APPENDIX P: COMMUNITY HEALTH STUDY

JINDAL MELMOTH IRON ORE PROJECT: HEALTH IMPACT ASSESSMENT

Melmoth

Prepared for: Jindal Iron Ore (Pty) Ltd

Client Ref: KZN 30/5/1/2/2/10108MR

Authority References:

SLR Project No.: 720.10023.0001
Report No.: 1
Revision No.:
March 2023

DOCUMENT INFORMATION

Title	Jindal Melmoth Iron Ore Project: Health Impact Assessment
Project Manager	Kate Hamilton
Project Manager Email	khamilton@slrconsulting.com
Author	Lisa Frost Ramsay
Reviewer	Sheena Muttoo
Keywords	Environmental health, iron ore, dust, mining
Status	Draft
Report No.	1
SLR Company	SLR Consulting (South Africa) (Pty) Ltd
Client Reference	KZN 30/5/1/2/2/10108MR

DOCUMENT REVISION RECORD

Rev No.	Issue Date	Description	Issued By

REPORT SIGN OFF AND APPROVALS

Kate Hamilton
(Project Manager)

Lisa Ramsay
(Author)

BASIS OF REPORT

This document has been prepared by an SLR Group company with reasonable skill, care and diligence, and taking account of the manpower, timescales and resources devoted to it by agreement with **Jindal Iron Ore (Pty) Ltd** (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

SLR shall not be liable for the use of or reliance on any information, advice, recommendations and opinions in this document for any purpose by any person other than the Client. Reliance may be granted to a third party only in the event that SLR and the third party have executed a reliance agreement or collateral warranty.

Information reported herein may be based on the interpretation of public domain data collected by SLR, and/or information supplied by the Client and/or its other advisors and associates. These data have been accepted in good faith as being accurate and valid.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

The copyright and intellectual property in all drawings, reports, specifications, bills of quantities, calculations and other information set out in this report remain vested in SLR unless the terms of appointment state otherwise.

This document may contain information of a specialised and/or highly technical nature and the Client is advised to seek clarification on any elements which may be unclear to it.

Information, advice, recommendations and opinions in this document should only be relied upon in the context of the whole document and any documents referenced explicitly herein and should then only be used within the context of the appointment.

EXECUTIVE SUMMARY

Jindal Africa has requested an Environmental and Social Impact Assessment (ESIA) to obtain a mining right and associated environmental licenses for the Melmoth Iron Ore Project (the Project). The Project includes an open pit iron ore mine and an associated processing facility.

The Jindal Iron Ore Project has the potential to positively and/or negatively influence the health status of surrounding communities by impacting on the spread of communicable diseases such as HIV and TB, the incidence of non-communicable diseases such as cardiovascular disease and asthma, the nutritional status of local communities, and access to health care facilities and institutional capacities. A Health Impact Assessment seeks to systematically evaluate any significant changes on the health of a defined population, acknowledging that impacts might not be evenly distributed across the population. A second phase of the assessment is to develop a Community Health Monitoring and Management Plan to measures any changes in impacts on health timeously, and to avoid or mitigate potential negative impacts while enhancing positive opportunities. This assessment is framed by a broad definition of health, moving beyond a traditional biomedical focus on the assessment of incidence and spread of disease to incorporate various aspects of physical, psychological, social and cultural well-being.

Professor JE Myers conducted Health Impact Scoping Assessment for the Project in 2021. He highlighted that although a previous scoping exercise was conducted by Golder for both the Project mine and processing plant in 2015, there was no health-related baseline information provided. He identified the key Environmental Health Areas (EHAs) in order of priority for the Project: Social Determinants of Health, specifically arising from the resettlement process, then potentially hazardous environmental and occupational exposures to nearby residents and project employees, followed by impacts on the health care system and its capacity and accessibility to community residents. Professor JE Myers highlighted that environmental baselines information would need to be collected for the Health Impact Assessment using a significance of impact methodology identified for the Project by SLR.

In line with Professor JE Myer's recommendations, a full HIA is completed here. The health implications of the following project impacts were considered:

- Displacement and resettlement
- Changing farming practices, market options and sources of nutrition
- Increased employment
- Influx of newcomers
- Increased traffic
- Increased ambient particulates and dust fallout
- Groundwater contamination
- Groundwater drawdown
- Flooding of mining infrastructure
- Increased exposure to vector-borne and zoonotic disease
- Changes in access to healthcare

Table 1 presents the results of this assessment of the unmitigated and mitigated health implications of these Project impacts. Project impacts with very high negative health implications under the unmitigated scenario are: changes in farming, market options and nutrition; influx of newcomers; groundwater drawdown; and

access to healthcare facilities. Under the mitigated scenario, in line with the Community Health Monitoring and Management Plan (CHMMP), all impacts are considered low to medium negative, with the potential for some positive impacts, particularly with anticipated improved employment and access to healthcare facilities.

Various health impacts and mitigation measures to limit or reverse these impacts are presented in this report, as are opportunities to enhance positive health impacts. The Community Health Monitoring and Management Plan also provides various measurement indicators of community health for measurement and evaluation to ensure community health, in the broader sense, is protected during the planning, construction, operational and closure phases of the project.

Table 1: Significance ratings of unmitigated and mitigated health implications of project impacts

Project Impacts	Unmitigated Health Implications						Mitigated Health Implications					
	Intensity	Duration	Extent	Consequence	Probability	Significance	Intensity	Duration	Extent	Consequence	Probability	Significance
Displacement and Resettlement	High -	Medium term	Local	High -	Probable	High -	Moderate -	Short term	Local	Medium -	Conceivable	Low -
Changing farming, market options and nutrition	High -	Permanent	Local	Very high -	Probable	Very high -	Moderate -	Permanent	Local	High -	Possible	Medium -
Increased employment	High +	Long term	Local	High +	Probable	High +	NA	NA	NA	NA	NA	NA
Influx of newcomers	High -	Permanent	Local	Very high -	Probable	Very high -	Moderate -	Permanent	Local	High -	Possible	Medium -
Increased traffic	Very high -	Long term	Local	Very high -	Possible	High -	High -	Long term	Local	High -	Conceivable	Medium -
Increased particulates during the construction phase	High -	Short term	Local	Medium -	Frequent	Low-	Moderate -	Short term	Local	Medium -	Frequent	Low -
Increased particulates during the operational phase	High -	Long term	Local	High -	Probable	High -	Low -	Long term	Local	Medium -	Probable	Medium-

Project Impacts	Unmitigated Health Implications						Mitigated Health Implications					
	Intensity	Duration	Extent	Consequence	Probability	Significance	Intensity	Duration	Extent	Consequence	Probability	Significance
Water contamination	Low -	Long term	Local	Medium -	Continuous	Medium -	Very low -	Long term	Local	Medium -	Continuous	Medium -
Groundwater drawdown	Very high -	Permanent	Local	Very high -	Continuous	Very high -	Moderate -	Permanent	Local	High -	Possible	Medium -
Flooding of mining infrastructure	Very high -	Long term	Local	Very high -	Conceivable	High -	Moderate -	Long term	Local	High -	Conceivable	Low -
Increased exposure to vector-borne and zoonotic diseases	Moderate	Permanent	Local	High -	Conceivable	Medium -	Low	Permanent	Local	High -	Unlikely	Low -
Changes in access to healthcare	High -	Permanent	Regional	Very high -	Definite	Very high -	High +	Long term	Regional	Very high +	Definite	Very high +

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
BEE	Black economic empowerment
CHMMP	Community Health Monitoring and Management Plan
CO_2	Carbon dioxide
COVID-19	Coronavirus disease of 2019
DFFE	Department of Forestry, Fisheries and the Environment
DM	District Municipality
EAP	Environmental Assessment Practitioner
EHA	Environmental Health Area
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
HIA	Health Impact Assessment
Fe	Iron
GN	Government Notice
ha	Hectare
HDI	Human Development Index
HIV/AIDS	Human immunodeficiency virus/acquired immunodeficiency syndrome
I&APs	Interested and affected parties
IFC	International Finance Corporation
IOGP	International Association of Oil & Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
km	Kilometer
KPI	Key performance indicator
KZN	KwaZulu-Natal
LM	Local Municipality
LoM	Life of mine
NEMA	National Environmental Management Act, Act 107 of 1998
NEM:AQA	National Environmental Management: Air Quality Act, Act 39 of 2004
NHA	National Health Act, Act 61 of 2003
NWA	The National Water Act, Act 36 of 1998
m	Meter

Acronym / Abbreviation	Definition
MRA	Mining Rights Application
mtpa	Million tonnes per annum
OECD	Organisation for Economic and Co-operative Development
PM	Particulate matter
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 microns
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 microns
PP	Public participation
PR	Prospecting Right
PS	Performance Standard
ROM	Run-of-mine
SDH	Social determinants of health
StatsSA	Statistics South Africa
TB	Tuberculosis
TSF	Tailings storage facility
USD	United States Dollars
WHO	World Health Organisation
WRD	Waste rock dump

Jindal Melmoth Iron Ore Project: Health Impact Assessment

1. INTRODUCTION

Community health is increasingly regarded as an important consideration when evaluating project developments. This health impact assessment (HIA) considers the health implication of the various phases of the Jindal Iron Ore Project (the Project) life cycle. The Project has the potential to positively and/or negatively influence the health status of surrounding communities by impacting on the spread of communicable diseases such as HIV and TB, the incidence of non-communicable diseases such as cardiovascular disease and asthma, the nutritional status of local communities, and access to health care facilities and institutional capacities. These impacts need to be systematically evaluated so that a Community Health Monitoring and Management Plan (CHMMP) can be developed to avoid or mitigate potential negative impacts while enhancing positive opportunities.

The specific activities of the HIA include:

- A desktop literature review outlining the community health profile.
- Baseline health questions included in the community household survey.
- Collection of additional secondary information in published and grey data.
- Description of the proposed Project designs, present and planned work activities;
- Description a of potential future health impacts on the health of the respective communities;
- Impact assessment and risk rating and ranking to systematically and consistently evaluate potential project related impacts.
- Assessment of existing health needs of the community based on health strategies, infrastructure, programmes, service priorities, delivery plans and challenges.
- Development of a Community Health Monitoring and Management Plan (CHMMP), designed to maximize potential positive health benefits and prevent or mitigate any detrimental health impacts that the Project may have on local communities.

2. DETAILS OF THE SPECIALIST WHO PREPARED THE REPORT

This Health Risk Assessment has been prepared by Lisa Frost Ramsay. Lisa consults part time and is engaged in research and postgraduate supervision part time in the Department of Environmental and Occupational Health, College of Health Sciences, University of KwaZulu-Natal.

Lisa declares that she is independent as required by the EIA Regulations GNR 543 of 18 June 2010, and has no vested interest in the proposed project.

2.1 QUALIFICATIONS

- University of Natal, BSc Hons. 2003.
- University of KwaZulu-Natal, MSc. 2005.
- University of Cambridge. MPhil. 2006.
- University of Cambridge. PhD. 2009.

2.2 CONSULTANCY EXPERIENCE

Lisa offers various consultancy services, including atmospheric dispersion modelling; compilation of atmospheric emission inventories and greenhouse gas inventories; odour monitoring, modelling and management; health impact assessments; environmental nuisance assessments, climate change impact assessments; and strategic air quality management plans.

Some recent health and nuisance-related consultancy experience is included below:

Table 2-1: Selected consultancy-related experience

Project Name	Description
SAPREF Emergency Shutdown and Startup, KwaZulu-Natal, South Africa (2020)	Assessment of ambient air quality impacts of emergency flaring during the COVID 19 shutdown and subsequent start-up of South Africa's largest crude oil refinery. A Level 3 (CALPUFF) dispersion model was run for peak hourly and 24-hourly emission scenarios to assess ambient concentrations of air pollutants at local sensitive receptors for comparison with health standards.
Nuisance Impact Assessment (2019) and Nuisance Management Plan for Glen Arum Farms, KwaZulu-Natal, South Africa (2020)	Nuisance risk assessment for Glen Arum's Impangele egg layer operation as part of a non-compliance directive from KZN EDTEA. The directive included the development of a corrective management plan to address odour and control vectors. The corrective action plan made recommendations for effective waste management, community engagement and complaints investigations.
Proposed Medical Waste Thermal Desorption Unit for Compass Waste, Gauteng, South Africa (2019)	Compilation of a community HRA for a proposed medical waste thermal desorption unit. The key potential health hazards associated with the proposed development were identified as atmospheric emissions, biohazards and pests, odour and noise. This study assessed likely health impacts from the proposed facility via multiple exposure pathways using internationally recognised methodologies for establishing distribution, likelihood and significance of impact.
Interwaste's Proposed Waste-to-Energy Project, Western Cape, South Africa (2016)	Compilation of an HIA (human, plant and animal health) for a proposed waste recovery, beneficiation and energy project comprising anaerobic digestion and direct combustion facilities. Potential health hazards associated with the proposed development included atmospheric emissions, water and soil contamination, biohazards and pests, and odour and noise. This study assessed likely health impacts from the proposed facility via multiple exposure pathways (including inhalation, dermal contact, and ingestion of locally produced crops and meat) using internationally recognised methodologies for establishing distribution, likelihood and significance of impact.

Project Name	Description
Bulk Terminal Iron Ore Staining Assessment, Transnet Port Terminals, Saldanha, Western Cape, South Africa (2015)	Development of an emissions inventory for the iron ore bulk storage facility at Saldanha Bay. A Level 3 atmospheric dispersion model (CALPUFF) was used to calculate ambient concentrations of particulate matter and levels of dust fallout. The study included a nuisance assessment of the red staining of surfaces in the nearby suburbs of Vredenburg, Langebaan and Bluewater Bay.
Medical Waste Incineration Facility, Sirela Trading, KwaZulu-Nata, South Africa (2013)	Specialist air quality and screening HJA for a proposed health care waste incinerator. Health risks (including carcinogenic risks) associated with the simulated ambient air quality concentrations of various toxins, including heavy metals and dioxins/furans, were assessed using an internationally accepted health screening approach.
Dust fallout assessment for AngloGold Ashanti Mine, Guinea (2012)	Environmental health and dust nuisance assessment for surrounding sensitive receptors of a gold mine in Guinea. A Level 2 dispersion model (ADMS) was used to calculate ambient concentrations of particulate matter and dust fallout in the region for comparison with the World Health Organisation (WHO) guidelines.

2.3 RESEARCH INTERESTS

Lisa is an Associate Professor in the College of Health Sciences, University of KwaZulu-Natal, where she maintains a broad research portfolio and supervises postgraduate students. Her key research areas are:

- Simulating dispersion of airborne pollutants.
- Characterising exposure to airborne pollutants.
- Adverse health effects of environmental exposures to airborne pollutants.
- Impacts of bioaerosols.
- The interplay between nuisance (odour, noise, visual impacts etc) and poor health.
- Climate, climate change and environmental health.

The report was reviewed by Dr. Sheena Muttoo, College of Health Sciences, University of KwaZulu-Natal.

3. DESCRIPTION OF THE SCOPE OF THE OVERALL ACTIVITY

3.1 PROJECT BACKGROUND

The Project site is located 25 km southeast of Melmoth, Mthonjaneni Local Municipality in the KwaZulu-Natal province of South Africa.

Jindal Iron Ore (Pty) Ltd (Jindal), is owned by Jindal Steel and Power (Mauritius) Limited (74%) and South African BEE partner, Mr. Thabang Khomo (Pty) Ltd (26%). Jindal holds two Prospecting Rights (PR) for the project site. These are referred to as North Block (PR 10644) and South Block (PR 10652) with a total combined area of 20,170 ha.

In 2019 through 2020 the iron ore price steadily recovered which encouraged Jindal to increase the rate of development of the Melmoth Iron Ore Project. In January 2021 Jindal appointed SLR Consulting South Africa as the independent Environmental Assessment Practitioner (EAP) to undertake a new Environmental and Social Impact Assessment (ESIA) and public participation process and prepare all documentation for a Mining Right Application (MRA). Jindal has also appointed consultants to produce a Bankable Feasibility Study for the envisioned Melmoth Iron Ore Mine.

3.2 PROPOSED ACTIVITIES

Jindal's intent with this MRA is to consolidate the Prospecting Rights for the North and South blocks into a single Mining Right. However, development of the mine and mining infrastructure would be undertaken in a phased approach with mining currently only proposed to be undertaken in the south-eastern section of the South Block (**Figure 1.**), where the iron ore resource has been defined through previous prospecting. Infrastructure would be developed to support this mining operation. The MRA and ESIA will consider the entire extent of the MRA area, but with a specific focus on Phase 1 of the Melmoth Iron Ore Project as described in this section.

3.2.1 Phase 1: Conceptual Design

An open cast pit mining operation is proposed to be developed in the south-eastern section of the South Block known as the South East Pit. Approximately 800 million tonnes of ore are expected to be mined from the pit over its lifetime (approximately 25 years). Waste rock will be stripped from the pit at a ratio of approximately 0.5 tonnes of waste rock per tonne of ore.

The waste rock will be disposed of on a Waste Rock Dump (WRD) proposed within the Mining Right Area. Drilling and blasting techniques will be used to excavate the iron ore (proposed to be 32 million tonnes per annum (mtpa)) which will then be loaded onto trucks and transported to the Run-of-Mine (ROM) ore stockpile area where it will be stored and subsequently transferred to the processing plant for milling and magnetic separation. The processing plant will produce iron ore concentrate and a tailings slurry. The approximately 7.5 mtpa of iron ore concentrate consisting of 67% Fe will be transported to the Richards Bay Port likely via rail (part of a separate application process). The concentrate will be exported as there are limited local markets. The tailings will be disposed of at a tailings storage facility (TSF) (also part of a separate application process). Associated infrastructure to support the mine will include access and haul roads, electrical transmission line and sub-stations, raw water abstraction and pipelines, stormwater management infrastructure, tailings pipelines, concentrate pipelines, offices, change house, workshops and perimeter fencing (amongst others).

Some of the infrastructure required for the mine (e.g. the access road, pipelines and TSF) may be located outside of the Mining Right Area. While the access road and water supply pipelines are part of this application to the Department of Mineral Resources and Energy (DMRE), certain other infrastructure will be subject to separate application, assessment and approval processes, as required by the applicable legislation (See Section 4).

Additional detail is provided in the following sections on the major infrastructure, where information is available.

South East Pit

The South East Pit as shown is approximately 4 km east to west and approximately 1km north to south at its widest point.

Waste Rock Dump

WRDs are required to accommodate overburden and waste rock excavated as part of the mining process. The waste rock dump would be designed to fit into the existing contours to the extent practical for stability and ultimate closure rehabilitation. The position is included in Figure 1.

Crushing and Screening

ROM ore will be transported via haul truck to a semi-mobile in-pit primary crusher. Crushed ore will be transported to the ROM stockpile via overland conveyor. ROM ore will be reclaimed from the ROM stockpile for further crushing before being deposited onto the crushed ore stockpile.

Processing Plant

Ore from the crushed ore stockpile will be fed into the processing plant. It is anticipated that the proposed processing plant would be designed to process 32 mtpa of iron ore. Iron ore will be processed using crushing, milling and magnetic separation techniques. The plant will produce wet iron ore concentrate (upgraded from 30% Fe in feed to 67% Fe in concentrate) which will be exported.

The plant will also produce thickened wet tailings slurry which will be deposited on a TSF (the permitting for the TSF is being undertaken as a separate process). The following standard activities are proposed as part the processing operations:

- Crushing and Screening;
- High Pressure Grinding Roll (HPGR) and ball/pebble milling;
- Magnetic separation and concentrate re-grind;
- Tailings disposal;
- Concentrate Dewatering and Filtration; and
- Transport, storage and shipment of final beneficiated product.

Water Infrastructure

The mining operations will require water for the processing plant, dust control, for vehicle wash down and for the change house and office use. Water requirements are likely to reduce as the pit deepens due to the reuse of water that collects within the pit. In addition, water management infrastructure will be required including dirty water dams, pollution control dams and storm water management.

Office Complex

An office complex is required to accommodate all management, technical, and administration staff for the mine. The office complex will include a car park, canteen, meeting rooms, hall, training complex, security and first aid station. The site will have a dedicated sewerage treatment plant.

Workshops

Engineering and vehicle workshops, tyre shops, wash down areas, garages, fuel depots and explosive magazines will be located at the centre of the activity that the facility services for ease of access.

Access Road

An access road has been indicated in **Figure 3-1**.

Power Supply

Existing 400 kV transmission lines owned by Eskom run through the South Block to a point approximately 700 m from the envisioned main plant intake substation. The lines are relatively new and have adequate installed capacity for the mine requirements. Connecting distribution lines and a substation will be required for the mining operations.

3.2.2 Possible Future Phases

Prospecting, including drilling programmes, will be undertaken in parallel with the Phase 1 mining. This would generate additional information on the iron ore resource in the North and balance of the South block and will be used to inform planning of possible future mining phases. Any future development phases of the Melmoth Iron Ore Project would need to be subject to the requisite regulatory application, assessment, and approval processes.

3.2.3 Tailings Storage Facility and Associated Infrastructure

The permitting for the TSF is being undertaken as a separate process.

3.2.4 Transport of Concentrate to Richard's Bay for Export

The final mode of transportation of the concentrate from the processing plant to the Richards Bay Port will likely be via rail. This would be permitted and assessed under a separate process.

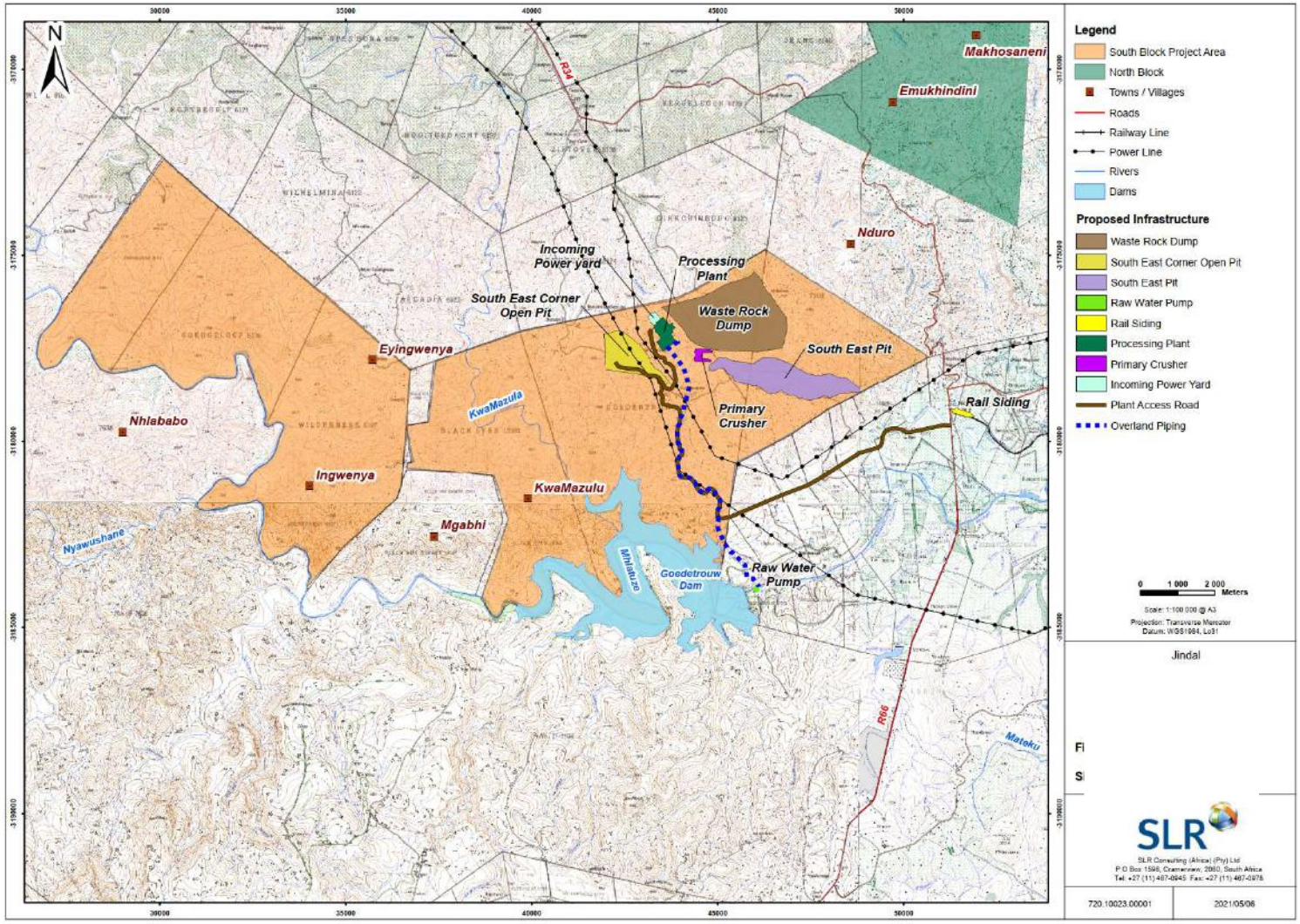

Figure 3-1: Conceptual site layout (2018)

4. LEGISLATIVE FRAMEWORK

Jindal requested that the HIA be conducted in line with South African Legislation and the International Finance Corporation (IFC) Performance Standards.

4.1 SOUTH AFRICAN LAW

Relevant South African Law includes:

- Section 24 of the Constitution of South Africa, Act 108 of 1996
- National Environmental Management Act, Act 107 of 1998
- Environmental Conservation Act, Act 73 of 1989
- National Environmental Management: Air Quality Act, Act 39 of 2004
- National Water Act, Act 36 of 1998
- Occupational Health and Safety Act, Act 85 of 1993
- Mine Health and Safety Act, Act 29 of 1996
- The Health Professions Amendment Bill of 2006
- The Traditional Health Practitioners Act, Act 35 of 2004
- Regulations relating to the Labelling and Advertising of Foodstuffs that came into effect in May 2012, and aim to empower citizens to make healthy food choices
- Municipal by-laws

Key aspects of South Africa Law are described below.

4.1.1 The Constitution of South Africa, Act 108 1996

The over-arching legislation of South Africa is the Constitution. Section 24 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, ecologically sustainable development and the utilisation of natural resources while promoting justifiable economic and social development.

4.1.2 The National Health Act, Act 61 of 2003

The National Health Act, Act No 61 of 2003 (NHA) provides a framework for a structured and equitable health system in South Africa, taking into account the obligations with regard to health services imposed on the national, provincial and local governments by the Constitution. Section 20 gives legal effect to the functions of environmental health management. The Director General (DG) is tasked to promulgate, 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.

Section 88 of the Act provides legal effect to environmental health investigations. 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 an HIA.

4.1.3 National Environmental Management: Air Quality Act, Act 39 of 2004

Until 2004, South Africa's approach to air pollution control fell under the Atmospheric Pollution Prevention Act, Act 45 of 1965 (APPA), which was repealed with the promulgation of the National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA). NEM:AQA represented a shift in South Africa's approach to air quality management, from source-based control to a more integrated approach that includes ambient standards.

The objectives of NEM:AQA are to:

- Protect the environment by providing reasonable measures for:
  - The protection and enhancement of air quality;
  - The prevention of air pollution and ecological degradation; and
  - Securing ecologically sustainable development while promoting justifiable economic and social development.
- Give effect to the Constitutional right to an environment that is not harmful to their health and well-being

Significant functions detailed in NEM:AQA include:

- The National Framework for Air Quality Management;
- Institutional planning matters, including:
  - The establishment of a National Air Quality Advisory Committee;
  - The appointment of Air Quality Officers (AQOs) at each level of government;
  - The development, implementation and reporting of Air Quality Management Plans at national, provincial and municipal levels;
- Air quality management measures including:
  - The declaration of Priority Areas where ambient air quality standards are being, or may be, exceeded;
  - The listing of activities that result in atmospheric emissions and which have the potential to impact negatively on the environment and the licensing thereof through an Atmospheric Emissions License;
  - The declaration of Controlled Emitters;
  - The declaration of Controlled Fuels;
  - Procedures to enforce Pollution Prevention Plans or Atmospheric Impact Reporting for the control and inventory of atmospheric pollutants of concern; and
- Requirements for addressing dust and offensive odours.

With respect to odour control, Section 35 of NEM:AQA (under Part 6: Control measures in respect of dust, noise and offensive odours) states the following:

- The minister or MEC may prescribe measures for the control of offensive odours emanating from the specified activities; and
- The occupier of any premises must take all reasonable steps to prevent the emission of any offensive odour caused by any activity on such premises.

4.1.4 The National Water Act, Act 36 of 1998

Water resources management in South Africa is governed by the National Water Act, Act 36 of 1998 (NWA). The Department of Water and Sanitation (DWS) must, as custodians of water, ensure that resources are used, conserved, protected, developed, managed, and controlled in a sustainable manner for the benefit of all persons and the environment.

Government Notice 704 (Government Gazette 20119 of June 1999) was established to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. The main conditions of GN 704 applicable to this project are:

- **Condition 4** indicates that no person in control of a mine or activity may locate or place any residue deposit, dam, reservoir, together with any structure of other facility within the 1:100-year flood line or within a horizontal distance of 100 metre from any watercourse.
- **Condition 5** indicates that no residue or substance which causes or is likely to cause pollution of a water resource may be used in the construction of any dams, impoundments or embankments or any other infrastructure which may cause pollution of a water resource.
- **Condition 6** describes the capacity requirements of clean and dirty water systems. Clean and dirty water systems must be kept separate and must be designed, constructed, maintained, and operated to ensure conveyance of the flow of a 1:50-year recurrence interval storm event. Clean and dirty water systems should therefore not spill into each other more frequently than once in 50 years. Any dirty water dams should also have a minimum freeboard of 0.8m above full supply level.
- **Condition 7** describes the measures which must be taken to protect water resources. All dirty water or substances which may cause pollution should be prevented from entering a clean water resource (by spillage, seepage, erosion etc.) and it should be ensured that water used in any process is recycled as far as practicable.

In addition to GN 704, the Department of Water and Sanitation (previously Department of Water Affairs and Forestry) has developed several Best Practice Guidelines (BPGs) for the mining industry. These include:

- BPG A4 for Pollution Control Dams (PCDs) defines the allowable PCDs spillage frequency as being one spill in every 50 years on average. This is equivalent to stating that an RWD or PCD should be designed with an annual spillage probability of 1:50 (2%) or less. In addition to this, BPG A4 recommends that the final design criteria should be determined through the use of a long term continuous simulation water balance model, modelled at an appropriate time step (preferably daily)
- BPG G1 Storm water Management, which defines a methodology of planning, designing and implementing storm water management measures to ensure separation of clean and dirty water and provides guidelines to ensure sustainability over the mine's life cycle.
- BPG G2: Water and Salt Balances, which defines a methodology of planning, designing and implementing water balance objectives to ensure suitable water management strategies and provides guidelines to ensure sustainability over the mine's life cycle.
- BPG G3: Water Monitoring Systems. Water monitoring is a legal requirement and can be used in negotiations with authorities for permits and authorizations.

Monitoring on a mine consists of various components. The successful development and implementation of an appropriate, accurate and reliable monitoring programme requires that a defined structured procedure be followed. Furthermore, it is important that this is done by a suitably qualified person.

The following water quality standards are used to guide the water quality assessment:

- South African National Standard (SANS). Drinking Water Standard SANS 241: 2015.
- Targeted Water Quality Range (TWQR) (DWA, 1996).

4.2 INTERNATIONAL LAW AND GUIDANCE

South Africa is a signatory to international conventions that may be applicable to the Project and these may be seen to provide additional direction in the absence or limitation of local legislation or policy. Various international bodies also provide relevant guidelines for health assessment. Those of relevance include:

- The United Nations Declaration on Rights of the Indigenous Peoples.
- Stockholm Convention on Persistent Organic Pollutants.
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal.
- United Nations Development Program. Global and Inclusive Agreement.
- United Nations Environmental Program.
- International Health Regulations as promulgated by the World Health Organization.

4.3 INTERNATIONAL MANAGEMENT STANDARDS

The relevant International Finance Corporation (IFC) requirements are outlined under:

- Performance Standard 4: Community Health, Safety, and Security, 2012.
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, 2012.

PS4 is of particular relevance in this assessment. The objectives of 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.
- 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.

The Performance Standard 4 community health and safety requirement states that the client will evaluate risks and impacts to the health and safety of the affected community during all stages of a project, and will establish preventative measures to mitigate and manage the identified health impacts. An Action Plan is to be disclosed and on-going engagement with affected communities is to be established.

Performance Standard 6 describes ecosystem services to include:

- **Provisioning services**, such as food, fresh water, timber, fibres, medicinal plants.
- **Regulating services**, such as surface water purification, carbon storage, climate regulation, protection from natural hazards.
- **Cultural services**, such as natural areas that are sacred sites, or important for recreation, aesthetic enjoyment.
- **Supporting services**, such as soil formation, nutrient cycling, and primary production.

5. METHODOLOGY

An HIA is a structured planning and decision-making process for analysing the potential positive and negative impacts of programmes, projects and policies on community health. The purpose of an HIA is to assess potential health-related impacts associated with the Project on a defined population. This assessment is framed by a broad definition of health, moving beyond a traditional biomedical focus on the assessment of incidence and spread of disease to incorporate various aspects of physical, psychological, social and cultural well-being.

Health impacts can be positive or negative, intended or not, single or cumulative. Furthermore, the range of changes may or may not be evenly distributed across the population. An HIA can inform key decision makers, relevant government authorities, other relevant stakeholders and to provide information to help identify management and mitigation measures. These mitigation measures aim to avoid, minimise and reduce potential health impacts.

The HIA process is designed to:

- Provide a systematic methodology and process of how a project, policy or programme is potentially generating human health impacts.
- Predict the consequences (positive, negative or both) and distribution of these impacts across potentially affected communities, including vulnerable individuals or groups.
- Identify positive health effects while prioritizing the prevention of potential negative health effects;
- Be multidisciplinary in approach and use information from many different health providers, disciplines and allied technical fields, e.g. environmental, socioeconomics and human rights.
- Facilitate discussions across decision makers and key stakeholders.
- Generate detailed baseline information that can be used to develop key performance indicators for future monitoring and evaluation.

An HIA can guide the planning process for health and social outreach programmes that extend beyond the fence line and into surrounding communities, e.g. capacity and institution building, health infrastructure support, information education and communication, vocational training, safe water projects and small-scale business (trade markets) infrastructure support. These programmes can provide positive health benefits, both in terms of strengthening public health services, and enhancing household-level health outcomes, the latter being strongly associated with improved income generation.

5.1 ENVIRONMENTAL HEALTH AREAS (EHA)

Given the broad definition of health, HIAs can potentially have extremely wide scope and latitude. The underlying philosophical model of the HIA often drives the scope of the HIA. The two traditional models of health are biomedical and social or socio-environmental. The biomedical model of health focuses on disease and illness, and related causal mechanisms. The socio-environmental model tends to focus on the broader factors or determinants that shape and influence health and well-being. Health determinants are personal (e.g. age, sex, genetic factors, income, education level, diet), social (e.g. population densities, social support practices, political engagement, access to education), cultural (e.g. hygiene practices, traditional diets, traditional care, housing and living arrangements), economic (e.g. average income, employment rates, access to health care etc) and environmental (e.g. air quality, water quality, soil contamination) factors that influence the health status of individuals and populations.

The environmental health perspective represents a shift from a disease-specific focus (e.g. tuberculosis, TB) toward an examination of the relationships between overall disease burden and infrastructure impacts. The 2012 IFC Performance Standards update included specific language regarding ecosystem services, thereby linking biomedical and socio-environmental models and ecosystem services.

The linkages between infrastructure-related activities and overall environmental health are apparent in the up to 50% improvement in key health performance indicators that can be achieved by improvements across four key sectors - housing; water and food; transportation; and communication and information management[1]. This integration of health and infrastructure is compatible with the design and execution of large, capital- intensive extractive industry projects in low and middle human development index (HDI) settings.

EHAs have been developed to capture a variety of determinants of health, developed by key international health and development agencies, i.e., WHO and the World Bank Group. In general, while each EHA may not be relevant for a given project, it is still important to systematically analyse the potential for project related impacts (positive, negative or neutral) across the various EHAs. The IFC methodology[1] makes use of twelve Environmental Health Areas (EHAs) to support the systematic analysis of health considerations. These have been developed by both the extractive industries sector and international multilateral lending institutions (e.g. IPIECA-IOGP, 2016[2]; IFC, 2012[3]). There are twelve defined EHAs that are traditionally utilized within an HIA. Professor JE Myers (2021) ordered these in relative importance to the Project:

1. Social determinants of health (SDH), e.g. psychosocial and economic conditions.
2. Exposure to potentially hazardous materials, e.g. air pollution.
3. Health systems infrastructure and capacity, e.g. access to medical care.
4. Cultural health practices, e.g. access to traditional medical providers.
5. Housing and communicable diseases, especially respiratory disease;
6. Food and nutrition related issues, e.g. subsistence farming.
7. Sexually transmitted infections, e.g. HIV/AIDS.
8. Accidents/injuries, e.g. road traffic crash.
9. Soil, water, sanitation and waste related issues, e.g diarrhoeal disease.
10. Non-communicable diseases, e.g. diabetes.
11. Vector-related disease, e.g. schistosomiasis.
12. Zoonotic diseases with animal to human disease transmission, e.g. rabies and brucellosis.

---

[1] IFC (2009). Introduction to Health Impact Assessment. Available at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_healthimpactassessment__wci__1319578475704.

[2] IPIECA-IOGP (2016). Health Impact Assessment: A Guide for the Oil and Gas Industry, IOGP Report 548, Available at: https://www.ipieca.org/resources/health-impact-assessment-a-guide-for-the-oil-and-gas-industry.

[3] IFC (2012). Environmental and Social Performance Standards. Available at: https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards/

These EHAs link 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. This is an advancement from a traditional, biomedically-framed HIA focusing primarily on disease-specific considerations. The critical objective is that the HIA utilizes a systematic methodology that is compatible with environmental, social and human rights impact assessment strategies.

Aspects of each EHA that could be relevant to the Project were highlighted by Professor JE Myers (2021) in the Health Impact Scoping Assessment for the Project.

5.1.1 Social Determinants of Health (SDH)

Here we consider various psychosocial elements, including resettlement/relocation, violence and security concerns, substance misuse (drug, alcohol, smoking), and changes to social cohesion. Psychosocial stress (due to e.g. resettlement, overcrowding, political or economic transitions), mental health, depression, gender issues, domestic violence, suicide, conflicts with newcomers to the area working on the Project, security concerns, substance misuse (drug, alcohol, smoking), family planning, health seeking behaviours. There is a significant overlap with the socio-economic impact assessment when assessing SDH.

5.1.2 Exposure to Potentially Hazardous Materials

Here we consider air pollution, whether indoor, related to cooking and heating, or outdoor, related to industrial activity (gaseous and particulate pollutants, including heavy metals), vehicles (exhaust emissions and road dust), and industrial combustion or incineration, landfilling or incineration of wastes, and use of any other project related solvents, paints, oils or cleaning agents. Noise, vibration, ionizing radiation, odour, visual impacts and water contamination are also relevant under this EHA.

5.1.3 Health Systems Infrastructure and Capacity

Factors to consider here include access to physical infrastructure, staffing levels and competencies, and technical capabilities of health care facilities. It is important to assess Project-related health care services.

5.1.4 Cultural Health Practices

Relevant factors include traditional diets, hygiene practices, access to traditional medical providers, indigenous medicines and practice of unique cultural health practices including burials tethered to place. and their alignment with existing health services (formal and traditional) at local and provincial levels.

5.1.5 Housing and Communicable Diseases

Transmission of communicable diseases, e.g. acute respiratory infections (viral and bacterial including COVID-19), pneumonia, TB, meningitis, that can be linked to poor housing design, overcrowding and housing inflation. It also considers indoor air pollution related to use of biomass fuels.

5.1.6 Food and Nutrition-Related Issues

Changes in subsistence practices and/or food inflation can result in malnutrition with associated stunting, wasting, anaemia, micronutrient diseases (including folate, Vitamin A, iron, and iodine), and gastroenteritis (bacterial and viral) and food-borne trematodiases. Access to land plays a major role in developing subsistence farming contexts.

5.1.7 Sexually Transmitted Infections

Syphilis, gonorrhoea, chlamydia, hepatitis B and HIV/AIDS incidence and spread can be impacted due to population flows related to the Project, both of workers and work-seekers.

5.1.8 Accidents and Injuries

These include construction related injuries, and road traffic related spills and releases. Furthermore, road traffic or work-related accidents and injuries, drowning, burns and falls are relevant.

5.1.9 Soil, Water, Sanitation and Waste-Related Issues

Diseases that are transmitted directly or indirectly through contaminated water, soil or non-hazardous waste (e.g. diarrheal diseases, schistosomiasis, hepatitis A and E, soil-transmitted helminthiases, giardiasis) should be considered.

5.1.10 Non-communicable Diseases

The incidence and treatment of hypertension, diabetes, obesity, cancer, stroke, and cardiovascular disorders are relevant here. These are inextricably linked with other EHAs, e.g. access to health care, food and nutrition, exposure to contaminants and others.

5.1.11 Vector-related Disease

Schistosomiasis (bilharzia) is likely to be present and could be aggravated by changes relating to the Project.

5.1.12 Zoonotic Diseases

Here we assess potential changes in disease distributions due to changes in animal migration patterns due to project-related activities or infrastructure. Of relevance are diseases affecting animals (e.g. TB) or that can be transmitted from animals to human (e.g. rabies, brucellosis, leptospirosis).

5.2 ASSESSMENT OF SIGNIFICANCE OF IMPACT

Table 5-1 presents definitions of the criteria used to determine the intensity of the impact.

Table 5-1: Criteria used for determining the intensity of the impact

Criteria	Description
Very high -	Severe change, disturbance, or degradation. Associated with severe consequences. May result in severe illness, injury, or death. Targets, limits, and thresholds of concern continually exceeded. Habitats or ecosystems of high importance for maintaining the persistence of species or habitats that meet critical habitat thresholds. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
High -	Prominent change, disturbance, or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits, and thresholds of concern regularly exceeded. Habitats or ecosystems which are important for meeting national/provincial conservation targets. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.

Criteria	Description
Moderate -	Moderate change, disturbance, or discomfort. Associated with real but not substantial consequences. Targets, limits, and thresholds of concern may occasionally be exceeded. Habitats or ecosystems with important functional value in maintaining biotic integrity. Occasional complaints can be expected.
Low -	Minor (Slight) change, disturbance, or nuisance. Associated with minor consequences or deterioration. Targets, limits, and thresholds of concern rarely exceeded. Habitats and ecosystems which are degraded and modified. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
Very low -	Negligible change, disturbance, or nuisance. Associated with very minor consequences or deterioration. Targets, limits, and thresholds of concern never exceeded. Species or habitats with negligible importance. No interventions or clean-up actions required. No complaints anticipated.
Very low +	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
Low +	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
Moderate +	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
High +	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
Very high +	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.

Table 5-2 presents definitions of the criteria used to determine the duration of the impact.

Table 5-2: Criteria used for determining the duration of the impact

Criteria	Description
Very short term	Less than a year or may be intermittent (less than 1 year). Quickly reversible.
Short term	Occurs for more than 1 but less than 5 years. Reversible over time.
Medium term	5 to 10 years.
Long term	Between 10 and 20 years. Likely to cease at the end of the operational life of the activity or because of natural processes or by human intervention.
Very long term/ permanent	+20 years. Irreversible. Beyond closure or where recovery is not possible either by natural processes or by human intervention.

Table 5-3 presents definitions of the criteria used to determine the extent of the impact.

Table 5-3: Criteria used for determining the extent of the impact

Criteria	Description
Site	A part of the site/property. Impact is limited to the immediate footprint of the activity and within a confined area.
Whole site	Whole site. Impact is confined to within the Project area and its nearby surroundings.
Beyond site	Beyond the site boundary, affecting immediate neighbours.
Local	Local area, extending far beyond site boundary.
Regional/ national	Regional/national. Impact may extend beyond district or regional boundaries with national implications.

Table 5-4 presents the matrices used for determining the consequence of the impact. The consequence is a product of the intensity (**Table 5-1**), duration (**Table 5-2**), and extent (**Table 5-3**) of the impact.

Table 5-4: Matrices used for determining the consequence of the impact

Duration	Extent				
	Site	**Whole site**	**Beyond the site**	**Local**	**Regional/ National**
Intensity: Very low					
Very long term / permanent	Low	Low	Medium	Medium	Medium
Long term	Very Low	Low	Low	Medium	Medium
Medium term	Very Low	Low	Low	Low	Medium
Short term	Very low	Very Low	Low	Low	Low
Very short term	Very low	Very Low	Very Low	Very Low	Low
Intensity: Low					
Very long term / permanent	Low	Medium	Medium	High	High
Long term	Low	Medium	Medium	Medium	High
Medium term	Low	Low	Medium	Medium	Medium
Short term	Very low	Low	Low	Medium	Medium
Very short term	Very low	Very low	Low	Low	Low
Intensity: Moderate					
Very long term / permanent	Medium	Medium	High	High	Very High
Long term	Low	Medium	Medium	High	High

Duration	Extent				
	Site	Whole site	Beyond the site	Local	Regional/ National
Medium term	Low	Medium	Medium	Medium	High
Short term	Low	Low	Medium	Medium	Medium
Very short term	Very low	Low	Low	Low	Medium
Intensity: High					
Very long term / permanent	Medium	High	High	Very High	Very High
Long term	Medium	Medium	High	High	Very High
Medium term	Low	Medium	Medium	High	High
Short term	Low	Medium	Medium	Medium	High
Very short term	Very low	Low	Low	Medium	Medium
Intensity: Very high					
Very long term / permanent	Medium	High	Very High	Very High	Very High
Long term	Medium	High	High	Very High	Very High
Medium term	Medium	Medium	High	High	Very High
Short term	Low	Medium	Medium	High	High
Very short term	Low	Low	Medium	Medium	Medium

Table 5-5 presents the matrix used to determine the significance or overall rating of the impact. The significance of the impact is a product of consequence (**Table 5-4**) and probability of the impact occurring. The interpretation of the significance of the impact is provided in **Table 5-6** below.

Table 5-5: Matrix used for determining the significance of the impact

Probability	Consequence				
	Very low	Low	Medium	High	Very high
Definite/ Continuous	Very Low	Low	Medium	High	Very High
Probable	Very Low	Low	Medium	High	Very High
Possible/ frequent	Very Low	Very Low	Low	Medium	High
Conceivable	Insignificant	Very Low	Low	Medium	High

Probability	Consequence				
	Very low	Low	Medium	High	Very high
Unlikely/ improbable	Insignificant	Insignificant	Very Low	Low	Medium

Table 5-6: Interpretation of the significance of the impact

Significance		Decision guideline
Very High	Very High +	Represents a key factor in decision-making. Adverse impact would be considered a potential fatal flaw unless mitigated to lower significance.
High	High +	These beneficial or adverse impacts are considered to be very important considerations and must have an influence on the decision. In the case of adverse impacts, substantial mitigation will be required.
Medium	Medium +	These beneficial or adverse impacts may be important but are not likely to be key decision-making factors. In the case of adverse impacts, mitigation will be required.
Low	Low +	These beneficial or adverse impacts are unlikely to have a real influence on the decision. In the case of adverse impacts, limited mitigation is likely to be required.
Very Low	Very Low +	These beneficial or adverse impacts will not have an influence on the decision. In the case of adverse impacts, mitigation is not required.
Insignificant		Inconsequential, not requiring any consideration.

5.2.1 Additional Assessment Criteria

Table 5-7 presents a description of the additional assessment criteria that were taken into consideration in the impact assessment process to further describe the impact and support the interpretation of significance in the impact assessment process.

Table 5-7: Description of additional assessment criteria

Criteria	Description
Degree to which the impact can be reversed	
Irreversible	Where the impact cannot be reversed and is permanent.
Partially reversible	Where the impact can be partially reversed and is temporary.
Fully reversible	Where the impact can be completely reversed.
Degree of to which the impact can be avoided	
None	Impact cannot be avoided and consideration should be given to compensation and offsets.
Low	Impact cannot be avoided but can be mitigated to acceptable levels through rehabilitation and restoration.
Medium	Impact cannot be avoided, but the significance can be reduced through mitigation measures.

Criteria	Description
High	Impact can be avoided through the implementation of preventative mitigation measures.
Degree to which the impact can be mitigated	
None	No mitigation is possible or mitigation even if applied would not change the impact.
Low	Some mitigation is possible but will have marginal effect in reducing the impact significance rating.
Medium	Mitigation is feasible and will may reduce the impact significance rating.
High	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the impact significance rating.
Potential for cumulative impacts	
Unlikely	Low likelihood of cumulative impacts arising.
Possible	Cumulative impacts with other activities or projects may arise.
Likely	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

6. SOCIO-ECONOMIC BASELINE

The proposed site is located near the town of Melmoth in the Mthonjaneni Local Municipality (LM) within the King Cetshwayo District Municipality (DM), previously uThungulu DM, in the northern coastal region of Kwa-Zulu Natal. The proposed site consists of a north block and a south block. The south block is located to the south of Melmoth Town and borders Nkandla DM to the southwest and uMlalazi DM to the southeast. The south block falls predominantly within Mthonjaneni LM ward 5 and intersects wards 6 and 8. The north block is located to the east of Melmoth Town and borders Ntambanana DM. The north block falls predominantly within Mthonjaneni LM Ward 3 and intersects Wards 1, 7, 9 and 10.

Melmoth Town is the primary node in the Mthonjaneni LM located along the R66/R34 road corridor. Melmoth Town is surrounded by rural activities. There are currently three Traditional Authority areas within the Mthonjaneni Municipality, namely Zulu-Entembeni, Obuka and Yanguye Traditional Authorities. All these Traditional Authority areas are solely owned by Ingonyama Trust.

Statistics South Africa[4] (StatsSA) provides a range of population descriptors from various collection instruments (i.e. 2011 census, the 2016 Community Survey and the 2019 General household survey etc.). StatsSA conducts a national census every 10 years, the census with latest available data is from 2011. The Community Survey is conducted between census years and its main objective is to provide municipal-level population and household statistics to the government and private sector. The 2016 Community Survey is the most recent large-scale survey with data available at a local municipality level.

[4] URL: www.statssa.com

Additionally, a quantitative household survey was undertaken by SLR and Nomad Consulting in September 2021 to gain an understanding of the community social baseline. The survey was conducted in the south block, in the area earmarked for resettlement based on the mine's current layout. The household questionnaire was administered to a random sample of households in targeted villages, 90 surveys were conducted.

The households to the south of the survey area, in the areas surrounding Dlozeyane Primary School and Gqokubukhosi High School, declined to partake in the survey. Therefore, no household surveys were conducted in the area.

6.1 DEMOGRAPHIC PROFILE

KwaZulu-Natal is the second most populated province in South Africa and has a large proportion of its population living in rural areas. The Project site will predominantly have an influence on rural areas. According the 2016 Community Survey 82% of households in King Cetshwayo DM live in rural geography types and 83% in Mthonjaneni LM. Both the King Cetshwayo DM and Mthonjaneni LM saw marginal annual growth rate in rural areas, 0.02% and 0.15% respectively (**Table 6-1**).

Table 6-1: Rural population distribution and annual growth between 2011 to 2016 (Census, 2011 and Community Survey, 2016)

Locality	Total population		Growth rate
	2011	2016	
King Cetshwayo DM	743,055	799,902	0.02
Mthonjaneni LM	40,003	70,628	0.15

During the survey process, information was gathered about 696 residents, of which 47% were male and 53% were female. **Figure 6-1** indicates a youthful population with 72% of residents under 35 years of age, and 36% of the population classified as children (<18 years old). This may be attributed to the lack of work opportunities in the area as 10% of household members work outside of the district and 77% of household members live in the homestead full time. This is consistent across the rural areas of the LM and DM where over 70% of the population is under 35 (**Figure 6-2**).

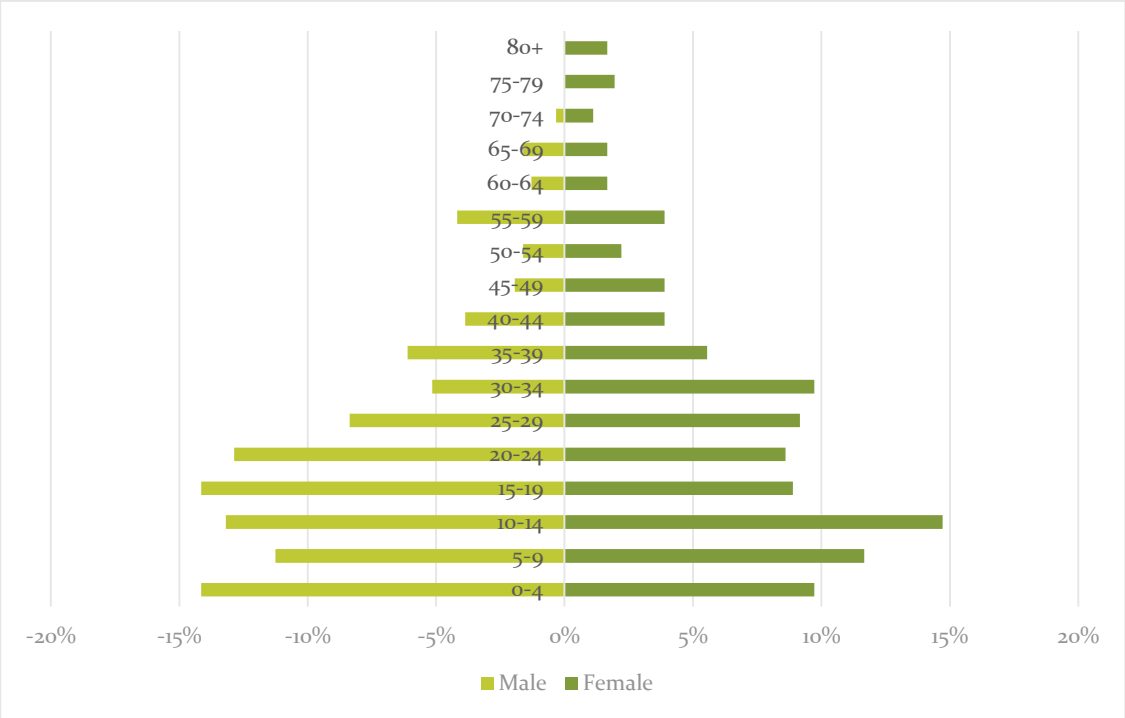

Figure 6-1: Population demographics of household members

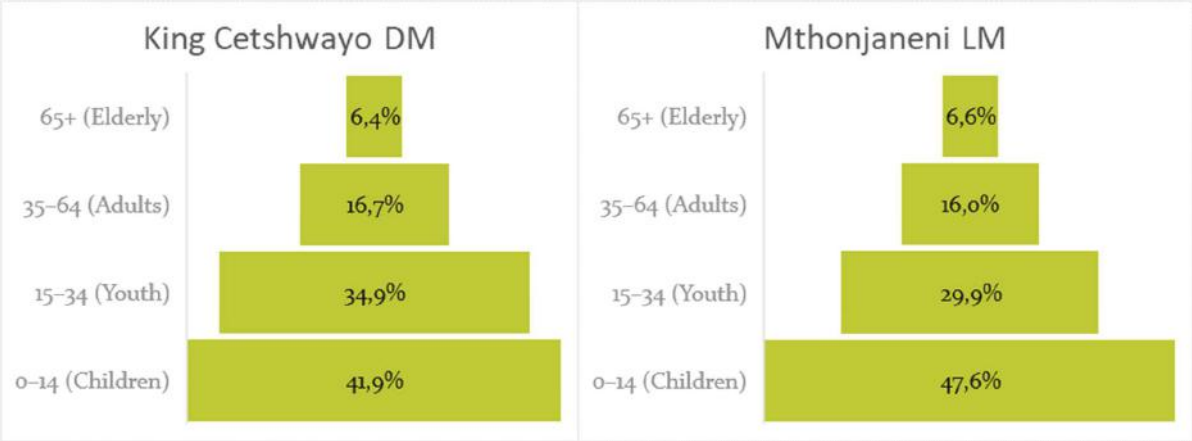

Figure 6-2: Broad age group distribution in rural areas of the DM and LM (Community Survey, 2016)

Homesteads house multiple generations and this leads to large household sizes. The average household size was 8 members. This is greater than average household size for in Mthonjaneni LM with 6 members. Majority of the households are female headed households (58%). This is consistent with the trends in rural areas of the Mthonjaneni LM and King Cetshwayo DM where over 60% of households were headed by females. In the survey area there are high levels of dependency on the household heads as 48% of household members were sons and daughters of the household head and 28% were grandchildren of the household head.

The survey found that 82% of residents grew up in the area and 76% of respondents indicated that they have lived on their plot for over 15 years. Only 5% of households have lived on their plots for less than 5 years. This indicates that households have deep rooted connections to the area and may find it difficult to

adapt to changes in residential location. Such a stable and entrenched community will have strong social ties and resettlement may disrupt the social support structures in the community.

The main land tenure status in the area is customary. The findings of the survey indicated the 90% of households have customary tenure with a verbal agreement while 10% of households have customary tenure with written permission to occupy.

6.2 EDUCATION

Education levels of the household members is low as shown in Table **6-2**. There is a large portion of the population with no formal education (32%) and only 30% of the household have attended school but did not complete high school. The low education levels of household members raise concerns around the vulnerability of households during the resettlement process and the information of presenting information in a clear and understandable way to local households.

The low levels of education are consistent across Mthonjaneni LM which has 76 public schools. The majority of people in the LM (38%) only have primary school education. In the Mthonjaneni LM 26% of people did not attend school. This is similar to figures found in the survey where 32% of household's members did not attend school (**Table 6-2**). Low education levels can be attributed to limited access to education in rural areas, particularly if students are required to travel great distances to schools. Low education levels can impact one's potential to have skills that are appropriate for the labour market.

Table 6-2: Highest level of education achieved of household members over 18

Highest level of education	%
No Formal Education	32%
Pre-School/Crèche (Grade R)	1%
Primary School (Grade 1 – Grade 7)	18%
High School (Grade 8 – Grade 9)	11%
High School (Grade 10 – Grade 12)	32%
Technical Certificate	4%
Tertiary/University/College	3%

School attendance is high with a 92% attendance rate. School attendance is similar for males and females, 46% to 54% respectively. Majority of children (51%) travel 30-60 minutes to school and 19% of children travel over an hour to school. Access to education can be a limiting factor to the attendance and completion of education. During the survey some interviewees indicated that reasons for children not attending school were that the schools are too far away and that the children were required to work in the household.

6.3 HEALTH AND NUTRITION

Table 6-3 shows the illnesses which households were affected by in the past six months. The most prevalent illness includes hypertension (26%) and Pneumonia (cough, fever and chest pains) (19%). None of the households indicated that they had household members with disabilities, however, there are instances of household members suffering with long-term illness such as hypertension and diabetes.

In terms to health care facilities, 78% of households are satisfied with the available health care facilities and for 82% of households this is their first action if someone gets sick. Transportation and distance to clinics was highlighted as a key challenge for health care facilities, at present 38% of households are 30-60 minutes from a health care facility and 47% are over an hour from a health care facility.

Table 6-3: Illnesses experienced by households in the past six months

Illness	Percentage
Hypertension (high blood pressure)	26%
Pneumonia (cough, fever and chest pains)	19%
Other Infections	9%
Diabetes (low / high sugar levels)	7%
Respiratory Illness	7%
Tuberculosis	6%
Epilepsy	4%
Injury from Interpersonal Violence	3%
Work Related Injury	3%
Heart Problems	2%
Kidney Problems	2%

There are no reliable statistics regarding health at a local municipal level, however, recent comprehensive data is available for the King Cetshwayo District from 2018/2019 District Health System Barometer (Health Systems Trust, 2020).

Figure 6-3 is recreated from the Health Systems Trust (2020) District Health Barometer 2018/2019 which derived the information from StatsSA and is for the reporting period 2013-2015. It provides information on percentage of death by broad cause for the King Cetshwayo DM.

Figure 6-3 highlights the following notable features:

- Communicable diseases together with maternal, perinatal and nutritional conditions account for the highest number of deaths in males (77%) and females (79%) for the age group under 1 year.
- Communicable diseases together with maternal, perinatal and nutritional conditions account for the highest number of deaths in males (48%) and females (45%) for the age group 1 – 4 years old.
- For ages 5 -14 years old, the percentages deaths for each category are evenly distributed in both males and females.
- 46% of female (aged 15 – 24 years old) deaths are linked to HIV and TB. While for males in this age group, a large proportion of deaths (57%) can be attributed to injures.
- A high number of deaths in the 25 – 49 age group are linked to HIV and TB in both males (50%) and females (56%).
- For the 50+ age group 74% of female deaths are linked to non-communicable disease and for males it is 62%.

Figure 6-3: Percentage of death by broad cause for males and female for both rural and urban areas in the King Cetshwayo District for reporting period 2013-2015 (Recreated from Health Systems Trust,2020)

*Communicable diseases together with maternal, perinatal and nutritional

**Noncommunicable diseases

Of the 90 households surveyed, 75% experienced hunger in the past year (**Figure 6-4**). On average households experienced hunger for three months of the year. The main reasons given for households going hungry were no money to buy food, natural calamities, Covid 19 lockdown and not enough labour to earn an income.

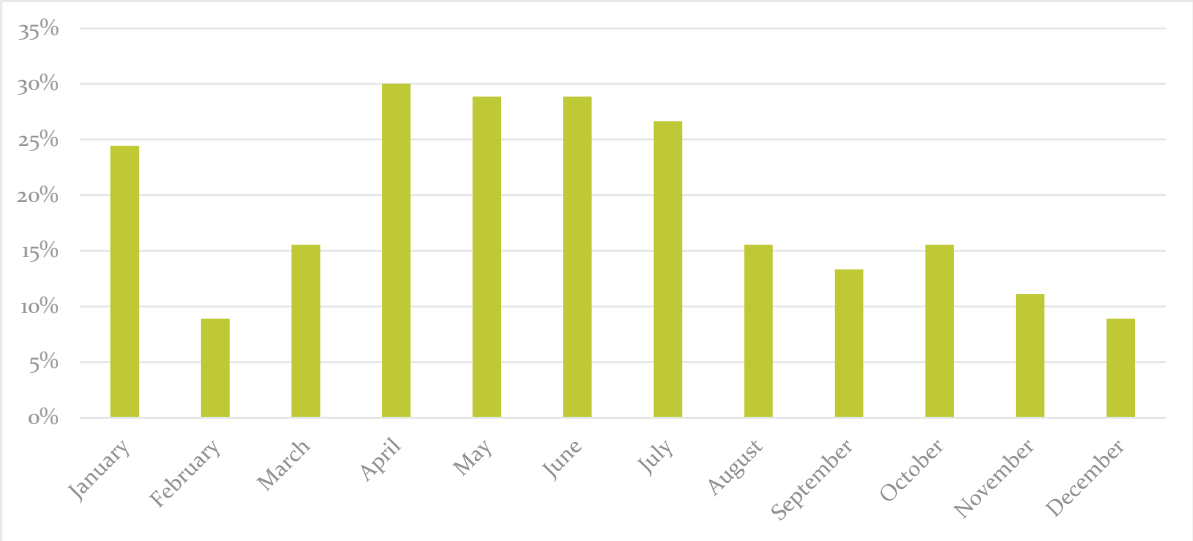

Figure 6-4: Months when households experienced hunger

It was found that 77% of households indicated that they consume meat once a week or more and 35% of households consume fish once a week or more (**Table 6-4**).

Table 6-4: Frequency that households consume meat and fish in their diet

Frequency	Meat	Fish
Daily	6%	1%
More than Once a Week	31%	13%
Once a Week	40%	21%
Once a Month	20%	42%
Never	1%	19%

6.4 HOUSING AND BASIC SERVICES

6.4.1 Structures

Within the survey area, on the land earmarked for the Project, there are approximately 221 homesteads with 1420 structures which will potentially be displaced according to the current project design. These figures are based on a desktop study conducted by Nomad Consulting in 2021.

Of the 90 households surveyed, there were a total of 370 structures. The average number of structures per household was four. The homesteads generally consist of many one room structures used for a single purpose, mostly commonly sleeping only buildings. Only half of respondents have multi-purpose structures in their homestead. It was found that 59% of structures were built with bricks/ concrete blocks and 38% of structures were constructed with natural building materials. Majority of households are involved in some form of subsistence livestock farming, 64% of households have a livestock enclosure on their homestead and 57% have a poultry enclosure on their homestead.

6.4.2 Basic Services

Access to services is a key social service and can often provide an indication of a community's social well-being. There are several indicators that can provide an understanding of service delivery at a local municipal level, such as water, removal of waste and energy sources

The survey area is a rural area with traditional homesteads and all the access roads to homesteads are dirt roads. The dirt roads are in moderate condition but access to areas can become limited during rains.

In terms of access to electricity 99% of households use electricity as their source for lighting and 73% of households use it as their main source for cooking (**Table 6-5**). There is large portion of households, 21%, that are reliant on wood as their main source of fuel for cooking. This can indicate a reliance of harvesting natural resources as a cheaper source of fuel for household use.

Figures for the surveyed households using electricity as their main fuel source for lighting were similar to the Mthonjaneni LM (over 90% of households). While, in terms of main source of fuel for cooking, the survey area is less reliant on wood as a source of energy than the LM with 42% of households using wood in the LM compared to 21% in the survey area. This could indicate that households in the study area have a more money available to buy electricity.

Table 6-5: Household main fuel source

Fuel Source	Lighting	Cooking
Electricity	99%	73%
Gas	-	6%
Wood	-	21%
Other	1%	-

Majority of households have access to drinking water from a tap inside their yard (76%). Other common practises include collecting drinking water from a river/stream (9%) and using water from rainwater tanks (8%) (**Table 6-6**). This indicates that three quarters of the households surveyed have access to a reliable clean water source near their homestead. The study area has better access to water within the yard than the Mthonjaneni LM where only 44% of households have piped water in their yard.

Table 6-6: Household source of drinking water

Drinking Water Source	Percentage
Tap Inside Yard	76%
Tap Inside House	1%
River / Stream	9%
Rainwater Tank	8%
Water Tanker	3%
Spring	2%

Sanitation practises vary amongst the households. As shown in **Table 6-7**, the most common toilets system used by households are pit latrines (60%) and chemical toilet (31%). This is consistent with the Mthonjaneni LM with 65% of households using pit latrines.

Table 6-7: Household sanitation practises

Toilet System	Percentage
Bucket Toilet	3%
Chemical Toilet	31%
Flush Toilet	2%
Pit Latrine (with ventilation)	58%
Pit Latrine (without ventilation)	2%
None (Use Bush/Forest)	3%

There is a lack of waste removal services in the area with 90% of households discarding their waste in the bush (**Table 6-8**). This may be due to the isolated nature of the area and the poor quality of access roads. This is consistent with trends found in the King Cetshwayo DM and Mthonjaneni LM, with over 80% of households utilizing a personal refuse dump. This indicates that municipal waste collection is limited throughout the district. The provision of municipal waste collection in rural areas can be challenging due to the isolation and geography of households. This raises increased health and environmental risks for nearby communities. This is particularly problematic where accumulation of waste occurs at poorly managed waste sites, spilling over into surround areas and causing hazardous conditions.

Table 6-8: Household waste disposal practises

Waste Disposal	Percentage
Throw away in Bush	90%
Dig a hole and burn	8%
Private Refuse Dump	2%

6.5 LIVELIHOODS

6.5.1 Employment

Unemployment and underemployment are chronic issues in South Africa. Statistics available for rural areas of KwaZulu Natal indicated that narrow unemployment rate is 16,7% (Quarterly Labour Survey, Q1 2021), which is on par with the national average for rural areas. The top three employment industries in the KZN Non-Metro rural areas are: social and personal services (29,1%), wholesale and retail trade (20%) and agriculture (14%) (Quarterly Labour Survey, Q1 2021). The informal section employed roughly 36% of people.

There are low levels of employment amongst household's members in the survey area, with over 50% of household members either unemployed, not engaged in an economic activity or a discouraged work-seeker (**Table 6-9**). Unemployment plays a key role in local social challenges. Unemployment is inextricably linked

to poverty, and fruitless job seeking can lead to despondency, depression and various associated social ills such as alcoholism and drug abuse, domestic violence and high-risk sexual behaviour.

Table 6-9: Household members employment status

Employment Status	Percentage
Employed	35%
Unemployed	49%
Discouraged Work-Seeker	3%
Not Economically Active	1%
Other	13%

There is a high level of dependency on social grants by the households which is as expected given the high levels of unemployment. From the survey it was found that 66% of households receive child grants and 44% receive pension/ old age grants (**Figure 6-5**). Only 29% of households received a monthly income from formal employment (government or private) and 14% of households receive an income from employment as casual labour. A small number of households (7%) that earn an income from the sale of agricultural goods.

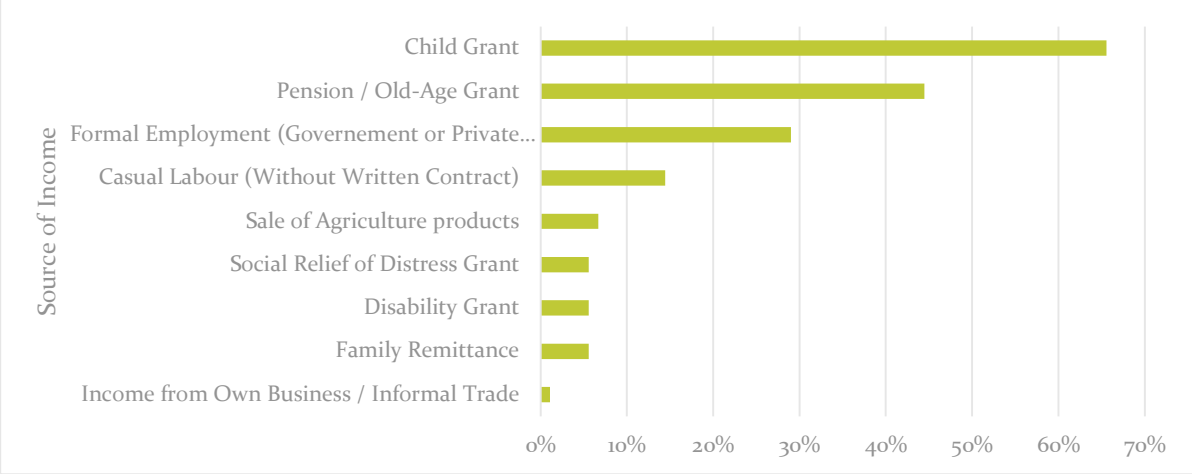

Figure 6-5: Household sources of income

*Multiple responses allowed

The average household income is R4400, however, most households earn between R1000 and R 3000 per month. It was found that 82% of households earn less than R10000 a month (**Figure 6-6**). The average amount spent per household is R2200 and it was found that majority of households (83%) are spending less money than they bring in a month. The most frequent responses to what the households spend their money include: food, personal items, household energy, and transport. Only 6% of households indicate that they are making monthly contributions to a savings.

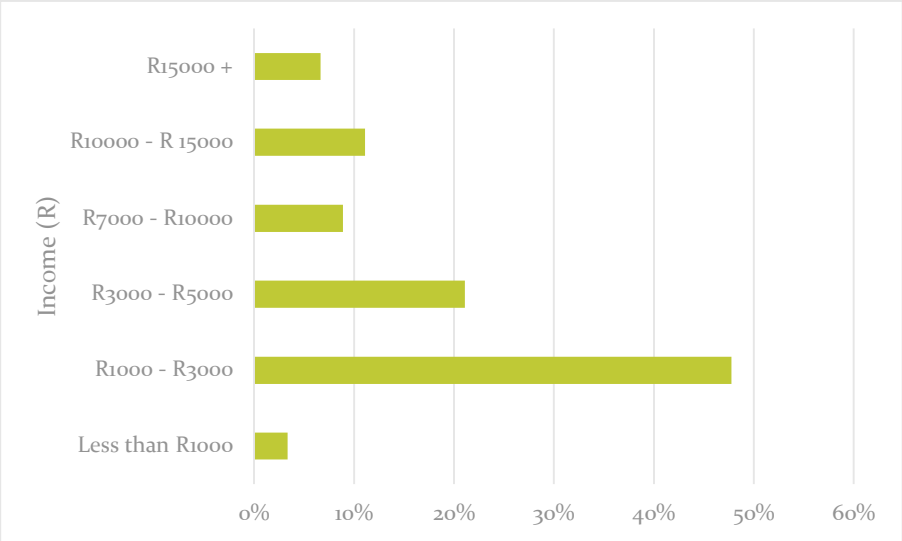

Figure 6-6: Household income category

6.5.2 Agriculture and Natural Resources

Findings from the survey show that 96% of households have access to fields. The households are involved in subsistence agriculture as majority of households consume the food they grow. On average a household has access to two fields. Ownership by the households of the fields is as follows: 68% private, 28% trust land and 3% sharecropping. The most frequently planted crops include maize (54%), amadumbe (24%) and various other vegetables such as beans and pumpkin.

The survey found that 86% of households own livestock. The households most frequently owned chickens (77%), cattle (49%) and goats (48%). The average size of the livestock herds owned by a household is shown in (**Table 6-10**).

Table 6-10: Average herd size of livestock

Livestock	Average herd size (heads)
Cattle	6
Chickens	14
Goats	8
Other (Specify)	1

The households collect and utilize various natural resources for personal use from the areas surrounding as shown in **Table 6-11**. The most commonly used resources include wood (57%) which is used by the households for cooking, and sand (22%) and grass (21%) which is used for the construction of buildings.

Table 6-11 Natural resources use by the households

Resource Collection	Percentage
Firewood	57%
Collecting Sand for Construction	22%

Resource Collection	Percentage
Collecting Grass for Thatching	21%
Collecting Wood for Carpentry	18%
Collecting Medicinal Plants	16%
Collecting Wood for Artisanal Items	14%
Hunting Animals and Birds	11%
Collecting Wild Fruit and Vegetables	9%
Fish	7%
Grazing Land for Livestock	6%

6.6 COMMUNITY FACILITIES

There are two schools in the survey area, Dlozeyane Primary School and Gqokubukhosi High School. The principal of Dlozeyane Primary School was not available for an interview while the principal of Gqokubukhosi High School was interviewed in October 2021. The following information was gathered regarding Gqokubukhosi High School:

Gqokubukhosi High School caters for Grade 8 -12 and has 150 students, male and female. The catchment area for the school is from the surrounding areas with students traveling approximately 30 – 60 minutes. The school employs six teachers, two cleaners, two staff for food preparation and one principal. In terms of facilities the school has six classrooms, an admin block with six rooms, one staff cottage with four rooms which is currently used for food preparations, two ablutions buildings and 8 pit latrines. The buildings are made of brick and the only the admin block has electricity. The school has one water tank, and the classrooms are equipped with blackboards and desks/ tables. The school provides lunches to the students through a government backed feeding scheme.

6.7 VULNERABLE GROUPS

Vulnerable persons identified during the study are outlined below:

- **Elderly headed households** (without another breadwinner in the household): Households that are headed by the elderly or households solely comprised of elderly with limited or no support from economically active mature adults (aged between 21 and 65 years of age). The elderly are particularly vulnerable because they often lack the physical capacity to support relocation or benefit from livelihood restoration opportunities. Twenty-two (22%) of surveyed households were headed by an older adult; considered 65 years and above but have other younger members able to contribute to the household's livelihood. Three elderly headed households are considered vulnerable as they have no younger household members (but over 21 years of age) able to contribute to the household's livelihood.
- **Female-headed households**: Female-headed or female exclusive households are likely to be disadvantaged from gender discrimination with respect to the ownership of land, as well as limit their ability to be engaged in the resettlement process or make decisions in the interest of their families. In the household survey, majority of the households interviewed are female headed (58%).
- During the household survey it was found that the **education levels of household members is low**. There is a large portion of the population with no formal education (32%) and only 30% of the

household have attended school but did not complete high school. The low education levels of household members raise concerns around the vulnerability of households during the resettlement process and information needs to be passed on in a clear and understandable way to the households.

7. HEALTH IMPACT ASSESSMENT

In the following sections, key Project impacts are considered for their potential health implications for the local community. The Project impacts considered are:

- Displacement and resettlement
- Changing farming practices, market options and sources of nutrition
- Increased employment
- Influx of newcomers
- Increased traffic
- Increased ambient particulates and dust fallout
- Groundwater contamination
- Groundwater drawdown
- Flooding of mining infrastructure
- Increased exposure to vector-borne and zoonotic disease
- Changes in access to healthcare.

A significance assessment of the health implications of each of these Project impacts now follows.

7.1 DISPLACEMENT AND RESETTLEMENT

A 500 m infrastructure buffer is assumed should the project proceed. A Resettlement Action Plan will finalise the impacted areas requiring resettlement of the local community. The psychosocial and socioeconomic impacts of displacement and resettlement fall under the *SDH* HRA, with the potential to also impact on access to traditional health services (*cultural health practices* HRA) and local farming practices (*food and nutrition related issues* HRA). Findings from the survey show that 96% of households have access to fields (see **Section 6.5.2**). The loss of access to agricultural land would have significant implications for local nutrition (see **Section 7.2**). There is the potential loss of existing health care facilities on the proposed Project site, impacting on local access to health care (*health services infrastructure and capacity* HRA).

While it is assumed that the upheaval of displacement and resettlement is negative, ultimately the impact may be positive for many of those resettled and compensated once settled in alternative living arrangements, with re-established social and community networks, and/or economically recovered.

The intensity of the impact of displacement is considered very high, but moderate if effectively and sensitively mitigated. The period of intense upheaval is considered medium term, with recovery occurring over time with prompt and effective resettlement or compensation. Supplementary assistance must be made available such that recovery does not extend beyond the short term, with particular focus on vulnerable households (e.g. elderly headed households, female headed households) and cognisance that low education levels in the community can be a barrier to engagement with the resettlement process. The extent of impact is considered local.

While displacement is an unavoidable consequence of the Project, the potential health impacts associated with displacement can be mitigated through effective resettlement and compensation. Careful planning in advance of resettlement will mean that many of the consequences are avoided, while others that are initially unavoidable (e.g. breakdown of social cohesion) can be mitigated. The effectiveness of livelihood restoration measures must be closely monitored. Corrective action must be taken should it be found that affected persons are unable to recover their pre-project lifestyles, standard of living and general quality of life within a reasonable time period (i.e. within the short term of one to five years). While negative impacts are probable under the unmitigated scenario, they are significantly less likely under the mitigated scenario. There is a low likelihood of cumulative impacts arising as there are no other projects identified in the vicinity requiring resettlement.

Table 7-1: Significance assessment of health implications of displacement/resettlement

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative (the mitigated impact may be positive for some but the potential for negative impacts remains)	
Phases of Project	Planning	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High -	Moderate -
Duration	Medium term	Short term
Extent	Local	Local
Consequence	High -	Medium -
Probability	Probable	Conceivable
Significance	High	Low
Degree to which impact can be reversed	Fully reversible	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	High	
Extent to which a cumulative impact may arise	Unlikely	

7.2 CHANGING FARMING PRACTICES, MARKET OPTIONS AND SOURCES OF NUTRITION

The loss of farmland and the increased opportunity for employment on the mine is likely to cause a shift in the local community away from subsistence agriculture towards a greater reliance on purchased food products. This can have various implications on diet (*food and nutrition related issues* HRA) and economic security (*SDH* HRA):

- An influx of people during the construction and operational phases of the proposed Project may result in food inflation, increasing food deprivation for the poorest, and nutrition-related diseases. If long-term food inflation occurs, food deprivation will disproportionally impact susceptible sub-populations such as the children and marginalised groups.
- Poor food hygiene practices associated with mass handling of food may also increase food-related illnesses (as opposed to in household food preparation practices on a small scale).
- Consumption of fast food related to increased income may increase non-communicable (lifestyle) diseases such as obesity and diabetes.
- Some positives associated with the shift away from subsistence diets includes decreased vulnerability to weather-related crop production variabilities, the potential for a greater diversity in the diet through food purchases, and greater efficiencies in access to food in general and semi-prepared and even prepared meals increases the time available in the household for other practices.
- However, a shift towards purchased diets may mean that homesteads cease to maintain vegetable gardens or keep animals, which means that when there are shocks to household income, these resources are not available to fall back on for food supply. Of the 90 households surveyed, 75% experienced hunger in the past year. On average households experienced hunger for three months of the year (see **Section 6.3**).
- Another positive is that there may be increased opportunity for some farmers to sell their produce to construction workers and mine workers during the operational phase, and potentially increased access to markets through improved road infrastructure. While economic benefits are obvious, there is an extensive literature base that highlights that increased market access for subsistence farmers does not automatically have positive socio-economic impacts.

The intensity of these impacts is considered high because there are significant health implications of changing diets and greater reliance on shop-bought goods. Changes in diet and lifestyle can be permanent if communities shift away from traditional lifestyles and subsistence agricultural practices. Health impacts of poor nutrition are considered only partially reversible through long-term improvements in diet. Children, for example, can experience developmental problems with poor diet with implications for the rest of their lives. Other factors may contribute negatively to local diets (e.g. weakening traditions and cultural practices, increased exposure to mass media, changing preferences in the youth) so results are considered potentially cumulative.

These impacts can be mitigated by:

- Compensation for loss of agricultural land through provision of alternative fields or financial compensation.
- Liaison with local supermarkets to curb food inflation during the construction phase,
- Provision of sanitation awareness materials to local district environmental health officers for educational sessions with slaughterhouse, food handlers and vendors.

- Education on lifestyle behaviours including eating habits, exercise, etc. Supply of educational materials for use in local clinics, with cognizance of the low levels of education in the community (see **Section 6.2**).
- Food security and childhood nutritional status can be improved through school feeding programmes, and education on food gardens, nutrition, and good nutritional habits.
- Engagement with charity organisations such as Gift of the Givers to establish a plan of action should there be critical food shortages in the region.

Table 7-2: Significance assessment of health implications of changing farming practices, market options and sources of nutrition

Description of Impact		
Type of Impact	Direct impacts on farming, indirect impacts on food choices and nutrition	
Nature of Impact	Negative (the mitigated impact may be positive for some but the potential for negative impacts remains)	
Phases of Project	Planning, Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High -	Moderate -
Duration	Permanent	Permanent
Extent	Local	Local
Consequence	Very High -	High -
Probability	Probable	Possible
Significance	Very high -	Medium -
Degree to which impact can be reversed	Partially reversible	
Degree to which impact can be avoided	Medium	
Degree to which impact can be mitigated	Medium	
Extent to which a cumulative impact may arise	Possible	

7.3 INCREASED EMPLOYMENT

Income and employment are key drivers of quality of life. Jobs in the mining industry are considered well-paid and have the potential to uplift a region. High income and employment generally mean higher living standards, which allow people to fulfil their own ambitions and develop skills and abilities.

It is expected that employment rates will increase with the proposed mine prioritising employment of local communities. Employment levels have implications for the *SDH* HRA. The Household Survey indicated low levels of employment amongst household members in the survey area, with only 35% of residents indicating that they were employed. There are high levels of unemployment with over 50% of household members either unemployed, not engaged in an economic activity or a discouraged work-seeker (see **Section 6.5**). Unemployment plays a key role in local social challenges. Unemployment is inextricably linked to poverty, and fruitless job seeking can lead to despondency, depression and various associated social ills such as alcoholism and drug abuse, domestic violence and high-risk sexual behaviour. As such, one can expect an overall improvement in these factors associated with increased employment. Employment within a household also decreases dependency on subsistence agriculture for household nutrition and thus decreases vulnerability to weather-related crop production variabilities.

The positive health implications of increased employment are likely to be seen during the construction and operational phases (i.e. long term). The intensity of the positive is considered high because the benefits of increased household income will be experienced by a number of household members. The average household size was found to be high, specifically 8 members, in the Household Survey (refer to **Section 6.1**). Other economic developments in the region over the LOM should decrease the negative impacts of mine closure on local employment rates. The positive impacts are considered probable, dependent on the mine prioritising local employment over employing outsiders.

Although the overall benefits of increased employment are expected to be positive, it is naïve to not consider potential negative impacts on SDH. There is the potential for inequalities to be created through mining employment, not only for mine workers versus the unemployed, and for mine workers and the non-mining workforce, but also for other population subgroups, such as locals versus newcomers, men versus women, and those living closing to the mine versus further away. Gender inequalities in mining communities are a key concern, with women generally not benefitting equally from local opportunities linked to mining, and the potential for mining developments to widen the gender gap.

Opportunities to enhance the employment benefits locally include:

- Upskilling of the local community through educational and vocational opportunities for both mining employees and the general community.
- To address inequalities between the mining and non-mining workforce, the mine can develop a policy of local procurement of goods and services, and can insist that local service providers employ locally and use local products when reasonable,
- Gender sensitive policies that incorporate an awareness of the unequal employment opportunities for men in mining, and thus favouring employment of women where appropriate.

Table 7-3: Significance assessment of health implications of increased employment

Description of Impact

Type of Impact	Direct	
Nature of Impact	Positive	
Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High +	NA
Duration	Long term	NA
Extent	Local	NA
Consequence	High +	NA
Probability	Probable	NA
Significance	High +	NA
Degree to which impact can be reversed	NA	
Degree to which impact can be avoided	NA	
Degree to which impact can be mitigated	NA	
Extent to which a cumulative impact may arise	Possible	

7.4 INFLUX OF NEWCOMERS

Newcomers are expected in the region with the commencement of the construction phase to work on the development of the mine and associated infrastructure. Workers will also be attracted to the region during the operational phase, including migrant workers whose families are based in other regions, provinces or states. There are various health implications for the influx of outsiders to the region that impacts on various HRAs:

- The increased demand for community housing (*housing and communicable diseases* HRA), food (*food and nutrition related issues* HRA), medical services (*health services infrastructure and capacity* HRA), water, sanitation and waste services (*soil, water, sanitation and waste related issues* HRA) can result in existing health needs going unmet and new health challenges arising.
- Higher population densities mean communicable diseases, such as TB, are transmitted more easily (*housing and communicable diseases* HRA). Communicable diseases are a significant cause of death across age groups, but particularly under the age of 50 in the local community. Communicable diseases together with maternal, perinatal and nutritional conditions account for the highest number of deaths in males (77%) and females (79%) for the age group under 1 year (see **Section 6.3**)

- Migrant workers separated from their partners may result in the spread of sexually transmitted diseases, including HIV, through unsafe sexual practices, e.g. increased prostitution (*sexually transmitted infections* HRA, *SDH* HRA).
- It is difficult to speculate whether the prevalence of tobacco smoking, drinking and/or drug abuse will increase due to the proposed Project. It is likely that it will increase as there will be an increase in the number of young people earning an income with greater access and exposure to these commodities with the influx of newcomers (*exposure to potentially hazardous materials* HRA, *SDH* HRA).
- Smoking exacerbates cardiovascular and respiratory diseases (*non-communicable disease* HRA). Non-communicable diseases are a significant cause of death for the 50+ age group in the local community (see **Section 6.3**).
- Increased substance abuse is associated with increased levels of violence and domestic abuse (*SDH* HRA, *accidents/injuries* HRA)
- There may be some positives associated with increased newcomers, such as increased cultural diversity, introductions to new experiences and cultural practices e.g. cuisine and music (*SDH* HRA).

The intensity of these impacts is considered high because there are significant health implications of increased population densities and exposure to newcomers. Some of the health implications can be permanent and irreversible, e.g. infection by HIV, health impacts of a dependency on hard drugs. Although the influx of people to the Project area is considered unavoidable, there are various opportunities to avoid some potential impacts and mitigate others. Since there are not any other significant local developments attracting newcomers, the impacts are not considered cumulative.

These impacts can be mitigated by:

- Ensuring there is sufficient housing and services for the influx of workers.
- Provision of health services to workers and financial support for health services for the larger community to promote health and early detection and quarantine of communicable diseases.
- Education on safe sexual behaviours and lifestyle choices with respect to smoking, alcohol and drug use. Supply of educational materials for use in local clinics, with cognizance of the low levels of education in the community (see **Section 6.2**).
- Financial support for sports fields, sports clubs and exercise facilities to encourage a healthy lifestyle and provide alternative activities to drinking and drug abuse.
- Financial support for rehabilitation facilities for alcohol and drug abuse.
- Financial support for centres that support victims of violence and domestic abuse.

Table 7-4: Significance assessment of health implications of increased influx of newcomers

Description of Impact	
Type of Impact	Direct (influx of workers and their families), indirect (influx of those attracted to new opportunities, services or facilities in the area)
Nature of Impact	Negative (the mitigated impact may be positive for some but the potential for negative impacts remains)

Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High -	Moderate -
Duration	Permanent	Permanent
Extent	Local	Local
Consequence	Very High -	High -
Probability	Probable	Possible
Significance	Very High -	Medium -
Degree to which impact can be reversed	Partially reversible	
Degree to which impact can be avoided	Medium	
Degree to which impact can be mitigated	Medium	
Extent to which a cumulative impact may arise	Unlikely	

7.5 INCREASED TRAFFIC

The proposed Project may lead to increased traffic loads on primary and access roads and has thus the potential to increase the number of vehicular and pedestrian accidents (*accident/injuries* HRA). Increased traffic also results in increased exhaust emissions of ambient air pollution (*exposure to potentially hazardous material* HRA).

Since a collision between a large haulage truck and a pedestrian can result in severe injury or death, the intensity of the impact is considered very high and irreversible. The intensity of accidents decreases with lower speeds, and the probability of accidents occurring is lower. The duration of the impact is long term (the operational life of the mine, LoM). The increase in vehicular traffic will be experienced most intensely locally. The impact can be avoided through effective mitigation measures. Since there are not any other significant local developments attracting haulage trucks the impacts are not considered cumulative.

These impacts can be mitigated by:

- Speed control measures and effective enforcement.
- Maintenance of mining-related vehicles to prevent tyre blow-outs and other dangerous occurrences.
- Clearly demarcated safe crossing areas. Barriers preventing crossings in high accident zones.
- Effective road signage.
- Education on road safety to community generally and in schools.

One potential positive impact of increased traffic is the greater opportunity for lifts for locals, and the greater population increasing the feasibility of running taxis, and thus fewer individuals walking long distances with the associated potential for pedestrian accidents. There is also increased opportunity for communities to access healthcare facilities at a distance. Transportation and distance to clinics was highlighted as a key challenge in the household survey, with 38% of households indicating they were 30-60 minutes from a health care facility and 47% over an hour from a health care facility (see **Section 6.3**).

Table 7-5: Significance assessment of health implications of increased traffic

Description of Impact		
Type of Impact	Direct (mine-related workers and vehicles) and indirect (traffic associated with general influx of newcomers)	
Nature of Impact	Negative (the mitigated impact may be positive for some but the potential for negative impacts remains)	
Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Very high -	High -
Duration	Long term	Long term
Extent	Local	Local
Consequence	Very high -	High -
Probability	Possible	Conceivable
Significance	High -	Medium -
Degree to which impact can be reversed	Potentially irreversible.	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	High	
Extent to which a cumulative impact may arise	Unlikely	

7.6 INCREASED AMBIENT PARTICULATES AND DUST FALLOUT

Particulate emissions have the potential to impact directly on human health through inhalation, and have nuisance impacts through dust fallout and soiling (*exposure to potentially hazardous material* HRA).

Particulate emissions will occur during the construction and operational phases of the Project as assessed by WKC (2023) in an Air Quality Impact Assessment for the Project.

7.6.1 Construction Phase

During construction, key sources of dust will include earth working onsite, exposed areas, construction activities (e.g. heavy machinery, vehicles idling) and the transport of materials and personnel on and offsite. The construction site will be located at a minimum of 500 m away from the community members and this buffer will limit the intensity of impacts associated with construction activities. However, construction vehicles are likely to use the access roads in the vicinity of the mine, where it is assumed, based on observations from the most recent Google Earth imagery, that there will be more than 100 receptors located within 50 m of the construction and access roads. Here the intensity of impact is expected to be high (unmitigated) and moderate (mitigated) but of short duration (limited to the construction phase) and will occur frequently (when a vehicle passes by). This results in a low significance of impact (unmitigated and mitigated).

While some health impacts of exposure to dust are reversible, intense and/or chronic exposure can result in irreversible (permanent) damage to the respiratory system. There is significant potential to avoid and mitigate impacts. There is a low likelihood of cumulative impacts arising as no other mining activities/dusty activities occur in the vicinity.

The mitigation measures recommended by WKC include:

- Hard surfacing the main mine access road.
- Wet suppression of stockpiles when necessary (including wind shielding, storage away from site boundaries, and restricted height of stockpiles).
- Restricting vehicle speeds on haulage routes and other unsurfaced areas of the site.
- Ensuring that vehicles carrying dry soil and other materials are covered during travel.
- Best practices adopted to control emissions from loading and dumping material include water application, minimisation of drop heights and suspension or modification of activities during adverse weather conditions.
- Increase frequency of site inspections by the responsible person for air quality and dust issues on site when activities with a high potential to produce dust are being carried out.
- Restrict vehicle access to defined areas to avoid unnecessary off-road vehicle movements outside of the active work sites.
- Implement methods of reducing wind speed around potentially dusty activities or areas. Early planting of site perimeter areas with native tree species, and / or the strategic use of ‘snow fencing’ will potentially reduce wind speed across the site.
- Display details of responsible person for air quality and dust issues at the site boundary.

For effective mitigation, the following monitoring is recommended:

- Daily inspection to ascertain the need for wet suppression and its subsequent implementation.
- Grading activities should be monitored on a daily basis.
- Weekly inspection of unsurfaced haulage routes. Daily inspection should be undertaken during particularly dry periods to determine the need for wet suppression.

Table 7-6: Significance assessment of health implications of exposure to construction-related particulates

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases of Project	Construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High - (adjacent to access roads)	Moderate - (adjacent to access roads)
Duration	Short term	Short term
Extent	Local	Local
Consequence	Medium -	Medium -
Probability	Frequent	Frequent
Significance	Low -	Low -
Degree to which impact can be reversed	Potentially irreversible	
Degree to which impact can be avoided	Medium	
Degree to which impact can be mitigated	High	
Extent to which a cumulative impact may arise	Unlikely	

7.6.2 Operational Phase

During the operational phase key sources of particulates will include ore handling and processing, blasting, dust entrainment by vehicles on unpaved roads and surfaces, and wind erosion of exposed areas. The atmospheric dispersion modelling by WKC (2023) indicated exceedances of the long- and short-term national ambient air quality standards (NAAQS) at various sensitive receptors, with associated potential impacts on human health.

While some health impacts of exposure to dust are reversible, intense and/or chronic exposure can result in irreversible (permanent) damage to the respiratory system. There is significant potential to avoid and mitigate impacts. There is a low likelihood of cumulative impacts arising as no other mining activities/dusty activities occur in the vicinity.

The mitigation measures recommended by WKC:

- Establish exact boundaries for any proposed resettlement activities, as this may overlap with receptors associated with high impact significance.
- Preparation of a dust management plan as part of the Project Environmental Management Programme (EMPr).
- Addition of surfactants and dust suppressants when watering, specifically in working areas close to the Project boundaries.
- Large trees and thick indigenous vegetation to be established along the Project boundary (in consultation with the Project ecologist) to reduce wind speeds and provide visual buffer between mining activities and community.
- Reduce vehicle speeds to 30 km/hr or below on all internal haul routes and roads.
- Utilise chutes at material handling transfer points.
- While the processing plant will be enclosed, all bag filters on extraction points should be designed for 30 mg/Nm^3.
- Ensure that vehicles carrying dry soil and other materials are covered during travel.
- Cover the surface of haul routes with less erodible aggregate material such as compacted and treated crusher run / aggregate.

The following monitoring is recommended:

- Install at least two continuous analysers (for PM_{10} and $PM_{2.5}$) at the Project boundary (or at other suitable locations such as homesteads), one upwind and one downwind.
- Install dust fallout gauges at a minimum of eight locations (principal wind directions) with monitoring commencing at least one year before the construction commences and continuing through the operational phase.
- Implement a community engagement and complaints / grievance mechanism.

There is a low likelihood of cumulative impacts arising as no other mining activities/ other dusty activities occur in the vicinity.

Table 7-7: Significance assessment of health implications of exposure to operation-related particulates

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases of Project	Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High -	Low -
Duration	Long term	Long term
Extent	Local	Local
Consequence	High -	Medium -
Probability	Probable	Probable

Significance	High -	Medium -
Degree to which impact can be reversed	Potentially irreversible	
Degree to which impact can be avoided	Medium	
Degree to which impact can be mitigated	High	
Extent to which a cumulative impact may arise	Unlikely	

7.7 GROUNDWATER CONTAMINATION

SLR (2023)[5] conducted a geohydrological assessment for the Project. The objective of the study was to characterise the current groundwater conditions in the study area and determine the expected impacts on the groundwater resources should the mining project commence. Exposure to contaminated water falls under the *exposure to potentially hazardous material* HRA.

The source term characterisation of the WRD indicated that seepage emanating from the WRD during the operational phase would not have any potential contaminants of concern and concentrations of macro- and micro-elements are not expected to exceed drinking water quality guidelines. As such no significant water quality issues are expected in proximity of the WRD as a consequence of seepage from the facility.

Generally, the health impacts of exposure to water contaminants are reversible, but it is recognised that high intensity and/or chronic exposure can result in irreversible health impacts, e.g. organ damage. The degree to which impacts can be avoided is high through the use of liners. Cumulative impacts are likely due to the separate project application for the TSF.

The mitigation measures recommended in SLR's (2023)[6] geohydrological assessment include:

- Water quality monitoring for the pit area (pit and WRD) to establish baseline.
- Monthly water quality monitoring at recommended borehole network.
- Rehabilitation of the WRD post mining.
- Post-mining monitoring to be conducted.

Table 7-8: Significance assessment of health implications of groundwater contamination

Description of Impact	
Type of Impact	Direct

[5] SLR (2023). *Geohydrological Assessment Report: Jindal Iron Ore (Pty) Ltd, Melmoth, KZN*. SLR Report no. 720.100023.00001
[6] *Ibid.*

Nature of Impact	Negative	
Phases of Project	Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low -	Very low -
Duration	Long term	Long term
Extent	Local	Local
Consequence	Medium -	Medium -
Probability	Continuous	Continuous
Significance	Medium -	Medium -
Degree to which impact can be reversed	Reversible (due to low intensity)	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	High	
Extent to which a cumulative impact may arise	Likely	

7.8 GROUNDWATER DRAWDOWN

Mining will create a cone of depression around the mining pit which will result in drawdown in water levels on farms adjacent to the mining area. Where drawdown exceeds 5 m, water users may observe a decline in yield in water supply boreholes. These farms include: Ntembeni 16921, Kromdraai 6110, Lot No 5 1038, Lot No 5 10383 GU, Lot 7 Umhlatuzi 10870, Lot 9 Umhlatuzi 10872, Hillcrest 15900, Loudwaters 11258, Lot 8 Umhlatuzi 10871, Maranqapawlu 15351.

The impacts on health of reduced access to borehole water supply are considered potentially irreversible as communities will not be able to survive in the region without clean drinking water or water for their crops and animals. Some may resort to surface water bodies if accessible (with associated contamination risks) while others may be forced to move out of the area. The intensity of the socioeconomic and health impacts of reduced water supply are considered very high without mitigation, and medium with mitigation. Health impacts can be avoided through the implementation of mitigation measures. Mitigation is feasible and will reduce the impact significance rating. Cumulative impacts are possible if farming activities intensify in the region to supply food to a growing population.

The cone of depression is expected to develop around the open pit as mining progresses and water levels on adjacent farms are expected to become impacted over time. A detailed hydrocensus of farms

neighbouring the pit area is required to understand the number, state and yields of boreholes utilised by the community surrounding the mine. Based on this survey, mitigation measures must be put in place to protect the water supply of surrounding water users. Measures that can be introduced include:

- Drilling deeper boreholes to replace existing shallower boreholes.
- Relocating water supply boreholes beyond the zone of impact.
- Tanker supply of fresh water in emergency situations.

Table 7-9: Significance assessment of health implications of groundwater drawdown

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases of Project	Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Very high -	Moderate -
Duration	Permanent (>20 years)	Permanent (>20 years)
Extent	Local	Local
Consequence	Very high	High
Probability	Continuous	Possible
Significance	Very high -	**Medium -**
Degree to which impact can be reversed	Potentially irreversible	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	Medium	
Extent to which a cumulative impact may arise	Possible	

7.9 FLOODING OF MINING INFRASTRUCTURE

SLR (2023)[7] conducted a floodline assessment for the South Block site. It has been established that the Plant, Southeast Pit, and the WRD traverse the 1:100-year floodline. These infrastructures are susceptible to flooding. In the event of heavy rainfall or rainfall of long duration, the watercourses traversing these buildings may overflow with associated flooding. Flooding impacts a number of HRAs, including

[7] SLR (2023). *Jindal Melmoth Floodlines Determination Study.* SLR Report Number 720.10023.00004.

accidents/injuries, *exposure to potentially hazardous materials*, and *soil, water, sanitation and waste related issues*.

In addition to potential injuries and loss of life associated with flooding, various waterborne diseases (e.g. cholera) can spread during stagnant water conditions. Flooding can also mobilise pollutants in soil and water bodies and increase exposure. The intensity of the impacts of flooding on health are considered very high without mitigation and moderate with mitigation. Flooding risks are considered long term since they are likely to cease at the end of the operational LoM in the case of site rehabilitation). Impacts are considered conceivable should a 100-year rainfall event occur during the LoM.

The health impacts associated with flooding are potentially irreversible. The degree to which the impact can be avoided is considered medium since the significance of the impact can be reduced through mitigation measures. The nature of cumulative impacts is considered possible in the context of increased artificial surfaces and exposed areas in the region associated with local developments. However, effective stormwater management can limit impacts.

Mitigation measures include:

- Relocation of mining infrastructure if feasible outside of the 1:100 year floodline.
- Progressive rehabilitation of disturbed land.
- Flood protection measures including a stormwater system (channels, berms and pollution control dams).
- Cut-off channels and culverts are proposed to divert clean water around proposed infrastructure and access routes.
- Earthen cut off/diversion channels and berms are proposed for construction around the Project site and WRDs. The cut-off channels will intercept and divert clean runoff from upstream catchments and contain dirty runoff within certain areas.
- Regular monitoring and inspection of channels, containment berms, silt traps, culverts, pipelines, for signs of erosion, cracking, silting and blockages of inflows, to ensure the performance of the storm water infrastructure.

Table 7-10: Significance assessment of health implications of the flooding due to mining infrastructure

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Very high -	Moderate -
Duration	Long term	Long term
Extent	Local	Local
Consequence	Very high -	High -

Probability	Conceivable	Unlikely
Significance	High -	**Low -**
Degree to which impact can be reversed	Potentially irreversible	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	Low	
Extent to which a cumulative impact may arise	Possible	

7.10 EXPOSURE TO VECTOR-BORNE AND ZOONOTIC DISEASE

While vector borne diseases (other than bilharzia perhaps) are not prevalent in the proposed Project area, the influx of people coupled with poor onsite mine management (e.g. stagnant water bodies) may lead to establishment of vector breeding sites, a situation that may lead to emergence and increase in prevalence of vector-borne diseases (*vector-related disease* HRA).

An increase in domestic waste can attract disease-carrying vermin to the region in the absence of regular waste collection and management services. Flies and cockroaches are attracted to putrefying domestic waste, and flies can be attracted to long-drop toilets in the absence of flushable services. It is possible that these services will become more viable in the region with increased population and provide existing residents with sewage and waste collection services, limiting the need to bury or burn waste. The latter could also improve local air quality.

The negative impact is considered moderate (unmitigated) and low with effective mitigation. The increase in population and associated impacts in the local region can be considered permanent. The likelihood of these impacts is conceivable (unmitigated) and unlikely (mitigated). Some vector-borne and zoonotic diseases are fatal (e.g. rabies) and this the impact is potentially irreversible. However, the presence of vectors and vermin can be avoided effectively. Cumulative impacts are unlikely as there are no other large developments planned for this locality.

Vector and vermin control options are as follows:

- Control of vector breeding sites through efficient removal of organic/domestic wastes, draining of stagnant water (e.g. in ditches or hollows), and sealing off of building roofs and basements.
- It is highlighted that the Household Survey indicated that most common toilet system used by households are pit latrines (60%) (see **Section 6.4.2**). These have the potential to attract flies. Replacement of toilets with flushable or dry diversion options can decrease flies significantly.
- Vector control in the local communities using indoor residual spraying is possible, however, sustainability is important and best practice guidelines should be implemented.

- Effective domestic waste management will be required with the influx of people to prevent disease-carrying vermin from being attracted to the region. The Household Survey indicated a lack of waste removal services in the area with 90% of households discarding their waste in the bush (see **Section 6.4.2**).
- Coordination with the relevant government departments (i.e. health and social development) in establishing vector awareness programs is also essential.
- Education on household and food hygiene and waste management for the control of vectors and vermin, keeping household surfaces clean, sealing off food storage. Supply of educational materials for use in local clinics, with cognisance of low education levels of local community (see **Section 6.2**).

Table 7-11: Significance assessment of health implications of exposure to vector-borne and zoonotic diseases

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative (the mitigated impact may be positive for some but the potential for negative impacts remains)	
Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate -	Low -
Duration	Permanent (>20 years)	Permanent (>20 years)
Extent	Local	Local
Consequence	High -	High -
Probability	Conceivable	Unlikely
Significance	Medium -	**Low -**
Degree to which impact can be reversed	Potentially irreversible	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	High	
Extent to which a cumulative impact may arise	Unlikely	

7.11 CHANGES IN ACCESS TO HEALTHCARE

The expected influx of construction workers and then mine workers (and potentially their families) during the operational phase has the potential to place pressure on already burdened healthcare services in the vicinity of the proposed Project area. Changes in access to healthcare falls under the *health services infrastructure and capacity* HRA. Emergency services are limited in the area and the potential for increased trauma and accidents (e.g. occupational injuries or vehicular accidents) will place additional burdens thereon. However, should the Project see an increased investment in healthcare facilities through direct (e.g. mine clinics for workers and their families) and indirect (investment in local emergency services, local healthy living campaigns, attracting doctors to the area) interventions, the impact could be positive. These positive impacts will extend for the LoM, albeit some of these services may become self-sustaining beyond the LoM.

The impact of the lack of (or provision of) healthcare facilities is considered high and definite. Since the incoming population is likely to remain in the region beyond the LoM, the demand for healthcare services is considered permanent. The impact is considered regional since individuals generally are willing to travel outside of their immediate locality for healthcare services. Increased population in the Project area is likely to result in increased demand on regional healthcare services if these are not available locally. Similarly, the provision of healthcare services locally will likely attract patients regionally if there are shortages in outside areas. The impacts of a lack of access to healthcare is considered potentially irreversible, particularly in the context of emergencies that may be fatal without critical care. The degree to which impacts can be avoided and mitigated is considered high through provision of effective healthcare. Impacts are considered cumulative should the mine attract other industries and services that increase the population size and demand for healthcare further. The positive impact can also be cumulative should the growing population attract medical service providers to the area or result in state investment in the development of healthcare facilities.

To shift impacts from potentially negative to positive, and to maximise these positive impacts, the following should be considered:

- Provision/support of basic clinic services. This could be through investment projects with existing clinics and/or the development of private clinics, for example onsite clinics for workers and their families, and potentially opening these up to the local community.
- Provision/support of private ambulance services.
- Support of local hospitals, particularly for emergency/casualty care.
- Health and healthy living (e.g. diet and exercise, dental care, clean water and food hygiene), and vaccination information campaigns to raise the baseline health level of the local community and limit the need for urgent healthcare.
- Engagement with the Department of Health to ensure that any investment in local healthcare projects is aligned with state healthcare plans for the region.
- Engagement with flight emergency services to ensure availability for critical cases that local hospitals are not equipped to care for and identification of (and engagement with) nearest equipped hospitals to receive these cases.

Table 7-12: Significance assessment of health implications of changes in access to healthcare

Description of Impact

Type of Impact	Direct (positive impacts through development of mine-related facilities) and indirect (increased pressure on state facilities through increases in population)	
Nature of Impact	Negative (without mitigation) / Positive (with mitigation)	
Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High -	High +
Duration	Permanent (>20 years)	Long term (possibly beyond)
Extent	Regional	Regional
Consequence	Very high -	Very high +
Probability	Definite	Definite
Significance	Very high -	**Very high +**
Degree to which impact can be reversed	Potentially irreversible	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	High	
Extent to which a cumulative impact may arise	Possible	

8. COMMUNITY HEALTH MONITORING AND MANAGEMENT PLAN

This assessment is framed by a broad definition of health, moving beyond a traditional biomedical focus on the assessment of incidence and spread of disease to incorporate various aspects of physical, psychological, social and cultural well-being. In this HIA, various potential health impacts associated with the Project, and mitigation measures to limit or reverse these impacts, are presented. Opportunities to enhance positive health impacts are also presented. These are highlighted below.

Displacement and resettlement:

- Effective resettlement and compensation in line with a comprehensive Resettlement Action Plan.

Changing farming practices, market options and sources of nutrition:

- Compensation for loss of agricultural land through provision of alternative fields or financial compensation.
- Liaison with local supermarkets to curb food inflation during the construction phase,

- Provision of sanitation awareness materials to local district environmental health officers for educational sessions with slaughterhouse, food handlers and vendors.
- Education on lifestyle behaviours including eating habits, exercise, etc. Supply of educational materials for use in local clinics, with cognizance of the low levels of education in the community.
- Food security and childhood nutritional status can be improved through school feeding programmes, and education on food gardens, nutrition, and good nutritional habits.
- Engagement with charity organisations such as Gift of the Givers to establish a plan of action should there be critical food shortages in the region.

Increased employment:

- Upskilling of the local community through educational and vocational opportunities for both mining employees and the general community.
- To address inequalities between the mining and non-mining workforce, the mine can develop a policy of local procurement of goods and services, and can insist that local service providers employ locally and use local products when reasonable,
- Gender sensitive policies that incorporate an awareness of the unequal employment opportunities for men in mining, and thus favouring employment of women where appropriate.

Influx of newcomers:

- Ensuring there is sufficient housing and services for the influx of workers.
- Provision of health services to workers and financial support of health services for the larger community to promote health and early detection and quarantine of communicable diseases.
- Education on safe sexual behaviours and lifestyle choices with respect to smoking, alcohol and drug use. Supply of educational materials for use in local clinics, with cognizance of the low levels of education in the community (see **Section 6.2**).
- Financial support for sports fields, sports clubs and exercise facilities to encourage a healthy lifestyle and provide alternative activities to drinking and drug abuse.
- Financial support of rehabilitation facilities for alcohol and drug abuse.
- Financial support for centres that support victims of violence and domestic abuse.

Increased traffic:

- Speed control measures and effective enforcement.
- Maintenance of mining-related vehicles to prevent tyre blow-outs and other dangerous occurrences.
- Clearly demarcated safe crossing areas. Barriers preventing crossings in high accident zones.
- Effective road signage.
- Education on road safety to community generally and in schools.

Increased ambient particulates and dust fallout:

Construction Phase

- Hard surfacing the main mine access road.
- Wet suppression of stockpiles when necessary (including wind shielding, storage away from site boundaries, and restricted height of stockpiles).
- Restricting vehicle speeds on haulage routes and other unsurfaced areas of the site.

- Ensuring that vehicles carrying dry soil and other materials are covered during travel.
- Best practices adopted to control emissions from loading and dumping material include water application, minimisation of drop heights and suspension or modification of activities during adverse weather conditions.
- Increase frequency of site inspections by the responsible person for air quality and dust issues on site when activities with a high potential to produce dust are being carried out.
- Restrict vehicle access to defined areas to avoid unnecessary off-road vehicle movements outside of the active work sites.
- Implement methods of reducing wind speed around potentially dusty activities or areas. Early planting of site perimeter areas with native tree species, and / or the strategic use of 'snow fencing' will potentially reduce wind speed across the site.
- Display details of responsible person for air quality and dust issues at the site boundary.

Operational Phase

- Establish exact boundaries for any proposed resettlement activities, as this may overlap with receptors associated with high impact significance.
- Preparation of a dust management plan as part of the Project Environmental Management Programme (EMPr).
- Addition of surfactants and dust suppressants when watering, specifically in working areas takes place close to the Project boundaries.
- Large trees and thick indigenous vegetation to be established along the Project boundary (in consultation with the Project ecologist) to reduce wind speeds and provide visual buffer between mining activities and community.
- Reduce vehicle speeds to 30 km/hr or below on all internal haul routes and roads.
- Utilise chutes at material handling transfer points.
- While the processing plant will be enclosed, all bag filters on extraction points should be designed for 30 mg/Nm^3.
- Ensure that vehicles carrying dry soil and other materials are covered during travel.
- Cover the surface of haul routes with less erodible aggregate material such as compacted and treated crusher run / aggregate.

Groundwater contamination:

- Water quality monitoring for the pit area (pit and WRD) to establish baseline.
- Monthly water quality monitoring at recommended borehole network.
- Rehabilitation of the WRD post mining.
- Post-mining monitoring to be conducted.

Groundwater drawdown:

- Drilling deeper boreholes to replace existing shallower boreholes.
- Relocating water supply boreholes beyond the zone of impact.
- Tanker supply of fresh water in emergency situations.

Flooding of mining infrastructure:

- Relocation of mining infrastructure if feasible outside of the 1:100 year floodline.

- Progressive rehabilitation of disturbed land.
- Flood protection measures including a stormwater system (channels, berms and pollution control dams).
- Cut-off channels and culverts are proposed to divert clean water around proposed infrastructure and access routes.
- Earthen cut off/diversion channels and berms are proposed for construction around the Project site and WRDs. The cut-off channels will intercept and divert clean runoff from upstream catchments and contain dirty runoff within certain areas.
- Regular monitoring and inspection of channels, containment berms, silt traps, culverts, pipelines, for signs of erosion, cracking, silting and blockages of inflows, to ensure the performance of the storm water infrastructure.

Increased exposure to vector-borne and zoonotic disease:

- Control of vector breeding sites through efficient removal of organic/domestic wastes, draining of stagnant water (e.g. in ditches or hollows), and sealing off of building roofs and basements.
- Replacement of drop toilets with flushable or dry diversion options can decrease flies significantly.
- Vector control in the local communities using indoor residual spraying is possible, however, sustainability is important and best practice guidelines should be implemented.
- Effective domestic waste management will be required with the influx of people to prevent disease-carrying vermin from being attracted to the region.
- Coordination with the relevant government departments (i.e. health and social development) in establishing vector awareness programs is also essential.
- Education on household and food hygiene and waste management for the control of vectors and vermin, keeping household surfaces clean, sealing off food storage. Supply of educational materials for use in local clinics, with cognisance of low education levels of local community.

Changes in access to healthcare:

- Provision/support of basic clinic services. This could be through investment projects with existing clinics and/or the development of private clinics, for example onsite clinics for workers and their families, and potentially opening these up to the local community.
- Provision/support of private ambulance services.
- Support of local hospitals, particularly for emergency/casualty care.
- Health and healthy living (e.g. diet and exercise, dental care, clean water and food hygiene), and vaccination information campaigns to raise the baseline health level of the local community and limit the need for urgent healthcare.
- Engagement with the Department of Health to ensure that any investment in local healthcare projects is aligned with state healthcare plans for the region.
- Engagement with flight emergency services to ensure availability for critical cases that local hospitals are not equipped to care for and identification of (and engagement with) nearest equipped hospitals to receive these cases.

These interventions can be linked to specific health programmes. These can be monitored and evaluated to ensure that they are meeting the desired objectives.

Monitoring generally refers to a process of measuring, recording and analysing data on the implementation of the programme and communicating it to the programme managers so that any deviation from the planned operations are detected, diagnosis for causes of deviation is carried out and suitable corrective actions are taken. Evaluation aims to assess whether the desired results of a programme have been achieved if not how it should be redesigned. Any monitoring system must have sufficiently sensitive and specific key performance indicators (KPIs) so that changes in key objective endpoints can be documented in an appropriate and timely fashion.

The Organisation for Economic and Co-operative Development's (OECD) 'well-being framework' measures whether, where and how life is getting better for people and what matters most in people's lives[8]. Using various national and international initiatives for measuring the progress of societies it reflects emerging international consensus that outcomes, which contribute to people's well-being include income, jobs, housing, health status, skills, the environment, governance and personal safety as well as more experiential elements of life, such as social connections, work-life balance and subjective well-being. The OECD well-being dimensions are categorised as material (e.g. income, jobs and housing) and quality-of-life (e.g. health status, social connections and environmental quality). In addition, four stocks of resources are identified to sustain those outcomes for the future. The resources focus on the broader natural, economic, human and social systems that embed and sustain individual well-being over time, they include human capital, social capital, natural capital and economic capital[9] (**Figure 8-1**).

The approach is people-centric, putting individuals and households at the centre of assessment. It focuses on well-being outcomes rather than inputs needed to deliver these outcomes (access to clinics rather than number of clinics). Third, it measures objective and subjective outcomes using third party observations to capture life circumstances as well individual experiences to reflect inner states and fourth considers different well-being outcomes for different population groups investigating disparities occurring due to age, gender, education and incomer recognising that national averages disguise a great deal of variation[10].

Table 8-1 presents various dimensions of well-being and provides some measurable indicators thereof. In **Table 8-2**, these indicators are translated into questions for interrogating biomedical aspects of health and broader community well-being, and the list of indicators are enhanced by identification of indicators specific to mining regions. These indicators can be useful for gauging changes in community health in the Project area over time. Regular monitoring and evaluation of these indicators can allow for timeous intervention if negative impacts become clear.

[8] For example, OECD (2014), *How's Life in Your Region? Measuring Regional and Local Well-being for Policy Making*, OECD Publishing, Paris,

[9] OECD (2019). *Enhancing Well-being in Mining Regions: Key Issues and Lessons for Developing Indicators*. Discussion Paper for the 3rd Meeting of OECD Regions and Cities in Skellefteå, Sweden, 26 pp.

[10] OECD (2017), *How's Life? 2017: Measuring Well-being*, OECD Publishing, Paris.

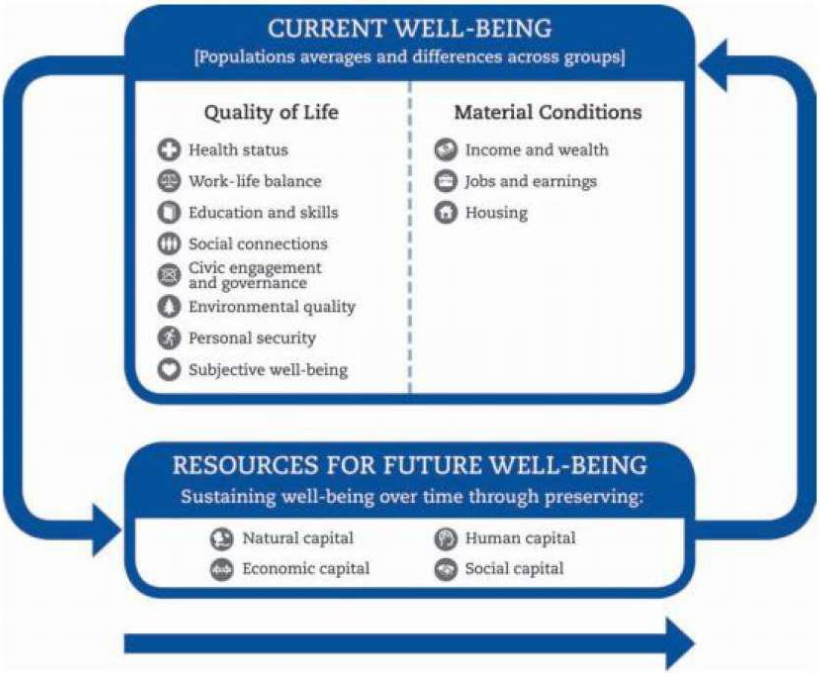

Figure 8-1: OECD framework for the enhancement of well-being

Table 8-1: Indicators of various dimensions of well-being

Category	Dimension	Indicators
Material conditions	Income	Household disposable income per capita
	Jobs	Employment rate
		Unemployment rate
	Housing	Number of rooms per person
Quality of life	Health	Life expectancy at birth
		Age adjusted mortality rate
	Education	% labour force with at least secondary education
	Environment	Estimated average exposure to air pollution in $PM_{2.5}$
	Safety	Homicide rate
	Civic engagement	Voter turnout
	Access to services	% households with broadband access
Subjective well-being	Community	% individuals with friends/relatives to rely on if in need
	Life satisfaction	Self-evaluation of satisfaction on a scale of 0 to 10

Table 8-2: Questions to interrogate indicators of well-being

Dimension	Question	Existing indicator in regional well-bring framework	Indicators specific to mining regions
Income	What does income performance look like and what kind of income inequalities exist?	Household disposable income	Wage inequalities across disciple
Jobs	Does local employment increase? In which sectors are jobs created? Who benefits from employment?	Employment and unemployment rates	Inequalities in employment Risk of automation in jobs Ratio of long distance commuters
Housing	Is there enough affordable housing for all population groups? Do housing shortages make certain population groups move?	Number of rooms per person	Housing expenditure
Health	Are there specific health challenges related to environmental and non-environmental conditions in mining regions?	Life expectancy	Common disease Suicide rates
Education	Are education and training linked to needs of the local labour market?	Highest level of education achieved	Ratio of low skilled to high skilled workers
Environment	Are there local environmental externalities that harm the environment or alternative livelihoods? How is the natural capital of the region affected through mining?	Air quality	Water quality Local CO_2 emissions Cleared forest land / vegetation Availability of recreational facilities and green space
Access to services	Are public services experiencing particular pressures due population change? Does service provision increase with mining activity?		Satisfaction with health facilities and distance Satisfaction with education facilities (childcare to schools)
Social connection	Does social cohesion increase or decrease with mining activities? Do people feel at home in mining regions and cities	Percentage of people who have friends and relatives to rely on in case of need	
Civic engagement	Do people feel they have a say in local decision making?	Voter turnout	Opportunity for community engagement in local decisionmaking

RECORD OF REPORT DISTRIBUTION

SLR Reference:	720.10023.0001
Title:	Jindal Melmoth Iron Ore Project: Health Impact Assessment
Report Number:	1
Client:	Jindal Iron Ore (Pty) Ltd

Name	Entity	Copy No.	Date Issued	Issuer

AFRICAN OFFICES

South Africa

CAPE TOWN
T: +27 21 461 1118

JOHANNESBURG
T: +27 11 467 0945

DURBAN
T: +27 11 467 0945

Ghana

ACCRA
T: +233 24 243 9716

Namibia

WINDHOEK
T: + 264 61 231 287