Proposed Rehabilitation of the Havelock Chrysotile Tailings Storage Facility (TSF) At Bulembu, Eswatini

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT REPORT

NOVEMBER 2022

Kobolondo Magnesium (Proprietary) Limited

Prepared on behalf of **Kobolondo Magnesium (Proprietary) Limited** by:

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ABBREVIATIONS AND ACRONYMS

The following abbreviations or acronyms have been used in this report:

AC - Asphalt Concrete

AIDS - Acquired Immune Deficiency Syndrome

ARD - Asbestos Related Diseases

ARV - Antiretroviral

As - Arsenic

BGB - Barberton Greenstone Belt

BMS - Bulembu Ministries Swaziland

BP - Before present

CCP - Child Care Programme

Cd - Cadmium

CFC - Chlorofluorocarbon

CMP - Comprehensive Mitigation Plan

CO - Carbon monoxide

CO_2 - Carbon dioxide

CIL - Carbon-In-Leach

CPR - Competent Person's Report

Cr - Chromium

CSI - Corporate Social Investment

dB - Decibel

dBA - Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.

DBST - Double Bituminous Surface Treatment

EC	-	Electrical Conductivity
ESIA	-	Environmental and Social Impact Assessment
f/m^3	-	Fibres per cubic metre
Ha	-	Hectares
HCFC	-	Hydrochlorofluorocarbon
HIV	-	Human Immunodeficiency Virus
Km	-	Kilometres
kPa	-	Kilopascal
kVA	-	Kilovolt-amperes
LAeq	-	The value of the average A-weighted sound pressure level measured continuously within a reference time interval T, which have the same mean square sound pressure as a sound under consideration for which the level varies with time.
Lmax	-	The highest sound pressure level over the measurement period.
m^2	-	Square metres
m^3	-	Cubic metres
Masl	-	Metres above sea level
µm	-	Micrometre/ micron
MMB	-	Minerals Management Board
Ml	-	Megalitres (million litres)
MLA	-	Mining Lease Area
Mo	-	Molybdenum
MSDS	-	Material Safety Data Sheet
MVA	-	Megavolt-amperes
Ni	-	Nickel

NO	-	Nitrogen oxide
NO_2	-	Nitrogen dioxide
Pb	-	Lead
pers. comm.	-	Personal communication with indicated individual
PCB	-	Polychlorinated biphenyl
PM	-	Particulate matter
POP	-	Persistent Organic Pollutant
ppb	-	Parts Per Billion
ppm	-	Parts Per Million
Sb	-	Antimony (heavy metal)
EEA	-	Eswatini Environmental Authority
EGB	-	Eswatini Greenstone Belt
SIBX	-	Sodium Isobutyl Xanthate
SO_2	-	Sulphur dioxide
TB	-	Tuberculosis
tpm	-	Tonnes per month
TSF	-	Tailings Storage Facility
WHO	-	World Health Organization

EXECUTIVE SUMMARY

Kobolondo Magnesium (Proprietary) Limited proposes to rehabilitate the Havelock Chrysotile Tailings Facility (TSF) at Bulembu, Eswatini. Primarily a Rehabilitation Project to address the abandoned Havelock chrysotile asbestos dump, the project will extract various minerals occurring in the dump, process them into concentrates which will be sold to generate revenue. The commodities include magnesium, nickel and iron. The revenue will thus finance the rehabilitation of the dump as well as contribute towards socio-economic regeneration of Bulmebu.

Background

Between 1939 and 2001, Bulembu was operated as a chrysotile asbestos mine which led to the development of the company mining town. Originally called Havelock Mine, the mine was operated by the Turner & Newall Group of Companies from 1939 until about 1990 when the company filed for bankruptcy. In 1991 the mine was purchased by HVL Asbestos Swaziland Limited which continued mining operations until 2001 when it finally closed following a decline in the asbestos market. Bulembu subsequently became a “ghost town” until it was purchased by the not-for-profit organization Bulembu Ministries in 2006 which established a Child Care Programme (CCP) for AIDS-orphaned children as well as other enterprises such as bee honey production, dairy farming, a bakery, spring water bottling, a museum and lodge.

Purpose of Project

The purpose of the project is to rehabilitate the open cast excavations and sites where the asbestos was dumped. This will prevent the potential and environmental and social disaster that would arise in the event of a partial and total collapse of the dumps, as well as mitigating the ongoing gradual accumulation of asbestos-contaminated sediment along downstream watercourses.

Project Description

The driving principle behind rendering chrysotile asbestos safe will be its chemical decomposition using sulphuric acid. The roasting of auriferous sulphide concentrate will generate sulphur dioxide (SO_2) gas which will be scrubbed at an efficiency of 99.8% and thus converted into sulphuric acid (H_2SO_4). The sulphuric acid will then be used to leach out the base metals from the tailings. This leaching process will effectively decompose the chrysotile, converting it into silica (sand) and sodium sulphate and calcium sulphate (gypsum).

The project will be implemented in 2 phases. Phase 1 entails the environmental and social impact assess followed by a 12-18 month construction period with operation planned to commence in February 2024. During Phase 1, the operation will treat 40,000 tonnes of tailings per month, employing approximately 200 people, of which 50 will be skilled and 150 semi-skilled. Phase 2 entails scaling up production from treating 40,000 tonnes per month of tailings to treating 200,000 tonnes per month. The number of employees is anticipated to increase from 200 to 300, comprising 80 skilled and 220 semi-skilled. The timing of Phase 2 is highly dependent upon the actual production that will be achieved in Phase 1

All material at the point of extraction will be kept wet using a sprinkler system to suppress dust. Water used for indoor dust suppression will pass through a collection system whereby solids will settle in a sump and the water re-circulated to the production process. Water will be sourced from existing groundwater recovered from the old mine with an estimate of approximately 40,000m^3 per month utilised. The material during the process will be in slurry form conveyed from one stage to the next through piping. All production facilities will be in enclosed buildings.

The residue, after extraction of the base metals and sulphides will be inert and pH neutral. All sulphides, heavy metals and chrysotile will have been removed, therefore the residue material will comprise silica and gypsum. The silica will be used for progressively backfilling the open cast excavations. A portion will be mixed with wood residue from local timber

enterprises and local garden clippings to produce top soil to enable the establishment of vegetation to protect the backfilled sections from erosion. The gypsum will be sold as fertilizer and, where required, a portion will be used as fertilizer to promote vegetation growth on the backfilled and landscaped sections.

Impacts and mitigations

The overall environmental and social impact of the project will be the protection of ecosystems and communities from the pollution and the potential collapse of the dumps. This will be enhanced through maintaining an optimal pace of rehabilitation to avoid collapse of the tailings from natural forces.

The destruction of natural habitats will be avoided and mitigated through education of employees and surrounding communities as well as through reclamation of habitats infested with invasive alien plants species.

The ongoing erosion of the tailings will be arrested by vegetating those sections of the dumps which are exposed and which are scheduled for being worked later in the project. The catch dams at the lower end of the dams will be reconstructed immediately to trap sediment current being eroded to downstream areas.

Contributions to climate change will be mitigated by using the exothermic reactions of the production process to minimise the use of fossil fuels. Heat recovered will be used to generate electricity for on-site consumption and to provide heating in the village.

Conclusion

Rehabilitation of the former asbestos mine dumps will arrest the current threats to the environment and communities and avert a potential disaster from a partial or total collapse of the dumps. The project will also generate employment opportunities and the socio-

economic regeneration of Bulembu, which in turn will be exemplary of economic sense of the rehabilitation of former mines and ensuring sustainable development in sectors of the economy.

1. INTRODUCTION

Kobolondo Mining (Pty) Limited proposes to unlock resource value by processing minerals through the rehabilitation of the Havelock Chrysotile Tailings Storage Facility (TSF) at Bulembu, Eswatini. This is primarily a Rehabilitation Project to address the abandoned Havelock chrysotile asbestos dump.

Between 1939 and 2001, Bulembu was operated as a chrysotile asbestos mine which led to the development of the company mining town. Originally called Havelock Mine, the mine was operated by the Turner & Newall Group of Companies from 1939 until about 1990 when the company filed for bankruptcy. In 1991 the mine was purchased by HVL Asbestos Swaziland Limited which continued mining operations until 2001 when it finally closed following a decline in the asbestos market. Bulembu subsequently became a “ghost town” until it was purchased by the not-for-profit organization Bulembu Ministries in 2006 which established a Child Care Programme (CCP) for AIDS-orphaned children as well as other enterprises such as bee honey production, dairy farming, a bakery, spring water bottling, a museum and lodge.

What remained of the previous mining operations was the TSF, also known as a mine dump, with an estimated 44-54 million tons of un-rehabilitated material which currently presents a substantial potential environmental hazard. The Commissioner of Mines together with the Minerals Management Board (MMB) engaged various parties, including the previous mine operators, international agencies and non-governmental organisations with a view to funding the rehabilitation, however attempts were unsuccessful. This led to seeking alternative opportunities through engaging potential partners and after extensive consultations and an evaluation period spanning 3 to 4 years, a feasible solution was arrived at, culminating in the granting of a rehabilitation mining lease to Kobolondo Mining (Pty) Limited by His Majesty King Mswati III at the end of 2016.

The TSF covers an area of several hundred hectares, is approximately 180m high and the majority of it is exposed to the elements since there is little vegetation cover. As such, one of the significant hazards is the slumping or outward movement of the material to the immediate surroundings, particularly after heavy rain. Furthermore, the emergency ponds which were designed to capture the tailings are already full, thereby posing the risk of material being translocated further afield from the dump. The reprocessing of the dump in the later stages of the mine's life generated even finer chrysotile tailings than the first operation and are situated on the "New TSF".

The overall objective of the proposed project is to rehabilitate the TSF by extracting, processing, transporting and marketing the several minerals contained in the dump thereby generating the revenue necessary for funding the rehabilitation. While the primary objective of the project is rehabilitation, the use of the term mining is due to the fact that the minerals contained in the dump, and their processing, fall under the auspices of the Minerals Management Board as established under the Mines and Minerals Act, 2011.

The requirement to undertake an Environmental and Social Impact Assessment (ESIA) was confirmed by the Eswatini Environment Authority (**Appendix A**). This ESIA report describes the potential environmental and social impacts of the proposed project and evaluates the significance of the impacts. The CMP describes the measures that will be taken to mitigate the negative impacts and enhance the positive impacts. The Rehabilitation Plan describes *how* disturbed areas within the project site, whether arising from previous mining activities or the proposed project, will be put to a environmentally and socially safe and sustainable usable condition since the project proponent recognises that restoration to the original undisturbed state is not realistically possible.

2. DESCRIPTION OF PROPOSED PROJECT

2.1 OFFICIAL PROJECT TITLE

The official project title is the **Proposed Rehabilitation of the Havelock Chrysotile Tailings Storage Facility at Bulembu, Eswatini** also referred to as the **Kobolondo Project**.

2.2 LOCATION AND EXTENT

2.2.1 Location

The Mining Lease Area (MLA) is situated on Lease No.1 of Farm No.815 (L1/815) in the Hhohho Region. While the primary objective of the proposed project is rehabilitation of the TSF, the use of the term "mining" in the description of the lease area arises from the statutory definitions in the Mines and Minerals Act, 2011 which under Section 2 stipulate that,

> *"mine" includes an area where a mineral is won by excavation, dredging or any other means.*

In the case of this project, magnesium in the initial phase and gold in subsequent phases, will be won by processing the existing tailings. Processing the tailings or mine dump falls under the category of "any other means". No excavation of virgin land or dredging will be used. Additionally, Sections 55, 56, 61 and 92 provide for the granting of a mining permit to work a mine dump, defined by the Act as any area where mine waste and tailings are stored, placed, stockpiled or dumped. Therefore, the area, including a mine dump, to which a permit to win a mineral applies is referred to as a Mining Lease Area.

2.2.2 Extent

Prior to establishment of the MLA, the property was named Farm No.815. Subdivision resulted in L1/815 measuring 200ha and the Remainder (R/815) measuring 1,513.0640ha. the MLA is shown in **Error! Reference source not found.**. The MLA encompasses the s outhern portion of Bulembu Village[1] as well as the TSF which contains an estimated 48 million tonnes of un-rehabilitated residue from the mining and extraction of chrysotile asbestos over an 80-year period which ended in 2001. The residue was stored to a height of approximately 196m at the highest point from its base.

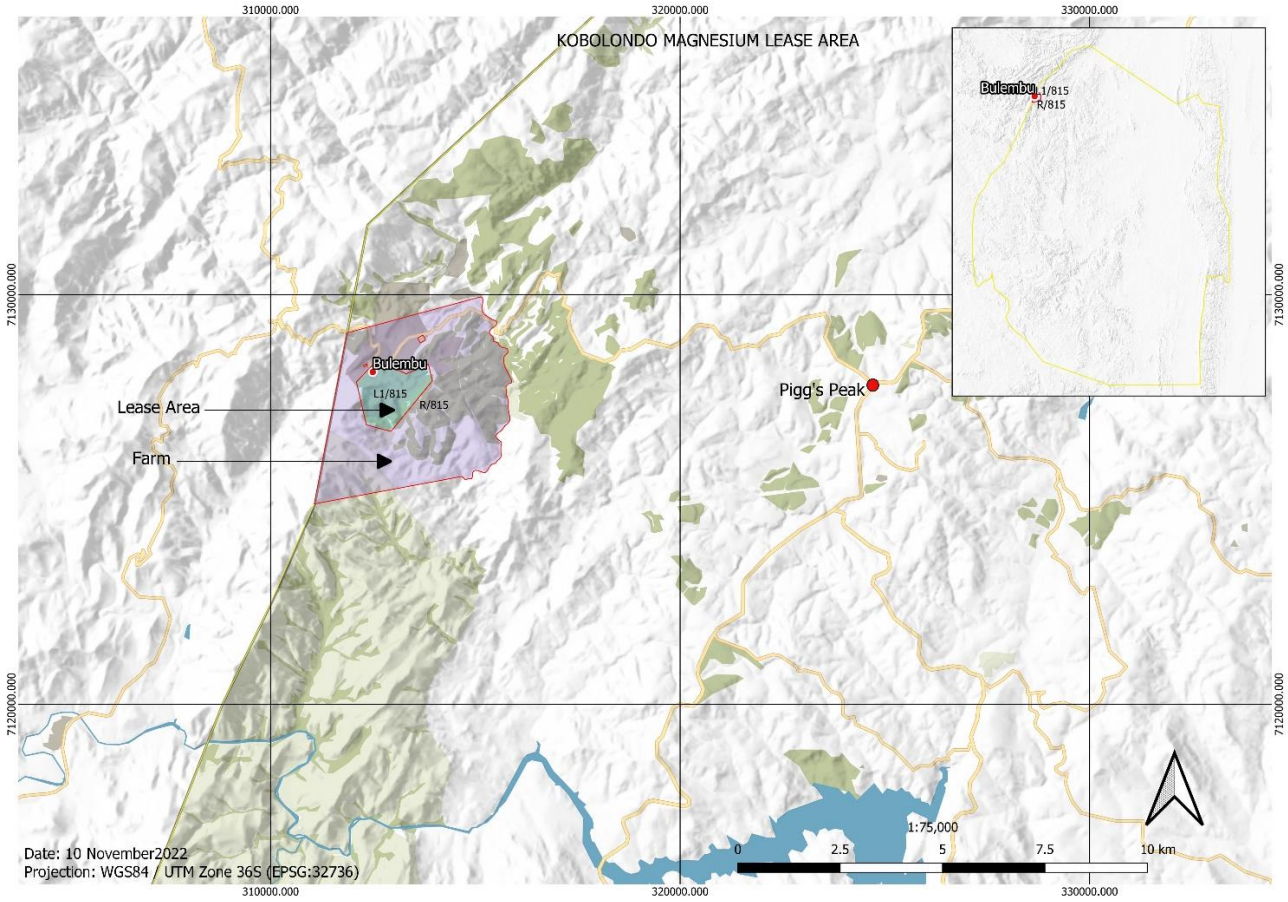


Figure 1 - Location of Bulembu

[1] For the purposes of this ESIA Report, "Bulembu Village" refers to the settlement which is managed by Bulembu Ministries Eswatini as distinct from the Bulembu community which comprises the surrounding settlements.

2.2.3 Sections of the Tailings Storage Facility

There are three distinct sections of the TSF as illustrated in **Error! Reference source not found.**:

- The Old TSF on the western section of the MLA comprises coarse material stored to a height of approximately 196m and occupies approximately 26ha.
- The New TSF on the eastern section MLA is new in the sense that it was established by the re-processing of a portion of the Old TSF during the previous mining operations. It comprises finer material stored to a height of approximately 39m and occupies approximately 23ha.
- The North TSF which comprises coarse material similar to the Old TSF, is piled to height of approximately 30m and occupies approximately 2.73ha.

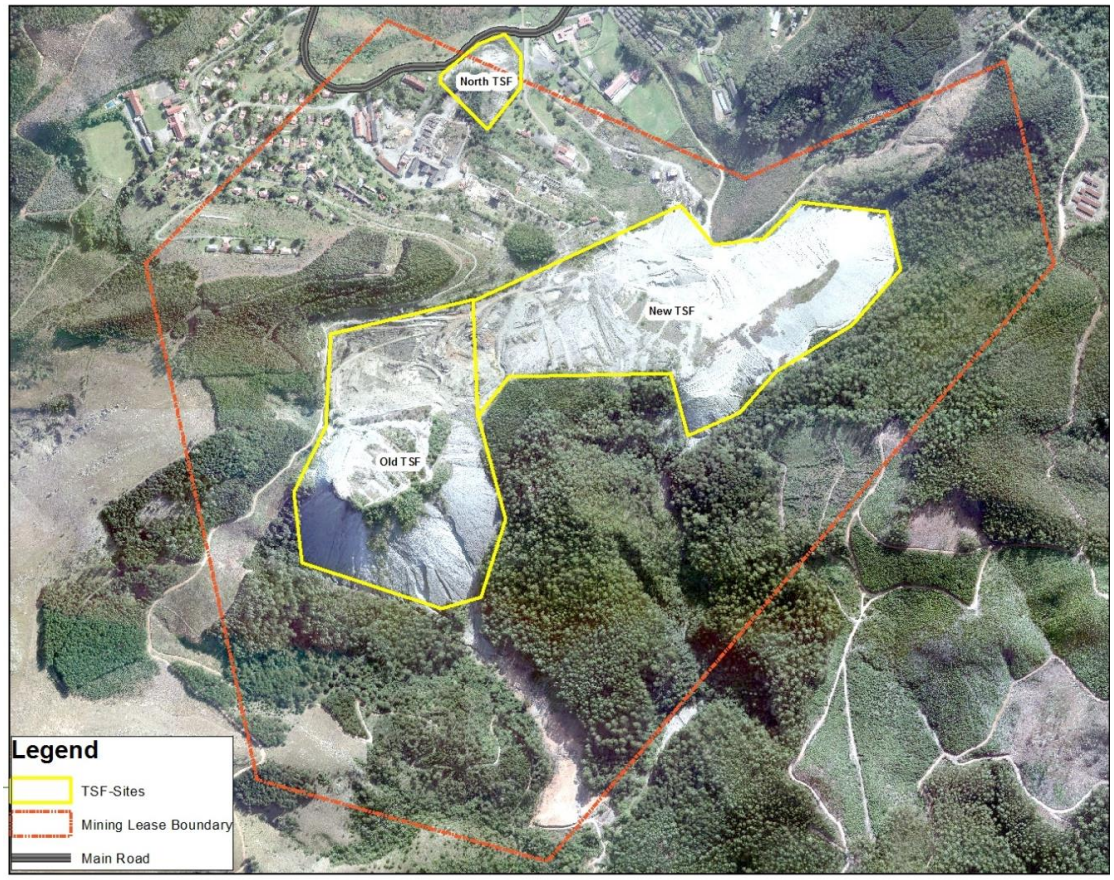


Figure 2 - Location of Tailings Storage

2.2.4 Existing land ownership

Farm No.815 is Title Deed Land (TDL) which was purchased by Bulembu Development Corporation (BDC) from HVL Asbestos Swaziland Limited through Deed of Transfer No.503/2004. An Agreement has been signed between Bulembu Development Corporation, other parties and Kobolondo Mining (Pty) Limited wherein the purchase of Farm No.815 forms a part of the Agreement, which will effectively transfer ownership to Kobolondo Mining (Pty) Limited.

2.2.5 Agreement

In order to secure the tenure of the land on which the Kobolondo Project will be developed, a Sale Agreement was negotiated and signed between BDC and Kobolondo Magnesium in respect of the purchase of the Farm No.815. Key components of the Agreement include:

- the purchase of 100% equity in BDC by Kobolondo Magnesium;
- the relocation of the Chid Care Programme from Bulembu to a suitable alternative site within a Relocation Budget Allocation.

The suspensive conditions prior to effecting the Agreement include:

i) receipt of the Environmental Authorization of the Kobolondo Project;
ii) completion of the necessary capital raise for the Kobolondo Project;
iii) approval of the Eswatini Competition Commission to the transaction.

2.3 PROJECT PROPONENT

The project proponent is Kobolondo Magnesium (Pty) Limited, a company incorporated in Eswatini and whose ownership comprises:

i) Ingwenyama in Trust for the Emaswati Nation – 25%
ii) The Government of the Kingdom of Eswatini – 25%
iii) Kobolondo Magnesium International (based in Mauritius) – 50%

The role of Kobolondo Mining (Pty) Limited, as the Mining Lease Holder, in the project will be to ensure that the project complies with the terms and conditions of the mining lease, which include all aspects of environmental compliance and socio-economic development. A mining contractor may be appointed by Kobolondo Mining (Pty) Limited to implement and manage technical aspects of the project in terms of Section 61(4) of the Mines and Minerals Act, 2011.

2.4 KEY PROJECT ACTIVITIES

This section of the ESIA Report provides an overview of the envisaged Production Process to be utilised in the Kobolondo Project. The main products from the Kobolondo Project will be magnesium, nickel, iron and gypsum. Gold production will be based on the roasting of auriferous sulphide concentrates. The potential for gold production from concentrates generated from other areas/ mines in Eswatini is an offset benefit of the project.

2.4.1 Overview of chemical decomposition of chrysotile asbestos

The driving principle behind rendering chrysotile asbestos safe will be its chemical decomposition using sulphuric acid. The roasting of auriferous sulphide concentrate will generate sulphur dioxide (SO_2) gas which will be scrubbed at an efficiency of 99.8% and thus converted into sulphuric acid (H_2SO_4). The sulphuric acid will then be used to leach out the base metals from the tailings. This leaching process will effectively decompose the chrysotile, converting it into silica (sand) and sodium sulphate and calcium sulphate (gypsum). The chemical process is illustrated in Figure 3.

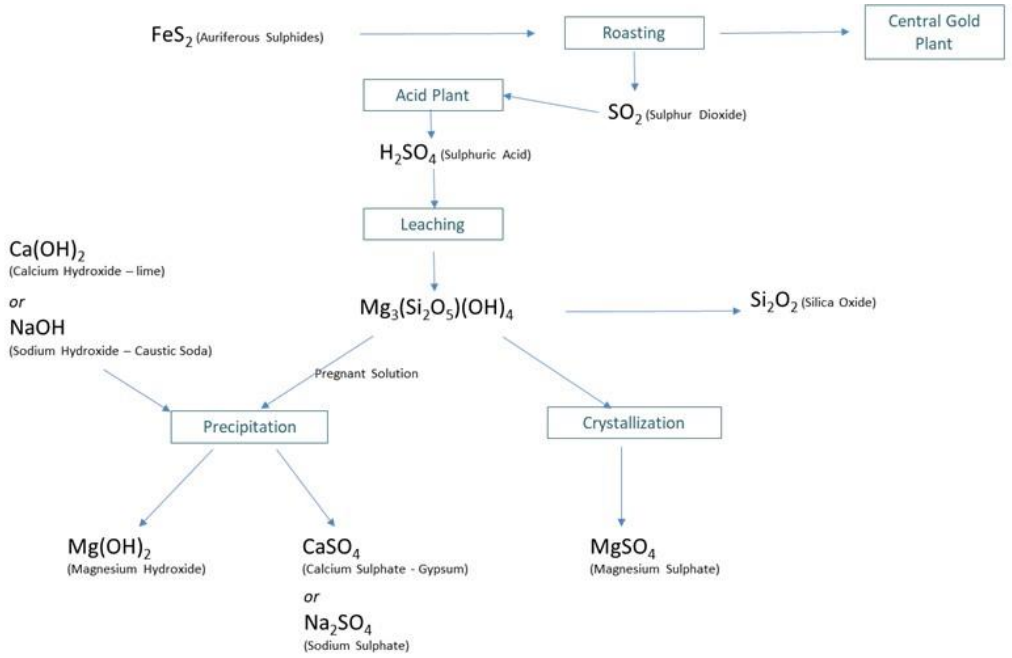


Figure 3 - Leaching process

The magnesium hydroxide and magnesium sulphate will be passed through the roaster driving off water and leaving magnesium oxide from the magnesium hydroxide and driving off sulphur dioxide and leaving magnesium oxide from the magnesium sulphate. The sulphur dioxide generated will join the gases that pass through the scrubber for conversion to sulphuric acid.

The advantages of the chemical decomposition process are:

- Chrysotile asbestos is chemically decomposed to sand and commodities which will generate revenue for the rehabilitation process. Magnesium sulphate and magnesium hydroxide will respectively processed through the roaster to produce magnesium oxide which will be sold as a high value mineral commodity. Calcium sulphate (gypsum) will be sold as a commodity to downstream industries which manufacture ceiling boards and the agricultural sector for use as fertilizer and soil amelioration. Sodium sulphate will be sold as a commodity in the manufacture of numerous products such as powdered soap. Sand will be used as an ingredient in soil for site rehabilitation. The final sand residue and commodities will therefore be free of asbestos fibres.
- Sulphuric acid will be converted, through the chemical process, to form part of the magnesium hydroxide and magnesium sulphate which in turn will be processed into magnesium oxide. Therefore there will be no waste chemical to be disposed of.
- Sulphuric acid allows the leaching of base metals at far higher levels than by flotation, cycloning, gravity and magnetic separation alone. These will still be used as supplementary extraction methods as shown in Figure 4.
- The process lends itself to the construction of a Central Gold Processing Plant due to the roasting of auriferous (gold bearing) concentrate. The Gold Processing Plant is planned for phase 2 and will facilitate the opening of refractory gold mines with a potential for establishment along the Barberton Greenstone Belt and in the North-West region of Eswatini from Ngwenya to Matsamo.

The Metallurgical Process Flow has been compiled by Kobolondo Mangensium's technical partners based on extensive knowledge, consultation with various specialists and experience of similar projects/ process flows. As such the Metallurgical Process Flow has been included in the project's Mine Plan which has been submitted to the Commissioner of Mines. In addition, the process flow has been reviewed and signed-off by an autonomous competent person, Minxcon which specialises in all aspects of mineral processing, extractive metallurgy and related technologies. The Competent Person's Report (CPR) has been compiled alongside the environmental and other planning components of the project. The overall process flow presented in this ESIA as well as in the Mine Plan, is highly unlikely to be amended to any degree that may impact the outcomes of this ESIA.

2.4.2 Phase 1 Production Processing

The key elements of Phase 1 comprise:

- Target tonnage of residue material to be processed: 40,000 tonnes per month;
- Capital investment: E700 million;
- Construction Timeline: 12 – 18 months;
- Phase 2 Timeline: Dependent on performance at the Phase 1 tonnage levels.

The production process is illustrated in Figure 4 while the raw materials and products are listed in Table 1. The Material Safety Data Sheets (MSDS) of the raw materials and products are provided in **Appendix N**.

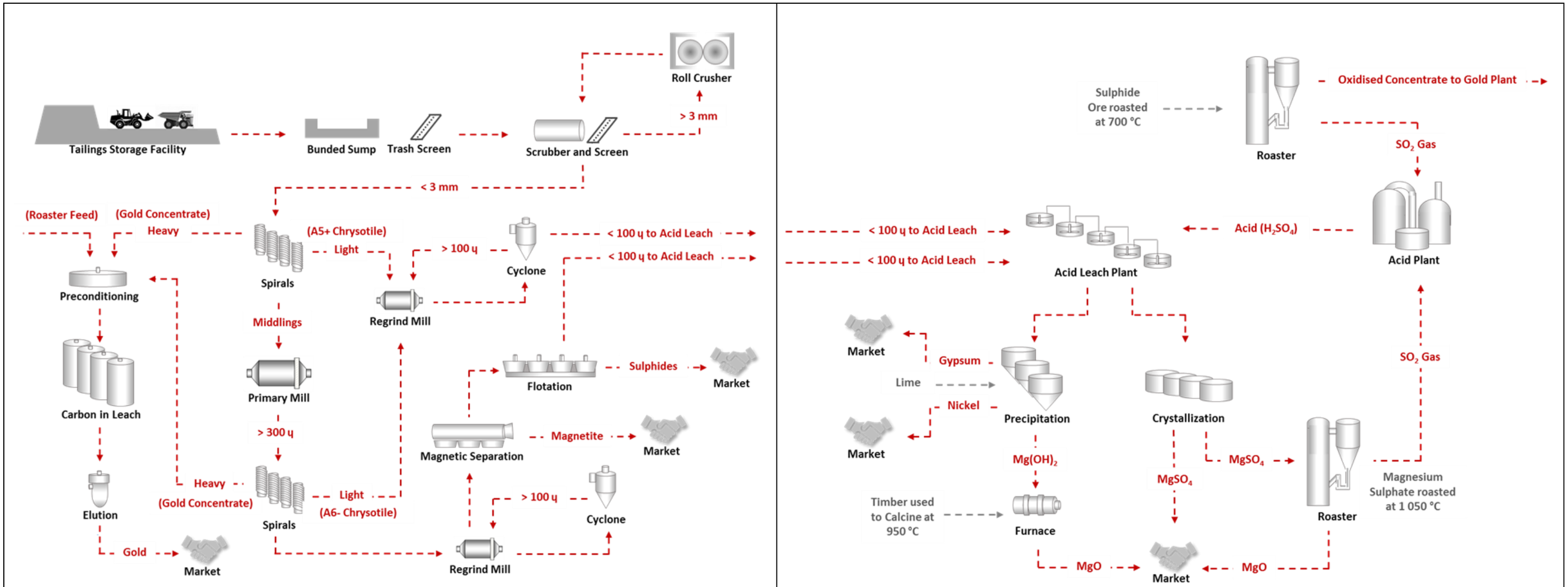


Figure 4 - Production Process

Table 1 – Raw materials and products

	Chemical Name/ Trade Name	Form (liquid/ solid/ gas)	Application	Storage method	Storage Quantity	Transportation Method	Transportation Quantity
1.	Calcium Hydroxide/ Lime [$Ca(OH)_2$]	Solid	Neutralisation/ Precipitation	Bulk tank	20 tonnes/ month	500kg woven bags on 20 tonne tautliner trucks	1 truck x 40 bags = 20 tonnes/ month
2.	Calcium Sulphate/ Gypsum [$CaSO_4$]	Solid	Sold as fertilizer	Stockpiled	100 tonnes/ month	20 tonnes side tipper trucks covered with tarpaulin sheeting	20 tonnes per truck = 5 x 20 tonne trucks/ month
3.	Magnesium Hydroxide [$Mg(OH)_2$]	Aqueous	Dried into pellets for sale as concentrate Also processed into Magnesium Oxide	In-process bulk tank when aqueous, then dried and pelletised into 10/ 20/ 50kg sealed plastic bags	80 tonnes/ day	20 tonne tautliner trucks	4 x 20 tonne trucks/ day = 80 tonnes/ day
4.	Magnesium Oxide [MgO]	Solid	Sold as concentrate	50kg woven bags	60 tonnes/ day	20 tonne tautliner trucks	3 x 20 tonne trucks/ day = 60 tonnes/ day
5.	Magnesium Sulphate [$MgSO_4$]	Solid	Sold as concentrate	Pelletised 10/ 20/ 50kg sealed plastic bags	80 tonnes/ day	20 tonne tautliner trucks	4 x 20 tonne trucks/ day = 80 tonnes/ day
6.	Sodium Hydroxide/ Caustic Soda [NaOH]	Solid	Neutralisation/ Precipitation	Bulk tank	30 tonnes/ month	Cylindrical tanker	1 truck (30 tonnes)/ month
7.	Sodium Isobutyl Xanthate [$C_5H_9NaOS_2$]	Solid	Flotation (solids separation)	Sealed bags within wooden crate	20 tonnes/ month	20kg bags on 20 tonne tautliner trucks	1 truck/ month = 20 tonnes/ month
8.	Sodium Sulphate [Na_2SO_4]	Solid	Sold as granules	Storage silos	50 tonnes/ month	25 tonne cylindrical tankers	2 x 25 tonne trucks/ month = 50 tonnes/ month
9.	Sulphuric Acid (98%) [H_2SO_4]	Liquid	Leaching of base metals	In-process tanks	20,000 litres/ day	Cylindrical tanker	20,000 litres/ day = 1 truck/ day

2.4.3 Loading, Scrubbing and Crushing

The residue material (tailings) will be moistened and then loaded by excavator onto trucks which will deposit the residue into a scrubbing plant. The >3mm fraction will be sent to a crushing plant which will break the fibres down further to a <3mm fraction size. Although Chrysotile (white asbestos) has been linked to fewer Asbestos Related Diseases (ARDs) than Amphibole (blue and brown asbestos variants), measures will be taken to ensure that employees working in this environment have no exposure to airborne asbestos fibre dust.

All material during this process will be kept wet using a sprinkler system to suppress dust. Water used for indoor dust suppression will pass through a collection system whereby solids will settle in a sump and the water re-circulated to the production process. Water will be sourced from existing groundwater recovered from the old mine with an estimate of approximately 40,000m^3 per month utilised. No chemicals will be utilised and no minerals extracted during this stage of the process. The quality of the groundwater water before use, after use and after treatment for re-use is shown in Table 2. Treated water will be reused for scrubbing, crushing, milling, gravity and magnetic separation. The solids from the sump will be recirculated to form part of the slurry exiting the scrubbing plant. The slurry containing the <3mm fraction will be pumped to the concentration plant.

Table 2 - Measured and anticipated quality of process water

Parameter	Water Pollution Control Regulations, 2010 WATER QUALITY OBJECTIVES (RAW WATER AND RECEIVING WATER BODIES) Blank spaces indicate no standard available	Water Pollution Control Regulations, 2010 EFFLUENT STANDARDS Blank spaces indicate no standard available	Purification of Industrial Water and Effluent Regulations, 1967 Water Act, 1967 repealed and replaced by Water Act, 2003 which is silent on effluent regulations. No new regulations have yet repealed or replaced 1967 regs Blank spaces indicate no standard available	Mineshaft Groundwater Quality (Measured Baseline)	Anticipated quality of water after use in dust suppression, scrubbing, crushing, milling, gravity and magnetic separation Increases are anticipated due to leaching of minerals from agitated sediment. Levels of anticipated increase are based on measured baseline of surface water immediately downstream of tailings	Anticipated quality of water after treatment in preparation for re-use in dust suppression, scrubbing, crushing, milling, gravity and magnetic separation Decreases are anticipated due to extraction of minerals from the production process and introduction of oxygen which will enable decomposition of organics
Aluminium (mg/l)	<0.2			0	0	0
Arsenic (mg/l)			<0.5	0	0	0
Asbestos fibres				0	0	0
Benzenes (mg/l)		<0.1				
Beryllium (mg/l)				0	0	0
Biological Oxygen Demand BOD (mg/l)	<5	<10				
Boron (mg/l)			<1	0.05	2	0.05
Cadmiun (mg/l)	<0.003			0	0	0
Calcium (mg/l)	no limit specified			17.19	20	10
Chemical Oxygen Demand COD (mg/l)	<10	<75	<75	1.5	10	1
Chlordane (mg/l)		<0.05				
Chlorides (mg/l)				0	0	0
Chlorine (mg/l)						
Chromium (mg/l)			<0.5	0.004	0.005	0
Cobalt (mg/l)				0	0	0
Colour (Pt–Co) [Platinum-cobalt colour]						
Colour (TCU) [True Colour Units]		<15	0			
Copper (mg/l)			<1	0	0	0
Cyanide as CN (mg/l)			<0.5			
DDT Metabolites (mg/l)		<0.05				
Dissolved Oxygen (mg/l)	≥ 4	>75	>75			
Dye (mg/l)						
Electric Conductivity EC (µS/cm)	<1800	<1500		237	350	200
Endrine (mg/l)		<0.001				
Faecal Coliforms Most Probable Number (MPN/100ml)	1 - 10	0				
Fluorine (mg/l)	<1		<1	0	0	0
Free ammonia (mg/l)	<0.6		<10			
Free chlorine (mg/l)						
Heptachlor (mg/l)		<0.05				

Parameter	Water Pollution Control Regulations, 2010 WATER QUALITY OBJECTIVES (RAW WATER AND RECEIVING WATER BODIES) Blank spaces indicate no standard available	Water Pollution Control Regulations, 2010 EFFLUENT STANDARDS Blank spaces indicate no standard available	Purification of Industrial Water and Effluent Regulations, 1967 Water Act, 1967 repealed and replaced by Water Act, 2003 which is silent on effluent regulations. No new regulations have yet repealed or replaced 1967 regs Blank spaces indicate no standard available	Mineshaft Groundwater Quality (Measured Baseline)	Anticipated quality of water after use in dust suppression, scrubbing, crushing, milling, gravity and magnetic separation Increases are anticipated due to leaching of minerals from agitated sediment. Levels of anticipated increase are based on measured baseline of surface water immediately downstream of tailings	Anticipated quality of water after treatment in preparation for re-use in dust suppression, scrubbing, crushing, milling, gravity and magnetic separation Decreases are anticipated due to extraction of minerals from the production process and introduction of oxygen which will enable decomposition of organics
Hexachlorobenzene (mg/l)		<0.01				
Hexavalent Chromium as Cr (mg/l)			<0.05			
Iron (mg/l)	<1			0	0	0
Lead as Pb (mg/l)			<1	0	0	0
Lindane (mg/l)		<0.01				
Magnesium (mg/l)				25.81	35	0
Malathion (mg/l)		<0.2				
Manganese (mg/l)	<0.5			0	0.007	0
Mercury (mg/l)	<0.001					
Mirex (mg/l)		<0.01				
Molybdenum (mg/l)				0	0	0
Nickel (mg/l)						
Nitrate as nitrogen NO3- (mg/l)	<10	<20		0	0	0
Nitrite as nitrogen NO2- (mg/l)	0.2 - 3.0			0	0	0
Odour/ Taste (mg/l Pt Scale)			0			
Oil and grease (mg/l)						
Oxygen Absorbed OA (mg/l)			<10			
Parathion (mg/l)		<0.01				
pH (–)	6.5-8.5	6.5-8.5	5.5-9.5	8.47	8.5	8
Phenolic Compounds as Phenol (mg/l)			<0.1			
Phenols (mg/l)		<0.1				
Phosphate (mg/l)						
Polychlorinated Biphenyls (PCB) (mg/l)		<0.01				
Polycyclic Aromatic Hydrocarbons (PAHs) (mg/l)						
Potassium (mg/l)				0.37	15	0
Residual Chlorine as Cl (mg/l)		<0.5				
Selenium (mg/l)				0	0	0
Silica (mg/l)						
Soap, oil, grease (mg/l)		<100	<5			
Sodium (mg/l)			Increase of <50 of intake water	3.63	10	0
Sodium Carbonate Na2CO3 (mg/l)						
Sodium Chloride NaCl (mg/l)						

Parameter	Water Pollution Control Regulations, 2010 WATER QUALITY OBJECTIVES (RAW WATER AND RECEIVING WATER BODIES) Blank spaces indicate no standard available	Water Pollution Control Regulations, 2010 EFFLUENT STANDARDS Blank spaces indicate no standard available	Purification of Industrial Water and Effluent Regulations, 1967 Water Act, 1967 repealed and replaced by Water Act, 2003 which is silent on effluent regulations. No new regulations have yet repealed or replaced 1967 regs Blank spaces indicate no standard available	Mineshaft Groundwater Quality (Measured Baseline)	Anticipated quality of water after use in dust suppression, scrubbing, crushing, milling, gravity and magnetic separation Increases are anticipated due to leaching of minerals from agitated sediment. Levels of anticipated increase are based on measured baseline of surface water immediately downstream of tailings	Anticipated quality of water after treatment in preparation for re-use in dust suppression, scrubbing, crushing, milling, gravity and magnetic separation Decreases are anticipated due to extraction of minerals from the production process and introduction of oxygen which will enable decomposition of organics
Sodium Hydroxide NaOH (mg/l)						
Sulphates (mg/l)				9	35	1
Sulphides (mg/l)			<1.0			
Sulphur trioxide (mg/l)						
Temp. (°C)		<35	<35			
Toluene (mg/l)		<0.05				
Total Alkalinity TA (mg/l) as CaCo3						
Total Coliforms Most Probabale Number (MPN/100ml)	1 - 10	<10		326	500	5
Total Dissolved Solids TDS (mg/l)		<500	Increase of <500 of intake water			
Total Hardness TH (mg/l) as CaCo3	<1000					
Total Kjeldahl Nitrogen TKN (mg/l)						
Total Suspended Solids TSS (mg/l)		<25	<25	0	100	5
Toxaphene (mg/l)		<0.001				
Turbidity (Nephelometric units)	<5					
Xylene (mg/l)		<0.3				
Zink (mg/l)			<5	0	0	0

2.4.4 Concentration

The purpose of concentration is to segregate slurry constituents by particle size and weight, thereby enabling separation of the mineral ores by their differing properties of mass per unit volume. This will be achieved through:

- Pumping the <3mm material from the scrubber, in slurry form, to a steady head which is a reservoir at a fixed height to enable the slurry to gravitate at constant pressure through spiral concentrators.
- Gravitating the slurry through vertical spirals to separate the constituents. A spiral consists of a tubular channel or conduit arranged in a vertical coil formation. As the slurry flows downward by gravity along the channel, the rotational movement causes all particles to be flung outwards from the centre of the spiral. Heavier particles settle sooner than lighter particles. Thus, heavier and coarser particles settle along the inside track of the channel while lighter and finer particles settle along the far edge. Medium particles settle along the middle. Pores along the bed of the channel bottom enable the particles to be drawn off while the liquid re-circulates to the crushing stage to form the slurry.

There will be three sets of spirals consisting of a rougher set, cleaner set, and scavenger set. The slurry from the crushing stage is fed into the rougher set. The output is fed into the cleaner set for retreatment to achieve a higher grade of separation. The output from the cleaner set is fed into the scavenger set for even further refinement.

The output from the spirals will consist of heavy particles “heavies”, medium particles “middlings” and light particles “lights”. During Phase 1, the heavies and middlings will be milled and procced to magnetic separation. During Phase 2, the heavies will be fed into the Central Gold Processing Plant. The lights will be milled and fed into cyclonic separators where particles >100µ will re-circulate to milling while those <100µ will proceed to acid leaching.

2.4.5 Magnetic separation

Heavies and middlings from the spirals will be milled to <100µ and fed into the magnetic separator in order to extract the magnetite (ferric oxide) which will be sold in crystalline form.

2.4.6 Flotation

Following the separation of the magnetite, the slurry will be fed into flotation tanks where air bubbles will be introduced, causing lighter particles to float and heavier particles to settle. The lighter particles will be skimmed and fed into the acid leach plant while the heavier particles consisting of metal sulphides will be sold to markets. Gold-bearing metal sulphides will be processed in the Central Gold Plant from Phase 2.

Polypropylene (plastic) woven bags of 500kg carrying capacity will be used to bag the material that is dispatched to market. The bags will be re-used until unfit for purpose and thereafter re-cycled on site through a melter that will heat numerous bags simultaneously to form plastic pellets which will be sold as raw material to plastic recyclers.

2.4.7 Acid leaching of asbestos

The lights from flotation will enter the leaching process which will use approximately 2,500 tonnes per month of sulphuric acid. The serpentinite, asbestos and mineral elements such as magnesium, nickel and chrome will be dissolved in the acid solution. The leaching process will be an exothermic reaction, generating temperatures of approximately 47 – 52^{o}C.

Nickel, gypsum and magnesium hydroxide will be recovered through precipitation while magnesium sulphate will be recovered through crystallization. Gypsum and nickel will be sold to markets while magnesium hydroxide will be passed through a Liquefied Petroleum Gas

(LPG) fired furnace to decompose into magnesium oxide and water. From Phase 2 onwards, the heat source will be heat recovered from the roaster. The magnesium sulphate will be passed through the roaster to undergo a 2-step decomposition: in step 1 magnesium oxide (MgO) and sulphur trioxide (SO_3) are formed. Since SO_3 is not stable at and above 700^oC, it decomposes to form SO2 and a single oxygen molecule which in turn combines with another to form O2. The final products of $MgSO_4$ thermal decomposition are therefore MgO, SO_2 and O_2, of which the SO_2 will be used in manufacturing the sulphuric acid for the acid leaching process. Some of the magnesium sulphate will be sold directly in solid form, without passing through the roaster, for use as fertilizer and pharmaceutical uses such as milk of magnesia.

2.4.8 Roasting

From Phase 2 onwards, gold concentrate received will be heated in the roaster to between 650°C and 700^oC to drive off the sulphur. To initiate the combustion of the concentrate, it will be heated with LPG in the presence of oxygen which will be introduced into the furnace with an air blower. Once initiated, the combustion will be self-sustaining, i.e. requiring no fuel, as the oxidation of the sulphur is exothermic. The temperature will be maintained at 650-700^oC by controlling the feed of concentrate and air. The heat will be recovered by generating steam, which in turn will drive turbines to generate electricity for the entire plant.

The oxidation of the sulphur will generate SO_2 which will be captured in a scrubber: the temperature of the gas exiting the roaster will be reduced to 350°C through a surface-cooling system and then pass through a cyclonic dust separator. This will leave 20-50g/Nm^3 of fine dust (0~10µm) in the gas. The gas will further pass through a high-temperature electric dust separator (with 99.3% efficiency) for dust collection. Thereafter, the gas with particulates removed will enter the acid-making plant where the SO_2 gas will be mixed with water to produce the sulphuric acid (H_2SO_4) for the leaching process. The final gas with particulates and SO_2 gas removed will be discharged to the atmosphere in compliance with the Air Pollution Control Regulations, 2010.

2.4.9 Residue

The residue material, after leaching and extraction of the base metals and sulphides will be inert and pH neutral. All sulphides, heavy metals and chrysotile will have been removed, therefore the residue material will comprise silica and gypsum. The silica will be used for progressively backfilling the open cast excavations. A portion will be mixed with wood residue from local timber enterprises and local garden clippings to produce top soil to enable the establishment of vegetation to protect the backfilled sections from erosion. The gypsum will be sold as fertilizer and, where required, a portion will be used as fertilizer to promote vegetation growth on the backfilled and landscaped sections.

2.4.10 Water management in dust suppression

The dust suppression system for keeping the tailings wet during extraction will entail pumping water from the existing underground mine shafts to a series of 10 header tanks of 10,000 litres each. The tanks will be placed 30m above the tailings extraction point and processing operations. Water will be piped to irrigate the extraction point with at least 3 bar (300kPa) pressure. The delivery nozzles will produce a fine spray to moisten the work areas thus preventing dust particles from becoming airborne. An estimated 40,000m^3 per month will be used for dust suppression of the extraction points during Phase 1.

The water draining from dust suppression on the tailings will drain in either of two routes. One route will be back to the mine shaft from where it will recirculate to the suppression system. The second route is to the tailings dams at the lower/ south end of the site whose purpose is to trap sediment eroded from the tailings by stormwater. The water exiting the tailings dams will be recirculated to the header tanks. Since the water in both routes will have been filtered by virtue of having percolated through the tailings, it will be suitable for reuse in

dust suppression. Water that does not drain back to the shafts and the tailings dams will evaporate to atmosphere, containing no asbestos fibres.

2.4.11 Water management in production

All water used in scrubbing, crushing, milling, gravity and magnetic separation, and that does not form part of the slurry at these respective stages, will be captured in a collector network which drains to a sump. This includes water used for general cleaning of the plant and floors. The solids from the sump will be recirculated to form part of the slurry exiting the scrubbing plant and from which minerals will be extracted in the subsequent stages described in preceding sections. The supernatant in the sump will be pumped back for reuse in the dust suppression system.

2.4.12 Chemical usage and management

The first point of use of chemicals in the flotation process, where non-hazardous frother and collector chemicals, such as Sodium Isobutyl Xanthate (SIBX) and Xanthate will be added. These are commonly used in floatation processes of sulphide ores and their respective effectiveness depends on the mineral targeted. When added, these chemicals which are a combination of alcohol, sodium hydroxide and carbon dioxide bind themselves to the surfaces of minerals. Since they are hydrophobic (repel water) they attach to the air bubbles introduced into the flotation tank. These properties enable them to collect the minerals which can then be drawn off with the froth from the tank.

The second point of use of chemicals is in the acid leaching process where sulphuric acid (H_2SO_4) is used to extract the minerals from the froth collected from the flotation process. The third point of use of chemicals is during precipitation where the solution from the acid leaching process is neutralised with lime and/ or caustic soda to precipitate the magnesium hydroxide, gypsum and sodium sulphate. The acid leaching and subsequent precipitation and

crystallization processes produce silica and saleable mineral products, leaving no chemical for disposal.

All chemicals will be transported from suppliers using qualified experienced contractors with suitable vehicles and trained drivers. Vehicles will be adequately covered to protect the product from the elements and lockable to prevent unauthorised access. Products will be transported on pallets to mitigate damage which would otherwise lead to leaks in transit. Vehicles will be adequately equipped with spill kits to enable containment and cleaning of minor leaks and spills. Safe, yet economical routes will be selected to mitigate the severity of impacts on the environment and communities in the event of a road traffic accident. This entails avoiding, where possible, routes through densely populated areas, hazardous mountain routes where avoidable. Drivers and conductors will be trained on safe handling of chemicals, keeping Material Safety Data Sheets of all chemicals being transported, displaying the appropriate signage of the chemicals in transit and how to use the spill kit.

All chemicals will be stored in sheltered buildings with secondary containment such as drip trays. Tertiary containment will be in the form of a bund at the entrances and exits of the storage area the prevent leaked chemicals escaping to the environment outside. Shelves and aisles will be marked with the names of the chemicals to which they are designated. Storage areas will be adequately signposted on the outside indicating that they are chemicals stores, the appropriate PPE to be worn when entering and handling them and that unauthorised entry is prohibited. All personnel handling chemicals will undergo pre-employment and regular medical examination and will be periodically trained on safe handling.

Empty chemical containers will be rinsed in a designated bay and the rinsings of each chemical will be stored in the chemical's dedicated labelled container to avoid mixing chemicals. Rinsings will be dosed into the production process thereby avoiding the wastage of chemicals and the need to dispose the rinsings. Rinsed containers will be returned to the

supplier for re-use for the same purpose and recycling, thereby mitigate the manufacture from virgin material.

2.4.13 Phase 2 Production

Phase 2, as shown in the Project Timeline in Table 3 entails scaling up production from treating 40,000 tonnes per month of tailings to treating 200,000 tonnes per month. The number of employees is anticipated to increase from 200 to 300. The timing of Phase 2 is highly dependent upon the actual production that will be achieved in Phase 1.

2.4.14 Central Processing Plant and Acid Production

The Central Gold Processing Plant earmarked for Phase 2 will accept sulphidic gold-bearing concentrates exported from Sub-Saharan countries, including mines in Eswatini as and when they open. The plant will cost between E1.5 billion and E2 billion and will comprise:

- Roasters
- Sulphuric Acid Production Plants
- An Acid Leach Plant
- A Carbon in Leach Gold Plant

The Central Processing Plant will be able to accept auriferous sulphidic concentrate from Eswatini mines. The timing of construction will be dependent upon the successful operation of Phase 1 and will take 2 year to construct.

2.4.15 Proposed site layout

Figure 5 shows the proposed site layout for Industrial Area 1 while Figure 6 shows the proposed site layout for Industrial Area 2.

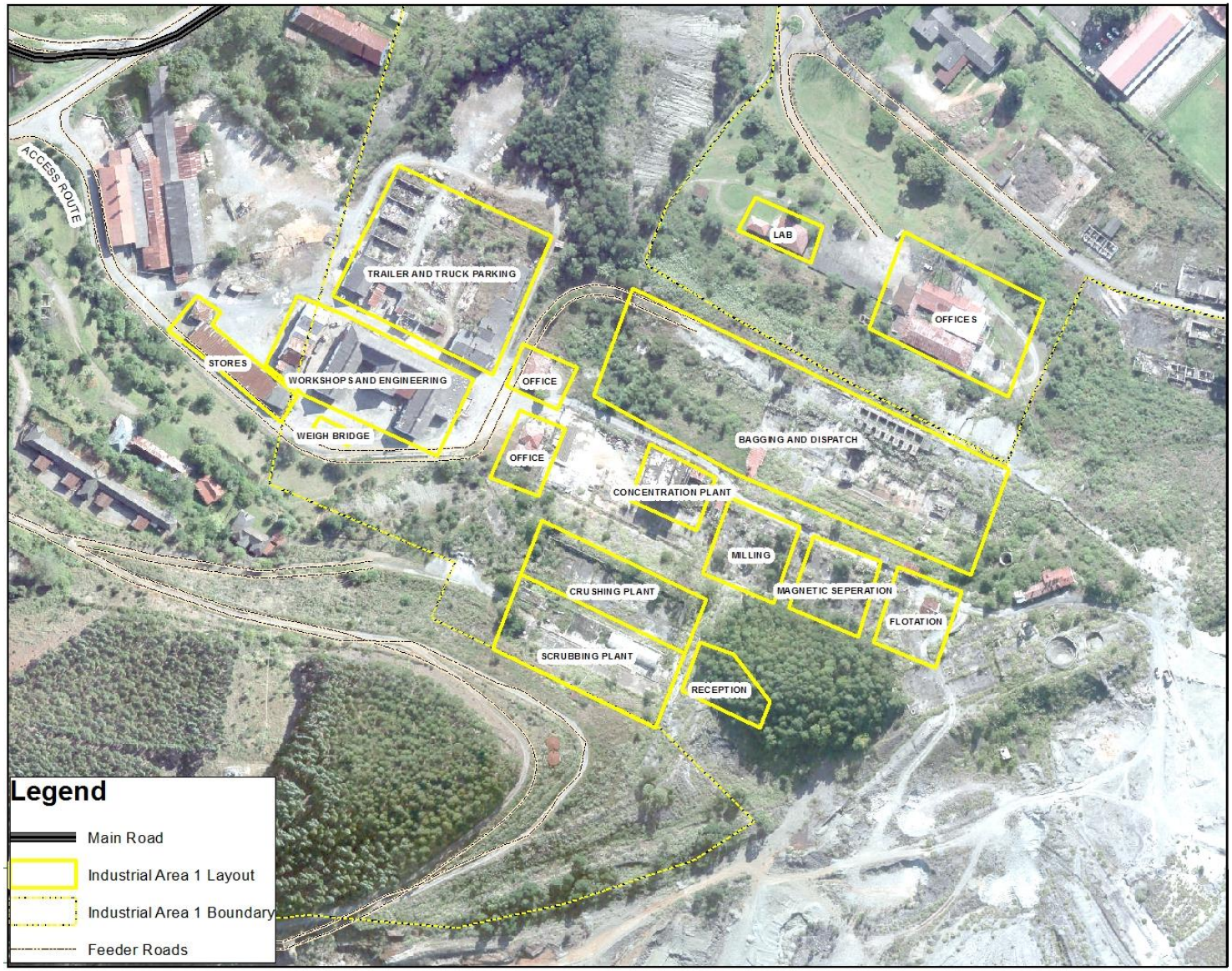


Figure 5 - Proposed site layout for Industrial Area 1

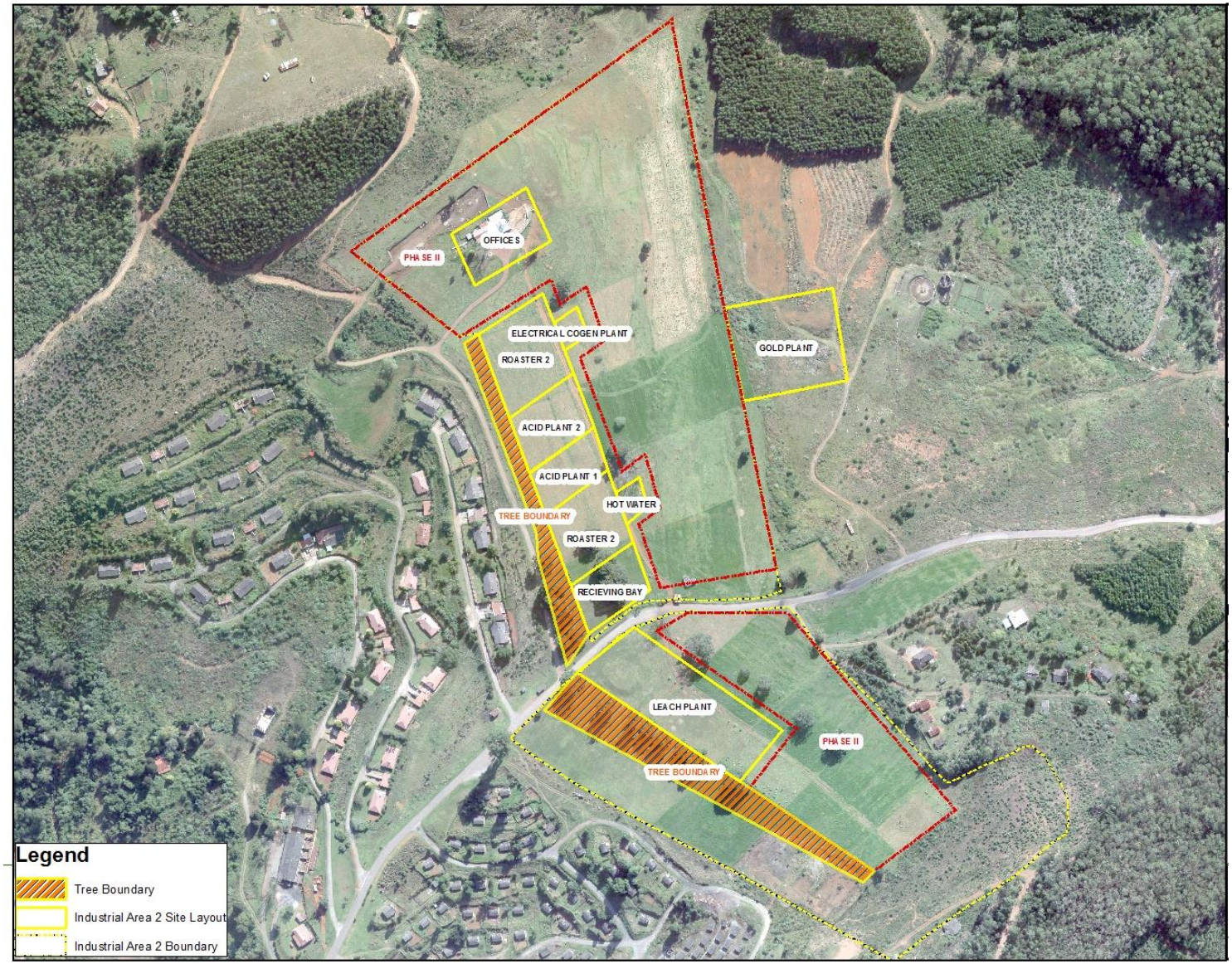


Figure 6 - Proposed site layout for Industrial Area 2

2.4.16 Project Timeline

Table 3 shows the project timeline.

Table 3 - Project Timeline

Phases	Scoping Phase	Construction Phase	Phase 1 - Mining Plan	Phase 2 - Mining Plan
Estimated Timeline	Mar - Dec 2022	Jan 2023- Feb 2024	2024 Onwards	To Be Determined
	Environmental Scoping, Impact Assessment, Comprehensive Management Plan & Rehabilitation Plan & Environmental Compliance Certificate	Site Establishment, Construction of Phase 1 Plant - Low Impact Operations, Process Flow & Operations to be tested	CIL & Gold Plant & Module 1 Roaster Commissioned & production commences	Additional Plant Construction & Production dependent on sulphuric acid supply
Key Activities/ Objectives	Environmental & Community Baseline Assessments & Monitoring Geological Scoping & Process Flow Planning & Competent Persons Report Relocation Planning - Bulembu Child Care Programme	Extract from structurally non-sensitive areas, Deposit into open cast areas Environmental Monitoring New CPP site to be built & relocation to be completed	Deposition to demarcated areas Environmental Monitoring	Deposition to demarcated areas Environmental Monitoring
Target Treatment (tpm)	-	-	40 000	200 000
Expected No. of Employees	15 (Un-Skilled Temporary)	100 (Specialist/Skilled: 50 Semi/Unskilled:50)	200 (Specialist/Skilled:50) Semi/Un-Skilled: 150)	300 (Specialist/Skilled:80) Semi/Un-Skilled: 220)

2.4.17 Transport and logistics

There are a number of options being considered for the transportation needs during the lifetime of the Kobolondo Project. Table 4 indicates the preliminary estimation of haulage volumes and possible routes. Figure 7 illustrates the possible entry and exit routes during construction. Figure 8 illustrates the possible entry routes during Phase 1 and 2. Figure 9 illustrates the possible exit routes during Phase 1 and 2. The TSF in Bulembu will be the central point of all subsequent transport routes. Materials will travel into Bulembu from South Africa for processing and the refined/ processed material will travel out for export. The movement of material from South Africa to Eswatini will be from the Barberton Greenstone belt into Bulembu either via Barberton and the Bulembu border post or via Ngwenya border post to Pigg's Peak and then across to Bulembu.

The two main alternatives once the material is at Bulembu are to transport product to export harbour either via Pigg's Peak in Eswatini or via Barberton in South Africa. Trucks coming into Eswatini will be primarily 6x4 rigid dump trucks on the Barberton to Bulembu route due to the nature and incline of the road leading to Bulembu and from there to the project site. The entrance route from Ngwenya to Pigg's Peak will be dump trucks as described above with the potential for 6x6 or 8x4 configuration, load dependent. Should the proposed MR20 road upgrade be complete, these trucks will continue to Bulembu. However, if the road remains in its current state, a transhipment depot in Piggs Peak where inbound concentrate can be transferred to a 6x6 or 8x8 rigid dump truck for the Piggs Peak to Bulembu leg, will be required. If and when the need arises, a separate environmental assessment of the transhipment site will be undertaken.

The export route will have dump trucks running the short haul from either Bulembu to Barberton or Bulembu to Pigg's Peak with 6x4 crane equipped rigid trucks, truck tractors with triaxle containers or super-link break bulk long-haul vehicles doing the transhipment depo to harbour run.

Table 4 - Preliminary estimation of haulage volumes and routes

Production Phases	Construction	Phase 1	Phase 2
Into Eswatini	3/4 Trucks/day	10-12 Trucks/day	50-52Trucks/day
	Containing: Supplies, Plant & Equipment, General cargo	*Containing*: -Bagged Concentrate (Drop-sided) -General Cargo	*Containing*: -Bagged Concentrate (Drop-sided) -General Cargo
Out of Eswatini	3/4 Trucks/day	8-11 Trucks/day	40-55 Trucks/day
	Containing: Empty	*Containing:* -Containerized Material for Market -Empty	*Containing:* -Containerized Material for Market -Empty
Possible Ports of Entry & Routes	1. Jhb to Josefsdal/Bulembu Border to Bulembu 2. Durban to Josefsdal/Bulembu Border to Bulembu 3. Jhb to Oshoek/Ngwenya Border to Piggs Peak to Bulembu 4. Durban to Oshoek/Ngwenya Border to Piggs Peak to Bulembu	1. Klipwal Mine to Piet Retief to Amsterdam to Barberton to Josefsdal/Bulembu Border to Bulembu 2. Klipwal Mine to Piet Retief to Amsterdam to Oshoek/Ngwenya Border to Piggs Peak to Bulembu 3. Gold Mines on the Greenstone Belt to Barberton to Josefsdal/Bulembu Border	1. Klipwal Mine to Piet Retief to Amsterdam to Barberton to Josefsdal/Bulembu Border to Bulembu 2. Klipwal Mine to Piet Retief to Amsterdam to Oshoek/Ngwenya Border to Piggs Peak to Bulembu 3. Gold Mines on the Greenstone Belt to Barberton to Josefsdal/Bulembu Border

Production Phases	Construction	Phase 1	Phase 2
Possible Ports of Entry & Routes	1. Bulembu to Josefsdal/Bulembu Border to Jhb/ Durban - (reverse route) 2. Bulembu to Piggs Peak to Oshoek/Ngwenya Border to Jhb/ Durban	1. Bulembu to Josefsdal/Bulembu Border to Barberton to Amsterdam to Piet Retief to Durban Port 2. Bulembu to Piggs Peak to Oshoek/Ngwenya Border to Amsterdam to Piet Retief to Durban Port 3. Bulembu to Piggs Peak to MR1/6/5 to Golela/Lavumisa Border to Durban (avoiding MR3MBABANE TO MANZINI) 4. Bulembu to Piggs Peak to Lomahasha Border to Maputo Port	1. Bulembu to Josefsdal/Bulembu Border to Barberton to Amsterdam to Piet Retief to Durban Port 2. Bulembu to Piggs Peak to Oshoek/Ngwenya Border to Amsterdam to Piet Retief to Durban Port 3. Bulembu to Piggs Peak to MR1/6/5 to Golela/Lavumisa Border to Durban (avoiding NR1 & Mbabane) 4. Bulembu to Piggs Peak to Lomahasha Border to Maputo Port
Assumptions/ Dependencies	Operating Mon-Fri Current Border Times at Oshoek/Ngwenya & Josefsdal/Bulembu	Operating Mon-Sat Current Border Times at all borders except Extended Border Times Josefsdal/Bulembu (6am to 6pm)	Operating Mon-Sat Current Border Times at all borders except Extended Border Times Josefsdal/Bulembu (6am to 6pm)
	Upgrade of Pigg's Peak – Bulembu Main Road (MR20) by Ministry of Public Works and Transport is anticipated during Construction and Phase 1.		To consider viability of cableway routes (Bulembu-Barberton or Bulembu to Piggs Peak) to accommodate increased volumes in haulage

2.4.18 Phase 1 of the Mining Plan

It is anticipated that Phase 1 of the Mining Plan will utilise one or more of the following import (red) and export routes (blue) routes:

1) IMPORT: Klipwal/ Greenstone Belt Mines– Josefsdal – Bulembu
2) IMPORT: Klipwal – Ngwenya – Piggs Peak – Bulembu
3) EXPORT: Bulembu – Piggs Peak – Lavumisa – Durban
4) EXPORT: Bulembu – Piggs Peak – Ngwenya – Durban
5) EXPORT: Bulembu – Josefsdal – Barberton – Durban
6) EXPORT: Bulembu – Piggs Peak – Lomahasha – Maputo

To be taken into consideration when weighing up these options is the status of the Pigg's Peak – Bulembu Road. At the time of updating this ESIA Report there had been no formal feedback on when the road construction project will commence or when it will be completed.

2.4.19 Phase 2 of Mining Plan

There are 2 alternatives that will be considered for the second phase of the project. The first is the use of the railway. This would still require trucking to the railway siding at Mpaka and would be dependent on the upgrade of the MR20. Should this road not be upgraded to a paved surface, triple handling of exports would not make the option of rail viable. The second option being considered for Phase 2 of the project is to replace road options to both Barberton and Pigg's Peak with Cableway. This will then service materials being exported from Eswatini as well as materials being brought into the country from South Africa.

There is an existing cableway that runs from Bulembu to Barberton. The cableway shut down when the previous mining operations ceased in the 1990's and is no longer useable. The entire cableway system would have to be replaced from Bulembu to Barberton or as an alternative a brand-new cableway would have to be constructed from Bulembu to Pigg's Peak. As yet, no formal feasibility study has been conducted examining the different options with regard to the upgrade of the previous cableway, or construction of a new cableway. However, the feasibility of the various options will be examined during Phase 1.

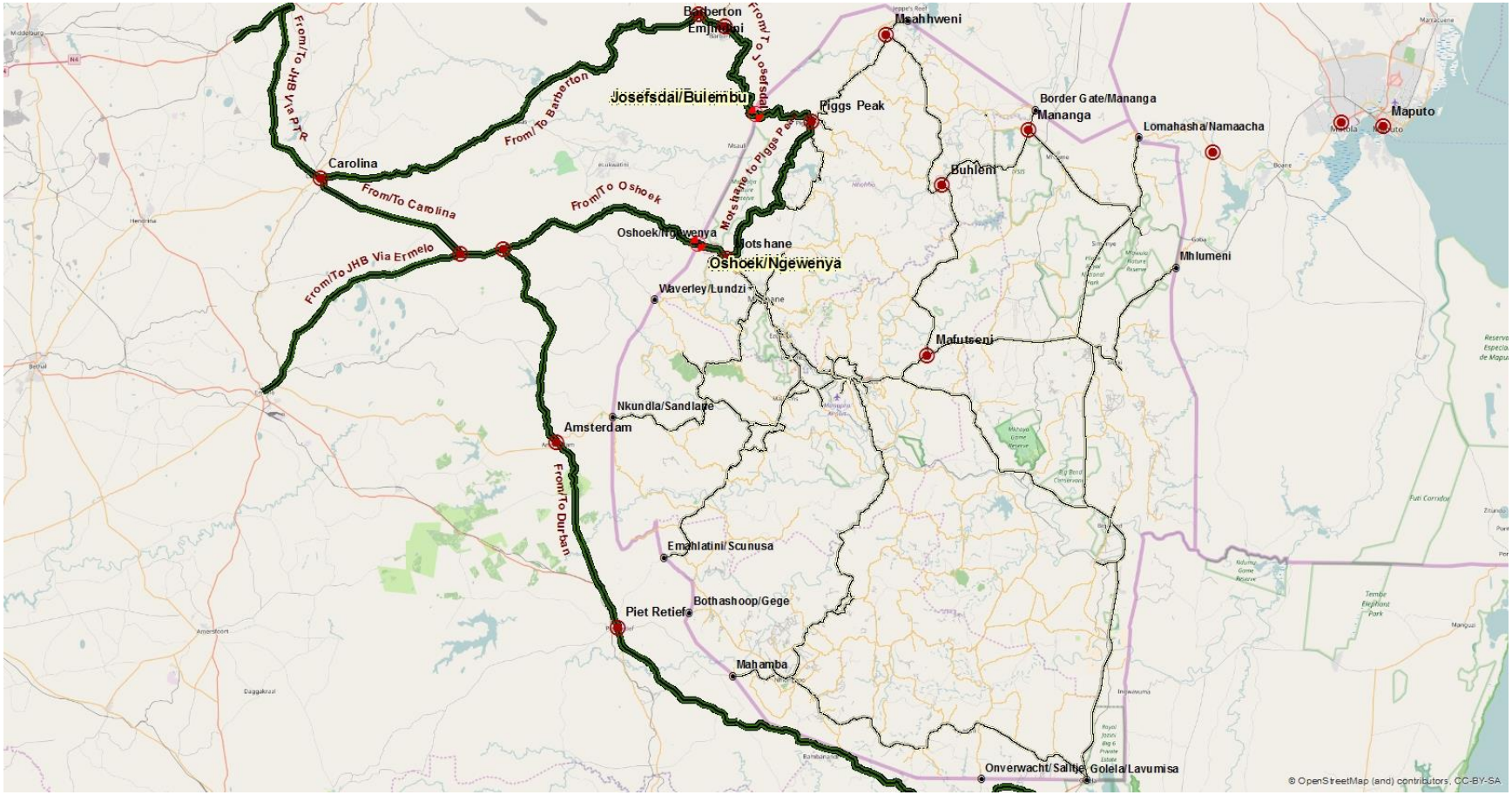


Figure 7 - Possible entry and exit routes during construction

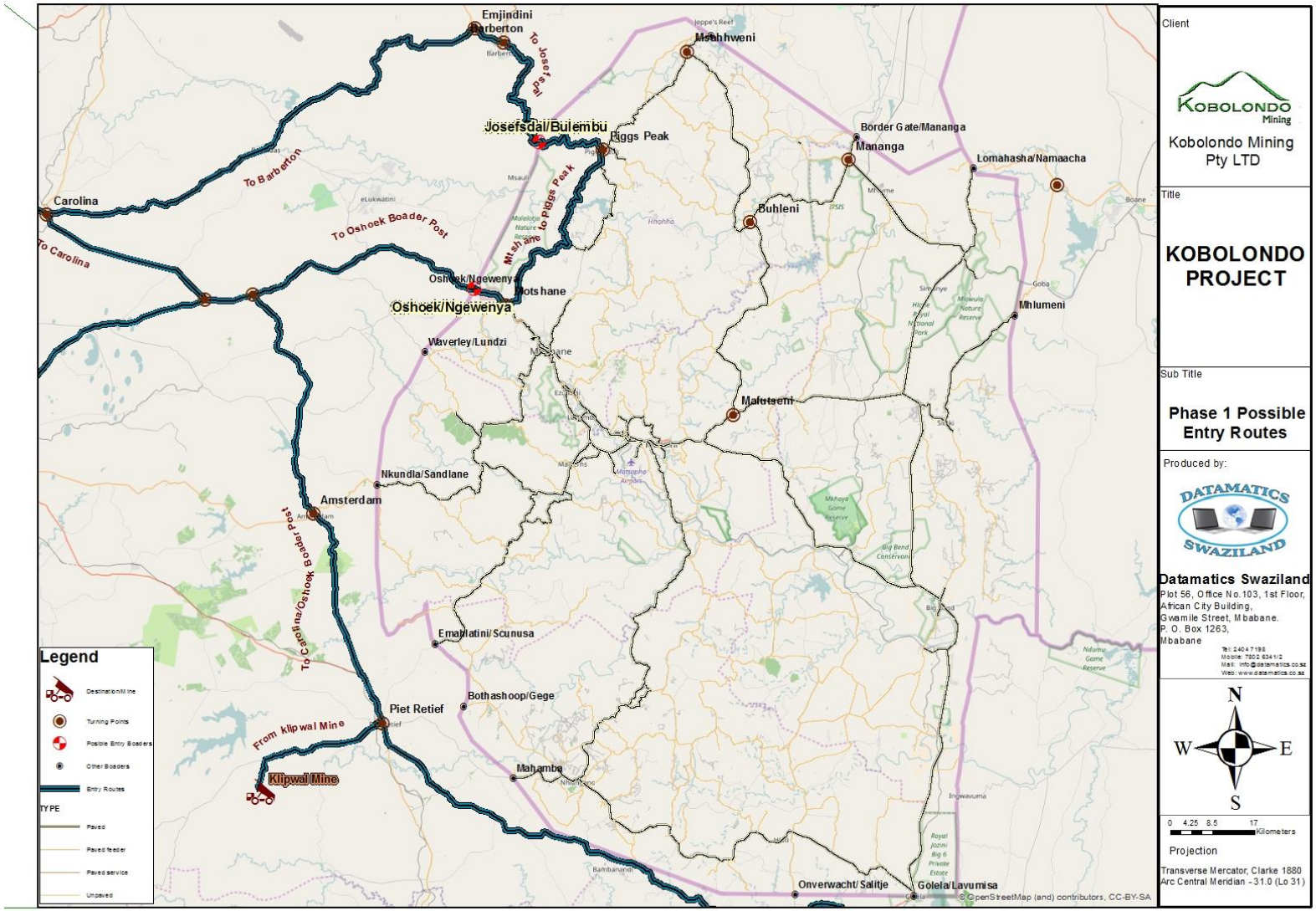


Figure 8 - Possible entry routes during Phase 1 and 2

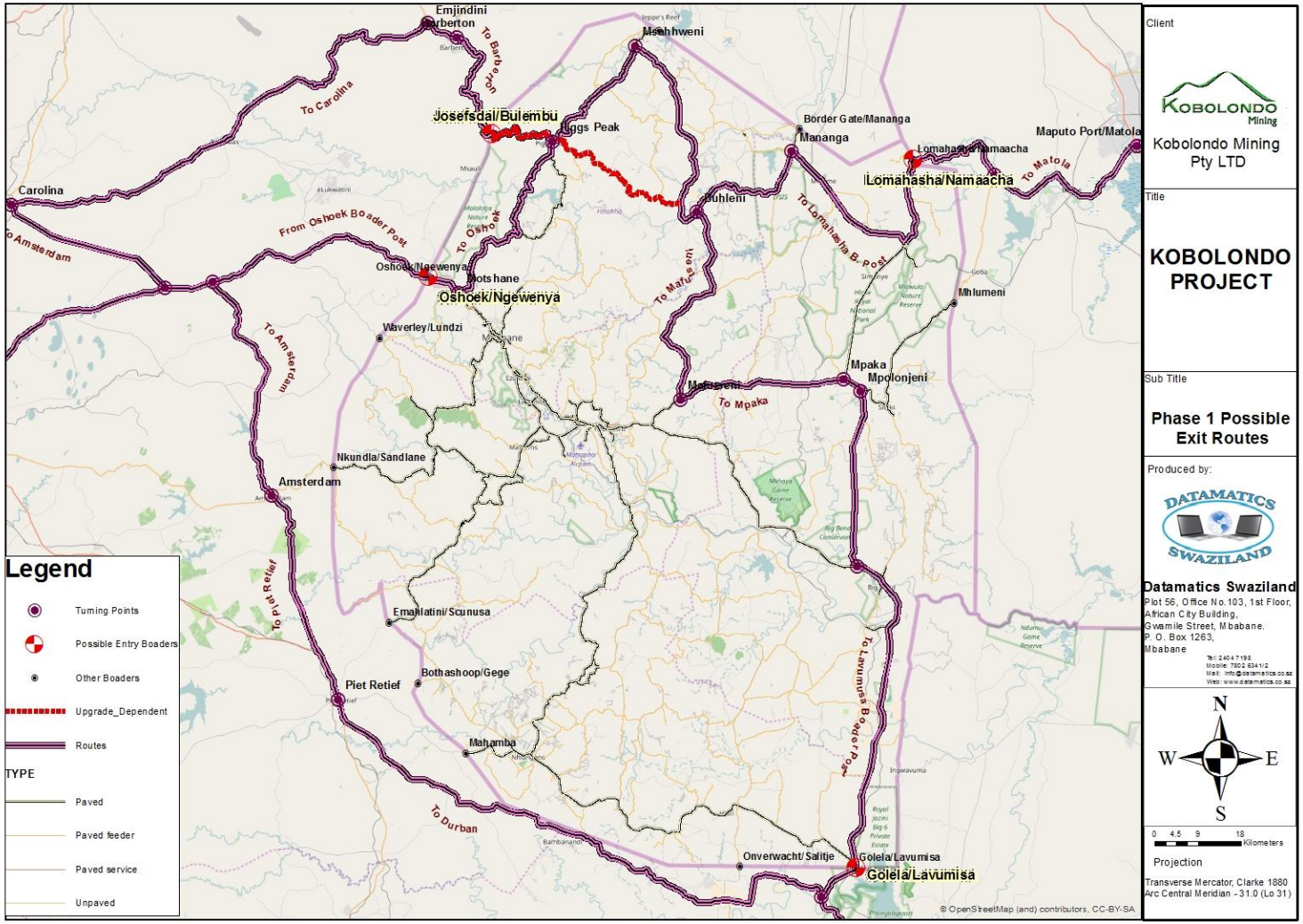


Figure 9 - Possible exit routes during Phase 1 and 2

2.4.20 Energy Sources

Bulembu village has an existing 1,5MVA incomer line. The roasters will generate surplus heat, which will be used to drive a turbine, generating approximately 500-600kVA. The 1,5MVA and the roaster-generated power will be sufficient to operate Phase 1. In addition to the electrical supply three 1MVA diesel generators will be installed to provide backup power.

3. LEGAL & REGULATORY FRAMEWORK

The implementation and operation of the project will be carried out with due regard to applicable legal and other requirements as described identified in this section of the Scoping Report. Additional legal and other requirements will be identified during the ESIA process.

3.1 ACTS

3.1.1 Building Act, 1968

This Act provides for the control of the design of buildings and the safety of such buildings. All building design and construction will be in conformity with this Act.

The provisions of this Act will apply to permanent buildings, such as the processing plant and any temporary shelters such as builders' sheds for any contractors.

3.1.2 Children's Protection and Welfare Act, 2012

The Act extends the provisions of Section 29 of the Constitution and other international instruments, protocols, standards and rules on the protection and welfare of children, the care and maintenance of children.

The provisions of this Act will apply to the project in that the process of relocating the Child Care Centre and Child Care Programme need to ensure that the welfare of the children under the care of BMS is protected and that the children in the community are also protected from any harm that may arise from the project. Applicable to the protection, welfare, care and maintenance of children during the relocation process is:

- *Part III – Rights of the Child and Responsibilities of Parents and the Sate. This part of the act addresses, inter alia,*

- *Section 9 – the Right to Education and Welfare. This will be pertinent in terms of mitigating disruption to education during the relocation process as well as ensuring that adequate shelter, diet, clothing, medical attention are provided at the destination of relocation.*
- *Section 10 – the Right to Social Activity. This will be pertinent in terms of ensuring that recreational facilities and cultural activities provided at the destination of relocation are available and are to a standard that is at least similar to that which is has been provided thus far by BMS.*
- *Section 22 – General Functions of the Department of Social Welfare. This will be pertinent in that the relocation process will need to ensure that Department of Social Welfare is consulted with and involved during all aspects of relocation of the Child Care Programme in order for the Department of Social Welfare to carry out its functions of providing information about the development of children.*

Applicable to the protection, welfare, care and maintenance of children in the community during project implementation and operation is:

- *Part III – Rights of the Child and Responsibilities of Parents and the Sate. This part of the act addresses, inter alia,*
  - *Section 16 – the Right to be Protected from Harmful Substances. This clause stipulates that a child has the right to be protected from the use of hallucinogens, narcotics, alcohol, tobacco products or psycho-tropic drugs and any other substances declared harmful and from being involved in their production, trafficking or distribution. This will be pertinent through the need for the proponent to cooperate with the community in controlling activities, such as the sale of liquor and the influx of job-seekers, what are likely to cause conditions that will ultimately expose children to harmful substances.*
  - *Section 22 – General Functions of the Department of Social Welfare. This will be pertinent in that the project proponent will need to ensure that Department of Social Welfare is consulted with during the implementation and operation of the*

project in order for the Department of Social Welfare to carry out its functions of providing support services to strengthen and support families in the community and to reduce the incidence of harm to children.

- *Section 23 – Child in Need of Care and Protection. This clause will be pertinent in mitigating the conditions which are likely to cause children to be exposed to neglect, physical and emotional harm, including sexual abuse. For example in cases where both parents are employed by the project measures will need to be developed to mitigate children's exposure to the aforementioned hazards while the parents are at work.*

3.1.3 Construction Industry Council Act, 2013

The Act provides for the establishment of the Construction Industry Council and the promotion and development of the construction industry in Eswatini, the registration of contractors, the affiliation to the Council of professional bodies and organisations whose members are engaged in activities related to the construction industry, the regulation of the construction industry and the training of persons engaged in construction or in activities related to construction.

Applicable to this project are:

- *Section 27(1) which stipulates that "a contractor shall not carry on business in the construction industry in Eswatini unless the contractor is registered under this Act," i.e. registered with the Construction Industry Council;*
- *Section 28 which stipulates that "contractor registered under this Act shall not undertake construction work in a category in respect of which that person is not registered."*
- *Section 39(1)which stipulates that "a person shall not award a contract for any construction works of such value as the Minister, upon the recommendation of the*

Council, may determine, to another person unless that other person is registered under this Act."

- *Section 40(1) which stipulates that "a person shall not award a contract for construction works to a foreign company or foreign firm without approval of the Council."*
- *Section 41(1) which stipulates that "a person shall not award a contract for any construction works to a foreign company or foreign firm unless the foreign company of foreign firm undertakes the construction works in partnership or jointly with a Swazi company or Swazi firm."*
- *Section 42 which prohibits the use of substandard construction materials.*

3.1.4 Employment Act, 1980

The Act provides for the improvement of the status of employees in Eswatini.

Parts of the Act applicable to the economic well-being of employees are:

- *Part IV which addresses issues pertaining to the establishment of contracts between employers and employees;*
- *Part V which addresses issues pertaining to the termination of contracts of employment;*
- *Part VI which addresses issues pertaining to remuneration and conditions of employment;*
- *Part X which addresses issues pertaining to the employment of women and children.*

Sections of the Act applicable to gender issues are:

- *Section 29, under Part IV, which prohibits the discrimination against employees on the grounds of sex (and other personal attributes such as marital status, race, colour, religion, etc.);*
- *Section 96, under Part X, which provides for equal pay for equal work between male and female employees;*
- *Sections 102 and 103, under Part X, which provide for entitlement to maternity leave by female employees;*
- *Section 105, under Part X, which prohibits termination of employment of female employees arising from or relating to the granting of maternity leave;*
- *Section 106, under Part X, which protects the seniority and/ or remuneration and any other conditions of employment of female employees subsequent to returning from maternity leave.*

3.1.5 Environment Management Act, 2002

This Act provides for environmental management principles and the establishment of regulations with regard to the conduct of environmental assessments.

Sections of the Act relevant to this project are:

- *Section 5 which outlines the Environmental Principles of preventing and minimizing adverse environmental effects, the polluter pays principle, the prudent use of non-renewable resources, the sustainable use of renewable resources;*
- *Sections 34-36 on Pollution Control which prohibit the discharge of contaminants into the environment;*
- *Section 41 on Waste Management which prohibits the collection, transport, sorting, recovery, treatment, storage and disposal of waste in such a manner that causes adverse environmental impacts.*

3.1.6 Explosives Act, 1961

This act provides for the establishment of the Explosives Regulations as empowers the Minister of Natural Resources and Energy to appoint one or more persons as an Inspector of Explosives for the purpose of issuing or granting licenses, certificates and permits in pursuance of any Regulations established under the Act.

While no explosives will be used in the extraction of tailings, this Act is applicable to this project in the event that any explosives, as defined by the Act, are imported, transported, stored, used and disposed in the course of carrying out any activity of the project. Such activities may include those in relation to construction of plant on previously undeveloped sections of the site and quarrying. Applicable sections of the Act are:

- *Section 2 which defines "explosives as:*
  - *gunpowder, nitroglycerine, dynamite, guncotton, blasting powders, fulminate of mercury or of other metals, coloured fires, and every other substance which is used or manufactured with a view to producing a practical effect by explosion or a pyrotechnic effect;*
  - *any fuse, rocket, detonator, cartridge and every adaptation or preparation of any explosive;*
  - *any other substance which the Minister of Natural Resources and Energy may declare to be an explosive.*
- *Section 5 which stipulates that any person who is convicted of an offense against the Regulations who holds a license or permit issued under the Regulations shall be liable, in addition to any other punishment, to the cancellation of his license or permit, or suspension of his licence or permit for a period as the court thinks fit.*

In the interest of public safety and the environment, it is therefore pertinent, in the event that explosives are imported, transported, stored, used and disposed with respect to construction activities (since no explosives will be used during the movement of the material on the TSF), that the project complies with the requirements of the Explosives Regulations.

3.1.7 Factories, Machinery and Construction Works Act, 1972

This Act provides for safe working conditions and the safe use of machinery at factories and construction sites.

This Act is applicable in terms of ensuring that the workplace and machinery are safe and used safely during implementation and operation of the project.

3.1.8 Flora Protection Act, 2001

This Act restricts the plucking, cutting, uprooting or digging up of protected flora. For any activity likely to impact upon indigenous flora, the proponent is required to carry out an impact assessment and develop a mitigation plan.

The key activities which form part of this project, such as site clearing for shaping the sides of the existing open cast as well as realignment of access roads at the site are likely to affect indigenous flora therefore an environmental assessment and mitigation plan are required.

3.1.9 Game (Amendment) Act, 1991

This Act, to be read in conjunction with the Game Act, 1953 provides for the protection of game in Eswatini.

Applicable sections to this project in particular are:

- *Section 8 which prohibits the hunting and dealing in Royal game as listed under the Second Schedule.*
- *Section 12 which restricts the hunting of game.*

These Sections are applicable as some of the protected species listed in the Act potentially occur in the vicinity of the project site, particularly in nearby protected areas.

3.1.10 Mines and Minerals Act, 2011

The Act consolidates the law on mining and provides for the management and administration of minerals and mineral oils.

Applicable to the environmental and social aspects of this project are:

- *Section 125 which requires the holder of a mineral right to obtain authorisation from the Eswatini Environment Authority prior to undertaking large scale mining operations;*
- *Section 126 which requires a mining operator to have a site rehabilitation and closure plan in place;*
- *Section 127 which requires the holder of a mining license to provide the Commissioner of Mines with a bond or some other form of financial security that is satisfactory to the Commissioner, that shall be sufficient to cover the costs associated with the implementation of the environmental and rehabilitation obligations set out in the site rehabilitation and mine-closure plans of the holder of the licence*.

3.1.11 National Trust Commission Act, 1972

This Act provides for the management of cultural institutions, declared national parks, nature reserves, monuments, relics and antiques through the Eswatini National Trust Commission (ENTC) which is a body corporate established under the same Act.

Applicable to this project are:

- *Section 11 which empowers the curator of a declared institution to receive, hold and preserve all specimens, collections or other moveable property of whatever kind placed under the care, loaned to or belonging to the institution. In the event that items such as relics and antiques are discovered during site clearing, the ENTC will be notified in order to collect such relics and antiques for preservation.*
- *Section 25 which provides for the Commission to:-*

- *Make recommendations to the Minister on the proclamation of a national monument, any area of land having a distinctive or beautiful scenery or geological formation, any area of land containing distinctive or beautiful flora or fauna, any area of land containing objects of archaeological, historical or scientific interest or value, or any waterfall, cave, grotto, avenue of trees, old building, or any other place or object (whether natural or constructed by man) of aesthetic, historical, archaeological, scientific, sacred, or religious value or interest.*
- *Make recommendations to the Minister on the proclamation as a relic any fossil of any kind, any drawing or painting or stone or petroglyph known or commonly believed to have been executed by aboriginal inhabitants of Southern Africa, or by any people who inhabited or visited Southern Africa in ancient days, and any implement or ornament known or commonly believed to have been used by them and any anthropological or archaeological contents of the graves, caves, rock shelters, shell mounts, or other sites used by them.*
- *Make recommendations to the Minister on the proclamation as an antique, any movable object (not being a monument or relic) of aesthetic, historical, archaeological or scientific value or interest, the whole or more valuable portion whereof has for more than thirty years been in any part of Southern Africa.*
- *Assume control over any such object requested by the person having the ownership or control thereof and as trustee for the Government accept any such object which the owner desires to donate or has bequeathed to the Government.*
- *Preserve, repair, restore or insure any monument, relic or antique under its control.*
- *Make a register of all monuments, relics and antiques.*

- *Section 26 which stipulates that no person shall destroy, damage, excavate, alter, remove from its original site or export any monument, relic or antique except under the authority of and in accordance with a permit granted by the Commission.*

While the establishment and management of the Musuem at Bulembu does not fall under the direct responsibility of ENTC, any potential implications on its preservation or relocation will require consultation with ENTC.

3.1.12 Occupational Safety and Health Act, 2001

The Occupational Safety and Health Act, 2001 provides for the safety and health of persons in the workplace and for the protection of persons other than those in the workplace against hazards to safety and health arising from work activities.

Relevant sections of this Act applicable to this project are:

- *Section 9 which stipulates the duties of the employer to ensure safe and healthy working conditions, make employees aware of the hazards of the workplace, provide personal protective equipment, provide training and supervision of employees, prevent exposure of non-employees to hazards arising from the works.*
- *Section 11 which stipulates the duties of the employee to cooperate and follow the instructions of the employer, use equipment and safety devices provided by the employer, report accidents and unsafe conditions to the employer.*
- *Section 28 which requires the employer to record and report minor and major accidents and dangerous occurrences to the Labour Inspector.*

3.1.13 Plant Control Act, 1981

This Act provides for the prevention of plant disease. It controls the import and export of plants. It also controls the registration of nurseries and regulates the sale of plants through the control of nurseries.

During rehabilitation the potential introduction of plants which are not indigenous to Eswatini, will be subject to this Ac: although unlikely, this will apply to the introduction of non-

indigenous grass species to stabilise slopes and which provided a platform for subsequent indigenous plant species to establish themselves. Additionally, Section 22 requires owners and occupiers of land to keep the land clear of noxious weeds as specified in the First Schedule of the Act.

3.1.14 Public Health Act, 1969

The Public Health Act, 1969 requires prevention of nuisances and public health hazards such as standing water, pollution of potable water and the disposal of waste water. It also provides for the control of unsanitary and unsafe buildings.

Any nuisance or condition that is likely to be offensive, dangerous or injurious to health will be removed in accordance with this Act.

3.1.15 Road Traffic Act, 2007

This Act provides for the regulation and control of traffic and transport on public roads.

Applicable sections of the Act are:

- *Section 73(1) which prohibits the operation on a public road of a vehicle which causes excessive noise. Environmentally this requirement will be applicable to the use of vehicles transporting material to and from the project site which are likely to generate noise that will be transmitted to neighbouring properties as well as those along the transport routes;*
- *Section 73(2) which prohibits the operation on a public road of a vehicle which emits excessive smoke or fumes. Environmentally this requirement will be applicable to the use of vehicles which will cause air pollution if not adequately maintained.*

3.1.16 Sexual Offenses and Domestic Violence Act, 2018

An Act to make provision concerning sexual offences and domestic violence, prevention and the protection of all persons from harm from other sexual acts and acts of domestic violence. The Act provides for, inter alia, the criminalisation of:

- Rape.
- Incest.
- Sexual assault.
- Causing a potential victim to believe that the potential victim will be sexually assaulted.
- Compelled sexual assault, wherein a person compels a third person, without the consent of that third person, to commit an act of sexual violation with another person without the consent of that other person.
- Compelled self-sexual assault, wherein a person compels another, without the consent of that person, to engage in self-sexual activities.
- Unlawfully administering of a substance, wherein a person intentionally administers or causes a substance to be taken by another person without consent of that person, with the intention of stupefying or overpowering that other person, so as to enable the administering person or any other person to engage in sexual activity with the person to whom the substance is administered.
- Unlawful stalking.
- Commercial sexual exploitation and promotion of commercial sexual exploitation.
- Procuring prostitution, wherein a person (e.g. a pimp or a madam) facilitates another to engage in prostitution.
- Benefiting from prostitution.
- Living from the earnings of prostitution.
- Keeping a brothel.

Applicable to the project will be the risk of sexual offences arising from the influx of project workers during implementation which will increase the vulnerability of persons, particularly women and children, to sexual offences. Another form of increased vulnerability will arise from parents and/or heads of households leaving their dependants at home unattended while at work, i.e. the dependants will be vulnerable to sexual offences committed by strangers from within the community or by other family members.

3.1.17 Water Act, 2003

This Act provides for the management of water resources in Eswatini. It provides for water management structures such as a National Water Authority, Water Apportionment Board, River Basin Authorities, and Irrigation Districts. It establishes a permit system for the abstraction and use of water resources. It also provides for the issuance of effluent control permits. The Water Apportionment Board formed under this Act controls and registers the use of water and the use and safety of water retaining structures such as dams.

Applicable to this project are:

- *Section 34 and 35 which require a permit for the abstraction and use of water from a natural water course. This is applicable to the project as water will be abstracted from either groundwater and/ or surface water sources depending on the variations of whichever is available throughout the life of the project.*
- *Section 62 and 63 which require a user of water for industrial purposes to apply for an effluent control permit. Although a closed circuit system will be used, these sections of the Act will nevertheless be applicable in view of accidental spills from the closed circuit system.*
- *Section 81 which stipulates that a person shall not alter or divert a water course without permission from the Water Apportionment Board (or River Basin Authority where one is in place in the river basin concerned). This will be applicable to this project in the event of any temporary diversion of water along nearby watercourses in pursuit of containing emergency spills or removing silt generated by the un-rehabilitated tailings storage facility which may have accumulated along nearby watercourses.*

3.1.18 Wild Birds Protection Act, 1914

This Act seeks to protect wild birds and makes it an offence for anyone who conveys a live wild bird over a public road or is in possession of it on land in which he is not the owner or lawful occupier.

This Act is applicable *since the project is likely to entail the operation and maintenance of tailings ponds which will inadvertently attract wild birds, resulting in their poisoning. Additionally, site employees are likely to capture live wild birds as bush meat, which will be unlawful.*

3.1.19 Workmen's Compensation Act, 1983.

The Act provides for the compensation and medical treatment of workmen who suffer injury or contract work-related diseases in the course of their employment.

This Act will apply in the event that employees of the project proponent or those of its contractors are injured or suffer work-related diseases in the course of their employment.

3.2 REGULATIONS

3.2.1 Air Pollution Control Regulations, 2010

These Regulations provide for air quality objectives, air quality monitoring, reporting of air pollution incidents and the obligation to take corrective and preventive measures against harm to air quality.

During implementation *and operation any activities that may cause harm to air quality will be subject to these regulations. Pertinent to the project will be the need to control dust and particulate matter which may adversely affect site employees, residents of the village surrounding communities as well as visitors.*

3.2.2 Building Operations Regulations, 1969

These Regulations provide for the control of building activities and the safety of buildings.

Applicable regulations are:

- *Regulation 5 which stipulates that no rubbish, materials or other matter from building construction, repair, maintenance and demolition shall be deposited in a street or public place. For this project this will be along public roads, neighbouring properties and communities;*
- *Regulation 12 which stipulates that building work shall be carried out such that surface and stormwater drains are kept clear at all times;*
- *Regulation 46 which stipulates that temporary sheds are to be kept in a safe and sanitary condition;*
- *Regulation 47 which stipulates that adequate and suitable latrines are to be provided for construction workers before construction work begins;*
- *Regulation 53 which stipulates that no roof, floor or any part of a building shall be overloaded with debris or materials as to render it unsafe;*

- *Regulation 54 which stipulates that a builder carrying out building work shall abate any public nuisance such as noise, dust, unsightliness caused by the work.*

3.2.3 Control of Plastics Regulations, 2021

The regulations control the production, import and usage of plastic bags. They further promote the re-use, recycling and safe handling of plastic bags.

Regulation 4 stipulates that a person who intends to import or manufacture plastic bags of less than 24 microns shall apply to EEA for a license. The regulations will apply to the packaging used in importing and exporting products. Where suitable alternatives are available, these will be used in preference to plastic bags. Where plastic bags are used, such use will be tracked and accounted to ensure that no bags enter the waste stream.

3.2.4 Environmental Audit, Assessment and Review Regulations, 2000

These Regulations control the environmental assessment process and stipulate requirements on the structure of reports and reporting procedures.

The Regulations are applicable to the environmental assessment of the proposed project, including public participation and the structure and format of the ESIA Report and CMP.

3.2.5 Explosives Regulations, 1961

The Regulations provide for the control of purchasing, importation, transportation, storage, use, possession and disposal of explosives.

While the Regulations focus on safety aspects, they are applicable to social and environmental aspects of the project in that failure to comply will cause the potential unintentional (from the point of view of the project proponent) release or distribution of

explosives to unauthorised persons who in turn may use such explosives for criminal activities, including acts of terrorism thereby endangering the public. The unsafe transportation, storage, use and disposal of explosives will potentially cause injuries to persons, damage to property as well as environmental hazards such as landslides, damage to natural habitats and obstruction of natural watercourses.

Parts of the Regulations applicable to the workplace safety as well as public safety and environmental aspects of the project are:

- *Part II – GENERAL, which requires a person to apply for a permit to import explosives, a permit holder to exercise duty of care when transporting, storing and using explosives;*
- *Part IV – CONVEYANCE OVERLAND, which stipulates the requirements for safe transportation of explosives;*
- *Part V – STORAGE, which stipulates the requirements for the safe storage of explosives;*
- *Part VI – SALE, PURCHASE OR ACQUISTION, which requires a person to obtain a permit to purchase, acquire and possess explosives and prohibits the sale of explosives to unauthorised persons;*
- *Part VII – UNLAWFUL POSSESSION, HIDING, AND ABANDONING OF EXPLOSIVES, which prohibits theft, unauthorised possession, unauthorised entry into storage areas, hiding or abandoning explosives and leaving explosives unattended;*
- *Part VIII – USE OF EXPLOSIVES, which stipulates the requirements for the safe use of explosives, including providing notices to the relevant authorities and public prior to blasting;*
- *Part IX – DUTIES OF BLASTING LICENSE HOLDERS, which stipulates the safe conduct of blasting operations;*
- *Part X – DUTIES OF GANGER OR MINER IN CHARGE WHO IS A BLASTING LICENSE OR PERMIT HOLDER, which stipulates the requirements for the employer in ensuring the safe condition of the workplace and workers involved in blasting operations.*

3.2.6 Factories, Machinery and Construction Works Regulations, 1974

These Regulations provide for safe working conditions and the safe use of machinery in the workplace.

These Regulations *are applicable in terms of ensuring that the workplace and machinery are safe and used safely during implementation and operation.*

3.2.7 Litter Regulations, 2011

These Regulations prohibit littering and define litter as discarded, used or consumed substance or waste.

The Regulations will be applicable throughout the implementation and operation of the project in relation to activities where waste is generated, collected and disposed. Applicable clauses are:

- *Regulation 4 which prohibits the dumping, depositing, dropping, throwing, discarding or leaving of litter upon any public place, private property, river, stream, or any body of water as well as from any vehicle upon a public road;*
- *Regulation 7(2) which stipulates that every owner of premises shall place at the entrance or anywhere within the premises receptacles for use by occupants and visitors;*
- *Schedule 2 which prescribes the fines for littering.*

3.2.8 Natural Resources (Public Stream Banks) Regulations, 1951

These Regulations restrict the cultivation or planting of crops or the destruction of natural vegetation within 100 feet (30m) of the banks of any bank or verge of a public stream.

The Regulations will apply with regard to the destruction of vegetation in pursuit of creating a temporary diversion of water along nearby watercourses for purposes of containing

emergency spills or removing silt generated by the un-rehabilitated tailings storage facility which may have accumulated along nearby watercourses.

3.2.9 Ozone Depleting Substances Regulations, 2003

These Regulations control the use of controlled substances and promote the use of ozone friendly substances, products, equipment and technology.

Air conditioning will be used in some project vehicles and buildings, therefore it will be pertinent that ozone friendly substances are used, maintained and disposed safely.

3.2.10 Waste Regulations, 2000

The Regulations control the collection, transport and disposal of solid and liquid waste.

Waste generated during implementation and operation, including demolition of existing structures and household waste generated by site employees, will be subject to the requirements of these Regulations.

- *Regulation 14(1) stipulates that no person shall transport special waste except under and in accordance with a special waste carrier licence issued by the Authority under this regulation, where "special waste" means hazardous waste and clinical waste. This clause will apply to the transportation of oily waste from the workshops on the premises to a central storage tank on the premises prior to re-use on the premises. It shall also apply to transportation of clinical waste from healthcare facilities at Bulembu for treatment and disposal at Bulembu.*
- *Regulation 17(1) stipulates that a person shall not operate a waste disposal facility except under and in accordance with a waste management licence issued by the*

Authority. This will apply to the operation of a non-hazardous waste disposal facility at Bulembu.

- *Regulation 26(1) stipulates that a person shall not undertake a business which involves the recovery of waste and which employs more than ten people, except under and in accordance with a waste recovery licence issued by the Authority. This will apply where recyclable waste is segregated and sent for recycling.*

3.2.11 Water Pollution Control Regulations, 2010

The Regulations provide for the control and reporting of the discharge of effluent. The intentional or negligent discharge of polluting substances above the stipulated limits is prohibited.

The monitoring *and reporting of the quality of any releases to the environment as well as the quality of nearby surface groundwater sources will be subject to these Regulations.*

3.2.12 Workmen's Compensation Regulations, 1983

The Regulations control the reporting of workplace accidents and work-related diseases, the provision and payment of medical treatment of injured employees and the compensation of such employees.

Any workplace accidents and dangerous occurrences during implementation and operation will be reported, and any payment of medical treatment and compensation of injured employees will be conducted in accordance with these Regulations.

3.3 ENVIRONMENTAL PERMITS

Table 5 lists the applicable environmental permits based on the legislation described in 3.1 and 3.2.

Table 5 - Applicable environmental permits

Permit Category	Legislation	Reference within legislation	Permit/ Licence Description	Status of Application
Environmental Authorisation	Environment Management Act, 2002	Section 32(1) No person shall undertake any project that may have an effect on the environment without the written approval of the Authority, or in the case of a review, of the Minister, and except in accordance with any conditions imposed in that approval.	Environmental Authorisation/ Environmental Compliance Certificate	Environmental & Social Impact Assessment (ESIA) Report is at re-submission stage, prior to Public Review.
Environmental Authorisation	Environmental Audit, Assessment and Review Regulations, 2000	Regulation 15(1) The Authority shall, within twenty (20) days after the expiry of the period for public review under regulation 11, or if a public hearing has been held, after receipt of a report of a public hearing consider any EA, IEE, EIA, CMP and summary in respect of which a notice of acceptance has been issued, the comments, submissions and objections put forward by interested and affected persons,	Environmental Compliance Certificate/ Environmental Authorisation	Environmental & Social Impact Assessment (ESIA) Report is at re-submission stage, prior to Public Review.

Permit Category	Legislation	Reference within legislation	Permit/ Licence Description	Status of Application
		and the report of any public hearing, and either issue, or refuse to issue, an environmental compliance certificate.		
Waste Management	Environment Management Act, 2002	Section 42 No person may construct, own or operate a landfill site, incinerator or other facility at which waste is permanently disposed of or is stored indefinitely, without possessing and being in compliance with all the necessary approvals under section 32.	Waste management licenses – see Waste Regulations below for: - Special Waste Carrier License - Waste Management License - Special Waste Management License	See waste management licenses below.
Waste Management	Waste Regulations, 2000	Regulation 14(1) No person shall transport special waste except under and in accordance with a special waste carrier licence issued by the Authority under this regulation. Where "special waste" means hazardous waste and clinical waste.	Special Waste Carrier License Will apply to waste from healthcare facilities, including employee medical examination facilities.	To be applied for upon receipt of Environmental Authorization.
Waste Management	Waste Regulations, 2000	Regulation 17(1) A person shall not operate a waste disposal facility except under and in accordance with a waste management licence issued by the Authority.	Waste Management License Will apply to the operation of a solid waste disposal facility.	To be applied for upon receipt of Environmental Authorization.
Waste	Waste Regulations,	Regulation 23(2)	Special Waste	To be applied for

Permit Category	Legislation	Reference within legislation	Permit/ Licence Description	Status of Application
Management	2000	Every owner or occupier of any land or premises on which special waste is kept, treated or disposed of shall make a written application to the Authority for a special waste management licence accompanied by payment of the fee prescribed in Schedule Four, and if the waste is kept, treated or disposed of within an urban area, shall simultaneously submit a copy of the application to any local authority concerned.	Management License Will apply to the storage and disposal of clinical waste from healthcare facilities.	upon receipt of Environmental Authorization.
Waste Management	Waste Regulations, 2000	Regulation 26(1) A person shall not undertake a business which involves the recovery of waste and which employs more than ten people, except under and in accordance with a waste recovery licence issued by the Authority.	Waste Recovery License Not likely to apply unless waste is recovered for commercial purposes, e.g. recovery of steel from maintenance and repairs for sale to recyclers.	To be determined during implementation and operation depending on quantities of waste recyclable material generated.
Water Use	Water Act, 2003	Section 35(1) An application for a permit (to use water for uses other than primary purposes) shall be made to the Board.	Water Use Permit	To be applied for upon receipt of Environmental Authorization. Not issued without first obtaining Environmental Authorisation.
Water Use	Water Act, 2003	Section 48(1)	Borehole/	To be applied for

Permit Category	Legislation	Reference within legislation	Permit/ Licence Description	Status of Application
		A person shall not abstract groundwater without a permit having been applied for and obtained from the Board.	Groundwater Abstraction Permit Will apply where water is abstracted from old mine shafts/ tunnels/ other boreholes within the property.	upon receipt of Environmental Authorization. Not issued without first obtaining Environmental Authorisation.
Water Use	Water Act, 2003	Section 62(1) A person who — (a) is using water for an industrial purpose or local authority purpose; or (b) applies for a permit or amends a permit to divert, store, or use water for an industrial purpose or local authority purpose, shall at the same time apply to the Board for an effluent control permit.	Effluent Control Permit Will apply to both industrial and domestic wastewater treatment, irrespective of whether or not a closed loop system is used.	To be applied for upon receipt of Environmental Authorization. Not issued without first obtaining Environmental Authorisation.
Plastic bags	Control of Plastic Bags Regulations, 2021	Regulation 4 A person who intends to import or manufacture plastic bags of less than 24 microns shall apply to EEA for a license.	Plastic bag importation and use License Will apply to packaging used in importing and exporting products.	To be applied for upon receipt of Environmental Authorization.

3.4 INTERNATIONAL AGREEMENTS

3.4.1 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989

Eswatini acceded to this international convention in March 2005 and is therefore bound by its requirements. This convention controls the passage of hazardous wastes from one sovereign state to another and the disposal thereof. Eswatini does not have a hazardous waste storage and disposal facility and is therefore dependent upon South African facilities in this regard.

Any hazardous waste, such asbestos-containing roof sheeting likely to be removed during any renovation or demolition of existing buildings, will need to be transported, using an authorised service provider, to South Africa for safe disposal at an authorised facility in accordance with the EEA's procedure and Basel Convention upon liaising with the EEA, until such time that Eswatini develops a hazardous waste disposal facility.

3.4.2 Convention on Biological Diversity, 1992

The Convention's three main goals are: conservation of biological diversity (or biodiversity); sustainable use of its components; fair and equitable sharing of benefits arising from genetic resources. It is the key document regarding sustainable development.

Relevant to the project is the goal of conservation of biodiversity, particularly because Eswatini ratified the Convention in 1994.

3.4.3 Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979 (effective 1983)

As a treaty under the ambit of the United Nations Environment Programme, CMS provides for the conservation and sustainable use of migratory animals and their habitats as well as international cooperation amongst countries through which wild animals pass. Party states to CMS strive towards protecting animals listed in Appendix I of CMS, conserving or restoring their habitats, mitigating obstacles to migration and controlling factors that may endanger listed animals.

Eswatini became a Party State in 2013 and with the listed animals under CMS Appendix I and II being continually reviewed the project will be cognizant of the need to mitigate adverse effects on the habitats of migratory species in accordance with Eswatini's conservation obligations under CMS.

3.4.4 Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), 1995 (effective 1999)

This is an intergovernmental agreement under CMS dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and Canada. AEWA applies to 255 species of birds that are ecologically dependent on wetlands and since all listed species cross international boundaries during their annual migration, the Agreement promotes the conservation of their populations and habitats.

Eswatini became a contracting party to the Agreement in 2013 and therefore the project will be cognizant of the need to mitigate adverse impacts and enhance positive impacts that will arise from the development.

3.4.5 Incomati Maputo Watercourses Tripartite Agreement, 2002

This is an agreement amongst Eswatini, South Africa and Mozambique on the sustainable utilization of the Incomati and Maputo watercourses.

As the Agreement relates to the sustainable use in terms of quality and quantity of the watercourses it will apply to the project, particularly with regard to the potential impacts on the quality and quantity of water along the Komati River.

3.4.6 Montreal Protocol, 1987

The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty whose objective is to protect the ozone layer by reducing and phasing out the production and use of numerous substances that are responsible for ozone depletion, i.e. significantly deplete and otherwise modify the ozone layer in a manner that is likely to result in adverse effects on human health and the environment. It was established in 1987, became enforceable in 1989. The Government of Eswatini acceded to it in November 1992 and has acceded to all four revisions since then, i.e. acceded to the London Amendment (1990) in December 2005, the Copenhagen Amendment (1992) in December 2005, the Montreal Amendment (1997) in December 2005 and the Beijing Amendment (1999) in December 2005.

Through accession to the Montreal Protocol, Eswatini is bound by its requirements, therefore it applies to the project in that it will be required to avoid any substances that are responsible for ozone depletion, such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), which are temporary replacements for CFCs, used in refrigeration and fire extinguishers.

3.4.7 Ramsar Convention on Wetlands, 1971

Adopted in the Iranian city of Ramsar in 1971, this is an intergovernmental treaty that provides for the conservation of wetlands through local and national actions as well as international cooperation as a contribution towards achieving sustainable development.

Eswatini became party to the Convention in 2013 with 3 listed sites which are Hawane Dam, Sand River Dam and van Eck Dam. Although none of the sites are within the project, Sand River Dam is situated approximately 60km downstream (south east) of the project site and draws its water from the Komati River, meaning that any adverse impacts along the river are likely to affect the dam.

3.4.8 Rotterdam Convention, 1998

The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade is a multilateral treaty to promote shared responsibilities in relation to importation of hazardous chemicals. The convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labelling, include directions on safe handling, and inform purchasers of any known restrictions or bans. Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting countries are obliged make sure that producers within their jurisdiction comply.

Eswatini acceded to this international convention in September 2012 and is therefore bound by its requirements. The Convention applies to the project in terms the import of chemicals that will be used in the processing plant. It will therefore be necessary to continually monitor any chemicals that continually added to the convention's list of restricted and banned substances. The potential listing of chrysotile asbestos under the Rotterdam Convention will have no material impact on the project since it will not be transported from the project site to

cross-border countries nor abroad, considering it will have been transformed to concentrates which do not contain asbestos.

3.4.9 Stockholm Convention on Persistent Organic Pollutants (POPs), 2001

Recognizing that POPs possess toxic properties, resist degradation, bioaccumulate and are transported, through air, water and migratory species, across international boundaries and deposited far from their place of release, where they accumulate in terrestrial and aquatic ecosystems, the objective of this Convention is to protect human health and the environment from persistent organic pollutants. Parties to the Convention therefore agreed to prohibit, eliminate and restrict the production and use of POPs as well as ensure their safe disposal.

Eswatini acceded to this international convention in January 2006 and is therefore bound by its requirements. The Convention applies to the project in that it will be necessary to determine and verify whether or not any of the existing and disused infrastructure, such as electrical transformers contain any POPs such as Polychlorinated biphenyls (PCBs) which will then need to be disposed in accordance with the aforementioned Waste Regulations, 2000 and Basel Convention.

3.5 NATIONAL POLICY

3.5.1 National Environmental Policy, 1998 (working document not yet adopted by Cabinet as a national policy)

The Policy promotes the enhancement, protection and conservation of the environment and the attainment of sustainable development in Eswatini.

The 11 principles of the Policy are applicable to the Kobolondo Project with respect to every project proponent's responsibility towards due care for the environment and communities in which operations are carried out. The 11 principles consist of:

Principle 1: Environmental Responsibility

The natural environment of Eswatini is the heritage of all its peoples who individually and collectively bear the responsibility of safeguarding it for both the present and future generations. All personnel and service providers will be made aware of this principle to ensure environmental protection in the supply chain.

Principle 2: Buntfu and Sustainable Use

All our interactions with the environment should be characterised by buntfu and use of the environment should be managed on the basis of sustainability, for the benefit of all Eswatini's inhabitants, both present and future. The preventive, mitigation and enhancement measures documented in this ESIA Report and CMP will be incorporated into operational policies and procedures during implementation and operation, thereby ensuring sustainability.

Principle 3: Environmental Rights

Every inhabitant of Swaziland is entitled to live in an environment that is conducive to health and well being, and to have access to the natural environment on an equitable and sustainable basis, and to the means of enforcing these rights. The environmental rights of

personnel, communities and the public will be safeguarded through adherence to applicable national legislation, national policies and international best practice.

Principle 4: Sustainable Development

Environmental protection and social and economic development are interdependent and indivisible. Integrating environmental protection into the process of social and economic development is essential to achieve equity-led growth and sustainable development. The ESIA has enabled early identification of potential environmental and social impacts and appropriate measures to ensure sustainable development. Risk assessments will continue to be undertaken prior to carrying out specific tasks accounting for the specific weather, environmental, occupational and social conditions at the time.

Principle 5: Public Awareness and Participation

Public awareness and public participation in decision-making concerning their environment is essential for effective, long-term environmental protection and equitable utilisation and management of natural resources, and will be encouraged and facilitated. The public will be given appropriate access to information concerning the environment that is held by public authorities, information on the environment will be made widely available, and education on environmental issues will be promoted.

Principle 6: Community Management

The Government and each person, organisation or community responsible must, wherever possible, take proactive measures to avoid and prevent environmental harm occurring. This principle will extend to Kobolondo's corporate social responsibility programmes which will promote environmental and social responsibility amongst community members.

Principle 7: Preventive Action

Where the environment is threatened with serious or irreversible damage, the government and other responsible parties will take cost-effective measures to prevent the damage. The

Kobolondo Project is itself preventive action against the threat of environmental and social disaster that would otherwise be posed by leaving the tailings un-rehabilitated.

Principle 8: Precautionary Approach

As an extension of the Preventive Action Principle, the Precautionary Approach promotes preventive action, even in the absence of full scientific certainty as to the damage and causes. The Kobolondo Project is precautionary in the sense that action now seeks to prevent a highly likely disaster in the future, despite the tailings having been in place since the operation of the former mine. The observed continual erosion and changes in long term climate suggest the possibility of a sudden collapse of the tailings if left unmanaged.

Principle 9: Polluter Pays

Measures will be taken wherever reasonably practical and with due regard to the public interest, to ensure that the cost of pollution and environmental degradation are borne by the polluter or person who causes the pollution or degradation. In the case of Bulembu, environmental rehabilitation was not undertaken by previous operators of the asbestos mine. Therefore the Kobolondo Project proposes a commercial approach to unlock the value of the tailings in order to fund the rehabilitation process and revitalization of the community. The precautionary principle will further be applied to project activities to prevent and mitigate environmental and social harm.

Principle 10: Proximity Principle

Wherever reasonably practical, pollution should be rectified and waste should be treated or disposed of, at or near the source. The Kobolondo Project is predicated on the prevention of waste in that by-products become raw materials for subsequent stages within the production process and all final products have a usable and economic value. Heat energy from the production process that would otherwise be lost through the atmosphere and transferred to receiving waters as colling water, will also be recovered to generate electricity as well as supply centrally heated water to Bulembu Village. Domestic waste generated by additional

inhabitants will be segregated for recycling, composting and the remaining balance disposed at a local purpose built solid waste disposal facility.

Principle 11: Global and Regional Responsibility

Eswatini will support international efforts to improve the protection of the global environment, will take all reasonable measures to ensure that activities within Eswatini, or subject to its control, do not cause damage beyond its borders, and will co-operate with other states in the region on transboundary environmental issues. The Kobolondo Project aims to set the global benchmark on sustainable rehabilitation of asbestos tailings and a regional and local example on sustainable rehabilitation of former mines. Whilst communication and cooperation with sovereign states will occur at governmental level, the Kobolondo Project will ensure that air and shared waters are not polluted, and that goods transported across borders are handled in a safe manner.

3.5.2 National Climate Change Policy, 2016

A policy framework to guide Eswatini in addressing the challenges posed by climate change. The framework further promotes an enabling environment for communities and investors to seize the opportunities presented by climate change to invest in activities that eliminate poverty and enable climate resilience.

Applicable to the Kobolondo Project are the policy goal, objectives and guiding principles. The goal of the Policy is to develop a sustainable, climate resilient and inclusive low-carbon green growth society. The policy objectives are to:

1) *Provide enabling policy framework for effective implementation of climate change adaptation and mitigation measures;*
2) *Enhance climate-resilient and inclusive low-carbon green growth investments;*
3) *Promote public education, information and awareness on climate change;*

4) *Provide mechanisms for coordination and building of partnerships in addressing climate change.*

Objectives 1) and 2) will be applicable to the generation of electricity from heat recovered from the roasting process where the heat is generated by the exothermic reaction of oxidation of the concentrate. Objective 3 will be applicable to promoting public awareness on the project's environmental performance through making performance data such as air quality, water quality, waste management, occupational safety and community development accessible to the public. This will also encourage communities and investors to participate in the project or replicate the principles elsewhere in Eswatini, thereby achieving Objective 4.

The guiding principles that form the foundation of the Policy are:-

A. Scientifically sound and appropriate information

Planning, policy formulation and decision-making will be based on scientifically and technically sound data and information, while recognizing the value of traditional knowledge.

Economic and technical data collected during laboratory tests and pilot plant runs, together with the baseline environmental and social data collected during ESIA has informed project planning, design and the CMP. Relating to climate change, one of the outcomes has been the recovery of heat energy from the roasting process in order to minimize the reliance on fossil fuel and associated greenhouse gas emissions. The recovery of SO_2 for use in the on-site production of sulphuric acid avoids emission to atmosphere.

B. Integrated approach

Climate change requires multi-sectoral, multi-level and multi-disciplinary approaches in order to build into the national sustainable development objectives.

At project level management of the processing operations, occupational health and safety, employee and community welfare will be interrelated since the project's effectiveness will rely

on a healthy and motivated workforce and supportive community. Therefore, community development will be an integral part of project implementation and operation.

C. Subsidiarity

Actions to address climate change will be undertaken through decentralization and devolution of authority and responsibilities at the lowest level possible.

The project will act at local level in contribution to national, regional and global efforts towards climate change mitigation and resilience.

D. Inter- and Intra-generational Equity

Actions taken to address climate change will be based on a long-term objective where present generations make choices that will benefit future generations.

The rehabilitation of Bulembu will be a long term process and thus its commencement now will benefit present and future generations.

E. Public Participation

A coordinated and participatory approach to climate change should be enhanced to ensure that the relevant government agencies, regional and community institutions, private sector, civil society and communities are involved in planning and decision making processes.

Consultations with local communities during the Scoping Process identified the desire of surrounding communities to be included in the development of Bulembu. The process also identified calls for increased transparency in the management of resources such as land and access to natural resources. This will be addressed through the BDC whose mandate will include the management of community development.

F. Precautionary Principle

Where there are credible threats of serious or irreversible damage associated with climate change, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent such damage.

Increased rainfall is likely to increase the rate of erosion of the tailings. Increased severity of drought will increase the dryness of the soil resulting in soil movement and a catastrophic collapse of the tailings. Therefore the rehabilitation process cannot be postponed.

G. Capacity Building

Capacity building of the key stakeholders, including government agencies, regional and community institutions, private sector, academia and Civil Society Organizations to address climate change will be continually enhanced.

In the Kobolondo Project, capacity building of personnel, service providers and the community will enhance the effectiveness of climate change mitigation and adaption measures.

H. International Cooperation

Multilateral, bilateral and regional agreements and instruments related to climate change should be domesticated and implemented.

Transboundary agreements between Eswatini and other countries will be adhered to at project level.

I. Strategic Partnerships

The challenge posed by climate change cannot be addressed by government alone but will require building of partnerships with relevant stakeholders, including local communities, traditional leaders, business community, Civil Society Organizations, academia and research community.

Climate change mitigation and adaptation measures will be included in partnerships and environmental and social initiatives at Bulembu involving collaboration with stakeholders, such as control of invasive alien pants, catchment management, waste management, water conservation, land use.

3.5.3 National Biodiversity Strategy and Action Plan, 2016

The National Biodiversity Strategy and Action Plan comprises national strategic goals which form a framework for biodiversity conservation. Targets under each strategic goal guide the actions to be taken at national level to achieve the respective goal. The 5 strategic goals comprise:

A) Addressing the underlying causes of biodiversity loss by mainstreaming biodiversity across Government and society.
B) Reducing the direct pressures on biodiversity and promoting sustainable use.
C) Improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity.
D) Enhancing the benefits to all from biodiversity and ecosystem services.
E) Enhancing implementation through participatory planning, knowledge management and capacity building.

These goals are encompassed in the impact prevention, mitigation and enhancement measures developed through this ESIA.

4. THE SCOPING PROCESS

4.1 CONSULTATION OF INTERESTED AND AFFECTED PARTIES

4.1.1 Consultations with governmental agencies, parastatals, corporate bodies, not-for-profit organisations

Kobolondo Magnesium held consultations with a wide range of stakeholders such as regional and traditional authorities, various governmental agencies (including authorising agencies), corporate bodies as well as the land owner, BMS. The engagement of stakeholders covered a wide range of subject matters relevant to each respective stakeholder. A list of the stakeholders engaged was included in the Scoping Report attached in **Appendix B**.

4.1.2 Public consultations

Following the publication of advertisements in the local daily newspapers and national radio, three Scoping Meetings were held with the objectives of presenting the proposed project to the public as well as receiving input on environmental and social issues to be taken into consideration during the ESIA study. Minutes of the scoping meetings are included in the Scoping Report which was reviewed and approved by the EEA.

4.1.3 Public awareness

In addition to the stakeholder engagements, public awareness on the proposed project was disseminated through publications in the local daily newspapers. Excerpts of the newspaper publications were included in the Scoping Report.

5. TERMS OF REFERENCE OF ESIA

The Terms of Reference were the issues to be studied by the ESIA. This included the issues raised during the consultation process as well as those relevant to the project, while taking cognisance of the applicable legal and regulatory framework.

5.1 EXISTING RESOURCES AND LAND USE

5.1.1 Resources

Identify and map existing resources and land uses within the Mining Lease Area and within the greater potential impact area. Resources and land uses include recreation, parks, traditional use and land claims, human habitation, drinking water sources, archaeological considerations, mining, logging, farming, hunting and fishing.

5.1.2 Land tenure

Identify land ownership and cultural rights within the Mining Lease Area including land use permits (formal and non-formal) such as those for power lines and transportation corridors. Identify Crown land and land claims. Clearly demarcate area under mining lease.

5.2 BIOPHYSICAL IMPACT ASSESSMENT

5.2.1 Climate

Compile baseline climatic data relevant to the Mining Lease Area in terms of temperature, wind, precipitation, evaporation. Determine potential impacts on climate change by the project and on the project by climate change.

5.2.2 Topography

Describe regional and Mining Lease Area's topography in terms of relevance to the proposed project using maps, stereo aerial photography, satellite imagery.

5.2.3 Geology

Describe geology and geochemistry in Mining Lease Area in terms of:

- surficial deposits (type, location, density, permeability);
- stratigraphy;
- geomorphology;
- mineral and petroleum resources;
- background elemental content.

5.2.4 Soils

Compile baseline soils data relevant to the Mining Lease Area in terms of:

- characteristics and soil chemistry;
- erosion potential;
- suitability for enabling establishment of indigenous vegetation during rehabilitation;
- suitability for post rehabilitation land uses.

5.2.5 Water resources

Compile baseline data on surface and groundwater resources in Mining Lease Area in terms of:

- watershed delineation and flow patterns;
- historical and potential flood events
- distribution of natural watercourses;
- groundwater yields;
- surface and groundwater quality;
- uses of surface and groundwater.

5.2.6 Ecology

Compile baseline data on flora, fauna, endangered species, threatened species, migratory species. Develop measures to prevent and mitigate negative impacts and measures to enhance positive impacts.

5.2.7 Air quality

Compile baseline data on ambient air quality in Mining Lease Area in terms of indicators such as dust, particulate matter, chemical pollutants. Develop measures to prevent and mitigate negative impacts and measures to enhance positive impacts.

5.2.8 Noise

Compile baseline data on sound levels in terms of community/ environmental noise in Mining Lease Area. Develop measures to prevent and mitigate negative impacts and measures to enhance positive impacts.

5.3 SOCIO-ECONOMIC IMPACT ASSESSMENT

5.3.1 Demographics

Compile baseline socio-economic data relevant to the Mining Lease Area in terms of:

- historical background of indigenous peoples in surrounding communities;
- historical background of residents and employees of BMS;
- population size;
- age and gender distribution;
- economic activities, including development initiatives and needs within community;
- living conditions;
- education, including literacy levels, skills, availability of schools and day care centres, access to and affordability of schools by local community;
- healthcare, including availability of healthcare facilities, access to healthcare facilities, groups exposed to and living with occupational illnesses and groups passively exposed to and living with asbestos related illnesses, prevalence of HIV/AIDS;
- vulnerable groups, including elderly people, children, women, disabled persons;

5.3.2 Occupational and Public Health

Compile baseline occupational health and public health data relevant to the Mining Lease Area in terms of:

- medical history of persons exposed to and living with occupational illnesses and persons passively exposed to and living with asbestos related illnesses;
- sources of exposure to asbestos related illnesses, i.e. amongst former employees of Havelock mine, dependents of former employees of Havelock mine, residents of Bulembu community including their dependants;
- existing availability and adequacy of healthcare facilities to diagnose and manage asbestos related illnesses.

5.3.3 Tourism and conservation

Using the outcome of identification of existing resources, consult further with Eswatini National Trust Commission, Roads Department under the Ministry of Public Works & Transport as well as tourism operators on identifying mechanisms for complementing and contributing to tourism and conservation initiatives in local community and along Pigg's Peak – Bulembu Road.

5.3.4 Influx of people

Using the outcomes of the identification of land ownerships and land claims, develop mechanism of controlling influx of people through consultation with regional and traditional authorities.

5.3.5 Transport and logistics

Compile baseline data on transport and logistics in terms of:

- existing transport routes;
- condition of transport and communication infrastructure;
- usage of public roads in terms of traffic volumes;
- accident rates and severity along transport routes.

5.3.6 Relocation of CCP

Identify:

- the enterprises that will remain after the relocation of the CCP;
- potential impacts on the remaining affected people and surrounding communities arising from the relocation of the CCP.

Develop appropriate measures to prevent and mitigate disruption to, and enhance livelihoods of remaining people and surrounding communities.

5.4 WASTE MANAGEMENT

5.4.1 Solid waste

Assess, prevent and mitigate impacts of solid waste streams and methods of disposal.

5.4.2 Wastewater

Assess, prevent and mitigate impacts of wastewater sources and methods of disposal.

5.5 ENERGY CONSERVATION

5.5.1 Sources of energy

Assess, prevent and mitigate impacts of energy sources and consumption.

6. DESCRIPTION OF THE ENVIRONMENT

6.1 TERRAIN

Bulembu is located in the north western Highveld which is characterized by steep mountainous terrain with rocky outcrops. The project site is at an altitude of approximately 1,158masl on a south facing slope bounded by steep hills to the west, north and east. The south facing slope forms the natural draining towards natural watercourses which drain to the Komati River. Figure 10 illustrates the terrain at Bulembu in relation to Pigg's Peak and Barberton as travelled along the main road.

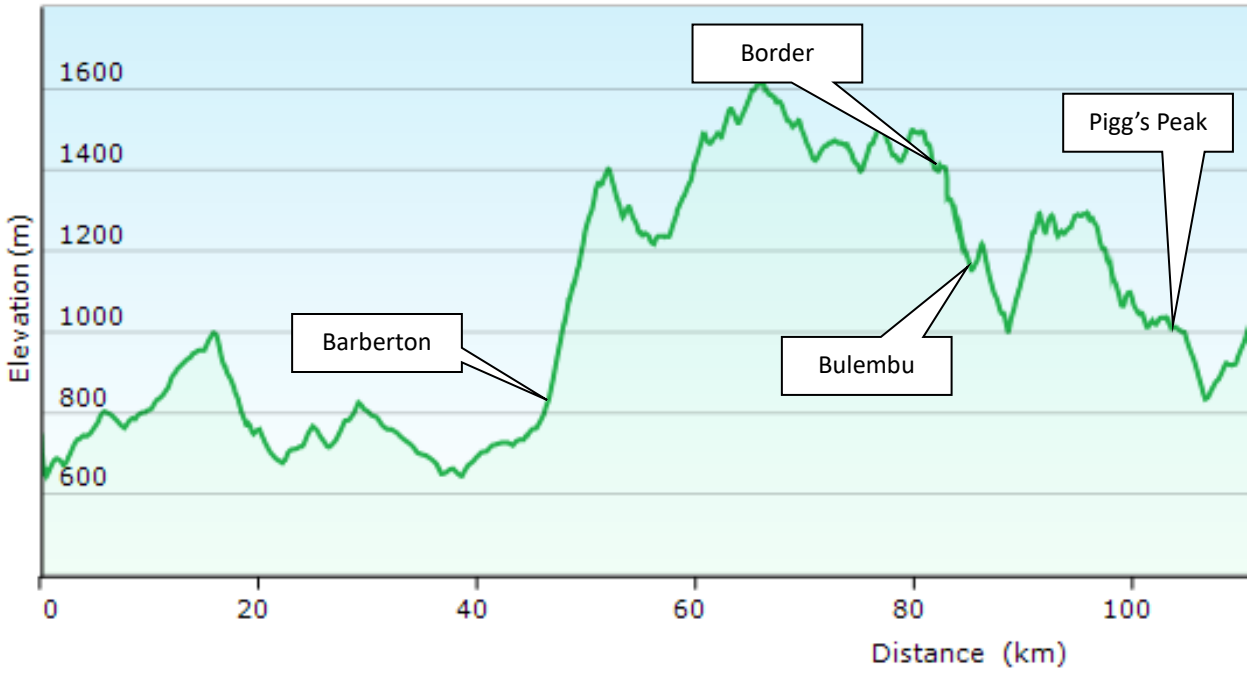


Figure 10 - Terrain at Bulembu in relation to nearest towns

Figure 11 shows various photos of the existing Tailings Storage Facility.

a) TSF at west end as viewed facing west. Open cast in foreground.

b) Crown pillar comprising 70m thick solid rock as viewed from the north facing south.

c) East end of TSF as viewed facing eastwards. Material is susceptible to erosion.

d) South west end of TSF as viewed from lower end facing northwards. Exposed slopes are susceptible to erosion.

Figure 11 - Selected images of un-rehabilitated Tailings Storage Facility

The relevance of terrain to this project is that the steep slopes will increase the vulnerability of the project to erosion, particularly during heavy rainfall, thereby increasing the risk of material being translocated to nearby watercourses.

6.2 GEOLOGY

6.2.1 Regional level

The Havelock mine and its tailings are located in the Barberton Greenstone Belt, a geological heritage area renowned as one of a few preserved sites with the oldest rocks on earth. The Barberton greenstone belt, located in eastern part of South Africa and part of northern Eswatini, occupies an area of 120 x 50 km with an estimated depth of less than 8 km. **Error! R eference source not found.** shows the geological of the Greenstone Belt.

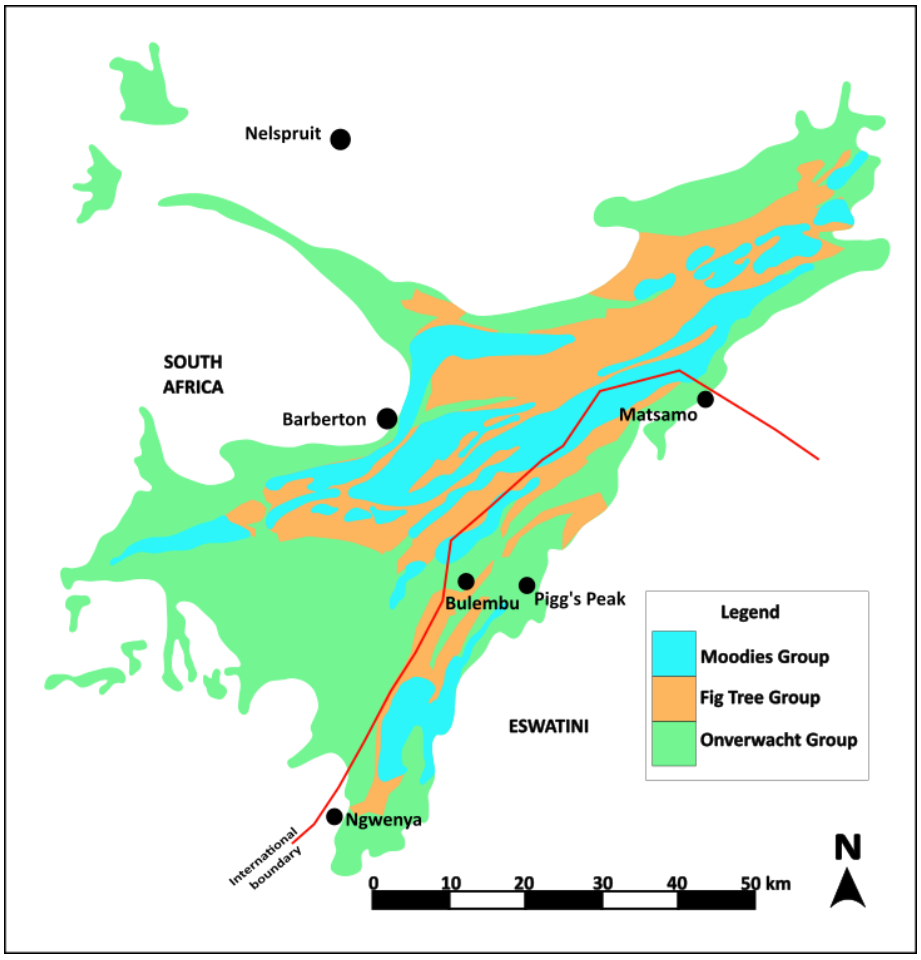


Figure 12 - Geological map of the Barberton Greenstone Belt

The Barberton greenstone belts consists of Archaean (ages ranging from 3,600 million years to 3,100 million years) mafic-ultramafic volcanic rocks and sedimentary rocks which are

entirely engulfed in intrusive granitoid rocks. **Error! Reference source not found.** shows the l ayering of the rocks and the approximate age of each layer.

Supergroup	Group	Age (Ma = million years)	Composition and formation
Barberton	Moodies	3225-3215	Mudrocks, Sandstones and conglomerates formed in alluvial, fluvial, deltaic, shoreline and tidal environment.
	Fig Tree	3255-3225	Sandstones, shales and conglomerates, mostly deposited in deep water; chemical sediments, including chert, banded iron formation, baryte; some volcanic strata.
	Onverwacht	3550-3260	Komatiites and basalts; fine-grained tuffs; some chert, banded iron formation; layered ultramafic-mafic intrusions consisting of dunite, pyroxenite and gabbro.

Figure 13 - Stratigraphy of Barberton Greenstone Belt

The main lithologies of the Barberton greenstone belt include komatiite, basalts, sandstone, shale, banded iron formation and granite. When the rocks of the greenstone belt get weathered, the mafic-ultramafic lithologies become serpentine soil which is rich in magnesium, nickel and chromium. The concentration of these metals is not conductive for plant growth and is sometimes toxic to plants.

6.2.2 Project level

The Kobolondo Project aims to treat the tailing material left by the old Havelock mine in Bulembu. There are 19 chrysotile deposits in the Barberton greenstone belt whose distribution is shown in Figure 14.

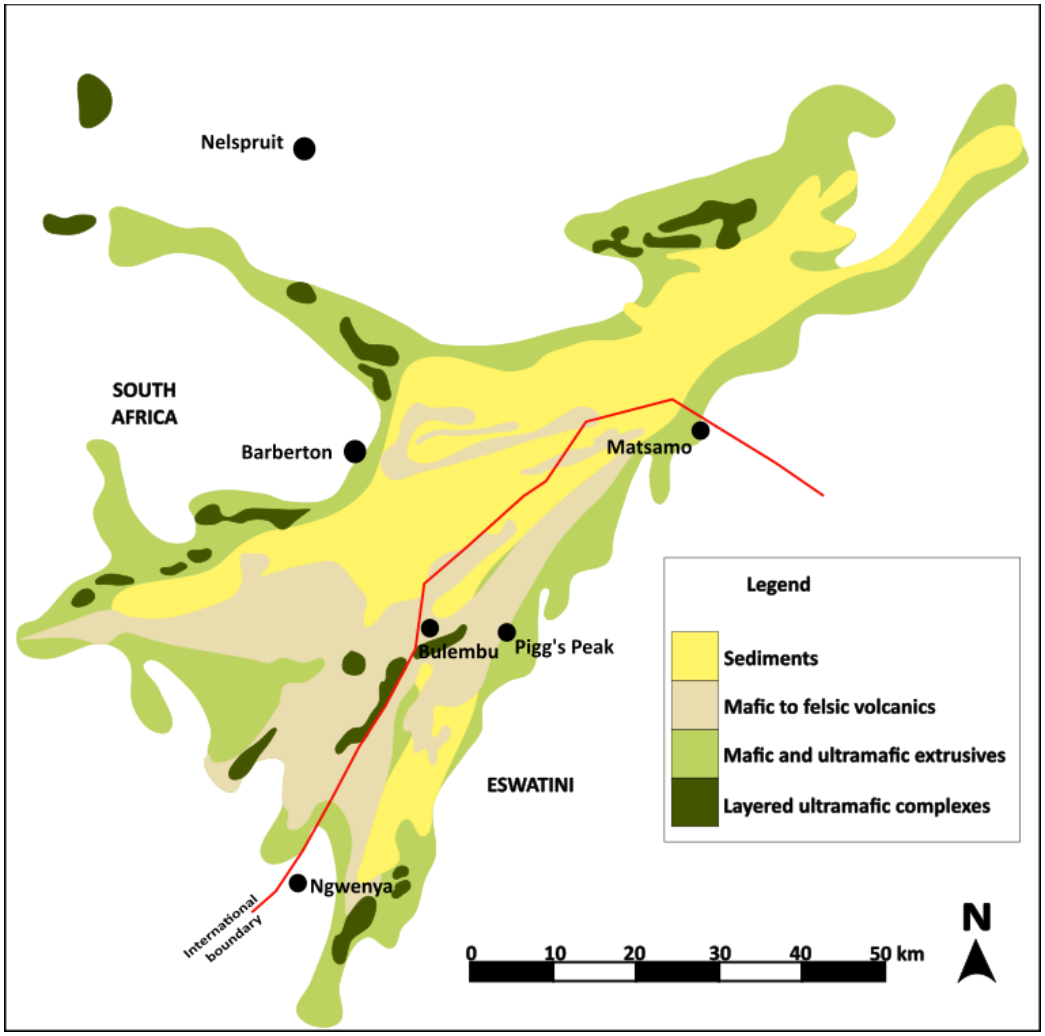


Figure 14 – Distribution of Chrysotile asbestos deposits (layered ultramafic complexes)

The Havelock mine was the largest asbestos producer in the Barberton region. It contained the second largest asbestos deposits in the southern hemisphere, after the Shabani mine in Zimbabwe. Geologically, the mine is situated in the uppermost division of the Onverwacht Group, consisting of mafic to felsic lithologies. The Chrysotile asbestos orebody occurs in an

allochthonous serpentinised dunite-harzburgite (the Havelock ultramafic body) as stockwork of cross-fibre seams. Figure 15 shows a west-east cross-section of the underlying geology.

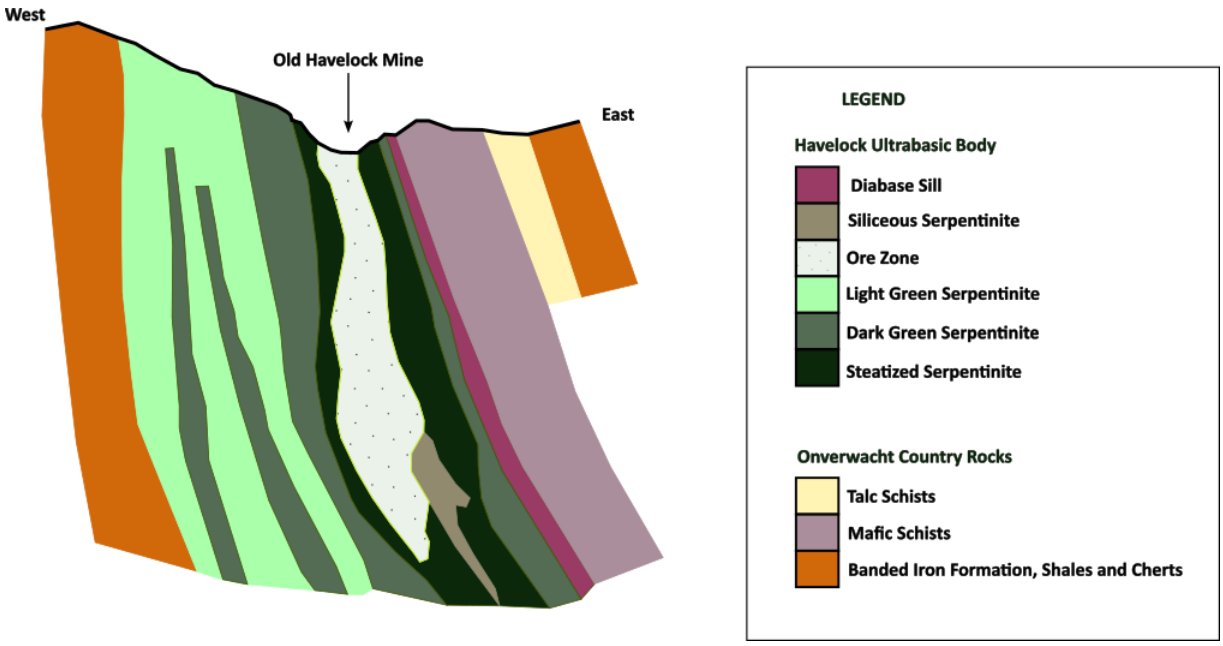


Figure 15 - Cross-section of underlying geology

The tailings dump contains the waste material disposed from the Havelock mine over a span of more than 62 years from 1939-2001. The surrounding hills are characterised by mafic and ultramafic volcanic sedimentary rocks of the Archean Onverwacht Group. This group comprises basalt, serpentinite, chert and sandstone. The successions have experienced deformation caused by folding and faulting, resulting in steep or vertical inclines.

The tailings are composed of fine and coarse particles of the serpentinite ranging from 0.1mm up to 5cm. Chrysotile is the main mineral accounting for up to 47% by volume. Other minerals include chlorite, talc and carbonate. They are derived from previously existing ferromagnesian silicate minerals, such as olivine and pyroxene. The abundance of the serpentine mineral (chrysotile) gives rise to the greenish colour of the tailings. Lithologies of the Archean Onverwacht Group in Bulembu were weathered to form the ferralitic soils characterized by intense leaching and very deep soil formation. This in turn created the sour mountain grassland ecosystem.

6.3 SOILS

6.3.1 Overview

According to the Soil Investigation Report included in **Appendix M** (First Environmental Consultants, 2017), the underlying rocks influence the composition of soils in Eswatini. The rocks in Bulembu belong to early Archaean Eswatini Supergroup. The Eswatini Supergroup comprises the Onverwacht Group which is overlain by the Fig Tree Group which in turn is overlain by the Moodies Group.

The Onverwacht Group comprises a variety of rocks including regionally metamorphosed mafic, ultramatic and acid lavas with minor metasediments which represent sandstones, cherts, marls and banded iron-stones.

The Fig-Tree Group conformably overlies the Onverwacht Group and contains shales, banded ironstones and cherts apparently underwent pre-consolidation slumping which resulted in the formation of minor contemporaneous folds and faults. The Onverwacht and Fig-Tree Groups were deformed and partly eroded prior to the deposition of the overlying molasee-like rocks of the Moodies Group. The series consist of greenstone belts and volcanic rock formations from the Archean Eon in the Kaapvaal Craton in South Africa (Barberton) and Eswatini (Bulembu). The Barberton Greenstone Belt derives its name from the green hue which is characteristic of the metamorphic minerals associated with it. These include asbestos and green cherts.

6.3.2 Physical characteristics

According to the Soil Investigation Report, the original soil types prior to mining and deposition of tailings were noted at the fringes of the mine tailings and other undisturbed area where vegetation grows. Soils in the MLA, but outside the TSF are characterised by red

sandy loam as topsoil, underlain by the Barberton Greenstone Group. Soils on the TSF comprise layers of asbestos deposits and erosivity. Sediments at the bottom of the TSF comprise hillwash mixed with mine tailings. Contamination by fibres is evident. The severity of erosion on the TSF and immediate surroundings is attributable to the composition of the soil, vegetation cover, nature of precipitation and terrain. These soils have a high sand content, which translates to poor cohesive properties. Some sections of the MLA have only a few centimetres of topsoil. The rainfall in the Bulembu area is frequently heavy and torrential and the terrain in most sections with the MLA is steep. This combination of factors contributes to the high erosion potential within the MLA.

6.4 HYDROLOGY

6.4.1 Overview

The Komati River basin measures approximately 7,423km^2 and receives 800-1,400mm of rainfall per year. Although the Komati River flows throughout the year there are a number of smaller tributaries that flow only after intense local down pours, therefore the storage of surface water runoff is essential for the success of agriculture in this basin. Figure 16 shows the Komati River Basin while Figure 17 shows the location of the tailings in relation to watercourses.

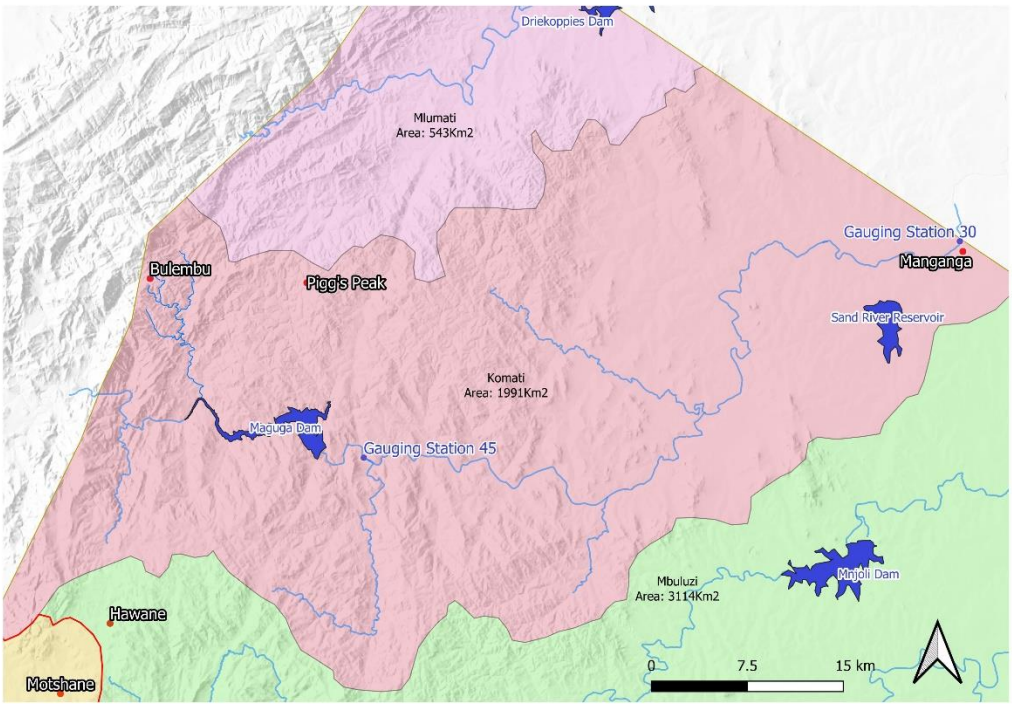


Figure 16 - Komati River Basin

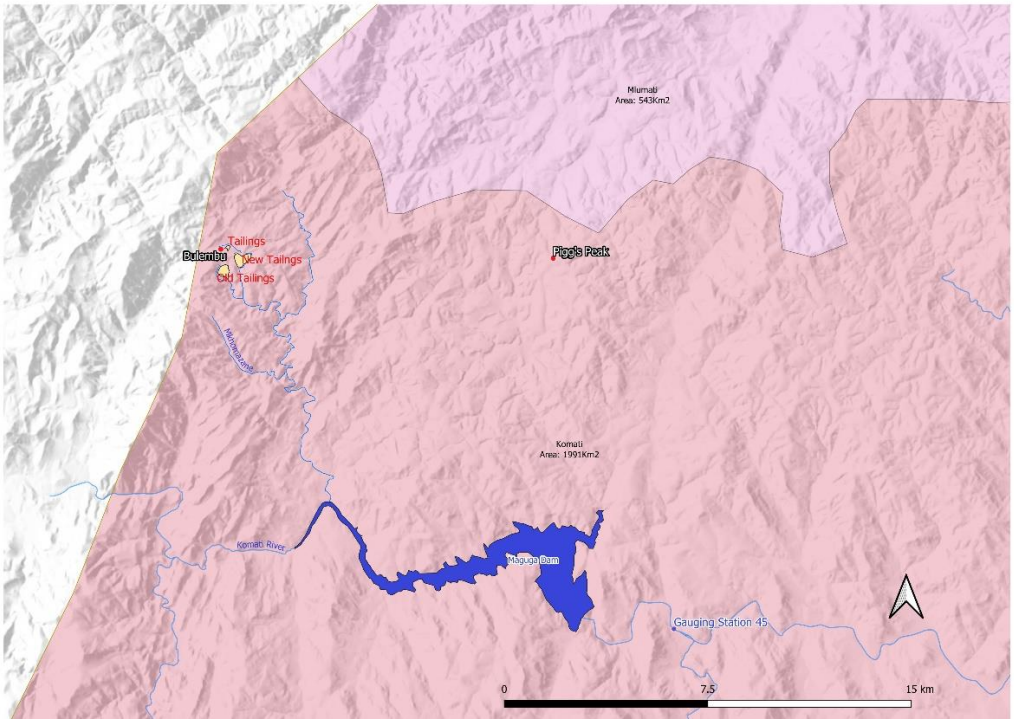


Figure 17 - Location of tailings in relation to watercourses

Surface run-off from the TSF drain to the Mzilanti which then joins the Mkhomazane in a south easterly direction to the Komati River 10km south east of Bulembu. The confluence with the Komati River is at the inlet to Maguga Dam. The Komati River flows from South Africa in the west, through Eswatini in an easterly direction, crosses into South Africa at Mananga and proceeds north eastwards into Mozambique where it loops south westwards to discharge into the Indian Ocean at Maputo. **Error! Reference source not found.** shows the a verage monthly river flows (m^3/s) along the Komati River.

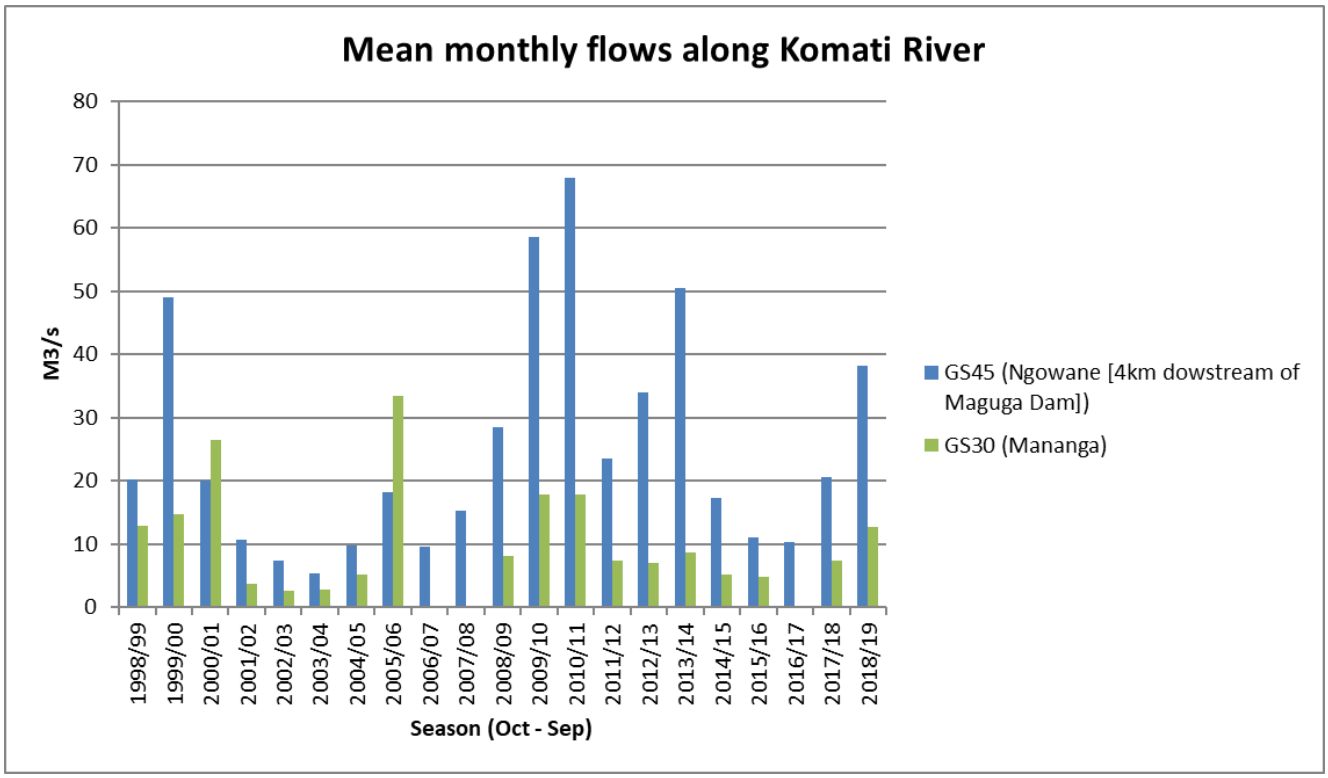


Figure 18 - Mean monthly flows along Komati River
Hydrological data courtesy of Department of Water Affairs, 2022

The chart shows the approximate 10-year cycle between dry periods. The wet period between 2009 and 2015 was wetter than that between 1998 and 2000. The difference between the two gauging stations is due to the abstraction of water between the stations. In accordance with the Precautionary Principle, the implication is that future wet periods are likely to be wetter, increasing the likelihood and severity of collapse of the existing tailings dumps. Therefore, urgent rehabilitation is essential.

6.4.2 Baseline water quality

According to the Geohydrological and Hydrological baseline assessment of the project site, included in **Appendix C** (Barrow & Belcher, 2017), the TSF and the historical mining activities at Bulembu have impacted on groundwater and surface water in the region. The impact of the historical site activities on groundwater and surface water is evident in the water quality analysis which indicates elevated pH, electrical conductivity (EC), sulphate, boron, calcium, chromium, magnesium, potassium and sodium. Asbestos was also detected at a single downgradient surface water sampling site (at the southern foot of the TSF). While these parameters are elevated with regard to background concentrations, they are still within the established water quality objectives and general drinking water limits, with the exception of boron as per the World Health Organisation (WHO) guideline value.

The boron concentration of the water discharging from the abandoned mine tunnel exceeds the WHO drinking water guideline value of 0.5mg/l. The elevated concentration is attributed to interaction between groundwater and the exposed host rock within the mine. With the exception of boron, there is no visible contamination from Bulembu that would impact on potential down gradient receptors (the aquatic ecosystems or water users of the lower Mzilanti, Mkhomazane or the Komati Rivers). The boron concentration is expected to decrease with distance from the discharge point at the southern foot of the TSF, and is comparable to background quality at the Komati River (inlet to Maguga Dam).

6.4.3 Flow regime

In terms of groundwater, the flow regime has been altered via drainage from the mine. Groundwater (drained under gravity through the internal mine tunnels) contributes significantly to surface water flow.

An assessment of the hydrology in the area indicates that the Mzilanti River contributes less than 0.5% of the flow of the Komati River at Maguga Dam and about 13% to the flow in the Mkhomazane River. The flow regime is characterized by torrential high flows during the wet season, from December to April, and relatively low flows in the dry season, from April to October. There is a close inter-dependence between groundwater and surface water in this area with most of the base flow in perennial rivers being contributed to from groundwater.

Due to the existing impacts of the past mining activity and the TSF as well as the ongoing impacts of the activities at Bulembu and the afforestation and agriculture in the surrounding catchment, the Mzilanti River is currently in a largely to seriously modified ecological state. The Mzilanti River is considered to be of a moderate Ecological Importance and Sensitivity, due largely to its link with the larger Mkhomazane and Komati River System and the indigenous fish populations that still occur within that system.

6.4.4 Anthropogenic influences on water quality

Human activities (past and present) contributing to the potential sources of contaminants for the Mzilanti River consist not only of the TSF but also the underground mine, Bulembu Village, adjacent agricultural and afforestation activities as well as the rural settlements within the upper catchment. Uses of the river water downstream of Bulembu considered to determine the water quality objectives for the rivers comprise domestic (basic human needs), recreation (full contact) and agriculture (livestock watering) use as well as the aquatic ecosystem.

6.5 CLIMATE

Eswatini has a sub-tropical climate, receiving about 75% of its annual rainfall between September and March. Figure 19 shows the physiographic zones whose climate is influenced by altitude.

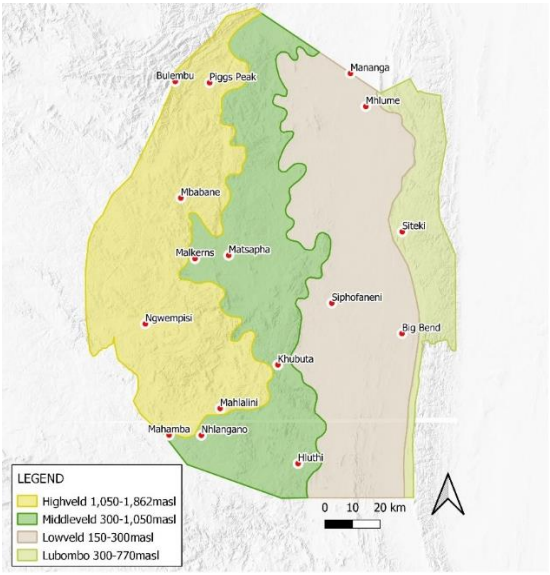
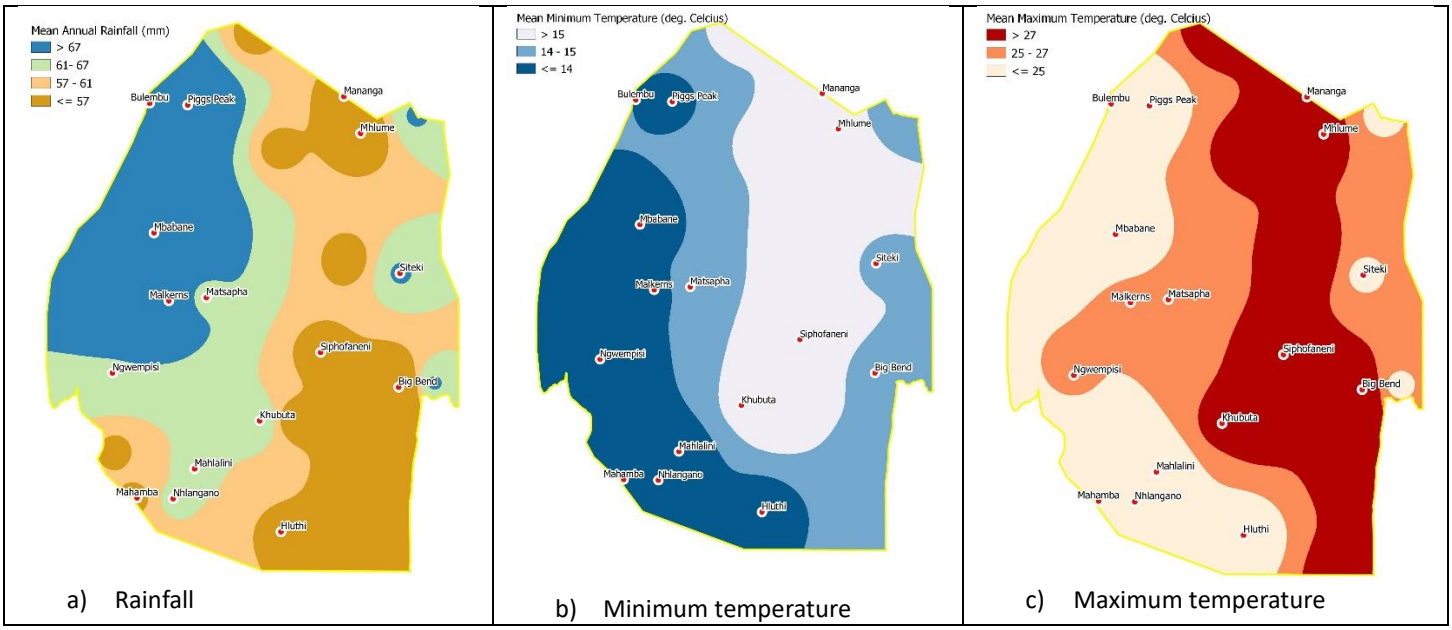


Figure 19 - Physiographic zones

Figure 20 shows the rainfall and temperature distribution across the country.

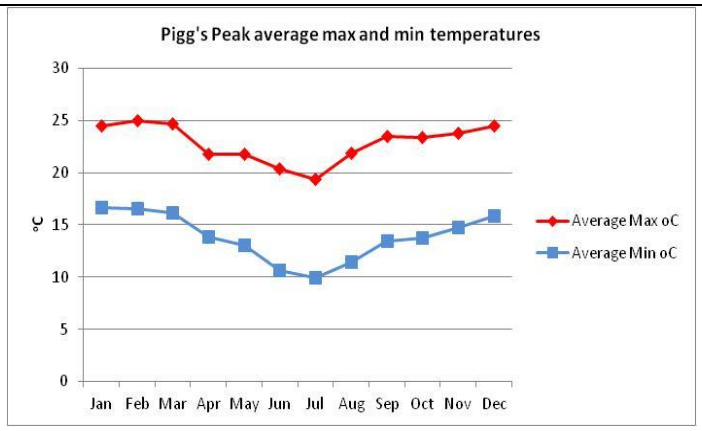


a) Rainfall b) Minimum temperature c) Maximum temperature

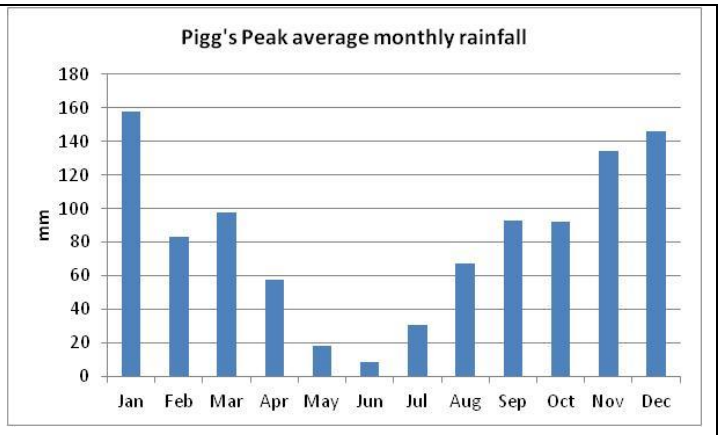
Figure 20 - Rainfall and temperature distribution

Climatic data courtesy of Eswatini Meteorological Service, 2022

The Highveld, where the project is located, experiences a mean annual temperature of 16°C and mean annual rainfall of 1,500mm. Figure 21 shows the average minimum and maximum monthly temperatures as well as average monthly rainfall.



a) Average minimum and maximum monthly temperature.



b) Average monthly rainfall.

Figure 21 - Temperature and rainfall at Pigg's Peak

An analysis of the long term temperature and rainfall trends for the Highveld shows that temperatures and rainfall have been declining. The dotted trend lines in Figure 22 show a gradual decline in temperatures.

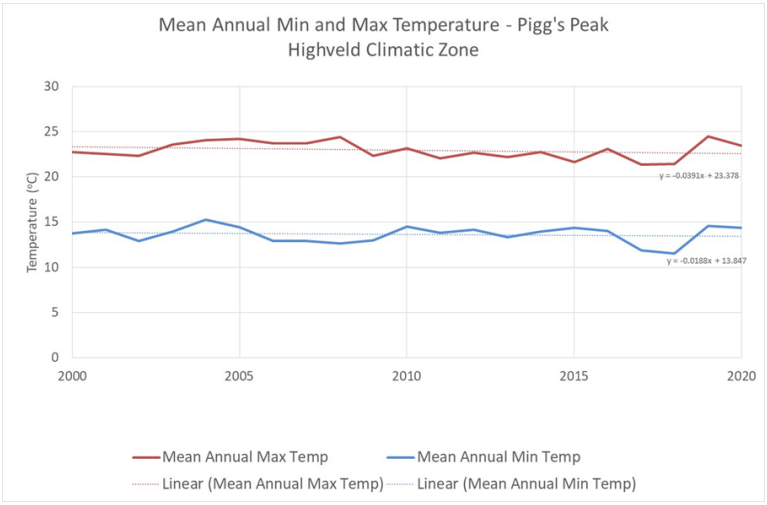


Figure 22 - Long term temperatures

The dotted trend line in Figure 23 shows a gradual decline in rainfall.

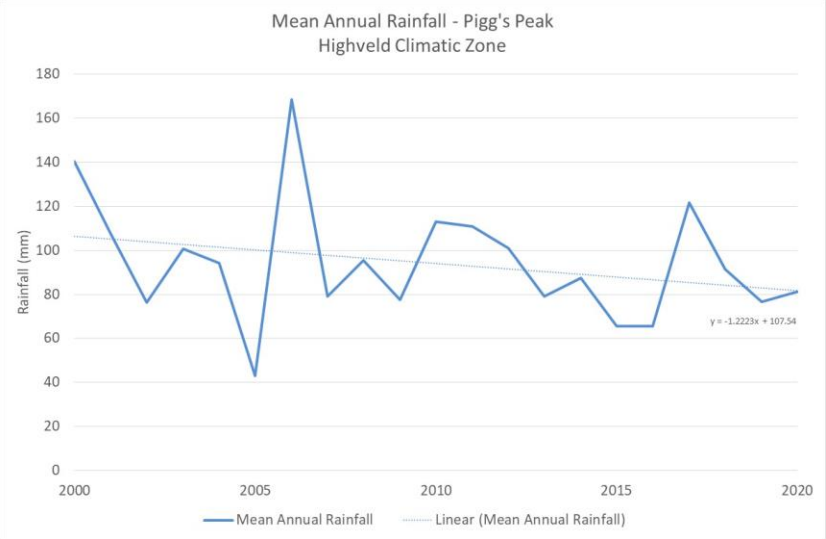


Figure 23 - Long term rainfall

The relevance of climate to the project is that the relative high rainfall will increase the risk of erosion of exposed surfaces. The trend in declining temperature and rainfall means that although the climate will likely become cooler and drier, the tailings will be susceptible to extremes in weather. This entails extreme rainfall and drought events, both of which will adversely affect stability of soils, including the tailings dump, if left unattended. It further means that any project activities likely to contribute to climate change will accentuate such change.

6.6 ECOLOGY

6.6.1 Overview

A total of 121 mammal species have been recorded in Eswatini, with highest species richness being recorded in the north-east and north-west of the country (Monadjem, 1998). This high species richness is attributed to the presence of protected areas in the north-east and north-west.

Approximately 500 bird species have been recorded in Eswatini (Parker, 1994; Barnes, 1998). This high species richness reflects the diversity of habitats and steep altitudinal gradient in the country. Fifty-eight percent of these species have been recorded in the savannah ecosystems in Eswatini (Monadjem et al., 2003).

Eswatini comprises 112 species of reptiles (Boycott, 1996; Litschka, Koen & Monadjem, 2008) which are composed of 61 species of snakes, 44 species of lizards, 5 chelonians (tortoises and terrapins) and 1 species of crocodile (Boycott et al., 2007).

Ecology is relevant to this project in that the project is situated in a region with the high biodiversity in the country. The mitigations developed and project alternatives therefore need to be cognizant of such species diversity in order avoid loss of diversity.

6.6.2 Local context of vegetation

According to the Specialist Botanical Survey, included in **Appendix D** (McCleland & Loffler, 2017), the ecological state of the vegetation assemblages represented within the Mining Lease Area is highly compromised, either through total habitat transformation (mining infrastructure, residential areas) or severe habitat modification (alien tree plantations). Three vegetation communities were identified and are described in the Specialist Botanical Survey Report, although only a small patch of natural grassland habitat is present along the southern

boundary of the Mining Lease Area. The larger corridor of grassland to which this patch is connected has high biodiversity conservation value and is representative of a threatened vegetation type (Barberton Montane Grassland) within the Barberton Centre of Plant Endemism. The list of flora occurring at Bulembu is provided in Table 6.

6.6.3 Local context of bird and mammal species

According to the Bird and Mammal Survey, included in **Appendix E** (Monadjem, 2017), the Mining Lease Area is situated within a globally important bird area which is the "Drakensberg Escarpment Endemic Bird Area" transformed within the Mining Lease Area. A total 45 species of birds and 16 species of mammals were recorded during this survey. None of these species are threatened globally or regionally. Furthermore, the majority of the species occurring in the Mining Lease Area are generalists, able to cope with a range of habitats. However, the presence of Serval (*Leptailurus serval*) and Mountain Reedbuck (*Redunca fulvorufula*) are of national conservation concern. In addition, five species of bird and two species of mammal are regional endemics, having global distributions restricted to South Africa and Eswatini. The list of birds is provided in Table 7 while the list of mammals is provided in Table 8.

6.6.4 Local context of amphibians, reptiles and freshwater fishes

According to the Reptile, Amphibian and Freshwater Fishes Survey, included in **Appendix F** (Boycott, 2017), a wide variety of amphibians, reptiles and fish was recorded from the Bulembu area. A total 44 species were recorded, comprising 9 amphibians, 31 reptiles and 4 fish. None of the species are threatened locally or internationally. However, due to their rarity, endemism, localised occurrence and restricted distribution in Eswatini, 10 species are considered regionally important.

None of the nine species of amphibians recorded from Bulembu are listed in the Eswatini Red Data Book (Monadjem et al. 2003). Three species are restricted to the temperate highveld

region and are not found anywhere else in Eswatini. These are the Plaintive Rain Frog (*Breviceps verrucosus*), the Natal Ghost Frog (*Hadromophryne natalensis*) and the Clicking Stream Frog (*Strongylopus grayii*). Due to their restricted distribution in Eswatini they are considered regionally important.

Thirty-one species of reptiles are presumed to occur in the Bulembu area, none of which are listed in the Eswatini Red Data Book (Monadjem et al. 2003). One species is a near-endemic and several other species are restricted to the temperate highveld region and are not found anywhere else in Eswatini. Due to their restricted distribution in Eswatini six species are considered regionally important.

Four species of fish were recorded from the two sampling sites none of which are listed in the Eswatini Red Data Book (Monadjem et al. 2003). One species, the Redtail Barb (*Barbus gurneyi*), is only known from three localities in Eswatini, two of which are in Malolotja Nature Reserve. The species was found to be scarce and in poor condition at the upper site. It was the only species recorded from this site. Factors affecting this population are the dam and hydroelectric power station in the Mkhomazane Gorge, sedimentation of the river and possibly contaminated runoff from the Havelock asbestos tailings higher up in the catchment. Due to its rarity and restricted distribution in Eswatini the Redtail Barb is considered regionally important. The list of amphibians, reptiles and fishes is provided in Table 9.

6.6.5 Inventory of flora

Table 6 - Flora

Scientific Name	Family	Growth Form	Conservation Status	Endemic Status	Protection Status	Open Grassland	Rocky Grassland / Shrubland	Plantation / Degraded Forest
FERNS								
Mohria vestita	Anemiaceae	Fern					x	
Asplenium cordatum	Aspleniaceae	Fern					x	
Blechnum tabulare	Blechnaceae	Fern					x	x
Alsophila dregei	Cyatheaceae	Fern			Schedule B		x	
Cheilanthes viridis var. *viridis*	Pteridaceae	Fern					x	
Pellaea calomelanos var. *calomelanos*	Pteridaceae	Fern					x	
Pellaea pectiniformis	Pteridaceae	Fern					x	
Selaginella dregei	Selaginellaceae	Fern					x	
GYMNOSPERMS								
Pinus patula var. *patula* *	Pinaceae	Tree					x	x
FLOWERING PLANTS: DICOTS								
Protorhus longifolia	Anacardiaceae	Tree						x
Searsia tumulicola var. *tumulicola*	Anacardiaceae	Shrub					x	
Alepidea setifera	Apiaceae	Forb			Schedule B	x		
Cussonia spicata	Araliaceae	Tree					x	x
Athrixia phylicoides	Asteraceae	Dwarf Shrub				x		
Berkheya echinacea subsp. *echinacea*	Asteraceae	Forb				x	x	
Berkheya zeyheri subsp. *rehmannii* var. *rehmannii*	Asteraceae	Forb					x	
Dicoma anomala subsp. *anomala*	Asteraceae	Forb					x	
Euryops pedunculatus	Asteraceae	Forb				x		
Gazania krebsiana subsp. *serrulata*	Asteraceae	Forb					x	
Gerbera piloselloides	Asteraceae	Forb			Schedule B	x		
Gerbera viridifolia	Asteraceae	Forb					x	
Haplocarpha scaposa	Asteraceae	Forb					x	
Helichrysum adenocarpum subsp. *adenocarpum*	Asteraceae	Forb				x		
Helichrysum aureonitens	Asteraceae	Forb				x		

Scientific Name	Family	Growth Form	Conservation Status	Endemic Status	Protection Status	Open Grassland	Rocky Grassland / Shrubland	Plantation / Degraded Forest
Helichrysum lepidissimum	Asteraceae	Forb					x	
Helichrysum nudifolium var. *nudifolium*	Asteraceae	Forb				x		
Helichrysum nudifolium var. *pilosellum*	Asteraceae	Forb				x		
Helichrysum pallidum	Asteraceae	Forb				x		
Helichrysum sp. (white flower)	Asteraceae	Forb					x	
Hilliardiella hirsuta	Asteraceae	Forb					x	
Laggera crispata	Asteraceae	Forb					x	
Schistostephium crataegifolium	Asteraceae	Forb					x	
Senecio oxyriifolius subsp. *oxyriifolius*	Asteraceae	Forb					x	
Senecio paludaffinis	Asteraceae	Forb					x	x
Senecio polyanthemoides	Asteraceae	Forb				x		
Senecio pterophorus	Asteraceae	Forb					x	
Senecio scitus	Asteraceae	Forb					x	
Senecio sp. A	Asteraceae	Forb					x	
Senecio sp. B	Asteraceae	Forb				x		
Senecio sp. C	Asteraceae	Forb				x		
Senecio sp. D	Asteraceae	Forb					x	
Senecio subrubriflorus	Asteraceae	Forb				x	x	
Unknown sp.	Asteraceae	Forb					x	
Wahlenbergia sp. A	Campanulaceae	Forb					x	
Trema orientalis	Cannabaceae	Tree					x	x
Pterocelastrus echinatus	Celastraceae	Tree					x	
Parinari capensis subsp. *capensis*	Chrysobalanaceae	Dwarf Shrub				x	x	
Cotyledon orbiculata var. *orbiculata*	Crassulaceae	Succulent					x	
Crassula cf. *alba*	Crassulaceae	Succulent					x	
Crassula sarcocaulis subsp. *sarcocaulis*	Crassulaceae	Succulent					x	
Scabiosa columbaria	Dipsacaceae	Forb				x		
Diospyros whyteana	Ebenaceae	Tree					x	
Erica drakensbergensis	Ericaceae	Shrub					x	
Acalypha glandulifolia	Euphorbiaceae	Forb					x	
Aeschynomene rehmannii var. *rehmannii*	Fabaceae	Dwarf Shrub					x	
Indigofera melanadenia	Fabaceae	Dwarf Shrub					x	

Scientific Name	Family	Growth Form	Conservation Status	Endemic Status	Protection Status	Open Grassland	Rocky Grassland / Shrubland	Plantation / Degraded Forest
Indigofera sanguinea	Fabaceae	Dwarf Shrub				x	x	
Pearsonia aristata	Fabaceae	Dwarf Shrub				x	x	
Rhynchosia hirsuta	Fabaceae	Dwarf Shrub				x		
Rhynchosia monophylla	Fabaceae	Creeper					x	
Rhynchosia sp. A	Fabaceae	Dwarf Shrub					x	
Unknown sp.	Fabaceae	Forb					x	
Plectranthus sp. A	Lamiaceae	Succulent				x		
Plectranthus sp. B	Lamiaceae	Succulent					x	
Stachys natalensis var. *natalensis*	Lamiaceae	Forb	DD				x	
Stachys sp.	Lamiaceae	Forb					x	
Cyphia elata var. *elata*	Lobeliaceae	Dwarf Shrub				x	x	
Cyphia sp. A	Lobeliaceae	Climber					x	
Morella brevifolia	Myricaceae	Dwarf Shrub				x		
Morella pilulifera	Myricaceae	Tree					x	
Rapanea melanophloeos	Myrsinaceae	Tree					x	
Eucalyptus spp. *	Myrtaceae	Tree						x
*Psidium guajava **	Myrtaceae	Shrub						x
Ochna natalitia	Ochnaceae	Shrub					x	
Alectra sp. A	Orobanchaceae	Forb					x	
Basananthe sandersonii	Passifloraceae	Forb				x		
*Phytolacca octandra **	Phytolaccaceae	Dwarf Shrub						x
Maesa lanceolata	Primulaceae	Shrub					x	x
Protea caffra subsp. *caffra*	Proteaceae	Tree			Schedule B		x	
Protea gaguedi	Proteaceae	Shrub			Schedule B	x	x	
Protea roupelliae subsp. *roupelliae*	Proteaceae	Tree			Schedule B	x	x	
Rubus niveus	Rosaceae	Shrub					x	
Burchellia bubalina	Rubiaceae	Tree					x	
Cephalanthus natalensis	Rubiaceae	Shrub					x	
Conostomium natalense var. *natalense*	Rubiaceae	Forb					x	
Kohautia amatymbica	Rubiaceae	Forb				x		
Otiophora cupheoides	Rubiaceae	Forb					x	
Pachystigma macrocalyx	Rubiaceae	Shrub					x	
Psychotria capensis subsp. *capensis*	Rubiaceae	Shrub					x	
Tricalysia galpinii	Rubiaceae	Shrub					x	
Gerrardina foliosa	Salicaceae	Shrub					x	

Scientific Name	Family	Growth Form	Conservation Status	Endemic Status	Protection Status	Open Grassland	Rocky Grassland / Shrubland	Plantation / Degraded Forest
Thesium sp. A	Santalaceae	Dwarf Shrub					x	
Thesium sp. B	Santalaceae	Dwarf Shrub					x	
Buddleja auriculata	Scrophulariaceae	Shrub					x	x
Halleria lucida	Scrophulariaceae	Tree					x	x
Jamesbrittenia grandiflora	Scrophulariaceae	Dwarf Shrub					x	
Selago capitellata	Scrophulariaceae	Forb					x	
Tetraselago natalensis	Scrophulariaceae	Forb				x	x	
Solanum mauritianum *	Solanaceae	Tree				x	x	x
Nuxia congesta	Stilbaceae	Tree					x	
Lasiosiphon kraussianus	Thymelaeaceae	Forb				x		
Peddiea africana	Thymelaeaceae	Shrub						x
Lantana camara *	Verbenaceae	Shrub						x
Lippia javanica	Verbenaceae	Dwarf Shrub						x
FLOWERING PLANTS: MONOCOTS								
Tulbaghia acutiloba	Alliaceae	Geophyte				x		
Tulbaghia leucantha	Alliaceae	Geophyte					x	
Eriospermum sp. A	Asparagaceae	Geophyte				x		
Aloe chortolirioides var. *chortolirioides*	Asphodelaceae	Succulent	EN B1B2abC2a	BCPE	Schedule C		x	
Cyanotis lanata	Commelinaceae	Forb					x	
Cyperus leptocladus	Cyperaceae	Sedge					x	
Scleria sp. A	Cyperaceae	Sedge				x	x	
Drimia sphaerocephala	Hyacinthaceae	Geophyte					x	
Eucomis autumnalis subsp. *clavata*	Hyacinthaceae	Geophyte					x	
Ledebouria cf. *cooperi*	Hyacinthaceae	Geophyte					x	
Ledebouria ovalifolia	Hyacinthaceae	Geophyte					x	
Ledebouria sp. A	Hyacinthaceae	Geophyte					x	
Hypoxis galpinii	Hypoxidaceae	Geophyte			Schedule A	x	x	
Dierama sp. A (no flowers)	Iridaceae	Geophyte					x	
Gladiolus sp. A (no flowers)	Iridaceae	Geophyte				x		
Watsonia pulchra	Iridaceae	Geophyte			Schedule B		x	
Eulophia ovalis var. *bainesii*	Orchidaceae	Geophyte			Schedule B		x	
Alloteropsis semialata subsp. *semialata*	Poaceae	Grass				x		
Aristida junciformis subsp. *junciformis*	Poaceae	Grass				x	x	

Scientific Name	Family	Growth Form	Conservation Status	Endemic Status	Protection Status	Open Grassland	Rocky Grassland / Shrubland	Plantation / Degraded Forest
Ctenium concinnum	Poaceae	Grass					x	
Cymbopogon nardus	Poaceae	Grass					x	
Eragrostis curvula	Poaceae	Grass						x
Eragrostis gummiflua	Poaceae	Grass				x	x	
Eragrostis racemosa	Poaceae	Grass					x	
Eragrostis superba	Poaceae	Grass					x	x
Hyparrhenia sp. A	Poaceae	Grass					x	
Loudetia simplex	Poaceae	Grass				x	x	
Melinis nerviglumis	Poaceae	Grass					x	
Monocymbium ceresiiforme	Poaceae	Grass				x	x	
Panicum natalense	Poaceae	Grass					x	
Rendlia altera	Poaceae	Grass					x	
Setaria sphacelata var. *sphacelata*	Poaceae	Grass				x		
Sporobolus africanus	Poaceae	Grass					x	
Themeda triandra	Poaceae	Grass				x	x	
Tristachya leucothrix	Poaceae	Grass				x		
Tristachya sp. A	Poaceae	Grass				x		
Smilax anceps	Smilacaceae	Climber					x	x
Strelitzia caudata	Strelitziaceae	Shrub			Schedule B		x	
Xerophyta retinervis	Velloziaceae	Dwarf Shrub				x	x	
TOTAL	143	143	2	1	11	46	107	19

EN = Endangered
DD = Data Deficient
BCPE = Barberton Centre of Plant Endemism

6.6.6 Inventory of fauna

Table 7 – Birds

Order	Family	Scientific Name	English Name	Regional Endemic	Global Red List	National Red List	Emlembe Mountain	Mining Lease Area
Accipitriformes	Accipitridae	*Buteo rufofuscus*	Jackal Buzzard	No	LC	LC	1	
Accipitriformes	Accipitridae	*Buteo vulpinus*	Steppe Buzzard	No	LC	LC	1	
Accipitriformes	Accipitridae	*Circaetus cinereus*	Brown Snake-Eagle	No	LC	LC	1	
Accipitriformes	Accipitridae	*Polyboroides typus*	African Harrier-Hawk	No	LC	LC	1	
Accipitriformes	Accipitridae	*Stephanoaetus coronatus*	African Crowned Eagle	No	Near Threatened	Vulnerable	1	
Apodiformes	Apodidae	*Apus barbatus*	African Black Swift	No	LC	LC	1	
Apodiformes	Apodidae	*Apus caffer*	White-rumped Swift	No	LC	LC	1	
Apodiformes	Apodidae	*Tachymarptis melba*	Alpine Swift	No	LC	LC	1	
Bucerotiformes	Bucorvidae	*Tockus alboterminatus*	Crowned Hornbill	No	LC	LC	1	
Coliiformes	Coliidae	*Colius striatus*	Speckled Mousebird	No	LC	LC	1	1
Columbiformes	Columbidae	*Aplopelia larvata*	Lemon Dove	No	LC	LC	0	1
Columbiformes	Columbidae	*Columba arquatrix*	African Olive-Pigeon	No	LC	LC	1	1
Columbiformes	Columbidae	*Streptopelia semitorquata*	Red-eyed Dove	No	LC	LC	1	
Columbiformes	Columbidae	*Streptopelia senegalensis*	Laughing Dove	No	LC	LC	0	1
Columbiformes	Columbidae	*Turtur tympanistria*	Tambourine Dove	No	LC	LC	1	
Coraciiformes	Alcedinidae	*Alcedo semitorquata*	Half-collared Kingfisher	No	LC	Near Threatened	1	
Coraciiformes	Alcedinidae	*Halcyon albiventris*	Brown-hooded Kingfisher	No	LC	LC	1	1

Order	Family	Scientific Name	English Name	Regional Endemic	Global Red List	National Red List	Emlembe Mountain	Mining Lease Area
Cuculiformes	Cuculidae	*Cuculus clamosus*	Black Cuckoo	No	LC	LC	1	
Cuculiformes	Muscicapidae	*Tauraco corythaix*	Knysna Turaco	Yes	LC	LC	1	1
Falconiformes	Falconidae	*Falco rupicolus*	Rock Kestrel	No	LC	LC	1	
Galliformes	Phasianidae	*Pternistis natalensis*	Natal Spurfowl	No	LC	LC	1	1
Galliformes	Phasianidae	*Scleroptila levaillantii*	Red-winged Francolin	No	LC	LC	1	
Passeriformes	Campephagidae	*Coracina caesia*	Grey Cuckooshrike	No	LC	LC	1	
Passeriformes	Cisticolidae	*Apalis thoracica*	Bar-throated Apalis	No	LC	LC	1	1
Passeriformes	Cisticolidae	*Camaroptera brachyura*	Green-backed Camaroptera	No	LC	LC	1	1
Passeriformes	Cisticolidae	*Cisticola aberrans*	Lazy Cisticola	No	LC	LC	1	1
Passeriformes	Cisticolidae	*Cisticola ayresii*	Wing-snapping Cisticola	No	LC	LC	1	
Passeriformes	Cisticolidae	*Cisticola erythrops*	Red-faced Cisticola	No	LC	LC	1	
Passeriformes	Cisticolidae	*Cisticola lais*	Wailing Cisticola	No	LC	LC	1	
Passeriformes	Cisticolidae	*Prinia subflava*	Tawny-flanked Prinia	No	LC	LC	1	1
Passeriformes	Corvidae	*Corvus albicollis*	White-necked Raven	No	LC	LC	1	1
Passeriformes	Dicruridae	*Dicrurus adsimilis*	Fork-tailed Drongo	No	LC	LC	1	1
Passeriformes	Dicruridae	*Dicrurus ludwigii*	Square-tailed Drongo	No	LC	LC	1	1
Passeriformes	Estrildidae	*Coccopygia melanotis*	Swee Waxbill	Yes	LC	LC	1	1
Passeriformes	Estrildidae	*Estrilda astrild*	Common Waxbill	No	LC	LC	1	
Passeriformes	Estrildidae	*Hypargos margaritatus*	Pink-throated Twinspot	No	LC	LC	1	1
Passeriformes	Estrildidae	*Lagonosticta rubricata*	African Firefinch	No	LC	LC	1	
Passeriformes	Estrildidae	*Spermestes cucullatus*	Bronze Mannikin	No	LC	LC	1	
Passeriformes	Estrildidae	*Uraeginthus angolensis*	Blue Waxbill	No	LC	LC	1	
Passeriformes	Fringillidae	*Crithagra mozambicus*	Yellow-fronted Canary	No	LC	LC	1	

Order	Family	Scientific Name	English Name	Regional Endemic	Global Red List	National Red List	Emlembe Mountain	Mining Lease Area
Passeriformes	Fringillidae	*Crithagra scotops*	Forest Canary	Yes	LC	LC	1	1
Passeriformes	Fringillidae	*Serinus canicollis*	Cape Canary	No	LC	LC	1	1
Passeriformes	Hirundinidae	*Delichon urbicum*	Common House-Martin	No	LC	LC	1	
Passeriformes	Hirundinidae	*Hirundo 117unereal117*	Greater Striped Swallow	No	LC	LC	1	
Passeriformes	Hirundinidae	*Hirundo fuligula*	Rock Martin	No	LC	LC	1	1
Passeriformes	Hirundinidae	*Hirundo rustica*	Barn Swallow	No	LC	LC	1	
Passeriformes	Hirundinidae	*Psalidoprocne holomelaena*	Black Saw-wing	No	LC	LC	1	
Passeriformes	Locustellidae	*Bradypterus barratti*	Barratt's Warbler	No	LC	LC	1	
Passeriformes	Macrosphenidae	*Sphenoeacus afer*	Cape Grassbird	No	LC	LC	1	
Passeriformes	Macrosphenidae	*Tchagra tchagra*	Southern Tchagra	Yes	LC	LC	1	
Passeriformes	Macrosphenidae	*Telophorus olivaceus*	Olive Bush-Shrike	No	LC	LC	1	
Passeriformes	Malaconotidae	*Dryoscopus cubla*	Black-backed Puffback	No	LC	LC	1	1
Passeriformes	Malaconotidae	*Laniarius ferrugineus*	Southern Boubou	No	LC	LC	1	1
Passeriformes	Motacillidae	*Anthus chloris*	Yellow-breasted Pipit	Yes	Vulnerable	Not Evaluated	1	
Passeriformes	Motacillidae	*Anthus lineiventris*	Striped Pipit	No	LC	LC	1	
Passeriformes	Motacillidae	*Anthus similis*	Long-billed Pipit	No	LC	LC	1	1
Passeriformes	Motacillidae	*Macronyx capensis*	Cape Longclaw	No	LC	LC	1	
Passeriformes	Motacillidae	*Macronyx croceus*	Yellow-throated Longclaw	No	LC	LC	1	
Passeriformes	Motacillidae	*Motacilla clara*	Mountain Wagtail	No	LC	LC	1	1
Passeriformes	Muscicapidae	*Cercomela familiaris*	Familiar Chat	No	LC	LC	1	
Passeriformes	Muscicapidae	*Cercotrichas signata*	Brown Scrub-Robin	No	LC	Near Threatened	1	
Passeriformes	Muscicapidae	*Cossypha caffra*	Cape Robin-Chat	No	LC	LC	1	1
Passeriformes	Muscicapidae	*Cossypha dichroa*	Chorister Robin-Chat	Yes	LC	LC	1	1

Order	Family	Scientific Name	English Name	Regional Endemic	Global Red List	National Red List	Emlembe Mountain	Mining Lease Area
Passeriformes	Muscicapidae	*Melaenornis pammelaina*	Southern Black Flycatcher	No	LC	LC	1	1
Passeriformes	Muscicapidae	*Muscicapa adusta*	African Dusky Flycatcher	No	LC	LC	1	1
Passeriformes	Muscicapidae	*Muscicapa caerulescens*	Ashy Flycatcher	No	LC	LC	0	1
Passeriformes	Muscicapidae	*Oenanthe bifasciata*	Buff-streaked Chat	Yes	LC	LC	1	
Passeriformes	Muscicapidae	*Psophocichla litsitsirupa*	Groundscraper Thrush	No	LC	LC	0	1
Passeriformes	Muscicapidae	*Saxicola torquatus*	African Stonechat	No	LC	LC	1	1
Passeriformes	Muscicapidae	*Thamnolaea cinnamomeiventris*	Mocking Cliff-Chat	No	LC	LC	1	
Passeriformes	Muscicapidae	*Turdus libonyanus*	Kurrichane Thrush	No	LC	LC	1	1
Passeriformes	Muscicapidae	*Turdus olivaceus*	Olive Thrush	No	LC	LC	1	
Passeriformes	Muscicapidae	*Zoothera gurneyi*	Orange Ground-Thrush	No	LC	Vulnerable	1	
Passeriformes	Nectariniidae	*Chalcomitra 118unereal118s118*	Amethyst Sunbird	No	LC	LC	1	1
Passeriformes	Nectariniidae	*Cinnyris afer*	Greater Double-collared Sunbird	No	LC	LC	1	1
Passeriformes	Nectariniidae	*Cinnyris chalybeus*	Southern Double-collared Sunbird	Yes	LC	LC	1	1
Passeriformes	Nectariniidae	*Cyanomitra olivacea*	Olive Sunbird	No	LC	LC	1	1
Passeriformes	Nectariniidae	*Nectarinia famosa*	Malachite Sunbird	No	LC	LC	1	
Passeriformes	Oriolidae	*Oriolus larvatus*	Black-headed Oriole	No	LC	LC	1	1
Passeriformes	Passeridae	*Passer 118unereal*	Southern Grey-headed Sparrow	No	LC	LC	1	1
Passeriformes	Phylloscopidae	*Phylloscopus trochilus*	Willow Warbler	No	LC	LC	1	
Passeriformes	Platysteiridae	*Batis capensis*	Cape Batis	No	LC	LC	1	1
Passeriformes	Ploceidae	*Euplectes ardens*	Red-collared Widowbird	No	LC	LC	1	
Passeriformes	Ploceidae	*Ploceus ocularis*	Spectacled Weaver	No	LC	LC	1	1
Passeriformes	Pycnonotidae	*Andropadus 118unereal118s*	Sombre Greenbul	No	LC	LC	1	1
Passeriformes	Pycnonotidae	*Phyllastrephus flavostriatus*	Yellow-streaked Greenbul	No	LC	Near Threatened	1	
Passeriformes	Pycnonotidae	*Phyllastrephus terrestris*	Terrestrial Brownbul	No	LC	LC	1	
Passeriformes	Pycnonotidae	*Pycnonotus tricolor*	Dark-capped Bulbul	No	LC	LC	1	1
Passeriformes	Stenostiridae	*Trochocercus cyanomelas*	Blue-mantled CrestedFlycatcher	No	LC	LC	1	

Order	Family	Scientific Name	English Name	Regional Endemic	Global Red List	National Red List	Emlembe Mountain	Mining Lease Area
Passeriformes	Sturnidae	*Onychognathus morio*	Red-winged Starling	No	LC	LC	1	1
Passeriformes	Viduidae	*Vidua 119unereal*	Dusky Indigobird	No	LC	LC	1	
Passeriformes	Zosteropidae	*Zosterops virens*	Cape White-eye	No	LC	LC	1	1
Pelecaniformes	Threskiornithidae	*Bostrychia hagedash*	Hadeda Ibis	No	LC	LC	1	1
Piciformes	Indicatoridae	*Prodotiscus regulus*	Brown-backed Honeybird	No	LC	LC	0	1
Piciformes	Lybiidae	*Pogoniulus bilineatus*	Yellow-rumped Tinkerbird	No	LC	LC	1	
Piciformes	Picidae	*Denropicos griseocephalus*	Olive Woodpecker	No	LC	LC	1	
Strigiformes	Strigidae	*Bubo africanus*	Spotted Eagle-Owl	No	LC	LC	1	
Trogoniformes	Trogonidae	*Apaloderma narina*	Narina Trogon	No	LC	LC	1	

Table 8 – Mammals

Order	Family	Scientific Name	English Name	Regional Endemic	Global Red List	National Red List	Emlembe Mountain	Mining Lease Area
Afrosoricida	Chrysochloridae	*Amblysomus hottentotus*	Hottentot golden mole	Yes	LC	LC	1	1
Carnivora	Canidae	*Canis mesomelas*	Black-backed jackal	No	LC	LC	1	
Carnivora	Felidae	*Leptailurus serval*	Serval	No	LC	Near Threatened	1	1
Carnivora	Herpestidae	*Atilax paludinosus*	Marsh mongoose	No	LC	LC	0	1
Carnivora	Herpestidae	*Galerella sanguineus*	Slender mongoose	No	LC	LC	1	1
Carnivora	Viverridae	*Genetta tigrina*	Large-spotted genet	No	LC	LC	1	1
Cetartiodactyla	Bovidae	*Cephalophus natalensis*	Red duiker	No	LC	LC	1	
Cetartiodactyla	Bovidae	*Redunca fulvorufula*	Mountain reedbuck	No	LC	Near Threatened	1	1
Cetartiodactyla	Bovidae	*Sylvicapra grimmia*	Grey duiker	No	LC	LC	1	1
Cetartiodactyla	Suidae	*Potamochoerus larvatus*	Bushpig	No	LC	LC	1	
Chiroptera	Rhinolophidae	*Rhinolophus clivosus*	Geoffroy's horseshoe bat	No	LC	LC	0	1
Chiroptera	Rhinolophidae	*Rhinolophus swinnyi*	Swinny's horseshoe bat	Yes	LC	Not Evaluated	1	
Chiroptera	Vespertilionidae	*Myotis tricolor*	Temminck's hairy bat	No	LC	LC	1	1
Chiroptera	Vespertilionidae	*Neoromicia capensis*	Cape serotine bat	No	LC	LC	1	1
Chiroptera	Vespertilionidae	*Neoromicia nanus*	Banana bat	No	LC	LC	1	
Chiroptera	Vespertilionidae	*Pipistrellus hesperidus*	Kuhl's pipistrelle	No	LC	LC	0	1
Chiroptera	Vespertilionidae	*Scotophilus dinganii*	Yellow house bat	No	LC	LC	1	1
Hyracoidea	Procaviidae	*Procavia capensis*	Rock hyrax	No	LC	LC	1	
Primates	Cercopithecidae	*Chlorocebus aethiops*	Vervet monkey	No	LC	LC	1	1
Primates	Cercopithecidae	*Papio hamadryas*	Chacma baboon	No	LC	LC	1	

Order	Family	Scientific Name	English Name	Regional Endemic	Global Red List	National Red List	Emlembe Mountain	Mining Lease Area
Primates	Galagidae	*Galago crassicaudatus*	Thick-tailed bushbaby	No	LC	LC	1	
Rodentia	Hystricidae	*Hystrix africaeaustralis*	Porcupine	No	LC	LC	1	1
Rodentia	Muridae	*Grammomys dolichurus*	Woodland mouse	No	LC	LC	1	
Rodentia	Muridae	*Micaelamys namaquensis*	Namaqua rock rat	No	LC	LC	1	
Rodentia	Muridae	*Mus minutoides*	Pygmy mouse	No	LC	LC	1	1
Rodentia	Thryonomidae	*Thryonomys swinderianus*	Cane-rat	No	LC	LC	1	
Soricomorpha	Soricidae	*Crocidura flavescens*	Giant musk shrew	No	LC	LC	0	1

Table 9 - Amphibians, reptiles and fishes

	Scientific Name	English Name
Amphibians	*Amietia angolensis*	Common River Frog
	Amietophrynus gutturalis	Guttural Toad
	Breviceps mossambicus	Mozambique Rain Frog
	Breviceps verrucosus	Plaintive Rain Frog
	Cacosternum nanum	Bronze Caco
	Hadromophryne natalensis	Natal Ghost Frog
	Hyperolius marmoratus	Painted Reed Frog
	Strongylopus grayii	Clicking Stream Frog
	Tomopterna natalensis	Natal Sand Frog
Reptiles	*Acanthocercus atricollis*	Southern Tree Agama
	Acontias plumbeus	Giant Legless Skink
	Afroablepharus wahlbergii	Wahlberg's Snake-eyed Skink
	Afrotyphlops bibronii	Bibron's Blind Snake
	Agama aculeata distanti	Distant's Ground Agama
	Amblyodipsas concolor	Natal Purple-glossed Snake
	Aparallactus capensis	Cape Centipede-eater
	Bitis arietans	Puff Adder
	Bitis atropos	Berg Adder
	Boaedon capensis	Brown House Snake
	Bradypodion transvaalense	Northern Dwarf Chameleon
	Causus rhombeatus	Common Night Adder
	Cordylus vittifer	Transvaal Girdled Lizard
	Crotaphopeltis hotamboeia	Herald Snake
	Dendroaspis polylepis	Black Mamba
	Dispholidus typus	Boomslang
	Duberria lutrix	Common Slug-eater
	Hemidactylus mabouia	Tropical House Gecko
	Inyoka swazicus	Swazi Rock Snake
	Leptotyphlops scutifrons conjunctus	Peter's Thread Snake
	Lycodonomorphus inornatus	Olive House Snake
	Lygodactylus capensis	Cape Dwarf Gecko
	Lygodactylus ocellatus	Spotted Dwarf Gecko
	Naja mossambica	Mozambique Spitting Cobra
	Psammophis brevirostris	Short-snouted Grass Snake
	Pseudaspis cana	Mole Snake
	Pseudocordylus melanotus	Common Crag Lizard
	Scelotes mirus	Montane Dwarf Burrowing Skink

	Scientific Name	English Name
	Thelotornis capensis	Vine Snake
	Trachylepis punctatissima	Montane Speckled Skink
	Trachylepis varia	Variable Skink
Freshwater Fish	*Amphilius uranoscopus*	Stargazer Mountain Catfish
	Barbus gurneyi	Redtail Barb
	Chiloglanis pretoriae	Shortspine Rock Catlet
	Labeobarbus marequensis	Lowveld Largescale Yellowfish

6.7 OCCUPATIONAL HEALTH AND PUBLIC HEALTH

6.7.1 Overview of occupational exposure to asbestos fibres

According to the Occupational and Public Health Survey, included in **Appendix G** (Lemmer, R. 2017), chrysotile is regarded as the least toxic of the different asbestos minerals. Nevertheless, it still has the potential to cause asbestos related pathology, i.e. asbestosis (a scarring of the lungs), mesothelioma (a cancer of the lining of the lungs) and diffuse pleural disease (an irritation or inflammation of the membrane surrounding the lungs that leads to breathlessness).

Breathing in asbestos fibres may lead to a number of serious health conditions, including asbestosis, mesothelioma and diffuse pleural disease. The risk of suffering from these asbestos-conditions may increase depending on the number of asbestos fibres a person has been exposed to, and the health of the person's lungs.

Most people who have suffered health conditions from exposure to asbestos particles usually worked in either the asbestos milling industry or asbestos mining. Others may have also worked in industries involved in manufacturing or installing asbestos products. In all these cases, the constant exposure to high levels of airborne asbestos dust is the cause of acquiring health conditions like lung cancer, asbestosis and mesothelioma.

It is essential to note that there appears to be a high level of correlation between smokers and ARDs. A healthy set of lungs, due to its acidity, is able to neutralise the effects of moderate doses of chrysotile, as was noted in the Occupational and Public Health Survey Report. The effect of any airborne substance is considerably exacerbated by compromised lungs. Accordingly, control and prohibition of smoking will be of the highest priority.

The symptoms of asbestos-related diseases may not appear until about 20 to 30 years, even up to 40 years, after the first exposure to asbestos. Hence, asbestos-induced conditions will

not affect a person immediately, but may cause health problems later in life. Upper Respiratory Tract Infections (URTI's) could be an indication of dust and/or asbestos dust exposure.

6.7.2 Local context of occupational exposure to asbestos

Whilst accurate records and associated statistics are limited, it is known that the mine employed between 2,000 and 3,000 people during its operations and the town, at the height of the mining operation, was home to about 10,000 people. From an occupational health perspective, whilst Personal Protective Equipment (PPE) was provided to employees and health and safety procedures were in place, there are no records to demonstrate adherence to policy requirements and the stringent use of the PPE, particularly dust masks. Photographic evidence depicts the incorrect use of the masks to prevent dust inhalation. In addition, the operation was not kept wet and therefore dust suppression methodologies appear limited. In terms of measures to minimise health and safety risks to community members there is no evidence of such measures from research conducted.

Historical information regarding occupational and public health impact is limited, especially for the earlier years of the Havelock mine operations. It is understood that the Turner & Newall Group of Companies went into bankruptcy due to, *inter alia*, medical claims filed against them as the effects of asbestos exposure became more apparent.

Since 2010 the Asbestos Relief Trust (ART), and recently also the Q(h)ubeka Trust (QT), have been screening former employees of the mine for possible Asbestos Related Diseases (ARD) and compensating them if found to suffer from such.

Data from Eswatini Department of Labour shows a total recorded number of 34 employees diagnosed with Asbestos Related Diseases (ARD). Data from the ART shows a recorded number of 330 presenting employees, of whom 15-20% were diagnosed with ARD between

the years 2007-2011. It is possible that people in the surrounding community were exposed and affected during the previous mining operations. Data in this regard is even more limited.

6.7.3 Occupational exposure limits and monitoring

The International Labour Organization (ILO), 1984 provides guidelines on occupational exposure limits for various countries around the world. The nearest listed country is Zambia whose limit is 0.5 f/ml for chrysotile and 0.2 f/ml for amosite. Other countries generally have higher limits, for example the USA is 2.0 f/ml for all types of asbestos, Australia is 1.0 f/ml while most other countries are between 1 and 2 f/ml.

In the absence of a national exposure limit, the Zambian limit of 0.5 f/ml will be used as a guideline on the Kobolondo Project. Assessment of exposure will be through:

a) Pre-employment, annual and exit medical examinations.
b) Regular personal monitoring where exposed employees are monitored with wearable devices.
c) Static monitoring where devices are placed at strategic locations in the workplace.

The occupational medical matrix in Table 14 shows the occupations and monitoring schedule.

6.7.4 Public Health

Pertinent public health issues are human immunodeficiency virus (HIV) and tuberculosis (TB). Immunisation and family planning are priority national health activities.

6.7.5 Health facilities

Occupational health facilities to diagnose and manage ARD currently do not exist within Bulembu, and are limited in the area. The nearest occupational health facilities, approximately 25 kilometres away, are privately operated within Peak Timbers clinic facility

which is primarily a primary healthcare facility which incorporates occupational health services from time to time as required.

Bulembu Clinic is a primary health facility operated and managed by BMS. This clinic provides primary healthcare to the CCP primarily and secondarily to the community. If a medical situation arises that Bulembu Clinic is unable to deal with the patient is referred or transferred to Piggs Peak Hospital for further treatment. There is one functional ambulance that belongs to Bulembu Clinic. Bulembu Clinic and Piggs Peak Hospital have a satisfactory and effective working relationship. Piggs Peak Hospital is a government owned and managed secondary care hospital and therefore provides primary and secondary care, however with limited facilities, equipment and staff. The Piggs Peak Clinic is located within these facilities.

6.8 BASELINE AIR QUALITY

6.8.1 Overview of ambient air quality in Bulembu

According the Baseline Air Quality Survey included in **Appendix H** (Aircheck, 2017), ambient air quality in Bulembu and surrounding communities was measured in terms of five categories:

- Gaseous air pollutants;
- Asbestos;
- Particulate matter;
- Silica;
- Heavy metals.

Measurement sites were:

- TSF
- Bulembu Community Church;
- Bulembu Country Lodge;
- Malanda community (north of Bulembu village);
- Ncenceni community (south of Bulembu village).

Ambient air quality pollutants were measured against the standards listed in Table 10.

Table 10 - Air quality parameters measured

Pollutants	WHO Air Quality Gudielines 2000	United States Environmental Protection Agency National Ambient Air Quality Standards	South African National Ambient Air Quality Standards	Eswatini Air Pollution control Regulations, 2010 Schedule 1 – Air Quality Objectives
CO	Not listed	35 000 ppb 1-hour mean	26 000 ppb 1-hour mean	1 hour : 30mg/m^3 24 hours: 10mg/m^3
NO	Not listed	Not listed	Not listed	Not listed
NO_2	106 ppb 1-hour mean	100 ppb 1-hour mean	106 ppb 1-hour mean	1 hour: 200µg/m^3 24 hours: 50µg/m^3 12 months: 40µg/m^3
SO_2	7,63 ppb 24-hour mean	75 ppb 1-hour mean	48 ppb 24-hour mean	1 hour: 350µg/m^3 24 hours: 125µg/m^3 12 months: 50µg/m^3
Asbestos	Not listed	Not listed	Not listed	Not listed
$PM_{2.5}$	25 µg/m^3 24-hour mean	35 µg/m^3 24-hour mean	Not listed	Not listed
PM_{10}	50 µg/m^3 24-hour mean	150 µg/m^3 24-hour mean	75 µg/m^3 24-hour mean	24 hours: 50µg/m^3 12 months: 40µg/m^3
Crystalline silica	Not listed	Not listed	Not listed	Not listed
Lead	Not listed	0,15 µg/m^3 rolling three-month average	0,5 µg/m^3 annual mean	24 hours: 20µg/m^3 12 months: 0.5µg/m^3
Arsenic (As)	Not listed	Not listed	Not listed	Not listed
Cadmium (Cd)	Not listed	Not listed	Not listed	Not listed
Chromium (Cr)	Not listed	Not listed	Not listed	Not listed
Molybdenum (Mo)	Not listed	Not listed	Not listed	Not listed
Nickel (Ni)	Not listed	Not listed	Not listed	Not listed
Antimony (Sb)	Not listed	Not listed	Not listed	Not listed

In order to contextualise ambient air quality at Bulembu in relation to its rural setting, results were evaluated against the WHO and research literature for rural and urban environments as shown in Table 11.

Table 11 - Expected urban and rural air quality

Pollutants	Rural	Urban	References
CO	—	50 - 120 ppb	WHO Air Quality Guidelines 2000.
NO2	—	16,1 - 55 ppb 1-hour mean	2016 National Trends in Nitrogen Dioxide Levels based on 207 sites, EPA, United States.
SO_2	[1] 0,05 - 0,12 ppb annual mean	[2] 7 - 21 ppb annual mean	[1] Weil and Sandler, 1997. [2] WHO Air Quality Guidelines 2000.
Asbestos	< 100 f/m^3	≤ 100 - 1000 f/m^3	Downwind from an asbestos-cement plant at 300 m - 2200 f/m^3.
$PM_{2.5}$	32 µg/m^3 annual mean	37 µg/m^3 annual mean	Mean annual concentration of $PM_{2.5}$ for Africa for 2014. WHO, *Ambient Air Pollution, A global assessment of exposure and burden of disease.*

The levels measured at Bulembu are shown in Table 12.

Table 12 - Air quality at Bulembu

No	Date	Measurement Point	Gas Levels (ppb)				Asbestos Fibre Level (f/m^3)	Particulate Matter ($\mu g/m^3$)		α-SiO_2 ($\mu g/m^3$)	Metals ($\mu g/m^3$)						
			CO	NO	NO_2	SO_2		PM2.5	PM_{10}		As	Cd	Cr	Mo	Ni	Pb	Sb
1.	02/08/17	Tailings Storage Facility	100	4,2	3,4	7,6 #	1165,2 #	—	—	BDL	BDL	BDL	0,13	BDL	BDL	BDL	BDL
2.	01/08/17	Bulembu Community Church	100	3,5	2,3	4,8 #	493,5 #	26,5 #	35,8	BDL	BDL	BDL	0,12	BDL	BDL	BDL	BDL
3.	01/08/17	Bulembu Country Lodge	200	2,7	3,1	5,2 #	335,7 #	—	—	BDL	BDL	BDL	0,07	BDL	BDL	BDL	BDL
4.	04/08/17	Receptor North	100	3,8	3,1	1,5 #	502,2 #	—	—	BDL	BDL	BDL	0,35	BDL	BDL	BDL	BDL
5.	02/08/17	Receptor South	100	2,8	2,7	7,0 #	2322,2 #	—	—	BDL	BDL	BDL	0,26	BDL	BDL	BDL	BDL

Legend:

#	*Exceed the recommended standard / criteria.*	#	*Above typical background level for rural areas.*
ppb	*Parts per billion.*	*As*	*Arsenic Detection limit 0.00025 µg*
µg/m³	*Microgram per square meter.*	*Cd*	*Cadmium Detection limit 0.00012 µg*
f/m³	*Fibres per cubic metres*	*Cr*	*Chromium Detection limit 0.00015 µg*
Fibres	*Fibres of length L > 5 µm, diameter D < 3 µm and aspect ratio L : D > 3 : 1*	*Mo*	*Molybdenum Detection limit 0.00013 µg*
$PM_{2.5}$	*Particulate matter 2.5-micron fraction.*	*Ni*	*Nickel Detection limit 0.00012 µg*
PM_{10}	*Particulate matter 10- micron fraction.*	*Pb*	*Lead Detection limit 0.00035 µg*
α-SiO_2	*Alpha quartz crystalline silica Detection limit 0.004 mg*	*Sb*	*Antimony Detection limit 0.00077 µg*
BDL	*Below the detection limit of the analytical method used.*		

The levels of gaseous air pollutants such as carbon monoxide and nitrogen oxides in Bulembu village and surrounding communities were found to be typical of rural districts. Sulphur dioxide levels were higher than the expected background level for rural areas, which is likely to be attributed to the manufacturing of charcoal at the local sawmill and elsewhere in the area.

Particle Matter includes PM_{10} or inhalable particles, with diameters that are generally 10µm and smaller and $PM_{2.5}$ which comprises fine inhalable particles, with diameters that are generally 2.5µm and smaller. The levels of $PM_{2.5}$ and PM_{10} measured at Bulembu Community Church were typical of the background levels that may be expected in a rural town in Africa. However, the $PM_{2.5}$ level exceeded the World Health Organization (WHO) air quality guideline of 25µg/m^3 (24-hour mean).

Levels of respirable asbestos fibres exceeded the WHO guideline for rural areas, furthermore details on levels of respirable asbestos are provided in Section 6.8.2 below.

6.8.2 Gaseous pollutants

The gaseous pollutants measured were carbon monoxide (CO), nitrogen oxide (NO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). The level of CO in Bulembu and surrounding communities ranged from 100 parts per billion (ppb) to 200ppb, which is consistent with the natural background level that is in the range of 50ppb and 120ppb for rural areas.

The Air Quality Objectives in Schedule 2 of the Air Pollution Control Regulations, 2010 stipulate the maximum concentration of CO in ambient air as 10mg/m^3(24-hour mean). Converting air quality measurement units requires the molecular weight of the gas to be taken into account. Therefore when converting the measured CO to mg/m^3, in order to compare against the Air Pollution Control Regulations, 2010, the level of CO in Bulembu and surrounding communities ranged from 0.11 to 0.23mg/m^3 which is below the legislated ambient air quality objective.

The level of NO_2 ranged between 2.3ppb and 3.4ppb at the various measurement locations, for example NO_2 levels were 2.3ppb at Bulembu Community Church, 3.1ppb in the Malanda community and 3.4ppb at the TSF. The Air Quality Objectives in Schedule 2 of the Air Pollution Control Regulations, 2010 stipulate the maximum concentration of NO_2 in ambient air as 50µg/m^3 (24-hour mean). Converting the measured units to the legislated units shows that the level of NO_2 ranged from 4.33µg/m^3 to 6.40µg/m^3, which is below the legislated limit.

The baseline level of SO_2 in Bulembu ranged between 1.5ppb and 7.6ppb, therefore the level in Bulembu is below the WHO guideline limit of 7.63ppb (24-hour mean). The Air Quality Objectives in Schedule 2 of the Air Pollution Control Regulations, 2010 stipulate the maximum concentration of SO_2 in ambient air as 125µg/m^3 (24-hour mean). Converting the measured units to the legislated units shows that the level of SO_2 ranged from 3.93µg/m^3 to 19.89µg/m^3, which is below the legislated limit.

Existing sources of CO, NO_2 and SO_2 pollution in Bulembu include domestic fuel burning for cooking and heating, motor vehicle exhaust emissions and possibly the burning of solid and organic waste. There is a charcoal plant at the local sawmill, as well as a number of small charcoal manufacturing operations in the hills in the vicinity which are the likely sources of SO_2.

6.8.3 Asbestos

Exposure to asbestos occurs through inhalation of fibres from contaminated air in the working environment, as well as from ambient air in the vicinity of point sources containing friable asbestos materials. The biologically important respirable asbestos fibres are those equal to, or longer than 5µm and having diameters less than 3µm with an aspect ratio equal to or greater than 3:1.

Respirable asbestos fibre levels in Bulembu ranged from 335.7 fibres per cubic metre (f/m^3) at Bulembu Country Lodge to 2,322.2 f/m^3 in the Ncenceni community south of the TSF. The level at Bulembu Country Lodge was measured after 0.2mm of precipitation in the early morning.

The prevailing levels recorded during the survey were consistently higher than the guidelines provided by the WHO for rural areas. The level of 1,165.2 f/m^3 on top of the TSF was more than 11 times above the level expected in rural areas, whilst wind generated dust is likely to be responsible for the high level of 2,322.2 f/m^3 in the Ncenceni community. The Air Quality Objectives in Schedule 2 of the Air Pollution Control Regulations, 2010 do not provide guidelines for asbestos fibre levels.

Asbestos fibres that are released into the environment may travel considerable distances due to their aerodynamic properties and since no chemical breakdown of the fibres occurs in the atmosphere, wash-out by rain is the only mechanism by which they are removed from the air. The chrysotile asbestos TSF in Bulembu is the main source of respirable asbestos fibre pollution.

6.8.4 Particulate matter

The level of $PM_{2.5}$ in Bulembu was 26.5µg/m^3, at Bulembu Community Church which was consistent with the background level of 32µg/m^3 (annual mean) for rural areas, but higher than the WHO air quality guideline of 25µg/m^3 (24-hour mean). The level of PM_{10} was 35.8µg/m^3, which was below the WHO air quality guideline level of 65µg/m^3. While PM2.5 is not included in the Air Quality Objectives in Schedule 2 of the Air Pollution Control Regulations, 2010, the limit for PM_{10} is stipulated as 50µg/m^3 (24-hour mean).

Existing sources of particulate matter pollution in Bulembu include the sawmill, charcoal manufacturing, domestic fuel burning for cooking and heating purposes, motor vehicle

exhaust emissions and dust generated by vehicles on gravel roads. Windblown dust generated from the TSF is likely to be a major source of $PM_{2.5}$.

6.8.5 Silica

The level of crystalline silica, as α-SiO2, in airborne dust was below the detection limit and is not included in the Air Quality Objectives in Schedule 2 of the Air Pollution Control Regulations, 2010.

6.8.6 Heavy metals

The levels of heavy metals, including arsenic (As), cadmium (Cd), molybdenum (Mo), nickel (Ni), lead (Pb) and antimony (Sb) in airborne dust were below the detection limit. Chromium (Cr) was present at levels that varied between 0.07µg/m^3 to 0.35µg/m^3, which is likely to originate from the TSF since asbestos tailings are reported to have high concentrations of chromium. The only heavy metal included in the Air Quality Objectives in Schedule 2 of the Air Pollution Control Regulations, 2010, is lead (Pb) which is stipulated as 20µg/m^3 and none was detected during the survey.

6.8.7 Future monitoring of air quality

The equipment that will be used for monitoring ambient air quality is listed in Table 13. For each equipment, the manufacturer's instruction manual will be followed in conjunction with the respective standard analytical method. All prospective service providers at tendering stage will be evaluated against the capacity to meet the requirements of Table 13. The occupational and environmental surveillance matrix is shown in Table 14.

Table 13 - Standard equipment and methods in ambient air quality monitoring

Pollutant	Instrumentation	Standard Method
CO	TSI Q-Trac Plus® portable direct reading carbon monoxide monitor.	National Institute for Occupational Health (South Africa) NIOSH 6604.
NO and NO_2	GILAIR® constant flow sampling pumps fitted with sorbent tubes (oxidizer + 2 triethanolamine-treated molecular sieve).	NIOSH 6014.
SO_2	GILAIR® constant flow sampling pumps fitted with filters + treated filters (cellulose + Na_2CO_3 preceded by 0.8-µm cellulose ester membrane).	NIOSH 6004.
Asbestos	GILAIR® constant flow sampling pumps fitted with mixed cellulose ester filters (25 mm diameter, 0.8 µm pore size). Olympus Microscope CX41 with G24 Walton / Beckett Graticule.	HSG 248, *Asbestos: The analysts' guide for sampling, analysis and clearance procedures*, HSE, United Kingdom.
PM2.5 / PM10	GILAIR® constant flow sampling pumps fitted with glass fibre filters (37 mm diameter) and M-PEM $PM_{2,5}$ / PM_{10} Impactors. A&D Gemini Series GR-202 Semi-Micro Balance.	MDHS 14/4.
Crystalline silica	GILAIR® constant flow sampling pumps fitted with mixed cellulose ester filters (37 mm diameter, 0.8 µm pore size). Respirable fraction cyclones.	NIOSH 7602.
Metals	GILAIR® constant flow sampling pumps fitted with mixed cellulose ester filters (37 mm diameter, 0.8 µm pore size).	NIOSH 7300.

Table 14 - Occupational medical and environmental surveillance

Operations	Pre-employment, Annual, Exit			Personal Asbestos Exposure Level	Static Asbestos Exposure Level	Chemical Exposure Assessment	Vibration Assessment	Ambient Air Quality Assessment	Noise	Water Quality
	Spirometry (lung function)	Audiometry (hearing)	Vision Assessment							
Administration	YES	YES	YES	6 months	12 months					
TSF excavation and filling	YES	YES	YES	Monthly	3 months		12 months			
Material Screening	YES	YES	YES	Monthly	3 months		12 months			
Scrubber	YES	YES	YES	Monthly	3 months					
Roll Crusher	YES	YES	YES	Monthly	3 months		12 months			
Spirals	YES	YES	YES	Monthly	3 months					
Primary Mill	YES	YES	YES	Monthly	3 months		12 months			
Regrind Mills and Cyclones	YES	YES	YES	Monthly	3 months		12 months			
Preconditioning	YES	YES	YES	Monthly	3 months	12 months	12 months			
Carbon in Leach	YES	YES	YES	Monthly	3 months	6 months				
Elution	YES	YES	YES	Monthly	3 months	6 months				
Magnetic Separation	YES	YES	YES	Monthly	3 months					
Flotation	YES	YES	YES	Monthly	3 months	12 months				
Roaster	YES	YES	YES	Monthly	3 months	12 months				
Acid Plant	YES	YES	YES	Monthly	3 months	6 months				
Acid Leach	YES	YES	YES	Monthly	3 months	6 months				
Precipitation	YES	YES	YES	Monthly	3 months	6 months				
Crystallization	YES	YES	YES	Monthly	3 months	6 months				
Furnace	YES	YES	YES	Monthly	3 months					
Packing	YES	YES	YES	Monthly	3 months					
Warehousing	YES	YES	YES	Monthly	3 months					
Transport	YES	YES	YES	Monthly	3 months		12 months			
Community								12 months	12 months	Monthly

6.9 BASELINE ENVIRONMENTAL NOISE

6.9.1 Overview of environmental noise

According the Baseline Environmental Noise Survey included in **Appendix I** (Aircheck, 2017), the operation of mining and beneficiation plant and equipment is recognized as a significant environmental noise pollutant. Sound which is disagreeable, discordant or which interferes with the reception of wanted sound may be regarded as noise. Noise can damage physiological and psychological health, which may result in stress, tension and hearing impairment. Sound of an annoying nature rarely reaches the sound pressure levels associated with hearing impairment, but may result in aggression, hypertension, high stress levels, tinnitus, sleep disturbances and other harmful effects.

The survey was conducted from 31st July 2017 to 04th August 2017 at six measurement points that were located within the project area. One measurement point was at the tailings facility, whilst four others were selected at sensitive receptors in and around the town of Bulembu. The final measurement point was selected next to the main road through the town to provide a baseline sound level for traffic. The measurement points are indicated in the Baseline Environmental Noise Survey Report.

6.9.2 Existing potential sources of noise

6.9.2.1 Commercial activities

Commercial and small enterprise activities in and around the town of Bulembu includes forestry, timber, honey, dairy, bakery and tourism. According to the Baseline Environmental Noise Survey, potential sources of noise are:

- Bulembu Sawmill, situated immediately outside Bulembu along the MR20 (Bulembu - Pigg's Peak), which included a charcoal plant, wood chipper and employs approximately 120 people;
- The logging operation that was often audible around Bulembu.

6.9.2.2 Roads and traffic

There is one main road (MR20) which enters the town from Pigg's Peak and becomes the main road that traverses through the town before climbing up the mountain pass towards the South African border post at Josefsdal. The road is paved for a distance of 3.4km from the border and thus the section which passes through Bulembu village is paved. Thereafter the section between Bulembu and Pigg's Peak is gravel. The remainder of roads are unpaved streets and access roads to the residential areas, community settlements and forestry activities. Traffic volumes were low at the time of the survey, with a total of three vehicles per hour passing the centre of Bulmebu village during day-time and very little or no traffic reported at night time.

6.9.3 Baseline sound measurements

While this ESIA Report describes the findings, the baseline sound measurements are tabulated in the Baseline Environmental Noise Survey Report.

6.9.3.1 TSF site

The average sound rating level (LAeq) during the day-time was 35.5dBA, with a maximum (Lmax) level of 65.6dBA. Audible sounds during the measurement period originated from chainsaws in the adjacent eucalyptus plantation, aircraft flying over, birds and insects. The background noise during day-time may be described as quiet, with the interrupted sounds from chainsaws that were responsible for the relatively high maximum (Lmax) level of 65.6dBA.

During the night time measurement interval, it became dead quiet with an average sound rating level (LAeq) of 22.9dBA and a maximum sound rating level (Lmax) of 52.9dBA. The only audible sounds were insects and the rustling of wind through the adjacent plantation.

6.9.3.2 Bulembu Community Church (Sensitive Receptor 1 [SR1])

The measurement point at the Bulembu Community Church was selected for its location, more or less in the centre of community activities in the village. There are several sensitive receptors in the village, amongst others, the church itself and the nearby school. It is located only a short distance, some 300m, from the northernmost foot of the TSF and is likely to be affected by noise emanating from the proposed rehabilitation operations.

The average sound rating level (LAeq) during day-time was 42.6dBA, with a maximum rating level (Lmax) of 56.6dBA. Chain saws from forestry activities were audible in the distance, but the maximum sound level recorded is rather attributable to vehicular traffic. Other sounds that were audible included pedestrians talking while passing by and children laughing and playing at the distant school.

The average night time noise rating level (LAeq) was 27.4dBA, which was dead quiet with only insect activity audible at times. The maximum sound rating level (Lmax) of 56.6dBA may be attributed to a single car passing by on the nearby main road.

Sound levels remained below the maximum equivalent continuous rating level (LAeq) of 45dBA for the day-time period and 35dBA for the night time interval for ambient noise in rural districts.

6.9.3.3 Bulembu Country Lodge (Sensitive Receptor [SR2])

The measurement point at the Bulembu Country Lodge represents sensitive receptors located in a residential area, approximately 500m north west of the TSF. Due to its proximity, the residential area is likely to be affected by noise emanating from the proposed rehabilitation operations.

The average sound rating level (LAeq) during day-time was 41.0dBA, with a maximum rating level (Lmax) of 65.5dBA. Vehicular traffic passing by on the adjacent MR20 was the only discernible source of sound during the measurement period and is also responsible for the maximum sound level of 65.5dBA.

During the night, the average sound rating level (LAeq) was 22.1dBA due to the absence of vehicular traffic during this period. However, cats frequenting the dustbins at the lodge and insects were audible from time to time and may be responsible for the maximum sound pressure level of 53.8dBA recorded at this point.

Sound levels remained below the maximum equivalent continuous rating level (LAeq) of 45dBA for the day-time period and 35dBA for the night time interval for ambient noise in rural districts.

6.9.3.4 Malanda Community (Sensitive Receptor [SR3])

Malanda community, which is situated approximately 2.2km to the north of the TSF was selected as it represents the furthest point the north of the proposed rehabilitation works. This community consists of several houses arranged along gravel roads that climb upwards against a steep hill. A school is located some short distance below the community.

The average sound rating level (LAeq) during the day-time was 44.1dBA, with a maximum (Lmax) level of 72.3dBA. The barking of dogs, both near and far, was characteristic of this measurement point, whilst radios, human activity and aircraft flying over were also audible.

During the night time period, the average sound rating level (LAeq) was 23.2dBA with mainly dogs and insects audible. The maximum sound rating level was 52.5dBA, most probably as a result of barking dogs.

Sound levels remained below the maximum equivalent continuous rating level (LReq,T) of 45dBA for the day-time period and 35dBA for the night time interval for ambient noise in rural districts.

6.9.3.5 Ncenceni Community (Sensitive Receptor [SR4])

Ncenceni, which is the community 2.6km to the south of the TSF was selected as it represents the closest sensitive receptor south of the proposed rehabilitation works. It is situated in a remote area, along a forestry road and almost adjacent to the South African border.

The average sound rating level (LAeq) during day-time was 34.6dBA, with a maximum rating level (Lmax) of 60.0dBA. Despite the remoteness of this community, several sounds were

audible during the measurement period, including a crying baby, barking dog, people talking and the ever-present chain saws in the distance.

The average night time noise rating level (LAeq) was 21.8dBA, which was dead quiet. A jackal was audible in the distance and insects could also be heard. The maximum sound rating level (Lmax) of 51.2dBA was not defined.

Sound levels remained below the maximum equivalent continuous rating level (LReq,T) of 45dBA for the day-time period and 35dBA for the night time interval for ambient noise in rural districts.

6.9.3.6 Main Road (MR20)

A measurement point was selected directly next to the MR20 where it passes through the centre of Bulembu village. The location of the measurement point was halfway between the fork in the road at the foot of the North TSF and the point where the road enters the town from Pigg's Peak.

The average sound rating level (LAeq) next to the road during day-time was 54.4dBA, with a maximum rating level (Lmax) of 76.2dBA. There was very little traffic passing through the town at the time of the survey, possibly as a result of the road from Pigg's Peak that was reported to be in a poor state of repair. Traffic volumes were low at the time of the survey, with a total of three vehicles per hour passing the centre of town during day-time and very little or no traffic reported at night time.

The average noise rating level (LAeq) during night time was 28.1dBA, with a maximum sound level of 58.0dBA. Only one vehicle passed during the night time measurement period.

6.10 BASELINE SOCIO-ECONOMIC ASPECTS OF PROJECT SITE

6.10.1 National level

The Kingdom of Eswatini is a land-locked nation, comprising 17,400km^2, situated in southern Africa bordering the Republic of South Africa (to the north, west and south) and Mozambique (to the east). Of this land, 62% is under permanent pasture and 7% is forested indicative of the key industries in the country – sugar cane and timber. The nation holds a very strong cultural heritage under the monarchy and continuously strives to enlarge its economic base and standing in the global and regional economies.

6.10.2 Regional level

Eswatini comprises 4 administrative districts: Manzini, Hhohho, Shiselweni and Lubombo. The Kobolondo Project is located in the Hhohho District in the north-west of Eswatini and the nearest major town to the project area is Pigg's Peak which is administered by its own Town Council. Hhohho is divided into 14 tinkhundla (constituencies or administrative centres) with its administrative centre in Mbabane, the administrative capital city of Eswatini, and comprises a population of 309,184.

Whilst the Hhohho District is the most economically advanced region of Eswatini, as it comprises the capital city of the country and the most urbanised regions, the area in which the project is situated is very rural, remote and has a low economic growth profile.

6.10.3 Local level

Aligned to the drivers of the Hhohho District's economy, in addition to the CCP which is located within Bulembu, the local economy at Bulembu is driven by tourism and timber, albeit a much lower scale.

6.10.3.1 Bulembu village

Once a mining town managed by the asbestos mining companies who operated the Havelock Mine, it is now owned by Bulembu Development Corporation (BDC) on behalf of BMS who operate the CCP and associated enterprises within the town. Since the arrival of BMS, there have been substantial changes within Bulembu village, taking it from a once abandoned mining ghost town, to a community geared to supporting the CCP and sustainable enterprise development, with a focus on tourism.

At the time of the BMS purchase, the village was almost deserted, with limited economic activity. What remained were the remnants of the old mining community and its operations. Over the last 10 years, the interventions of BMS have rescued Bulembu village from being a ghost town through a joint strategy of community care and community enterprise. This was achieved through starting several businesses, including Bulembu Honey, Bulembu Water, Bulembu Country Lodge, a dairy and a timber business. Currently, the village of Bulembu houses an integrated and comprehensive CCP for approximately 380 vulnerable children.

According to the Socio-Economic Impact Assessment (**Appendix J**), the majority or residents within Bulembu village are employed and this is likely linked to the employment profile and the ownership structure of the village wherein BMS, the landowner and primary employer, manages the housing allocations. The gender profile of the unemployed and employed Heads of Households within the village indicates that the majority (71%) of those who are employed are male, whilst the majority (73%) of those who are unemployed are female.

There is currently a high dependency across the village on the services provided by the Bulembu Clinic and, to some degree, the Bulembu Academy (primary and secondary schools). Grocery shopping and other requirements such as pension collections are predominately conducted in Piggs Peak.

6.10.3.2 Surrounding communities

The 4 communities surrounding Bulembu village comprise Mkhawululweni, Madanzini, Malanda and Ncenceni. Bulembu and the surrounding communities fall under the Bulembu Chiefdom of His Royal Highness (HRH) Prince Mnikwa. The majority of the surrounding communities are situated on Swazi Nation Land. Settlement patterns on Swazi Nation Land are subject to Chiefs' control at the Community level, whilst the King controls settlement patterns at the regional or national level.

Any request for land is put before the Community Committee. The Community Committee then takes the request to the Chief. The Chief will send his Indvuna to assess the land, to ascertain if there is sufficient space for allocation of another plot. The Indvuna makes the decision and should he give permission, the applicant chooses the plot and pays the amount the land is deemed to be worth. The amount payable is determined by the size and the location of the land in question. Both males and females are allowed to apply for land and the same process is used for the allocation of land when existing community members want a portion of land for their families.

The national rate of unemployment was recorded as 28.1% in 2013/14 (National Labour Force Survey, Eswatini Department of Statics). Unemployment amongst the population residing in the 4 communities surrounding Bulembu village is currently estimated at 70%. This correlates to the reported average household income which indicates that 50% of the homesteads surveyed during the Socio-Economic Impact Assessment receive less than E800 per month. Due to the high unemployment rate, many households rely on subsistence agriculture as a means of survival.

Access to basic services in the communities, such as healthcare and education is of a fairly good standard, as 3 medical facilities and multiple schools, both primary and secondary level, are viable. The majority of community residents use Bulembu Clinic for their basic medical

needs, whilst some use Pigg's Peak Hospital. The majority of secondary and high school pupils attend various schools in Pigg's Peak.

Services such as running water, electricity and sanitation are however not as accessible. Many homes rely on alternative fuel sources for heating, cooking and lighting and none have access to piped sewage facilities.

6.10.3.3 Incidence of crime

According to the Royal Eswatini Police, the incidence of crime in Bulembu (comprising the village and surrounding communities) is relatively wherein at total of 25 crimes were recorded in 2016. The most common crimes were theft and illegal mining. While the police data does not specify the minerals constituting illegal mining, the offenders were not in possession of permits required by the Mines and Minerals Act, 2011 and the Environmental Management Act, 2002.

6.11 BASELINE HERITAGE

6.11.1 Regional context

Heritage comprises an object, property, custom, quality, practice(s) or valued thing(s) which have been passed down over many years from one generation to the next within a family or amongst a social group of peoples.

Humans evolved in eastern and southern Africa and thus Eswatini has been continuously inhabited from the start of the human species. Evidence suggests that human occupation of Eswatini began 2.5 million years ago, covering the stone ages, the iron ages, the colonial period up to the present (Masson, J. 2011).

The San, often referred to as the 'Bushman', and their ancestors were the early occupants of Southern Africa, including Eswatini as demonstrated by several rock art sites in various parts of the country. According to Masson (2011), the San were followed by the early Iron Age pastoralists who arrived from about 500AD and thereafter by influxes of Iron Age agropastoralists comprising the Sotho, Tsonga and Nguni groups. The Dlamini arrived in the mid-18th century (1700s) and, over the subsequent 100-year period, assimilated their predecessors to form the present day Emaswati Nation.

6.11.2 Local context

6.11.2.1 The San

According to Masson (2011), there are several Early Stone Age sites along the banks of the Komati River to the west of the inlet to Maguga Dam (10km south of Bulembu) and these sites contain some of the largest handaxes and cleavers observed in Eswatini. Masson suggests that the probable cause of attraction of this habitat to early humans is difficult to

determine other than the general observation that most Early Stone Age sites tended to occur along broad valleys with ample alluvial deposits from which stone tools were made.

The rock paintings of Eswatini belong to the San and, although unevenly distributed, they occur predominantly in the in the north western part of the country which is characterised by granite rocks, on which the paintings are situated. Sites in relative proximity to Bulembu include Nsangwni which is 20km to the south east, Nkhaba which is 20km to the south. The Heritage Survey (Forrester, B. 2017) included in **Appendix K**, refers to a site which is on Farm 815, but outside the MLA, between the MLA and the northern section of Malolotja Nature Reserve.

The reasons for occupation of the north western Highveld by the San are likely to have been, according to Masson (2011) and Forrester (pers. comm.), a combination of factors stemming from the competition for resources, resulting in their gradual expulsion from the lower altitude Middleveld. Consequently, although there was some degree of co-existence between the San and the agropastoralist newcomers, and indeed some assimilation of the San into the societies of the Bantu-speaking newcomers (some of whom later formed the Swazi Nation), the San sought refuge from persecution in the mountainous terrain of the Highveld.

6.11.2.2 Emaswati

According to Matsebula, J.S.M (1988), the Emaswati Nation are descendants of Bantu-speaking agropastoralists who migrated from Central Africa southwards. They were Iron Age agriculturalists who gradually became cattle-keeping communities, while still retaining their agricultural practices, as distinct from the San who were hunter-gatherers. They manufactured tools and weapons of iron. The southward migration was over many generations, and they arrived in south east Africa shortly after 400A.D. Upon reaching the area between the Zambezi River (present-day southern Zambia) and the Limpompo River (present-day southern Zimbabwe) the Bantu-speakers separated into two groups, the Sotho

and Nguni. Further southward migration resulted in the further establishment of new societies with variations in their cultures, languages and dialects. The Sotho migrated southward separating into two groups, the Sotho and the Tswana. The Nguni migrated south eastwards separating into two groups, the Ntunga-Nguni and the Embo-Nguni.

The Embo-Nguni settled in the coastal area of southern present-day Mozambique, before migrating further southward as sub-groups or clans into present-day KwaZulu Natal and westward into present-day Eswatini. Clans consisted of between 200 and 400 people (pers. comm., Bob Forrester) and when they grew larger than this they formed smaller clans under a leader and migrated to establish new settlements. According to Matsebula, J.S.M. (1988), when clans migrated, they left behind smaller clans to guard the graves of kings as well as to take care of the departed area on behalf of royalty.

By the beginning of the 18th century (1700s) there were numerous clans occupying present-day Eswatini, some of Sotho extraction and some of Ntungwa-Nguni extraction who had migrated southward from the north west interior of present-day South Africa and had arrived in Eswatini before those of Embo-Nguni extraction.

The Dlamini, under the leadership of Dlamini III, migrated westward from the coastal area, crossed the Lubombo mountains and settled in south eastern Eswatini. His successor, Ngwane III, migrated north westwards, conquered and absorbed the clans of Sotho extraction who were occupying the southern part of present-day Eswatini. His followers were consequently known as *bakaNgwane* (people of Ngwane) and the land they occupied was *kaNgwane* (the land of Ngwane). Ngwane III was succeeded by Sobhuza I who was referred to as Raputsa by the Sotho-speaking clans and thus his followers were known as *baRaputsa*. He continued conquering clans and thus growing the size of the nation, but also introduced a policy of avoiding conflict with any clans who were militarily more powerful and this included the European settlers. Sobhuza I was succeeded by Mswati II, who continued the process of conquering and assimilating clans, some of whom fled to him to seek refuge from their

enemies and thus the nation grew northward and westward. The unified followers of Mswati II were known as *bakaMswati*/ *amaSwazi* and the European settlers referred to them as the Swazis and subsequently their land became known as Eswatini.

6.11.2.3 Surrounding communities at Bulembu

In the interest of brevity, this ESIA Report will fast-forward to how the present-day communities surrounding Bulembu came into existence. This brevity by no means waters down or ignores the notoriety of the period of the land concessions which influenced the alienation of the local inhabitants from what later became Title Deed Land.

Prior to the establishment of Bulembu as a mining town, settlements were distributed in and around present-day Bulembu village (pers. comm., Forrester quoting Laterza, V., 2012). When the mining town was established, those residing upon the land on which the mine and village were developed, were relocated to join the existing community of Malanda to the north. The Ncenceni community to the south was not affected and thus the community to the north is more densely populated than the community to the south.

6.11.2.4 Importation of labour

Prior to Southern African countries gaining independence from Britain after World War II, the British had established labour recruitment agencies at various centres within the colonial territories. While the majority of recruited labourers were despatched to work in the South African mines, labourers were also despatched to wherever else in Southern Africa the colonial administrators, in consultation with the mine operators, saw fit (pers. comm. Forrester). As a result, some labourers recruited in Malawi and some recruited in South Africa were brought to Havelock Mine. In some cases the mine imported skilled and semi-skilled workers from the aforementioned countries. This explains the occurrence of the surnames,

such as Phiri (Malawian and Zambian) and Mokoena (Sotho) in Bulembu and surrounding communities.

6.11.2.5 Acknowledgement of history of local inhabitants

This ESIA Report is not intended and does not purport to be a detailed historical account of the establishment of the settlements in and around Bulembu, but it is necessary to at least acknowledge the history of the indigenous peoples of the project site since such acknowledgement will better inform any social impact interventions arising from the project, e.g. the nature of sensitivities that will need to be taken into consideration when addressing issues (whether real or perceived) relating to alienation from the land.

6.11.3 Findings of Heritage Survey

6.11.3.1 Archaeological remains

According to the Heritage Survey Report (Forrester, B. 2017) no archaeological remains were found within the MLA and none were found along the stream bed immediately downstream of the TSF. Although a Stillbay point (Middle Stone Age) was found on the surface of a gravelled track between Bulembu Lodge and the old cinema, there is no indication of a site there, therefore it is likely that this point was brought in as road fill from an unknown source at an unknown period to stabilise the track's surface. This does establish the Stillbay culture (*circa* 75,000 to 67,000BP) in proximity to Bulembu, but is not place specific. There are known Stillbay sites on the nearby Komati River.

6.11.3.2 Cableway station

Mining operations in Bulembu commenced in 1937, as demonstrated by the signatures of mine engineers on underground mine maps which required annual certification. The

asbestos was stockpiled until the cableway opened in 1939. During this period management houses were built, as was the General Manager's house and a house for the Postmaster. The cableway station construction commenced, and from Havelock Mine files, was completed in 1939 shortly after the outbreak of World War II.

The cableway station is one of only three surviving pre-World War II major mining cableway stations worldwide, making it an extremely rare example of 1930s mining technology. The operating machinery is intact. By comparison, the station at Barberton has been completely stripped of all machinery by scrap metal thieves, though the extensive structure remains. There are two cableway towers in Eswatini associated with the cableway. Havelock Mine was the dominant source of government income from 1939 to the mid 1960s when Ngwenya Mine supplanted it. It is therefore of historical significance because the tax revenue generated funded the colonial government administration. The cableway station is on the list of future National Monuments proposed by the ENTC.

6.11.3.3 Cottage

There is a cottage near the current security offices that was used by King Sobhuza II for accommodation when he visited Bulembu, then Havelock. It is currently used to receive visitors during the day when the chief of the Bulembu / Malanda area, Prince Mnikwa Dlamini, visits and is reserved for his use. Prince Mnikwa's chieftainship is mostly around the Mlumati on the Lowveld flatlands near Ngonini, and the Bulembu component of his chieftainship is not contiguous with the remainder. This is a relic of the 1907 land partition when Eswatini's land was split into approximate thirds; Swazi Nation Land, Crown Land, and European settler land.

6.11.3.4 Artefacts

There is an electricity substation on the edge of an earth platform at the far end of the old factory zone. This is currently in use and much of the internal equipment dates back to the 1930s. While the building is of no significance, the antique machinery contained therein, together with the numerous geological maps and diagrams, social and economic files of the mining operations depict the mining technology at the time.

The Bulembu Museum is currently housed within the cableway station and the adjoining old stores building and integrates the old cableway machinery into the displays and the historical timeline. The museum has general displays on mining and colonialism on the ground floor and displays specific in Bulembu and asbestos mining on the mezzanine. In addition thousands of old files from the running of the mine are stored within the cableway station in two locations. These files cover social and financial running of the mine, not geology. There are also numerous health files stored in the old hospital, along with X-rays, giving a clear picture of the health of the workers.

6.11.3.5 Graves

According to the Socio-Economic Impact Assessment, a total of 78 graves were recorded in Bulembu, of which 49 were within individual homesteads in the surrounding communities, 14 were at Bulembu cemetery and 15 were at Malanda cemetery. There are three cemeteries in the Malanda community. There are three cemeteries immediately to the east of the existing dairy farm. The sites effectively encircle the existing wastewater treatment plant which is situated at the east end of Bulembu village.

No graves were found and there are no known burial sites within the MLA. This however, does not preclude the potential discovery of burial sites in the future particularly in view of the fact that the area has been inhabited for many centuries.

6.12 TRANSPORT AND LOGISTICS INFRASTRUCTURE

6.12.1 Regional context

The primary modes of transporting goods from source to the project site during construction and products to destinations during operation will be land and sea. Long distance transportation of goods (to and from beyond Southern Africa) will be by sea. Long distance transportation (beyond South Africa) of personnel and hardcopies of documentation will be by air while short distance transportation (within and between Eswatini and South Africa) will be by land. Modes of telecommunication will be by telephone and electronic mail. All these applicable modes of transport and logistics are available in Southern Africa, however the varying distribution in the condition of the infrastructure and services will influence the selection of optimal modes and routes.

6.12.2 Sea

The nearest sea ports to Bulembu, based on the shortest routes by road, are Maputo (230km) in Mozambique as well as Richard's Bay (450km) and Durban (620km) in South Africa.

Durban is the largest (in terms of capacity) and busiest (in terms of seaborne traffic) port in Southern Africa and amongst the largest in Africa, second to Port Said in Egypt (African Development Bank, African Development Report, 2010). It is worth noting that apart from capacity, ports vary according to their function:

- Hub ports are large regional ports with high volumes of direct large-vessel calls. They also service smaller ports by transshipping containers and general cargo in smaller vessels. Durban is a hub port;
- General cargo ports are medium sized ports, with container terminals, and sufficient volume to attract direct vessel calls. An example is Port Elizabeth;

- Feeder ports are smaller ports with depth restrictions and limited direct vessel calls. They are serviced by coastal vessels from hub ports and the feeder services as well as double handling of goods contribute to higher transportation costs. An example is Maputo;
- Bulk Ports predominantly handle large volumes of bulk goods. An example is Richard's Bay which handles bulk coal;
- Dedicated oil terminals receive crude oil transported on large vessels. An example is Durban.

According to the Transport and Logistics Survey (Lee, J., 2017) included in **Appendix L**, Maputo and Richards Bay do not have dedicated container handling terminals, but rather operate a feeder service to the Port of Durban. This means that despite being closer, they would be less economically optimal to the proposed project compared to Durban.

6.12.3 Land

Since Eswatini is landlocked, road and rail are the primary modes of transporting goods to the ports in neighbouring Mozambique and South Africa. The objectives of the SADC Transport Sector Programme are:

- the promotion of integration of regional transport networks;
- elimination or reduction of hindrances (non-tariff barriers) and impediments to the movement of persons, goods, and services thereby making SADC goods and services competitive;
- public and private investment to develop, preserve, and improve viable strategic transport infrastructure.

Therefore, where relevant, there is cooperation between countries to develop and integrate road and rail infrastructure. An example is the Swazi Rail Link Project which is an intergovernmental initiative between South Africa and Eswatini.

6.12.3.1 Roads

While there is an extensive road network linking Eswatini, South Africa and Mozambique and most connecting routes are in good condition, the SADC (2009, p.36) has observed that,

> *"Transport is heavily skewed in favour of road, resulting in accelerated damage to road infrastructure, congestion at borders, high transport costs and delays in transport logistics."*

Each of the three aforementioned countries has programmes for constructing new roads as well as maintaining and upgrading existing roads. While Eswatini's main roads are managed by the government, those of South Africa and Mozambique are managed by autonomous agencies, with government providing policy and regulatory frameworks.

6.12.3.2 Rail

In general the rail network linking Eswatini, South Africa and Mozambique complements the road network, although as described in the preceding paragraph above, utilization is unbalanced in favour of roads. Mutambara, T. (2009) noted that the prolonged civil war in Mozambique resulted in significant damage to the rail network and the effects continue to be apparent despite current initiatives to rehabilitate the network. Eswatini and South Africa are in the process of enhancing their network through the Swazi Rail Link Project.

6.12.3.3 Air

While air transport will not form part of the movement goods during the project, it will be important in the movement of skilled personnel such as engineers, senior management and hardcopies of documentation between the project site and various parts of the region and the world. As such, its role cannot be altogether ignored. In this respect there is an adequate

international airport (King Mswati III) in Eswatini which links the country to the regional hub, OR Tambo, in South Africa.

6.12.4 Telecommunication

Telecommunication is vital not only to the movement of goods and business operations, but also in keeping employees connected to their loved ones. In this regard, Eswatini is adequately connected to neighbouring countries and international destinations by means of telephone networks, email, postal and courier services. Unit costs of internet services and mobile telephony affect affordability and thus are potential constraints to ease of access. Reliability and speed of internet services are constraints to user experience while uneven distribution of coverage between urban centres and rural areas is a further potential constraint to access.

6.12.5 National and local context

According to the Transport and Logistics Study (Lee, J. 2012) included in **Appendix L** the country's transport infrastructure comprises a well-developed transport network that has been maintained to a high standard. At the time of the study, both the rail and road networks operated well below capacity and therefore had room for increased traffic volumes. Cross-border facilities however lacked efficiency and presented a significant barrier to trade for the country.

6.12.6 Road infrastructure

6.12.6.1 Overview of national road infrastructure

The Transport and Logistics Study found that Eswatini's main road network measures approximately 1,500km and varies in standard from unsealed to freeway, 75% of which is

paved with either a Double Bituminous Surface Treatment (DBST) or Asphalt Concrete (AC) surface and the remaining 25% is gravel. Generally, the surfacing on the main road network is suitable for its current level of traffic and therefore provides a high level of mobility within the country and to major economic centres in both neighbouring countries.

6.12.6.2 Condition of main road to and from Pigg's Peak

Bulembu is situated along the Main Road (MR20) which runs from Bulembu to Pigg's Peak. With an Average Daily Traffic (ADT) of 677 vehicles, the road carries fairly low traffic volumes and according the Ministry of Public Works and Transport's road condition classification, this is the only main road which is classified as bad, where "bad" is defined as traffic unable to maintain a reasonable speed of 50km/h. A short 3.4km section between Bulmebu border post and Bulembu village is paved while 18km between Bulembu and Pigg's Peak is gravel. The entire road has not been maintained since 2013 and thus continues to deteriorate. At the time of this ESIA Report, the Ministry of Public Works and Transport had scheduled the road for upgrading to a paved surface with an asphalt concrete mix to the national standard of 40mm with dual carriageway lane width of 3.65m and a 2.85m shoulder.

In terms of public transport, approximately 10 minibus taxi permits have been granted permits to operate along the road, but most are not active due to the condition of the road. There is one private bus per day, catering mainly for school children attending school at Pigg's Peak. The condition of the road therefore causes Bulembu to be effectively be trapped from an accessibility point of view.

6.12.6.3 Condition of main roads from Pigg's Peak and beyond

The MR20 (Bulembu – Pigg's Peak) connects to the MR1 (Matsamo – Motjane) at Pigg's Peak. As a transport node, Pigg's Peak provides access to and from Matsamo Border Post in the

north east as well as additional main roads to and from the east and south and these in turn provide access to and from border posts.

According to the Transport and Logistics Study, the MR1 is paved with a DBST and its condition is classified by the Ministry of Public Works and Transport as “good” which is defined as having minor deformations and few pot holes. It is a single carriageway with one lane for opposing traffic and no central reservation for separating opposing traffic. Some sections have edge failure thereby constricting traffic flow. Climbing lanes are however provided along some sections.

The MR1 connects with the MR3 (Ngwenya – Lomahasha) at Motjane which is 8km from Ngwenya Border Post. The MR3 is Eswatini’s major highway traversing from west to east through the central part of country thereby connecting several transport nodes to all other parts of the country. As such, it is the most trafficked road and the section between Ngwenya and Manzini, which is a dual carriageway with a central reservation separating opposing traffic, is classified as “very good” which is defined as having few defects. The section between Mbabane and Manzini experiences a high accident rate and therefore the Ministry of Public Works and Transport has advised against the use of this route for the Kobolondo Project. This leaves the Motjane – Ngwenya section of the MR3 for access to and from westerly routes while easterly routes will be accessible via other main roads. The proposed routes are described in 2.4.17 above.

6.12.7 Rail infrastructure

Eswatini Railway, a parastatal organisation, owns and maintains the railway infrastructure which comprises a 300km rail network. Stations are located at Matsapha, Sidvokodvo, Phuzumoya, Big Bend, Nsoko, Lavumisa, Mlawula, Mpaka and Mhlume.

According to the Transport and Logistics Study, the railway network comprises two lines:

- The West – East line (111km) which runs from Matsapha via Phuzumoya and Mpaka to Siweni at the Mozambican border carries a maximum axle load of 18.5t. This carries import and export cargo to and from the Port of Maputo;
- The North – South line (189km) which runs from Mhlume, in the north, via Mpaka and Phuzumoya to Lavumisa in the south and carries a maximum axle load of 22t. This line carries mainly transit cargo from Komatipoort in the north to Richard's Bay and Durban in the south.

At the time of this ESIA Report the implementation of the Swazi Rail Link Project was still in progress. This entails the construction of a 150km line from Lothair, South Africa to Sidvokodvo, Eswatini with 50km in South Africa and 100km in Eswatini. The project also includes the upgrading of adjacent existing lines to align and provide support to the new link (Transnet Freight Rail and Eswatini Railway, Media Release, 14th July 2017). According to the Media Release,

> *"the project will result in a dedicated General Freight Business Corridor for Transnet, while providing necessary additional capacity for Eswatini Railway. In addition the new link will enable road to rail migration. The project will aid added capacity on general freight business, decongesting the Coal line and unlocking capacity on the eastern mainline and the North South Corridor."*

The Transport and Logistics Study states that based on the preliminary estimates of haulage volumes, neither the construction phase nor Phase 1 of production during the Kobolondo

Project, justify the double handling costs and potential export and import delays often encountered when transporting by rail. During Phase 2, export tonnage is likely to justify the utilization of railways as an alternative to road transport.

6.13 BASELINE WASTE MANAGEMENT

6.13.1 Solid waste disposal

Solid waste generated within Bulembu village has been disposed in shallow open pit at the top of the Old TSF. Building rubble, including broken asbestos cement roof sheets, has also been dumped at various points on top of the old TSF. Timber off-cuts, saw dust and garden waste have been dumped on the surface along the top of Old TSF and New TSF. Some waste has also been in the disused air vent shaft of the mine which is situated at the north foot of the New TSF. Old components from mining equipment, such as conveyor belts and pieces of metal are also present on the Old and New TSF.

The presence of old and recent waste on the TSF indicates that solid waste disposal has historically been haphazard since the previous mining operations. The homesteads in surrounding communities use pits within the homesteads in which the refuse is burnt.

6.13.2 Sewage disposal

Sewage at Bulembu village is treated at a sewage treatment plant situated at the east end of the village. Final treated effluent is discharged to a stream which is a tributary to the Mkhomazane River. The majority of homesteads in the surrounding communities use pit latrines.

7. IMPACT ASSESSMENT METHODOLOGY

Evaluating the significance of potential impacts enables their ranking from high to medium to low. This in turn enables prioritisation of mitigation and enhancement measures so that adequate time and resources are allocated to addressing the impacts according to their importance. This approach optimises resource allocation and usage as well as the overall effectiveness of the interventions.

7.1 IMPACT IDENTIFICATION

Potential environmental and social impacts were identified during stakeholder consultations discussed in Section 4-THE SCOPING PROCESS and Section 5-TERMS OF REFERENCE OF ESIA, respectively. Potential impacts were categorised by environmental and social function:

- Ecology (flora, fauna and natural habitats)
- Water Resources (water sources, availability and quality)
- Soil
- Air quality
- Noise
- Occupational Health
- Public Health
- Waste Management
- Heritage
- Socio-economic

7.2 IMPACT SIGNIFICANCE

A quantitative methodology of evaluating impact significance was applied. This entailed classifying the attributes of each impact as follows:

- **Direction** – a determination of whether the impact is negative (adverse) or positive (beneficial);
- **Extent** – the geographical range of how far the impact is reasonably expected to reach;
- **Severity/ Magnitude** – the degree of disruption to social functions (human activities) and/ or natural processes in the ecosystem.
- **Duration** – the timeframe over which the impact is reasonably expected to last.
- **Risk** – the level of exposure to an outcome. Actual or anecdotal experience may be used in making this determination.
- **Probability** – the likelihood of an event occurring.
- **Significance** – level of importance expressed as High, Medium or Low, calculated using the formula in the table.

Each attribute was further classified by its characteristic which was assigned a ranking from 1 to 5 as shown Table 15.

Table 15 - Quantification of impact significance

IMPACT ATTRIBUTE	IMPACT CLASSIFICATION	CLASSIFICATION DESCRIPTION	RATING
Direction	Negative (N)	Resulting in adverse effects.	Inherits significance rating
	Positive (P)	Resulting in enhancing effects.	Inherits significance rating
Extent ***(i.e. the spatial extent of an impact)***	Site	Within the confines of the project site and up to 30m beyond that boundary.	1
	Local	From the site boundary up to 1km radius from that boundary.	2
	Regional	Geographic or political region within the country.	3
	National	Within the boundaries of Eswatini.	4
	International	Trans-boundary, SADC and beyond.	5
Severity/ Magnitude ***(the degree to which an impact is severe at the spatial scale noted)***	Low	Natural or social functions/ processes are negligibly altered.	1
	Moderate	Natural or social functions/ processes are notably/ moderately altered.	2
	High	Natural or social functions/ processes are severely/ highly altered.	3
	Very high/ do not know	Degree of alteration to natural or social functions/ processes is very high or not known.	4
Duration ***(The period over which the impact is likely to pertain)***	Momentary	Less than 5 minutes.	1
	Short term	0-6 months.	2
	Medium term	6-12 months.	3
	Long term	Over 12 months, but reversible.	4
	Permanent	Irreversible.	5
Risk/ Uncertainty (the level of certainty)	Low	Low exposure to an outcome.	1
	Medium	Moderate exposure to an outcome.	2
	High	High exposure to an outcome.	3
Probability	Improbable	Not likely to occur.	1
	Likely	A possibility of occurrence (could happen).	2
	Definite	A certainty of occurrence (will happen).	3
Significance	Formula for calculating significance:	Significance = (Extent + Severity + Duration + Risk) x Probability S = (E+Se+D+R)xP	
	Minimum rating:	S = (1+1+1+1) x 1 = 4	
	Maximum rating:	S = (5+4+5+3)x3 = 51	
	Splitting the range into cohorts to produce categories of High, Medium, Low:		
	4 – 19 both inclusive	Low overall importance of an outcome.	Low
	20 – 35 both inclusive	Moderate overall importance of an outcome.	Medium
	36 – 51 both inclusive	High overall importance of an outcome.	High

The impact significance is first calculated in relation to the baseline conditions and assuming no project-initiated interventions. Using the subsequent significance rating, an intervention is determined that will be appropriate to the level of significance. Finally, in consideration of the intervention, the significance is calculated as a second stage evaluation what the significance will be when the interventions are implemented. This second stage or final significance is referred to as the residual impact, i.e. the level of impact which will remain after mitigation and enhancement measures have been taken.

A spreadsheet is used for performing the calculations and the cells containing the results are formatted to display colours wherein positive impacts have a green gradation while negative impacts have a red gradation. **Error! Reference source not found.** describes the colour g radation.

Table 16 - Impact significance rating

Significance Rating (S)	Nature of impact		Description
	NEGATIVE (N)	POSITIVE (P)	
4 – 19	Low	Low	Negative Low does not hinder project, Positive Low does not in isolation justify project since it does not represent a significant enhancement.
20 – 34	Medium	Medium	Negative Medium will moderately hinder project and affected environmental processes unless mitigation measures are taken. Positive Medium will not hinder project and affected environmental processes. Enhancement measures are taken to optimize positive impacts.
36 – 51	High	High	Negative High will hinder project and environmental processes unless mitigation measures are taken. Positive High will optimize the project's benefits to itself and to environmental processes. Safeguards are still warranted to avoid diminishing returns.

8. IMPACT EVALUATION

8.1 IMPACTS ON ECOLOGY

8.1.1 Impacts on flora

The assessment of impacts on flora and vegetation assemblages within the project area takes into account the current ecological state of these assemblages. The ecological state of the assemblages within the MLA is almost entirely modified in the form of alien tree plantations (pine and eucalyptus), mining infrastructure and residential areas. The only natural habitat remaining in the MLA is a small patch of grassland along the southern boundary that is connected to a larger montane grassland corridor linking with Malolotja Nature Reserve. In addition, the un-rehabilitated TSF is currently slumping and releasing sediment into the downstream riparian zone, further compromising the ecological state of this zone.

8.1.1.1 Destruction of natural habitat

A small portion of natural grassland habitat exists along the southern boundary of the MLA about 250m from the southern part of the TSF. This patch is connected to a large area of grassland between the MLA and the South African border and Malalotja Nature Reserve. While no infrastructure is planned within the grassland patch, some vegetation is likely to be destroyed or degraded through site clearing and construction of access roads along the southern boundary of the TSF. The impact significance is rated low since the patch of grassland is situated on steep rocky terrain, therefore for site clearing for road access will entail and thus be limited to rehabilitating the existing gravel access road which runs along the east boundary of the patch of grassland. Across the existing access road is the alien tree plantation/ degraded forest which covers the south western section of the TSF.

8.1.1.2 Degradation of downstream riparian habitat

Two riparian zones downstream of the TSF within the MLA have been significantly impacted by sedimentation from the TSF and are currently ecologically compromised. Rehabilitation activities will, if not appropriately managed, accelerate the erosion of the TSF by wind, rain and surface run-off and thus exacerbate sedimentation of downstream riparian habitats, both within and beyond the MLA. The impact significance is rated high due to the existing level of sedimentation caused by exposure of the TSF to the elements, even without disturbance from human activities on the TSF at present.

8.1.1.3 Harvesting of plant resources

An increase in human activity within and around the TSF will enable increased access, particularly amongst employees, to those sections of the MLA which are currently frequented only by existing employees of BMS, e.g. beekeepers and timber employees. This will result in more people accessing the adjacent grassland habitat and harvesting medicinal and other plant resources, thereby causing further loss of biodiversity. The impact significance is rated medium since the ecological state of the flora habitats within the MLA are almost entirely modified and the adjacent grassland to the west and south will be too far from the work site and too steep for employees to wander off on foot during working hours, including during tea and lunch breaks.

The impacts on flora are summarised in Table 17.

Table 17 - Summary of Impacts on flora

Activity	Site clearing, construction and vehicular traffic	Rating
Impact	Destruction of natural habitat	
Direction	Negative	
Extent	Local	2
Severity/ Magnitude	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Negative - Low	**18**

Activity	Operation of earthmoving equipment on Tailing Storage Facility	Rating
Impact	Acceleration of erosion leading to increased sedimentation and degradation of riparian habitats downstream of the Tailings Storage Facility	
Direction	Negative	
Extent	Local	2
Severity/ Magnitude	High	3
Duration	Permanent	5
Risk/Uncertainty	High	3
Probability	Likely	2
Significance	Negative - Medium	**26**

Activity	Movement of site employees in vicinity of grassland habitat	Rating
Impact	Loss of biodiversity from harvesting of plant resources due to increased presence and access by site employees	
Direction	Negative	
Extent	Local	2
Severity/ Magnitude	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

8.1.2 Mitigations to impacts on flora

8.1.2.1 Mitigations to destruction of natural habitat

Destruction of natural habitat will be mitigated by:

- Constructing the infrastructure on existing built and modified sections to the north of the TSF, thereby avoiding the patch of grassland to the south west;
- Restricting site clearing for road access to the rehabilitation of existing access roads, thereby avoiding the need to clear undisturbed areas;
- Demarcating areas earmarked for site clearing, construction, stockpiling, vehicular movement, thereby avoiding incidental destruction of natural habitats.

8.1.2.2 Mitigation of sedimentation and degradation of downstream riparian habitats

The sedimentation and degradation of downstream habitats will be mitigated by:

- Creating a berm around the base of the TSF in order to trap and prevent further sediment reaching the adjacent riparian habitats;
- Progressively rehabilitating those sections of the TSF which are worked during Phase 1 of the production process in order to prevent them being exposed to the elements which would otherwise accelerate the movement of sediment to the containment berm and potentially overflow to downstream habitats;
- Restoring the riparian habitat immediately south of the TSF by recovering the sediment contaminated with tailings for reuse in the Phase 1 production process and removing the alien invasive plants from the banks of watercourses within the Mining Lease Area.

8.1.2.3 Mitigation of harvesting of plant resources

Loss of biodiversity arising from the harvesting of plant resources from the grassland habitat, as well as riparian habitats will be mitigated by:

- Educating site employees on the provisions of the Flora Protection Act, 2001 which restricts the plucking, cutting, uprooting and digging up of protected flora;
- Maintaining the signage around the Mining Lease Area which prohibits unauthorised access to the site, thereby controlling access to the grassland and riparian habitats;
- Implementing a preventive measure of liaising with community representatives to educate residents of surrounding communities on the need to adhere to access control signage in the interest of public safety as well as to avoid harvesting plant resources within the Mining Lease Area in the interest of environmental protection;
- Conducting security patrols to ensure that the control of access is enforced.

8.1.3 Impacts on birds and mammals

Although the north western Highveld is rich in bird and mammal species, including a number of threatened and near-endemic species, the habitat falling within the MLA is highly degraded and supports deficient bird and mammal fauna in comparison to the rest of the region. Species occurring within the MLA are generalists and able to cope with a range of habitats.

8.1.3.1 Degradation of downstream riparian habitat

Rehabilitation activities will, if not appropriately managed, accelerate the erosion of the TSF and thus exacerbate sedimentation of the riparian habitats immediately south of the TSF. Increased sedimentation will adversely affect the populations of aquatic macro-invertebrates, including crabs and various insect groups, which form the dominant diet of at least one mammal species recorded in the area, the Marsh mongoose (*Atilax paludinosus*).

The impact significance is rated high since although the species occurring within the MLA are able to cope with a range of habitats, any unmitigated sedimentation will spread further downstream along the Mzilanti and Mkhomazane Rivers to reach the inlet of Maguga Dam

along the Komati River and thus adversely affect a wider foraging area for birds and mammals.

8.1.3.2 Harvesting and snaring of wildlife

An increase in human activity within and around the TSF will cause an increase in pedestrian traffic, particularly amongst employees, to those sections of the MLA which are currently frequented only by existing employees of BMS. For example, some employees will walk to and from the workplace using shortcuts through the bush and thus come into contact with birds' nests and other wildlife. There are sustainable populations of several medium and large-sized mammals in the area, which is rather unusual for an area that falls outside of a designated protected area (such as a nature reserve or national park). One of these is the Mountain reedbuck (*Redunca fulvorufula/ liNcala*).

While harvesting and snaring of wildlife will not necessarily be carried out by site employees themselves, word of the presence and locations of wildlife will spread, resulting in such harvesting and snaring being carried out by persons who are not employees. This will be exacerbated by the influx of job seekers who, if not controlled, will exert pressure on the surrounding habitats by constructing makeshift accommodation and if unable to find employment, will be tempted to harvest and snare wildlife for sustenance and/ or sale.

The harvesting and snaring of wildlife will cause a loss of biodiversity since it will at rates which are not sustainable. The impact significance is rated high since the capture of wild animals is an offence under the Game Act, 1991 and Wild Birds Protection Act, 1914 and the project site is in close proximity to Malolotja Nature Reserve and Emlembe Mountain, which is a protection-worthy area likely to become a proclaimed protected area in the future.

8.1.3.3 Disturbance of bat roosts

Bats are mammals which are divided into two sub-families comprising fruit-eating bats and insect-eating bats. The role of fruit-eating bats in the ecosystem is to pollinate the flowers of plants thereby ensuring that plants produce fruit and seeds. The role of insect-eating bats is to eat night-flying insects, some of which are agricultural pests, thereby controlling the insect population. In both cases of the bat sub-families, they provide ecosystem services not only to plants, but to humans as well, particularly in agriculture and thus food production.

Bats roost in trees and caves which provide shelter, however in some cases they prefer man made structures, particularly in cases where tree cover is either not present or is subjected to disturbance during the day, e.g. continual logging.

The Bird and Mammal Survey found that the majority of bat species in the MLA are insect-eating bats, some of which roost in the abandoned mine shafts. Approximately 200-500 individuals of Geoffroy's horseshoe bat (*Rhinolophus clivosus*), which is an insectivore, were observed roosting in the abandoned mine shaft.

The disturbance of bat roosts, arising from operation of vehicles and machinery in the vicinity of the mine shafts as well as site clearing of the alien tree forests along the southern foot of the TSF, will result in a decline in bat populations, moreso since there are few suitable natural habitats for them to migrate to since the nearby forests are continually harvested for timber. A reduction in bat populations will in turn reduce the ecosystem services which they provide and thus ultimately adversely affect agricultural food production.

The impact significance is rated high due to the lack of suitable habitats for roosting, other than the existing abandoned mine shafts.

The impacts on birds and mammals are summarised in Table 18.

Table 18 - Summary of impacts on birds and mammals

Activity	Operation of earthmoving equipment on TSF	Rating
Impact	Acceleration of erosion leading to increased sedimentation and degradation of riparian habitats downstream of the Tailings Storage Facility	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Permanent	5
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**39**

Activity	Increased presence of people in vicinity of grassland and riparian habitats	Rating
Impact	Loss of biodiversity from harvesting of and snaring of wildlife	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**36**

Activity	Site clearing of trees along edges of TSF and operation of earthmoving equipment on TSF	Rating
Impact	Destruction of natural habitats of bats and obstruction of man-made habitats (mine shafts), resulting in decline in bat population and ecosystem services provided by bats	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**36**

8.1.4 Mitigations to impacts on birds and mammals

8.1.4.1 Mitigations to degradation of downstream riparian habitat

The sedimentation and degradation of downstream habitats will be mitigated by:

- Creating a berm around the base of the TSF in order to trap and prevent further sediment reaching the adjacent riparian habitats;
- Restoring the riparian habitat immediately south of the TSF by recovering the sediment contaminated with tailings for reuse in the Phase 1 production process and removing the alien invasive plants from the banks of watercourses within the Mining Lease Area;
- Avoiding any project activities, such as construction or sourcing of gravel to the west of the Mining Lease Area, thereby preventing sedimentation as well as providing an ecological corridor for medium and large sized mammals (particularly Mountain reedbuck) between Malolotja Nature Reserve and Emlembe Mountain.

8.1.4.2 Mitigations to harvesting and snaring of wildlife

Loss of biodiversity arising from the harvesting and snaring of wildlife on the grassland habitat, as well as riparian habitats will be mitigated by:

- Educating site employees on the provisions of the Game (Amendment) Act, 1991 which provides for the protection of game in Eswatini;
- Maintaining the signage around the Mining Lease Area which prohibits unauthorised access to the site, thereby controlling access to the grassland and riparian habitats;
- Liaising with the Umphakatsi on enforcing existing measures of controlling the establishment of homesteads and controlling the accommodation of people from outside the community by existing residents, thereby controlling the influx of job seekers;
- Liaising with community representatives to educate residents of surrounding communities on the need to adhere to access control signage in the interest of public

safety as well as to avoid harvesting and snaring wildlife within the Mining Lease Area in the interest of environmental protection;

- Conducting security patrols to ensure that the control of access is enforced.

8.1.4.3 Mitigations to disturbance of bat roosts

Since project activity in close proximity to the mine shafts will be inevitable, a suitable habitat in the nearby forest will be developed. This will be carried out by:

- Restoring the riparian habitat immediately south of the TSF by removing the alien invasive plants from the banks of watercourses within the Mining Lease Area in order to enable the growth and propagation of indigenous trees which will provide bat roosts. Selected sections of the adjacent forest within the Mining Lease Area will be demarcated to prevent harvesting of timber, thereby providing tall trees in which to roost;
- Engaging a qualified and experienced mammal specialist to install screens at the entrances to the mine shafts. The screens will be installed in such a manner as to allow bats out, but prevent re-entry. Uninhabited houses and buildings within Bulembu village will also be sealed along crevices and provided with one-way openings to allow bats out. Upon failing to re-enter the mine shafts and any uninhabited houses, the bats will relocate to the newly provided habitats along the watercourses and in the demarcated sections of the adjacent forest.

8.1.5 Impacts on amphibians, reptiles and freshwater fishes

The project site is located adjacent to the internationally recognised Malolotja/ Songimvelo Transfrontier Conservation Area (TFCA). The objective of this initiative is to promote cross-border co-operation and the involvement of local communities in the conservation of natural resources.

Although the Herpetofauna and Ichthyofauna Survey found a relatively high diversity of amphibians, reptiles and fish in the vicinity of the project site, most of the species were found outside the Mining Lease Area. The habitats within the Mining Lease Area and immediate vicinity have been transformed by mining and forestry and are highly degraded and therefore are unlikely to support more than a few generalist species that are tolerant of disturbed habitat.

8.1.5.1 Degradation of riparian habitat

Project activities, if not appropriately managed, will accelerate the erosion of the TSF and thus increase the sediment load of the Mzilanti River and lead to water pollution. The fauna that will be most adversely affected will be the amphibians and fish since they will be unable to survive outside the aquatic ecosystem. It is worth noting that another aspect of the existing degradation of the Mzilanti River, apart from the current sedimentation, is the canalisation of the Luhhumaneni River as it passes through Bulembu village and its diversion at the north foot of the TSF via a tunnel through the mountain. The Luhhumaneni River prior to diversion was a tributary to the Mzilanti River, therefore its canalisation and diversion have resulted in the historical impact of reducing the amount of habitat available to amphibians. Sedimentation arising from the TSF will therefore exacerbate the loss of aquatic habitat.

The impact significance of loss of riparian habitat is rated high since one amphibian species, the Natal ghost frog (*Hadromophryne natalensis*), and one fish species the Redtail barb (*Barbus gurneyi*), both of which occur in the vicinity of the MLA and are not known to occur

in other regions of the country, require fast flowing clear mountain streams and cannot survive nor breed outside the aquatic habitat. Although not listed in the listed in the Eswatini Red Data Book, further sedimentation will result in their extinction in the locality.

8.1.5.2 Persecution of wildlife and roadkills

An increase in human activity within and around the TSF will result in increased contact and confrontation between humans and wildlife. This will lead to the persecution and killing of snakes. The increase in traffic from project vehicles along access roads and public roads will lead to increased road mortalities of both amphibians and reptiles.

Amphibian and reptile species are listed as threatened locally or internationally. However due to their rarity, endemism, localised occurrence and restricted distribution in Eswatini, several species are considered regionally important. These include the Natal ghost frog (*Hadromophryne natalensis*), Swazi Rock Snake (*Inyoka swazicus*), Berg Adder (*Bitis atropos*), Spotted Dwarf Gecko (*Lygodactylus ocellatus*), Northern Dwarf Chameleon (*Bradypodion transvaalense*), Olive House Snake (*Lycodonomorphus inornatus*) and Drakensberg Crag Lizard (*Pseudocordyus melanotus*).

While amphibian and reptile species are of regional importance, the impact significance of persecution and roadkills is rated low since the habitat is predominantly to the south of the TSF and main road (MR20). Additionally, any migration to the upper reaches of the watercourses will mainly be along the watercourses which have bridges for traffic to pass over.

The impacts on amphibians, reptiles and fishes are summarised in Table 19.

Table 19 - Summary of impacts on Reptiles, amphibians and fishes

Activity	Operation of earthmoving equipment on TSF	Rating
Impact	Acceleration of erosion leading to increased sedimentation and degradation of riparian habitats downstream of the Tailings Storage Facility	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Permanent	5
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**39**

Activity	Historical canalisation and diversion of Luhhumaneni River through Bulembu village	Rating
Impact	Degradation of aquatic habitat for amphibians and fishes	
Direction	Negative	
Extent	Regional	3
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**39**

Activity	Increased presence of people in vicinity of grassland and riparian habitats	Rating
Impact	Persecution of wildlife and increased road mortalities of amphibians and reptiles	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Negative - Low	**16**

8.1.6 Mitigations to impacts on amphibians, reptiles and fishes

8.1.6.1 Mitigations to degradation of riparian habitat

The sedimentation and degradation of downstream habitats will be mitigated by:

- Creating a berm around the base of the TSF in order to trap and prevent further sediment reaching the adjacent riparian habitats;
- Restoring the riparian habitat immediately south of the TSF by recovering the sediment contaminated with tailings for reuse in the Phase 1 production process and removing the alien invasive plants from the banks of watercourses within the Mining Lease Area.

The historical degradation of the aquatic habitat which resulted from the canalisation and diversion of the Luhhumaneni River through Bulembu village will be mitigated by:

- Re-vegetating the TSF with suitable indigenous plants, as part of the rehabilitation plan, to provide an ecological corridor for amphibians and reptiles to migrate between the south of the TSF and the upper catchment of the Luhhumaneni River where there is an existing weir (next to the pumphouse) which will provide an aquatic habitat;
- Installing wooden frog ladders/ ramps spaced at least 20m apart along the canal. Each ladder/ ramp will slant downstream and swivel at its top end to prevent trapping debris or breaking off in the event of floods. Since the canal has vertical sides, the ladders/ ramps will enable frogs to climb out of the concrete lined canal when migrating up and down the canal, thereby preventing them from being trapped within the canal.

8.1.6.2 Mitigations to persecution of wildlife and roadkills

The persecution and killing of snakes will be mitigated by:

- Educating employees on the role of snakes in the ecosystem, e.g. the ecosystem service of controlling rodent populations;
- Educating employees on the types of snakes they are likely to encounter, how to avoid being bitten and on first aid measures in the event of being bitten;
- Instructing employees not to kill snakes;
- Ensuring that Bulembu village is kept clean and tidy in order to mitigate attracting rodents which in turn will attract snakes, resulting in human confrontation with snakes.

Road mortalities of amphibians and reptiles will be mitigated by:

- Keeping the banks along watercourses on Farm 815 free of alien invasive plants, thereby providing suitable habitats for breeding, foraging and ecological corridors along which to migrate;
- Ensuring that the sides of the main road (MR20) as it passes through Bulembu are kept clean and free of litter which will otherwise attract scavengers (including birds and mammals) as well as insects which will in turn attract insectivores, resulting in them being struck and killed by vehicles.

8.2 IMPACTS ON WATER RESOURCES

8.2.1 Impacts on surface and groundwater

The instream habitat of the Mzilanti River is considered to be in a largely modified condition upstream of Bulembu as a result of channel and flow modification, adjacent mining and urban activities as well as growth of invasive alien vegetation within the riparian zone of the river. Downstream impacts to the instream habitat relate largely to the diversion of the river and the associated flow modification. Afforestation activities have had a significant impact on the riparian habitat with only pockets of the indigenous vegetation remaining.

The Mzilanti River is considered to be of moderate ecological importance and sensitivity. Despite the surrounding impacts, the river provides important refugia for aquatic biota as well as a corridor for the movement of biota within the transformed landscape.

The Mzilanti River, upstream of Bulembu village has a mean annual flow of 1.4 million m^3 and contributes 5.8% to the flow of the Mkhomazane River to which the Mzilanti is diverted via a tunnel at the north foot of the TSF.

The Mzilanti River downstream of the TSF has a mean annual flow of 1.7 million m^3 and contributes 6.9% to the flow of the Mkhomazane River. Overall, the Mzilanti contributes 13% to the flow in the Mkhomazane River and less than 0.5% of the flow of the Komati River at Maguga Dam. By comparison, the Mkhomazane River with a mean annual flow of 24 million m^3 contributes 3.5% of the flow of the Komati River.

There is a weir along the Mzilanti River, approximately 740m north of the centre of the village, from which 0.5 to 2 million litres per day are pumped for use as potable water in the village as well as irrigation of the dairy farm. No sources from downstream of the TSF are used.

There are currently 2 boreholes at Bulembu village. The first is situated at the north west of the village alongside the main road (MR20), approximately 740m from Bulembu Border Post. The second borehole is situated at the north east of the village within the dairy farm. Each borehole yields approximately 1l/s and they are used for supplying the water bottling plant. The groundwater within the mine is not utilized.

8.2.1.1 Degradation of water quality

The current impact of the mine and TSF on groundwater is evident. What is uncertain is the extent to which the impact is a result of host rock interaction in the open cast and underground mine workings and to what extent it is caused by leaching from the TSF. It is most likely a result of both. The proposed reworking of the TSF is therefore expected to have a positive impact on the groundwater situation in the long term.

Without mitigation, the working of the TSF will cause increased sedimentation of the downstream watercourses as well as water pollution from leached minerals in stormwater run-off. Pollution of groundwater will also arise from leached minerals. The impact significance is rated low in view of the existing situation, i.e. the contribution from the project will be negligible in view of the existing medium to high risk from leaving the TSF unattended. This nevertheless does not negate the need for mitigation measures.

8.2.1.2 Changes in surface water flows and groundwater yields

8.2.1.2.1 Shaping of TSF

Alteration to the shape, cover and stormwater management at the site will modify the runoff characteristics from the TSF and as a result may impact on the flow characteristics in the Mzilanti River. In view of the fact that the Mzilanti River is already diverted at the north foot of the TSF, any run-off from the TSF will contribute negligibly to the flow of the Mzilanti River

downstream of the TSF. Although negligible, the impact will be positive in the long term when the rehabilitation is complete since the some of the run-off currently flows to the north side of the TSF and recharges groundwater, whereas with appropriate shaping of the rehabilitated site, run-off will be channelled to the Mzilanti River.

8.2.1.2.2 Water abstraction

Water abstraction for the project activities will reduce surface water flows and groundwater yields. The project proposes to abstract groundwater from within the mine and this water is the main source of water along the Mzilanti River downstream of the TSF. The water exits the mine through a partially blocked tunnel entrance on the south foot of the east TSF to join the original course of the Mzilanti River. There are however other sources which comprise springs and run-off from the grassland to the south west of the TSF.

The project proposes abstracting 40,000m^3 per month (480,000m^3 per year) from the mine. The Mzilanti River downstream of the TSF has a flow of 1,700,000m^3 per year. Therefore, assuming that the majority of the river's flow is from the mine's groundwater, the project will abstract 28% of the river's source water, leaving 1,220,000m^3. In view of the Mzilanti contributing 6.9% to the flow of the Mkhomazane River and overall less than 0.5% of the flow of the Komati River, impact significance of abstracting groundwater from the mine is rated medium since there will still be water available for the ecosystem along the Mzilanti downstream of the TSF.

The impacts on water resources are summarised in Table 20.

Table 20 - Summary of impacts on water resources

Activity	Processing of material on TSF and operation of gold plant	Rating
Impact	Acceleration of erosion leading to increased turbidity of surface water and increased chemical pollution of surface water and groundwater	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Negative - Low	**16**

Activity	Shaping (rehabilitation) of TSF	Rating
Impact	Increased surface water flow along Mzilanti River	
Direction	Positive	
Extent	Local	2
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Positive - Low	**16**

Activity	Water abstraction	Rating
Impact	Reduction of groundwater water source leading to reduction of surface water along Mzilanti River	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

8.2.2 Mitigations to impacts on water resources

8.2.2.1 Mitigations to degradation of water quality

Degradation of surface and groundwater quality will be mitigated by:

- Creating a berm around the base of the TSF in order to trap and prevent further sediment reaching the adjacent riparian habitats;
- Restoring the riparian habitat immediately south of the TSF by recovering the sediment contaminated with tailings for reuse in the Phase 1 production process and removing the alien invasive plants from the banks of watercourses within the Mining Lease Area;
- Re-circulating the water used within the production process thereby preventing any contamination of surface and groundwater;
- Establishing and maintaining a surface and groundwater monitoring programme.

8.2.2.2 Enhancements to surface flow along Mzilanti River

Surface flow along the lower catchment of the Mzilanti River (downstream of the TSF) will be enhanced by:

- Shaping the TSF such that surface run-off is no longer trapped on the north side of the TSF, after which it seeps to groundwater. The site will be shaped to enable surface water to flow into and thus augment the Mzilanti River;
- Vegetating the site, during rehabilitation, with indigenous plants which will stabilise the soil to prevent erosion which will otherwise lead to sedimentation. The vegetation will also control run-off thereby preventing flash floods along the downstream section of the Mzilanti River.

8.2.2.3 Mitigations to water abstraction

The reduction of the groundwater source in the mine which feeds the Mzilanti River will be mitigated by:

- Abstracting process water only from the mine groundwater and not the surrounding watercourses;
- Installing measuring devices at the point of abstraction and at the point where the groundwater joins the Mzilanti River to ensure that abstraction is not excessive and that water remains available for the ecosystem downstream of the TSF.

8.3 IMPACTS ON SOIL

8.3.1 Impacts on physical and chemical characteristics of soil

The mobility of fibres from sites of asbestos-bearing strata is often due to sparse vegetation cover due to adverse physical and chemical conditions which are not conducive to plant growth. Some sections of the TSF and the Mining Lease Area have only a few centimetres of topsoil, which together with the high rainfall intensity and steep terrain, contributes to the existing high rate of erosion.

In terms of soil chemistry, Bulembu and the surrounding communities are rural, with few potential sources of soil pollution. However, the industrial activities of processing the material on the TSF, rehabilitating the TSF and operating a gold plant may accelerate the leaching of minerals (in the case of the TSF) and introduce hazardous chemicals (in the case of the gold plant).

8.3.1.1 Site clearing, construction of infrastructure and access roads

Site clearing for construction of infrastructure and access roads will expose the cleared surfaces to erosion by rain and wind. This will result in the spread of erosion to vulnerable adjacent areas as well as further sedimentation of downstream areas. Affected downstream areas will include the lower section of the Mzilanti River as well as the upper catchment of the Mkhomazane River along the east of the Mining Lease Area, i.e. the source will be the existing dairy farm site where Industrial Area 2 is proposed to be situated. The impact significance is rated high due to the high erosivity of the soils in the project area, exacerbated by the relatively high rainfall and steep terrain.

8.3.1.2 Processing of material from TSF

The operation of earthmoving equipment on the TSF, i.e. driving on the surface and loading the material, will expose the underlying surface to wind and rain, thereby causing erosion. Vibrations from heavy vehicles will cause chunks of the steep angled material to break off, thereby creating vertical cliffs which in turn will accelerate erosion. Material eroded by rain will be deposited downstream while most of that which is eroded by wind will be deposited upslope in the village due to the prevailing winds. Deposited material will then expose people and fauna to asbestos fibres and will also cause soil pollution through the acceleration of leaching of minerals into the surrounding ground and water resources.

The impact significance is rated high due to the high erosivity of the TSF as demonstrated by the evidence of slumping and contamination of sections downslope of the TSF with asbestos.

8.3.1.3 Sourcing of soil for rehabilitation of TSF and any other disturbed sites

Soils in the project area are highly erodible and where available soils are thin. This means that sourcing soil for covering the rehabilitated sections will transfer the erosion risk to the sites, e.g. borrow pits, from where soil is sourced. The impact significance is rated medium since there is an abundance of wood residue and with which to create mulch and thus avoid excavation of virgin soil.

8.3.1.4 Rehabilitated TSF

The production process of the rehabilitation project will break down the chrysotile fibres, thereby extracting magnesium, leaving a silica skeleton and gypsum. Saleable products such as the magnesium and gypsum will be sold thereby generating income, while the silica will be inert and usable as backfill. The process will therefore have converted the TSF from an

environmental hazard to an economic and environmental benefit. Therefore the impact significance is rated as highly positive.

The impacts on soil are summarised in Table 21.

Table 21 - Summary of impacts on soil

Activity	Site clearing, construction of infrastructure and access roads	Rating
Impact	Acceleration of erosion	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	39

Activity	Processing of material from TSF	Rating
Impact	Acceleration of erosion; Soil contamination from leaching of minerals and asbestos fibres from deposited eroded material	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	36

Activity	Sourcing of soil for rehabilitation of TSF and other disturbed sites	Rating
Impact	Soil erosion at sites from which top soil is sourced	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Very high	4
Duration	Short term	2
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - Medium	33

Activity	Rehabilitated TSF	Rating
Impact	Elimination of sedimentation of watercourses and soil pollution from asbestos fibres	
Direction	Positive	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	36

8.3.2 Mitigations and enhancements to impacts on soil

8.3.2.1 Mitigations to acceleration of soil erosion from site clearing and construction

Soil erosion from site clearing and construction will be mitigated by:

- Installing berms and cut-off drains above and below work sites in order to divert stormwater run-off from upslope sections and retain sediment within areas being worked on;
- Inspecting, repairing and maintaining berms and cut-off drains at regular intervals, particularly after rain events in order to ensure their continued effectiveness;
- Bunding stockpiled excavated material by using berms in order prevent the stockpiled material being eroded and flushed into watercourses;
- Vegetating stockpiles with grass in order to protect them from wind and rain. Where stockpiles are not conducive for seeding with grass, they will be covered with suitable material, such as geo-membrane.

8.3.2.2 Mitigations to erosion and soil contamination from processing of material from TSF

Soil erosion and contamination from processing of material from the TSF will be mitigated by:

- Creating a berm around the base of the TSF in order to trap and prevent further sediment reaching the adjacent riparian habitats;
- Controlling the rate at which the surface of the TSF is kept wet with irrigation water sourced from the mine. This will minimize the risk of saturating the material to unsafe levels which will otherwise cause landslides.
- Controlling and supervising the speed with which earthmoving equipment moves over the surface of the TSF as well as demarcating the routes to be used, thereby mitigating vibrations which will otherwise destabilize the surface.

8.3.2.3 Mitigations to soil erosion at sites from which top soil is sourced

Soil erosion at sites from which top soil is sourced will be mitigated by:

- Stockpiling top soil separately from sub-surface material when site clearing. The top soil will be re-used when covering the TSF as well as when covering the ground around constructed buildings. This will mitigate the sourcing of top soil from fresh sites;
- Top soil cleared from the top of the TSF will be stockpiled for later re-use, thereby mitigating the sourcing of top soil from fresh sites;
- Where borrow pits are established, top soil will be cleared and stockpiled separately from sub-surface material, thereby mitigating the sourcing of top soil from fresh sites;
- Installing berms and cut-off drains above and below work sites in order to divert stormwater run-off from upslope sections and retain sediment within areas being worked on;
- Utilizing available organic material such as sawdust and woodchips from the sawmill to augment the soil used in covering the TSF, thereby mitigating the sourcing of top soil from fresh sites.

8.3.2.4 Enhancements to rehabilitated TSF

The rehabilitated site will be enhanced by:

- Shaping and contouring the TSF such that surface run-off does not cause erosion;
- Vegetating the site, during rehabilitation, with indigenous plants which will stabilise the soil to prevent erosion.

8.4 IMPACTS ON AIR QUALITY

8.4.1 Impacts on ambient air quality

Much of the surface of the TSF is exposed to the elements of wind and rain. In its present state, there are no human activities that disturb the surface so as to generate dust. The surface has a very thin crust, formed from the binding of particles by rain and when dry, there is no discernible dust in moderate to strong wind. This however does not suggest that the surface is safe from wind erosion, particularly since some sections show signs of slumping, therefore dust is likely to be generated when the drier underlying layers are exposed after such slumping. Furthermore, numerous cattle tracks are evident throughout the TSF, suggesting that some particles are likely to be tracked back into the village and surrounding communities when as the cattle return to the homesteads. This will cause material to be crushed by pedestrians and vehicles, thereby releasing asbestos fibres into the air, albeit localised.

8.4.1.1 Site clearing and rehabilitation of access roads to and within TSF

Site clearing and rehabilitation of access roads to and within the TSF will generate dust through the disturbance of the surface. This will lead to the inhalation of asbestos fibres by site employees and windy conditions the dust will be blown to the nearby village resulting in exposure of the residents. The impact significance is rated high due to deleterious health hazards of asbestos fibres.

8.4.1.2 Site clearing and construction of Industrial Area 1 adjacent to TSF

The demolition of old buildings, site clearing and construction of Industrial Area 1 which is proposed to be situated immediately north of the TSF will generate dust, exposing site employees, residents and the general public travelling along the main road (MR20) to

airborne asbestos fibres. The impact significance is rated high due to the asbestos cement roof sheets of the old buildings as well as the proximity to residential areas, social amenities and public road.

8.4.1.3 Processing of material from TSF

The operation of earthmoving equipment on the TSF, i.e. driving on the surface and loading the material, will, if not kept wet as proposed by the project description, expose the underlying surface to wind and some of the material being loaded will become airborne, thereby exposing site employees to asbestos fibres. During windy conditions the material being loaded will also be blown towards the village, thereby exposing residents.

The impact significance is rated high due to the toxicity of asbestos fibres as well as the fact that the prevailing winds blow in the direction of the village.

8.4.1.4 Site clearing and construction of Industrial Area 2

Site clearing and construction of the industrial site will generate dust which will be inhaled by construction workers, nearby residents and the general public travelling along the main road (MR20). The proposed site is at the existing dairy farm, whose underlying geology is not asbestos-bearing. Therefore the impact significance is rated medium due to the nuisance factor of the dust, rather than a health and safety hazard.

8.4.1.5 Operation of processing plant

The operation of the plant will entail crushing and handling of material which contains asbestos fibres. Site employees and residents will be exposed to airborne particles containing asbestos fibres, resulting in asbestos related diseases. All sections of the production plant will be in enclosed environments and methods of conveying the materials with the plant will be

pipelines therefore materials handling will be enclosed. Mist sprays will be applied at all sections where dust is generated within the plant thereby suppressing airborne particles. Collected particulate matter will be re-circulated for processing. All employees will be issued appropriate PPE as an additional protective measure.

The impact significance is therefore rated medium due to the proposed mitigation measures and is subject to being revised to low, depending on the demonstration of the effectiveness of the proposed mitigation measures.

8.4.1.6 Operation of Roaster

While the roaster is part of the processing plant, it is dealt with separately in the impact assessment since it will generate SO_2 gas in addition to the oxidised concentrate. After a cyclone dust separator, there will be 20-50g/Nm3 of fine dust (0~10μm) in the gas. The gas will further go through a high-temperature electric dust separator (with 99.3% efficiency for dust collection). Thereafter, the clean gas will enter the acid-making workshop before being discharged to the atmosphere. The impact significance of air pollution is rated medium since although the SO_2 gas will be utilised in the acid leaching process rather than being emitted to the atmosphere, the site is close to the border with South Africa, therefore any accidental emissions will cause transboundary concern.

8.4.1.7 Renovation of houses

The renovation of houses and amenities for site employees will entail removal of the existing asbestos cement roof sheets. This will generate airborne asbestos fibres which are likely to be inhaled by construction workers, resulting in asbestos related diseases if the Health and Safety conditions of the Mining Lease relating to the protection of employees handling asbestos material are not enforced. The impact significance is rated high since asbestos related diseases often lead to fatalities.

8.4.1.8 Rehabilitated TSF

The production process of the rehabilitation project will break down the chrysotile fibres, thereby extracting magnesium, leaving a silica skeleton and gypsum. Saleable products such as the magnesium and gypsum will be sold thereby generating income, while the silica will be inert and usable as backfill. The process will, over the project life-cycle, eliminate the environmental hazard currently posed by the chrysotile asbestos contained in the TSF. Therefore the impact significance of the end state of the site with regard to air quality is rated as highly positive.

The impacts on ambient air quality are summarised in Table 22Error! Reference source not found..

Table 22 - Summary of impacts on air quality

Activity	Site clearing and rehabilitation of access roads to and within TSF	Rating
Impact	Generation of dust, resulting in asbestos related diseases from exposure to airborne asbestos fibres by site employees and residents	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**36**

Activity	Site clearing and construction of Industrial Area 1 adjacent to TSF	Rating
Impact	Generation of dust, resulting in asbestos related diseases from exposure to airborne asbestos fibres by site employees, residents and general public	
Direction	Negative	
Extent	Regional	3
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**39**

Activity	Processing of material from TSF	Rating
Impact	Generation of dust, resulting in asbestos related diseases from exposure to airborne asbestos fibres by site employees and residents	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**36**

Activity	Site clearing and construction of Industrial Area 2	Rating
Impact	Dust nuisance to site employees, residents and general public	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Medium term	3
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - Medium	**33**

Activity	Operation of processing plant	Rating
Impact	Generation of dust, resulting in asbestos related diseases from exposure to airborne asbestos fibres by site employees	
Direction	Negative	
Extent	Site	1
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Negative - Low	**14**

Activity	Operation of Roaster	Rating
Impact	Gas emissions to atmosphere	
Direction	Negative	
Extent	International	5
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Negative - Medium	**22**

Activity	Rehabilitated TSF	Rating
Impact	Elimination airborne asbestos fibres from TSF	
Direction	Positive	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	**36**

8.4.1.9 Mitigations and enhancements to impacts on air quality

8.4.1.10 Mitigations to generation of dust during site clearing and rehabilitation of access roads to and within TSF

The generation of dust and exposure to dust during site clearing and rehabilitation of access roads to and within TSF will be mitigated by:

- Restricting site clearing to existing access roads, thereby avoiding the need to clear additional areas, i.e. over and above the existing roads;
- Demarcating areas earmarked for site clearing, thereby avoiding excessive clearing;

- Demarcating and keeping to access routes;
- Keeping the access routes wet during and after clearing by using water tankers in order to suppress dust;
- Washing down construction vehicles with water before they leave site in order to prevent vehicles tracking mud containing asbestos fibres into the village and along the public road;
- Providing all construction vehicles with sealed air conditioned cabins in order to protect operators from asbestos fibres;
- Conducting pre-employment and regular medical examinations on employees, which include lung function tests;
- Establishing and maintaining an Environmental Rehabilitation Trust which includes post-employment medical examination and rehabilitation of employees found to have developed asbestos related health conditions as a consequence of the project's activities and products;
- Issuing site employees and visitors with appropriate PPE, which includes respiratory protection, and enforcing its use;
- Controlling access to the site.

8.4.1.11 Mitigations to generation of dust during site clearing and construction of Industrial Area 1 adjacent to TSF

The generation of dust and exposure to dust during site clearing and construction of Industrial Area 1 will be mitigated by:

- Keeping the site wet during and after clearing by using water tankers in order to suppress dust;
- Washing down construction vehicles with water before they leave the construction site in order to prevent vehicles tracking mud containing asbestos fibres into the village and along the public road;
- Controlling access to the site;

- Providing all construction vehicles with sealed air conditioned cabins in order to protect operators from asbestos fibres;
- Conducting pre-employment and regular medical examinations on employees, which include lung function tests;
- Establishing and maintaining an Environmental Rehabilitation Trust which includes post-employment medical examination and rehabilitation of employees found to have developed asbestos related health conditions as a consequence of the project's activities and products;
- Issuing site employees and visitors with appropriate PPE, which includes respiratory protection, and enforcing its use;
- Keeping rubble and scrap metal and all other demolition waste within a fenced designated area to avoid access by unauthorised salvagers who will otherwise be exposed to asbestos contaminated material recovered from demolition work.

8.4.1.12 Mitigations to generation of dust during processing of material from TSF

The generation of dust and exposure to dust during the processing of material from TSF will be mitigated by:

- Controlling the rate at which the surface of the TSF is kept wet with irrigation water sourced from the mine. This will minimize the risk of the surface of the TSF becoming too dry and too wet;
- Controlling and supervising the speed with which earthmoving equipment moves over the surface of the TSF thereby avoiding rapid drying of wetted surfaces which will otherwise generate dust;
- Providing all earthmoving machinery and vehicles with sealed air-conditioned cabins in order to protect operators from asbestos fibres;
- Conducting pre-employment and regular medical examinations on employees, which include lung function tests;

- Establishing and maintaining an Environmental Rehabilitation Trust which includes post-employment medical examination and rehabilitation of employees found to have developed asbestos related health conditions as a consequence of the project's activities and products;
- Washing down earthmoving machinery and vehicles with water before they leave site in order to prevent vehicles tracking mud containing asbestos fibres into the village and along the public road;
- Issuing site employees and visitors with appropriate PPE, which includes respiratory protection, and enforcing its use.

8.4.1.13 Mitigations to site clearing and construction of Industrial Area 2

The generation of dust and exposure to dust during the processing of material from TSF will be mitigated by:

- Keeping the site wet during and after clearing by using water tankers in order to suppress dust;
- Washing down construction vehicles with water before they leave the construction site in order to prevent vehicles tracking mud onto the public road which will otherwise generate dust when dry;
- Keeping the public road surface in the vicinity of the construction site clean by using a water tanker to hose off any sediment tracked onto the road by construction vehicles.

8.4.1.14 Mitigations to generation of dust during operation of processing plant

The generation of dust and exposure to dust during the processing of material from TSF will be mitigated by:

- Carrying out scheduled inspection and maintenance of processing plant to ensure its effectiveness in containing and suppressing dust;
- Establishing and maintaining an air quality monitoring programme which includes the TSF site and strategic sensitive receptors in the village and surrounding communities;

- Conducting pre-employment and regular medical examinations on employees, which include lung function tests;
- Establishing and maintaining an Environmental Rehabilitation Trust which includes post-employment medical examination and rehabilitation of employees found to have developed asbestos related health conditions as a consequence of the project's activities and products.

8.4.1.15 Mitigations to gas emissions during operation of Roaster

Gas emissions to atmosphere during operation of the Roaster will be mitigated by:

- Carrying out scheduled inspection and maintenance of the Roaster to ensure the effectiveness of the cyclone and electric dust collectors and separators;
- Establishing and maintaining an air quality monitoring programme which includes the Roaster's chimney stack emissions.

8.4.1.16 Enhancements to rehabilitated TSF

While the residual material will be harmless, the control of dust from the rehabilitated site will be enhanced by:

- Vegetating the site with suitable indigenous plants that will act as a barrier against wind erosion as well as retain the soil moisture, thereby preventing the generation of dust which will otherwise be a nuisance.

8.5 IMPACTS FROM NOISE

8.5.1 Noise sources from project activities will comprise:

- Site clearing and rehabilitation of access roads to and within TSF. Noise will emanate from the operation of road construction machinery and vehicles.
- Site clearing and construction of Industrial Area 1 adjacent to TSF. Noise will emanate from demolition work as well as operation of construction machinery, vehicles and impact of hammering steel structures.
- Processing of material from TSF. Noise will emanate from the operation of processing plant, equipment and vehicles.
- Site clearing and construction of Industrial Area 2. Noise will emanate from the operation of construction machinery, vehicles and impact of hammering steel structures.
- Operation of processing plant. Operation of the gold processing plant will generate noise, particularly venting of steam from the Roaster.

8.5.2 Impacts on baseline sound levels

Noise attenuates over distance, therefore the potential for a negative impact is reduced as the distance from the source to the receiver increases. Factors, other than project activities, which will influence the sound character of Bulembu include:

- Existing noise sources. Noise sources that were identified at Bulembu include aircraft routes, forestry activities and the sawmill.
- Traffic along MR20. The future upgrade of the MR20 will likely increase vehicular traffic through the village.
- Weather. Temperature, humidity, wind direction and wind speed play important roles in the transmission of sound over distance. The colder the weather the denser the air molecules and thus the further sound is transmitted. Similarly the higher the humidity the denser the air and thus the further sound is transmitted. While the prevailing winds

are southerly (blow from the south) wind direction and speed within Bulembu vary particularly in winter when the wind blows from all directions and this is likely due to the surrounding mountainous terrain. Generally , the most affected will be residents and homesteads to the north of the TSF due to the prevailing southerly wind.

- Barriers and Terrain. Natural and man-made barriers attenuate noise reaching the receptors while terrain such as deep valleys promote the transmission of sound. For example, Bulembu is situated in a narrow valley therefore the sound from the hillsides will be transmitted from one hillside to another opposite hillside, however the sound will be attenuated by the surrounding alien forest plantations. The hillside to the east of the village is a barrier to sound from the sawmill while the existing TSF is a barrier to sound generated within Bulembu village reaching the Ncenceni community in the south.

The Noise Impact Assessment (Aircheck, 2017) predicted the noise impact based on the noise level generated by a similar processing plant and mining and construction operations in South Africa. Based on such benchmarking, the impact on the key sensitive receptors will be as follows:

8.5.2.1 Bulembu Community Church (Sensitive Receptor [SR1])

During project activities, particularly operation of the plant, the average residual sound rating level (LAeq) at the Bulembu Community Church is predicted to increase from an average sound rating level (LAeq) of 42.6dBA to 54.1dBA during day-time, which accounts for an increase of 11.5dBA. The average sound rating level (LAeq) during the night time period may increase by 26.7dBA. The predicted average sound rating level (LAeq) of 54.1dBA also exceeds the standard for both day and night time maximum sound rating levels in rural districts of 45dBA and 35dBA, respectively.

8.5.2.2 Bulembu Country Lodge (Sensitive Receptor [SR2])

Noise from project activities, particularly operation of the plant, will increase the average sound rating level (LAeq) at Bulembu Country Lodge from 41.0dBA during the day-time and 22.1dBA at night time with 8.7dBA and 27.6dBA, respectively.

8.5.2.3 Malanda Community (Sensitive Receptor [SR3])

Noise emanating from project activities is not expected to have an impact on Malanda (north of Bulembu village) during the day-time. The reasons for the absence of an impact during day-time is attributed to the extensive distance (2.2km) from the source and the fact that this community had the highest baseline or residual sound rating level during the baseline measurement.

The average sound rating level (LAeq) during the night time period will increase by 13.6dBA. The predicted average sound rating level (LAeq) of 36.8dBA at Malanda is consistent with the day-time maximum noise rating level in rural districts of 45dBA, but exceeds the maximum night time level of 35dBA.

8.5.2.4 Ncenceni Community (Sensitive Receptor [SR4])

Noise emanating from project activities will increase the average sound rating level (LAeq) at Ncenceni (south of Bulembu village) from 34.6dBA to 35.4dBA during the day-time. The increase is less than 1dBA. The average sound rating level (LAeq) during the night time period will increase by 13.6dBA. The predicted average sound rating level (LAeq) of 35.4dBA at Ncenceni is consistent with the day-time maximum noise rating level in rural districts of 45dBA, but exceeds the night time level of 35dBA.

8.5.3 Noise Impact Assessment

Despite existing noise sources from some commercial activities such as forestry activities and the saw mill, noise levels at Bulembu are consistent noise levels in rural districts, therefore the project activities will increase the noise levels, resulting in noise induced hearing loss to employees working in noise zones and nuisance to residents of Bulmebu and surrounding communities. Noise nuisance will be exacerbated at night since the village and surrounding communities are currently relatively quiet after hours. This is likely to lead to stress and sleeping disorders amongst both site employees and residents, which in turn are likely to lead to general fatigue during the day.

Noise is likely to cause stress to wildlife, particularly medium to large mammals resulting in them being driven away from their existing habitats, thereby increasing the risk of road mortalities as they escape as well as conflict with humans at destination locations.

The impact significance on humans is rated high since noise induced hearing loss amongst site employees will be irreversible while noise nuisance will be long term since the gold processing plant will continue to operate after completion of the TSF rehabilitation. The impact significance on wildlife is rated medium since nearby protected areas are available, although this may adversely affect the carrying capacity of the land.

The impacts from noise are summarised in Table 23.

Table 23 - Summary of impacts from noise

Activity	Project activities	Rating
Impact	Generation of noise, resulting in noise-induced hearing loss to exposed employees	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Very high	4
Duration	Permanent	5
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**42**

Activity	Project activities	Rating
Impact	Generation of noise, resulting in nuisance to tourists and residents, including employees after their respective shifts	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**39**

Activity	Project activities	Rating
Impact	Generation of noise, resulting in stress to wildlife, particularly medium to large mammals	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

8.5.4 Mitigations to impacts from noise

8.5.4.1 Mitigations to noise in the workplace

Noise in the workplace will be mitigated by:

- Obtaining sound rating levels of machinery from suppliers during the procurement process. This will enable the determination of noise zones prior to commissioning of plant and equipment;
- Giving priority to electrically driven machinery over diesel powered machinery where practicable and reasonable during the design and procurement processes;
- Including, where practicable, sound absorption or insulation in the design specification of covers, casings and mufflers of plant and equipment;
- Including, where practicable, vibration damping in the design specification of support bases and points of contact between components of plant and equipment, e.g. in drive couplings;
- Enclosing, where practicable, noisy plant and equipment such as steam powered turbines within structures that prevent the transmission of noise to the external environment;
- Establishing and maintaining a planned maintenance programme for ensuring that plant and equipment operate optimally, thereby preventing frequent breakdowns and noise generation;
- Implementing pre-employment and regular medical examination on employees to in order to detect and manage noise-induced hearing loss at an early stage;
- Issuing appropriate hearing protection to employees and visitors and enforcing its use, whilst prioritising the aforementioned engineering means of mitigating noise.

8.5.4.2 Mitigations to transmission of noise to the environment

In addition to the aforementioned engineering solutions to mitigating noise in the workplace, the transmission of noise to the environment and the noise nuisance will be mitigated by:

- Restricting construction activities to day-time working hours;
- Notifying residents of the village and surrounding communities in advance where abnormal conditions will require working extended hours;
- Where, practicable, installing temporary screening around sections of the construction site, thereby providing sound barriers during construction;
- Planting indigenous trees around the perimeter of the respective industrial areas in order to reduce the sound reaching the receptors;
- Implementing and maintaining an environmental noise monitoring programme;
- Continually reviewing the effectiveness of noise mitigation measures by analysing the results of the noise monitoring programme and feedback from stakeholders.

8.5.4.3 Mitigations to noise pollution to wildlife

In addition to the aforementioned engineering solutions to mitigating noise in the workplace and mitigations to transmission of noise to the human environment, noise pollution to wildlife will be mitigated by:

- Planting indigenous vegetation around habitats such as bodies of water in order to prevent compromising the audibility of mating calls amongst wildlife such as frogs and birds, which will otherwise lead to gradual decline in population. The screening of noise will also mitigate driving away medium to large mammals;
- Implementing long term programmes through partnering with Eswatini-based specialists and researchers to monitor bio-indicators such as species and population distribution in the Bulembu area to determine correlations as well as cause and effect relationships between noise sources and fauna. The results of such long term monitoring will determine the effectiveness of the mitigation measures taken, e.g.

where no correlations and cause-effect relationships are found, this will suggest that the measures taken have been effective, based on the data collected.

8.6 IMPACTS ON OCCUPATIONAL HEALTH AND PUBLIC HEALTH

8.6.1 Impacts on occupational health

Impacts of asbestos related diseases from inhalation of asbestos fibres by site employees and residents as well as noise induced hearing loss have been described under previous sections of air quality and noise, respectively. This section therefore describes impacts on occupational health other than asbestos related diseases and noise-induced hearing loss.

8.6.1.1 Operation of machinery

The operation of machinery during construction and processing of material from the TSF will subject operators to vibrations, which in the long term will cause hand-arm vibration and whole-body vibration. During the construction phase and when carrying maintenance work during the operational phase, employees who repeatedly use vibrating hand tools will be exposed to hand-arm vibration which over time will cause disorders such as pain in their upper limbs, exacerbated in cold weather as well as loss of grip.

During the construction phase and when carrying maintenance work during the operational phase, employees who repeatedly operate vibrating machinery such as construction and earthmoving plant will be exposed to whole-body vibration. Over time this will cause the development of a wide range of ailments such as fatigue, lower back pain, headaches and loss of balance.

The impact significance is rated high since the project will be long term and employees such as truck drivers will drive over long distances and thus exposure will be extensive. Operators of hand tools and earthmoving equipment will be exposed on site during eight hours shifts, although operation will not be continuous throughout each shift, but nevertheless the project will be long term.

8.6.1.2 Working in low light conditions

Working in low light conditions, e.g. night shift workers, during the operational phase will cause strain on the eyes or being blinded by excessively bright lights leading to vision impairment in the long term. Eye strain amongst plant operators will also be caused by small text on bright computer monitors. The impact significance is rated medium since light intensity is relatively easily adjustable at the workstation. The increase in accident rates amongst machine operators and truck drivers arising from low light conditions, blinding light and vision impairment is a safety impact rather than an impact on occupational health. While there is an overlap of the causes and effects, impacts on safety are described separately.

8.6.1.3 Handling chemicals

From an occupational health perspective, long term exposure to industrial chemicals will cause respiratory disorders such as exacerbation of asthma where such chemicals are inhaled, or exacerbation of allergies leading to skin diseases where skin contact is frequent. Again, impacts such as momentary irritation and chemical burns are safety related rather than occupational health diseases. The impact significance of occupational health diseases arising from long term exposure to chemicals is rated medium since pre-employment and regular medical examinations will be carried out on employees.

The impacts on occupational health are summarised in Table 24.

Table 24 - Summary of impacts on occupational health

Activity	Operation of machinery	Rating
Impact	Health disorders resulting from long term exposure to vibrations	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**39**

Activity	Working in low light conditions	Rating
Impact	Vision impairment resulting from strain to eyes due to low light conditions, blinding light and computer monitors	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

Activity	Handling chemicals	Rating
Impact	Exacerbation of allergies	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

8.6.2 Mitigations to impacts on occupational health

8.6.2.1 Mitigations to long term exposure to vibrations

Occupational health disorders arising from long term exposure to vibrations will be mitigated by:

- Procuring hand tools that are ergonomic and have in-built vibration damping, e.g. shock absorption on handles;
- Procuring plant and equipment that are ergonomic to operators, e.g. heavy vehicles equipped with vibration damping on seats;
- Planned maintenance of tools, plant and equipment to ensure that vibrations are kept at a minimum;
- Training and supervising operators on the safe use of tools, plant and equipment in order to ensure the effectiveness of in-built vibration damping.

8.6.2.2 Mitigations to vision impairment arising from working in low light conditions

Vision impairment arising from working in low light conditions will be mitigated by:

- Designing workstations to provide adequate illumination, i.e. not too low and not excessive;
- Positioning external lights on premises in such a manner as to avoid blinding machine operators;
- Engaging qualified professional service providers to carrying out surveys of workstations at least annually to evaluate the adequacy of illumination and adjusting illumination accordingly to suit the requirements of the respective workstation;
- Including vision testing in pre-employment and regular medical examinations on employees;
- Providing appropriate eye protection and enforcing its use amongst employees exposed to bright light, e.g. welders.

8.6.2.3 Mitigations to health disorders and allergies from handling chemicals

Health disorders and allergies from handling chemicals and exposure to gases will be mitigated by:

- Designing safe loading, offloading and storage facilities for chemicals;
- Providing appropriate equipment for loading and offloading chemicals;
- Providing gas extraction in zones where employees will be exposed to gases, e.g. welding workstations;
- Designating all zones within the TSF and all production buildings outside the TSF as respirator zones, issuing and enforcing the use of respiratory protection.
- Conducting pre-employment and regular medical examinations on employees exposed to chemicals;
- Providing appropriate PPE and enforcing its use amongst employees exposed to chemicals.

8.6.3 Impacts on public health

Impacts of asbestos related diseases from inhalation of asbestos fibres by residents have been described under the air quality section. This section therefore describes impacts on public health other than asbestos related diseases.

8.6.3.1 Operation of plant

The operation of plant such as the Roaster will emit SO_2 gas and particulate matter, however these will be controlled such that emissions to atmosphere are negligible. This will be achieved by installing cyclone and electric dust separators to capture particulates, while SO_2 gas will be used in the acid leach plant. Therefore, the impact significance of respiratory disorders amongst residents is rated low.

8.6.3.2 Pollution of water resources

Sources of pollution of water resources, if not managed appropriately, will lead to health disorders from consuming polluted and contaminated water. These sources include:

- The TSF site which will release asbestos fibres via stormwater run-off and leach minerals into water bodies;
- Construction sites from which oil and fuel spills will be flushed into water bodies;
- Chemical storage areas from which leaks and spills of chemicals and stockpiled material will, if unsafely stored, will escape to water bodies;
- The existing sewage treatment plant which, if neglected, will discharge inadequately treated effluent to the Mkhomazane River;
- The solid waste disposal site whose leachate will seep to groundwater sources;
- The extensive use of pit latrines in surrounding communities, thereby posing a long term health hazard to groundwater sources, which in turn will adversely affect the public health of residents in Bulembu village as well as those in the community since groundwater eventually reaches the surface via springs.

The impact significance of water pollution and contamination is rated high since water is a scarce resource and Bulembu village and surrounding communities rely on the local surface and groundwater sources, with no alternative sources (other than a minority of homesteads which practice rainwater harvesting).

8.6.3.3 HIV/ AIDS

According to the Occupational and Public Health Survey Report (Lemmer, R. 2017), Bulembu Clinic provides HIV care and treatment to an average of 104 patients per month. Bulembu Clinic is a private clinic run by BMS primarily servicing their employees, children from the CCP

and members of the rural community in the surrounding area. According to the Socio-Economic Impact Assessment Report (Kobolondo, 2017),

> *"the level of HIV/AIDS within the country was approximately 26% of people aged between 15-49 years in 2015 (according to CDC Global health). A great deal of focus and investment has gone into reducing the national statistics of those affected by HIV/AIDS. Mining-related communities are renowned internationally for high levels of HIV/AIDS and sexually transmitted diseases, often due to high levels of migrant labour and single-male-headed households who reside in communities separate from their families. An increase in spending power amongst these employees has been known to attract prostitution, drug and alcohol usage. As a result, it is mostly young girls who are easily lured into sexual relationships with migrants and end up contracting STDs and falling victim to unwanted teenage pregnancies and HIV/AIDS."*

The impacts significance of the spread of HIV is rated high due to the high prevalence of HIVS/ AIDS at a national and local level which will be exacerbated by the aforementioned factors in the preceding quoted paragraph as well as long distance truck drivers, some of whom will likely enter into multiple relationships along their respective transport routes.

8.6.3.4 Communicable diseases

Closely associated with HIV/AIDS is tuberculosis (TB) which is highly contagious airborne disease that can be caught by breathing air that has been contaminated by an infected person through breathing, sneezing and coughing. The spread of TB will be exacerbated by employees and job-seekers living in overcrowded shared accommodation and travelling on the limited public transport from Bulembu to Pigg's Peak whose windows will often be closed in order to keep out the dust from the existing gravel road.

While these aspects of exposure to communicable diseases overlap with the prevailing socio-economic issues of limited accommodation for job-seekers, limited public transport and the existing condition of the road between Bulembu and Pigg's Peak, the project will trigger an

escalation of the health hazards and thus the health of project employees and community residents will ultimately be adversely affected, thereby adversely affecting the project as well as the community. The impact significance of the spread of communicable diseases is therefore rated high.

The impacts on public health are summarised in Table 25.

Table 25 - Summary of impacts on public health

Activity	Operation of plant	Rating
Impact	Respiratory disorders resulting from exposure to gas emissions	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Negative - Low	**16**

Activity	Project activities	Rating
Impact	Pollution of water sources resulting in health disorders from consuming polluted and contaminated water	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

Activity	Sexual contact amongst people	Rating
Impact	Spread of HIV/AIDS	
Direction	Negative	
Extent	National	4
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**45**

Activity	Housing provision	Rating
Impact	Overcrowding in accommodation and public transport leading to spread of communicable diseases	
Direction	Negative	
Extent	National	4
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**42**

8.6.4 Mitigations to impacts on public health

8.6.4.1 Mitigations to exposure to gas emissions

Exacerbation of respiratory conditions arising from exposure to gas emissions will be mitigated by:

- Avoiding the use of unclean forms of fuel such a coal in furnaces;
- Optimising the exothermic reaction in the leaching process as a clean energy source, thereby avoiding the use of fossil fuel;
- Using surplus heat from the exothermic reaction in the leaching process to provide central heating for houses and hot water in the village and where possible to nearby homesteads, thereby avoiding the use of coal and wood fuelled heating systems which in turn will enable cleaner air in the locality;
- Carrying out planned maintenance of all plant and equipment that emits gases to ensure the efficiency of combustion processes such as engines, thermal reactions and furnaces as well as the effectiveness of pollution control devices fitted on plant and equipment;
- Establishing and maintaining an air quality monitoring programme which includes all point source emissions, e.g. furnace chimney stacks as well as ambient air quality at sensitive receptors within Bulembu village and surrounding communities.

8.6.4.2 Mitigations to public health hazards from consuming polluted and contaminated water

Public health hazards arising from consuming polluted water will be mitigated by protecting surface and groundwater through:

- Containing and re-using the stormwater run-off from the TSF to top up dust suppression water, thereby preventing leached minerals reaching and contaminating groundwater and downstream water sources;

- Storing fuel, oil and chemicals within bunded areas and providing secondary containment such as drip trays for fuel, oil and chemicals stored in containers of up to 200 litres;
- Carrying out planned maintenance on machinery, plant and vehicles in order to prevent fuel and oil leaks;
- Operating and maintaining the sewage treatment plant in such a manner that ensures its optimal and effective performance, thereby ensuring that the final effluent complies with the Water Pollution Control Regulations, 2010;
- Managing the solid waste disposal facility such that hazardous waste, such as waste oil, is not disposed at the site;
- Including the promotion of sanitation in the Corporate Social Investment (CSI) Programme whereby support will be provided to the surrounding communities to install environmentally safer alternatives to pit latrines, e.g. waterless toilets;
- Liaising with the *Umphakatsi* to control the influx of job-seekers, thereby preventing informal settlements which in the long term will cause public health hazards from unsafe disposal of sewage and solid waste.

8.6.4.3 Mitigations to the spread of HIV/ AIDS

The spread of HIV/ AIDS will be mitigated through:

- Establishing and maintaining prevention, treatment, care and support programmes and initiatives which will form part of the CSI Programme. For example, free antiretroviral (ARV) medication will be issued to employees and members of surrounding communities through cooperation with the Ministry of Health;
- Implementing awareness promotion programmes in partnership the Ministry of Health and Non-Governmental Organizations involved in HIV/ AIDS in the promotion of awareness, voluntary counselling and testing;

- Providing suitable accommodation for employees to live with their families in cases where employees with specialised skills are recruited from outside the community, thereby mitigating the opportunities for multiple casual sex partners;
- Segregating shared accommodation such that males and females do not share accommodation units as this will increase the risk of casual sex and incidents of rape which will in turn spread HIV/ AIDS;
- Holding regular meetings with the community stakeholders and employees to review behavioural patterns amongst employees and community residents and exploring means of encouraging responsible behaviour and discouraging immorality, e.g. drug and alcohol abuse which will otherwise increase the risk of casual sex and prostitution;
- Liaising with the *Umphakatsi* to control the influx of job-seekers who will reside in the surrounding communities, increasing the risk of sexual misconduct.

8.6.4.4 Mitigations to the spread of communicable diseases arising from housing provision

The spread of communicable diseases arising from housing conditions will be mitigated through:

- Allocating accommodation units to employees such that overcrowding is avoided;
- Providing adequate natural ventilation in accommodation units to enable the circulation of fresh air;
- Providing the collection, removal and disposal of refuse from industrial, commercial and residential premises in the village. Refuse will be disposed safely at the proposed non-hazardous solid waste disposal site immediately to the west of the TSF;
- Liaising with the *Umphakatsi* to control the influx of job-seekers, thereby preventing the risk of overcrowding within the houses of the relatives of the job-seekers.

8.7 IMPACTS OF WASTE

8.7.1 Sources of waste

The project will generate waste directly and indirectly. The various types of waste generated will be in a solid, liquid, gaseous state as well as energy in the form of heat.

The activities that will generate waste are:

- Site clearing and rehabilitation of access roads to and within TSF. Cleared vegetation and spoil material will be generated by site clearing;
- Site clearing and construction of Industrial Area 1 adjacent to TSF. Rubble and scrap metal will be generated from demolition work. The rubble will include broken pieces of asbestos cement roof sheeting which is hazardous due to the asbestos content. Site clearing will generate cleared vegetation, some of which comprises alien weeds and trees;
- Processing of material from TSF. Waste generated will include scrap metal, tyres, pieces of conveyor belts, scrap metal, all of which were dumped on the TSF by previous mining operations. Recently dumped waste includes timber, building maintenance rubble which included broken asbestos cement roof sheets, household waste, some of which contains electronic waste from used household appliances as well as garden waste from the maintenance of premises within Bulembu village;
- Site clearing and construction of Industrial Area 2. Site clearing will generate rubble and scrap metal from the existing dairy building;
- Operation of processing plant. Operation of the processing plant (Industrial Area 1 and 2) will generate waste packaging from received chemicals and product packaging which is no longer fit for purpose, scrap metal, used oil and oil-contaminated waste (bearings, gears, rags) from plant maintenance and repair. Waste heat will be generated from the exhaust gases in the Roaster. Heat will also be generated from the condensation of

steam after it has been used in the generation of electricity in the Roaster, therefore any condensate which is not re-circulated or re-used will contain waste heat;

- Operation of laboratory. Operation of the laboratory which will be situated at Industrial Area 1 will generate solid waste in the form of packaging of analytical chemicals and electronic waste from analytical equipment. Liquid waste will be in the form of samples flushed together with used analytical chemicals;
- Accommodation and social amenities. Provision of accommodation and social amenities will generate building rubble from renovation and maintenance of buildings and structures. This will contain asbestos cement roof sheets. Other waste will be household refuse and garden waste. Lighting will generate used fluorescent tubes and lamps. Liquid waste will be in the form of wastewater which includes sewage;
- Healthcare facility. Healthcare provision at the clinic will generate 'special waste' defined as hazardous waste and clinical waste under the Waste Regulations, 2000;
- Transport and logistics. Use of trucks and engine driven loading equipment will generate gas emissions, while repairs and maintenance will generate used vehicle components, oil-contaminated waste, used oil and used tyres.

8.7.2 Impacts from disposal of non-hazardous solid waste

The disposal of non-hazardous solid waste, such as cleared vegetation, rubble, scrap metal not contaminated with asbestos fibres, household waste, garden waste will utilise space at the disposal site, resulting in the rapid depletion of space. The impact significance is rated medium since there is sufficient space at the proposed site immediately west of the TSF.

Decomposing waste, particularly household waste which contains food waste, will generate odours causing a nuisance to residents. Decomposing waste will also attract flies and pests such as rodents both of which will cause public health hazards. Leachate from the disposed soil waste will seep through the ground to reach and pollute groundwater, which in turn will

cause public health hazards to users of groundwater. The impact significance of public health hazards and odour nuisance is rated high due to the proximity to Bulembu village.

8.7.3 Impacts from disposal of hazardous waste

All waste currently dumped on the TSF will be considered as hazardous waste by virtue of being contaminated with asbestos fibres. This includes the household waste which has been dumped on the TSF. Other hazardous waste from sources other than that dumped on the TSF includes asbestos cement roof sheets from all sites of the village, electronic waste from discarded mining equipment, scrap metal which is strewn about the site where Industrial Area 1 is proposed to be situated – this scrap metal is contaminated with asbestos fibres since has come into contact with bare ground.

The impact significance of disposing the hazardous waste is rated high since employees handling the waste will be exposed to asbestos fibres and, if disposed improperly, will transfer the asbestos fibres to the disposal site thereby spreading the contamination to surface and groundwater sources as well as to the air. Furthermore, oil-contaminated waste, spent fluorescent tubes and laboratory waste will contaminate the soil, surface and groundwater sources.

8.7.4 Impacts from disposal of healthcare waste

Healthcare waste, if disposed unsafely, will expose handlers to health hazards of contracting diseases through contact with the waste and safety hazards of being pierced by sharps such as used needles. Healthcare waste which is handled and disposed unsafely will also cause public health hazards through the spread of infectious diseases from the handlers of healthcare waste to other persons in the community with whom they come into contact. The impact significance is rated high since the transmission of diseases from healthcare waste to handlers and in turn to the community will lead to terminal illnesses. Furthermore, expired

medication and chemicals stored in the clinic will, if disposed unsafely, contaminate surface and groundwater sources.

8.7.5 Impacts from gas emissions from internal combustion engines

Exhaust gases from engines of plant, machinery and haulage trucks will emit greenhouse gases such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The emission of greenhouse gases will contribute to global warming, which in turn will contribute to climate change. Exhaust gases from engines, if not managed, will cause irritation to respiratory systems amongst the public, particularly road users and pedestrians as well as a nuisance to the public, hence Section 73(2) of the Road Traffic Act, 2007 prohibits the operating a vehicle which emits excessive smoke on a public road.

While the contribution of the project, in the global context, to global warming and climate change will be low, the potential contravention of Section 73(2) of the Road Traffic Act, 2007 in the local context raises the impact significance of engine exhaust emissions to medium.

8.7.6 Impacts from waste heat

Waste heat released to the atmosphere via chimney stacks at the Roaster will have a negligible direct impact to the atmosphere and air quality. The indirect impact will be that processes which require heat, such as heating of domestic water, will consume more electricity and thus contribute to the depletion of fossil fuel, from which much of the electricity in Eswatini which is imported from South Africa is generated. Therefore, the emission of waste heat to the atmosphere represents a lost opportunity of reducing the reliance on fossil fuel-based imported electricity. This is both an environmental and socio-economic impact whose significance is rated high since Eswatini is heavily dependent on imported electricity.

Any excess hot condensate from steam generated electricity in the Roaster, if discharged to the environment without being adequately cooled, will increase the temperature of received surface water bodies, thereby causing the dissolved oxygen in the receiving water to come out of solution and bubbling to the air. A reduction in dissolved oxygen in aquatic habitats will thus kill fish and other organisms on which other fauna depend as a food source, ultimately causing population reduction and loss of biodiversity.

While the impact significance of discharging hot condensate to receiving water bodies will be medium due to the diluting and cooling effect of other tributaries in the Mkhomazane River, the lost opportunity of heat recovery for reducing electricity consumption for domestic water heating raises the impact significance to high.

The impacts of waste are summarised in Table 26.

Table 26 - Summary of impacts of waste

Activity	Disposal of non-hazardous solid waste	Rating
Impact	Depletion of space for waste disposal	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

Activity	Disposal of non-hazardous solid waste	Rating
Impact	Public health hazards from contamination of surface and groundwater and attraction of pests. Nuisance from odours	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**36**

Activity	Disposal of hazardous waste	Rating
Impact	Asbestos related diseases amongst waste handlers. Contamination of surface and groundwater sources	
Direction	Negative	
Extent	Regional	3
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**39**

Activity	Disposal of healthcare waste	Rating
Impact	Contraction of diseases amongst healthcare waste handlers. Spread of communicable diseases from healthcare waste handlers to community	
Direction	Negative	
Extent	Regional	3
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**42**

Activity	Operation of plant, machinery and haulage trucks	Rating
Impact	Public nuisance from emission of smoke in exhaust gases	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

Activity	Operation of plant	Rating
Impact	Lost opportunity for heat recovery resulting in increased consumption of electricity	
Direction	Negative	
Extent	National	4
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**45**

8.7.7 Mitigations to impacts from waste

8.7.7.1 Mitigations to depletion of space for disposal of non-hazardous solid waste

Depletion of space for disposal of non-hazardous solid waste will be mitigated by:

- Segregating recoverable materials during demolition and sending recyclable material such as metals for recycling. Recyclable material such as scrap metal which has been contaminated with asbestos fibres will be washed down on the TSF to clean off the asbestos while leaving it on the TSF. Thereafter the scrap metal will be sent for recycling. The asbestos-contaminated water will be channelled to the dust suppression reticulation system which entails recirculating the water for use in scrubbing, crushing, milling, gravity and magnetic separation;
- Stockpiling rubble, excluding broken asbestos cement sheets, at a designated site for later re-use as fill material in the TSF and any other disturbed areas such as borrow pits;
- Stockpiling cleared vegetation in a designated area for later shredding and re-use as organic material for top soil on the TSF;
- Educating employees and site employees on waste reduction and segregation, thereby promoting recycling.

8.7.7.2 Mitigations to public health hazards and nuisance from disposal of non-hazardous solid waste

Public health hazards and nuisance from disposal of non-hazardous solid waste will be mitigated by:

- Creating a berm around the perimeter of the disposal site in order to prevent stormwater run-off entering the site and being polluted by the waste;
- Providing a suitable lining to prevent leachate from reaching and polluting groundwater;

- Capturing and storing in a lined containment area the stormwater which lands directly on the disposal site. Installing subsurface drainage in the disposal site to drain leachate to lined containment area which will be situated at the lowest end of the disposal site. The captured leachate and stormwater will be re-circulated by pump and irrigated onto the disposal site in order to keep the disposed waste moist, thereby accelerating decomposition;
- Compacting the waste and covering it with the inert silica from the TSF rehabilitation process, thereby forming successive layers (sandwiching) of waste and silica. Waste will be covered at weekly intervals to prevent attraction of pests. The irrigation of the leachate over the waste will also suppress dust. In the event of prolonged drought, the re-circulated leachate will be topped up with final treated effluent from the wastewater plant which will be brought in by water tanker. This will avoid the need to abstract top-up water from streams;
- Educating employees and residents on waste segregation, thereby preventing the mixing of hazardous and non-hazardous waste, which will otherwise compromise the effectiveness of the solid waste disposal facility.

8.7.7.3 Mitigations to impacts from disposal of hazardous waste

Public health hazards and exposure to asbestos fibres amongst handlers of hazardous waste will be mitigated by:

- Wetting down asbestos contaminated scrap metal to suppress dust during transportation to the TSF where it will be washed down further to remove the asbestos fibres and deposit them on the TSF. The asbestos contaminated water resulting from wetting down scrap metal will be recirculated with the dust suppression water that will be used on the TSF. Thereafter the scrap metal and any other recyclable waste will be sent for recycling by being sold to authorised local recyclable material collectors;
- A section of the solid waste disposal site will be designated to the storage of hazardous waste until such time that a national hazardous waste disposal facility, e.g. the

proposed Mafutseni Site, is established. Small items of hazardous waste such as used chemical containers and expired chemicals and medication will be disposed safely by transporting them, using an authorised service provider, to South Africa for safe disposal at an authorised facility in accordance with the EEA's procedure and Basel Convention upon liaising with the EEA, until such time that Eswatini develops a hazardous waste disposal facility.

8.7.7.4 Mitigations to impacts from disposal of healthcare waste

Health hazards of handling and disposing healthcare waste will be mitigated by:

- Enforcing the collection and storage of healthcare waste in accordance with the Waste Regulations, 2000 wherein appropriate bins will be provided for storing sharps separately from other healthcare waste;
- Enforcing the segregation of healthcare waste, thereby preventing its disposal with general refuse;
- Installing a diesel fuelled healthcare waste incinerator at Bulembu Clinic, thereby mitigating exposure to hazards during transportation;
- Transporting the ash from the incinerator for disposal at the designated hazardous waste storage site within the proposed solid waste disposal site. The hazardous waste storage site will be fenced off from the rest of the solid waste disposal site.

8.7.7.5 Mitigations to emission of smoke from operation of plant, machinery and haulage trucks

Smoke from exhaust gases emitted during the operation of plant, machinery and haulage trucks will be mitigated through:

- Procurement of plant, machinery and vehicles fitted with fuel economic engines and emissions control devices;
- Planned maintenance of plant, machinery and vehicles;

- Replacing haulage vehicles when they have exceeded their optimal working life.

8.7.7.6 Mitigations to waste heat from operation of plant

Waste heat from operation of plant will be mitigated by:

- Recovering the heat from chimney stacks for use in pre-heating water within the plant;
- Using surplus heat from the exothermic reaction in the leaching process to provide central heating for houses and hot water in the village and where possible to nearby homesteads.

8.8 IMPACTS ON TRANSPORT AND LOGISTICS

8.8.1 Impacts on transport and logistics infrastructure

Since raw materials and products will be transported by land, the impact assessment focuses on road and rail infrastructure. Sea and air transport are beyond the geographical boundary of the project and therefore not described in the impact assessment section of this ESIA Report.

8.8.1.1 Impacts on road infrastructure

The haulage of raw materials and products, if not managed, will result in the overloading of haulage trucks in a bid to maximise haulage efficiency which will increase the rate and severity of wear and tear of the public roads to and from the project site. This will result in funds having to be diverted from other infrastructure projects to the repair and maintenance of the project's haulage routes, thereby diminishing the social benefit of the project to the Hhohho Region and the nation as whole. While the Transport and Logistics Study asserts that the existing road infrastructure is mostly classified as being in good condition and that the MR20 (Bulembu – Pigg's Peak) is scheduled for upgrading, the upgrade will attract more non-project traffic along the road, such as additional timber haulage trucks and other heavy vehicles which currently use alternative routes to and from South Africa due to the existing poor condition of the MR20. The combined effect will therefore be the rapid deterioration of the road and other routes connecting to the MR20. Since it is not possible to accurately predict the precise level of increase of additional traffic without an extensive survey that is beyond the scope of this ESIA, the impact significance of increased wear and tear on public roads is rated medium. If the MR20 had not been scheduled for upgrading, the impact significance would be high since the road would be worsened from its current poor condition by project traffic.

8.8.1.2 Impacts on rail infrastructure

The existing rail infrastructure has capacity to accommodate the project's freight, however as described in the Transport and Logistics Study, the preference towards road transport in the early phases of the project is based mainly on the economic factor of avoiding additional costs from transhipment, where the economic returns at the early stage will not justify the additional road to rail transhipment costs.

The impact significance on rail infrastructure is rated positive and low since the physical rail capacity is available and will further be increased with the completion of the Swazi Rail Link Project. The shift towards rail in the latter stages of the project will increase the positive impact rating to medium, and possibly high since rail will shift from being under-utilised. Similarly the impact on roads will shift from being negative to positive since the use of road and rail will be more balanced, thereby relieving the pressure from road infrastructure.

8.8.1.3 Traffic congestion

The Transport and Logistics Study predicts that,

> *"During the construction phase, it is unlikely that there will be a noticeable impact on traffic along the roads or at the intersection of the MR20-MR1 or MR1-MR3 on-ramp, as there will be less than a 20% increase in the volume of heavy vehicles at these intersections. Once production begins the volume of traffic received at the major intersections will increase to approximately 46 heavy vehicles per day. Phase 2 of the project will generate an estimated 218 heavy vehicles per day into and out of Bulembu, which will cause congestion at various intersections."*

In view of the Transport and Logistics Study basing the prediction on project traffic alone, the impact significance is rated medium since additional non-project traffic is likely to be

attracted by the upgrade of the MR20 (Bulembu – Pigg's Peak). Furthermore, the increase traffic will not cause congestion to motorists, but will increase stress amongst pedestrians who will experience delays and anxiety in crossing the road from one side of the community to the other. This physical and psychological barrier, often referred to as community severance, will contribute to the perpetuation of the existing feelings of alienation of the surrounding communities from Bulembu village, thereby undermining any efforts towards breaking down social barriers.

8.8.1.4 Impacts on road safety

The increase in volumes of heavy vehicles will result in increased congestion which, exacerbated by the slow moving vehicles, will cause some motorists to be impatient and thus overtake on blind rises and other sections where it is unsafe to overtake. Haulage trucks following each other too close, will extend the tandem of haulage trucks and thus obstruct overtaking motorists, leaving them with room to return to their lane. Both of these scenarios will cause an increase in head-on collisions.

The long and strenuous distances will cause fatigue amongst haulage truck drivers, resulting in the loss of concentration which will lead to accidents. Aggressive driving, particularly amongst male truck drivers will further contribute to road traffic accidents. Performance targets, in terms of throughput, imposed upon truck drivers will cause speeding along flat and downhill sections, thereby exacerbating aggressive driving, leading to accidents.

The impact significance on road safety is rated high due to the wide range of aforementioned contributory causes of accidents, exacerbated by the narrow single carriageway roads and steep sections of road in the north western Hhohho Region.

The impacts on transport and logistics are summarised in Table 27.

Table 27 - Summary of impacts on transport

Activity	Road haulage	Rating
Impact	Increased wear and tear on road infrastructure from overloading	
Direction	Negative	
Extent	National	4
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**42**

Activity	Rail freight	Rating
Impact	Diversion of traffic from road network to rail network leading to reduced wear and tear on road infrastructure	
Direction	Positive	
Extent	National	4
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Likely	2
Significance	Positive - Medium	**20**

Activity	Road transport	Rating
Impact	Increased traffic congestion and community severance	
Direction	Negative	
Extent	Regional	3
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Likely	2
Significance	Negative - Medium	**26**

Activity	Driving behaviour	Rating
Impact	Increased road traffic accidents	
Direction	Negative	
Extent	International	5
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**48**

8.8.2 Mitigations to impacts on transport and logistics

8.8.2.1 Mitigations to impacts on wear and tear on road infrastructure

Wear and tear on road infrastructure will be mitigated by:

- Selecting routes that are capable of accommodating the haulage traffic volumes and masses of the consignments of raw materials and products;
- Keeping consignment loads within the permissible maximum axle mass load limit of the respective sections of scheduled routes;
- Tracking haulage vehicles to ensure that they keep to scheduled routes.

8.8.2.2 Enhancements to use of rail freight

The rail network will be used when it is economically viable to do so, in order to balance the distribution of cargo between road and rail, thereby reducing the wear and tear on road infrastructure as well as optimising the use of rail infrastructure.

8.8.2.3 Mitigations to traffic congestion and community severance

Traffic congestion and community severance will be mitigated by:

- Liaising with the Ministry of Public Works and Transport, together with the Royal Eswatini Police on the planned dates for delivery of abnormal loads, such as components of the plant which will have been fabricated off site. Public notices will be published in the local newspapers notifying the public of the delivery routes for abnormal loads, thereby enabling the public to use alternative routes where available during the scheduled dates and times. A police escort will be requested throughout the delivery route when the abnormal load is transported. Additional assistance from the Royal Eswatini Police Service will be requested for busy intersections along the delivery route to control traffic in order to ensure the smooth and safe flow of traffic;

- Avoiding peak hours, during the phase, at busy intersections and towns along the route when delivering shipments of construction material and components other than abnormal loads;
- Scheduling delivery times and ensuring sufficient resources for offloading construction material in order to avoid delivery vehicles causing long queues which extend from the delivery site up to and along the MR20 at Bulembu;
- Rehabilitating the existing access routes through the forest at the east end of the Mining Lease Area, thereby enabling project vehicles to access the TSF via the south east rather than through the village;
- Liaising with the *Umphakatsi* and office of the Regional Administrator in identifying and prioritising, through the CSI Programme, existing community access roads that require rehabilitation in order to facilitate the ease of access between the surrounding communities and Bulembu village, as well as between the communities themselves. This will also alleviate bottlenecking caused by opposing traffic along community roads, thereby relieving community residents of the psychological stress of travelling to and from Bulembu village.

8.8.2.4 Mitigations to road traffic incidents

Road traffic incidents will be mitigated by:

- Procuring vehicles that are roadworthy, capable of safely carrying the loads that will be transported and maintaining the vehicles in safe working condition;
- Providing emergency field services that will rapidly, efficiently and effectively attend to breakdowns of haulage trucks along transport routes, thereby mitigating risks of accidents by broken down trucks obstructing traffic;
- Pre-employment and regular medical examinations on drivers to ensure that they are medically fit to drive;

- Providing training, awareness and refresher courses to drivers on defensive driving, first aid and the use of emergency equipment fitted onto trucks, e.g. fire extinguishers and spill kits;
- Encouraging women drivers to take up heavy duty driving as a career. This will alleviate aggressive driving in what is currently a male-dominated profession. Such encouragement will be implemented through recruiting women drivers in light duty driving, identifying amongst them those with an interest in heavy duty driving, and thereafter providing them with training towards attaining a heavy-duty driver's license;
- Liaising with the Eswatini Post and Telecommunications Corporation (SPTC) to ensure that public telephones at Bulembu are available and kept in working order to enable drivers to affordably maintain contact with family members. This will alleviate some of the root causes of stress;
- Providing access to ablutions to drivers who do not reside at Bulembu, thereby enabling them to freshen up by having a warm shower, particularly after long journeys thus alleviating stress, frustration and fatigue;
- Alternating drivers thereby mitigating stress from the monotony of travelling the same route;
- Allow drivers time off thereby enabling them to spend time with family, thereby alleviating stress;
- Liaising with the Fire and Emergency Services as well as the Royal Eswatini Police to identify and prioritise, through the CSI Programme, specific needs of capacity building, equipment and mutual assistance for enhancing emergency preparedness and response to road traffic safety in the Hhohho Region. This will alleviate the pressure on limited resources in preventing, monitoring and responding to road traffic incidents.

8.9 IMPACTS ON CULTURAL HERITAGE

As described in 3.1.11 above, Section 25 of the National Trust Commission Act, 1972 empowers Commission to make recommendations to the Minister of Tourism and Environment on the proclamation of national monuments, relics and antiques.

The Act defines a monument as, *inter alia*,

> *"any area of land having a distinctive or beautiful scenery or geological formation, old building, or any other place or object (whether natural or constructed by man) of aesthetic, historical, archaeological, scientific, sacred, or religious value or interest."*

The Act defines a relic as,

> "*any fossil of any kind, any drawing or painting or stone or petroglyph known or commonly believed to have been executed by aboriginal inhabitants of Southern Africa, or by any people who inhabited or visited Southern Africa in ancient days, and any implement or ornament known or commonly believed to have been used by them and any anthropological or archaeological contents of the graves, caves, rock shelters, shell mounts, or other sites used by them."*

The Act defines an antique as,

> *"any movable object (not being a monument or relic) of aesthetic, historical, archaeological or scientific value or interest, the whole or more valuable portion whereof has for more than thirty years been in any part of Southern Africa."*

8.9.1 Impacts on monuments

8.9.1.1 Places and objects of archaeological value or interest

The Heritage Survey found no indications of archaeological material within the Mining Lease Area. It is also improbable that the TSF contains any archaeological material since it is residue from previous mining operations, therefore any archaeological material would have been destroyed during mining. The impact significance on archaeological material is therefore rated low.

8.9.1.2 Old buildings

While the National Trust Commission Act, 1972, does not define an "old building" in terms of age in years, the Heritage Survey identified, within Bulembu village, several old buildings and structures which are potential candidates for proclamation and preservation. These include:

- Mine management houses, built between 1937 to 1939, situated along Park Lane and Hyde Park Streets at the west end of the village. The houses, which are currently in use, are characterised by corrugated iron wall cladding over breeze blocks. The houses depict the mining functionalist style of architecture;
- The Postmaster's house, constructed before World War II by the South African Post Office and stylistically dissimilar from the aforementioned mine management houses. The house is situated outside the Mining Lease Area, but is situated near the centre of Bulembu village and depicts a departure from the architectural style of the other management houses;
- The cableway station which was completed in 1939 and is one of only three surviving pre-War major mining cableway stations worldwide, making it an extremely rare example of 1930s mining technology;
- A cottage near the current security offices that was used by King Sobhuza II for accommodation when he visited Bulembu, which was then Havelock. The cottage is

historical interest in that the visit signified the economic importance of Bulembu at the time.

The impact significance of disturbance to or demolition of the historical buildings is rated medium since they have not yet been proclaimed as national monuments under the National Trust Commission Act, 1972.

8.9.1.3 Areas of land having a distinctive or beautiful scenery or geological formation

While there are no proclaimed sites as having a distinctive or beautiful scenery or geological formation, there is reportedly an initiative to establish geo sites which will form part of a geotrail along the MR20 (Bulembu – Pigg's Peak). The initiative, conceptualised by the Barberton Tourism and Biodiversity Corridor (BATOBIC) identified various locations along MR20 which are worthy of being developed into geo sites to form part of the Barberton Makhonjwa Geotrail in pursuit of recognition and listing as a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site. The original intention was to extend the Geotrail into Eswatini, but plans were reportedly temporarily suspended with the advent of the of the iron ore project at Ngwenya. BATOBIC hopes to resuscitate plans of extending the Geotrail into Eswatini in the future, the objective being to establish the geo sites during the construction of the Pigg's Peak - Bulembu road so the sites serve as a tourist attraction and an educational resource on the geological formations of the area and a history of the local inhabitants.

The initiative is predicated on the fact that the Makhonjwa Mountains, of which Bulembu and Pigg's Peak are a part, are host to some of the oldest (3.2 and 3.6 billion years) geological formations in the world.

The impact significance of disturbance to the geo sites which have not yet been proclaimed on the Eswatini side of the border, is rated low since only one proposed geo site is situated

within the Mining Lease Area. It is at the north foot of the North TSF alongside the MR20 near the centre of Bulembu village.

8.9.2 Impacts on relics

The Stillbay culture is the name assigned by archaeologists to a Middle Stone Age stone tool manufacturing culture of approximately 75,000 - 65,000 years ago. The Heritage Survey found that,

> *"a Stillbay point was found in 2016 on the surface of a gravelled track between Bulembu Lodge and the old cinema, however there is no indication of a site there. It is likely that this point was brought in as road fill, from an unknown source at an unknown period, to stabilise the track's surface. There are known Stillbay sites along the nearby Komati River."*

The Heritage Survey states that there is a San / Bushman rock art site on BDC land between the Mining Lease Area and northern section of Malolotja Nature Reserve. Since no relic is presently known to occur within the Mining Lease Area, the impact significance of disturbance to relics is rated low.

8.9.3 Impacts on antiques

The Heritage Survey found that the Bulembu museum has general displays on asbestos mining and colonialism. There are also many old files from the running of the mine which are stored within the cableway station. Additionally, much of the internal equipment in the electricity substation at the far end of the old factory zone dates back to the 1930s and depicts mining technology at the time, although the building itself is of no historical significance.

While the collection of antiques in the Bulembu museum and elsewhere in Bulembu have not been proclaimed under Section 25 of the National Trust Commission Act, 1972 and are thus

private collections, they are capable of being proclaimed as antiques by virtue of having been in the country for more than 30 years. This therefore qualifies them for being prohibited from being removed or exported without the written consent of the ENTC, irrespective that they do not belong to the ENTC.

Since the antiques are stored within buildings which are situated within the proposed site of Industrial Area 1, the impact significance of their loss or damage prior to site clearing and construction is rated high.

8.9.4 Impacts on graves

There are no graves or grave sites within the Mining Lease Area. There are 3 cemeteries adjacent to the proposed site of Industrial area 2. These are between the existing dairy farm and wastewater treatment plant at the north east end of Bulembu village. While proposed siting of Industrial area 2 has been cognizant of the cemeteries, and has been sited so as to avoid their disturbance, accidental disturbance will occur if site clearing and construction activities are not closely supervised. While no relocation of graves will be necessary, the impact significance of disturbance of the graves during construction is rated high due to their proximity to the proposed industrial site.

The impacts on heritage are summarised in **Table 28**.

Table 28 - Summary of impacts on cultural heritage

Activity	Site clearing and rehabilitation of access roads	Rating
Impact	Destruction of archaeological material	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Improbable	1
Significance	Negative - Low	**8**

Activity	Renovation of existing buildings	Rating
Impact	Damage and destruction of old buildings of historical importance	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Moderate	2
Duration	Long term	4
Risk/Uncertainty	Medium	2
Probability	Likely	2
Significance	Negative - Medium	**20**

Activity	Site clearing and construction of plant	Rating
Impact	Disturbance and degradation of sites of beautiful scenery and distinctive geological formation	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Improbable	1
Significance	Negative - Low	**8**

Activity	Site clearing and construction of plant and rehabilitation of access roads	Rating
Impact	Disturbance to relics such as sites and objects of ancient cultures	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	Low	1
Duration	Long term	4
Risk/Uncertainty	Low	1
Probability	Improbable	1
Significance	Negative - Low	**8**

Activity	Site clearing and construction of plant	Rating
Impact	Loss and destruction of antiques	
Direction	Negative	
Extent	International	5
Magnitude/Severity	Very high	4
Duration	Permanent	5
Risk/Uncertainty	High	3
Probability	Likely	2
Significance	Negative - Medium	**34**

Activity	Site clearing and construction of plant	Rating
Impact	Disturbance to graves in adjacent cemetery, resulting in distress to living relatives	
Direction	Negative	
Extent	National	4
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**42**

8.9.5 Mitigations to impacts on heritage

8.9.5.1 Mitigation to destruction of archaeological material

Although unlikely, any archaeological material found during site clearing and rehabilitation of access roads will be brought to the attention of the ENTC will determine the appropriate measures to be taken in order preserve such material.

8.9.5.2 Mitigations to damage and destruction of old buildings

Damage and destruction of old buildings will be mitigated by:

- Liaising with the ENTC to catalogue old buildings in order for the ENTC to thereafter submit a motivation to the Minister of Tourism and Environment for the proclamation of the catalogued buildings as national monuments, thereby providing the buildings with an official status of protection;
- Liaising with the ENTC to determine and document in writing, where an old building has been proclaimed as a national monument, the specific characteristics of the building that are to be preserved during renovation. This will ensure that future owners and/ or tenants are clear on what may and may not be altered when carrying out renovations.

8.9.5.3 Mitigations to disturbance of sites having distinctive or beautiful scenery or geological formation

Disturbance to sites which have distinctive or beautiful scenery or geological formations will be mitigated by:

- Liaising with the ENTC in order for the ENTC to identify sites along the section of the MR20 which passes through Farm 815 which are capable of being proclaimed as national monuments. Thereafter it shall be the discretion of the ENTC to submit a

motivation to the Minister of Tourism and Environment for the proclamation of such sites as national monuments;

- Assisting the ENTC, where the ENTC so requests assistance, in enhancing sites proclaimed as national monuments along the section of the MR20 which passes through Farm 815.

8.9.5.4 Mitigation to disturbance of relics such as sites and objects of ancient cultures

Disturbance to sites and objects of ancient cultures found during site clearing and construction of plant as well as rehabilitation of access roads will be mitigated by alerting the ENTC who will determine the appropriate measures to be taken in order preserve such relics.

8.9.5.5 Mitigation to loss and destruction of antiques

The loss and destruction of displays in the museum and antiques kept within Bulembu will be mitigated by:

- Liaising with the ENTC to catalogue all displays and antiques in order for the ENTC to thereafter submit a motivation to the Minister of Tourism and Environment for the proclamation of the catalogued articles as antiques;
- Relocating the proclaimed articles to alternative premises within Bulembu village, where they shall be made accessible for viewing by the general public;
- Handing the proclaimed antiques to the ENTC for preservation, if in the future, Kobolondo Mining (Pty) Limited decides to discontinue its direct involvement in the operation of the museum, e.g. when approaching project decommissioning and closure.

8.9.5.6 Mitigations to disturbance of graves within cemetery

The physical disturbance to the graves in the cemeteries adjacent to the proposed Industrial Area 2 will be mitigated by:

- Demarcating and fencing off the cemeteries in order to avoid construction vehicles inadvertently driving over the graves or stockpiling excavated material on them;
- Providing access to the graves by means of a pedestrian gate.

8.10 SOCIO-ECONOMIC IMPACTS

Some socio-economic impacts overlap with those already described in previous sections. For example, impacts on ecosystem services provided by wildlife, impacts on water resource availability and quality, impacts on air quality, impacts from noise, impacts on public health will affect social the social well-being of employees and residents of Bulembu village and the surrounding community. This section describes those impacts which have not yet been described in previous sections, although in some cases there will be overlaps, therefore the mitigations will be the same or similar. The Socio-Economic Impact Assessment Report provides a more detailed description of the potential positive and negative impacts of the project.

8.10.1 Impacts on employment opportunities

With the national unemployment rate at 28.1% and the unemployment amongst the population in the surrounding communities estimated at 70%, the project will create much needed employment opportunities, not only locally through direct employment, but also nationally through procurement of goods and services. The positive impact significance is rated high due to the alleviation of the high unemployment rate.

8.10.2 Impacts on Small, Medium and Micro-sized Enterprises

Small, Medium and Micro-sized Enterprises (SMMEs) range from consultancy firms and self-employed skilled professionals to building contractors, metal fabrication, workshop repair service providers, vendors, accommodation service providers, cleaning service providers, etc.

The project will directly and indirectly generate a demand for services from SMMEs. Examples of direct demand will be management consultancy services, maintenance of infrastructure such as buildings and access roads and hospitality services. Examples of indirect demand will be shop and market services, cleaning services, e.g. domestic helpers for employees and car wash services.

In the case of direct demand, SMMEs will gradually improve their service delivery capabilities and thus market or enable themselves to provide services beyond Bulembu, thereby diversifying their customer base so that when the project closes, they are not left stranded. Thus the project will have played a role in their development. The positive impact significance is rated high due to the effect of enabling SMMEs to sustain themselves beyond the project site.

8.10.3 Impact on purchasing power

The project, through the direct and indirect employment opportunities will increase the disposable income of direct and indirect employees, who in general, will spend their income on purchases within the country, although some purchases will be outside the country. This will contribute positively to the national economy, therefore the impact significance is rated high since it alleviate poverty at a national level.

8.10.4 Impact on tax revenue

The project will contribute to the national economy through tax revenue, particularly since it will act as a catalyst to other potential gold mines in the country who in turn will also contribute to the tax revenue. The impact significance is rated high due to the multiplier effect that the project will have on the growth of tax revenue from the country's mining industry.

8.10.5 Impact on funds for environmental and social rehabilitation

The project will generate the funds for the environmental rehabilitation of the TSF and will serve as a model for other rehabilitation programmes for abandoned mines in the country whose un-rehabilitated tailings possibly pose a potential environmental hazard and whose closure left surrounding communities in social and economic regression. The positive impact significance is rated high since the project will kick-start the rejuvenation, growth and sustainable management of the country's mining industry.

8.10.6 Impact of relocation of CCP

The relocation of the CCP to Hawane entails the core components of child care while the enterprises will remain. Table 29 shows the list of relocating components of the CCP and remaining enterprises.

Table 29 - Relocating and remaining activities

	Category	Activity	Persons
Relocating	Child Care Programme	Babies and toddlers	
		Dvudvusi Children	200
		Senior boys, girls and young adults	120
		Staff	146
	Child Education	Teachers (Pre-School, Primary and High School)	41
	Church	Church	7
		Subtotal	**514**

Remaining	Enterprise	Administration	13
		Bakery	4
		Bulembu Country Lodge	5
		Bio-Charcoal	2
		Essential Oils	84
		Dairy	6
		Honey	1
	Services	Services and Maintenance	41
	Healthcare	Clinic	2
		Subtotal	**158**

Upon consideration of the potential socio-economic depression that would occur if a majority of the community enterprises were to relocate together with the CCP, a decision was reached to retain the enterprises at Bulembu to continue providing services to the community and new personnel that will arrive.

While the number of people relocating with the CCP is higher than those remining with the enterprises and services, the initial adverse impact on the community will be medium due to the mitigation taken to retain the enterprises. As project implementation and operation progress, the impact will be reversed to positive high due to the socio-economic development of Bulembu.

8.10.7 Impacts from influx of job-seekers

The influx of job-seekers has been described in previous sections from a public health and environmental health perspective, but deserves reiteration under socio-economic impacts due to its significance. Socio-economically, the influx of job-seekers to Bulembu village and surrounding communities will result in an increase in crime, drug and alcohol abuse and a strain on local services and amenities such as healthcare, public transport and recreational facilities. In some cases this will lead to conflict between the job-seekers and local residents as well as conflict amongst the residents wherein those who are victims of social misconduct and crime will blame those relatives who are hosts of the job-seekers. Furthermore, animosity against Kobolondo Mining (Pty) Limited will develop amongst local residents if jobs are given to non-local residents, thereby straining relations between Kobolondo Mining (Pty) Limited and surrounding communities.

The impact significance of influx of job-seekers is rated high due to the small population in Bulembu village and surrounding communities whose small size will cause such influx to be pronounced.

8.10.8 Impacts on gender

During implementation the majority of jobs are likely to be male-dominated as is observed in the construction sector. This increases the likelihood of sexual harassment of some female employees by counterparts. Perceived gender roles may also cause hiring managers to channel jobseekers into and/ or away from certain available jobs. For example, channelling women towards lighter tasks and preferring males for physically demanding tasks, despite candidates being able to perform either type. Societal perceptions may also cause hiring managers to assume it to be acceptable to pay women lower rates that their male counterparts performing the same task, such as machine operation. Practicing and condoning sexual harassment and discrimination in the workplace is not only in contravention of national legislation (SODV Act, 2018 and Employment Act, 1980), but is also unethical and against internationally accepted human rights. Hence the impact of distress amongst victims is rated high.

Outside the workplace, the influx of project workers and jobseekers will increase the exposure of women and girls to the sexual advances of males, thus increasing their vulnerability to harassment, abuse and sexually transmitted diseases. Job opportunities will cause parents and other family members to spend much time away from the household during day, leaving children, elderly and disabled people more vulnerable when left alone. This will cause a greater level of stress to women, particularly single parents. Similarly, amongst the people left at home during the day, women and girls will be more vulnerable than males. The impact of increased exposure of vulnerable groups and the stress to their carers, particularly women, is rated high due to the exceptional demands on women and home and at work.

The socio-economic impacts are summarised in Table 30.

Table 30 - Summary of socio-economic impacts

Activity	Recruitment of labour	Rating
Impact	Employment opportunities resulting in poverty alleviation	
Direction	Positive	
Extent	National	4
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	**42**

Activity	Procurement of services	Rating
Impact	Development of SMMEs resulting in growth and resilience of national economy	
Direction	Positive	
Extent	National	4
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	**45**

Activity	Remuneration of employees	Rating
Impact	Increased purchasing power of employees and trickling down of disposable income	
Direction	Positive	
Extent	National	4
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	**45**

Activity	Taxation	Rating
Impact	Increase tax revenue for strengthening of national economy	
Direction	Positive	
Extent	National	4
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	**42**

Activity	Kobolondo Project implementation and operation	Rating
Impact	Generation of income for funding environmental and social rehabilitation	
Direction	Positive	
Extent	Local	2
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	**39**

Activity	Relocation of CCP, support services and enterprises	Rating
Impact	Degradation of emotional and economic well-being of directly affected parties	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Likely	2
Significance	Negative - Medium	**24**

Activity	Socio-economic development of Bulembu	Rating
Impact	Improved quality of life for community	
Direction	Positive	
Extent	Local	2
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Positive - High	**39**

Activity	Influx of job-seekers	Rating
Impact	Social conflict, strain on social services and degradation of moral standards	
Direction	Negative	
Extent	Local	2
Magnitude/Severity	High	3
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Likely	2
Significance	Negative - Medium	**24**

Activity	Job selection	Rating
Impact	Gender discrimination, sexual harassment and increased vulnerability of women	
Direction	Negative	
Extent	Regional	3
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**42**

8.10.9 Enhancements and mitigations to socio-economic impacts

8.10.9.1 Enhancements to employment opportunities

Employment opportunities will be enhanced through:

- Ongoing consultations with the community representatives and legitimate recruitment organisations to ensure proper identification of human resources to fill available positions and to ensure continuous communication back to the communities regarding available opportunities;
- Establishing, implementing and maintaining recruitment and training policies and procedures which comply with all applicable and relevant legislation;
- Liaising with Eswatini based training and development institutions to determine availability of relevant training programmes within Eswatini to enable further training of recruits;
- Giving priority to local residents when recruiting unskilled and semi-skilled labour.

8.10.9.2 Enhancements to development of SMMEs

The development of SMMEs will be enhanced through:

- Identifying and mentoring those SMMEs providing direct goods and services to the project in order to enable them to continually improve performance and service provision to the project and other customers;
- Liaising with existing governmental and non-governmental agencies which are focused on SMME development in order to optimise existing development programmes.

8.10.9.3 Enhancement of purchasing power

The purchasing power of employees and subsequent trickling down of their disposable income into the national economy will be enhance through:

- Equitable, transparent and timely remuneration of employees;
- Promoting and supporting the development of SMME's.

8.10.9.4 Enhancements to tax revenue

Contributions to tax revenue will be enhanced through:

- Transparent and frequent reporting to the requisite government institutions, aligned to prevailing legislation;
- Adhering to the provisions of the Mining Licence, Environmental Compliance Certificate and all applicable legislation for the duration of the project.

8.10.9.5 Enhancements to funding of environmental and social rehabilitation

The funding of environmental and social rehabilitation will be enhanced through:

- Establishing trust funds for the environmental rehabilitation of the project and Community Development;
- Contributing from the proceeds of the project to the trust funds, thereby ensuring that the funds reach the intended target population in the Bulembu community.

8.10.9.6 Mitigations to relocation of CCP and enhancement of community development

Degradation of emotional and economic well-being of directly affected parties arising from the relocation of the CCP will be mitigated by:

- Liaising with the Ministry of Labour and Social Welfare who will oversee that, where BMS is not relocating employees to the new site, the requirements of the Employment

Act, 1980 and applicable Codes of Good Practice with respect to retrenchments, terminations and/ or transfers to the new employer by BMS are complied with by BMS.

- Restructuring Bulembu Development Coporation to promote the development of Bulembu and surrounding communities.

8.10.9.7 Mitigations to influx of job-seekers

Social conflict, strain on social services and degradation of moral standards arising from influx of job-seekers will be mitigated through:

- Liaising with the traditional authorities, communities, Ministry of Housing and Urban Development and Royal Eswatini Police Service to establish mechanisms for controlling the influx of people;
- Enforcement by the security contractor to ensure that there is no illegal or unauthorised occupation of vacant housing and/ or land within the farm.

8.10.9.8 Mitigations to negative impacts on gender

Gender discrimination and sexual harassment in the workplace and increased vulnerability of women to poverty in the Bulembu community will be mitigated by:

- Providing equal employment opportunities in the recruitment of men and women;
- Equitable and transparent remuneration of men and women performing the same tasks;
- Adhering the provisions of the Employment Act, 1980 with respect to terms and conditions of employment, which include and are not limited to granting of maternity leave;
- Giving priority to community members when job opportunities arise in order to prevent the increased vulnerability of women, children, the elderly and the disabled.

8.11 CLIMATE CHANGE

Climate change is considered from both the Kobolondo Project's likely contribution to climate change and from the perspective of resilience to climate change.

8.11.1 Contribution to climate change

The use of fossil fuel in operating construction machinery will generate greenhouse gases which contribute to global warming, which in turns causes climate change. While the project's contribution to national and global emissions may be negligible, the global impact results in severe localised impacts, such as flooding, drought, extreme heat and cold.

As discussed inprevious sections, at a local level the indiscriminate clearing of vegetation, proliferation of invasive alien plant species, destruction of natural habitats, overabstraction of water resources, pollution of the environment will cause the deterioration and loss of ecosystem services. For example, erosion of the land and siltation of watercourses will restrict the ability rivers and stream to adequately channel water, leading to floods downstream. Introducing extensive hardened surfaces will increase the volume and velocity of stormwater run-off, increasing the flood risk during extreme rainfall events both locally and downstream.

The Impact significance of the contribution to climate change is rated high because the overall effects are not confined to the source.

8.11.2 Resilience to climate change

In view of the altitude of Bulembu and likely future extremes in weather, climate change exposure is rated high due to the low temperatures and high rainfall of the location. It is therefore necessary to ensure resilience against extreme cold, wet and dry conditions. For

example, heavy rains will increase the risk of collapse of the tailings, which in turn would be flushed into downstream watercourses causing siltation of Maguga Dam and increased vulnerability of downstream communities to drought. Lower than normal temperatures will increase the demand on the electricity network due to increased use of heating appliances, resulting increased power outages at Bulembu and surrounding areas. This would possibly discourage skilled personnel from staying at Bulembu, resulting in their departure and thus reduced productivity of the project. The impact of pressure from weather extremities is rated high as it will likely trigger a vicious cycle of impacts, ultimately leading to the unsustainability of the project and socio-economic depression.

The impacts of climate change are summarised in Table 31.

Table 31 - Summary of impacts on and from climate change

Activity	Contribution to climate change	Rating
Impact	Increased contribution to global warming, desertification, flooding and vulnerability to cliamtye extremes	
Direction	Negative	
Extent	International	5
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**48**

Activity	Vulnerability to climate extremes	Rating
Impact	Threat to human life, infrastructure and economy	
Direction	Negative	
Extent	National	4
Magnitude/Severity	Very high	4
Duration	Long term	4
Risk/Uncertainty	High	3
Probability	Definite	3
Significance	Negative - High	**45**

8.11.3 Mitigations to climate change

8.11.3.1 Mitigating contribution to climate change

Contributions to climate change will be mitigated by:

- Maintaining vehicles and machinery in optimal working condition to avoid inefficiencies of internal combustion engines;
- Avoiding indiscriminate destruction of natural habitats and rehabilitating surrounding habitats threated by loss, e.g. clearing invasive alien plant species;
- Mininmising hardened surfaces by designing new buildings to enable stormwater to soak into the ground, thus preventing floods to downstream areas;
- Using the exothermic reactions of the project raw materials to minimise the use of fossil fuels;
- Recover the SO_2 from the production process for use with the process thereby preventing emissions of greenhouse gases.

8.11.3.2 Resilience to climate change

Resilience to climate change will be strengthened by:

- Immediately vegetating the exposed sections of the tailings in order to protect them from erosion;
- Shaping the tailings around the point of extraction so that stormwater does not erode and cause a collapse;
- Maintaining an optimal pace of rehabilitation to avoid collapse of the tailings from natural forces;
- Recovering the heat from the production process for use in the community, thereby mitigating the demand on electricity for the grid;
- Educating employees and the community on the responsible use of natural resources and waste prevention.

9. ALTERNATIVES

According to Part B of the Second Schedule of the Environmental Audit, Assessment and Review Regulations, 2000, the environmental impact assessment process is required to identify reasonable alternatives and select the preferred alternative.

9.1 NO PROJECT OPTION

The No Project Option would be to leave the Tailings Storage Facility exposed to the natural elements of wind and rain. This will continue the existing process of the erosion of the TSF, thereby exposing surface water to potential contamination with asbestos fibres since the containment facilities on the south side of the Old TSF have long since been breached, i.e. there are gaps in the berms which allow surface run-off to carry material to the adjacent watercourses.

The existing un-rehabilitated material is void of organic material, particularly along the steep slopes of the TSF, therefore there is no vegetation to stabilise the exposed slopes. What little vegetation is present occurs on the tops of the TSF, but it cannot propagate effectively to cover the steep slopes. This results in the risk of chunks of the steep slopes being broken off and sliding downslope. Evidence of this is more prominent along the south-facing slope of the Old TSF. Leaving the slopes unmanaged will therefore lead to potential sedimentation which will obstruct adjacent watercourses, particularly downstream of the existing TSF. The specialist ecological and water resources reports have identified that the existing habitats within the Mining Lease Area and immediately downstream of the TSF have already been highly modified and degraded from mining activities and the current un-rehabilitated state of the TSF. Therefore, leaving the TSF un-rehabilitated will perpetuate and accelerate the rate of habitat degradation.

9.2 LEVELLING AND CAPPING THE EXISTING TAILINGS STORAGE FACILITY

The existing TSF could be shaped or levelled to reduce the angle of the slopes and thereafter capping with soil to enable growth of vegetation. While technically possible, this option would require the construction of a containment facility to retain and treat any surface run-off and groundwater seepage from tailings. It would be necessary to ensure that such a containment facility is appropriately lined to prevent seepage of the contaminated water to groundwater, monitor and maintain such lining indefinitely so that any damage to the lining, arising from settling of the material as well as natural wear and tear, is timely identified and repaired. Furthermore, the soil for capping the shaped or levelled material would need to be sourced from nearby, which would result in the need to adequately rehabilitate the site from where the soil is sourced since the risk of severe erosion would be high due to the steep terrain of the surrounding area. This would then increase the overall footprint of the rehabilitation project as well as the long term financial cost due to the need to monitor and maintain both the rehabilitated TSF and the site from which soil is sourced. Therefore, since this option would not be self-funding compared to the proposed option, a major factor making this alternative non-viable is the lack of funding to complete the levelling and capping exercise and in view of the size and scale of the TSF, this alternative would significantly exceed the economic cost.

9.3 PREFERRED OPTION

The preferred reasonable option is that proposed in the project description of this ESIA Report, i.e. the Kobolondo Project. The reason is that the proposed Kobolondo Project will enable the potential negative impacts of the No Project Option to be averted while simultaneously enabling income generation from the un-rehabilitated material. The need for importing soil under the preferred option will still be necessary, but is less critical than the alternative options since the final residue will be inert silica.

Essentially, the preferred option achieves multiple objectives:

- The chrysotile is destroyed and the base metals and sulphides extracted, thus achieving a complete rehabilitation of the current TSF;
- Gold mines in the area become viable, as they will have access to a central roasting and processing plant, which they could not finance or operate on their own due the significant capital and operating cost thereof;
- The by-product of the gold extraction, sulphuric acid, is used to extract the base metals from the TSF, to the significant financial benefit of the nation, local community, employees and shareholders;
- The rehabilitation does not cost the Swazi Nation financial capital required for other uses.

10. CONCLUSION

The environment is a complex interrelationship amongst air, water, land and living organisms, including the physical, psychological, social and economic aspects of humans. Therefore human activities affect and are affected by the attributes of the various compartments of the environment as well as the interrelationships amongst those compartments, including interrelationships between humans themselves. This is demonstrated by the impacts identified and described in this ESIA Report, wherein impacts on flora and fauna will in turn cause impacts on social and economic activities such as agriculture, impacts on water resources will affect natural habitats and public health.

The proposed rehabilitation project will generate jobs and revenue for Emaswati, facilitate the re-emergence of the gold mining industry, as well as avert the potential significant adverse impacts on the environment.

Kobolondo Magnesium is committed to managing the environmental impacts arising from its processes, activities and products. The Scoping Process enabled the identification of the issues to be studied in the ESIA for the proposed Rehabilitation of the Havelock Chrysotile Tailings Storage Facility at Bulembu. The ESIA was conducted in accordance with the Environmental Audit, Assessment and Review Regulations, 2000 as well as the Environment Management Act, 2002 thereby enabling the preparation of an ESIA report and CMP which will be used by Kobolondo Magnesium as the instruments for planning, implementing and managing the processes, activities and impacts of the project in order to ensure that the proposed rehabilitation project is implemented and operated in an environmentally and socially responsible manner.

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