Project may lead to loss of income may result in more people in a house, exacerbating the prevalence of respiratory diseases • Increasing prevalence of respiratory health outcomes, including TB		
Mitigation measures: • Support community-based information campaigns related to TB symptoms and the need to seek care. The campaign should address the risk of co-infection between HIV and TB; • Influx management and advice with regards to town planning to prevent overcrowding; and • Develop partnerships to support the community-based TB control programs in conjunction with the DoH and any NGOs. This needs to include case detection, management and surveillance activities under the national TB program policy and strategy.		

15.3 EHA #3: Veterinary Medicine and Zoonotic Issues

A zoonotic disease is a disease that can be passed between animals and humans. Zoonotic diseases can be caused by viruses, bacteria, parasites, and fungi. These infectious diseases of animals have different modes of transmission. In direct zoonosis the disease is directly transmitted from animals to humans through media such as air (influenza) or through bites and saliva (Rabies). In

contrast, transmission can also occur via an intermediate species (referred to as a vector), which carry the disease pathogen without getting infected.

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

Note: The proposed project would not be linked to this EHA. While this topic is discussed in the report for general awareness, it is not evaluated as part of the current assessment

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

15.4.1 Transmission of STIs and HIV/AIDS

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

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

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

Women and young girls are extremely vulnerable and have limited negotiating power for safe practices and family planning. According to respondents, gender based sexual violence is not very common in the surveyed communities. It is important to recognise the role gender plays in sexuality and its effects on HIV transmission and prevention. HIV/AIDS should be considered a major risk for the Project and the community and interventions should be implemented on a broad base in the workforce and the community.

15.4.2 Project Impact Mitigation

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

- Awareness campaigns, to emphasise the big role that family plays in the fight against HIV;

- Restoration of values campaigns by encouraging church leaders, community leaders, traditional leaders and schools to play a role in the fight against the spread of HIV and AIDS;
- Condom distribution campaigns, working with taxi drivers, business owners and other departments to encourage and teach the proper use of condoms;
- Teen pregnancy campaigns through Motivational talks at schools and to different youth structures; and
- Collaborating with sector departments, social partners, NGO's and CBO's in the fight against HIV/AIDs and related diseases.

15.4.3 Occupational Health and Safety

- During operations support the development of family-friendly accommodation arrangements where possible and adjust rotations to reduce the potential for developing local sexual relationships such as opportunities for positive social interaction through sport, family days, etc.;
- Widespread availability and social marketing of condoms in the workplace. These should form part of the reporting on HIV programmes; and
- Ensure the Project medical service can effectively perform Voluntary Counselling and Testing (VCT) and care and treatment of employees and their dependents as defined by the company's benefits. This should include diagnostic services for HIV, STIs and opportunistic infections and also the ability to monitor patients on anti-retroviral treatment (ART) with the support of a CD4 unit. Provide ART to patients that meet the required criteria - this should not only be based on the latest WHO criteria but should also consider national guidelines.

15.4.4 Impact Evaluation

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

Table 15-3: Impact Evaluation –EHA #4

EHA #4: Sexually Transmitted Infections, including HIV/AIDS		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Site or Local (2)	Site or Local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Low (2)	Very Low (1)
Probability (Definite, Possible, Unlikely)	Possible (2)	Unlikely (1)
Calculated Significance Rating (Low, Medium, High)	Negligible (-18)	Negligible (-16)

EHA #4: Sexually Transmitted Infections, including HIV/AIDS		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Reversible (1)	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts: • Increase in HIV and STI prevalence		
Mitigation measures: • Support local procurement of resources. • An HIV/AIDS policy and programme that incorporates workplace and community considerations should be developed. • Careful planning, stakeholder engagement, and support mechanisms are essential to managing these changes effectively and ensuring that the benefits of the Project are maximized while minimizing potential negative impacts		

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

The additional waste generated from the industry to be disposed of at the local Makhado – and/or Musina municipality's landfill will fasten the depletion of the respective municipality's landfill airspace. It might be necessary to establish the available airspace at the existing municipality's landfill to determine its lifespan with the additional waste to be disposed of. In addition, heavy industrial projects can potentially change these exposures by adding or removing substances in the air, water and/or soil. Some of the substances that may be added can remain in the environment and/or the food chain for decades after the closure of a project, and therefore may have transgenerational health impacts.

15.5.1 Water and Sanitation

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

Water studies completed by AECOM and SMEC and socio-economic impact assessment study done by DEMACON were used to determine the shortfall and water requirements for the proposed SEZ site as well as water requirements around the site due to expansions of the Musina and Makhado local municipalities involved as well as the potential influx of people due to the economic growth in the area. Influx may also play a role in availability of water due to increased demand, which may ultimately negatively affect

water quality. Water-borne diseases such as diarrhoea are currently not very common but where it occurs, are linked to contaminated water and poor sanitary conditions. Water-washed diseases such as eye and skin infections are common. These are linked to poor hygiene.

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

Although water is an essential requirement in the SEZ operations for various purposes, the use of it has the potential to affect the quality of surrounding resources. The metallurgical industries should perhaps be required to contain, recycle and re-use dirty water within their operational systems, to avoid discharging contaminated water into the natural environment. Water contamination may occur as a result of runoff from contaminated surfaces and from any dirty water discharges including treated sewage effluent within the SEZ Project boundary into any nearby water courses in proximity to the proposed SEZ Project site.

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

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

The indirect impacts will be:

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

There is limited local data on basic water and sanitation practices or burden of disease linked to specific water and sanitation indicators. As the potential for the project to be accused of polluting the water bodies in the surrounding communities from plant or domestic water exists, it is important to establish firm baselines for mitigation. Water and sanitation are significant existing needs in the communities and if The Applicant supports any related initiatives they should be linked to specific indicators to measure impact.

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

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

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

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

15.5.2 Project Impact Mitigation

- Conduct baseline water and sanitation studies on communities based on accepted health indicators;
- Monitor for groundwater organics, bi-annually, including: Total Coliform, E. Coli and Heterotrophic plate count;
- Ensure proper disposal of human waste that is generated from the Project;
- Ensure proper waste management from Project generated waste according to waste management principles;
- Support the local authority in supporting and improving water and sanitation services, including the collection and disposal of waste in the communities;
- Establish water and sanitation committees in the communities to manage their own water and sanitation services. This will improve sustainability of any outreach support;
- Support information campaigns in the community on water use, hygiene and general sanitation;
- Manage the on-site activities in compliance with the WMP;
- Ensure all necessary waste management-related permits and approvals required by the authorities, have been obtained;
- Hire and manage the contractors, subcontractors and SEZ approved third-party service providers for off-site waste diversion, treatment and disposal services; and
- Provide all necessary resources for personnel orientation, including induction and training materials.

On-site storage of hazardous waste should be avoided and should only be in small quantities until collection. The hazardous waste storage sections on-site are to be provided with the following:

- Roof for shelter from direct sunlight and any rain events;
- Concrete base and dike/bund walls to contain spillages and to avoid contamination of soil and groundwater by the hazardous substances in the case of a spill. The storage area should include a spill containment system to capture and collect any spills from the containers stored in the area.
- Adequate drainage system to keep storm water away from hazardous areas;

- Similar to non-hazardous waste, separate compartments for each different waste type;
- Containers and storage tanks comprising of suitable / compatible material to contain the hazardous waste and properly labelled;
- Signboards for each waste type and storage area along with personnel protective equipment (PPE) to be used in handling of each waste.
- Any spillage or rinsate from transfer or washing operations shall be captured for appropriate management; and
- Access for mobile equipment to this area is to be provided to facilitate material movement.

Depending on the results of the baseline data gathering, support the government's school deworming programme in partnership with local authorities.

15.5.3 Impact Evaluation

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

Table 15-4: Impact Evaluation –EHA #5

EHA #5: Soil-, Water- and Waste-related Diseases		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Regional (3)	Regional (3)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Medium (3)	Medium (3)
Probability (Definite, Possible, Unlikely)	Highly Likely (4)	Possible (2)
Calculated Significance Rating (Low, Medium, High)	Moderate (-52)	Low (-26)
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Recoverable (3)	
Irreplaceable loss of resources: (Yes or No)	Yes	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts		
• Disease outbreaks from infrastructure failure or poor maintenance • Environmental degradation from illegal dumping or uncollected waste. • Health impacts from stagnant water if stormwater systems are poorly managed. • Community exposure to waterborne and soil-related diseases during early occupation phases if hygiene education is not prioritized.		
Mitigation measures		
• Provide households with access to clean and safe drinking water in line with SANS 241 standards		

EHA #5: Soil-, Water- and Waste-related Diseases		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
• Ensure proper construction and connection of sanitation systems to licensed treatment facilities • Install sufficient, hygienic temporary toilets for construction workers on-site • Implement a formal waste collection and disposal system to prevent illegal dumping and burning • Develop effective stormwater management and soil erosion control plans to prevent environmental contamination • Conduct community awareness campaigns on hygiene, safe water use, and sanitation practices • Regularly monitor compliance with environmental and health standards as per EMP and EA requirements • Assign clear responsibility to the developer for ongoing infrastructure maintenance and waste management • Report and address water and waste-related complaints or incidents promptly • Engage with local authorities to ensure alignment with municipal water and sanitation strategies		

15.6 EHA #6: Food and Nutrition-Related Issues

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

15.6.1 Changes in Income and Expenditure Consumption

An increase in disposable income often means that benefiting households (who are also consumers) have the opportunity to make a wider variety of lifestyle choices. In the context of the Musina-Makhado SEZ southern Site, workers employed during construction and operation as well as their households will increase the income of their respective households and can expect an improvement in their quality of life and standards of living. Increased revenues coupled with careful planning and checks and balances have the potential to make significant contributions to the progressive realisation of internationally protected economic, social and cultural rights (Delta, 2019). However, without transparency, good governance including channels for complaints and remedies (grievance mechanisms), and plans for inclusive growth, large foreign investments into natural resources may translate into huge profits for a few and harmful impacts for local communities most directly affected.

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

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

15.6.1.1 Water Quality and Quantity

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

15.6.1.2 Influx

This can influence nutrition in a number of ways including:

- Unplanned developments in the area may limit the land available for agricultural purposes. Poor planning might lead to erosion which might eventually reduce the quality of soils and lead to poor crop yields; and
- Supply and demand may create food inflation and make vulnerable groups more susceptible to escalating food prices in the Project area.

15.6.1.3 Change of Livelihoods and Practices

This can influence nutrition in a number of ways including:

- As a result of economic upliftment, the community might change their diets and eating habits most likely be refined products or the adoption of a more westernised diet. A reduction in physical exertion may also result as a result of changing livelihoods. Ironically, the final result could be an increased incidence of obesity and eventually non-communicable diseases (NCD).

15.6.2 Occupational Health and Safety

- Conduct education campaigns in the workforce on proper water use, hygiene and sanitation;
- Provide accommodation camps and work areas with proper and sufficient potable water facilities and conduct surveillance to ensure that water is potable;
- The Project will need to sustain its own water, sanitation and waste management systems. These need to have sufficient capacity so as not to impact on the community water supplies; and
- As part of the pre-employment examination, any prospective employee that has blood in the urine and/or faeces should be tested for schistosomiasis and have this excluded as an illness and treated.

15.6.3 Impact Evaluation

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

Table 15-5: Impact Evaluation –EHA #6

EHA #6: Food and Nutrition-Related Issues		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Site or Local (2)	Site or Local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Low (2)	Very Low (1)
Probability (Definite, Possible, Unlikely)	Possible (2)	Unlikely (1)
Calculated Significance Rating (Low, Medium, High)	Negligible (-18)	Negligible (-16)
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Reversible (1)	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts: - Unplanned developments in the area may limit the land available for agricultural purposes. Poor planning might lead to erosion which might eventually reduce the quality of soils and lead to poor crop yields; and - Supply and demand may create food inflation and make vulnerable groups more susceptible to escalating food prices in the Project area.		
Mitigation measures: - Reduce project-related communicable diseases that may impact nutrition; - Support local procurement of food items in combination with incentives to increase local production		

15.7 EHA #7: Accidents/Injuries

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

15.7.1 Physical Injuries

The proposed SEZ Project may provide employment opportunities which are relatively safe and well-managed compared with other options available to many workers and can reduce work-related injuries in the population overall. However, project-related accidents,

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

Below are the most common causes of injury and illness in the iron and steel industry:

- slips, trips and falls on the same level;
- falls from height;
- unguarded machinery;
- falling objects;
- engulfment;
- working in confined spaces;
- moving machinery, on-site transport, forklifts and cranes;
- exposure to controlled and uncontrolled energy sources;
- exposure to asbestos;
- exposure to mineral wools and fibres;
- inhalable agents (gases, vapours, dusts and fumes);
- skin contact with chemicals (irritants (acids, alkalis), solvents and sensitizers);
- contact with hot metal;
- fire and explosion;
- extreme temperatures;
- radiation (non-ionizing, ionizing);
- noise and vibration;
- electrical burns and electric shock;
- manual handling and repetitive work;
- exposure to pathogens (e.g. legionella);

- failures due to automation;
- ergonomics;
- lack of OSH training;
- poor work organization;
- inadequate accident prevention and inspection;
- inadequate emergency first-aid and rescue facilities;
- lack of medical facilities and social protection.

Fatigue may also present itself as a problem because of shift work, pressing deadlines, combined with arduous tasks, awkward PPE and hot ambient conditions.

15.7.2 Road Traffic Accidents and Other Accidental Injuries

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

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

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

- Transport of goods and personnel to service the needs of the proposed SEZ Project. This can include long-distance truck hauling and use of light duty vehicles. Sections of the roads have been destroyed by potholes. The roads are busy and un-roadworthy vehicles and poor driving practices are common;
- Transport of staff at shift changes in buses to their home in different communities; and
- Light vehicle traffic to support the general requirements of the proposed SEZ Project.

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

- Improvement in the local economy and the ability to buy motorised forms of transport. Use of safety devices and adherence to common road laws is likely to be inadequate/ not the norm with the potential for increased accidents;

- Social influences in the community. These may be associated with influx and a change in the social cohesion and traditional structures in the local communities. These have the potential to result in internal conflicts; and
- Increased use of alcohol and potentially drugs due to increased disposable income. This may also influence the social cohesion and may contribute to crime and violence.

15.7.3 Project Impact Mitigation

- Engage the Local Municipality and interested and affected parties to assist with programmes targeted at improving traffic management and road safety in the study area;
- Develop a clear policy for the management of emergencies or accidents in the community as a direct result of the projects activities; and
- Support with local safety and security as addressed in these specialist studies.

15.7.4 Impact Evaluation

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

Table 15-6: Impact Evaluation –EHA #7

EHA#7: Accidents/Injuries		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Regional (3)	Site or Local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	High (4)	Medium (3)
Probability (Definite, Possible, Unlikely)	Highly Likely (4)	Possible (2)
Calculated Significance Rating (Low, Medium, High)	High (-64)	Low (-24)
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Irreversible (5)	
Irreplaceable loss of resources: (Yes or No)	Yes –irreversible loss of human life.	
Can impacts be enhanced: (Yes or No)	No	

EHA#7: Accidents/Injuries

Residual impacts

- Increased risk of occupational injuries during construction (e.g., falls, machinery accidents).
- Traffic-related accidents due to increased heavy vehicle movement and poor traffic control.
- Pedestrian safety risks, especially for children and elderly during both phases.
- Injuries from poorly maintained roads, sidewalks, or lighting in operational phase.
- Delayed emergency response due to lack of nearby or equipped facilities.
- Risk of domestic accidents due to inadequate household safety awareness in dense settlements.

Mitigation measures

- Enforce a comprehensive site-specific Occupational Health and Safety Plan.
- Provide and ensure use of Personal Protective Equipment (PPE) for all workers.
- Demarcate and fence off all active construction zones.
- Develop and enforce a Traffic Management Plan, including signage and flag personnel.
- Construct sidewalks, pedestrian crossings, and speed bumps in high-use areas.
- Install adequate street lighting for roads, parks, and pedestrian paths.
- Conduct public safety awareness campaigns, especially on road safety and domestic hazards.
- Establish or strengthen local emergency response services (e.g., clinics, fire, ambulance).
- Require contractor compliance monitoring and regular audits for health and safety.
- Include incident reporting systems for quick response and corrective action

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

The gaseous emissions are generated as flue gases at furnaces in steel plant, rolling mill and producer gas unit. Gaseous emissions are also generated from waste heater boiler in coke oven plant. Fugitive emissions are generated in the industry during storage and handling of coal and coke and other solid raw materials. Dust is generated during loading and unloading, movement in conveyors, crushing and screening operations of these products. Fugitive emission is also generated on due to vehicular movement in the premises. The information on gaseous emission from project activities is furnished in the Air Quality Impact Assessment Report.

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

Primary pollutants in waste gases are iron oxide, dust and oxides of sulphur, carbon etc. of these, dust is by far the most important air pollutant in the industry. Solid waste mainly comprises of slags from blast furnace and steel melting shops and dust separated in gas cleaning plants and ventilation systems.

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

15.8.1 Air Quality and Criteria Air Pollutants

- The main findings of the Air Quality Impact Assessment (Airshed, 2019) are as follows:
- PM, NO_x, SO₂ and CO emissions will be released during the construction, operational decommissioning, and closure phases. Only the operational phase air quality impacts were quantified since construction and decommissioning
- SEZ operations:
 - PM₁₀, PM_{2.5}, NO₂, SO₂, CO, Mn, Cr6+ and H₂S emissions and impacts were quantified.
 - The PM₁₀ and PM_{2.5} emissions and simulated concentrations were likely underpredicted in this study.
 - Simulated PM₁₀ concentrations were found to exceed the evaluation criteria beyond boundary but not at AQRs.
 - Simulated PM_{2.5}, NO₂, SO₂, Mn and Cr6+ concentrations were found to exceed the evaluation criteria beyond boundary and at AQRs.
 - The significance of proposed SEZ operations related inhalation health impacts is considered “very high”.

15.8.1.1 Carbon Monoxide (CO)

Carbon monoxide (CO) is a tasteless, odourless and colourless gas which has a low solubility in water. In the human body, after reaching the lungs it diffuses rapidly across the alveolar and capillary membranes and binds reversibly with the haem proteins. Approximately 80 - 90% of CO binds to haemoglobin to form carboxyhaemoglobin. This causes a reduction in the oxygen-carrying capacity of the blood which leads to hypoxia as the body is starved of oxygen. Severe hypoxia due to acute poisoning results in headaches, nausea and vomiting, muscular weakness, loss of consciousness, shortness of breath and finally death, depending on the concentration and time of exposure. Poisoning may cause both reversible, short-lasting neurological deficits and severe, often delayed, neurological damage. Neurobehavioral effects include impaired co-ordination, tracking, driving ability, vigilance and cognitive ability (WHO, 2000).

15.8.1.2 Sulphur Dioxide (SO₂)

SO₂ is classified as a criteria air pollutant in terms of the South African National Environmental Management: Air Quality Act (No. 39 of 2004). Studies suggest that over 85% of SO₂ originates from human activities, particularly the combustion of sulphur-containing fuels at various industrial facilities and power plants (EPA, 2017).

SO₂ is a colourless gas that has a pungent odour and can have negative effects on human health when inhaled (Brauer et al., 2002). Being soluble, SO₂ be harmful to the human respiratory system because it can be readily absorbed in the mucous membranes of the nose and upper respiratory tract, causing difficulties in breathing in both children and the elderly (EPA, 2017). Exposure to SO₂ and sulphur containing compounds may cause irritation of the eyes, nose, and throat and lung air ways. Common symptoms of exposure include a reflex cough and a tight chest (www.mfe.govt.nz, 2013).

Effects of short-term exposure to SO₂ are short-lived, with lung function reverting back to the normal state within a few minutes to hours (WHO, 2000). However, long-term exposure to SO₂ may exacerbate respiratory symptoms such as wheezing, and coughing in adults, and reduce lung function in children in some cases, particularly when SO₂ exposure occurs in the presence of other chemical compounds such as sulphates. Recent studies on health impacts have demonstrated that vehicle and industrial SO₂ emissions released into the air can affect mortality (total, cardiovascular and respiratory), even at low concentrations. (WHO, 2000).

15.8.1.3 Nitrogen Dioxide (NO₂)

NO₂ is a red-brown gas which is mainly released during combustion processes from mobile sources (vehicles) and stationary sources (factories, refineries, power stations, etc). In urban environments vehicle emissions account for the majority of NO₂ released into the atmosphere. (Kamarehie et al., 2017).

NO₂ is a highly reactive gas with strong oxidizing properties and contributes significantly to formation of ground level ozone and brown haze (pollution smog). Furthermore, when NO₂ is emitted into the atmosphere, it can easily react with water to form nitric acid which can in turn, result in acid rain. In this respect, exposure to elevated levels of NO₂ may cause eye, mucus membrane and respiratory infections because NO₂ is highly reactive with water. Studies indicate that prolonged exposure to NO₂ can cause respiratory infections and permanent lung damage (EPA, 2017).

NO₂ can be absorbed into the mucus membrane of the respiratory tract. The most impact on human health occurs at the section (in the human body) between the conducting airway and the gas exchange region of the lungs. The impact of NO₂ on the upper airways is less because of the aqueous nature of the airways – NO₂ is not very soluble in aqueous surfaces. Exposure to NO₂ may additionally increase the risk of respiratory infections, increase airway resistance in asthmatics, and decrease pulmonary function (Kamarehie et al., 2017).

Pulmonary function in adults that have been exposed to NO₂ (>200 µg/m³) for short periods may be altered; pronounced decreases in pulmonary function may be experienced when exposure to NO₂ concentrations above 500µg/m³ occurs (WHO, 2005). Long-term epidemiological studies have been conducted to determine the link between indoor use of gas cooking appliances and health effects. These studies have shown that children aged 5 – 12 years may be at higher risk of respiratory symptoms and diseases when exposed to elevated NO₂ concentrations from the cooking appliances. Similar but increased and prolonged health impacts may be noticed in children that have been exposed to outdoor ambient NO₂ over long periods (WHO, 2000).

15.8.1.4 Cadmium

The heavy metals cadmium, lead and mercury are common air pollutants, being emitted mainly as a result of various industrial activities. Cadmium is released into the atmosphere by natural and anthropogenic means. The anthropogenic sources of cadmium include non-ferrous metal production, stationary fossil fuel combustion, waste incineration, iron and steel production and cement production (Nriagu, 1989). Cadmium exposures are associated with kidney and bone damage. Cadmium has also been identified as a potential human carcinogen, causing lung cancer.

15.8.1.5 Mercury

Mercury exists in various forms: elemental (or metallic) and inorganic (to which people may be exposed through their occupation); and organic (e.g., methylmercury, to which people may be exposed through their diet). These forms of mercury differ in their degree of toxicity and in their effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes (WHO, 2017).

Mercury occurs naturally in the earth's crust. It is released into the environment from volcanic activity, weathering of rocks and as a result of human activity. Human activity is the main cause of mercury releases, particularly coal-fired power stations, residential coal burning for heating and cooking, industrial processes, waste incinerators and as a result of mining for mercury, gold and other metals (*ibid.*).

Mercury is toxic to the central and peripheral nervous systems. The inhalation of mercury vapour can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested (WHO, 2017). Neurological and behavioural disorders may be observed after inhalation, ingestion or dermal exposure of different mercury compounds. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches and cognitive and motor dysfunction. Mild, subclinical signs of central nervous system toxicity can be seen in workers exposed to an elemental mercury level in the air of 20 µg/m³ or more for several years. Kidney effects have been reported, ranging from increased protein in the urine to kidney failure (*ibid.*).

15.8.1.6 Lead (Pb)

Lead is a naturally occurring substance in the Earth's crust, although the majority of lead found on the surface is due to anthropogenic causes such as mining, refining, petrol constituents, jewellery making, etc. (WHO, 2010). Lead enters the bloodstream of human beings via food and water consumption, and inhalation of, dust, paint odours and industrial smog.

Long-term exposure to lead can increase health risk vulnerability, especially in children and elderly people. Typically, anyone who is exposed to lead may experience symptoms such as persistent fatigue, insomnia, poor muscle coordination, irritability, nerve damage hearing and vision impairment (Wani et al., 2015).

15.8.2 Dust Fallout (TSP)

Dust-fall are particles with an aerodynamic diameter greater than 20µm that have been entrained into the air by a physical process such as wind, movement of vehicles, stack emissions and from fugitive dust. These particles are generally too heavy to remain in suspension in the air for any period of time and fall out of the air over a relatively short distance depending on a combination of

various factors such as particle size, density, temperature (of the air and particle), emission velocity or method, ambient wind speed and humidity (Rayten, 2019). These particles are therefore commonly known as “dust-fall”. Particulates in this range are generally classified as a nuisance dust and can cause physical damage to property and physical irritation to plants, animals and humans.

11.8.1 Particulate Matter

Particulate matter (PM) comprises solid or liquid particles suspended in the air. These vary in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. Ambient particulates limit visibility and pose health risks since small particles (PM₁₀) can penetrate deep into lungs, while even smaller particle sizes (PM_{2.5}) can enter the bloodstream via capillaries in the lungs. Morbidity effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function. Long-term exposure to low concentrations (~10 µg/m³) of particulates is associated with mortality and other chronic effects such as increased rates of bronchitis and reduced lung function (WHO, 2000). Those most at risk include the elderly, individuals with pre-existing heart or lung disease, asthmatics and children.

11.8.2 Diesel Particulate Matter

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

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

11.8.2.1 Health Impacts of DPM: Cancer

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

11.8.2.2 Health Impacts of DPM: Cardiac and Pulmonary

Although cancer risk is understandably of great concern to the public, cardiac and respiratory effects of diesel exposure have an even larger public health impact because they cause death and illness for a greater number of people. DPM can exacerbate asthma and emphysema, induce heart attacks and strokes, and has been associated with congenital heart abnormalities. According to a landmark study by Pope et al (2002), each 10 µg/m³ increase in DPM was associated with a 6% increase in cardiopulmonary

mortality. In a follow-up to this study, Pope et al (2004) demonstrated that their previously observed increase in cardiopulmonary mortality was largely driven by increases in cardiovascular, as opposed to pulmonary mortality. In this follow-up study, a 10 ug/m³ increase in PM_{2.5} was associated with a 12% increase in mortality due to 'all cardiovascular disease plus diabetes' and an 18% increase in mortality due to 'ischemic heart disease'. Further epidemiological investigations have revealed that these estimates are likely largely underestimating the effect of PM_{2.5} due to inadequate exposure characterization. Published in the New England Journal of Medicine, Miller et al. (2007) utilized a novel exposure characterization method and reported from the Women's Health Study that a 10 ug/m³ increase in PM_{2.5} was associated with a 76% increase in death due to cardiovascular disease.

It is well understood that ambient air pollution and fine ambient particulate matter strongly contribute to disease burden and death, but it has been less clear as to how much an individual's living proximity to a major roadway or direct PM_{2.5} source influences health risks. An individual's exposure to PM_{2.5} is dependent on where he/she lives and works and that this strongly influences health outcomes. Van Hee et al. (2009) demonstrated that living close to a major roadway was a strongly associated with left ventricular hypertrophy, an important marker of cardiovascular disease and a strong predictor of heart failure and mortality. Additional work by this group has demonstrated an individual's exposure to PM_{2.5} impairs how well blood vessels dilate and how well the heart functions, providing a basis for our understanding of previously observed increases in mortality (Van Hee et al. 2011, Krishnan et al. 2012).

There are very specific physiological effects with DPM exposure. A recent study by Cosselman et al (2012) showed that diesel exhaust exposure, to healthy human volunteers, rapidly increases systolic blood pressure (SBP). In their study, SBP increased within 15 minutes of being exposed to dilute diesel exhaust and reached a maximum increase in SBP within one hour. Additional work utilising controlled diesel exhaust exposures to human volunteers has revealed that these acute exposures results in impairment in blood vessel function and alters blood coagulability⁷, both of which are extremely deleterious effects and increase the risk of acute cardiovascular events such as heart attack and stroke (Mills et al. 2005, 2007, and Törnqvist et al. 2007). Fitting with these findings, epidemiological investigations have consistently demonstrated that acute increases in PM_{2.5} result in an increased risk of heart attack (Peters et al. 2001).

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

11.8.3 Heat Stress

Heat exposure has a great impact on workers' health and productivity in many industrial workplaces, especially steel industry where excessive heat exposure is a major occupational problem (Ahmed et al, 2018). The nature of some of the work tasks are laborious

⁷ Coagulation (also known as clotting) is the process by which blood changes from a liquid to a gel, forming a blood clot. It potentially results in haemostasis, the cessation of blood loss from a damaged vessel, followed by repair.

and demanding (especially plant maintenance and construction related tasks), coupled with a hot climate, which makes heat a potential hazard. Ambient heat exposure includes all occupations within the smelter, furnace areas and slag handling operations (prior to cooling and crushing) and molten metal handling. Heat sources are the furnaces, converters, and steel covered structure (hot months), as well as molten material in ladles during slag and metal handling, and molten metal at the casting area. Exposure to heat also occurs during cleaning tasks involving hot liquid spills, e.g. after tapping.

Common symptoms of heat stress include higher body temperature, sweating, excessive thirst, insomnia, fatigue and muscular discomfort. Stress from heat, humidity, welding fumes, metal dust and gas emissions increases strain may be reflected on the workers' physical and psychological state, negatively affecting their productivity and performance.

Workers exposed to heat (or even cold), as well as their supervisors, should be trained:

- to recognize symptoms which may lead to heat stress or hypothermia, in themselves or others, and the steps to be taken to prevent onset and/or emergencies;
- in the use of rescue and first-aid measures; and
- in action to be taken in the event of increased risks of accidents because of high or low temperatures.

Workers should also be advised of the importance of physical fitness for work in hot or cold environments; and the importance of drinking sufficient quantities of suitable liquid and the dietary requirements providing intake of salt and potassium and other elements that are depleted due to sweating.

11.8.4 Noise

Increased noise levels are directly linked with the various activities associated with the construction of the proposed SEZ and related infrastructure, as well as the operational phase of the activity. The development of the SEZ could result in a number of different noise generating activities, from various equipment during different operating periods. Increased traffic volumes will cumulatively add to existing and future noises (Gudani, 2019).

While there is a risk of a noise impact, the impact can be mitigated and reduced, with the magnitude of the reduction depending on the options selected as well as how the operation is managed. The proposed SEZ Project may not introduce potential fatal flaws in terms of acoustics. With the selection of the required mitigation options, projected noise levels can be managed. If not mitigated, this will result in a noise impact of high significance during the operational phase. There is a potential noise impact of medium significance during the critical night-time operational phase. Measures are available and proposed that may assist in reducing noise levels and the probability of a noise impact occurring. The Noise Assessment Report advises that the development of industrial zones should not be developed/ established closer than 2,000m from existing communities/ farms/ homesteads.

11.8.5 Solid Waste (General and Hazardous)

Waste streams likely to be produced during the construction phase will include both general (non-hazardous) and hazardous wastes, and are expected to be similar in composition to the non-process wastes or co-products produced during the operational phase. The

domestic waste stream will be comprised predominantly of non-hazardous waste types including paper, plastic, cloth and some food waste. In addition, relatively insignificant quantities of hazardous wastes may be included in this waste stream, including batteries, empty containers for cleaning chemicals, fluorescent light tubes, pesticide aerosol cans etc.

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

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

Contaminants emitted or released by hazardous waste might play a role for the occurrence of diseases without-factor etiology, however evidence of an association was limited, as in the case of liver cancer. In the above-mentioned review of municipal waste management, inadequate evidence was attributed to the association between liver cancer and landfills (Porta *et al*, 2009). B and C hepatitis viruses, alcohol consumption, tobacco smoking and aflatoxins are the main ascertained risk factors for liver cancer.

A range of reproductive effects including low birth weight was studied around the large hazardous waste disposal site in Los Angeles County, California, after previous investigations of vital records found that trends in low birth weight and neonatal deaths corresponded closely with times and quantities of dumping at the landfill. Results for the whole study period showed no increase in adverse reproductive effects, but during the period of heaviest dumping, birth weights were significantly lower in exposed areas than in control areas using odour complaint frequency zones to classify exposure.

Evidence of hazardous waste effects on asthma and adverse reproductive effects was considered limited.

By reducing the number of contaminants released into the environment and the volume of waste requiring disposal, pollution prevention activities protect human health and the environment. Decreasing the volume or toxicity of process materials and wastes can reduce worker exposure to potentially harmful constituents. Preventing the release and disposal of waste constituents to the environment also reduces human and wildlife exposure and habitat degradation.

If hazardous wastes are generated as a result of operations, accidental spills or discovery of contaminated soils or ground water, a Remedial Action Plan (RAP) must be developed as appropriate and wastes removed according to the Waste Management Plan. The RAP will encompass the recommendations of the Contaminated Soils and Ground Water Plan.

11.8.6 Project Impact Mitigation

- The SEZ must implement an integrated waste management hierarchy of prevention, reduction, reuse, recycling, recovery, treatment, and as a last option, landfill disposal;
- Haulage roads are sprinkled with water at regular intervals for which water tankers with sprinkler arrangement are deployed;
- Trucks carrying coal and other raw material are covered with tarpaulin to prevent spreading of dust during transportation;
- Green belt and greenery development around storage yards, around plants, either side of roads and around the periphery of the industry/ SEZ;
- Dust respirators are provided for the people working dust generating locations;
- All internal roads in the premise are paved /tarred;
- Develop a dust management plan;
- Apply wetting agents, dust suppressant or binders on the exposed area;
- Vegetate, with grass or a gravel monolayer, the exposed areas;
- Reduce erosion loss by roughening slope surface - this dissipates energy of water or wind moving over the slope;
- Assess the angle of the slope, as maximum erosion occurs on slopes with angles between 30° and 35°;
- Improve upon the surface strength of a slope, which will lower the rate of erosion;
- Implement PM monitoring and continue with ongoing dust fallout monitoring;
- Collect data on a longitudinal basis from the local health centres on incidence of increased respiratory disease - especially respiratory tract infections that could be ascribed to dust. While these may not be specifically ascribed to the Project, the prevailing trends are useful to monitor so that any concerns could be addressed. This may require health systems strengthening to support recording; and
- Establish a monthly and annual reporting structure to appraise performance, compliance and complaints.
- A comprehensive, continuous air quality monitoring programme must be undertaken to ensure that mitigation measures are applied at all times to keep ambient air concentrations of PM₁₀ and PM_{2.5} within the NAAQS over residential areas;
- Machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective;
- Environmental noise monitoring;
- Develop and implement a Storm Water Management Plan.

15.8.3 Impact Evaluation

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

Table 15-7: Impact Evaluation –EHA #8

EHA #8: Exposure to Potentially Hazardous Materials, Noise and Malodours		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Regional (3)	Site/local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	High (4)	Medium (3)
Probability (Definite, Possible, Unlikely)	Definite (5)	Likely (3)
Calculated Significance Rating (Low, Medium, High)	High (-80)	Moderate (-42)
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible (5)	
Irreplaceable loss of resources: (Yes or No)	Yes	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts		
- Residual risk of soil and water contamination from accidental spills of hazardous materials during construction. - Potential temporary noise disturbance affecting workers and nearby residents during construction activities. - Minor operational noise from traffic and community activities, possibly causing localised disturbance. - Occasional malodours from waste management and sanitation, mainly during operation. - Low risk of chronic health effects if hazardous materials are improperly managed.		
Mitigation measures		
- Implement a strict Hazardous Materials Management Plan including safe storage, handling, and spill response procedures. - Provide training and PPE to all workers handling hazardous substances. - Conduct regular site inspections and monitoring for contamination risks. - Enforce a Noise Management Plan that limits noisy activities to daytime hours and uses noise-reducing equipment where possible. - Establish buffer zones and screening to reduce noise transmission to nearby residents. - Ensure timely and efficient waste collection and sanitation services to minimise malodours. - Promote community awareness on noise and waste-related impacts and reporting procedures. - Maintain an effective complaints and incident reporting system for quick response. - Develop and implement a Construction Environmental Management Programme (CEMP) that integrates these controls.		

15.8.4 Emergency Preparedness and Response

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

15.9 EHA #9: Social Determinants of Health

It is not the intention of the cHIA to address social issues in detail. However, it is important to recognise the wellbeing and perceptions on quality of life have both a social and health basis.

Impacts under this EHA can be summarised as:

- Change in morbidity and mortality data related to psychosocial distress such as depression, anxiety, substance abuse, and changes to family structure;
- Change in median household income;
- Change in unemployment;
- Change in the percentage of households living below poverty line;
- Change in educational attainment;
- With the expected population growth and influx of job seekers, who may bring their families along, household size may increase resulting in overcrowding;
- Construction workers and an influx of national and international people in search of economic opportunities are expected to put enormous pressure on the South African Police Services and immigration control;
- Increase in psychosocial problems, including depression as a result of retrenchment at decommissioning phase;
- A positive impact on poverty status for a number of people employed at the Project site; and
- Influx of people and increased income may result in illegal substances being available more freely.

15.9.1 Influx Management

When the proposed SEZ Project triggers significant migration (labourers, extended families, service providers, and so on) to the proposed SEZ Project area, it can pose potential significant impacts to surrounding communities. These impacts may occur, to varying degrees, across all phases of the proposed SEZ Project (preconstruction, construction, operations, and decommissioning).

A strong interaction and mixing among local workers, imported specialty workers, and expatriates can facilitate the spread of respiratory disease, including the production of explosive epidemics that can pass back and forth between the proposed SEZ Project and the community. In addition, food-borne epidemics are significant and can spread back and forth between the proposed SEZ Project worksite and the community via food handlers or petty traders.

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

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

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

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

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

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

- Increased links to mainstream economy;
- Increased local skills-base;
- Business-development opportunities;
- Employment-creation;
- Increased local labour pool;

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

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

15.9.2 Change in Number of Households Living Below the Poverty Line

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

15.9.3 Education Levels and Unemployment

The level of educational attainment in a household can influence community health. Economic status may create a powerful context for human health and improved income is generally thought to be associated with improved community health outcomes. While there are many indicators used to assess economic status, the HIA reports median household income, employment, and the percentage of households living below poverty levels.

Local communities can potentially take maximum advantage of employment opportunities to be created by the proposed SEZ Project. However, it may not be possible to employ and train individuals from the local population in time for construction or operation, due to

the level of skills required not being available locally. The Applicant may be forced to make use of skilled migrant workers, as training required may be too complex and time-consuming. A situation like this may pose a risk of xenophobia as the local population may feel threatened.

15.9.4 Creation of Employment

A third of the working age population in the Musina Local Municipality are unemployed. The development of the Musina-Makhado SEZ southern Site will improve this situation and positively impact the community (Delta, 2019). This will improve the socio-economic well-being of the benefitting population, albeit for a temporary period. The demand for supporting services and other goods and services to be created as a result of multiplier effects will also lead to the creation of additional jobs, increasing the positive effect on employment in the region.

15.9.5 Change in Educational Attainment

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

15.9.6 Gender-based Violence, Alcohol and Drugs

15.9.7 Impact Evaluation

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

Table 15-8: Impact Evaluation –EHA #9

EHA #9: Social Determinants of Health		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Regional (3)	Regional (3)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	High (4)	High (4)
Probability (Definite, Possible, Unlikely)	Highly likely (4)	Highly likely (4)
Calculated Significance Rating (Low, Medium, High)	Moderate (+ 54)	
Impact Status: (positive or negative)	Positive	
Reversibility: (Reversible or Irreversible)	Recoverable (3)	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Positive impacts such as employment gain can be enhanced	
Residual impacts • Change in median household income • Change in unemployment • Change in the percentage of households living below poverty line • Change in educational attainment • A positive impact on poverty status for a small number of people employed at the Project site		
Mitigation measures • Plan for project closure • Implement local procurement policies and support local businesses.		

15.9.8 Gender-based Violence, Alcohol and Drugs

Gender-based violence is often related to substance abuse. Substance abuse influences many health outcomes such as accidents and injuries. Substance abuse includes illegal drugs (e.g., marijuana, even cocaine etc.), alcohol addiction, and binge drinking. Women and young girls are often the most vulnerable. Although alcohol abuse is currently a major problem in the Community, drug use and abuse were not reported as prevalent or common. In addition to this, at the time of the FGD, there were no known cases (by the community) of domestic violence within the community. However, drug use has the potential to increase during the lifespan of the proposed Project.

Influx of people and increased income may result in illegal substances being available more freely. It is difficult to speculate whether the prevalence of tobacco smoking and or substance abuse will increase due to the presence of the proposed 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.

15.9.9 Expectations from the proposed Project

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

Table 15-9: Impact Evaluation –EHA #9

EHA #9: Social Determinants of Health		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Regional	Regional
Duration (Short term, Medium term, Long term)	Long Term > 5 years	Long Term > 5 years
Magnitude (Major, Moderate, Minor)	Major -	Minor -
Probability (Definite, Possible, Unlikely)	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	High	Medium
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Partially Irreversible	
Irreplaceable loss of resources: (Yes or No)	Yes	
Can impacts be enhanced: (Yes or No)	Positive impacts such as employment gain can be enhanced	
Residual impacts		
• Change in morbidity and mortality data related to psychosocial distress such as depression, anxiety, substance abuse, and changes to family structure; • With the expected population growth and influx of job seekers, who may bring their families along, household size may increase resulting in overcrowding; • Construction workers and an influx of national and international people in search of economic opportunities are expected to put enormous pressure on the South African Police Services and immigration control; • Increase in psychosocial problems, including depression as a result of retrenchment at decommissioning phase; and • Influx of people and increased income may result in illegal substances being available more freely.		
Mitigation measures		
• Conducting substance-abuse prevention education programs at the mine and within the Community; • Contributing to the establishment of appropriate community recreation facilities- considering needs and assets of the community through the S&LP and Corporate Responsibility projects; • Participating in violence-prevention education programs, particularly focusing on gender violence and tribalism. • Supporting education programs with a gender equity focus; • Plan for mine closure through the S&LP; and		

EHA #9: Social Determinants of Health

	Impact Rating Without Mitigation	Impact Rating With Mitigation
Support graduate training programs for the youth in the community.		

15.10 EHA #10: Cultural Health Practices

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

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

15.10.1 Impact Evaluation

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

Table 15-10: Impact Evaluation –EHA #10

EHA #10: Cultural Health Practices		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Site or Local (2)	Site or Local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Medium (3)	Low (2)
Probability (Definite, Possible, Unlikely)	Possible (2)	Unlikely (1)
Calculated Significance Rating (Low, Medium, High)	Low (-20)	Negligible (-9)
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Reversible (1)	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts • More people are practicing and using traditional medicine which may contribute to reducing the health burden if they are trained and knowledgeable • Negative health outcomes		

EHA #10: Cultural Health Practices		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Mitigation measures Develop a disease-prevention plan that involves traditional healers and build onto indigenous knowledge, including assisting with disease-prevention through use of medicinal plants, home-based care, etc.		

15.11 EHA #11: Health Systems Issues

There are several healthcare facilities within the Makhado and Musina Local Municipalities and the greater Vhembe District Municipality. However, the capacity of these facilities remains a challenge. In terms of the proposed Project impacts, influx may create increased demand for what is already a scarce resource. This has the potential to create tension. Health information management is generally good in the health facilities that surround the proposed Project. This data is limited by the fact that diagnostics and human resource capacity is basic. However, it serves as the best form of health surveillance for the monitoring of health impacts if supported and managed well. Strategic investment in local health facilities can support this.

15.11.1 Health systems strengthening

Industrial activities require health systems strengthening to ensure that potential health impacts are managed effectively and that local healthcare services can accommodate the increased demand. These are:

- **Emergency Preparedness:** Develop and enhance emergency response infrastructure, including medical response units, emergency rooms, and rapid response teams, to manage potential accidents or incidents related to operations.
- **Training and Drills:** Conduct regular training and drills for emergency responders and healthcare providers to ensure readiness for industrial accidents or environmental emergencies.
- **Preventive Measures:** Establish preventive health measures and routine health checks to identify and address potential health issues early.
- **Community Support Policies:** Implement policies that support community health and well-being, including access to healthcare services and environmental protection measures.

15.11.2 Health service delivery capacity and expectations on the proposed Project

The status of health service delivery capacity in the two Local Municipalities can be characterized by several factors;

- **Healthcare Facilities:** The project area has various public and private healthcare facilities, including hospitals and clinics. However, some facilities may be under-resourced or in need of upgrades, impacting service quality.

- **Workforce Challenges:** There may be shortages of healthcare professionals, particularly specialists, which can lead to longer wait times and reduced access to care.
- **Funding Issues:** The local healthcare system often faces financial constraints, affecting its ability to expand services and improve infrastructure.
- **Access to Services:** While urban areas may have better access to healthcare services, rural parts of the municipality might experience significant barriers, including transportation difficulties.
- **Community Health Programs:** There are some community health initiatives (ie Mobile clinics) aimed at addressing public health needs, but the coverage and effectiveness of these programs can vary.

It is expected that the proposed project may cause further strain on existing health facilities through an increase in health issues related to the project. It can further increase strain on existing facilities through influx of people.

15.11.3 Healthcare Funding

Health care funding challenges in the two local municipalities can significantly impact the quality and accessibility of health services.

Key challenges include:

- **Budget Constraints:** Limited financial resources can lead to insufficient funding for essential services, affecting staffing, facilities, and equipment.
- **Rising Healthcare Costs:** Increasing costs of medical supplies, technology, and pharmaceuticals can further strain budgets.
- **Community Services:** Insufficient investment in preventative and community health services can lead to higher long-term costs and increased pressure on acute services

15.11.4 Health Service Inequalities

Health service inequalities in the two local municipalities can be influenced by various factors, including socioeconomic status, access to healthcare facilities, and demographic differences. Key aspects include;

- **Socioeconomic Disparities:** Lower-income areas often experience higher rates of chronic illnesses and limited access to quality healthcare services.
- **Access to Healthcare:** Geographic barriers can limit access to healthcare facilities, particularly for those in rural or underserved urban areas.
- **Transport Issues:** Lack of reliable public transport can hinder access to medical services, affecting attendance at appointments and follow-up care.

- **Preventive Services:** Disparities in access to preventive healthcare, such as screenings and vaccinations, can lead to poorer health outcomes in certain communities.
- **Health Literacy:** Variations in health literacy can affect individuals' ability to navigate the healthcare system and seek necessary care.

15.11.5 Occupational health and Safety

- **Health and Safety Training:** Provide comprehensive health and safety training for all mine employees, covering topics such as use of personal protective equipment (PPE), emergency procedures, and hazard recognition.
- **Workplace Safety Standards:** Ensure compliance with occupational and health and safety standards and regulations to minimize workplace injuries and illnesses.
- **Health Surveillance:** Regular health monitoring for mine workers to address occupational health risks, including exposure to pollutants, noise, and heat.

15.11.6 Impact Evaluation

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

Table 15-11: Impact Evaluation –EHA #11

EHA #11: Health Systems Issues		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Local (2)	Local (2)
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Medium (3)	Low (2)
Probability (Definite, Possible, Unlikely)	Likely (3)	Possible (2)
Calculated Significance Rating (Low, Medium, High)	Low (-36)	Low (-22)
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Recoverable (3)	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts		
• Change in ratio of general public-to-health care providers.		

EHA #11: Health Systems Issues		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
- Change in time needed for emergency response. - Influx of people resulting in overburdened health facilities with inadequate health service. - Overburdened community health facilities, inadequate health service resulting from more people in the area		
Mitigation measures - To strengthen health systems' capacity in mining regions, several strategies can be implemented: - Workforce Development: Training /retaining healthcare professionals to work at the proposed project and conduct bi-annual health check-ups on employees to reduce load on local health care facilities - Influx management through support of local procurement - Support community volunteer programs through expansion of the community-based peer health educator group⁸. - Integrated Health Services: Implementing integrated health services that cater to the specific health challenges of mining communities, including occupational health, mental health, and disease surveillance. - Community Engagement and Empowerment: Engaging local communities in health-related decisions, empowering them with knowledge and resources, and involving them in health promotion and education initiatives.		

15.12 EHA #12: Non-Communicable Diseases

15.12.1 Mental Health and Well-being

Industrial activities such as that of the proposed project has several implications for mental health and well-being, both for workers and the local community. Managing these expectations effectively is crucial to ensuring positive outcomes and mitigating potential negative impacts. Here's a comprehensive overview of the mental health and well-being expectations associated with such a project:

- Workplace Stress:** The demanding nature of the construction and operation phases can lead to stress among workers, including long hours, high-pressure environments, and physical demands

⁸ Community-based peer health educator groups consist of trained volunteers from within the community who promote health awareness and education among their peers. These educators facilitate discussions on various health topics, including disease prevention, healthy lifestyles, and available health services. By expanding this group, the project aims to enhance community engagement, improve health literacy, and empower individuals to take charge of their health. This initiative not only fosters a sense of ownership within the community but also helps to build trust between community members and health services. Additionally, peer educators can provide valuable feedback on community health needs, which can inform future health interventions and support the overall well-being of the population.

- **Shift Patterns:** Irregular or long shift patterns can affect workers' work-life balance and contribute to fatigue and stress.
- **Community Impact:** The development of the Mine can bring significant changes to the local community, including increased population, changes in the local economy, and alterations to the environment, which can impact mental health and well-being.
- **Project Information:** Provide clear and transparent information about the project's scope, timeline, and potential impacts to reduce uncertainty and anxiety among workers and the local community.

15.12.2 Project Impact Mitigation

Mitigation measure include (but not limited to) the following;

- **Mental Health Support:** Provide access to mental health resources, including counselling services, stress management programs, and mental health awareness training to support workers.
- **Supportive Policies:** Implement policies to promote work-life balance, such as flexible shift scheduling, adequate rest periods, and support for family life.
- **Access to Care:** Ensure that workers have access to external mental health services and support, including referral systems and partnerships with local mental health providers.
- **Community Support Programs:** Develop community support programs to address potential stress and anxiety related to these changes. This includes providing mental health resources and community counselling.
- **Feedback Mechanisms:** Establish channels for feedback and concerns, allowing community members and workers to voice their issues and receive timely responses.
- **Stigma Reduction:** Work to reduce stigma around mental health issues by encouraging open conversations and normalizing mental health care.

15.12.3 Impact Evaluation

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

Table 15-12: Impact Evaluation –EHA #12

EHA #12: Non-Communicable Diseases		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Extent (Local, Regional, International)	Site or Local (2)	Site or Local (2)

EHA #12: Non-Communicable Diseases		
	Impact Rating Without Mitigation	Impact Rating With Mitigation
Duration (Short term, Medium term, Long term)	Long Term > 5 years (4)	Long Term > 5 years (4)
Magnitude (Major, Moderate, Minor)	Medium (3)	Low (2)
Probability (Definite, Possible, Unlikely)	Likely (3)	Possible (2)
Calculated Significance Rating (Low, Medium, High)	Low (-36)	Low (-22)
Impact Status: (positive or negative)	Negative	
Reversibility: (Reversible or Irreversible)	Recoverable (3)	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	No	
Residual impacts - Change in mortality and morbidity data due to NCDs. - Behavioural changes at the household level such as alcohol use, smoking, or dietary changes that may contribute to a rise in non-communicable disease outcomes affecting health service delivery. - Social and environmental factors that increase stress and unhealthy behaviours		
Mitigation measures - Addressing NCDs related to mining involves implementing various measures: - Health Education and Awareness: Providing education on healthy lifestyle choices, disease prevention, and access to healthcare services for affected communities. - Environmental Management: Implementing measures to minimise environmental pollutants and contaminants that contribute to respiratory and cardiovascular issues through continuous air quality and water monitoring and addressing any findings. - Community Health Programs: Establishing healthcare programs focused on early detection, management, and treatment of NCDs within mining-affected communities. - Support health education programs as part of a community-based peer health educator program. These should focus on lifestyle risk factors such as diet, exercise, smoking and alcohol consumption - Support the local healthcare personnel with training on disease-management programs and the recognition of NCD symptoms and associated management. This should include integrated management to include proper management strategies for hypertension and high cholesterol		

16 Cumulative Impacts

Cumulative impacts refer to the combined, incremental effects of an action when added to other past, present, and reasonably foreseeable future actions. According to the International Finance Corporation (IFC, 2013), cumulative impacts are contextual and occur across different spatial and temporal scales. They are not necessarily new or unique types of impacts, but rather the result of individually minor effects that, when considered collectively, may become significant. These cumulative effects may occur through spatial concentration of similar developments or through temporal accumulation of impacts from one or multiple activities.

16.1 Defining Cumulative Health Impacts

In the context of a Health Impact Assessment (HIA), cumulative impacts are particularly important as they relate to the aggregate burden of exposure to environmental, social, and economic stressors on a community's health and well-being. These may include exposures to pollutants, noise, traffic, social displacement, mental health triggers, and strain on health services.

Cumulative health impacts may arise when:

- Multiple developments occur within the same geographic area, leading to overlapping environmental or socio-economic changes.
- Communities are exposed repeatedly or chronically to stressors, even if each individual exposure is below a regulatory threshold.
- Access to health care, housing, clean water, sanitation, and food is gradually eroded due to combined demands from multiple developments or changes in land use.
- As outlined by Dutta et al. (2012), even projects with minimal individual impacts may contribute to significant long-term consequences when assessed cumulatively.

16.2 Vulnerable Groups

Cumulative impacts are not distributed evenly. Certain population groups in the project area are disproportionately affected due to pre-existing vulnerabilities:

- Children: More susceptible to respiratory illnesses and developmental impacts from environmental exposures.
- Elderly persons: Vulnerable to chronic disease complications, mobility issues, and reduced resilience to environmental stress.
- People with disabilities or chronic illness: May face barriers to healthcare and be more sensitive to environmental triggers.

- Low-income households and informal settlers: Often have poor access to clean water, healthcare, and food, increasing their cumulative health burden.

These groups may experience multiple, overlapping exposures that compound their health risks beyond what single-project assessments may capture (Briggs, 2003).

16.3 Strategic Implications and Recommendations

Addressing cumulative health impacts requires a systems-level and multi-stakeholder approach. The following are recommended:

- Regional Collaboration: Coordinate with local authorities to align environmental management strategies, especially around air quality, waste management, and health service support.
- Monitoring Framework: Establish a long-term health monitoring system linked to key environmental indicators such as air quality, water quality, and disease incidence, in partnership with the local Department of Health and environmental authorities.
- Capacity Building: Invest in strengthening local health systems, including clinic capacity, outreach programmes, and training for environmental health officers.
- Community-Based Surveillance: Encourage participatory health monitoring, including early reporting of respiratory, gastrointestinal, or vector-borne diseases, supported by mobile clinics or CHWs (Community Health Workers).
- Cumulative Impact Mitigation Plan: Develop a cumulative impact mitigation strategy that goes beyond project-level mitigation — including integrated waste management, urban greening, and mental health services



17 Monitoring and Evaluation

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

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

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

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

Table 17-1 outlines the different health indicators that could be collected and used for monitoring by the proposed Project. It is important that a robust baseline is used to support these KPIs.

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

Table 17-1: Health Monitoring Plan

Health Impact	Structural Indicators	Process Indicators	Outcome Indicators
Air Pollution-Related Illnesses (e.g. respiratory diseases)	- Air quality monitoring stations established on/near sites - Availability of baseline air quality data	- Frequency of air quality monitoring - Number of inspections for emission control compliance - Percentage of industries using emission-reduction technologies	- Incidence rate of respiratory diseases (e.g. asthma, bronchitis) in nearby communities - Levels of PM2.5 and PM10 in the air over time
Waterborne and Sanitation-Related Diseases (e.g. diarrhoea, cholera)	- Access to clean water and sanitation in surrounding communities - Wastewater treatment facilities serving the zone	- Regular testing of drinking water quality - Proportion of industrial facilities complying with effluent standards	- Incidence of waterborne diseases - Reports of contamination in local water sources
Occupational Health and Safety Risks	- Trained occupational health staff on-site - On-site health and safety infrastructure (PPE, first aid, clinics)	- Worker safety training sessions held - Compliance audits for safety procedures	- Rate of occupational injuries and illnesses - Days lost due to work-related incidents
Vector-Borne Diseases (e.g. malaria during construction)	- Availability of vector control services - Mapping of stagnant water and breeding sites	- Frequency of vector control campaigns - Community education/outreach programs	Incidence of vector-borne diseases in workers and nearby residents

Health Impact	Structural Indicators	Process Indicators	Outcome Indicators
Mental Health and Psychosocial Impacts	Availability of psychosocial support services for workers and communities	- Mental health awareness activities conducted - Referral systems established for support	- Reported cases of mental health conditions - Utilization rates of psychosocial services
Road Traffic Injuries and Accidents	- Upgraded road infrastructure for industrial traffic - Designated pedestrian and vehicle zones	- Traffic safety enforcement operations - Training on road safety for workers and drivers	- Number of traffic-related injuries and fatalities - Community perception of road safety
Exposure to Hazardous Waste and Chemicals	- Hazardous waste storage and treatment facilities - Emergency response plans in place	- Audits for waste handling compliance - Training for chemical safety protocols	- Exposure-related health incidents - Environmental contamination reports
Health Services Capacity and Burden	- Health facility capacity (beds, staff, medicines) - Partnerships with local health systems	- Joint planning with health departments - Referral and reporting protocols established	- Patient load trends at local clinics and hospitals - Response time and effectiveness of services

18 Conclusion

The Musina-Makhado Special Economic Zone (MMSEZ) presents significant opportunities for regional industrial growth, economic development, and job creation. However, its implementation also introduces potential risks to community health and well-being, particularly in relation to air and water pollution, occupational hazards, vector-borne diseases, and increased pressure on local health systems and infrastructure.

This Community Health Impact Assessment (CHIA) has identified key health impacts associated with the development of the MMSEZ at both Site 1, which is designated for logistics and manufacturing, and Site 2, intended for the metallurgical cluster. The assessment underscores the need to integrate public health considerations into all stages of planning and implementation to ensure long-term sustainability and inclusiveness.

To manage these risks and enhance health outcomes, a comprehensive set of mitigation measures and a detailed Health Monitoring Plan have been outlined in this report. These include structural safeguards, regulatory compliance mechanisms, regular monitoring, stakeholder involvement, and targeted community health interventions.

It is therefore essential that the mitigation measures and the Health Monitoring Plan are fully implemented and continuously reviewed. Furthermore, these measures should be formally incorporated into the Environmental Management Programme (EMPR) to ensure they are subject to regular compliance monitoring and enforcement.

Given the above, the project may be allowed to proceed provided that the recommended mitigation measures are rigorously followed and effectively integrated into the EMPR. This condition will help ensure that potential negative health impacts are minimized, while public health and environmental safety are safeguarded throughout the project's lifecycle.

In conclusion, the true success of the MMSEZ should not only be assessed by its economic performance but also by its capacity to protect and promote the health and well-being of surrounding communities. A coordinated, health-informed approach guided by this CHIA will be vital in achieving a balanced and sustainable development path.

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