0957: DRAFT INTEGRATED ENVIRONMENTAL SCOPING REPORT FOR THE PROPOSED LEIDEN COAL MINE

PREPARED ON BEHALF OF:

MASHALA RESOURCES (PTY) LTD

AS PER REGULATION 49 OF THE MPRDA & REGULATION 28 OF THE NEMA

DMR REFERENCE NUMBER:

30/5/1/1/2/10091 MR

DEA REFERENCE NUMBER:

14/12/16/3/3/3/105

MDEDET REFERENCE NUMBER:

17/2/3 GS-242

APRIL 2014

Environmental Impact Management Services (Pty) Ltd
Block 5 Fernridge Office Park, 5 Hunter Avenue,
Ferndale, Randburg.
P.O. Box 2083, Pinegowrie 2123
Tel: +27(0)11 789-7170
Fax: +27(0)11 787-3059

Leaders in Environmental Management

DOCUMENT CONTROL

0957: Draft Integrated Environmental Scoping Report for the Proposed Leiden Coal Mine

	NAME	DATE
Compiled:	**Kelly Nesbitt**	**25 April 2014**
Checked:	**Elizabeth Cooper** **Bradley Wilson**	
Authorized:	**Khalid Patel**	

DISTRIBUTION LIST

AGENCY, ORGANISATION OR PERSON	# OF COPIES
Adri Joubert of Geo Soil & Water CC	1
Department of Mineral Resources - Mpumalanga	7
Department of Environmental Affairs (DEA)	7
Mpumalanga Department of Economic Development, Environment and Tourism(MDEDET)	7

REVISION AND AMENDMENTS

DATE	No.	DESCRIPTION OF REVISION OR AMENDMENT
2014-04-22	0	Draft 0957 Integrated Environmental Scoping Report for the Proposed Leiden Coal Mine

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS

ABET	:	Adult Basic Education and Training
APPA:		Atmospheric Pollution Prevention Act
AEL	:	Air Emissions Licence
AMD	:	Acid Mine Drainage
BEE	:	Black Economic Empowerment
CCL	:	Continental Coal Limited
DEA	:	Department of Environmental Affairs
DMR	:	Department of Mineral Resources
DWA	:	Department of Water Affairs (formerly DWAF)
DWAF	:	Department of Water Affairs and Forestry
EA	:	Environmental Authorisation
EAP	:	Environmental Assessment Practitioner
ECA	:	Environmental Conservation Act
EI	:	Ecological Importance
EIA	:	Environmental Impact Assessment
EIMS	:	Environmental Impact Management Systems (Pty) Ltd.
EMP	:	Environmental Management Plan
EMPR	:	Environmental Management Program
EMS	:	Environmental Management System
ES	:	Ecological Sensitivity
FRAI	:	Fish Response Assessment Index
GDP	:	Gross Domestic Product
GSDM	:	Gert Sibande District Municipality
HIA	:	Heritage Impact Assessment
HSDA	:	Historically Disadvantaged South Africans
I&AP	:	Interested and Affected Party
IHI	:	Index of Habitat Integrity
IRR	:	Issues and Response Report

ISO	:	International Organisation for Standardisation
IWULA	:	Integrated Water Use License Application
IWWMP	:	Integrated Water and Waste Management Plan
LSU	:	Livestock Unit
LOM	:	Life of Mine
MDEDET	:	Mpumalanga Department of Economic Development and Tourism
MLM	:	Mkhondo Local Municipality
MPRDA	:	Mineral and Petroleum Resources Development Act
NEMA	:	National Environmental Management Act
NEMAQA	:	National Environmental Management: Air Quality Act
NEMBA	:	National Environmental Management: Biodiversity Act
NEMWA	:	National Environmental Management: Waste Act
NOMRA	:	New Order Mining Right Application
NHRA	:	National Heritage Resources Act
NWA	:	National Water Act
PCD	:	Pollution Control Dam
PES	:	Present Ecological Status
POI	:	Points of Interest
PM_{10}	:	Particulate Matter with an aerodynamic diameter of less than 10μm
$PM_{2.5}$	:	Particulate Matter with an aerodynamic diameter of less than 2.5μm
PPP	:	Public Participation Process
ROM	:	Run of Mine
SAS	:	South African Scoring System
SHE	:	Safety, Health and Environmental
SHI	:	Site Habitat Integrity
SLP	:	Social and Labour Plan
TIA	:	Traffic Impact Assessment
WML	:	Waste Management License

EXECUTIVE SUMMARY

INTRODUCTION AND PROJECT DESCRIPTION

Mashala Resources (Pty) Ltd (hereafter Mashala), a subsidiary of Continental Coal Limited (CCL) was granted a Prospecting Right (710/2006 PR) for the Leiden Project on the 17th October 2006. In order to comply with national legislation the proposed Leiden Coal Mine will require authorisation in terms of the following pieces of interlinked legislation:

- Mineral and Petroleum Resources Development Act (Act No. 28 of 2002, MPRDA);
- National Environmental Management Act (Act No 107 of 1998, NEMA);
- National Environmental Management: Waste Act (Act No 59 of 2008, NEMWA);
- National Water Act (Act No. 36 of 1998, NWA)

Mashala has appointed EIMS to act as the independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment for the proposed Leiden project. A New Order Mining Right Application (NOMR), in terms of the MPRDA was submitted to the Department of Mineral Resources (DMR) and was subsequently accepted on 14 April 2014. An application for authorisation of listed activities under the NEMA and NEMWA was submitted to the Department of Environmental Affairs (DEA) on 12 February 2014 and to the Mpumalanga Department of Economic Development, Environment and Tourism on 15 January 2014.

A joint Public Participation Process (PPP) will be implemented to engage with I&AP's and meet the requirements for Public Participation as stipulated by the relevant legislation. The PPP provides stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP and Integrated Water Use Licence Application (IWULA) process. This will ensure public involvement at each key step in the process and allow for comments, concerns, suggestions, and objections to the proposed Leiden coal mine to be included in each of the submissions to the relevant Government Authorities.

The application area is located on Portion Remaining Extent (RE) of the Farm Leiden 340 IT. The application area is approximately 1 291 hectares in extent and falls within the jurisdiction of the Mkhondo Local Municipality in the Gert Sibande District Municipality of Mpumalanga. The proposed Leiden Coal Mine will comprise of bord and pillar underground mining with a small area of rollover open cast mining at the adit. The proposed Leiden Coal Mine will aim to produce up to a planned monthly production rate of 35 000 tpm (for a period of approximately 18 months) for the opencast mining, and up to 25 000 tpm from the underground mining operations for approximately 10 years LOM. Coal will be produced primarily for export markets, with some product also available for the local market (e.g. Eskom). The proposed project would create job opportunities to approximately 102 people.

PROJECT MOTIVATION

Coal is one of the five minerals selected for local beneficiation by the Department of Mineral Resources (DMR) because of its strategic importance and is considered critical to the on-going development of South Africa (Beneficiation Strategy for the Minerals Industry, June 2011). The driving force behind the emphasis of the importance of coal and coal mining is primarily due to concerns voiced by Eskom over the future security of coal supply in both the medium and long term, to its electricity generating power stations in order to meet the growing energy requirements of the country as detailed in the Eskom Transmission Ten Year Development Plan 2011-2020 (Eskom, 2011). Eskom's concern over coal supply to its power stations has been heightened due to competition from Indian buyers for the low grade coal required by that country's power stations and for which, until recently, there has been no viable export markets. A third of the coal produced by the proposed Leiden Coal Mine will be low quality coal and sold to Eskom. The sale of low quality coal will assist the energy producer in meeting the needs of increased energy requirements in both the present and future. In addition, the Leiden Coal Mine will also produce export quality coal for sale in international markets such as Asia, Europe and USA ensuring a constant flow of foreign capital in South Africa and the project region specifically.

Furthermore the Mpumalanga economy currently benefits strongly from the demand for energy provided by coal fired power stations. In addition, the major industry sectors in the Mpumalanga economy, mining and manufacturing, are likely to exhibit sustainable economic growth in the future. This emphasises the strong economic need for coal resources for energy production. It is also noted that the MLM is in great need of business investment and job creation due to a reduction in employment levels over the last decade, as a result of the downscaling of forestry operations. Therefore the Leiden Coal Mine fits with the overall provincial economic structure in terms of employment and industry sector growth. One hundred and two (102) jobs are expected to be created by the implementation and production of the Leiden Coal Mine. Although the mining activities offer a period of increased job availability, this is short term as the Leiden Coal Mine will only be operational for approximately 10 years

ENVIRONMENTAL BASELINE

The description of the baseline receiving cultural and socio-economic environment (on site and surrounding) was obtained from the studies undertaken by the specialist team and in conjunction with EIMS. All specialist studies undertaken for the proposed Leiden Coal Mine are included as supporting technical appendices to this report.

CULTURAL AND HERITAGE RESOURCES

During the site assessment, nine cultural and historical sites and resources were identified within the study area comprising six cemeteries, one historic farmstead, one historic rock engraving site as well as one abandoned historic farm worker homestead. The potential also exists for further cultural and heritage sites and resources to be identified during the EIA phase. Due to the fact that the underlying Vryheid Formation sediments and coal beds will only be exposed during the mining operations and associated infrastructure development, it is unlikely that any fossils will be observed before the mining takes place. Dolerite will not contain any fossils because of its igneous nature.

SOCIO-ECONOMIC ENVIRONMENT

The project application area is located in in Ward 2 of the Mkhondo Local Municipality (MLM) which is located in the Gert Sibande District Municipality (GSDM). The main economic activities identified in the MLM are forestry and agriculture. Forestry is the dominant landuse in the municipal area with Mondi, Sappi, TWK and SAFCOL the major players in the forestry industry. The rest of the land within the municipality consists of unimproved grassland used for stock grazing with the cultivation of commercial crops being scattered in small areas across the municipality. Mining does occur in the MLM but the main concentration of mining is situated in the west of the municipality.

Generally the communities in the area surrounding Leiden 340 IT are poorer than other communities situated in the Mpumalanga Province. This may be attributed to the lower levels of employment and poor infrastructure. Although the area is dominated by agriculture and forestry, jobs are selectively available seasonally for unskilled labourers The prominent language of the area is SiSwati, which is widely spoken throughout the community. Other dominant languages are IsiZulu, Xitsonga, IsiNdebele, and Sepedi. Education in the area is poor as a result of the lack of schools available.

The consideration of fatal flaws within the scoping study were assessed by identifying the following potential impacts to the creation of opportunities, traffic impacts, vibrations, water, safety, negative community relations, influx of people, additional social infrastructure, visual and sense of place. None of the afore mentioned potential impacts are considered to be a fatal flaw due to the fact that they can be mitigated against.

The Mpumalanga economy benefits from the strong demand for energy provided by coal fired power stations. In addition, the major industry sectors in the Mpumalanga economy, mining and manufacturing, are likely to exhibit sustainable economic growth in the future. This emphasises the strong economic need for coal resources for energy production. It is also noted that the MLM is in great need of business investment and job creation due to a reduction in employment levels over the last decade, as a result of the downscaling of forestry operations. Therefore the Leiden Coal Mine fits with the overall provincial economic structure in terms of employment and industry sector growth. One hundred and two (102) jobs are

expected to be created by the implementation and production of the Leiden Coal Mine. Although the mining activities offer a period of increased job availability, this is short term as the Leiden Coal Mine will only be operational for approximately 10 years.

GEOLOGY

In general, the area has been divided into three lithological units. i.e. dolomite, arenite, and dolerite. Dolomite refers to the chemical sedimentary rocks of the Malmanie Group consisting of calcium-magnesium carbonate rocks, whereas the arenite refers to the siliciclastic coal-bearing rocks of the Ecca Group (and probably the Vryheid Formation). The dolerite is a late-stage igneous rock which has been emplaced into the sedimentary rocks.

TOPOGRAPHY

The natural pre-mining topography falls gently to the east, with slopes of between 2% and 5% and is generally undulating throughout. The site also includes several stream beds and other depressions in the landscape, with dams occurring in several places. Opencast mining will impact on the topography of application area; however this is likely to be minimised due to mitigation measures that will be instituted during the process and during the rehabilitation phase.

CLIMATE

The overall climate in the study area is typical of the South African Highveld with warm summers and cold winters. High evaporation rates reduce infiltration rates, while the high rainfall levels can increase the erosion potential and the formation of erosion gullies. The presence of vegetation does however allow for surface infiltration thereby reducing the effects of erosion. The mixing of atmospheric layers resulting in the formation of temperature inversion and the presence of cloud cover limits the dispersion of pollutants into the atmosphere. These climatic aspects need to be taken into consideration during rehabilitation and surface water management planning.

SOILS

The site is dominated by yellow-brown, structure less soils. The wetland soils on site have been identified as most sensitive and impacts to these areas would not be easily mitigated. The rest of the soils are classified as low sensitivity in relation to wetland soils, although these soils are generally moderately deep to deep, with a moderate to high potential for agricultural production. These are therefore still valuable soils and it will be imperative to ensure that they do not become disturbed or degraded to any excessive degree otherwise rehabilitation of the area post mining could become problematic.

CURRENT LAND USE

The current land uses on site comprise of commercial forestry plantations, sawmill operations, cattle grazing, old fields, wilderness and tracts of vacant land. The predominant land use on site is forestry with an operational sawmill located on the property. The plantation and sawmill within the application area are owned and operated by the family of the landowner. Based on several site visits and discussions with the landowner it has been determined that while forestry is the dominant land use on site; it is not effectively commercially exploited due to timber harvesting operations being undertaken at irregular intervals.

LAND CAPABILITY

Mining operations may change the land capability, potentially limiting the extent of the forestry due to the changes in the soil (depth, compaction, drainage etc.).The land capability is likely to vary throughout the study area. Currently the predominant land use is plantation forestry, although the soil fertility is generally good and land capability is therefore relatively high and may support other land uses. It is notable however that very little agricultural activity takes place in the greater area.

FLORA

The majority of the study area falls within the Eastern Highveld Grassland vegetation type, which is classified as Endangered by Mucina and Rutherford (2006) and as Vulnerable in the NEMBA list (2011). The south-west corner of the site falls within the Wakkerstroom Montane Grassland vegetation type, which is classified as Least Threatened, although very little of it is formally protected (Mucina & Rutherford 2006). These classes/rankings are important as they assist in determining the area's floral sensitivity. A number of broad vegetation communities were identified on site:

- Plantations (Alien species);
- Primary vegetation (Primary grasslands and Primary rocky grassland);
- Old fields (Disturbed); and
- Wetland vegetation.

The site includes vegetation communities falling within threatened and protected vegetation types. Portions of the site are listed under the Mpumalanga C-Plan as Important and Necessary habitats. The site may also have a number of plant species protected under the National Environmental Management: Biodiversity Act or the Mpumalanga Nature Conservation Act. Portions of the site may therefore be of moderate or high sensitivity and mining has the potential to impact these areas negatively. Some of these impacts are preventable in certain areas, while others may be mitigated to varying degrees.

FAUNA

There are a number of animal species of conservation concern that may occur in habitats within the study area. Wetlands and drainage lines, ridges, and intact patches of connected grassland; irrespective of their ecological condition, represent the most sensitive faunal habitats present within the application area. The loss of these habitats may result in negative effects for these species. However, most of the species of concern are mobile animals that are likely to move away from the path of any development. The development of the site is therefore highly unlikely to have a noticeable negative effect on the species currently present in the study area.

AQUATIC ECOLOGY

The Leiden study site stretches across two catchments: W52A and W53A. The DWAF desktop survey (Kleynhans 2000) classifies both quaternary catchments as having an Ecological Importance and Sensitivity of 'High'. Catchment W52A is drained by the Hlelo River and its tributaries, while W53A is drained by the Ngwempisi and its tributary, the Sandspruit. The two river systems that will be affected by the proposed development both flow in an easterly direction and converge in Swaziland to form the Usutu River which then flows through Mozambique to the Indian Ocean.

The risk of water quality deterioration is highlighted given the current good quality water within the affected river systems, the Ngwempisi and Hlelo Rivers, which also support a number of sensitive aquatic species and have been classed as Freshwater Ecosystem Priority Areas (FEPA's). The on site assessment of habitat integrity as well as the aquatic macroinvertebrate results, largely confirm the desktop data which indicates that most current impacts to aquatic ecosystems are to habitats and not to water quality which is relatively good. The presence of the catchment transfer scheme further highlights the need to focus on maintaining water quality as any impairment could have significant impacts on downstream water users.

SURFACE WATER

The Leiden project is located within the W52 and W53 quaternary catchments (Mfolozi/Pongola catchment). The catchments of the upper reaches of the Ngwempisi River (W53A), to the north and Hlelo River (W52A) to the south, are moderately disturbed. Both quaternary catchments fall within the W50 (Usuthu River Basin) drainage area, which constitutes an internationally shared basin and will be subject to existing treaties that govern releases and water quality at the Swaziland border. The water requirements of Swaziland are an important factor in this catchment, and it is accepted that 50% of natural base-flow for the rivers should be available at the downstream border of Swaziland, and that water should at least meet South African SANS standards for irrigation water. Base-line water quality analyses indicates that the surface water quality is reasonably good and should be used as a benchmark for the future water quality of the water affected by the Leiden operations.

The watercourses within the application area have been identified as highly sensitive areas. The results of the assessment show that the predicted water level of the watercourse is not approaching the boundary of the proposed opencast area during a 1:100 year flood event. However in order to fulfil all requirements of GN704, a detailed assessment will be undertaken in the EIA phase to calculate flood lines for this section. However the proposed underground area will intersect with several water courses and is therefore partially located in highly sensitive areas. These areas will be further investigated during the risk assessment of the EAI/EMP.

WETLANDS

Three wetland systems were identified in the study area, all draining from west to east. In the north, the upper reaches of the Ngwempisi River fall within the study site; in the south an unnamed tributary of the Hlelo River originates on site; and within the central regions of the site a smaller, third wetland systems originates and eventually forms a tributary of the southern wetland system. In total, the wetlands cover 239.2 hectares (ha) of the site, equal to roughly 18.5% of the surface area. The dominant wetland types on site are the hillslope seepage wetlands (almost 60% of wetland area) and the channelled valley bottom wetlands (35% of wetland area). Four small farm dams were also observed on site.

Although the wetlands have been exposed to frequent impacts associated with agricultural activities, the wetland types and wetland vegetation type occurring on site are indicated as being Critically Endangered, indicating that significant loss of these wetlands has occurred within the area, elevating the importance of the remaining wetlands. The proposed mining activities, opencast and underground, as well as related infrastructure developments are likely to impact extensively on the wetlands of the area. The extent of the impacts however will be assessed in more detail during the EIA phase of the project where appropriate mitigation measures will be determined.

GROUND WATER

The area displays two main aquifers, namely a shallow weathered aquifer and a deeper fractured aquifer. The shallow weathered aquifer is typically low yielding and is generally not used for water supply. The deeper fractured rock aquifer, is typically found between 20 and 50 m bgl, and shows typical blow yields ranging between 0.5 and 3 l/s on average, with exceptions between 5 and 10 l/s found at dolerite intrusion contacts and fault zones.

The hydrocensus indicated nine boreholes, three springs and three groundwater seepage features. It was found that the majority of these boreholes are used for domestic water supply and livestock watering with the two other boreholes being used as monitoring points and two that had been abandoned. The water levels found were between 3 – 20 m below ground level (bgl), these depths are indicative of the afore mentioned aquifers.

Water quality results indicated that groundwater quality is generally good across much of the site, however there is evidence of localised groundwater contamination which is possibly linked to historical mining activities. The site visit (to a certain degree) confirmed this as a road constructed nearby the sampling point was constructed using potentially coal bearing rock A detailed ground water assessment will be undertaken during the EIA phase, at which time a ground water model will be developed and potential impacts of the proposed mining operations will be investigated. Appropriate mitigation measures will be developed to address the identified impacts.

AIR QUALITY

The baseline air quality for the region is unknown, with no ambient measurements available for any of the relevant particulates. It is assumed that the air quality is relatively good as there are no major sources of pollution located near the site. The main sources likely to contribute to cumulative PM_{10} impact are vehicle entrainment on unpaved road surfaces, windblown dust from exposed areas, and biomass burning. The closest residential development to the project area is Sheepmoor ~16 km to the north and Iswepe ~22km to the east-northeast. Individual residences (i.e. farm houses) as well as a local school are also within the study area of the proposed operations. The school is considered a particularly sensitive receptor and the proximity to one of the proposed haul routes renders that option a no-go unless that section of road or the school are moved.

Mining operations are likely to increase ground-level $PM_{2.5}$ and PM_{10} concentrations and dust fall-out, thus increasing possible affects to human health. Since many of the impacts of particulates are dosage dependent, the extent of impact will be assessed during the EIA phase. The modelled ground-level concentrations of total suspended particulates (TSP), PM10 and PM2.5 will be compared to National Standards and Guidelines at the sensitive receptors during the EIA phase.

NOISE

The pre-mining noise environment resembles a rural atmosphere but does have slightly elevated ambient noise levels. Measured data indicate sound levels typical of an area with a rural district sound character with wind and agricultural activities raising the sound levels. The dominant source of noise is natural, mainly wind induced noises and birds. Daytime measured data indicate sound levels typical of an area with a rural to sub-urban district character. Night-time levels however are far higher than expected for such an area, likely due to sounds from both the cattle farming activities as well as insects and frogs.

Potential Noise Sensitive Receptors (NSD's) in and within approximately 2,000 meters around the proposed development were identified. Based on the location of the proposed mining development and the potential noise-sensitive developments there exists a low risk of a noise impact on these receptors.

VISUAL

The study area has a placid and peaceful pastoral sense of place with the farmsteads and residences, schools and church introducing a rural component to the sense of place. The placid and peaceful sense of place is derived from the mountain back drop and undulating topography covered in plantations, crops and grassland vegetation. Grazing and other agricultural activities introduce the pastoral element. It is evident from the description of the landscape character above, that the introduction of the mining structures and related activities would create strong contrast with the existing landscape characteristics. It is further anticipated that indirect negative effects related to the mining activities such as dust and light pollution would also add to the major disruption of the landscape character and sense of place if left unmitigated.

The visual assessment has identified highly sensitive, moderately sensitive and low sensitive viewers that may potentially be affected by this project. The south-eastern half of the site has been determined to be more sensitive than the northwestern half, with the north-western corner being the least sensitive area of the site. In the EIA phase, detailed mitigation measures that could reduce the impact of the Project, will be proposed.

BLASTING AND VIBRATION

The application of explosives for breaking rock will always have an effect on the surrounding environment. These effects can manifest in the form of ground vibration, air blast, fumes, fly rock etc. These short duration events may be noticeable by communities and individuals living in the immediate environment. The study area is considered to be a moderately sensitive area with POI's present in the surroundings. It is expected that the most critical area is the 1500 m around the project area. Depending on the final blasting operation scale, the installations within this boundary are expected to be possibly impacted. Installations further than 1500 m from blasting operations is certain to be impacted to lesser degree but will need consideration as well. It is important to note that impacts arising from blasting may be attributed mainly to blast designs, and it is generally possible to successfully mitigate the impacts of blasting with the correct blast design for each blast.

TRAFFIC

The proposed site will be accessed via either Gravel Road 1 or Gravel Road 2, both of which link from the N2. From the desktop assessment it was established that both access roads are local gravel roads providing access mainly to the forestry activities. Both access roads will be difficult to negotiate during the wet seasons of the year and regular maintenance would be require in terms low water bridge crossings and dust control. However Gravel Road 1 will be difficult to negotiate even in dry weather and has several water crossings. Gravel Road 2 is already utilised by forestry trucks which indicates that the road is designed to handle heavy loads. In terms of social considerations, the school located next to Gravel Road 1 is much

closer to the road than the school near Gravel Road 2. This makes Gravel Road 2 the preferred option from a social perspective. From a traffic engineering perspective, the traffic assessment concluded that the proposed development is not expected to have a significant negative impact on the road network subject to the results of a detailed traffic impact study assessment.

IDENTIFICATION OF POTENTIAL IMPACTS

The following is a list of some of the potential impacts that may occur as a result of the project. It must be stated that the list is not exhaustive and will be investigated further during the EIA phase and in consultation with stakeholders.

CULTURAL AND HERITAGE RESOURCES

The following key potential impacts relating to cultural and heritage resources have been identified:

- Disturbance, damage, or destruction of unidentified heritage features.
- Disturbance, damage, or destruction of identified heritage features.
- Disturbance, damage, or destruction of unidentified graves and cemeteries.
- Disturbance, damage, or destruction of identified graves and cemeteries.
- Disturbance, damage, or destruction of unmarked child graves.
- Disturbance, damage, or destruction of palaeontological resources.

SOCIO-ECONOMIC

The following key potential impacts relating to the socio-economic environment have been identified:

- Community expectations regarding social and economic benefits;
- Negative public perceptions of the mine and negative community relations with the mine based on perceptions of conduct and performance of mines in general;
- Expectations regarding the creation of jobs and other opportunities;
- Potential reduction in current land owner livelihoods;
- Potential relocation of current land occupiers (This impact will only occur if relocation has to take place);
- Influx of people, potential resulting in social disintegration and cultural differentiation, as well as an increase in HIV/AIDS if prostitution increases;
- Decrease in community safety due to mining and associated activities

- Loss of jobs and other economic opportunities as one labour skill set replaces another;
- Expectations and perceptions regarding inadequate rehabilitation and closure;
- Creation of jobs and other economic opportunities;
- Loss of jobs and other economic opportunities (upon closure of the mine);
- Increase in direct, indirect and induced employment opportunities in the mining, manufacturing, construction, trade, retail and services sector;
- Limited increase in GDP due to export of coal.

TOPOGRAPHY

The following key potential impacts relating to topography have been identified:

- Alteration of natural topography;
- Surface subsidence.

SOILS

The following key potential impacts relating to soils have been identified:

- A reduction of natural soil fertility;
- Increased soil erosion;
- Soil compaction; and
- Soil pollution or contamination.

LAND USE

The following key potential impacts on the land uses of the study area have been identified:

- Interference and potential replacement of existing land uses; and
- The potential sterilisation of the land as a result of mining activities occurring in the application area.

LAND CAPABILITY

The following potential impacts on land capability have been identified:

- The loss of potentially productive agricultural land, along with a reduction in land capability.

FLORA

The following key potential impacts on flora have been identified:

- Mining and associated activities may result in the removal and destruction of primary vegetation communities;
- Removal of threatened and protected species;
- Encroachment of invasive species within the application area;
- Increase of erosion potential due to the removal and disturbance of vegetation within the application area;
- Reduction in vegetation growth, photosynthesis, and respiration due to potential excessive dust levels; and
- Adverse effect of pollutants on vegetation growth; and
- Negative effect of altered hydrological regimes on natural vegetation.

FAUNA

The following key potential impacts on flora have been identified:

- Loss or fragmentation of habitat for threatened animal species; and
- Loss of individuals of animal species of concern.

AQUATIC ECOLOGY

The following key potential impacts relating to aquatic ecology have been identified:

- Altered habitats and a decrease in habitat integrity;
- Deterioration of water quality;
- Increase in the occurrence of alien invasive species;
- Loss of aquatic species and overall aquatic biodiversity; and
- Alteration to hydrological regimes.

WETLANDS

The following key potential impacts relating to wetlands have been identified:

- The potential loss of wetland vegetation and habitat within the footprint of the proposed mining developments.
- Increased sediment deposition within wetlands and watercourses can result in alteration to benthic habitats and the establishment of reed beds in areas of sediment deposition.
- Erosion of wetlands and watercourses may occur at storm water discharge points due to point source discharges of high velocity flows. The erosion of channels through

wetlands results in the local lowering of the water table with resultant partial desiccation and changes in vegetation structure and composition.

- An increase in the occurrence of alien invasive vegetation within wetlands due to disturbances and changes to the supporting hydrology caused by the proposed mining activities.
- Deterioration of water quality may occur as a result of the decanting of low pH, high metal and sulphate rich water from the mine post closure.

SURFACE WATER

The following key potential impacts relating to surface water resources have been identified:

- A reduction in stream flow may occur due to proposed mining activities.
- A decrease in water quality may occur due to seepage and overland storm water flows from the opencast area.
- Surface water quality may deteriorate as a result of the decanting of low pH, high metal and sulphate rich water from the mine post closure.
- There is the potential for flood lines to negatively affect the surface area of the mine.
- Decreased infiltration and increased run-off may occur due to soil compaction.
- Surface water pollution or contamination due to spillage of chemicals, hydrocarbons, or contaminated water during mining activities.
- In the event of the collapse of the underground mine workings surface subsidence may result, altering the movement of water on the surface and into groundwater.

GROUND WATER

The following key potential impacts relating to ground water have been identified:

- Ground water pollution or contamination due to spillage of chemicals, hydrocarbons, or contaminated water during mining activities;
- A reduction in recharge to groundwater due to surface compaction;
- Reduction of ground water reserves due to mine dewatering;
- Reduction of stream baseflow, surrounding ground water levels, and aquifer levels as a result of mine dewatering; and
- The potential contamination of groundwater due to the continued oxidation of coal material in the mine void and the waste material on-site.

AIR QUALITY

The following key potential impacts relating to air quality have been identified:

- Suspended particulate matter may result in damage to the physiology, death of vegetation, reduction in the efficiency of gaseous exchange, and the reduction in photosynthetic activity of vegetation in the area.
- Suspended particulate matter may result in physical stress to animals and a corresponding decrease in physical health.
- Suspended particulate matter may result in adverse effects on human health.

VISUAL

The following key potential impacts relating to visual aesthetics have been identified:

- Adverse effect of alteration to the sense of place on the psychological well-being of sensitive receptors.
- Adverse effect of alteration to landscape character on the psychological well-being of sensitive receptors
- Adverse effect of alteration to the view shed on the psychological well-being of sensitive receptors.

NOISE

The following key potential impacts relating to noise have been identified:

- Increase in ambient sound levels;
- Noise impacts on animals;
- Adverse effect of an audible acoustic energy on the physiological and/or psychological well-being of sensitive receptors.
- Disturbance of learners in the nearby schools;
- Mine workers in very close proximity to noisy activities would be at risk to hearing damage if the proper precautions (e.g. use of personal protective equipment) are not taken.

BLASTING AND VIBRATION

The following key potential impacts relating to noise have been identified:

- Ground vibration may disturb animals and result in a decrease in animal productivity;
- Air blast may be result in damage to structures and increased stress to sensitive receptors;
- Fly rock may result in damage to structures and injury to sensitive receptors;
- Noxious fumes may cause a decrease in heath of sensitive receptors; and

- Community reaction to blasting due to negative perceptions surrounding mining.

TRAFFIC

The following potential impacts have been identified:

- Increase in traffic on adjacent road network resulting in additional damage to the roads and a potential for an increase in the number of accidents;
- Additional heavy traffic over bridges and culverts may result in damage to these structures;
- Additional heavy vehicles traveling through communities may affect the normal usage of these roads.

POTENTIAL CUMULATIVE IMPACTS

Without proper mitigation measures and continual environmental management, most of the identified impacts identified above may potentially become cumulative, affecting areas outside of their originally identified zone of impact. The following is a list of some of the key potential impacts that may result in a **significant** cumulative impact as a result of the project. It must be stated that the list is not exhaustive and will be investigated further during the EIA phase and in consultation with stakeholders.

- Contribution to losses of potentially productive agricultural land, along with a reduction in land capability as a result of site sterilisation due to mining activities;
- Contribution to air quality impacts, specifically relating to increased suspended particulate matter (dust);
- Contribution to reduction in surface water quality;
- Increase in traffic;
- Disturbance of fauna;
- Invasion of alien plant species;
- Increase in ambient noise levels and potential adverse effect of noise sensitive receptors;
- Downstream sedimentation;
- Disturbance, damage or destruction of heritage features;
- Increased vulnerability and community safety-related risks and impacts; and
- Localised areas of acid mine drainage and groundwater contamination.

POTENTIAL FOR ACID MINE DRAINAGE

Acid Mine Drainage (AMD) can be defined as the outflow or seepage of acidic water from old metal or coal mine areas. AMD is comprised of a low pH, iron and sulphate water and it usually occurs when water is exposed to the atmosphere via outflow or seepage, thus oxidising. Samples were collected during previous research projects for the Water Research Commission from the coal seams, as well as their roof and floor lithologies in the Highveld, Witbank, and Ermelo coalfields. Acid-base accounting (ABA) results for the collected samples show that the lithological units in the coalfields have the ability to contribute to deterioration in ground and surface water quality. A positive correlation was also recognized between the types of minerals, (modal proportion of sulphide, carbonate, and clay minerals) present in the coal and the associated water quality, i.e. the severity of the AMD problem.

According to the sediment rock and borehole testing for Leiden during the site visit by the Geochemistry specialists, the geological formation is unlikely to yield AMD formation. In general, the area has been divided into three lithological units. i.e. dolomite, arenite, and dolerite. Arenite and dolerite do not significant potential to generate AMD, because they do not contain any sulphide minerals. As such the potential formation is considered a low risk due to the nature of the predominant geologies of the site. The geochemical specialist study in the EIA phase will involve further detailed assessment, including ABA analysis, to determine the potential for AMD at Leiden. Regardless of the potential for AMD formation, a proactive approach will be adopted for the Leiden Coal Mine with the development of a detailed AMD avoidance and management strategy to be implemented throughout the LoM.

PROJECT ALTERNATIVES

The identification and assessment of alternatives is a key component to the success of any EIA process. Two tiers of alternatives are investigated and considered which culminate into the identification of three feasible development alternatives to be assessed, in detail during the EIA Phase. Tier One alternatives include land use, location, mining method and site access alternatives. The alternatives were comparatively assessed and have culminated into the identification of three feasible development alternatives. These three feasible development alternatives are discussed below and will be assessed, in detail during the EIA Phase namely:

- Alternative 1: No Go Alternative;
- Alternative 2: Maximum Mine Production; and
- Alternative 3: Sensitivity Planning Approach.

THE PREFERRED ALTERNATIVE

The most appropriate development alternative going forward is considered to be Alternative 3: Sensitivity Planning Approach. This alternative will emphasise resource protection and use

stringent mitigation measures to minimise identified adverse impacts. This alternative will use specialist planning and evaluation of the following in order to avoid impacting on consolidated sensitive environmental features. The sensitivity planning approach is also likely to have further implications in terms of mine design as well as economic viability of the proposed project, all of which will be evaluated in the EIA investigation. Regardless, all three feasible development alternatives described above will also be comparatively assessed and evaluated during the EIA Phase to determine the most appropriate alternative going forward.

PUBLIC PARTICIPATION PROCESS

The PPP for the proposed Leiden project has been undertaken in accordance with the requirements of the MPRDA, NEMA, and NWA, in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&AP's are afforded an opportunity to comment on the project. A joint PPP will be implemented to engage with I&AP's and meet the requirements for Public Participation as stipulated by the relevant legislation. The PPP provides stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP and Integrated Water Use Licence Application (IWULA) process. This will ensure public involvement at each key step in the process and allow for comments, concerns, suggestions, and objections to the proposed Leiden coal mine to be included in each of the submissions to the relevant Government Authorities.

The first phase of an EIA is the Scoping Phase. In terms of the MPRDA and the NEMA, I&AP's must be given the opportunity to comment on the proposed project. The Draft Scoping Report aims to describe the proposed project, the environment in which the project is located, and the potential impacts that may result if the project goes ahead. This Draft Scoping Report is being made available for public comment from 25 April 2014 to 12 June 2014 (a period of 45 days). The comments received from I&AP's thus far have been captured in an IRR accompanying this Draft Scoping Report (Appendix Q). An EIA Report, including an EMPR, will be compiled and presented for public comment as the next step of this EIA process during which time further stakeholder engagement will take place.

PLAN OF STUDY FOR EIA

The EIA process is being carried out in accordance with the NEMA 2010 EIA regulations. Each of the specialists will undertake a detailed EIA assessment. Included in this report is a detailed plan of study provided by each of the appointed specialists to be implemented during the EIA phase. Potential impacts identified during the EIA will be assessed by the specialists for each development alternative and for each phase of the project. The EIA and specialist studies will provide input into the EMP which will provide the necessary action plans and management measures to mitigate the identified impacts.

CONCLUSION

In order to comply with national legislation the proposed Leiden Coal Mine will require authorisation in terms of the MPRDA, NEMA, NEMWA and NWA. As such the project is required to undertake and submit the following reports for adjudication by the relevant Authorities:

- Scoping Report and EMPR as per the requirements of the MPRDA;
- Scoping, EIA and EMPr as per the requirements of the NEMA and NEMWA; and
- Integrated Water Use License (and waste management plan) as per the requirements of the NWA.

Thus, in parallel to the application in terms of the MPRDA, an application in terms of NEMA and NEMWA, and an application in terms the NWA will be compiled and submitted to the relevant Government Authorities for decision-making. Each of the applications, in terms of the legislation listed above, require public involvement and interaction, and as such a joint PPP will be implemented to engage with I&AP's and meet the requirements for Public Participation as stipulated by the above mentioned legislation. This will ensure public involvement at each key step in the process and allow for comments, concerns, suggestions, and objections to the proposed Leiden coal mine to be included in each of the submissions to the relevant Government Authorities.

The first phase of an EIA is the Scoping Phase. Sixteen specialists were appointed to undertake scoping level assessments to describe the baseline receiving environment and potential impacts that may result if the proposed mining goes ahead. Included in this report is a detailed plan of study provided by each of the appointed specialists to be implemented during the EIA phase. Potential impacts identified during the EIA will be assessed by the specialists for each development alternative and for each phase of the project. An EIA Report, including an EMPR, will be compiled and presented for public comment as the next step of this EIA process during which time further stakeholder engagement will take place.

This Draft Scoping Report is being made available for public comment from date to date (a period of 45 days). The comments received from I&AP's thus far have been captured in an IRR accompanying this Draft Scoping Report (Appendix Q).

1 PROJECT BACKGROUND

1.1 INTRODUCTION

The project area is situated in the Ermelo coalfield, although the coal seams which occur on the property have been logged as the Utrecht Coalfield seams of Gus and Dundas. According to historical exploration records, a total of 187 000t (in situ) was mined from the Dundas seam more than 10 years ago by Kangra Coal (Pty) Ltd. Mashala was granted a Prospecting Right (710/2006 PR) for Leiden on the 17th October 2006 and the Prospecting Right has subsequently been renewed twice.

In order to comply with National legislation the proposed Leiden coal mine will require authorisation in terms of the MPRDA, NEMA, NEMWA, and NWA. This application for authorisation for the Leiden Coal Mine falls under the Integrated Environmental Approach. Thus, in parallel to the application in terms of the MPRDA, an application in terms of NEMA and NEMWA, and an application in terms the NWA must be compiled and submitted to the relevant Government Authorities for decision-making.

The NOMRA was submitted to DMR and was subsequently accepted on 14 April 2014. An application for authorisation of listed activities under the NEMA and NEMWA was submitted to DEA and MDEDET and the application was subsequently accepted by both DEA and MDEDET.

1.2 PROJECT LOCATION

The site for the proposed Leiden Coal Mine is located approximately 58km southeast of the town Ermelo and approximately 61km northwest of Piet Retief in the Mpumalanga Province of South Africa. Leiden is located 18km south southeast of the small settlement Sheepmoor. The proposed Leiden coal mine is located on the Remaining Extent of the Farm Leiden 340 IT. The proposed site covers an area of approximately 1 291 hectares and falls within the jurisdiction of the Mkhondo Local Municipality in the Gert Sibande District Municipality. The locality of the application area is presented in Figure 1 below.

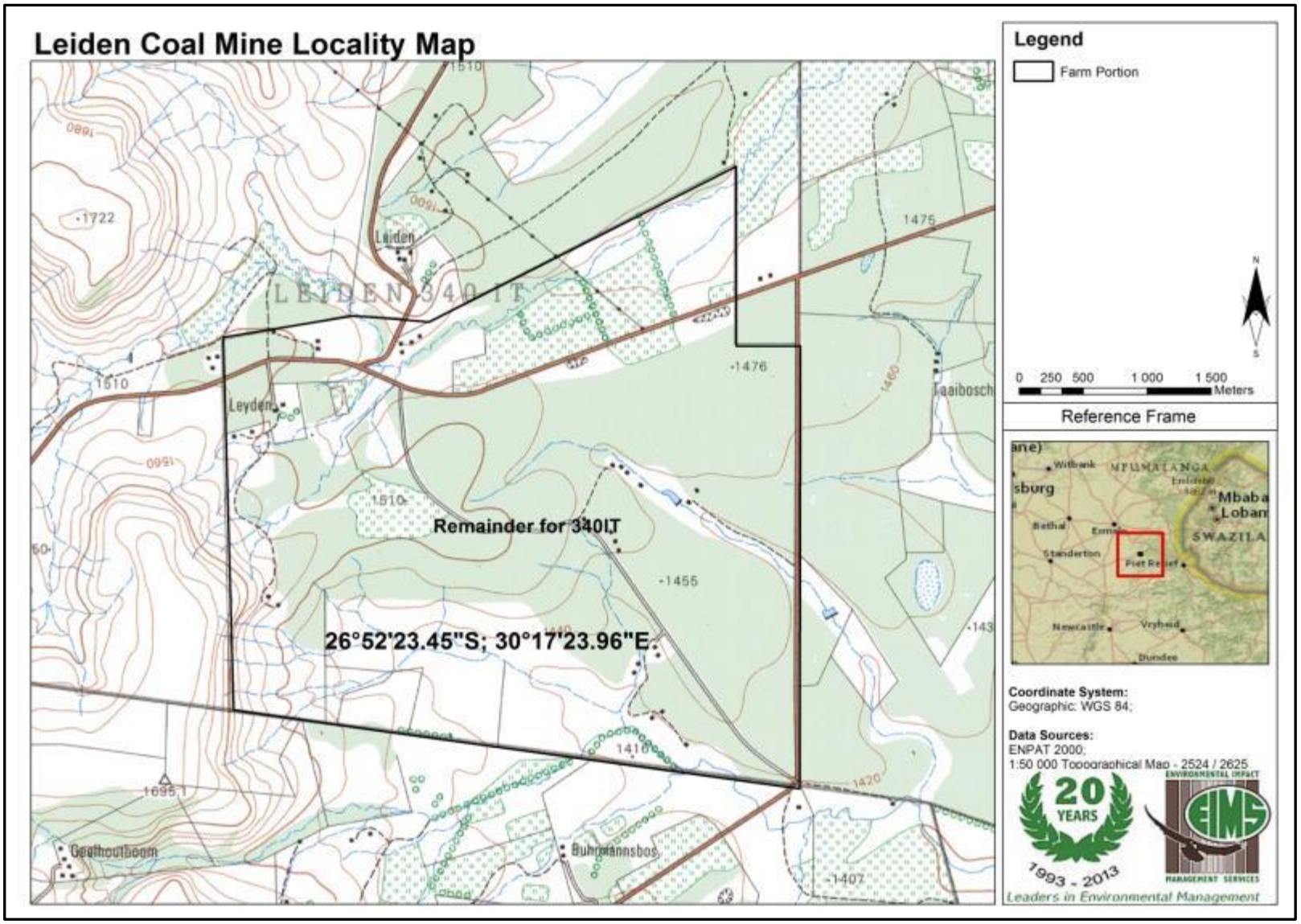


Figure 1: Location of Proposed Leiden Coal Mine

1.2.1 SURFACE OWNERSHIP

Mashala does not currently own any surface rights at Leiden. As such a formal agreement with the surface rights owners will be required. A list of farm portions and registered owners is provided below.

Table 1: List of land parcels and surface rights holders

Farm Name	Farm Portion	Registered Owner
Leiden 340 IT	RE	Le Roux van Niekerk

1.2.2 COMMUNITY DESCRIPTION

The proposed mine will be located in Ward 2 of the Mkhondo Local Municipality (MLM) that forms part of the GSDM in Mpumalanga. It must be noted that the site is relatively close to the borders with the Msukaligwa Local Municipality and the Pixley ka Seme Local Municipality. No communities were identified within the application area itself, however there are a number of rural homesteads occur in the surrounding area. Generally the communities in the project application area are poorer than other communities situated in the Mpumalanga Province. This may be attributed to the lower levels of employment and poor infrastructure. Most people in the surrounding area are fairly poor with a relatively low standard of living and high levels of unemployment. Educational and skills levels are not very high. Although the area is dominated by agriculture and forestry, jobs are selectively available seasonally for unskilled labourers. The prominent language of the area is SiSwati, which is widely spoken throughout the community. Other dominant languages are IsiZulu, Xitsonga, IsiNdebele, and Sepedi. Education in the area is poor as a result of the lack of schools available.

For further details of the community, please refer to the detailed description of the social environment in section 5.2.

1.3 BRIEF PROJECT DESCRIPTION

This section provides a brief overview of the proposed Leiden project. Please refer to section 9 of this report for a detailed project description.

A NOMR was submitted to DMR and was subsequently accepted on 14 April 2014. The application area is situated on the farm Leiden 340IT (RE) and covers an area of 1 291.75 ha. The proposed Leiden Coal Mine will comprise of bord and pillar underground mining with a small area of rollover open cast mining at the adit. The proposed Leiden Coal Mine will aim to produce up to a planned monthly production rate of 35 000 tpm (for a period of approximately 18 months) for the opencast mining, and up to 25 000 tpm from the underground mining operations for approximately 10 years LOM. Coal will be produced primarily for export markets, with some product also available for the local market (e.g. Eskom). The proposed project would create job opportunities to approximately 102 people.

1.4 PROJECT MOTIVATION (NEED AND DESIRABILITY)

1.4.1 SOCIO-ECONOMIC IMPACT OF THE MINE IF AUTHORIZED

The proposed Leiden Coal Mine will have favourable economic impacts on both the local and regional economies. Expenditure on the construction and operation of the mine will lead to positive economic impacts as they would constitute an injection of capital into the local and regional economy resulting in increased commercial activity. Coal will be produced primarily for export markets, with some product also available for the local market (e.g. Eskom). The production and sale of coal will ensure a constant inflow of foreign capital into South Africa and into the project region as well as providing further low quality coal to Eskom for use in coal fired power stations thereby ensuring future energy demand within the country.

The proposed Leiden Coal Mine will provide employment opportunities for a workforce from the surrounding area which houses many historically disadvantaged South Africans that require employment. It is the intention of the mine to give priority to the local community when recruiting people for the jobs associated with the mine activities. 102 employees will be employed on the mine when it is fully operational. Note that not all mining operations will be contracted out. The personnel on the mine will however have the necessary skills to conduct the mining operations. Since the Leiden Mine is not in existence, all required infrastructure would need to be constructed. Thus the construction work necessary to bring the mine into operation. Various employment opportunities will therefore arise through the construction of the mine. Although the proposed project will only create a small addition to the existing employment opportunities in the area, the project will ensure the following:

- A mining operation with a sustainable life of mine of approximately 10 years;
- Provision of sustainable employment (retention);
- On-going economic input into the area;
- Provision of a regional socio-economic benefit;
- Economic injection into the region in terms of small business enterprises (e.g. community services);
- On-going supply of export and local coal;
- Supply of coal to ESKOM when needed.

Mashala will adopt a systematic, fully integrated process of workforce planning as outlined in the Social and Labour Plan (SLP), that involves proactively planning ahead to avoid skills surpluses or shortages. This integrated process is designed to ensure that the right people are in the right roles to meet the current and future organisational requirements. This includes identifying the skills required and the mechanisms by which those skills will be acquired. Such

human resource planning mechanisms will continue to be utilised during the life of the operation.

A preferential procurement policy will be developed during the 2014 period that will clearly state the Mine's commitment to BEE. In terms of the Mining Charter, the policy will specifically focus on procurement from HDSA vendors and to promote new opportunities for meaningful participation by Historically Disadvantaged South Africans (HDSA) companies in Leiden Coal Mine's procurement spend. The company is committed to ensure that all employees in need of basic numeracy and literacy training have access to accredited ABET facilities. The policy will specifically focus on procurement from HDSA vendors and to promote new opportunities for meaningful participation by HDSA companies in Leiden Coal Mine's procurement spend.

The policy will make provision for the following methodology:

1. New suppliers will be required to disclose information regarding their ownership/control and internal BEE programmes;
2. Leiden Coal Mine will put measures into place to monitor and verify the status quo of various suppliers and to ensure that such information is reliable;
3. Preference will be given to products supplied and services rendered by HDSA suppliers;
4. The Mine will encourage suppliers to form partnerships or joint ventures with HDSA supplier companies where there is no HDSA mine tendering to supply the required goods or services; and
5. Tender requirements will be comprehensively communicated to HDSA companies.

The proposed Leiden Coal Mine will fully subscribe to the principles of the Mining Charter, and strive to achieve more than the minimum requirements. The Applicant believes that Employment Equity is an integral part of building an effective and representative workforce and to ensuring equality for all employees. The Mine will therefore develop an Employment Equity Policy to ensure that HDSA employees, especially women, are developed and targets are met. Particular effort will be directed at identifying HDSA's with talent, and providing accelerated training and development initiatives to assist their progression. These vacancies require skills to conduct the intended mining operations. 102 employees will be employed on the mine when it is fully operational.

1.4.2 THE ENVIRONMENTAL SPECIALIST TEAM

Mashala has appointed EIMS to act as the independent Environmental Assessment Practitioner (EAP) for the proposed Leiden project. EIMS consists of a team of specialists from a broad range of fields. Details of the environmental specialist team are provided below.

1.4.3 ENVIRONMENTAL IMPACT MANAGEMENT SERVICES (PTY) LTD

Environmental Impact Management Services (Pty) Ltd (EIMS) was founded in 1993 and has steadily grown to be a significant player in the environmental management consulting industry in South Africa and the rest of Africa. EIMS and its resources have been involved with many significant EIA projects involving the and offers access to a broad body of knowledge and experience with the various Integrated Environmental Management tools (EIA; EMPR; EMP; SEA; EMF; etc). EIMS is responsible for project management and the compilation of the Environmental Management Programme (EMPR) and EIA/EMP for the Leiden project with the input of the specialists listed below.

1.4.4 SPECIALIST CONSULTANTS

The following table lists the specialists responsible for each component of the scoping report and EIA:

Table 2: List of specialists appointed to the project

Component	Company Responsible
Air Quality	Airshed Planning Professionals
Blasting and Vibration	Blast Management Consulting
Closure Costing, Rehabilitation and Final Land Use	Reichardt and Reichardt
Economic	Strategy 4 Good
Fauna	David Hoare Consulting
Flora	Spatial Ecologist
Geochemistry	Ferret Mining and Environmental Services
Geohydrology	GCS Water and Environment
Heritage	Professional Grave Solutions
Noise	Enviro-Acoustic Research
Social	Equispectives Research and Consulting Services
Social and Labour Plan	Equispectives Research and Consulting

Component	Company Responsible
	Services
Soils, Land Use and Land Capability	ARC Institute for Soil, Climate and Water
Surface Water	GCS Water and Environment
Traffic	ITS Engineers
Visual	Newtown Landscape Architects
Wetlands and Aquatic Ecology	Wetland Consulting Services

2 PURPOSE OF THE SCOPING REPORT

Mashala has appointed EIMS to conduct the EIA/EMP and Public Participation Process (PPP). A joint PPP will be implemented to engage with I&AP's and meet the requirements for Public Participation as stipulated by the relevant legislation. The PPP provides stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP and Integrated Water Use Licence Application (IWULA) process. This will ensure public involvement at each key step in the process and allow for comments, concerns, suggestions, and objections to the proposed Leiden coal mine to be included in each of the submissions to the relevant Government Authorities.

The first phase of an EIA is the Scoping Phase. In terms of the MPRDA and the NEMA, I&AP's must be given the opportunity to comment on the proposed project. The Scoping Report describes the proposed project, the environment in which the project is located, and the specialist studies that have been undertaken.

This Draft Scoping Report is being made available for public comment from 25 April 2014 to 12 June 2014 (a period of 45 days). The comments received from I&AP's thus far have been captured in an IRR accompanying this Draft Scoping Report (Appendix Q). An EIA Report, including an EMPR, will be compiled and presented for public comment as the next step of this EIA process.

3 LEGAL FRAMEWORK

3.1 APPLICABLE LEGISLATION

The legal framework within which the proposed Leiden coal mine is governed by many acts, regulations, standards, guidelines and treaties on an international, national, provincial and local level. Legislation applicable to the project includes:

3.1.1 THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT

The Mineral and Petroleum Resources Development Act (Act No 28. Of 2002, MPRDA) aim is to "make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources". The Act outlines the procedural requirements that need to be met to acquire mining rights in South Africa. In this regard Mashala have compiled and submitted a new order mining right application to the DMR. The application was consequently accepted and the applicant is now required to, as per Section 22(4)(a) & (b) to conduct an environmental impact assessment and submit an environmental management programme for approval as well as to notify in writing and consult with interested and affected parties within 180 days of acceptance. The MPRDA also requires adherence with related legislation, chief amongst them is the National Environmental Management Act (Act No. 107 of 1998, NEMA) and the National Water Act (Act No. 36 of 1998, NWA).

It is important to note that the MPRDA has been amended (Act 49 of 2008), with the majority of the amendments coming into effect on 7th June 2013. These include, but are not limited to, the amendment of Section 102, concerning amendment of rights, permits, programmes and plans, to requiring the written permission of the Minister for any amendment or alteration; and the section 5A(c) requirement that landowners or land occupiers receive twenty-one (21) days' written notice prior to any activities taking place on their properties. The new requirement to follow the full NEMA process for any mining related activities will only come into effect with the NEMA amendment.

3.1.2 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

The National Environmental Management Act (Act No. 107 of 1998, NEMA) aim is to "To provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state; and to provide for matters connected therewith." The Act outlines the procedural requirements that need to be met to achieve this. The following table identifies the Listed Activities the proposed Leiden Coal Mine triggers and consequently requires authorisation prior to commencement:

Table 3: Listed activities to be authorised

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):	Triggered by:
Activities for Basic Assessment:			
GNR 544 of 18 June 2010	Activity 9	The construction of pipelines exceeding 1 000 m in length for the abstraction of water and transport of water/sewage.	Pipelines for water abstraction and water/sewage transport
GNR 544 of 18 June 2010	Activity 10	The construction of a substation for the transmission and distribution of electricity outside of an urban area.	Construction of Eskom substation
GNR 544 of 18 June 2010	Activity 11	The construction of canals, channels, dams, bulk stormwater outlets, and administrative infrastructure to be constructed within 32 m of a watercourse	Construction of storm water management measures,a PCD, bridges/watercourse crossings, temporary ablution block and temporary placement of office block/containers within 32 m of a water course
GNR 544 of 18 June 2010	Activity 12	The construction of infrastructure for the off-stream storage of water with a combined capacity of 50 000 cubic m	Water storage in PCD and associated dams
GNR 544 of 18 June 2010	Activity 13	The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres	Diesel, chemical and explosive storage and handling
GNR 544 of 18 June 2010	Activity 18	Infilling or deposition of any material of more than 5 cubic m into a watercourse.	Infilling/deposition during upgrade/expansion of bridges/river crossings.
GNR 544 of 18 June 2010	Activity 22	The construction of a road outside of urban areas:	Internal haul roads and external roads to off-site

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):	Triggered by:
		(i) with a reserve wider than 13,5 m (ii) where no reserve exists where the road is wider than 8 m	mineral processing complex.
GNR 544 of 18 June 2010	Activity 26	Any process of activity identified in terms of Section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004)	Operating in a threatened/protected eco-system if applicable
GNR 544 of 18 June 2010	Activity 39	The expansion of canals, channels, and bridges within a watercourse or within 32 m of a watercourse.	Expansion or upgrading of existing watercourse crossings or bridges
GNR 544 of 18 June 2010	Activity 47	The widening of a road by more than 6 m or the lengthening of a road by more than 1 km: (i) where the existing reserve is wider than 13,5 m (ii) Where no road reserve exists, where the existing road is wider than 8 m	Upgrades to existing roads for transport of RoM to off-site minerals processing complex
GNR 544 of 18 June 2010	Activity 55A	The construction of facilities for the treatment of effluent, wastewater or sewage with an annual throughput capacity of more than 2 000 cubic m but less than 15 000 cubic m.	The construction of a temporary modular waste water and sewage treatment facility to be used by the mine to treat waste water, sewage, and effluent.
Activities for Scoping, EIA and EMP:			
GNR 545 of 18 June 2010	Activity 3	The construction of facilities/infrastructure for the storage and handling of dangerous goods with a combined capacity of more than 500 cubic m.	The construction of diesel storage facilities for use by mine equipment and vehicles and the construction of facilities for explosives and chemical storage for use

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):	Triggered by:
			during mine construction and operation. The combined storage capacity of the facilities (diesel, explosives and chemicals) will be more than 500 cubic m.
GNR 545 of 18 June 2010	Activity 10	Construction of facilities/infrastructure for the transfer of 50 000 cubic m or more per day to a water treatment plant and PCD.	Water treatment plant and PCD.
GNR 545 of 18 June 2010	Activity 19	The construction of a dam where the highest part of the wall is 5 m or higher or where the high water mark of the dam covers an area of 10 hectares or more.	Construction of PCD and associated dams.
GNR 545 of 18 June 2010	Activity 20	Any activity which requires a mining right or renewal thereof as contemplated in Section 22 and 24 respectively of the MPRDA (Act. No. 28 of 2002).	Mining Right Application.
GNR 545 of 18 June 2010	Activity 27	The construction of facilities for the treatment of effluent, waste water, or sewage with an annual throughput capacity of 15 000 cubic m or more.	The construction of waste water/temporary modular sewage treatment facilities.
Provincial Specific Activities:			
GNR 546 of 18 June 2010	Activity 4	Construction of roads wider than 4 m with a reserve less than 13.5 m in a: (ii)(aa) protected areas identified in terms of NEMPAA (ii)(bb) national protected expansion strategy (ii)(cc) sensitive area identified in an EMF.	Eastern Valley Grassland, Wakkerstroom Luneburg Grassland, and possibly MTPA CBA or expansion areas.
GNR 546 of 18 June 2010	Activity 5	The construction of facilities and infrastructure such as PCD's and storm water infrastructure which requires a permit or license in terms of national or provincial legislation	Facilities or infrastructure requiring a WUL such as PCD's and storm water

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):	Triggered by:
		governing the release of emissions, pollution or effluent not identified in GNR 544.	infrastructure.
GNR 546 of 18 June 2010	Activity 10	Construction of facilities/infrastructure for storage/handling of dangerous goods with a combined capacity of 30 but not exceeding 80 cubic m in: (ii)(aa) protected areas identified in terms of NEMPAA (ii)(bb) national protected expansion strategy (ii)(cc) sensitive area identified in an EMF.	Storage in Eastern Valley Grassland, Wakkerstroom Luneburg Grassland and possibly MTPA CBA or expansion areas.
GNR 546 of 18 June 2010	Activity 12	The clearance of an area of 300 square metres of more where 75% constitutes indigenous vegetation within a critically endangered or endangered eco-system listed in terms of Section 52 of the NEMBA	Clearance of Eastern Valley and Wakkerstroom Luneburg grassland
GNR 546 of 18 June 2010	Activity 13	Clearance of an area of 1 hectare or more of vegetation where 75% or more constitutes indigenous cover within: (a) Any critically endangered or endangered ecosystem; or (b) Within critical biodiversity areas identified in bioregional plans	Clearance of Eastern Valley and Wakkerstroom Luneburg grassland
GNR 546 of 18 June 2010	Activity 14	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative covers constitutes indigenous vegetation in all areas outside of urban area.	Clearance of Eastern Valley and Wakkerstroom Luneburg grassland
GNR 546 of 18 June 2010	Activity 16	The construction of : (iii) Buildings with a footprint exceeding 10 square metres in size or (iv) Infrastructure covering 10 square metres or more Where such construction occurs within 32 m of a watercourse in any critically endangered or endangered ecosystem or within a critical biodiversity area.	Construction of potential supporting mining infrastructure such as container offices, pipelines, and Pollution Control Dams within 32 m of a watercourse and within NEMBA

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):	Triggered by:
			listed ecosystems, namely Eastern Valley grassland and Wakkerstroom Luneburg grassland.
GNR 546 of 18 June 2010	Activity 19	Widening of roads by more than 4 m or lengthening by more than 1 km outside urban areas in any critically endangered or endangered ecosystem or within a critical biodiversity area.	Widening and lengthening of roads in Eastern Valley and Wakkerstroom Luneburg Grassland.
Activities for Waste Management Licence (WML) for Scoping, EIA, and EMP			
Category B of July 2009	Activity 1	Storage of hazardous waste: (1) Storage including temporary storage of hazardous waste in lagoons.	A PCD and waste water/temporary modular sewage treatment plant.
Category B of July 2009	Activity 4	Treatment of waste: (4) Treatment of hazardous waste using any form of treatment regardless of size or capacity of such facility to treat such waste.	Water treatment plant and temporary ablution facilities.
Category B of July 2009	Activity 5	Treatment of waste: (5) Treatment of hazardous waste in lagoons.	Water treatment plant and oil separators.
Category B of July 2009	Activity 10	Construction of facilities and associated infrastructure: (10) For activities listed in Category B of the Schedule.	The construction of PCD's and water treatment plant.
Activities for Waste Management Licence (WML) for Norms and Standards for Storage of Waste			
Category C of November 2013	Activity 1	The storage, including temporary storage of general waste at a facility that can store in excess of 100 cubic m of waste at one time, excluding waste stored in a lagoon.	General waste storage facility.
Category C of November	Activity 2	The storage of hazardous waste at a facility that has the capacity to store in	Storage of hazardous

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):	Triggered by:
2013		excess of 80 cubic m of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons or temporary storage of such waste.	waste in a PCD.

The requirements of the NEMA also includes due consideration of the following Acts:

- National Environmental Management: Waste Management Act (Act No 59 of 2008, NEM:WA);
- The National Environmental Management: Air Quality Act (Act No 39 of 2004, NEM:AQA); and
- The National Environmental Management: Biodiversity Act (Act No 10 of 2004, NEM:BA).

3.1.3 THE NATIONAL WATER ACT

The National Water Act (Act No 36 of 1998, NWA) aims to "To provide for fundamental reform of the law relating to water resources; to repeal certain laws; and to provide for matters connected therewith." To comply with this Act Mashala will need to apply for the following Section 21 water uses:

- Section 21 (a) – Taking water from a water resource;
- Section 21(b) – Storing water;
- Section 21(c) - Impeding or diverting the flow of water in a watercourse;
- Section 21(d) - Engaging in a stream flow reduction activity contemplated in section 36;
- Section 21 (f) – Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
- Section 21(g) - Disposing of waste in a manner which may detrimentally impact on a water resource;
- Section 21 (i) – Altering the beds, banks, course or characteristics of a water course; and
- Section 21(j) - Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.

3.1.4 THE NATIONAL HERITAGE RESOURCES ACT

The primary piece of legislation protecting national heritage in South Africa, is the South African Heritage Resources Act (Act No. 25) of 1999. In accordance with Section 38 (Heritage Resources Management) of the act, developers must apply to the relevant authority (South African Heritage Resources Agency - SAHRA) for authorisation to proceed with their planned activities. This application must be accompanied by documentation detailing the expected impact this will have on national heritage in particular.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include among other categories:

- Geological sites of scientific or cultural importance;
- Objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- Objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

To address concerns relating to the protection of these particular heritage resources, a Heritage Impact Assessment (HIA) may be required to assess any potential impacts to archaeological and palaeontological heritage within the footprint of the proposed development.

3.2 DETERMINED LICENSING REQUIREMENTS

In order to comply with National legislation the proposed Leiden coal mine will require authorisation in terms of the MPRDA, NEMA, NEMWA, and NWA. This application for authorisation for the Leiden Coal Mine falls under the Integrated Environmental Approach, described in detail below.

3.3 THE INTEGRATED ENVIRONMENTAL IMPACT APPROACH

The Leiden Coal Mine requires authorisation and approval in terms of several pieces of South African legislation, chief amongst them are the MPRDA, NEMA, NEMWA, and NWA. As such the project is required to undertake and submit the following reports for adjudication by the relevant Authorities:

- Scoping Report and EMPR as per the requirements of the MPRDA;
- Scoping, EIA and EMPr as per the requirements of the NEMA and NEMWA; and
- Integrated Water Use License (and waste management plan) as per the requirements of the NWA

Thus, in parallel to the application in terms of the MPRDA, an application in terms of NEMA and NEMWA, and an application in terms the NWA will be compiled and submitted to the relevant Government Authorities for decision-making. Each of the applications, in terms of the legislation listed above, require public involvement and interaction, and as such a joint PPP will be implemented to engage with I&AP's and meet the requirements for Public Participation as stipulated by the above mentioned legislation. This will ensure public involvement at each key step in the process and allow for comments, concerns, suggestions, and objections to the proposed Leiden coal mine to be included in each of the submissions to the relevant Government Authorities.

3.4 SCOPING REPORT FRAMEWORK AND STRUCTURE

The scoping report comprises the following broad framework:

- The project background, including the introduction, project location, project description, and motivation for the project;
- The Legal framework;
- The existing status of the cultural and heritage, socio-economic, and biophysical environment;
- A detailed description of the project;
- Potential impacts associated with the project.
- Land use and development alternatives;
- Stakeholder engagement; and
- Finally, a plan of study for the EIA phase of the project.

In terms of the MPRDA Regulations (GNR R527) and Regulation 543 of the 2010 NEMA EIA Regulations, Table 4 below provides a guide to the relevant sections where the information is contained.

Table 4: Legal Requirements

Environmental Regulation	Description	Section in Report
MPRDA GNR R527 and DMR Scoping Guideline Requirements		
Regulation 49(1)(a): Describe the methodology applied to conduct scoping	• Name the community as defined in the guideline, or explain why no such community was identified • Specifically state whether or not the Community is also the landowner • State whether or not the Department of Land Affairs been identified as an interested and affected party • State specifically whether or not a land claim is involved • Name the Traditional Authority identified by the applicant • List the landowners identified by the applicant. (Traditional and Title Deed owners) • List the lawful occupiers of the land concerned • Explain whether or not other persons' (including on adjacent and non-adjacent properties) socio-economic conditions will be directly affected by the proposed prospecting or mining operation and if not, explain why not. • Name the Local Municipality identified by the applicant. • Name the relevant Government Departments, agencies and institutions responsible for the various aspects of the environment, land and infrastructure	1. Project Background 1.1. Introduction 1.2. Project Location 1.2.1. Surface Ownership 1.2.2. Community Description 1.3. Brief Project Description 1.4. Project Motivation (Need and Desirability) 2. Purpose of the Scoping Report 4. Methodology Applied to Scoping Appendix Q

Environmental Regulation	Description	Section in Report
	which may be affected by the proposed project. • Submit evidence that the landowner or lawful occupier of the land in question, and any other interested and affected parties including all those listed above, were notified.	
Regulation 49(1)(b): Describe the existing status of the environment prior to the mining operation	• Confirmation that the identified and consulted interested and affected parties agree on the description of the existing status of the environment. • A description of the existing status of the cultural environment that may be affected. • A description of the existing status of any heritage environment that may be affected. • A description of the existing status of any current land uses and the socio-economic environment that may be directly affected. • A description of the existing status of any infrastructure that maybe affected. • A description of the existing status of the biophysical environment that will be affected, including the main aspects such as water resources, flora, fauna, air, soil, topography etc.	5. Existing Status of The Cultural and Socio-Economic Environment 6. Existing Status of the Biophysical Environment 7. Existing Status of the Built Environment
Regulation 49(1)(c): Identify and describe the anticipated	• Provide a description of the proposed project including a map showing the spatial locality of infrastructure, extraction area, and any associated activities. • Describe any listed activities (in terms of the NEMA EIA regulations) which will	3.1.2. The National Environmental Management Act Table 3: Listed activities to be

Environmental Regulation	Description	Section in Report
environmental, social and cultural impacts, including the cumulative effects, where applicable	be occurring within the proposed project. • Specifically confirm that the community and identified interested and affected parties have been consulted and that they agree that the potential impacts identified include those identified by them • Provide a list of potential impacts on the cultural environment. • Provide a list of potential impacts on the heritage environment, if applicable. • Provide a list of potential impacts on the socio- economic conditions of any person on the property and on any adjacent or non-adjacent property who may be affected by the proposed mining operation. • Provide a list of potential impacts (positive & negative) on: • Employment opportunities, community health, community proximity, and links to the Social and Labour Plan. • Provide a list of potential impacts on the biophysical environment including but not be limited to impacts on: flora, fauna, water resources, air, noise, soil etc. • Provide a description of potential cumulative impacts that the proposed mining operation may contribute to considering other identified land uses which may have potential environmental linkages to the land concerned.	authorised 9. Detailed Project Description 9.1. Mining Operations 9.3. Mineral Processing 9.5. Surface Infrastructure 9.6. Bulk Power Supply 9.7. Water Management 9.8. Logistics 9.9. Discard Management 9.10. Solid Waste Management 10. Description of Potential Impacts Associated with Activity 10.1. Cultural and Heritage Resources 10.2. Socio-Economic Environment 10.3. Biophysical Environment 10.4. Built Environment

Environmental Regulation	Description	Section in Report
		10.5. Community Health and Safety
Regulation 49(1)(d): Identify and describe reasonable land use or development alternatives to the proposed operation, alternative means of carrying out the proposed operation and the consequences of not proceeding with the proposed operation	• Provide a list of any alternative land uses that exist on the property or on adjacent or non-adjacent properties that may be affected by the proposed mining operation. • Provide a list of any land developments identified by the community or interested and affected parties that are in progress and which may be affected by the proposed mining operation. • Provide a list of any proposals made in the consultation process to adjust the operational plans of the mine to accommodate the needs of the community, landowners and interested and affected parties. • Provide information in relation to the consequences of not proceeding with proposed operation.	12. Project Alternatives 12.1. Land Use Alternatives 12.2. Location Alternatives 12.3. Mining Method Alternatives 12.4. Site access alternatives 12.5. Development Alternatives 12.5.1. Alternative 1: No Go Alternative 12.5.2. Alternative 2: Maximum Mine Production 12.5.3. Alternative 3: Sensitivity Planning Approach 12.6. Most Appropriate Development Alternative Going Forward 1.4. Project Motivation (Need and Desirability) 1.4.1. Socio-Economic Impact of

Environmental Regulation	Description	Section in Report
		the Mine if Authorized 1.4.2. The Environmental Specialist Team
Regulation 49(1)(e): Describe the most appropriate procedure to plan and develop the proposed mining operation	• Provide information on its response to the findings of the consultation process and the possible options to adjust the mining project proposal to avoid potential impacts identified in the consultation process. • Describe accordingly the most appropriate procedure to plan and develop the proposed mining operation with due consideration of the issues raised in the consultation process.	12.6. Most Appropriate Development Alternative Going Forward 13.4. Issues and Responses by I&AP's 14. Plan of Study Appendix Q
Regulation 49(1)(f): Describe the process of engagement of identified interested and affected persons, including their views and concerns.	• Provide a description of the information provided to the community, landowners, and interested and affected parties to inform them in sufficient detail of what the prospecting or mining operation will entail on the land, in order for them to assess what impact the prospecting will have on them or on the use of their land; • Provide a list of which of the identified communities, landowners, lawful occupiers, and other interested and affected parties were in fact consulted. • Provide a list of their views in regard to the existing cultural, socioeconomic or biophysical environment, as the case may be,	13. Stakeholder Engagement 13.1. Legal Compliance 13.1.1. General Approach to Scoping and Public Participation 13.2. Announcement of the Project 13.3. Consultation Meetings 13.4. Issues and Responses by I&AP's

Environmental Regulation	Description	Section in Report
	• Provide a list of their views raised on how their existing cultural, socio-economic or biophysical environment potentially will be impacted on by the proposed prospecting or mining operation; • Provide a list of any other concerns raised by the aforesaid parties. • Provide the applicable minutes and records of the consultations. • Provide information with regard to any objections received.	Appendix Q
Regulation 49(1)(g): Describe the nature and extent of further investigations required in the environmental impact assessment report.	Describe the nature and extent of further investigations required in the environmental impact assessment report, including any specialist reports that may be required	14. Plan of Study 14.1. Specialist Studies 14.2. The Impact Assessment Methodology 14.3. Time Frame
NEMA Regulation 543 (2010) as amended		
Regulation 28(1)(a)	details of— (i) the EAP who prepared the report; and (ii) the expertise of the EAP to carry out scoping procedures;	1.4.2. The Environmental Specialist Team 1.4.3. Environmental Impact Management Services (Pty) Ltd

Environmental Regulation	Description	Section in Report
		1.4.4. Specialist Consultants
Regulation 28(1)(b)	Description of the proposed activity	1. Project Background 1.1. Introduction 1.2. Project Location 1.3. Brief Project Description 1.4. Project Motivation (Need and Desirability) 2. Purpose of the Scoping Report 4. Methodology Applied to Scoping 9. Detailed Project Description
Regulation 28(1)(c)	Description of any feasible and reasonable alternatives that have been identified	12.1. Land Use Alternatives 12.2. Location Alternatives 12.3. Mining Method Alternatives 12.4. Site access alternatives 12.5. Development Alternatives 12.5.1. Alternative 1: No Go

Environmental Regulation	Description	Section in Report
		Alternative 12.5.2. Alternative 2: Maximum Mine Production 12.5.3. Alternative 3: Sensitivity Planning Approach 12.6. Most Appropriate Development Alternative Going Forward
Regulation 28(1)(d)	Description of the property on which the activity is to be undertaken and the location of the activity on the property	1. Project Background 1.1. Introduction 1.2. Project Location 1.2.1. Surface Ownership 1.2.2. Community Description 1.3. Brief Project Description
Regulation 28(1)(e)	Description of the environment that may be affected by the activity and the manner in which activity may be affected by the environment	5. Existing Status of The Cultural and Socio-Economic Environment 6. Existing Status of the Biophysical Environment 7. Existing Status of the Built

Environmental Regulation	Description	Section in Report
		Environment
Regulation 28(1)(f)	Identification of all legislation and guidelines that have been considered in the preparation of the scoping report	3. Legal Framework 3.1. Applicable Legislation 3.2. Determined Licensing Requirements 3.3. The Integrated Environmental Impact Approach 3.4. Scoping Report Framework and Structure
Regulation 28(1)(g)	Description of environmental issues and potential impacts, including cumulative impacts, that have been identified	10. Description of Potential Impacts Associated with Activity 10.1. Cultural and Heritage Resources 10.2. Socio-Economic Environment 10.3. Biophysical Environment 10.4. Built Environment 10.5. Community Health and

Environmental Regulation	Description	Section in Report
		Safety 10.6. List of potential Cumulative Impacts
Regulation 28(1)(h)	Details of the public participation process conducted in terms of regulation 27(a)	13. Stakeholder Engagement 13.1. Legal Compliance 13.1.1. General Approach to Scoping and Public Participation 13.2. Announcement of the Project 13.3. Consultation Meetings 13.4. Issues and Responses by I&AP's Appendix Q
Regulation 28(1)(i)	Description of the need and desirability of the proposed activity	1.4. Project Motivation (Need and Desirability) 1.4.1. Socio-Economic Impact of the Mine if Authorized
Regulation 28(1)(j)	Description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on	12. Project Alternatives 12.1. Land Use Alternatives

Environmental Regulation	Description	Section in Report
	the environment and the community that may be affected by the activity	12.2. Location Alternatives 12.3. Mining Method Alternatives 12.4. Site access alternatives 12.5. Development Alternatives 12.5.1. Alternative 1: No Go Alternative 12.5.2. Alternative 2: Maximum Mine Production 12.5.3. Alternative 3: Sensitivity Planning Approach 12.6. Most Appropriate Development Alternative Going Forward 1.4. Project Motivation (Need and Desirability) 1.4.1. Socio-Economic Impact of the Mine if Authorized 1.4.2. The Environmental Specialist Team
Regulation 28(1)(k)	Copies of any representations, and comments received in connection with the	13.4. Issues and Responses by

Environmental Regulation	Description	Section in Report
	application or the scoping report from interested and affected parties	I&AP's Appendix Q
Regulation 28(1)(l)	Copies of the minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants; and	13.3. Consultation Meetings Appendix Q
Regulation 28(1)(m)	Any responses by the EAP to those representations and comments and views	13.4. Issues and Responses by I&AP's Appendix Q
Regulation 28(1)(n)	A plan of study for environmental impact assessment which sets out the proposed approach to the environmental impact assessment of the application	14. Plan of Study 14.1. Specialist Studies 14.2. The Impact Assessment Methodology 14.3. Time Frame
Regulation 28(1)(o)	Any specific information required by the competent authority; and	N/A
Regulation 28(1)(p)	Any other matters required in terms of sections 24(4)(a) and (b) of the Act. "The EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act (investigation of the potential consequences or impacts of the alternatives to the	12. Project Alternatives 12.1. Land Use Alternatives 12.2. Location Alternatives

Environmental Regulation	Description	Section in Report
	activity on the environment and assessment of the significance of those potential consequences or impacts, including the option of not implementing the activity) and motivation if no reasonable or feasible alternatives, as contemplated in subregulation (1)(c), exist.	12.3. Mining Method Alternatives 12.4. Site access alternatives 12.5. Development Alternatives 12.5.1. Alternative 1: No Go Alternative 12.5.2. Alternative 2: Maximum Mine Production 12.5.3. Alternative 3: Sensitivity Planning Approach 12.6. Most Appropriate Development Alternative Going Forward 1.4. Project Motivation (Need and Desirability) 1.4.1. Socio-Economic Impact of the Mine if Authorized 1.4.2. The Environmental Specialist Team

4 METHODOLOGY APPLIED TO SCOPING

The scoping level methodology is as follows:

Each specialist was required to complete a desktop level assessment as well as a short site visit in order to draft their components for the Scoping Report. The result of each scoping assessment included the following as a minimum:

- Desktop description of the baseline receiving environment specific to the field of expertise (general surrounding as well as site specific environment);
- Identification and description of any sensitive receptors in terms of each aspect that occur in the study area, and the manner in which these sensitive receptors may be affected by the activity;
- Site visit to verify desktop information;
- Screening to identify any critical issues relating to the each aspect (potential fatal flaws) that may result in project delays or rejection of the application;
- Map identifying sensitive receptors in the study area, based on available maps, database information & site visit verification;
- GIS sensitivity map of the study area;
- Identification and description of any impacts that may result from the proposed activities (both mining and supplementary) during all phases of the project, including cumulative, residual and latent impacts. This should include dispersion modelling to identify potential impacts on sensitive receptors. All phases of the project should be considered and these phases shall be classified as:
    - Planning and Design;
    - Construction;
    - Operation;
    - Decommissioning;
    - Rehabilitation and Closure.
- Identification of any legislated constraints (e.g. "No-Go" areas or buffer zones) and preparation of a map illustrating No-Go areas and buffers (if relevant);
- Identify any gaps in knowledge, data or information that could hamper the impact identification and evaluation process;
- Identification and justification (screening to obtain key issues) of impacts which require further investigation during the EIA phase (including further specialist inputs);

- Identify any legal provisions relevant to the specific field of expertise and the proposed activity (including relevant legislation, both National and Provincial, Department Guidelines and Management Frameworks);
- Provide a detailed plan of study for the EIA and EMP, including;
    - A description of the tasks that should be undertaken and the manner in which these tasks should be undertaken; and
    - A description of the proposed methodology.

A criteria based assessment was utilised which investigates constraint and opportunity areas within the study area, applicable to each environmental component. **Figure 2** is a graphic representation of the sensitivity mapping and alternative identification process. This process is explained in further detail in this section.

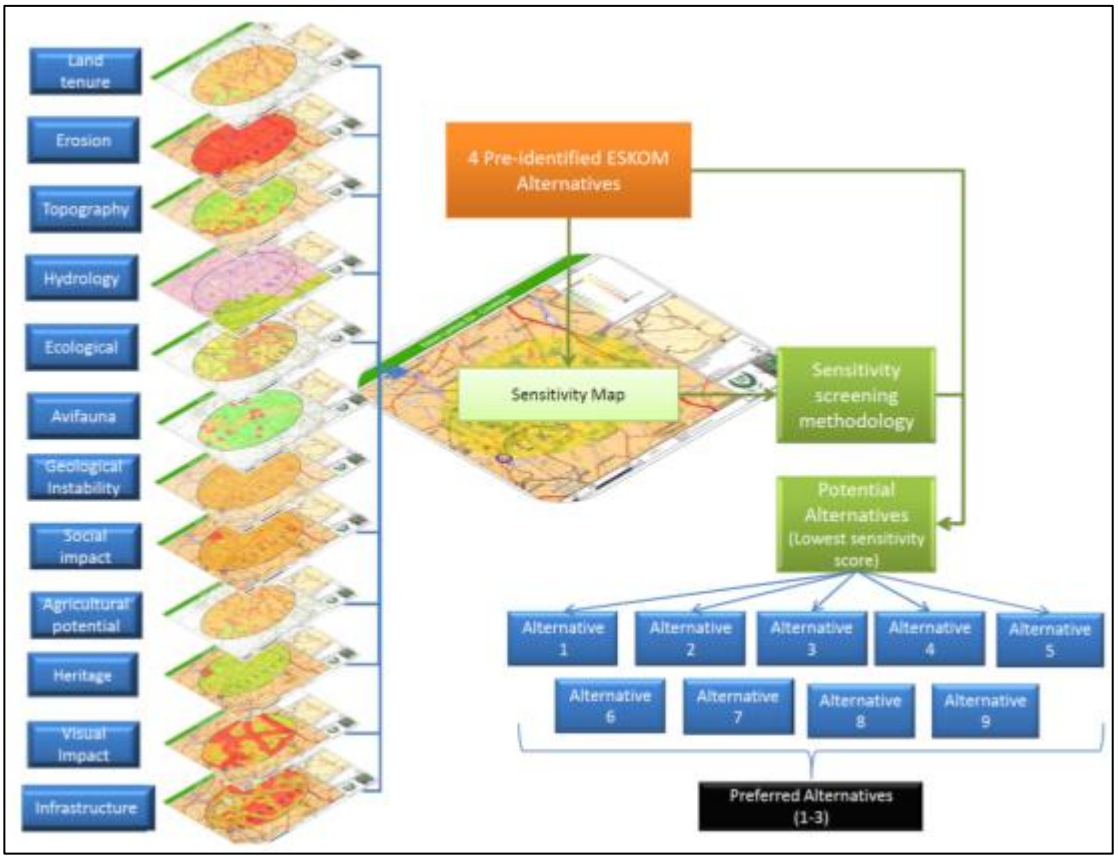
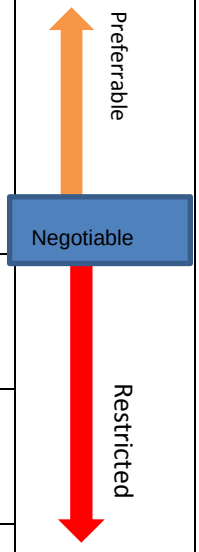


Figure 2: Alternative site identification process.

A spatial sensitivity map has been prepared for each identified environmental and technical component. The sensitivity map, for the purposes of scoping and screening, is high level and does not necessarily include detailed site investigations and verification. The detailed site investigations and verification will be undertaken in the EIA phase. **Table 5** was used to define the exclusion and inclusion ratings.

Table 5: Sensitivity ratings and weighting

Sensitivity Rating	Description	Weighting	Preference
Least Concern	The inherent feature status and sensitivity is already degraded. The proposed development will not affect the current status and/or may result in a positive impact. These features would be the preferred alternative for mining or infrastructure placement.	-1	
Low/Poor	The proposed development will have not have a significant effect on the inherent feature status and sensitivity.	0	
High	The proposed development will negatively influence the current status of the feature.	+1	
Very High	The proposed development will negatively significantly influence the current status of the feature.	+2	

The individual sensitivity maps for each environmental component are provided in the description of the baseline environment (see sections 5, **Error! Reference source not ound.**, and 7). The final step in the screening was to consolidate the individual sensitivity maps and create an overall, merged sensitivity map which depicts areas that are preferred, negotiable and restricted for the purposes of mining and infrastructure placement. The scoring for each individual component was summed to obtain a final consolidated sensitivity score. This score was used to identify the least sensitive areas. The consolidated sensitivity map is presented in section 12.6.

5 EXISTING STATUS OF THE CULTURAL AND SOCIO-ECONOMIC ENVIRONMENT

The description of the baseline receiving cultural and socio-economic environment (on site and surrounding) was obtained from the studies undertaken by the specialist team and in conjunction with EIMS. All specialist studies undertaken for the proposed Leiden Coal Mine are included as supporting technical appendices to this report.

5.1 CULTURAL AND HERITAGE RESOURCES

Professional Grave Solutions (PGS) Heritage and Grave Relocation Consultants was appointed by EIMS to undertake the archaeological and palaeontological specialist study for the Leiden project. The following sections provide a summary of the cultural heritage environment that may be affected by the proposed Leiden project. Information has been sourced from the PGS scoping report. For further information, please refer to the full heritage scoping report which is included in Appendix A.

5.1.1 INTRODUCTION

Mining activities have the potential to destroy, damage, or disturb cultural and heritage resources. These resources include graves, cemeteries, palaeolithic features and structures that are more than 60 years old. It is of great importance to identify these features prior to the mining activities to ensure that they are correctly protected thereby attempting to prevent disturbance or damage to the features.

5.1.2 DATA COLLECTION

A desktop palaeontology study was completed to identify the potential fossiliferous rock units such as groups and formations represented within the study area. These units were determined from geological maps. Literature was utilized from previous paleontological impact studies completed in the same region to support the desktop study.

PGS completed a scoping level assessment of the archaeological and historical background for the Project application area in October 2013. The first aspect of the specialist study was a desktop investigation to establish the potential for heritage resources to be located in the area. This was accomplished by means of a literature review to compile a general background to the study area and surrounding landscape. This component included an assessment of archival and historical maps as well as an examination of Google Earth satellite imagery (desktop study). Thereafter, a site specific study was undertaken to identify potential heritage resources located within the study area. The aim of the site assessment was to confirm those features identified in the desktop assessment as well as searching for any other features which may be present.

5.1.3 RESULTS

5.1.3.1 Palaeontology

The project application area is almost entirely underlain by sedimentary rocks of the Permian aged Vryheid Formation. This formation forms part of the Ecca Group, which lies in the Karoo Supergroup. A small section along the western edge of the study area is underlain by Jurassic aged Dolerite. Due to the igneous nature of the rock, dolerite will contain no fossils; however the Vryheid Formation is well known for the occurrence of coal beds that resulted from the accumulation of plant material over long periods of time. According to Bamford (2011), little data has been published on these potentially fossiliferous deposits.

The potential to find well preserved plant fossil material can differ from place to place. These are however more likely to be found around the coal bearing strata than elsewhere. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites. In the interests of heritage and science, however, such sites should be well recorded, sampled and the fossils kept in a suitable institution. With regards to animal fossils, the late Carboniferous to early Jurassic Karoo Supergroup sediments of South Africa are almost entirely lacking in complete fossils. Trace fossils (ichnofossils) are however abundant in the area surrounding the site.

5.1.3.2 Archaeological Sites

The desktop study revealed the potential for archaeological sites such as Later Stone Age shelters (with or without paintings) as well as Late Iron Age sites to be located within the study area. While no such sites were identified during the site visit, it would be important for an archaeological field survey of the final mining development footprint to be undertaken during the EIA Phase of the project to identify the presence of such sites within these areas.

5.1.3.3 Historical Sites and Structures

Assessment of topographical maps and satellite imagery indicated the presence of one farmstead as well as a number of farm workers housing (Figure 3). The age of these structures could not be determined during the scoping assessment, but they may potentially be more than 60 years old. The age of these structures will be investigated further during the EIA Phase. It is important to bear in mind that structures considered to be 60 years and older are protected in terms of the National Heritage Resources Act of 1999 (NHRA).

5.1.3.4 Graves and Cemeteries

During discussions held with the landowner it was indicated that there are a number of grave sites and cemeteries located across the property. The site visit identified six cemeteries (Figure 3). It is however possible that there may be even more cemeteries and grave sites located within the study area. A detailed site assessment will be undertaken during the EIA Phase.

5.1.3.5 Unmarked Graves in Homesteads

The desktop study undertaken yielded the presence of a number of homesteads within the study area. Based on experience of similar sites and the knowledge of cultural customs and traditions, it is known that stillborn babies and deceased infants occasionally were buried within the homesteads of black rural communities. These children were sometimes buried underneath the floors and walls of houses and huts and the burials were not marked, but were known to the immediate family. Further investigation of these sites will take place during the EIA Phase.

5.1.3.6 Historic Rock Engravings

One site comprising historic rock engravings was identified during the site visit. Possible archaeological material in the form of clay potsherds and one Later Stone Age lithic were also observed here (Figure 3). While the engravings are not formally protected by existing heritage legislation, they are of high enough historic significance to warrant their conservation. The possibility exists for the nearby potsherd scatter to be of archaeological age and formally protected.

The desktop evaluation and preliminary site visit of the study area confirmed the presence of nine sites, of which six were cemeteries, one a historic farmstead, one historic farm worker dwelling and one historic rock engraving. Once the final study area has been defined, this will have to be assessed by way of detailed walkthroughs during the EIA Phase of the project. This will allow for an assessment of the actual impact of the proposed development on any heritage sites located there. The heritage sites identified during the site visit portion of the specialists study are represented in Figure 3.

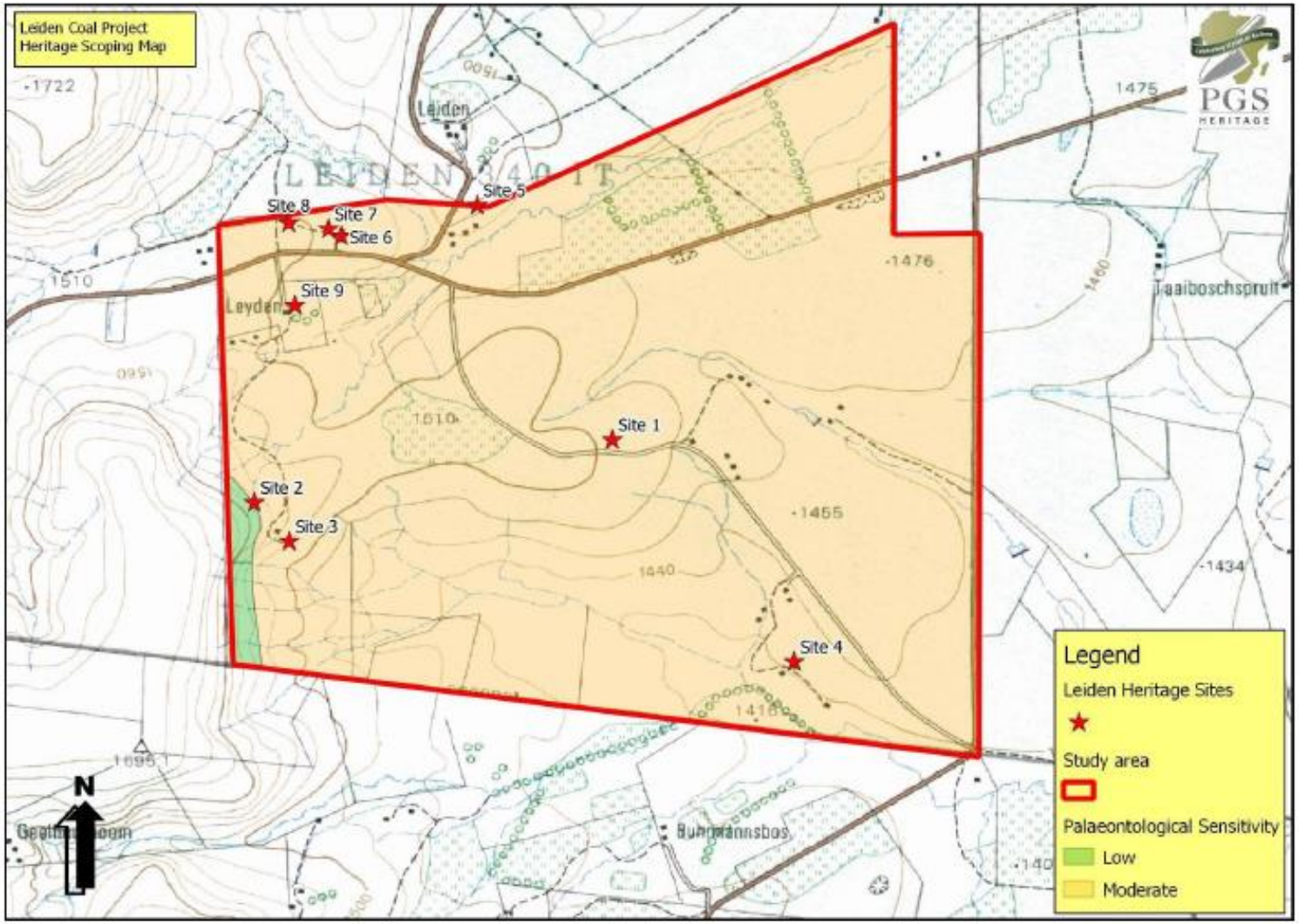


Figure 3: Heritage features identified during the fieldwork portion of the study

5.1.3.7 Sensitivity Map

Due to the fact that the Vryheid Formation sediments and coal beds will only be exposed during the mining operations and associated infrastructure development, it is unlikely that fossils will be observed before the mining takes place. For this reason a moderate palaeontological sensitivity is allocated to the larger portion of the study area. Dolerite will not contain any fossils because of its igneous nature and the small area along the south-western edge underlain by dolerite has thus been allocated a low palaeontological sensitivity as indicated in the palaeontological sensitivity map (Figure 4).

Graves and burial grounds have high levels of emotional, religious and historical significance. As a result these sites have a High Significance. The historic engravings on the cliff face and the two associated rock shelters can be considered to contain high historic value and are also quite unique. As a result this site has a Medium Significance. The historic to recent homestead site can be considered to have a Medium Significance should there be no graves present at the site. However, until such time that the presence of graves here has been confirmed or disproved, the site must be viewed as containing graves. As such the site has a High/Medium Significance. The final site identified comprises an old farmstead consisting of a number of buildings. It is located at the formal entrance on the northern end of the modern farmstead. The site possesses high levels of historic and emotional significance. The buildings have however been modified over time. As a result the site has a Medium Significance. All the relevant sources of heritage information used in this study was summarised in a heritage sensitivity map (Figure 5). This map provides a zoned depiction of the study area wherein areas of varying heritage sensitivity are indicated.

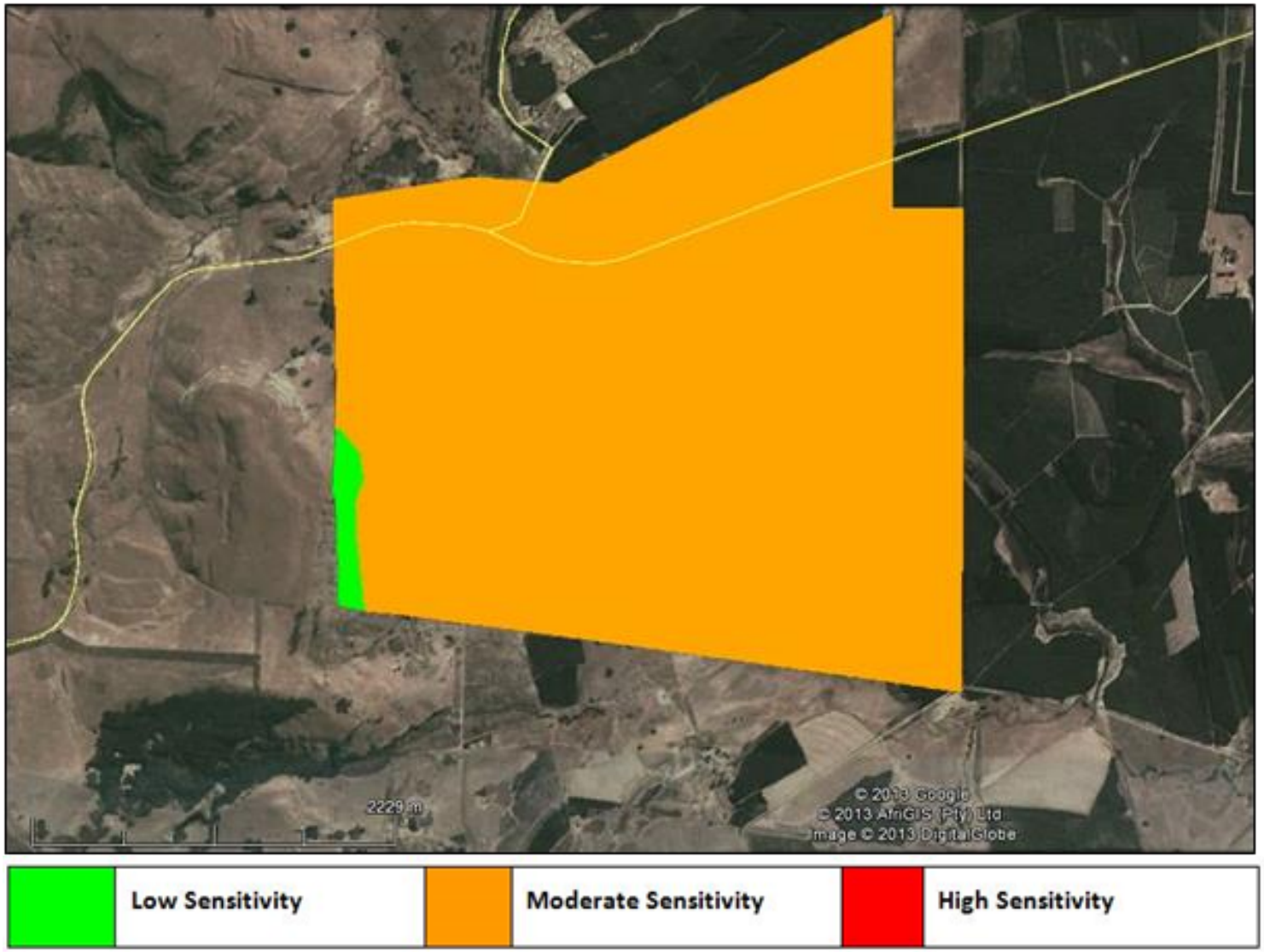


Figure 4: Palaeontological sensitivity

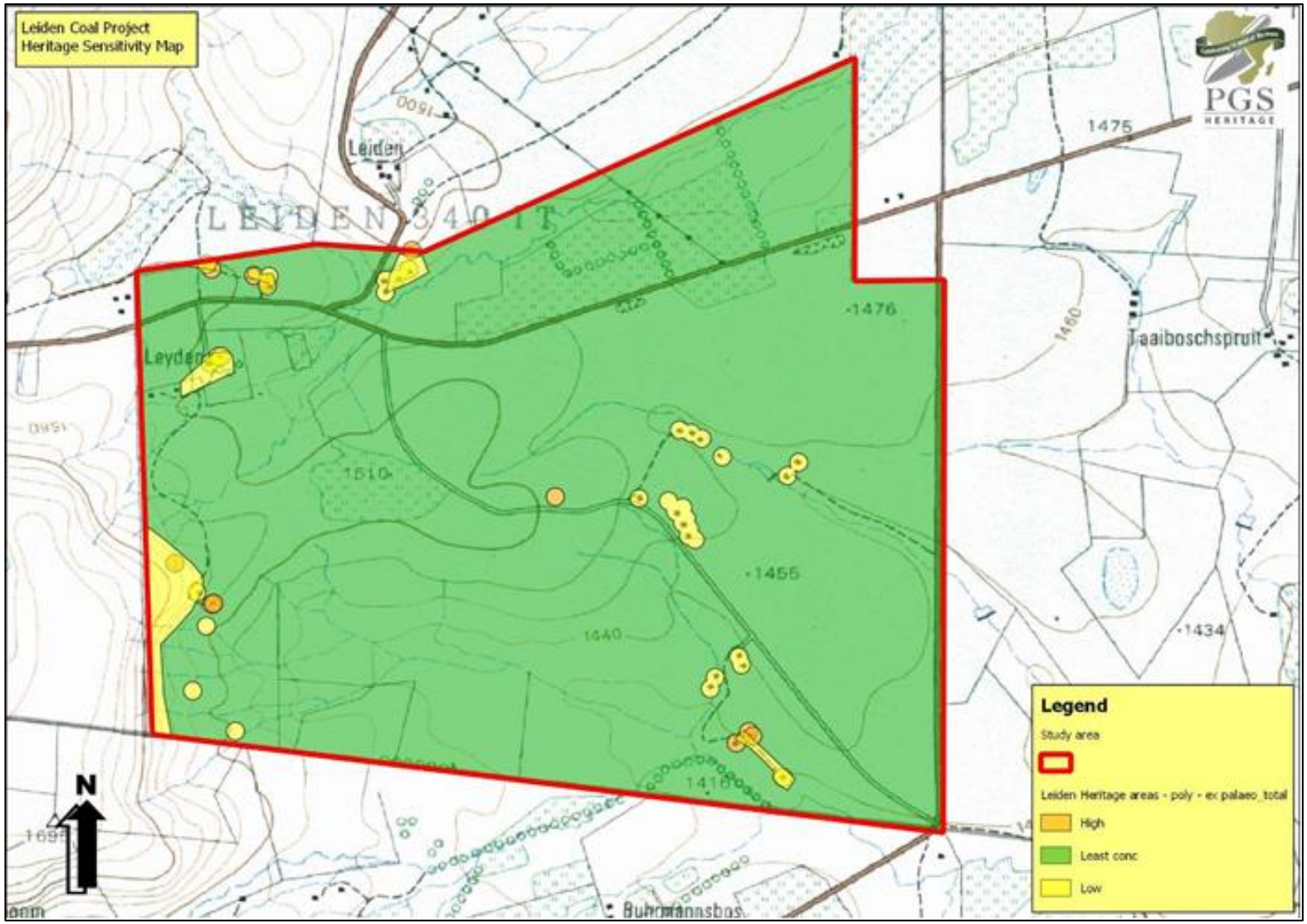


Figure 5: Heritage sensitivity

5.1.4 CONCLUSION

Due to the fact that the underlying Vryheid Formation sediments and coal beds will only be exposed during the mining operations and associated infrastructure development, it is unlikely that any fossils will be observed before the mining takes place. Dolerite will not contain any fossils because of its igneous nature.

The desktop study and site visit for the project application area shows that the project application area has historical and archaeological history. There is therefore potential for archaeological sites and related artefacts to exist in the application area. During the site assessment, nine cultural and historical sites and resources have been identified within the study area comprising six cemeteries, one historic farmstead, one historic rock engraving site as well as one abandoned historic farm worker homestead. The potential also exists for further cultural and heritage sites and resources to be identified during the EIA phase.

5.2 SOCIAL

Equispectives Research and Consulting Services was appointed by EIMS to undertake the social specialist study for the Leiden project. The following sections provide a summary of the social environment that may be affected by the proposed Leiden project. Information has been sourced from the Equispectives scoping report. For further information, please refer to the full social scoping report which is included in Appendix B.

5.2.1 INTRODUCTION

The current social environment for the project area is indicative of a poorer landscape than that of surrounding suburbs in Mpumalanga. As a result it is important to understand the impact that the mining operations will have on the social environment. This socially sensitive area will benefit from an increase in jobs to the area which will in turn increase financial stability among the local people for the life of mine. Expected changes are likely to be seen in the communities as a result of the short term nature of the operations. The mining operations will however be limited in duration (LOM is approximately 10 years) and as a result when operations cease job losses are likely to be seen. It is important that the change in the social environment is assessed further in the EIA phase to determine the full extent of the outcomes that the mine will have on the social environment of the project application area.

5.2.2 DATA COLLECTION

The information used in this study was based on a literature review, data from Statistics South Africa and a site visit in October 2013 which consisted of a face to face meeting with the affected landowner.

5.2.3 RESULTS

5.2.3.1 Description of the Area

5.2.3.1.1 Mpumalanga Province

The proposed mine is located in the Mpumalanga Province which is located in the north eastern part of South Africa and covers an area of approximately 82 333 km^2 (www.mputopbusiness.co.za). Mpumalanga is South Africa's major forestry production area and is also the world's largest producer of electrolytic manganese metal. Mpumalanga currently produces 83% of South Africa's coal. Electricity generation and the synthetic fuel industry account for 90% of South Africa's coal consumption.

5.2.3.1.2 Gert Sibande District Municipality

Spatially the GSDM is the largest district in the Mpumalanga Province, with the smallest population size. More than half of the population stay in urban areas. The settlements are mainly rural in nature with some towns. According to national census data, the poverty rate in the district has declined since 2001 but remains higher than the provincial average. Even though the poverty rate is declining, the actual number of people in poverty is increasing (GSDM IDP 2013/14). The GSDM is said to be dealing with problems in terms of providing basic needs to its community.

5.2.3.1.3 Mkhondo Local Municipality

The project application area is located in in Ward 2 of the Mkhondo Local Municipality in this province, which is located in the GSDM. It must also be noted that the site is relatively close to the borders with the Msukaligwa Local Municipality and the Pixley ka Seme Local Municipality. The main economic activities identified in the MLM are forestry and agriculture. Forestry is the dominant landuse in the municipal area with Mondi, Sappi, TWK and SAFCOL the major players in the forestry industry. The rest of the land within the municipality consists of unimproved grassland used for stock grazing with the cultivation of commercial crops being scattered in small areas across the municipality. Mining does occur in the MLM but the main concentration of mining is situated in the west of the municipality. Tourism is dominated by guesthouse facilities around the town of Piet Retief, while conservancies and private reserve developments are increasing in the Ngwempisi and Assegai River valley and catchments. Figure 6 shows the location of the proposed Leiden Coal Mine in relation to the municipalities described above.

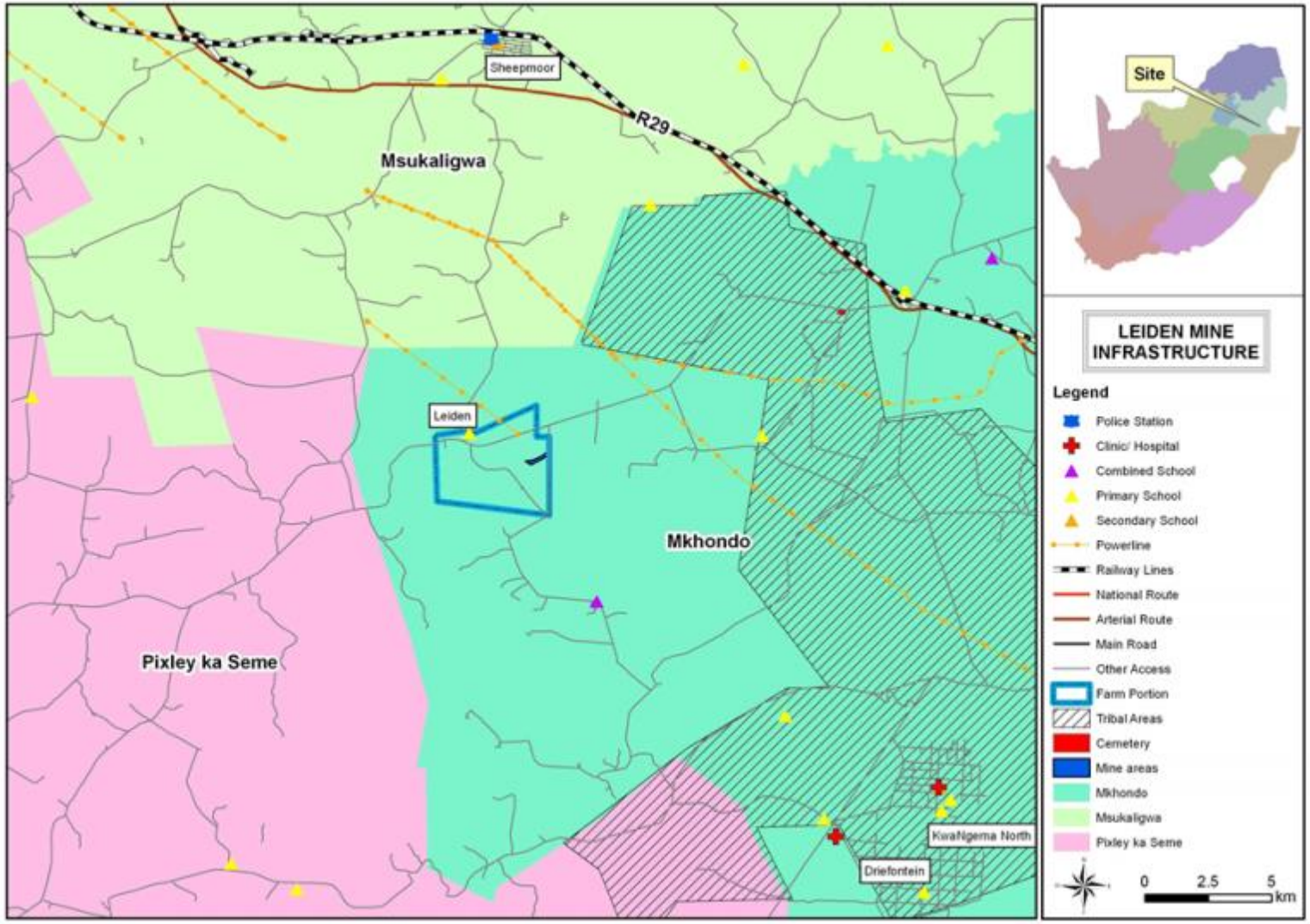


Figure 6: Proposed Leiden Coal Mine

5.2.3.2 Description of the Population

5.2.3.2.1 Population Composition

Considering the project application area, the majority of the population belongs to the Black population group, but the proportions differ. Ward 2 has the highest proportion of people belonging to the Black population group.

5.2.3.2.2 Age

The age distribution of the study areas under investigation shows that about two fifths of the population of Ward 2 are children aged 14 years or younger. This is higher than on local or district level and places greater pressure on the working age population.

5.2.3.2.3 Gender

The gender distribution for the study areas shows a bias towards females, especially on local and ward level. This can be indicative of males migrating to other areas in search of employment, leaving females behind to look after the children and the aged.

5.2.3.2.4 Language

The dominant home language in Mpumalanga is SiSwati, followed by IsiZulu, Xitsonga, IsiNdebele, and Sepedi. In the MLM almost 90% of the population have IsiZulu as home language, with an even higher proportion in Ward 2. As home language gives an indication of culture, it suggests that the MLM is culturally less heterogeneous than the district or provincial levels.

5.2.3.2.5 Education

The MLM has lower education levels than on district or provincial level, but not as low as on a ward level where a quarter of the population aged 20 years or older have received no schooling.

5.2.3.2.6 Employment

The area around the proposed development is rural in nature with high levels of poverty and unemployment. Ward 2 has the lowest proportion of people of economically active age (aged between 15 years and 65 years) that are employed. The proportion on ward level is almost half of the proportion on district level. This suggests that there are very few employment opportunities in the area. The majority of the employed people in the areas under investigation work in the formal sector. Ward 2 has the highest proportion of people working in the informal sector.

5.2.3.2.7 Household Income

The MLM has a lower average annual household income than on a district or provincial level with more than 80% of the households having a household income of less than R38 201 per year. On a ward level this figure is more than 90%, suggesting that this is a very poor area.

5.2.3.2.8 Housing

In the MLM more than a third of the households live in formal residential areas, and another third live on land that is classified as farms. The MLM has the largest proportion of households living on land classified as farms on all levels. In Ward 2 just over three quarters of households live in traditional residential areas and a fifth live on farms. Most of the dwellings in the area are houses or brick/concrete block structures that are on a separate yard, stand or farm. A large proportion of households in Ward 2 are made of traditional materials. The MLM has the smallest proportion of households that own and have fully paid off the residences, but the largest proportion of households that occupy their dwellings rent-free. In Ward 2 almost two-thirds of households own and have paid their residences off fully. Household sizes on a ward level tend to be much bigger than on local, district or provincial level, with just more than 40% of households consisting of more than four people, compared to just over 30% on local level and less on district and provincial level.

5.2.3.2.9 Access to services

On a ward level, just over half of the households get their water from a local or a regional water scheme while about a fifth gets their water from boreholes. Ward 2 has the highest proportion of households on all levels that get water from a borehole and the lowest proportion of households that get their water from a regional or local water scheme. Access to piped water, electricity and sanitation relate to the domain of Living Environment Deprivation as identified by Noble *et al.* (2006). On a ward level very few households have access to piped water inside the dwelling, but almost half have access to piped water inside the yard while about a third does not have access to piped water at all. Compared to local, district and provincial level, the proportion of people with piped water inside their dwellings are extremely low and the proportion of people with no access to piped water quite high.

In Ward 2 just over 10% of households do not have access to any sanitation services, while three quarters have access to pit toilets without ventilation. Access to clean water and sanitation were some of the major issues raised during IDP/budget consultations (GSDM IDP 2013/14).

Electricity is seen as the preferred source for lighting (Noble *et al*., 2006) and the lack thereof should thus be considered a deprivation. Even though electricity as an energy source may be available, the choice of energy for cooking may be dependent on other factors such as cost. Ward 2 has a higher incidence of households that use electricity as an energy source for

lighting than the MLM with more than three quarters of the households in the ward having access to electricity. Candles are the source of lighting that is used second most.

A relatively large proportion of households on both the local as well as ward levels has indicated that they have no rubbish disposal. More than 80% of households on a ward level have indicated that they have their own refuse dumps. Households with their own refuse dumps rely mostly on backyard dumping, burial and burning. These practices adversely impact on human health and the environment.

5.2.3.3 Social Infrastructure

There are several primary schools in the MLM that are widely distributed through the area and generally also cover rural areas (MLM IDP 2012/13). There are 15 secondary schools in the area that are scattered across the wards, but the need for more arises as the population grows. Mondi has a Science and Career Guidance centre that assists in career guidance and youth development for the people of Mkhondo.

There is one hospital in the municipal area that is located in Piet Retief as well as ten other health facilities (mainly clinics). Three of these facilities are located in Piet Retief. In addition there are two alcohol and drug rehabilitation centres, two old age homes, two centres for people with disabilities and two orphanages in the area. There are also four police stations and three post offices in the MLM. There is a need for more health care facilities, especially in rural areas to create easier access to basic health and family planning services.

5.2.3.4 Sensitivity Map

From a social perspective areas close to current residences of farmers and farm workers are regarded as having a **high** sensitivity rating as these people will then have to be relocated, and if they do not have to be not relocated, mining activities will have a very disruptive effect on their daily lives in terms of environmental nuisances such as vibrations, dust, noise, traffic as well as their sense of place. The area of **least concern** is where previous mining activities have been indicated as this area has already been disturbed. The areas in between are of **low** sensitivity as the impact on people will not be that high, but cattle grazing or forestry areas may be impacted on. This is indicated in the social sensitivity map in Figure 7.

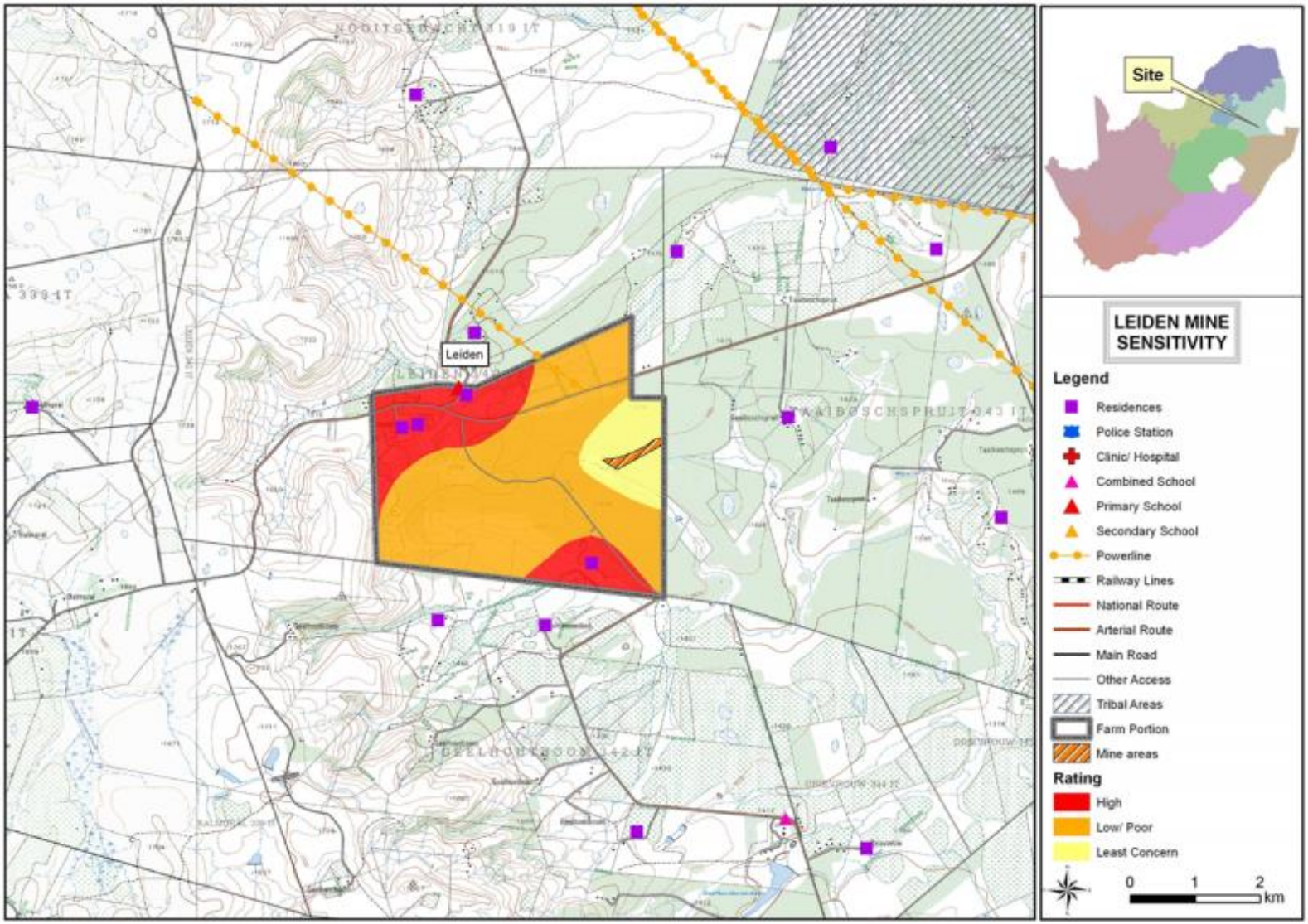


Figure 7: Social Sensitivity

5.2.4 CONCLUSION

Generally the communities in the area surrounding Leiden 340 IT are poorer than other communities situated in the Mpumalanga Province. This may be attributed to the lower levels of employment and poor infrastructure. Although the area is dominated by agriculture and forestry, jobs are selectively available seasonally for unskilled labourers. The prominent language of the area is SiSwati, which is widely spoken throughout the community. Other dominant languages are IsiZulu, Xitsonga, IsiNdebele, and Sepedi. Education in the area is poor as a result of the lack of schools available.

The consideration of fatal flaws within the scoping study were assessed by identifying the following potential impacts to the creation of opportunities, traffic impacts, vibrations, water, safety, negative community relations, influx of people, additional social infrastructure, visual and sense of place. None of the afore mentioned potential impacts are considered to be a fatal flaw due to the fact that they can be mitigated against.

5.3 ECONOMIC

Strategy4Good was appointed by EIMS to undertake the economic specialist study for the Leiden project. The following sections provide a summary of the economic environment that may be affected by the proposed Leiden project. Information has been sourced from the Strategy4Good scoping report. For further information, please refer to the full economic scoping report which is included in Appendix C.

5.3.1 INTRODUCTION

The study of economic development, which is generally broad in its scope, refers to the standard of living of citizens; most often measured by GDP per capita, literacy rate, and life expectancy. Economic development incorporates many elements of pure macro-economics, such as price stability, high employment, and sustainable growth. However, this is underpinned by the study of infrastructure and social development programs, such as education, housing, and road networks. The generic aspects that require assessment in the economic impact assessment are outlined below (Figure 8).

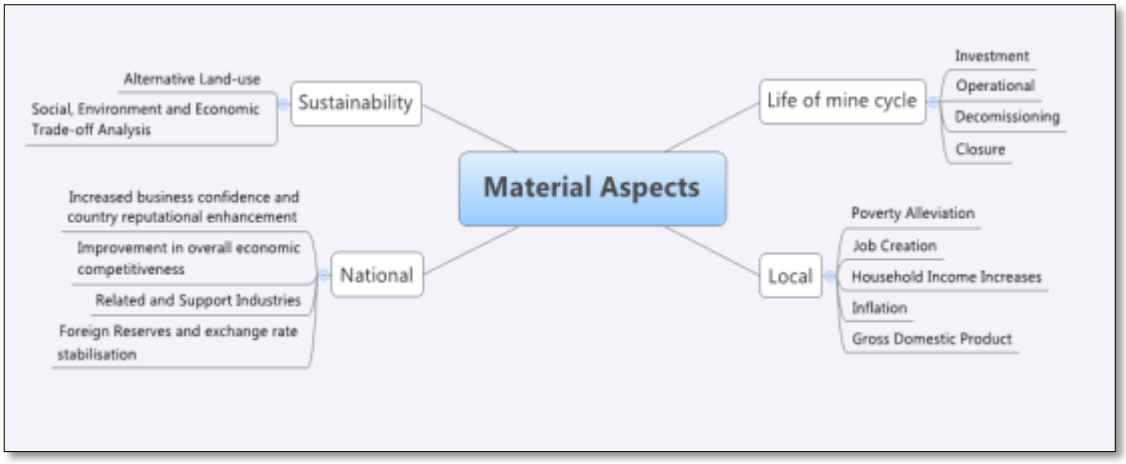


Figure 8: Material Aspects of an Economy

Mine operations have the potential to positively or negatively influence/affect the economic environment of the area. Mines contribute directly towards employment, procurement, skills development and taxes on a local, regional and national scale. In addition, mines indirectly contribute to economic growth in the local and regional economies because the increase in the number of income earning people has a multiplying effect on the trade of other goods and services in other sectors. However, the introduction of a mine into an area can have undesirable implications in the surrounding environment. This is because changes occur not only to the pre-existing land uses but also to the existing associated social structures and general way of life. The closure phase of the mine can have highly negative impacts because the surrounding environment loses the economic support that it receives during the operation of the mine. To ensure the economic safety of the communities which are affected by the mining operations, mitigation measures post closure of the mine will need to consider the economic environment of the communities and address these impacts effectively.

5.3.2 DATA COLLECTION

This study is mainly based on secondary economic data. The macro-economic data for this analysis was supplied by Quantec, a reliable regional economic data provider in South Africa.

5.3.3 RESULTS

5.3.3.1 Baseline Economic Environment

The national GDP growth rate is the key indicator of economic trends and business confidence in an economy; and this translates to willingness or unwillingness to invest, which is one of the spurs for any economic growth.

The Quantec data for industry sector GDP's as a percentage of the total South African GDP, measured over the period 2006 to 2011, indicates that the mining and construction industries had relatively good growth rates (in real terms) and the manufacturing industry suffered as a result of weak consumer demand. The largest industry sectors in the economy today are the

finance and service industries; which follows trends worldwide where the tertiary sectors are outgrowing the primary and secondary sectors.

Agriculture, an industry sector that ought to be a high employer in the country, has done relatively poorly in the national economy, and its relevance in terms of alternative land-use to mining needs to be noted. The hypothesis can be made that mining development would look more attractive than agricultural development purely based on national industry sector performance. This hypothesis would need to be tested on a micro-level in the Impact Assessment Report.

Figure 9 below provides a comparison of the provincial and national industry sector growth rates, as well as the relative sizes of the industry sectors compared to South Africa as a whole. It is clear that the mining industry sector contributes three (3) times as much to the provincial economy as compared to this industry sector's contribution nationally. Therefore, mining is a very large part of the Mpumalanga's economy and there are locational advantages to development in this sector in the Mpumalanga Province. In addition to this, the mining sector grew more strongly in Mpumalanga than nationally (2001-2011).

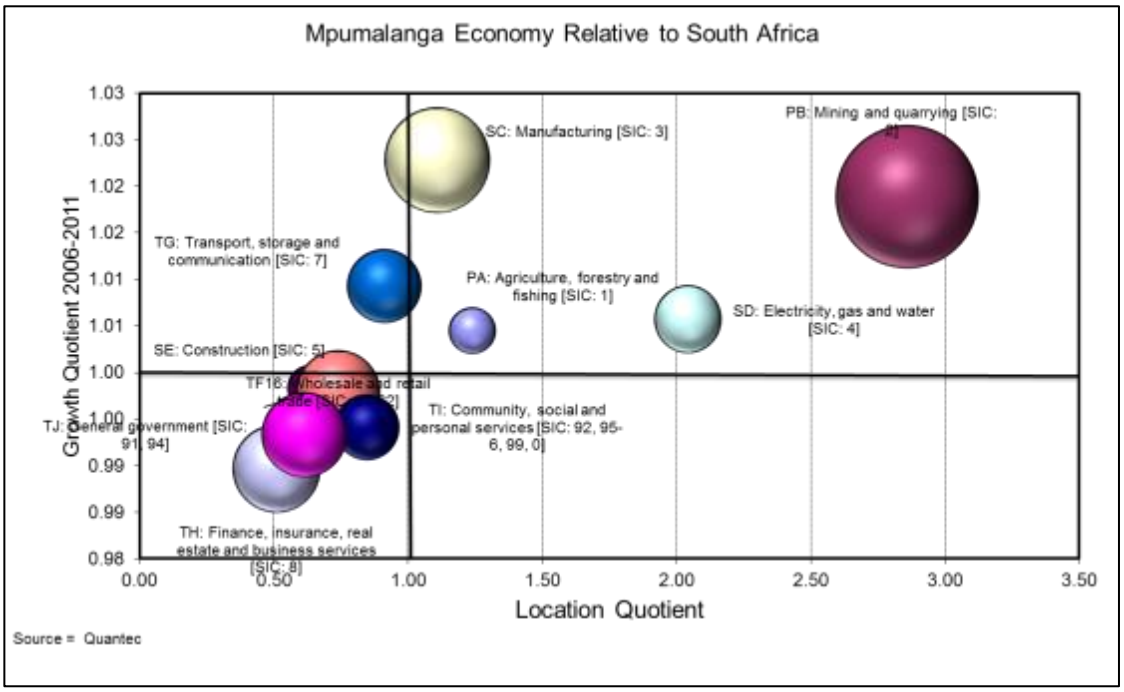


Figure 9: Mpumalanga Economy Relative to South Africa

The mining industry sector is also the mainstay of the GSDM and MLM economies. GSDM has a strong energy nexus, with coal miners, ESKOM, and Sasol very prominent players in the district economy. The GSDM and MLM economies have both grown better than the national economy in the last five years and this is likely due to the strong demand and development in the energy sector.

5.3.3.2 Employment and Under-Employment

The number of people formally employed in the MLM dropped by almost 50% from 2001 to 2011, which is probably the result of the downscaling of forestry operations. Timber and forestry remain under serious threat due to the increasing use of technology and a lower demand for paper in the economy. It also highlights the devastation caused by business discontinuity, of which mine closure in itself is a good example, and this aspect would require in-depth thought during mine development.

It is noteworthy that only 2 out of 10 working age people in the MLM have a formal job. This factor is a major driver in the emigration of people from this municipality. The national average for formal employment is approximately 3 out of 10 people, which is only slightly better than the MLM employment level.

Looking at the GDP versus Employment profile of the MLM below (**Figure 10**), one finds that 50% of formal employment is in the primary sector, namely mining and agriculture. This in itself poses a potential dilemma for alternative land-use as both these industries are heavily reliant on land and water resources for its well-being. Thus at any given time, these two industries are likely to compete for land-use and this will have a major impact on employment and livelihoods. An evaluation of this will be made in the EIA Phase.

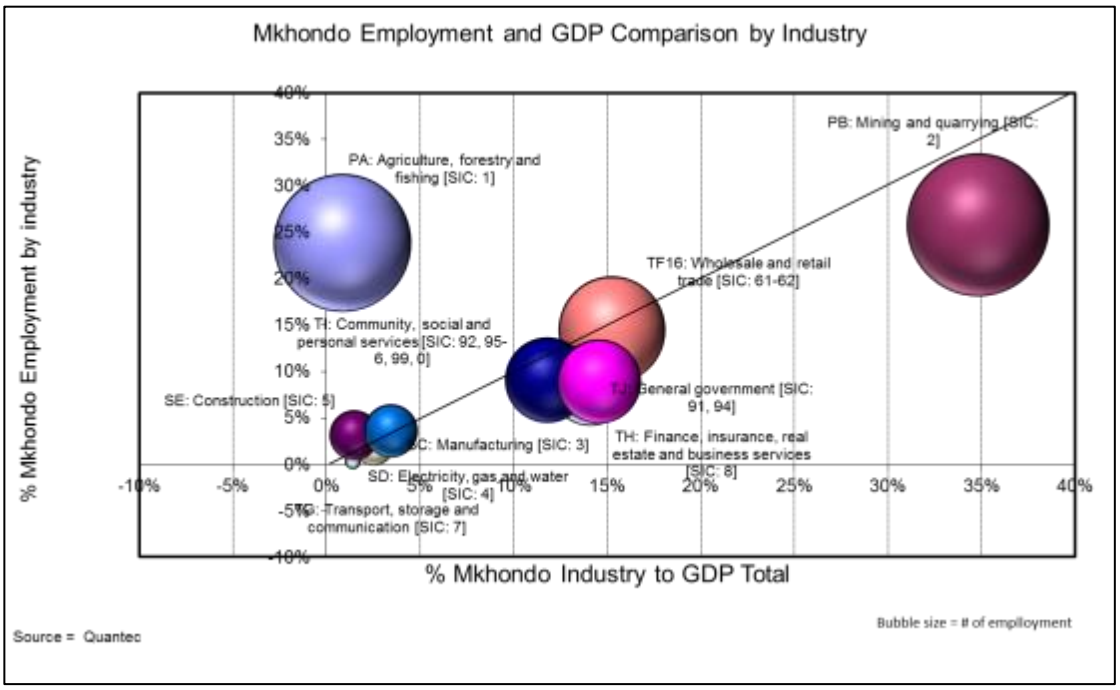


Figure 10: GSDM GDP and Employment Comparison

5.3.3.3 Economic Contribution of the Proposed Mine

The coal resources over the period of the LoM are estimated at 18 363 715 tonnes (measured, indicated, and inferred). It is estimated that a total of 2 199 404 tonnes of coal will be sold over the LoM; of which approximately 65% will be exported and 35% will be sold locally to Eskom. The total revenue is estimated at R1.3 billion over the life of mine.

One hundred and two (102) jobs are expected to be created by the implementation and production of the Leiden Coal Mine. Although the mining activities offer a period of increased job availability, this is short term as a mine is by definition not a sustainable enterprise. The Leiden Coal Mine will only be operational for 10 years. However, it is likely that several positive economic impacts will remain after closure of the mine.

5.3.3.4 GSDM Economic Development Plan

It will be vital for the proposed Mine to align with the GSDM Economic Development Plan. The GSDM, in its 2012/13 IDP, recognises the key problem of unemployment in the district's economy and has proposed the following initiatives to increase economic growth and improve employment:

- Sustainable Integrated Agricultural Development Programme for GSDM Land Reform Projects
- Establishment of the GSDM Development Agency;
- Potential Economic Development Corridors;
- Heyshope Dam Scoping Study;
- District Industrial Development Strategy (DIDS);
- Mining Beneficiation Master Plan;
- New Regional Information Management and Tourism Exhibition Centre;
- Development of the District Biodiesel Plant;
- SMME/Co-operatives Development and Support;
- Responsible Tourism Development, Promotion and Support;
- Development of a Regional Airport;
- Development and operationalization of a Region Library and Exhibition Centre;
- Promotion of Urban Renewal Programmes within the Municipality;
- Promote the Expansion of the Greening Economy in the District;
- Regional Training (Skills Development); and
- Establishment of a Regional Sports Complex.

For further information regarding each of the above initiates, please refer to the full economic report included in Appendix C of this report.

5.3.4 CONCLUSION

The Mpumalanga economy benefits from the strong demand for energy provided by coal fired power stations. In addition, the major industry sectors in the Mpumalanga economy, mining and manufacturing, are likely to exhibit sustainable economic growth in the future. This emphasises the strong economic need for coal resources for energy production. It is also noted that the MLM is in great need of business investment and job creation due to a reduction in employment levels over the last decade, as a result of the downscaling of forestry operations. Therefore the Leiden Coal Mine fits with the overall provincial economic structure in terms of employment and industry sector growth.

6 EXISTING STATUS OF THE BIOPHYSICAL ENVIRONMENT

The description of the baseline biophysical environment was obtained from the studies undertaken by the specialist team and in conjunction with EIMS. All specialist studies undertaken for the proposed Leiden Coal Mine are included as supporting technical appendices to this report.

6.1 GEOLOGY

The information presented below was summarised from the heritage specialist study and the geochemistry specialist study. For further information please refer to the full reports for these studies which are located in Appendix A and Appendix D respectively.

6.1.1 INTRODUCTION

The prevailing baseline geology and associated geological features are significant in that they provide an understanding of the following:

- Geological processes responsible for the determination of soil forms and paleontological resources;
- The potential for sterilisation of mineral resources due to infrastructure placement;
- Geochemistry and potential pollution of water resources from mineralised waste and stockpiles; and
- Preferential flow paths of groundwater that influence the dispersion of potential pollution.

6.1.2 DATA COLLECTION

Information regarding the geology of the area and study site was sourced from published literature together with the findings of the baseline palaeontological and geochemical studies undertaken. The geochemistry report also utilised geological data sourced from SA Data ENPMP00 Map Series in Shapefile format from 2000.

6.1.3 RESULTS

All of the known coal deposits in South Africa are hosted in sedimentary rocks of the Karoo Basin, a large retro foreland basin which developed on the Kaapvaal Craton and filled between the Late Carboniferous and Middle Jurassic periods. The Karoo Supergroup is lithostratigraphically subdivided into the Dwyka, Ecca, and Beaufort groups, succeeded by the Molteno, Elliot, Clarens, and Drakensburg formations. The coals range in age from Early Permian (Ecca Group) through to Late Triassic (Molteno Formation) and are predominantly

bituminous to anthracite in rank, which is a classification in terms of metamorphism under the influence of temperature and pressure.

Within the Karoo Basin, nineteen (19) coalfields have been defined based on variations in sedimentation, origin, formation, distribution and quality of the coals. These variations are in turn related to specific conditions of deposition and the local tectonic history of each area. The Project area under discussion is located in the Ermelo Coalfield, historically one of the most important coal producing areas of South Africa.

The Karoo Supergroup succession in the Ermelo Coalfield begins with the Dwyka Group diamictites, which occur unconformably above a pre-Karoo basement. These in turn are overlain by the coal bearing Vryheid Formation (Ecca Group), the basal Pietermaritzburg Formation of the Ecca Group not being present. A number of coarsening and fining upward sequences occur in the Vryheid Formation, which has been given various names by early workers. Cairncross (1986) adapted a more straightforward approach to the stratigraphic analysis of the Vryheid Formation strata, subdividing the entire column into only three simple units, which contain five (5) coal seams. These units are from the base up the A - E Seams sequences. The Vryheid Formation in this region hosts the complete sequence of Ermelo Coalfield coal seams. Numerous Jurassic aged dolerite dykes and sills intrude the Vryheid Formation at various stratigraphic levels. These intrusions tend to influence the stratigraphy and coal qualities in places.

The geochemical environment is fundamentally dictated by the mineralogy of the various lithological units. In general, the area has been divided into three lithological units. i.e. dolomite, arenite, and dolerite. Dolomite refers to the chemical sedimentary rocks of the Malmanie Group consisting of calcium-magnesium carbonate rocks, whereas the arenite refers to the siliciclastic coal-bearing rocks of the Ecca Group (and probably the Vryheid Formation). The dolerite is a late-stage igneous rock which has been emplaced into the sedimentary rocks.

Although Leiden is situated within the Ermelo Coalfield, the seams which occur on the property have been logged as the Ulrecht Coalfield seams of Gus and Dundas. The Gus seam lies stratigraphically above the Dundas seam with a parting of approximately 15 m. The Gus seam occurs at a depth of approximately 30 m from surface with an average width of 0.70 m, whilst the Dundas seam occurs at a depth of 45 m from surface with an average width of 1.45 m. Faults and dolerites occur with the project area. Dolerite was intersected in 8 boreholes. The local dip is typically around 2° to 4° within a local synclinal structure with a central axis striking southwest to northeast.

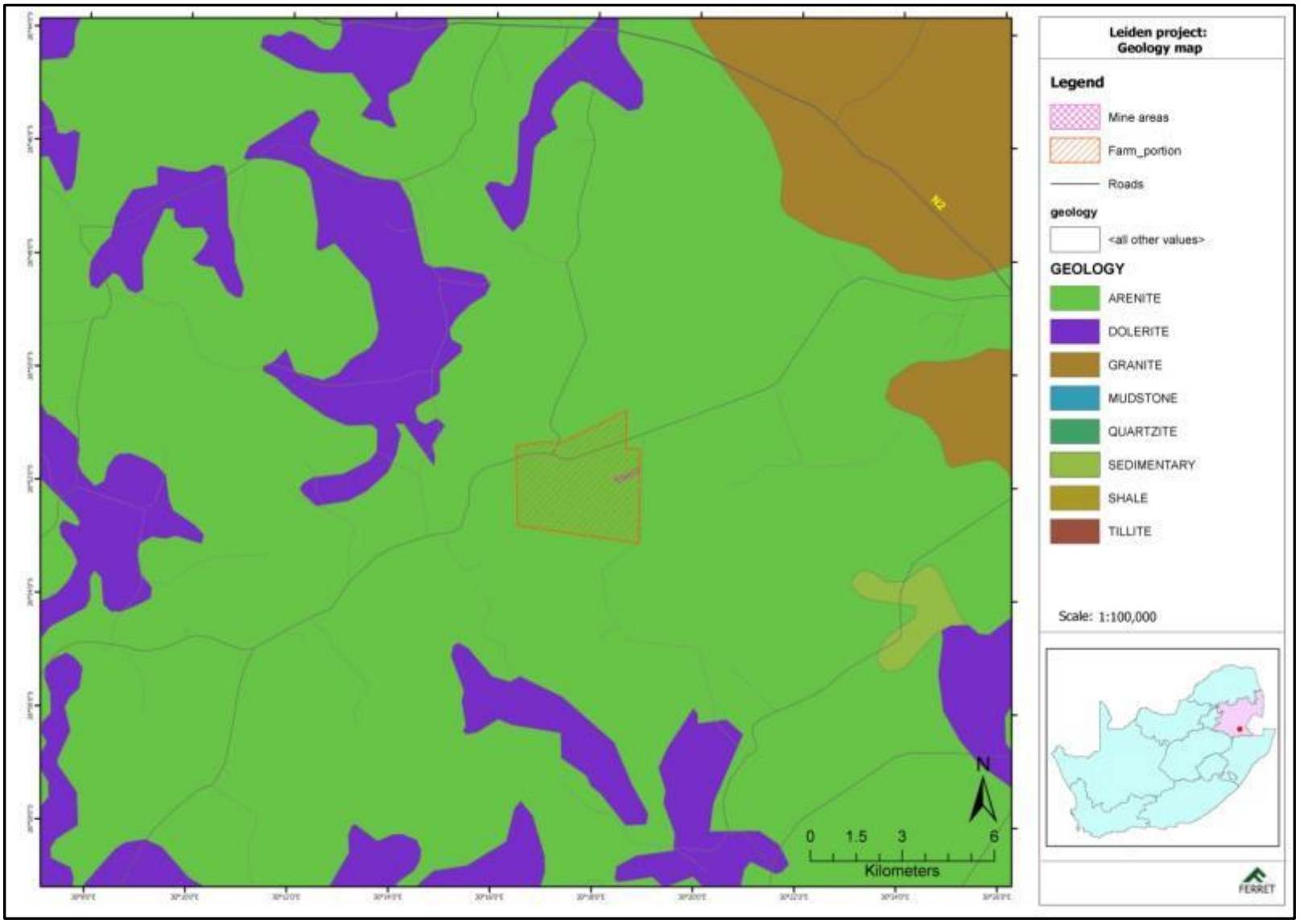


Figure 11: The Geology associated with the study site and the project application area

6.1.3.1 Sensitivity Map

Identification and description of sensitive receptors in relation to geochemistry are mainly based on the sulphide mineral content of the rock type. As explained in the geochemistry background section, the weathering of sulphide minerals, mainly pyrite, gives rise to the formation of AMD. AMD is the most important environmental threat related to mining. Coal-bearing rocks have the potential to generate AMD, because of the low modal distribution of sulphide minerals, i.e. mainly pyrite. Arenite and dolerite do not have such potential, because they do not contain any sulphide minerals, and are therefore classified in the “low sensitivity” category as identified in Figure 12.

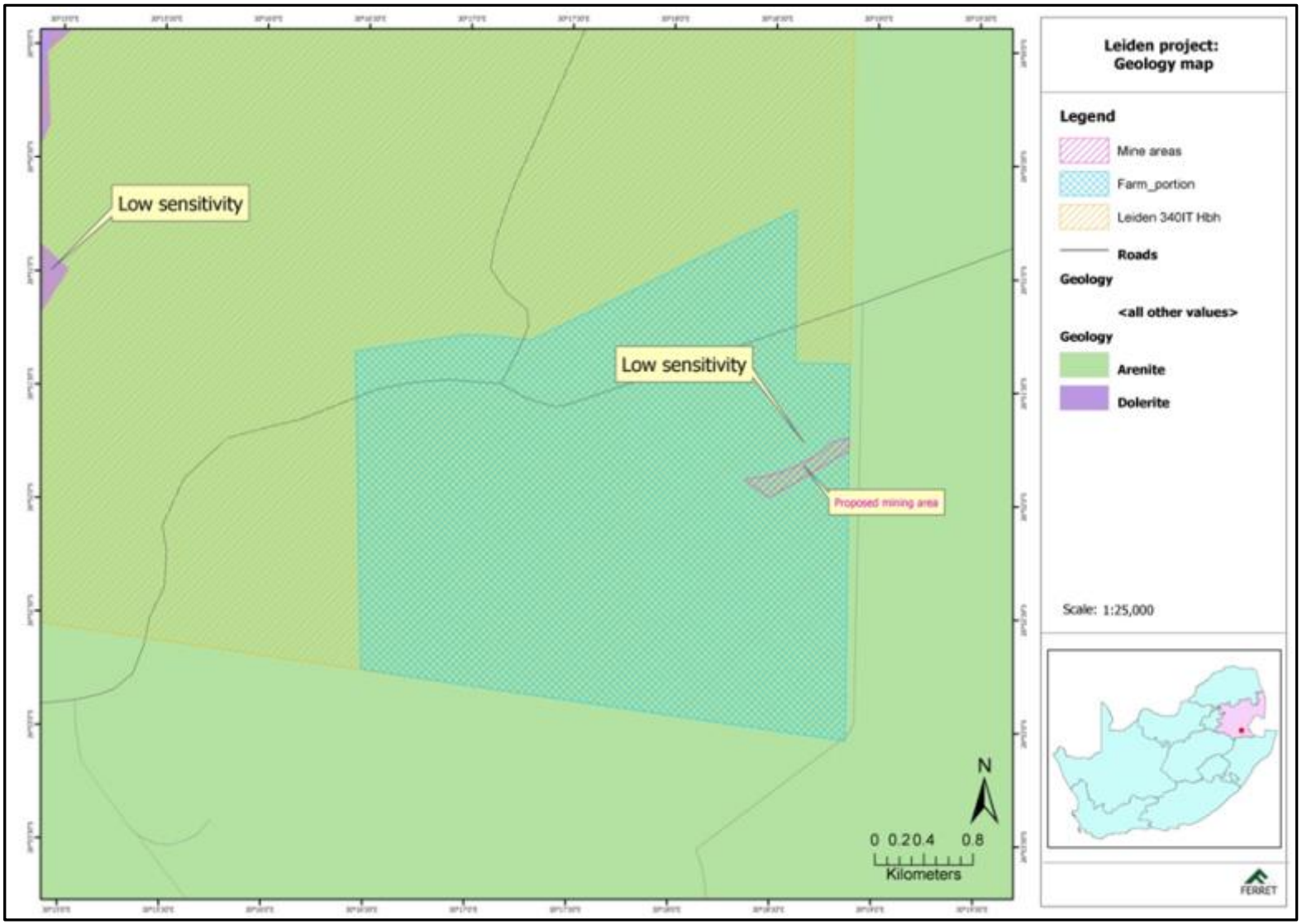


Figure 12: Geochemical sensitivity

6.1.4 CONCLUSION

The geochemical environment is fundamentally dictated by the mineralogy of the various lithological units. In general, the area has been divided into three lithological units. i.e. dolomite, arenite, and dolerite. Dolomite refers to the chemical sedimentary rocks of the Malmanie Group consisting of calcium-magnesium carbonate rocks, whereas the arenite refers to the siliciclastic coal-bearing rocks of the Ecca Group (and probably the Vryheid Formation). The dolerite is a late-stage igneous rock which has been emplaced into the sedimentary rocks. The weathering of sulphide minerals, often found in coal bearing rocks, gives rise to the formation of AMD; which is further discussed in Section 11.

6.2 TOPOGRAPHY

The information summarised below was sourced from the visual specialist study and the faunal specialist study. For further information, please refer to the full reports which are included in Appendix N and Appendix G respectively.

6.2.1 INTRODUCTION

Topography refers to the surface shape and features of an area. The topography has the potential to be altered by the removal of the mineral resource from the study area. Possible changes to the current topography can occur which may impact on ground water, surface water drainage, visual character and the safety of both people and animals if not properly mitigated.

6.2.2 DATA COLLECTION

Data regarding the topography of the study area was sourced from the 1:50 000 scale topo-cadastral map. Warnock, S. & Brown, N. (1998) and Lynch, K. (1992) were utilised as source documents for descriptions of the topography of the site.

6.2.3 RESULTS

The study area lies between 1 450 and 1 600 m above sea level, with the highest point on the western boundary. The terrain falls gently to the east, with slopes of between 2% and 5% and is generally undulating throughout. The area is drained by tributaries of the Ngwempisi and Hlelo Rivers, which flow generally from west to east. The opencast area of the mine and its relevant infrastructure will have a minimal influence the baseline topography due to the limited nature of the invasive activities scheduled to take place.

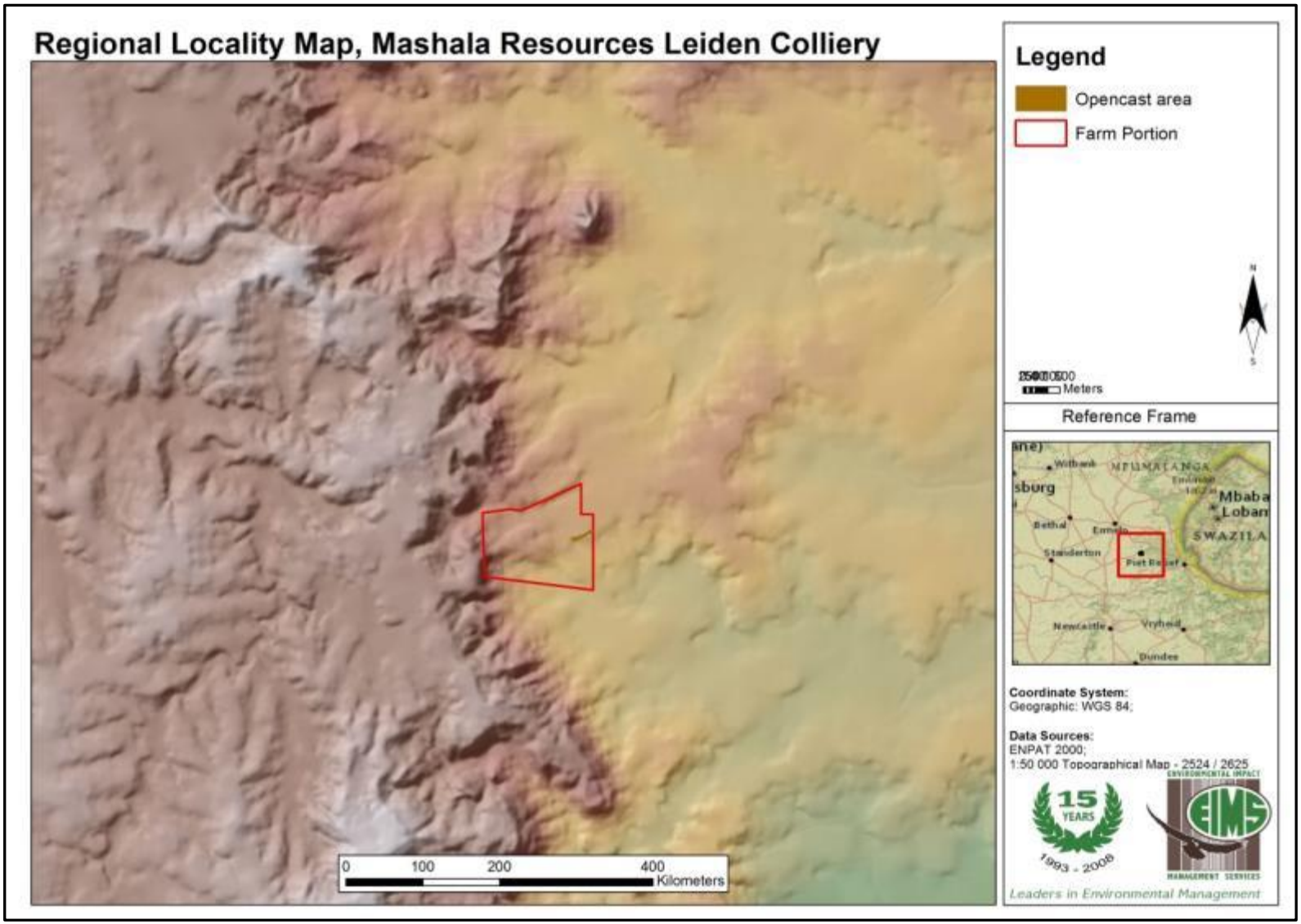


Figure 13: A DEM depicting the locality of the Leiden 340 IT study area and the respective elevation

6.2.4 CONCLUSION

The natural pre-mining topography falls gently to the east, with slopes of between 2% and 5% and is generally undulating throughout. The site also includes several stream beds and other depressions in the landscape, with dams occurring in several places. Opencast mining will impact on the topography of application area; however this is likely to be minimised due to mitigation measures that will be instituted during the process and during the rehabilitation phase.

6.3 CLIMATE

The information summarised in the section below was sourced from the air quality specialist study. For further information, please refer to the full air quality scoping report which is included in Appendix L.

6.3.1 INTRODUCTION

Climate can be defined as weather conditions that have occurred over a long period of time in an area. Dominant climatic features that climate is centred around are temperature, rainfall, wind and evaporation. These climatic features can affect the mining environment in a number of ways:

- Influence erosion;
- Influence vegetation growth, which affects rehabilitation planning;
- System monitoring of ground water balance/availability;
- Evaporation rates influence vegetation growth;
- Air temperature can influence air dispersion through atmospheric stability and mixing layers; and
- Wind speed and direction can influence erosion and the dispersion of potential atmospheric pollutants.

6.3.2 DATA COLLECTION

Fifth-Generation Penn State/NCAR Mesoscale Model (MM5) modelled meteorological data for the application area (26.866761°S; 30.308845°E) were used to generate wind roses based on 16 spokes, representing the directions from which winds blew during the period 2010 – 2012. A monthly-average ambient temperature trend was calculated using MM5 data, with the location of the theoretical MM5 station located in the centre of the proposed open pit. The long-term temperature trends recorded for Nooitgedacht Weather Station from 1951-1984 were considered to be representative of the proposed mine site. Nooitgedacht is located at 26° 31” S and 29°58” E, near the centre of Ermelo and is the nearest historical weather station available.

6.3.3 RESULTS

A description of the climate of the study area is based on the climate of the closest weather station, Nooitgedacht. The climate of the study area is typical of the South African Highveld with warm summers and cold winters. The rainfall associated with the Mpumalanga region is deemed Mediterranean. The majority of the annual average rainfall of 748 mm falls in summer (October to April). The extreme maximum temperature is 24.6^{o}C and the extreme minimum temperature is 0^{o}C. Fog occurs for an average of 20 days a year, generally in the winter.

Wind roses based on 16 spokes, representing the directions from which winds blew during the period 2010 - 2012 (Figure 14) were created for the study area. The colours reflect the different categories of wind speeds with the dotted circles indicating the frequency of occurrence. The flow field is dominated by winds from the east and east-north-east as well as the west and west-north-west. During day-time conditions, frequency of stronger winds from the west and west-north-west increases while winds from the north-east and east-north-east are more common at night.

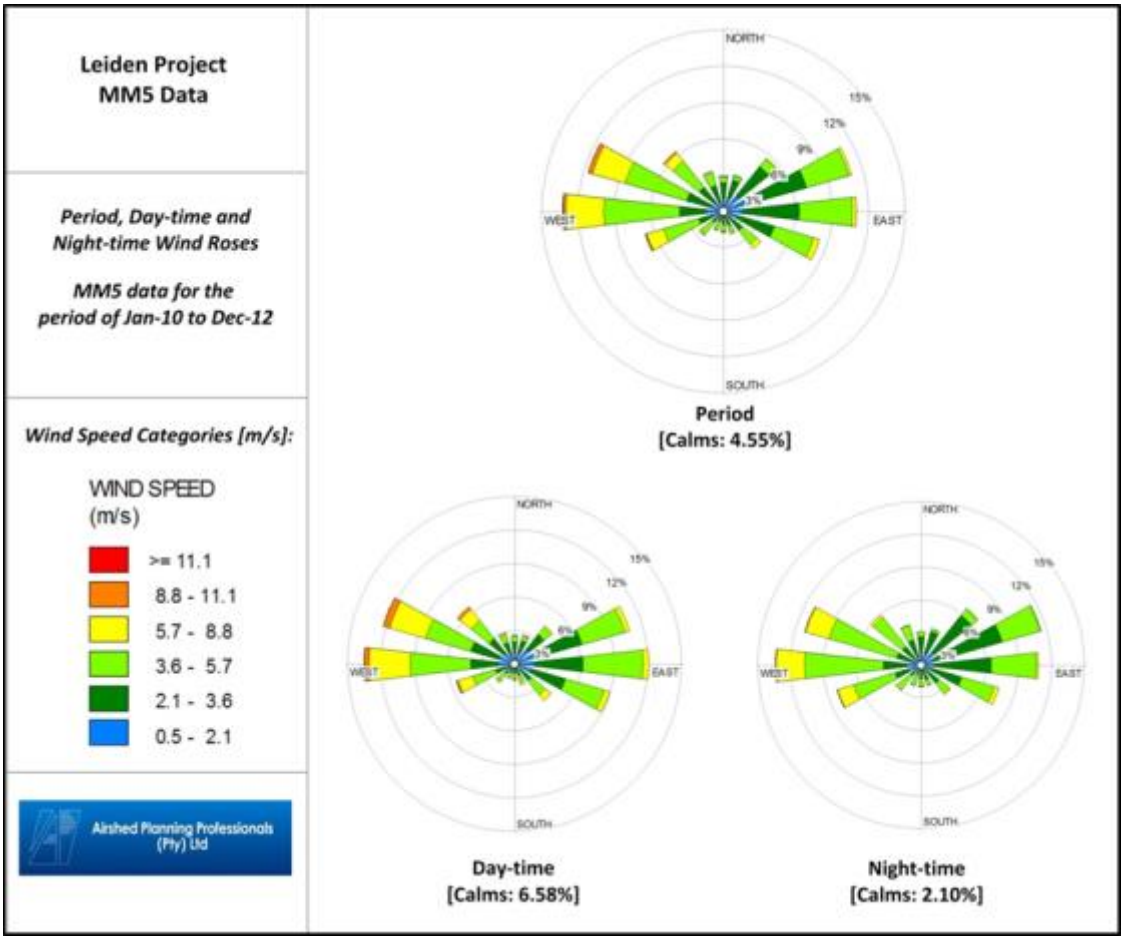


Figure 14: Seasonal variation in wind direction

Seasonal variation in wind direction is also evident (Figure 14) with winds from the west and west-north-west dominating during autumn and winter. Easterly winds are more frequent in

summer and spring. Strong westerly's and west-north-westerly's occur during winter and spring.

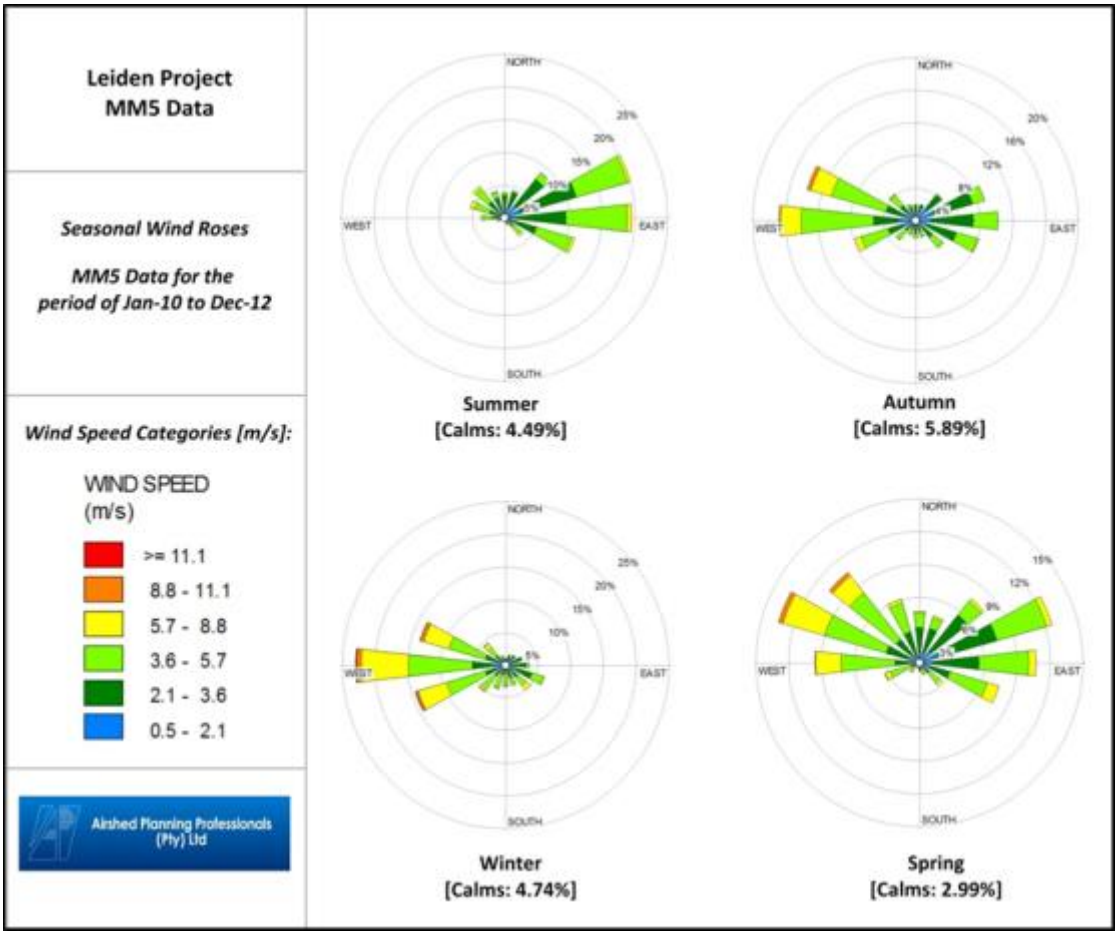


Figure 15: Monthly average ambient temperature trend

A monthly-average ambient temperature trend (Figure 15) shows temperatures typically range between 14°C and 24°C during summer months at the site, with daily-averages in the order of 18°C. During winter months, temperature ranges of between 3°C and 16°C are typical, with average temperatures of 8.3°C in June and 8.1°C in August.

The vertical dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness (Tiwary and Colls, 2010).

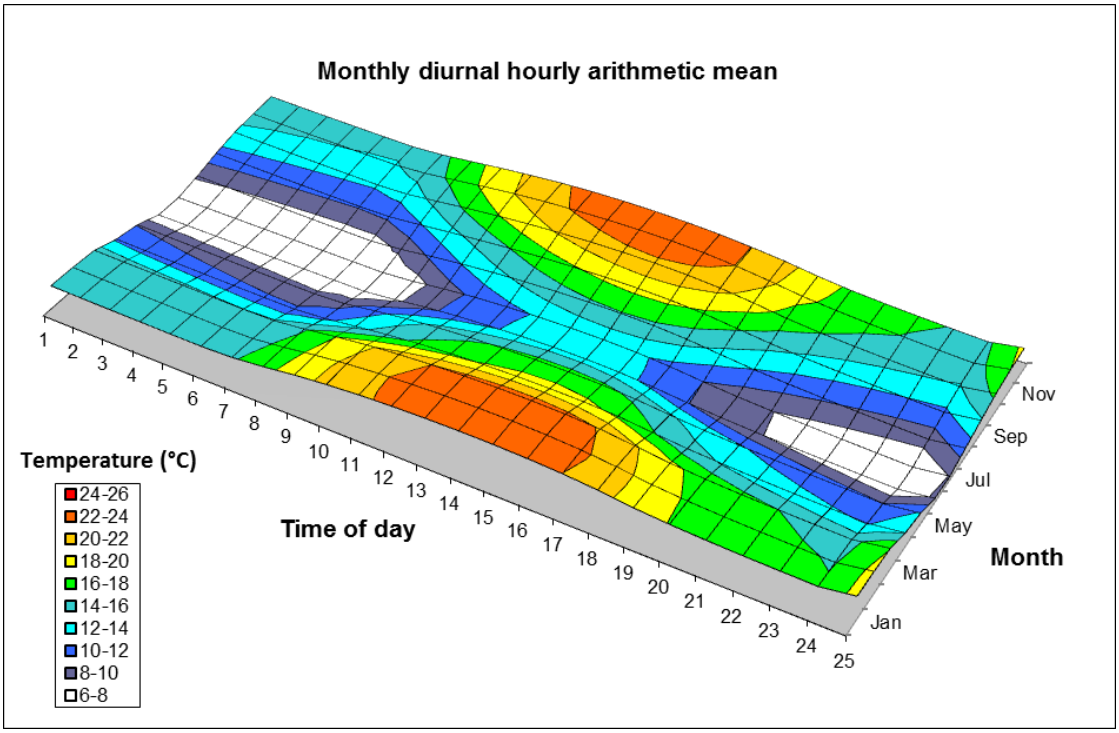


Figure 16: Monthly diurnal hourly arithmetic mean

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers (Tiwary and Colls, 2010). Temperature provides an indication of the extent of insolation, and therefore of the rate of development and dissipation of the mixing layer. The long-term temperature trends recorded for Nooitgedacht from 1951-1984 seen in Figure 16 were considered. Minimum long-term temperatures have been recorded as ranging from 0°C to 16.9°C with maximum temperatures ranging between 16.3°C and 24.6°C (Table 6). Mean temperatures, recorded over the long-term, ranged between 3.1°C and 16.9°C.

Table 6: The long-term temperature trends recorded for Nooitgedacht from 1951-1984

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nooitgedacht	Max	24.6	24.3	23.6	21.2	18.9	16.3	16.8	19.5	22.5	23.2	23.2	24.2
	Mean	16.9	16.1	14.8	11.8	7.7	3.1	3.4	7.1	12.1	14.7	16.1	16.9
	Min	12.9	12.6	11.1	7.8	3.6	0	0	2.6	6.6	9.4	11.1	12.3

The rainfall associated with the Mpumalanga region is deemed Mediterranean. The long-term average total annual rainfall for Nooitgedacht is ~748 mm. Long-term monthly average rainfall data shows that rain falls mainly in summer from October to April (Figure 17), with the peak being in December (Schulze, 1986). Between 2010 and 2012 MM5 modelled data shows higher than average annual rainfall, especially in January and December (Figure 17). While

snow and hail are relatively rare, fog does occur in the vicinity of Nooitgedacht for an average of 20 days per year, especially in the winter months.

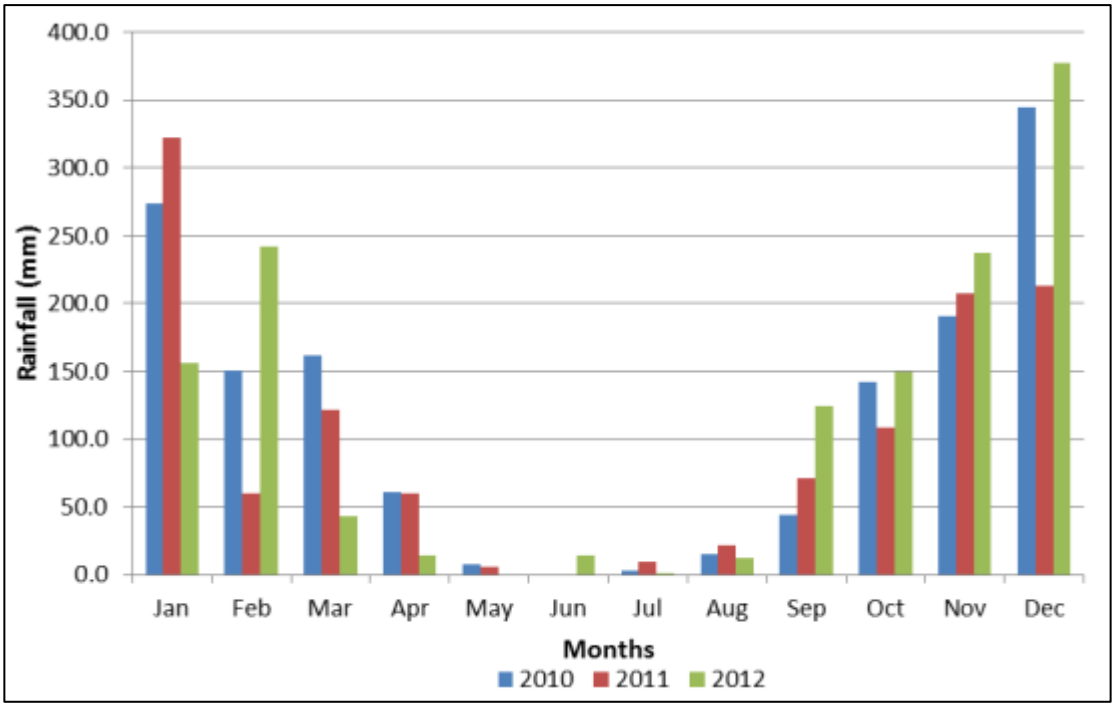


Figure 17: Long-term average total annual rainfall for Nooitgedacht

Figure 17 indicates that the site receives the majority of its rain during the summer months. December and January see the most rainfall in the summer with June and July the least rainfall occurring in the winter months. December 2012 yielded the highest rainfall in the dataset at over 350 mm. The lowest rainfall represented was 0 mm for May 2012, June 2010 and 2011.

6.3.4 CONCLUSION

The overall climate in the study area is typical of the South African Highveld with warm summers and cold winters. High evaporation rates reduce infiltration rates, while the high rainfall levels can increase the erosion potential and the formation of erosion gullies. The presence of vegetation does however allow for surface infiltration thereby reducing the effects of erosion. The mixing of atmospheric layers resulting in the formation of temperature inversion and the presence of cloud cover limits the dispersion of pollutants into the atmosphere. These climatic aspects need to be taken into consideration during rehabilitation and surface water management planning.

6.4 SOILS

The Agricultural Research Council Institute for Soil, Climate and Water (ARC-ISCW) was appointed by EIMS to undertake the soils, land use, and land capability specialist study for the Leiden project. The following sections provide a summary of the soil environment that

may be affected by the proposed Leiden project. Information has been sourced from the ARC-ISCW scoping report. For further information, please refer to the full soil scoping report which is included in Appendix E.

6.4.1 INTRODUCTION

Soils are an important component of most ecosystems. It can be considered an ecological driver and is the medium in which most vegetation grows and a range of vertebrates and invertebrates exist. From a mining perspective, soil is even more significant as mining is a temporary land use where after rehabilitation (using soil) is the key to re-establishing post closure land capability that will support post closure land uses.

Mining projects have the potential to damage soil resources through physical loss of soil and/or the contamination of soils, thereby impacting on the soils ability to sustain natural vegetation and altering land capability. The contamination of soils may contribute to the contamination of surface and groundwater resources. Loss of the topsoil resource reduces chances of successful rehabilitation and restoration.

6.4.2 DATA COLLECTION

Data sources for the assessment included the existing map sheet 2630 Mbabane (Schoeman and Fitzpatrick, 1979) from the National Land Type Survey (published at a 1:250 000 scale), together with a small scale site visit during which auger samples were collected. The soils are classified according to MacVicar et al. (1977).

6.4.3 RESULTS

A land type is defined as an area with a uniform terrain type, macroclimate, and broad soil pattern. Information obtained from the Land Type Survey (Schoeman & Fitzpatrick, 1976) indicated that the area is dominated by yellow-brown, structure less soils (land type Bb35). The soil varies slightly from sandy loam to sandy clay loam and the effective depth also varies somewhat, generally between 600 mm and 1200 mm. Small areas of the study area are dominated by shallow soils and a few surface outcrops. The prevailing agricultural potential of the area is moderate to high. The majority of the soils on site have an average effective soil depth of 800 mm or more which is more than adequate for agricultural activities. The application area under investigation, based on a desktop survey, is covered by two land types, namely Bb35 and Fa162. The distribution of the land types occurring in the study area is shown in **Figure 18**.

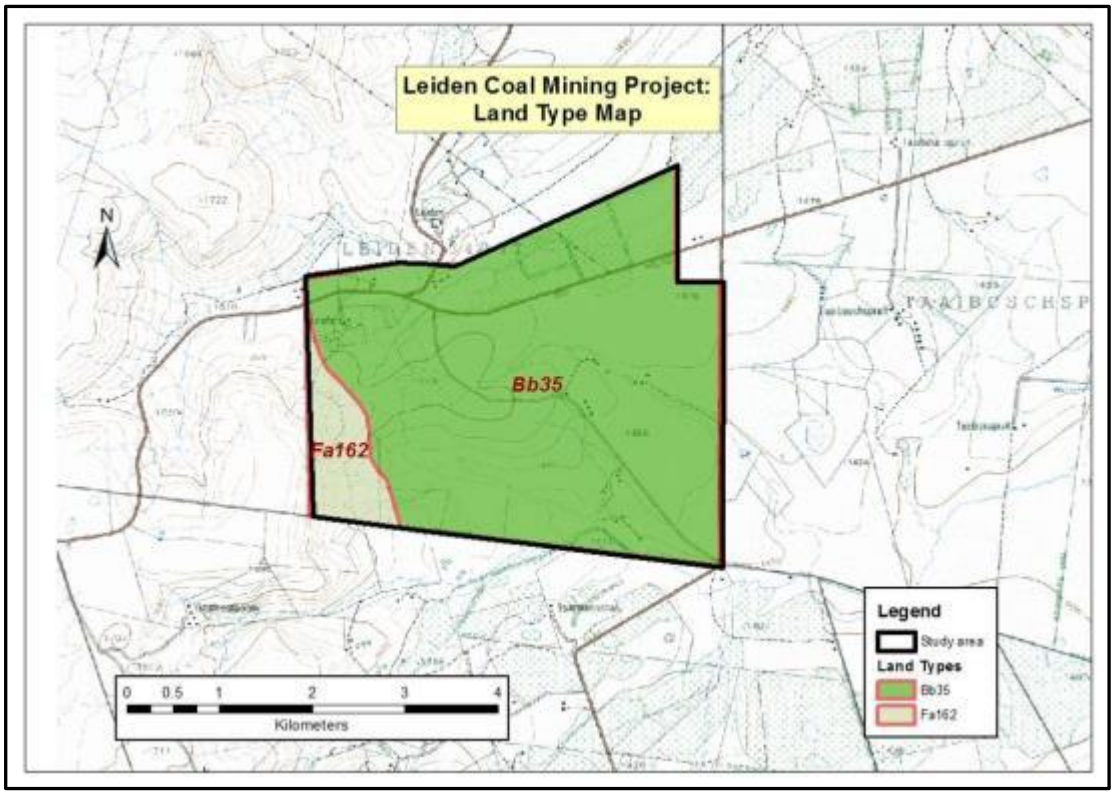


Figure 18: Land type map, Leiden Coal Mining Project

Table 7 below indicates the soils in order of their dominance on the site.

Table 7: Dominant soil types and their respective characteristics

Land Type	Dominant Soils	Depth (mm)	Percentage of Land Type	Characteristics	Agricultural Potential (%)
Bb35	Clovelly 16/17/18	450-900	18%	Yellow-brown, structureless, sandy clay loam soils on weathering rock	High: 29.6 Mod: 21.5 Low: 48.9
	Hutton 17/18 + Griffin 12/13	600-1200	16%	Red-brown to yellow-brown, structureless, sandy clay loam soils, on weathering rock	
	Avalon 16/17	600-1200	13%	Yellow-brown, structureless, sandy clay loam soils on mottled, soft plinthite	
Fa 162	Mispah 10 + Glenrosa 16/17	200-450	25%	Grey-brown, structureless, sandy loam to sandy clay loam topsoils on hard to weathering rock	High: 4.6 Mod: 2.2 Low: 93.2
	Rock	-	25%	Surface outcrops	

	Hutton/Clovelly 16	400-600	15%	Red-brown to yellow-brown, structureless, sandy clay loam soils, on hard to weathering rock	

6.4.3.1 Sensitivity Map

The two categories of sensitivity within the study area, as far as soils are concerned, are:

- High (rating +1): comprising wetland areas, where it is very important to retain the natural soil characteristics, including soil drainage;
- Low (rating 0): all remaining areas, comprising moderately deep to deep, friable soils suitable for arable cultivation. However, due to the fact that the mining operations will comprise underground workings, these areas should be relatively little affected.

In terms of this report, the exact extent of these areas cannot be determined in more detail at this stage, but by using topographical and aerial photo maps, as well as a reconnaissance visual inspection during the site visit, the general extent of these areas has been assessed, and this is shown in Figure 19.

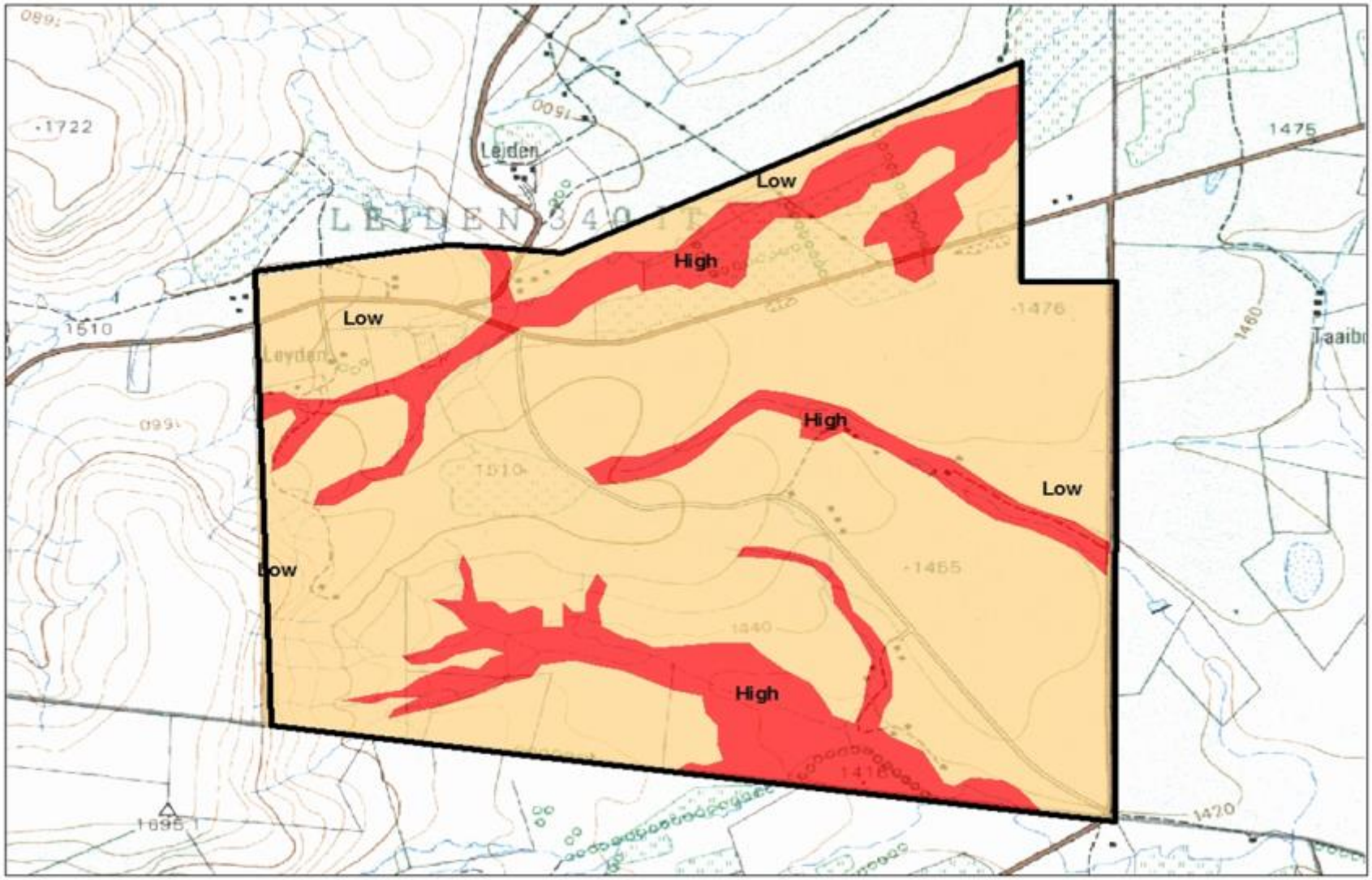


Figure 19: Soil sensitivity

6.4.4 CONCLUSION

The site is dominated by yellow-brown, structure less soils. The wetland soils on site have been identified as most sensitive and impacts to these areas would not be easily mitigated. The rest of the soils are classified as low sensitivity in relation to wetland soils, although these soils are generally moderately deep to deep, with a moderate to high potential for agricultural production. These are therefore still valuable soils and it will be imperative to ensure that they do not become disturbed or degraded to any excessive degree otherwise rehabilitation of the area post mining could become problematic.

6.5 LAND USE

The Agricultural Research Council Institute for Soil, Climate and Water (ARC-ISCW) was appointed by EIMS to undertake the soils, land use, and land capability specialist study for the Leiden project. The following sections provide a summary of the land uses that may be affected by the proposed Leiden project. Information has been sourced from the ARC-ISCW scoping report. For further information, please refer to the full soil scoping report (Appendix E) and vegetation assessment report (Appendix F).

6.5.1 INTRODUCTION

Each land use of an area has an inherent value based on the employment and income it generates. Mining activities have the potential to affect land uses both within the surface use area and in the surrounding areas. This can be caused by physical land transformation and through direct or secondary impacts. The key related impacts include loss of soil, loss of biodiversity, pollution of water, dewatering, air pollution, noise pollution, and damage/destruction from blasting.

6.5.2 DATA COLLECTION

The land use for the project application area was deduced by means of site visits undertaken on the 3rd and 16th September 2013 by ARC-ISCW and SPEC respectively. During the first of these site visits a visual inspection and survey was completed, confirming the land type described by Schoeman & Fitzpatrick (1979). Land uses were also identified and discussed with the landowner during a meeting with Equispectives Research and Consulting Services.

6.5.3 RESULTS

The proposed area for mining lies immediately to the east of the south-eastern Mpumalanga escarpment. To the west, above the escarpment, the dominant land use is grazing land, with occasional areas of dry land cultivation. Below the escarpment are more favourable soils where commercial forestry plantations take place, extending to the east and north-east.

The results for the desktop study and the site visit determined that forestry plantations occur in most of the higher-lying parts of the study area. Closer to the stream beds, and especially

in the wider valley floors in the north and south of the study area, grassland (either natural or cultivated pastures) occur, presumably because the soils are too wet for sustainable tree growth.

Figure 20 provides a representation of the different land uses that are found to occur within the study site, namely:

- Forest Plantation;
- Wilderness (consisting of grasslands and wetlands);
- Built-up Land; and
- Vacant (Old Fields).

Although the aforementioned land uses compete for space, there will be co-existing land uses occurring within the project application area.

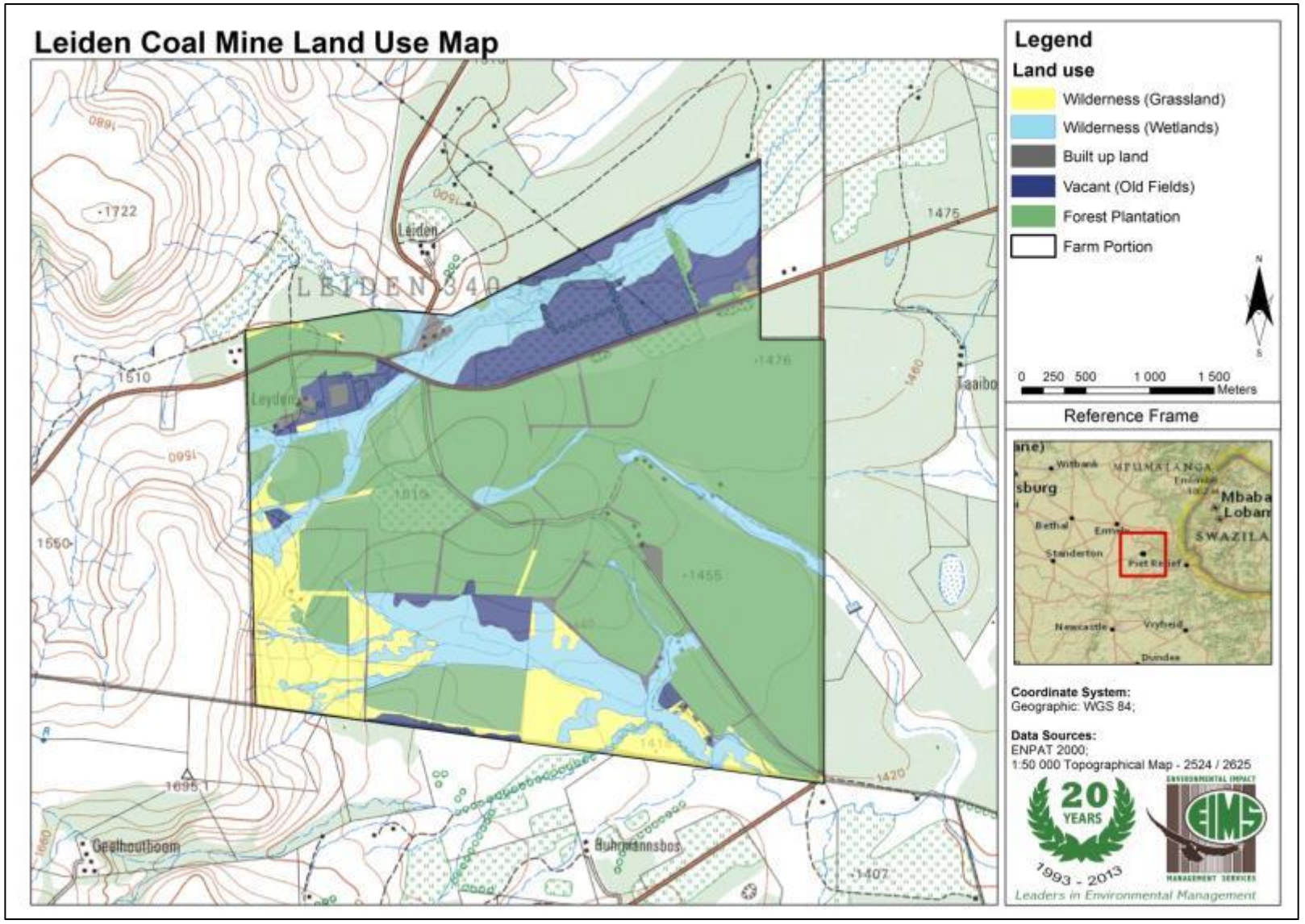


Figure 20: Land use map for Leiden 340 IT

Figure 20 illustrates the different land uses that can be found within the study area. The map is based on the desktop studies undertaken together with brief site visits and will be refined in the EIA Phase.

6.5.4 CONCLUSION

Several land uses are present on the site, with various levels of disturbance included. The predominant land use at present is forestry followed by wilderness and vacant land including old fields. Coal deposits are prevalent across the study area deeming it potentially minable. Mining operations often conflict with existing land uses and therefore the proposed mine has the potential to affect the current land use and negatively affect it.

6.6 LAND CAPABILITY

The Agricultural Research Council Institute for Soil, Climate and Water (ARC-ISCW) was appointed by EIMS to undertake the soils, land use, and land capability specialist study for the Leiden project. The following sections provide a summary of the land capability that may be affected by the proposed Leiden project. Information has been sourced from the ARC-ISCW scoping report. For further information, please refer to the full soil scoping report which is included in Appendix E.

6.6.1 INTRODUCTION

It is important to adopt a holistic approach towards the land capability of the study area in order to recognize how the area will possibly be affected by the Leiden Coal Mine. The land capability classification is based on the soil properties and related potential to support various land use activities. Arable land was identified as the dominant land capability class. The land capability is expected to vary with certain soils having a higher potential for arable cultivation. Mining operations have the potential to significantly transform the land capability, often irreparably. The types of impacts related to land capability involve post mining compaction, loss of fertility, impeded soil drainage and insufficient depth of the replaced soil. In many cases, mining may result in the land capability class would change from arable to grazing post closure.

6.6.2 DATA COLLECTION

The data used in this study was obtained from Schoeman & Fitzpatrick (1979) and was used together with a site visit and soil sampling results to determine the pre-mining land capability of the Leiden Coal Mine area.

6.6.3 RESULTS

Plantation forestry, grasslands, wetlands and wilderness areas were pre-identified land capabilities that could be affected by mining operations. The land capability is expected to vary, with certain soils having a higher potential for arable cultivation than others. The soils

occurring in the study area are generally moderately deep to deep, with a moderate to high potential for agriculture, although the prevailing land use is forestry (which also requires deep soils). The land capability is influenced by factors such as rainfall in the area and the soil depth. Where the natural drainage regime of the soil is disturbed, waterlogging can occur in previously freely-drained environments, both as a result of soil compaction and that caused by changes in the underlying material. This in turn can result in changes to land capability. It will therefore be critical to try and ensure that the prevailing topography, with associated drainage aspects, is retained, so that the natural soil drainage patterns are disturbed as little as possible.

The grazing capability by livestock is predicted to be high with around 6-8 ha per large stock unit (Schoeman & van der Walt, 2004). It is not possible to provide a detailed land capability map at this time as the specific distribution in the area must still be established, which will be undertaken in the EIA phase.

6.6.4 CONCLUSION

Mining operations may change the land capability, potentially limiting the extent of the forestry due to the changes in the soil (depth, compaction, drainage etc.).The land capability is likely to vary throughout the study area. Currently the predominant land use is plantation forestry, although the soil fertility is generally good and land capability is therefore relatively high and may support other land uses. It is notable however that very little agricultural activity takes place in the greater area.

6.7 FLORA

Spatial Ecological Consulting (SPEC) was appointed by EIMS to undertake the vegetation assessment specialist study for the Leiden project. The following sections provide a summary of the vegetation that may be affected by the proposed Leiden project. Information has been sourced from the SPEC scoping report. For further information, please refer to the full vegetation assessment scoping report which is included in Appendix F.

6.7.1 INTRODUCTION

Vegetation is a key component of ecosystems for a number of reasons. Vegetation forms the foundation of the food web as well as providing both habitat and food for animals. Many plant species also hold cultural, medicinal or spiritual meaning to certain communities. The plantations associated with the project application area also provide a source of income.

The mining activities and the establishment of the supporting infrastructure have the potential to result in loss of vegetation, habitat disruption, loss of ecosystem functionality, habitat transformation, spread of alien invasive species and ultimately a reduction in overall biodiversity.

6.7.2 DATA COLLECTION

The data used in this vegetation study was collected from a number of sources to provide a clearer view of the vegetation on site. Data was acquired from Mucina and Rutherford (2006), together with a desktop analysis and a site visit were undertaken to establish a baseline for the area. Species lists from a quarter-degree search of the site and project application area was also utilized from the biodiversity information database SIBIS (http://sibis.sanbi.org/) and compared to the South African plant Red Data list and the NEMBA threatened and protected species list.

6.7.3 RESULTS

The majority of the study area falls within the Eastern Highveld Grassland vegetation type, which is classified as Endangered by Mucina and Rutherford (2006) and as Vulnerable in the NEMBA list (2011). The south-west corner of the site falls within the Wakkerstroom Montane Grassland vegetation type, which is classified as Least Threatened, although very little of it is formally protected (Mucina & Rutherford 2006). These classes/rankings are important as they assist in determining the area's floral sensitivity.

A number of broad vegetation communities were identified on site:

- Plantations (Alien species);
- Primary vegetation (Primary grasslands and Primary rocky grassland);
- Old fields (Disturbed); and
- Wetland vegetation.

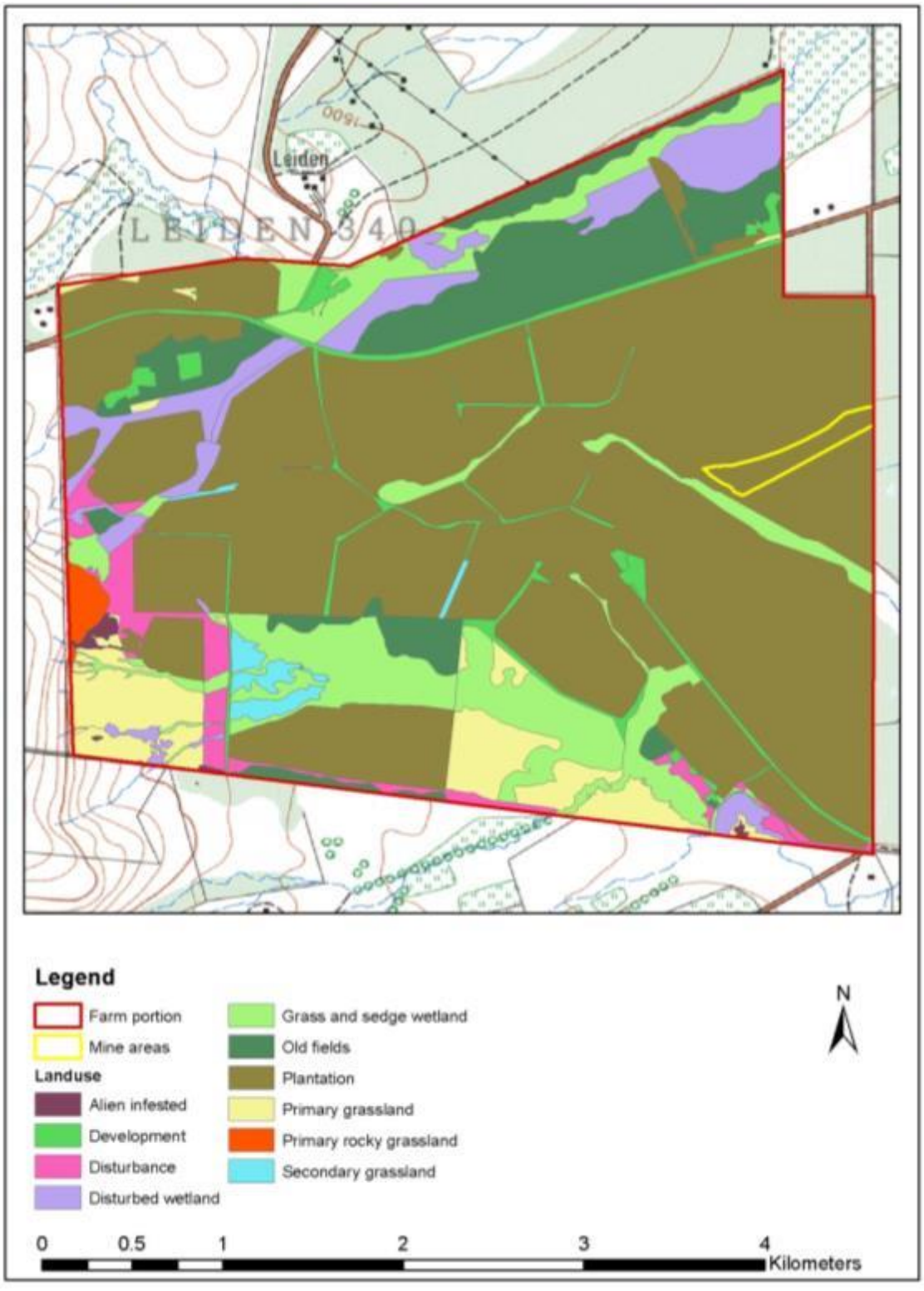


Figure 21: Map indicating the vegetation types and land uses that may be located within the study area

Several threatened species were recorded in the surrounding area and a number of these species may potentially occur within the site itself. The species that may potentially be present on site are indicated in Table 8. Most of the species are expected to occur in the hilly area in the south-western corner of the site with some occurring in the areas of primary vegetation.

Table 8: Threatened species list

Species Name	IUCN Status	Habitat	Presence On Site
Aloe kniphofioides	VU	In hilly and mountainous areas, in stony ground and in damp grassy places.	Possible
Asclepias bicuspis	CR	Mistbelt grassland, in well-drained soil in annually burned grasslands, including firebreaks, 1 200-1 500 m.	Possible
Aspidonepsis shebae	VU	Montane grassland	Possible
Eugenia pusilla	EX	KaNgwane Montane Grassland	Unlikely, believed to be extinct
Geranium ornithopodioides	EN	Scarp forest on sandstone, in forest margins or along streams, 300-700 m.	Unlikely
Gerbera aurantiaca	EN	Mistbelt grassland, well-drained doleritic areas.	Possible
Gladiolus malvinus	VU	Dolerite outcrops in grassland, around 2000 m.	Unlikely
Indigofera hybrida	VU	Dry highveld grassland.	Possible
Khadia carolinensis	VU	In quartzitic soils in grassland vegetation above 1400m altitude.	Possible
Leobordea difformis	VU	Grassland	Possible
Merwilla plumbea	NT	Montane mistbelt and Ngongoni grassland, rocky areas on steep, well drained slopes. 300-2500 m.	Possible
Miraglossum davyi	VU	Grassland	Possible
Nerine platypetala	VU	Montane grassland, margins of permanently moist vleis and levees of river banks.	Possible
Protea parvula	NT	Most prominent in Lydenburg montane grassland.	Unlikely
Protea roupelliae subsp. hamiltonii	CR	Confined to Barberton montane grassland.	Unlikely

Protea subvestita	VU	Confined to infrequently burned habitats, often associated with gullies, scarps and forest margins. Occasional fires are required for successful recruitment.	Possible

Several invasive species listed under Conservation of Agricultural Resources Act (CARA, 1983) and the Mpumalanga Nature Conservation Act were observed on site and it is likely that more species may be identified on site during the summer assessment of the area. The invasive species observed on site are listed in **Table 9** below.

Table 9: Invasive species

Species	CARA	Mpumalanga
Acacia mearnsii	Category 2	X
Acacia melanoxylon	Category 2	X
Datura stramonium	Category 1	X
Eucalyptus sp	Category 2	X
Lantana camara	Category 1	X
Pinus sp	Category 2	X
Populus alba	Category 2	X
Rubus cf cuneifolius	Category 1	X
Solanum sisymbrifolium	Category 1	

Several medicinal plants are also likely to occur on site, even though it is unlikely that the medicinal species are utilised on site. Medicinal plants include common and rare species, as well as invasive plant species, such as *Datura stramonium*.

According to the Mpumalanga C-Plan (Ferrar & Lötter, 2007) seen below in **Figure 22**, most of the site has no natural habitat remaining. The rest of the site is located in areas indicated to be Least Concern or Important and Necessary. The Highly Significant and Important and Necessary habitats are mostly located in the portion of primary vegetation and wetland vegetation remaining within the study area. There are therefore a few portions of vegetation on site that are important for protection of the biodiversity of Mpumalanga.

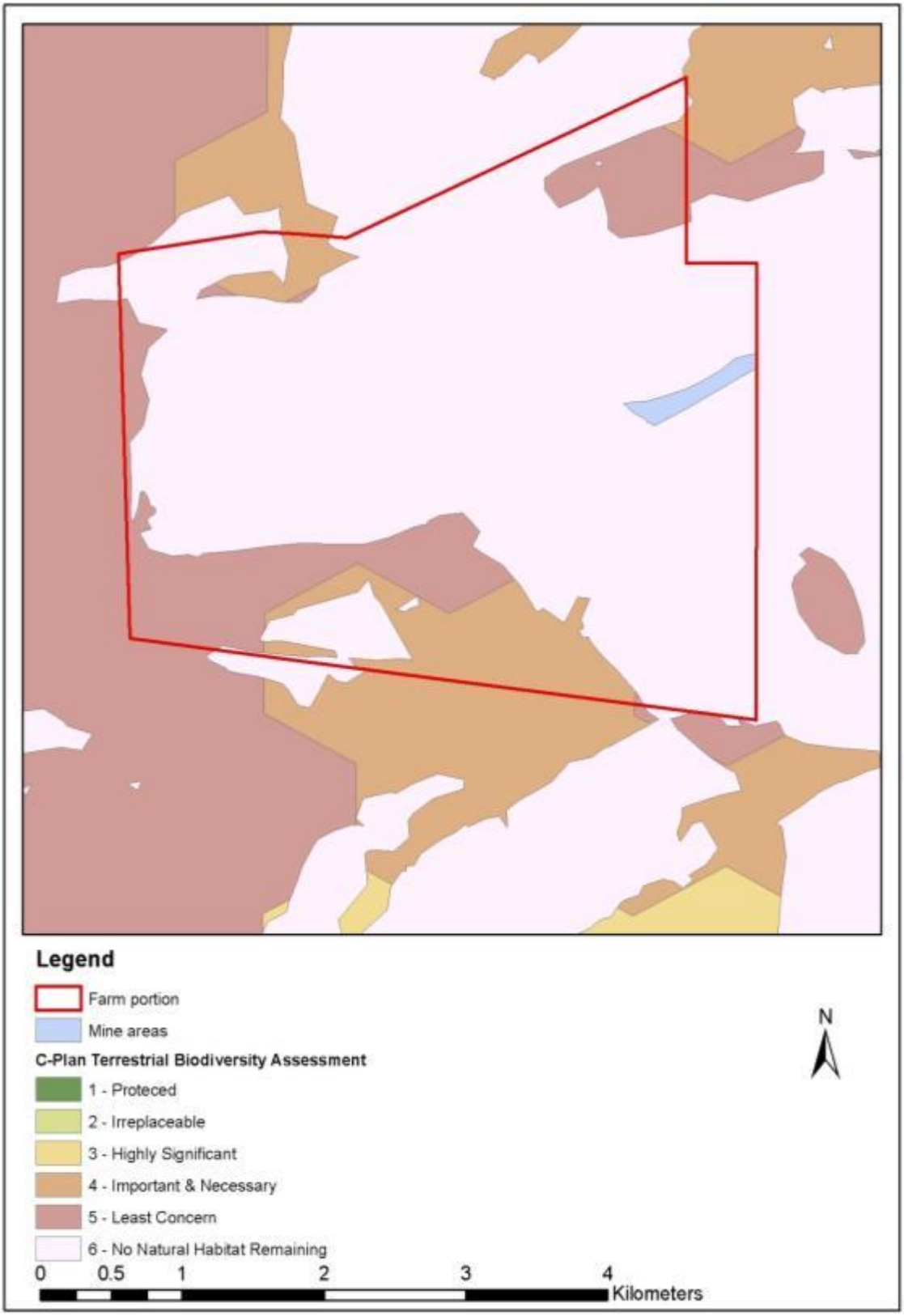


Figure 22: Important terrestrial areas according to the Mpumalanga C-Plan

6.7.3.1 Sensitivity Map

The sensitivity map (Figure 23) of the site was compiled according to the following categories:

- **Very High:** These areas are of such value that no development should take place in this system. This includes areas of primary vegetation, which is protected on a regional or national level as areas that is irreplaceable or areas that are incompatible with the proposed land use.
- **High**: Good vegetation cover exists, with no severe impacts noted and little problem plant or weed species, for instance a low percentage of plants associated with overgrazing and / or mechanical disturbance, as well as a healthy looking A-horizon (which means good organic content). No or slight management intervention or land use is required to return vegetation to pristine condition. Vegetation that is a good representation of a threatened vegetation type is also included in this category, even if a few alien and invasive species are present.
- **Low/Poor**: Signs of overgrazing, some shift in species composition, some degree of soil degradation. Management Intervention is required, but may also recover if natural processes occur and the impact is removed.
- **Least Concern**: Extensive soil erosion, plant cover dominated by noxious and / or grazing resistant species. Somewhat diverted climax plant communities. Will not recover without serious management intervention, if ever. This also includes areas with very low plant species diversity such as cultivated pastures.

This map is based on the scoping level assessment only, not the full vegetation assessment. The map may therefore change based on the results of the full vegetation assessment.

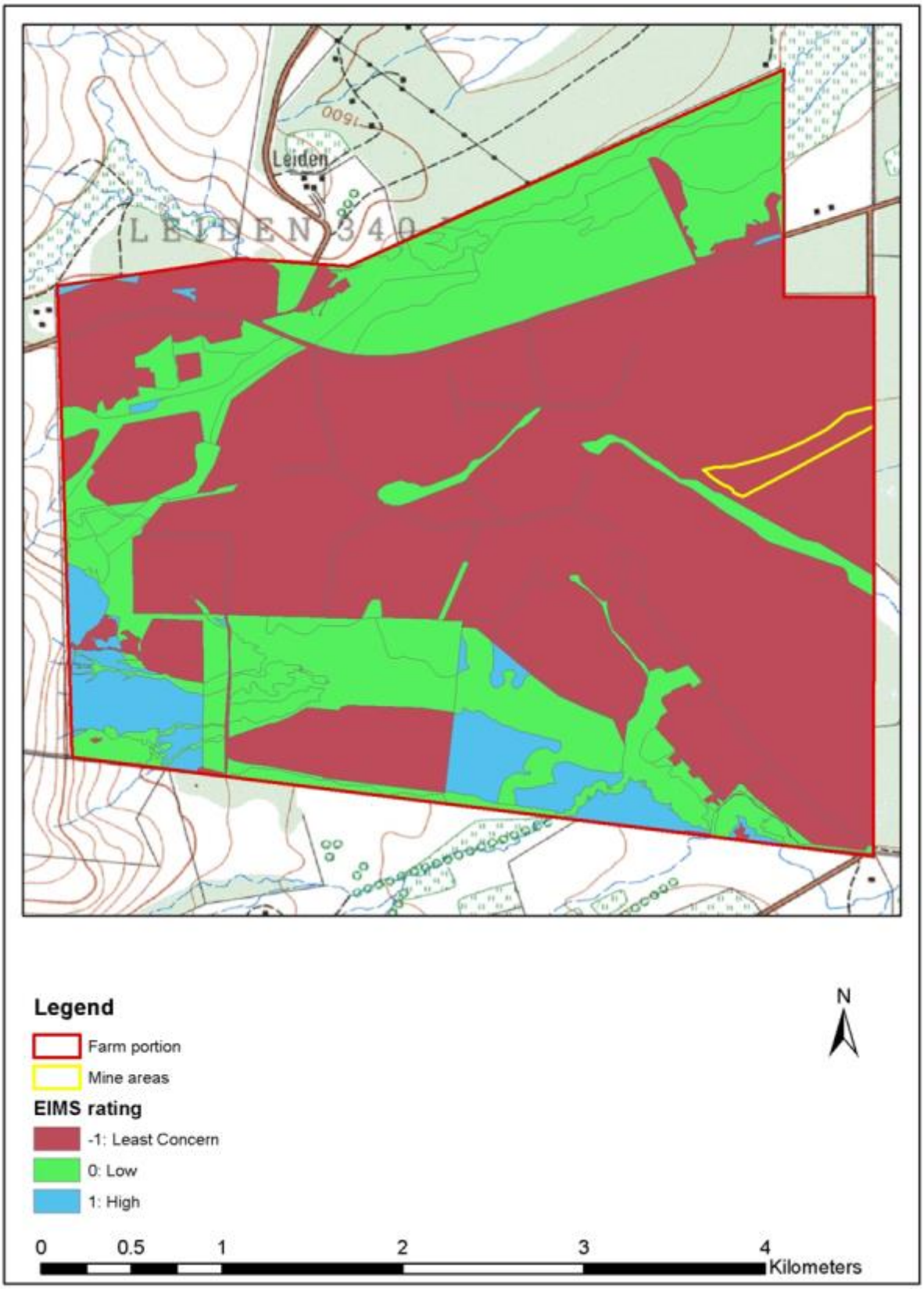


Figure 23: Floral habitat sensitivity

6.7.4 CONCLUSION

The site includes vegetation communities falling within threatened and protected vegetation types. Portions of the site are listed under the Mpumalanga C-Plan as Important and Necessary habitats. The site may also have a number of plant species protected under the National Environmental Management: Biodiversity Act or the Mpumalanga Nature Conservation Act. Portions of the site may therefore be of moderate or high sensitivity and mining has the potential to impact these areas negatively. Some of these impacts are preventable in certain areas, while others may be mitigated to varying degrees.

6.8 FAUNA

David Hoare Consulting cc was appointed by EIMS to undertake the fauna specialist study for the Leiden project. The following sections provide a summary of the fauna that may be affected by the proposed Leiden project. Information has been sourced from the fauna scoping report. For further information, please refer to the full fauna scoping report which is included in Appendix G.

6.8.1 INTRODUCTION

Fauna may be directly or indirectly affected by the mining operations and related activities. As a result, sections of habitats may be damaged or negatively influenced. Sensitive faunal habitats are by their very nature, highly complex. The establishment of infrastructure and mining operations have the potential to result in damage to habitat, loss of biodiversity, the introduction of foreign animals, direct and indirect mortality of animal species, and the loss of or damage to sensitive and protected species. A scoping faunal assessment was undertaken to identify the sensitive species and habitats on site so that adequate measures can be put in place to avoid these sensitive features when mining operations commence.

6.8.2 DATA COLLECTION

Faunal data for the study was collected in a number of different ways. A desktop study was used to identify issues that might arise with respect to a significant species, rare habitats, and processes. Literature on animal species distribution and IUCN Red List Data was used to a large extent to determine the species on site for the project area in the form of a habitat review. A site visit was also completed to familiarise the consultant with the site, the scale of the project and to determine the appropriate field programme for the area.

6.8.3 RESULTS

Wetlands and drainage lines, ridges, and intact patches of connected grassland; irrespective of their ecological condition, represent the most sensitive faunal habitats present within the Application area. A land cover map (Fairbanks *et al*. 2000) of the study site was used to indicate that a large proportion of the site consists of forestry plantations, except for a band of

natural grassland vegetation running in an arc along the western boundary of the site. The literature investigation provided information regarding the sensitive species that could possibly occur on site. These species are briefly discussed below.

The five sensitive mammal species identified as having a probability of occurring on site are the Brown Hyaena, the Spotted-necked Otter, the Honey Badger, Temminck's Ground Pangolin, and the White-tailed Rat. None of these species are at risk from the proposed project; either due to the fact that they are mobile enough not to be affected by activities on site or the habitats that they could potentially occur in will not be affected. The project application area contains no unique or important mammalian habitats and no mammal species are likely to be significantly negatively impacted by development of mining on site.

Habitat found within the area supports a number of frog species, although none have been identified as being sensitive. The Giant Bullfrog is the only frog, potentially occurring within the area, that has been listed in a threat category. However, based on the geographical distribution of this species, the Giant Bullfrog is unlikely to occur on the site. There are therefore no frog species of conservation concern that may be expected to be negatively impacted by the proposed activities.

A total of 64 reptile species have a geographical distribution that includes the general study area in which the site is found. Of these, the species of concern which may occur in the area include the Southern African Python, Striped Harlequin Snake, Yellow-bellied House Snake, and Swazi Rock Snake. Two of these reptile species of concern are anticipated to potentially occur within the site, namely the Striped Harlequin Snake and Yellow-bellied House Snake, both of which are listed as Near Threatened.

A total of 343 bird species have a geographical distribution that includes the general study area in which the site is found. Of particular concern are those species that may be resident on the site, i.e. use the site for more than foraging. A number of such species are expected to occur within the site, including the Blue Crane, Grass Owl, Short-tailed Pipit, Southern Bald Ibis, Striped Flufftail, Denham's Bustard, Yellow-breasted Pipit, Blackwinged Lapwing, Blue Korhaan, Crowned Eagle, Lanner Falcon, and Secretary bird. This species list is not comprehensive and other bird species of conservation concern may also be affected by activities on the site. A number of the bird species with a geographical distribution that includes the project area have been listed in the Eskom Red Data Book of the Birds of South Africa, Lesotho and Swaziland. It is possible that some of these species are likely to be negatively impacted by the development of mining in the application area.

Twelve species of concern were identified that may be negatively affected by development of the site, the Blue Crane (VU = Vulnerable), Grass Owl (VU), Short-tailed Pipit (VU), Southern Bald Ibis (VU), Striped Flufftail (VU), Denham's Bustard (VU), Yellow-breasted Pipit (VU), Black winged Lapwing (NT = Near Threatened), Blue Korhaan (NT), Crowned Eagle (NT), Lanner Falcon (NT), and Secretary bird (NT).

Significant habitat for faunal species on the site is lowlands with water bodies, wetlands or marsh areas, as well as any adjacent grassland areas. Plantation forests can also support populations of sensitive species, especially small raptors.

6.8.3.1 Sensitivity Map

The preliminary sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of potential sensitivity are shown in Figure 24. The information provided in the background information was used to compile a map of remaining natural habitats and areas important for maintaining ecological processes in the study area. There are a number of factors that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

- Potential occurrence of populations of Red List fauna that have been evaluated as having a probability of occurring within natural habitats within the study area.
- Suitability of habitats on site for Red List fauna that have been evaluated as having a probability of occurring within natural habitats within the study area.

Areas classified as having very high and high sensitivity (natural areas, particularly wetlands, drainage lines and adjacent grasslands, as well as mountain grassland) are potentially restricted in terms of development footprints (require mitigation to offset impacts); areas classified as having low sensitivity are negotiable and remaining areas are preferred as sites for potential development.

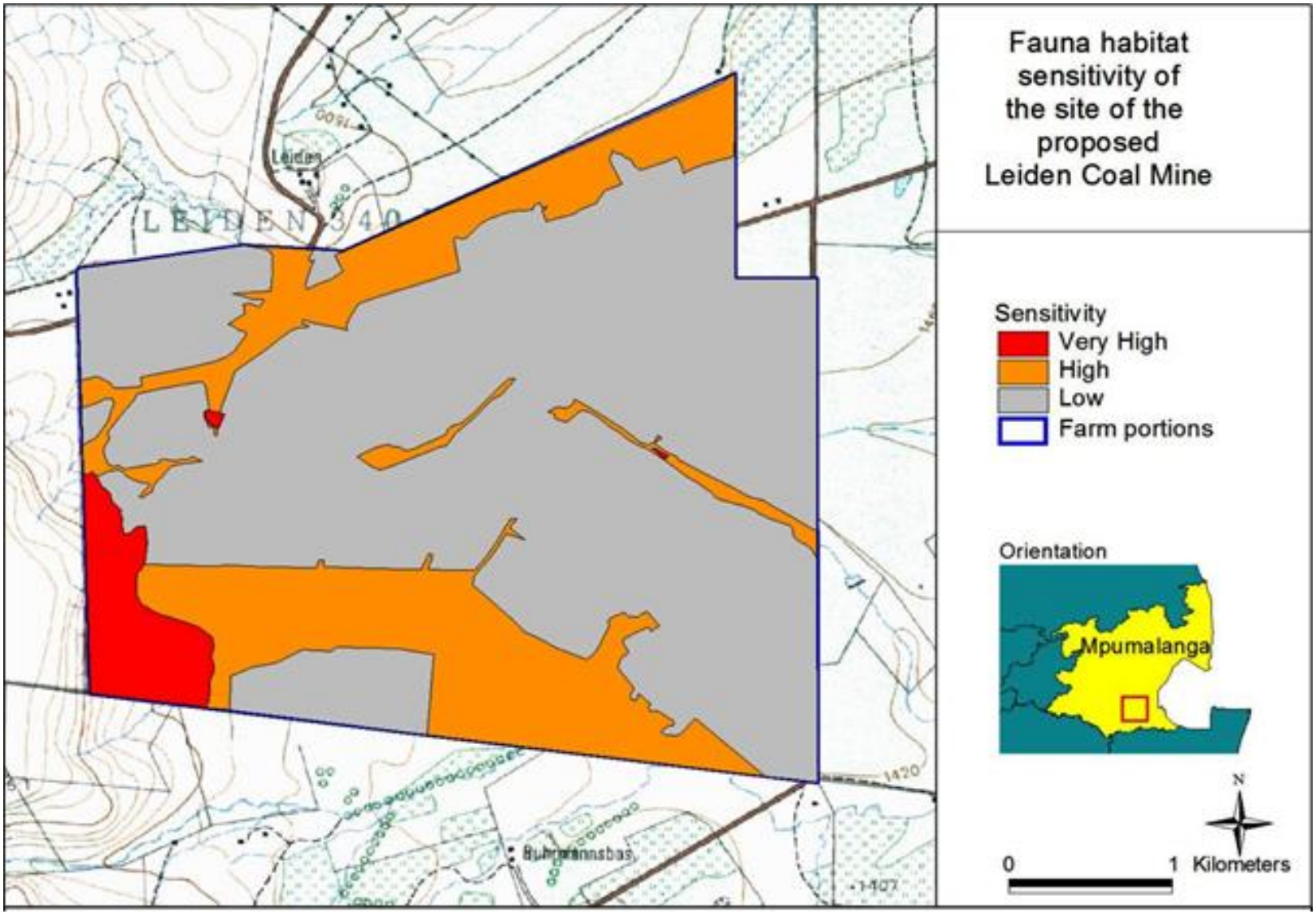


Figure 24: Faunal habitat sensitivity

6.8.4 CONCLUSION

There are a number of animal species of conservation concern that may occur in habitats within the study area. The loss of related habitats may result in negative effects for these species. However, most of the species are mobile animals that are likely to move away from the path of any development. The development of the site is therefore highly unlikely to have a noticeable negative effect on the species currently present in the study area.

6.9 AQUATIC ECOLOGY

Wetland Consulting Services (WCS) was appointed by EIMS to undertake the aquatic ecology specialist study for the Leiden project. The following sections provide a summary of the aquatic environment that may be affected by the proposed Leiden project. Information has been sourced from the WCS scoping report. For further information, please refer to the full heritage scoping report which is included in Appendix I.

6.9.1 INTRODUCTION

The aquatic habitats form the template of the biological composition of any system. If the habitat components are undisturbed, and in good condition, the biological composition of the system can be expected to be normal and one can expect a high biodiversity within the system. If the habitat components are however degraded, due to human activities, the biota of the system will reflect this by a loss, firstly of the most intolerant species (Davies & Day, 1998). The proposed mining activities have the potential to result in a loss of aquatic ecosystems, a loss of biodiversity, alteration of the hydrological regime, the spread of alien fish species, a decline in water quality, and erosion and sedimentation of water courses.

6.9.2 DATA COLLECTION

A desktop study of the site was undertaken and the study area was visited in November 2013. Sites were selected to be representative of all the aquatic ecosystems within the study area and which could potentially be affected by proposed developments.

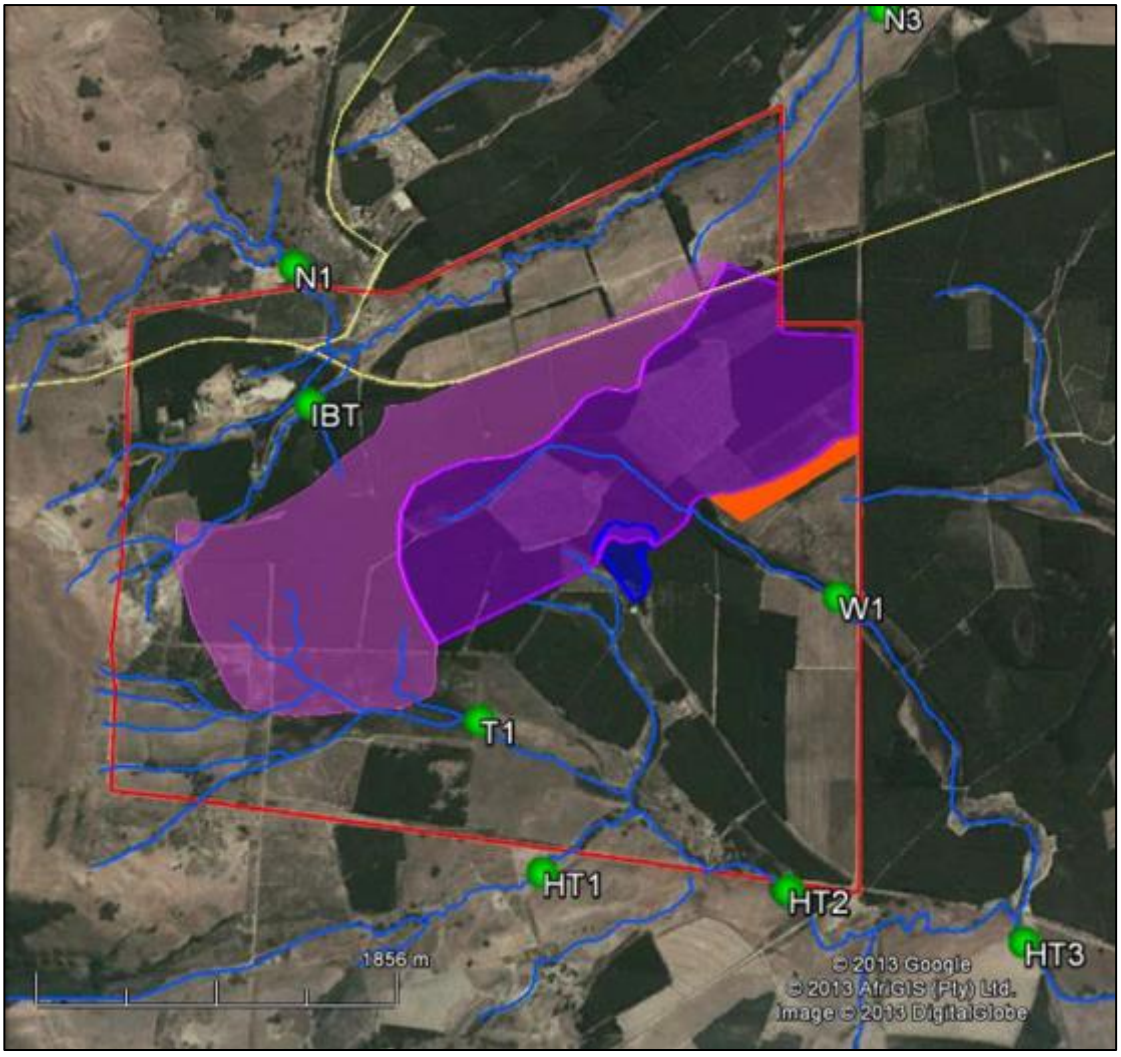


Figure 25: Google Earth image showing aquatic sampling sites for the Leiden project

Fish sampling of representative sites and habitats was performed using a SAMUS battery operated electro-fisher by wading in shallow habitats and using a boat in deeper areas. All fish species were identified to species level and returned to their natural habitats. The latest version of the Fish Response Assessment Index (FRAI) (Kleynhans, 2008) was used to determine the Present Ecological Status (PES) of the aquatic ecosystem in the study area.

The description of the PES of the aquatic ecosystems in the study area was broadly conducted according to the methodology described for River EcoClassification during Reserve Determinations (Kleynhans & Louw, 2008). The overall PES of different river reaches was based on the results of the draft (preliminary) desktop update of PES and Ecological Sensitivity (ES) and Ecological Importance (EI) project (currently conducted by Department of Water Affairs). Kleynhans & Louw (2008) defined ecological importance of a river as its importance to maintain biological diversity and ecological functioning on a local and wider scale. The ecological sensitivity (or fragility) on the other hand refers to a river's ability to resist disturbance and its capability to recover from disturbances once it has

occurred. The EI and ES of the river reaches of concern were determined using the desktop update of PES EI-ES (in progress).

Table 10: PES

CATEGORY	BIOTIC INTEGRITY	DESCRIPTION OF GENERALLY EXPECTED CONDITIONS
A	Excellent	Unmodified, or approximates natural conditions closely. The biotic assemblages compares to that expected under natural, unperturbed conditions.
B	Good	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modifications. Most aspects of the biotic assemblage as expected under natural unperturbed conditions.
C	Fair	Moderately modified. A lower than expected species richness and presence of most intolerant species. Most of the characteristics of the biotic assemblages have been moderately modified from its naturally expected condition. Some impairment of health may be evident at the lower end of this class.
D	Poor	Largely modified. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderately intolerant species. Most characteristics of the biotic assemblages have been largely modified from its naturally expected condition. Impairment of health may become evident at the lower end of this class.
E	Very Poor	Seriously modified. A strikingly lower than expected species richness and general absence of intolerant and moderately tolerant species. Most of the characteristics of the biotic assemblages have been seriously modified from its naturally expected condition. Impairment of health may become very evident.
F	Critical	Critically modified. Extremely lowered species richness and an absence of intolerant and moderately tolerant species. Only intolerant species may be present with complete loss of species at the lower end of the class. Most of the characteristics of the biotic assemblages have been critically modified from its naturally expected conditions. Impairment of health generally very evident.

It must be emphasised that the A→F scale represents a continuum, and that the boundaries between categories are notional, artificially-defined points along the continuum. This situation falls within the concept of a fuzzy boundary, where a particular entity may potentially have membership of both classes (Robertson *et al.,* 2004). These boundary categories are denoted as B/C, C/D, etc.

The Index of Habitat Integrity (IHI) was used to determine habitat condition. This approach is based on the assessment of physical habitat disturbance (Kleynhans, 1997) and classifies the present ecological state of instream and riparian habitat integrity according to the Present Ecological State categories given in **Table 10**, ranging from pristine/undisturbed to critically modified. Analysis of major anions and cations, conductivity, TDS, pH and temperature was conducted. These data were interpreted in terms of ecological responses only. Aquatic macroinvertebrates were assessed using the SASS 5 (South African Scoring System) methodology. SASS5 is based on the presence or absence of sensitive aquatic macroinvertebrates collected and analysed according to the methods outlined in Dickens and Graham (2002).

On-site habitat assessments were conducted by using existing habitat evaluation indices. The general characteristics of the site and its immediate surroundings were described. The composition and ability of the habitats to meet the requirements of different fish species were broadly based on the Habitat Cover Rating method (Kleynhans, 1997). This approach was

developed to assess habitats according to different attributes that are surmised to satisfy the habitat requirements of various fish species (Kleynhans, 1997). A simplified index of habitat integrity, namely Site Habitat Integrity (SHI) was used to determine the broad habitat integrity or condition, based on the extent that different human activities may have on the fish habitats at each sampling site. This approach is based on the assessment of physical habitat disturbance (Kleynhans, 1997).

6.9.3 RESULTS

The Leiden study site is located south of the N2 between Ermelo and Piet Retief and stretches across two catchments: W52A and W53A. Catchment W52A is drained by the Hlelo River and its tributaries, while W53A is drained by the Ngwempisi and its tributary, the Sandspruit. The Hlelo River is itself a tributary to the Ngwempisi, which in turn is a tributary to the uSuthu. The uSuthu is an international river, draining across Swaziland and into the Phongola River, which flows along the border between South Africa and Mozambique to the Indian Ocean. The Department of Water Affairs and Forestry (DWAF) desktop survey (Kleynhans, 2000) classifies both quaternary catchments as having both a High Ecological Importance and a High Ecological Sensitivity.

Based on the preliminary results of the DWA study, the Ngwempisi River reach in the study area, as well as the downstream receiving reach, is considered to be Largely Modified (Category D). The tributary of the Hlelo River within and adjacent to the study area is classified as Largely Natural (Category B) while the downstream receiving Hlelo River reach is considered Moderately Modified (Category C).

Most of the reaches of concern are of moderate ecological importance according to the DWA study. The exceptions are the Hlelo tributaries (W52A-1934) which are classified as being of high ecological importance. All reaches of concern are classified as being of high ecological sensitivity.

The on site assessment of habitat integrity, using the Index of Habitat Integrity confirmed the desktop findings to some extent. The overall Present Ecological State (PES) was considered Pristine (Category A) to Largely Natural (Category B) within the Hlelo tributaries. Within the Ngwempisi River, habitat integrity was relatively good (Category B, Largely Natural) upstream of the site but deteriorated sharply downstream of the interbasin transfer (from Heyshope Dam) discharge point. The downstream site was considered moderately to Largely Modified (Category C to D) in terms of habitats. The high volumes and velocities of transferred water within the Ngwempisi have significantly altered flows, eroded out marginal habitats, scoured the river bed and inundated instream habitats. Water quality was considered good at all sites and no physico-chemical measurements were found to be limiting to aquatic biota.

The aquatic macroinvertebrate results confirmed the above findings. Most current impacts to aquatic ecosystems are to habitats and not to water quality. More than two species of baetid mayfly were recorded at all sampling sites, indicating good water quality. Taxa sensitive to

changes in water quality and habitats were prevalent at all Hlelo tributary sites and the upstream Ngwempisi site.

The Hlelo tributaries were considered Pristine to Moderately Modified (Category A-B) for aquatic macroinvertebrates. Within the Ngwempisi River, there was a significant decrease in diversity evident between the upstream and downstream Ngwempisi sites as a result of the loss of habitats due to increased flows from the inter-basin transfer. The Ngwempisi River was classified as Moderately Modified (Category C) at its downstream site. However, sensitive taxa were still present indicating that that the decline in PES was mainly due to habitat loss and not water quality deterioration.

The diversity of Odonata (dragonflies and damselflies) was particularly high within the study area and included rarer damselfly families (Chorolestidae and Lestidae – the latter family collected from Site N1 (see **Error! Reference source not found.**) and all Hlelo tributary ites). A less common dytiscid beetle (as yet unidentified) was also observed. This diversity within the Coleoptera and Odonata points to a high overall invertebrate diversity within the region.

The most significant impact on the site-specific habitat integrity for fish of the streams in the study area was identified to be flow modification, bed modification, channel modification, inundation, exotic vegetation encroachment and bank erosion. The primary causes of these impacts were related to the inter basin transfer as well as forestry in the area.

The diversity of velocity-depth categories was generally low with only slow-shallow and slow-deep habitats being present. Cover features for fish were generally limited, mostly being provided in the form of overhanging vegetation, undercut banks and substrate (stones).

During the baseline survey conducted at selected sites in the study area during November 2013 two indigenous fish species (*Barbus pallidus* and *Barbus anoplus*) and one alien fish species *Micropterus salmoides* were sampled. Fourteen fish species have a low to definite probability of occurrence in the river reaches of concern (study area and downstream receiving reach).

Barbus brevipinnus is listed as vulnerable based on the latest IUCN classification (moderate to high probability of occurrence in the area). *Chiloglanis emarginatus* was previously classified as near threatened (Skelton, 2004) but according the latest IUCN ratings it is now least concern. This species is however very scarce and should its presence be confirmed inside or downstream of the study area, it should be treated as a species of conservation importance. The remainder of the expected or observed fish species are not classified as threatened on any scale (international, national or regional) but the distribution ranges of many of these species are however decreasing due to increased development and deterioration in the condition of their habitat.

Based to the FRAI index results (indicating the present ecological status based on fish assemblage), the Ngwempisi River is currently in a Largely Modified state (category D), while

the tributary of the Hlelo River is in a relatively good state (B, Largely Natural). Fish assemblages are responding to the following identified stressors: inter basin transfer and forestry resulting in flow modification, sedimentation, physical disturbance, water quality deterioration, migration barriers and the presence of a predatory alien fish species.

In terms of the overall aquatic diversity assessment, the southern catchment (W52A), which covers roughly two thirds of the study area, is considered “Highly Significant”; while the northern sub-catchment (W53A) is termed to be important for “Ecosystem Maintenance”.

6.9.3.1 Sensitivity Map

An assessment of the sensitivity of the valley bottom wetland was assessed as part of the Wetland Assessment and is not repeated here. It is, however, shown on the sensitivity map for the sake of completeness.

The following factors were considered in assessing sensitivity per spatial unit:

- Sensitivity of the aquatic ecosystem in terms of water quality.
- Sensitivity of the aquatic ecosystem in terms of habitat integrity.
- Sensitivity of downstream reaches (cumulative and catchment-scale considerations).
- Sensitivity of the ecosystems to biodiversity loss (i.e. loss of sensitive or rare species).

Two additional layers were considered independently of the above.

- Legislative requirements pertaining to aquatic ecosystems.
- Sensitivity to flow changes (assessed separately as there are too many unknowns regarding the significance of this impact).

The outcome of the spatial sensitivity assessment is given in Figure 26.

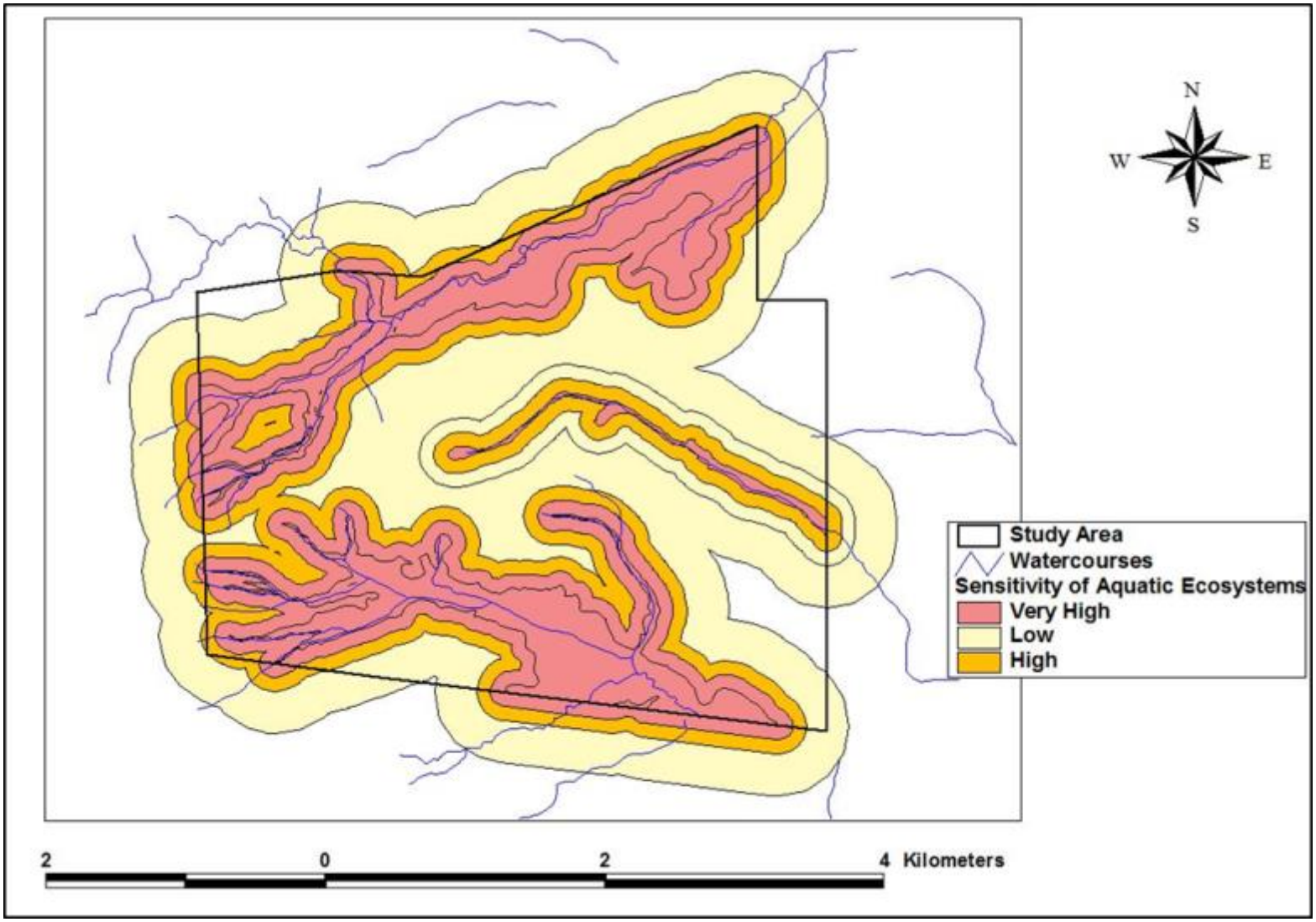


Figure 26: Aquatic ecology sensitivity

6.9.4 CONCLUSION

There are two river systems that will be affected by the proposed development. Both flow in an easterly direction and converge in Swaziland to form the Usutu River which then flows through Mozambique to the Indian Ocean. The study area falls over two quaternary catchments, namely W53A and W52A. The DWAF desktop survey (Kleynhans 2000) classifies both quaternary catchments as having an Ecological Importance and Sensitivity of 'High'.

The risk of water quality deterioration is highlighted given the current good quality water within the affected river systems, the Ngwempisi and Hlelo Rivers, which also support a number of sensitive aquatic species and have been classed as Freshwater Ecosystem Priority Areas (FEPA's). The presence of the catchment transfer scheme further highlights the need to focus on maintaining water quality as any impairment could have significant impacts on downstream water users.

6.10 SURFACE WATER

GCS Water and Environmental Consultants was appointed by EIMS to undertake the surface water specialist study for the Leiden project. The following sections provide a summary of the surface water resources that may be affected by the proposed Leiden project. Information has been sourced from the WCS scoping report. For further information, please refer to the full surface water scoping report which is included in Appendix I.

6.10.1 INTRODUCTION

Surface water resources includes rivers, streams, drainage lines, flow paths of storm water runoff, as well as water collection and channelling through the use of irrigation furrows, canal, channels, and dams. Mining activities have the potential to alter surface water drainage patterns through actual mining methods employed as well as the placement of infrastructure. In addition, these activities also have the potential to result in the pollution and/or contamination of surface water resources through geological exposure, seepage, spillages and waste streams both mineralised and non-mineralised.

6.10.2 DATA COLLECTION

The data was collected in a number of different ways to formulate an understanding of the project area. The desktop portion of the study utilized generally-accepted algorithms and methodologies to determine design floods at various points in the area, to estimate flood depths. Runoff from the various streams was analysed by using accepted techniques, such as ARC-View and ARC-GIS for Geographic Information Systems work and mapping (ESRI, 2012) and UPD (Alexander W., 2002). The SANRAL Drainage Manual (SANRAL, 2007) was used for flood determination to downscale quaternary catchment data. Base-line runoff data was obtained from WRSM (as published in WR 2005: Water Resources of South Africa; WRC

Reports TT 380 to 382/08) were used for (WRC, 2005). Literature utilised for baseline data also included the South African Weather Service (SAWS) and/or databases of WR2005 and 20m contour data was obtained from RSA National Geospatial Institute 1:50 000 Topographical Series: map code 2630CB. A site visit was undertaken in September 2014 to confirm results from the desktop study and to provide additional baseline surface water information.

6.10.3 RESULTS

The project application area straddles the watershed between Quaternary Catchments W52A and W53A. The catchments which are located in the upper regions of the Ngwempisi River (W53A) to the north and Hlelo River (W52A) to the south are moderately disturbed.

A large inter-basin water transfer scheme releases some 45 million cubic meters of raw water into the Ngwempisi River. This water flows down the slightly modified watercourse of the Ngwempisi River, through the northern section of the study area.

W52A and W53A quaternary catchments which fall into the Mfolozi/Pongola catchment are reported as having average rainfalls of 836 mm in W52A and 825 mm in W53A per annum (W53A is a larger catchment that extends further away from the escarpment). The Mean Annual Runoff is approximately 102 mm, but simulations to assess the impact of forests indicate that this value is likely to reduce to 61 mm in afforested areas. Rainfall will be distributed according to WR 2005 Rain Zone W5C, and annual Symons Pan evaporation[1] of 1400 mm will correspond to Evaporation Zone 13A.

6.10.3.1 Downstream Water Demands

Both quaternary catchments fall within the W50 (Usuthu River Basin) drainage area, which constitutes an internationally shared basin and will be subject to existing treaties that govern releases and water quality at the Swaziland border. The Usutu catchment is characterised by large transfers out of the catchment (and out of the Water Management Area (WMA)) to the Vaal system and the Olifants WMA for cooling purposes at power stations. The only significant in-basin use is afforestation with an estimated area of 1 930 km^2, making this catchment the most afforested in the WMA. The water requirements of Swaziland are an important factor in this catchment, and, unlike the Pongola catchment, international agreements with Swaziland and Mozambique do not allow much, if any, scope for further development in this catchment. The joint Maputo Basin Study will however identify possible joint development opportunities which could involve developing the resource in the upper Usutu for joint utilisation with Swaziland (DWA, 2004).

It is accepted that 50% of natural base-flow for the rivers should be available at the downstream border of Swaziland, and that water should at least meet South African SANS standards for irrigation water. Base-line water quality analyses derived from water samples

taken during the site visit indicate reasonably good water quality (see **Error! Reference ource not found.**).

Table 11: Base line water quality

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: Leiden Coal		
		WETUP	WETDS	PipeDS
Sample Number		17934	17935	17936
pH – Value at 25°C	WLAB001	7.2	7.1	7.9
Electrical Conductivity in mS/m at 25°C	WLAB002	20.1	53.1	12.4
Total Dissolved Solids at 180°C *	WLAB003	134	376	108
Total Acidity as $CaCO_3$*	WLAB022	24	12	8
Total Alkalinity as $CaCO_3$	WLAB007	104	24	44
Chloride as Cl	WLAB046	5	5	5
Fluoride as F	WLAB014	<0.2	<0.2	<0.2
Nitrate as N	WLAB046	<0.2	<0.2	0.2
Nitrite as N	WLAB046	<0.1	<0.1	<0.1
Sodium as Na	WLAB015	7	12	6
Potassium as K	WLAB015	3.9	5.1	1.7
Calcium as Ca	WLAB015	15	46	9
Magnesium as Mg	WLAB015	11	29	5
Aluminium as Al (Dissolved)	WLAB015	<0.100	<0.100	1.47
Iron as Fe (Dissolved)	WLAB015	0.531	<0.025	1.22
Manganese as Mn (Dissolved)	WLAB015	<0.025	<0.025	<0.025
% Balancing	---	95.4	98.1	99.1

It is suggested that these samples should define future water quality objectives for rivers and streams below the project application area. To date, no current regional water conservation or management plans will impact directly on the proposed mining development.

6.10.3.2 Flood Flows

Flood flows from the 1:50 and 1:100 year rainfall storm events were calculated for the three natural catchments within the application area (see Table 12 and Figure 27). Calculations were based on current conditions which represent control conditions in the three catchments.

Within catchment 2 of project area, the distance between the proposed opencast area and the watercourse is approximately 100 m. An indicative flood level of the watercourse was calculated for a cross section in this water course next to the opencast area to check whether

the opencast area may fall within a potential flood line. The results show that the water level is not approaching the boundary of the opencast area during a 1:100 year flood event. It is important to note that the simulated flood level was modelled utilising desktop information (20m contours) and as such is not considered highly accurate. However in order to fulfil all requirements of GN704, a detailed assessment will be undertaken in the EIA phase to calculate flood lines for this section.

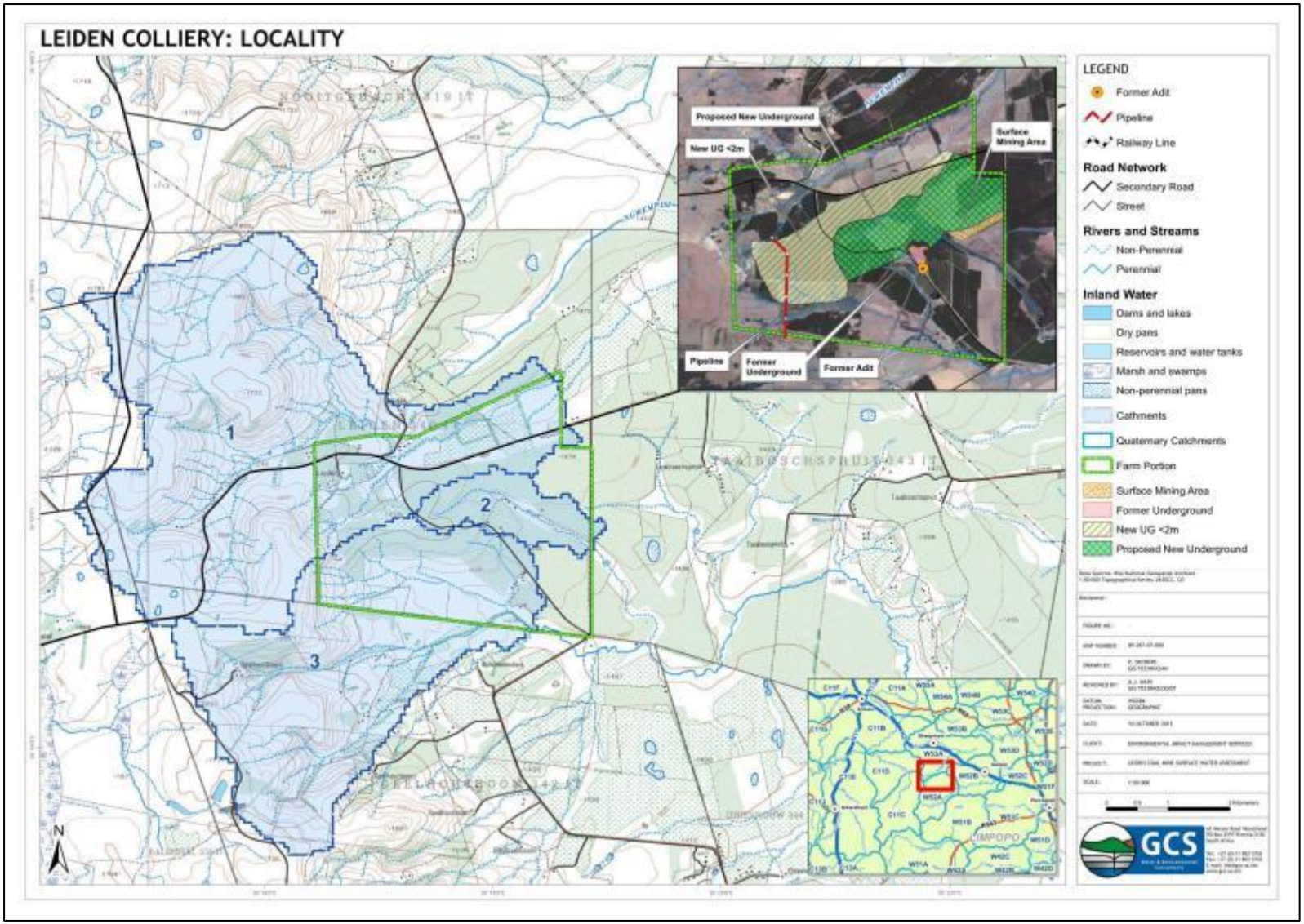


Figure 27: Catchments for the study area

Table 12 Catchment flood flows

1: 50 Peak Flood (m^3/s)	Rational Method	Alternative Rational Method	Standard Design Flood Method
Catchment 1	146.5	116.2	159.1
Catchment 2	19.7	15.2	21.3
Catchment 3	114.4	93.6	121.3
1: 100 Peak Flood (m^3/s)	**Rational Method**	**Alternative Rational Method**	**Standard Design Flood Method**
Catchment 1	187.4	139.2	201.5
Catchment 2	25.5	18.4	27.0
Catchment 3	146.1	112.9	153.6

6.10.3.3 Sensitivity Map

The determined sensitivities (indicated in Figure 28) were based on findings of the desktop assessment and site visit. The only areas that have been identified as “very high” sensitivity areas are those which are also protected in terms of legislation, namely watercourses protected in terms of GN704 of the NWA (1998). According to GN704 no development is allowed within a horizontal distance 100m or the 1:50 (pits) and 1:100 (infrastructure) flood lines of any watercourse, or whichever is furthest. The proposed opencast pit area is not located within the sensitive areas. However the proposed underground area will intersect with several water courses and is therefore partially located in a highly sensitive area. These areas will be further investigated during the risk assessment of the EAI/EMP.

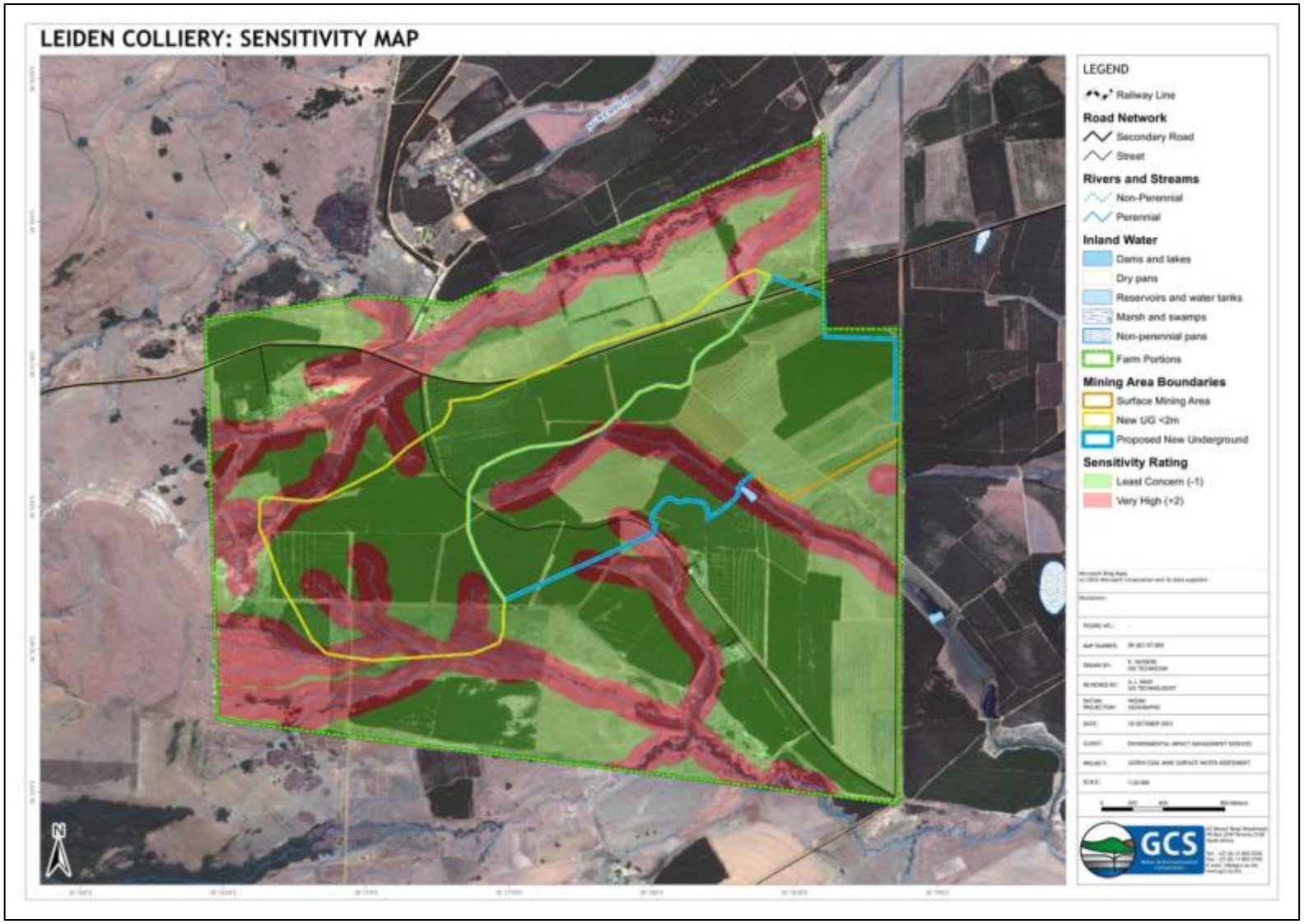


Figure 28: Surface water sensitivity

6.10.4 CONCLUSION

The Leiden project is located within the W52 and W53 quaternary catchments (Mfolozi/Pongola catchment). The catchments of the upper reaches of the Ngwempisi River (W53A), to the north and Hlelo River (W52A) to the south, are moderately disturbed. A large inter-basin water transfer scheme releases some 45 million cubic meters of raw water into the Ngwempisi River. This water flows down the slightly modified watercourse of the Ngwempisi River, through the northern section of the Mining Rights Area.

Both quaternary catchments fall within the W50 (Usuthu River Basin) drainage area, which constitutes an internationally shared basin and will be subject to existing treaties that govern releases and water quality at the Swaziland border. The water requirements of Swaziland are an important factor in this catchment, and it is accepted that 50% of natural base-flow for the rivers should be available at the downstream border of Swaziland, and that water should at least meet South African SANS standards for irrigation water. Base-line water quality analyses indicate that the surface water quality is reasonably good and should be used as a benchmark for the future water quality of the water affected by the Leiden operations.

The watercourses within the application area have been identified as highly sensitive areas. The results of the assessment show that the predicted water level of the watercourse is not approaching the boundary of the opencast area during a 1:100 year flood event. However in order to fulfil all requirements of GN704, a detailed assessment will be undertaken in the EIA phase to calculate flood lines for this section. However the proposed underground area will intersect with several water courses and is therefore partially located in a highly sensitive area. These areas will be further investigated during the risk assessment of the EAI/EMP.

6.11 WETLANDS

Wetland Consulting Services (WCS) was appointed by EIMS to undertake the wetlands specialist study for the Leiden project. The following sections provide a summary of the wetlands that may be affected by the proposed Leiden project. Information has been sourced from the WCS scoping report. For further information, please refer to the full wetlands scoping report which is included in Appendix J.

6.11.1 INTRODUCTION

water and perched groundwater. The wetland types are differentiated by their hydro-geomorphic (HGM) characteristics; i.e. the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems. Mining activities have the potential to damage and/or disturb wetland habitat, deterioration of water quality, erosion, increased transport and sedimentation in wetlands, increased alien vegetation, increased surface run-off, and the deterioration of water quality. A scoping wetland study has been undertaken to identify wetlands within the site and to delineate these sensitive areas. A

full EIA level wetland assessment will also be undertaken to ensure adequate mitigation measures are identified for any identified impacts.

6.11.2 DATA COLLECTION

A desktop study was completed to establish a baseline understanding of the receiving environment together with the delineation of suspected wetland areas based on available aerial imagery, including colour 1:10 000 aerial photographs, black and white 1:10 000 aerial photographs and Google Earth imagery. A site visit was also undertaken to verify the findings of the desktop delineation. It should however be noted that ground truthing of wetland boundaries was targeted to a specific wetland system only (e.g. the wetland system adjacent to the proposed opencast mining area) and undertaken based on the wetland delineation guidelines published by the Department of Water Affairs (DWAF, 2005).

6.11.3 RESULTS

The wetlands located on the project area, Leiden 340 IT, have been delineated in Figure 29.

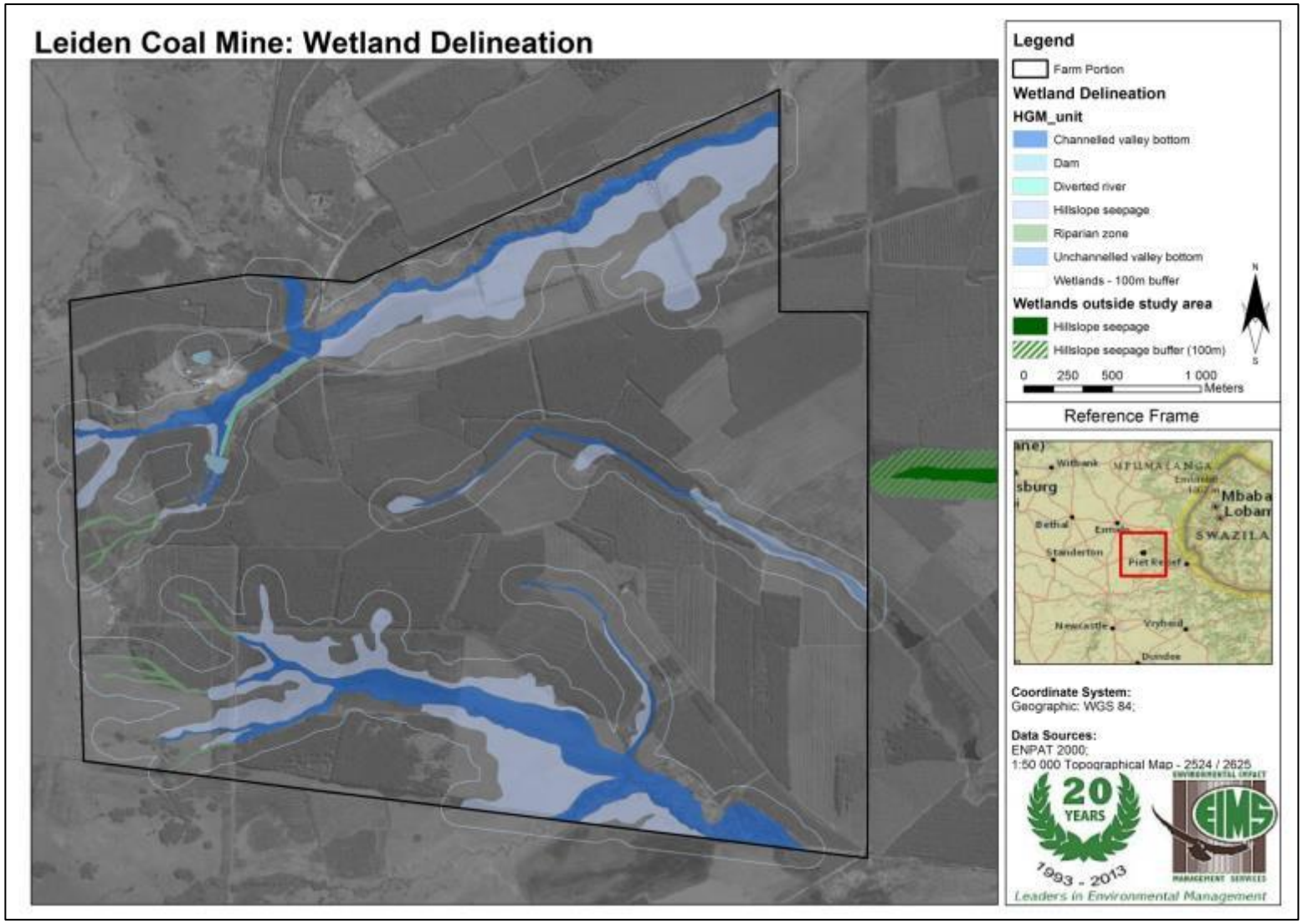


Figure 29: Wetland delineation for Leiden 340 IT

Three wetland systems were identified in the study area, all draining from west to east. In the north, the upper reaches of the Ngwempisi River fall within the study site; in the south an unnamed tributary of the Hlelo River originates on site; and within the central regions of the site a smaller, third wetland systems originates and eventually forms a tributary of the southern wetland system.

The northern Ngwempisi wetland systems is characterised by a channelled valley bottom wetland and associated hillslope seepage wetlands located mostly along the southern bank. The valley bottom wetland has been heavily impacted and invaded by alien tree species, mostly *Acacia mearnsii* (black wattle), while the southern hillslope seepage wetland has mostly been converted to planted pasture. A pipeline was observed discharging into the upper reaches of this wetland system, presumably a catchment transfer scheme from the nearby Heyshope Dam, and thought to form a sub-system to the Usutu-Vaal Government Water Scheme.

The central wetland system consists of a narrow valley bottom system that is channelled in its upper reaches but unchannelled downstream of the small farm dam. A narrow band of footslope seepage wetlands occur along the margins of the valley bottom. This wetland system drains an area of intensive plantation forestry with mostly pine plantations extending up to the edge of the wetland system and, for a portion of the upper reaches, right across the wetland. The plantations present would have played a role in reducing flows within the system.

The southern wetland system is located within the largest area of natural grassland remaining on site. The system originates on the steep slopes in the west of the study site as a number of narrow riparian zones and channelled valley bottom wetlands. Once the slope decreases the system widens significantly and becomes a broad, flat valley bottom wetland with a clearly incised channel. A narrow riparian fringe extends along the channel. Widespread hillslope seepage wetlands occur on both side of the valley bottom wetland.

In total, the wetlands cover 239.2 hectares (ha) of the site, equal to roughly 18.5% of the surface area. The dominant wetland types on site are the hillslope seepage wetlands (almost 60% of wetland area) and the channelled valley bottom wetlands (35% of wetland area). Four small farm dams were also observed on site. The total area of the wetland types are described in Table 13 below.

Table 13: Wetland types

Wetland Type	Area (ha)	% of Wetland Area	% of Study Area
Channelled valley bottom	85.25	35.64	6.60
Unchannelled valley bottom	2.49	1.04	0.19

Riparian zone	5.79	2.42	0.45
Hillslope seepage	142.28	59.49	11.02
Diverted river	1.60	0.67	0.12
Dam	1.76	0.73	0.14
Total	239.17	100.00	18.52

6.11.3.1 Sensitivity Map

Compiling a wetland sensitivity map and assessing risk to wetlands is no easy task, and a number of factors need to be considered as the importance of wetlands is multi-faceted in that not only do they exist as unique ecosystems in the landscape that support biodiversity differing from the surrounding landscape, but they also provide a range of goods and services through a number of functions they perform. Ascribing sensitivity to wetlands based on these functions is further complicated by the fact that the functions attributed to wetlands are performed by the wetland within the landscape and isolating the wetland from its catchment is not possible. Any significant change to either the wetland or its catchment will result in degradation/change of the wetland habitat and impairment of the functions it performs.

Within the Leiden Coal Mine study area, the small size of the proposed opencast pit will limit the effect of the opencast mining on the wetlands as only a small percentage of the catchment of the central wetland system will be impacted. The introduction of a pollution source into a catchment that currently has good quality water is however of concern.

The impact of underground mining on the movement of water through the landscape is less severe as the soil profile and lithological controls generally remain intact. Only where collapse of the underground workings occurs and the surface subsides, does the potential for increased ingress of surface water (and thus decreased flows within the wetlands and rivers) materialize. Once again the creation of a potentially significant pollution source in the form of decanting acid mine drainage is of concern.

The results of the sensitivity mapping are shown in Figure 30 below.

- All wetlands and watercourses were classified as being of Very High sensitivity;
- A 100m buffer zone around all wetlands and watercourses is classified as High sensitivity;
- A 500m buffer zone around all wetlands is classified as Low sensitivity.

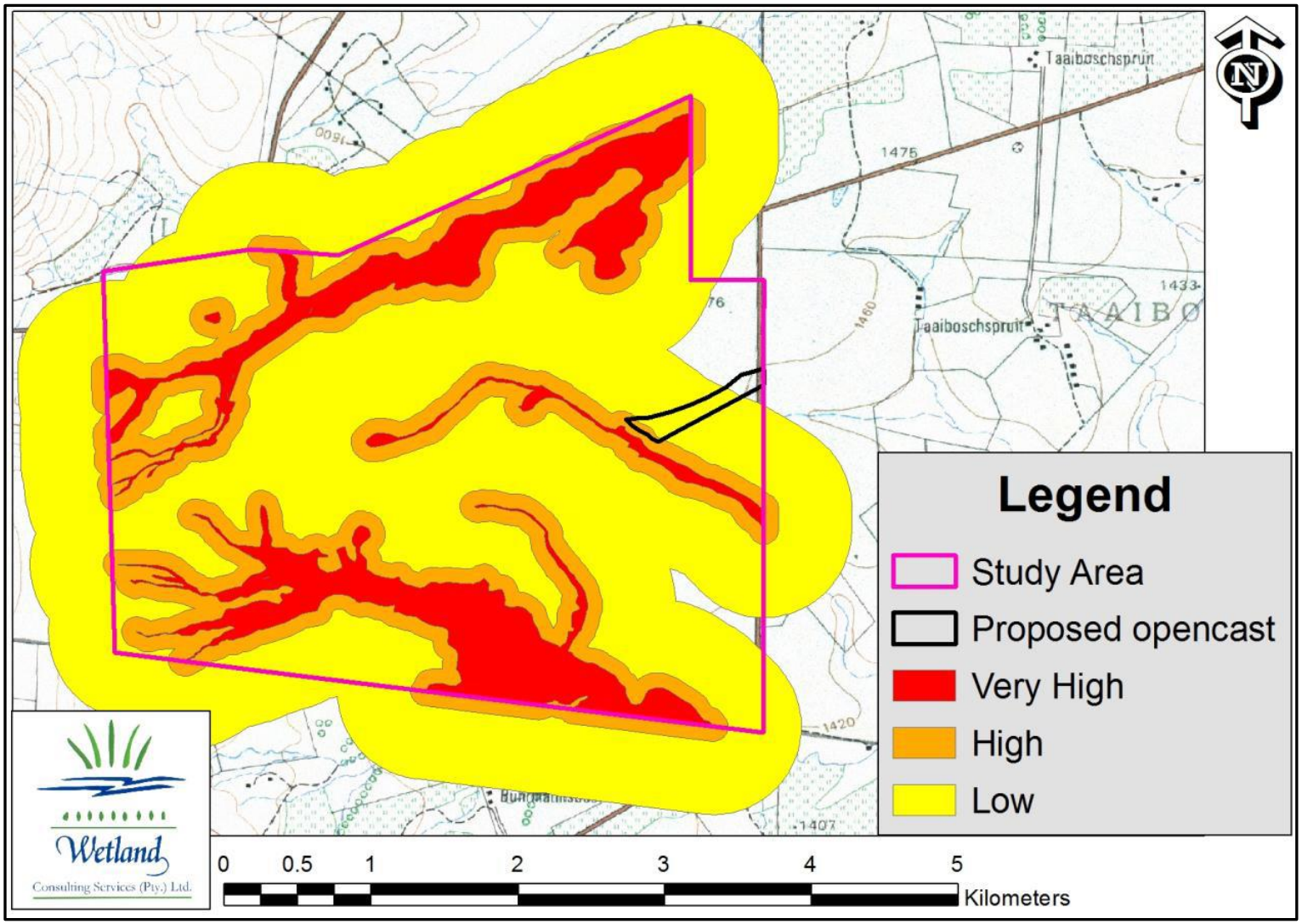


Figure 30: Wetland sensitivity

6.11.4 CONCLUSION

Based on the desktop wetland delineation, wetland habitat covering more than18 % of the study area is expected to occur on site. Three wetland types – hillslope seepage wetlands, channelled valley bottom wetlands, and unchannelled valley bottom wetlands – occur on site, with hillslope seepage wetlands being the dominant wetland type. A discharge point of a catchment transfer scheme also occurs on site.

Although the wetlands have been exposed to frequent impacts associated with agricultural activities, the wetland types and wetland vegetation type occurring on site are indicated as being Critically Endangered, indicating that significant loss of these wetlands has occurred within the area, elevating the importance of the remaining wetlands.

The proposed mining activities, opencast and underground, as well as related infrastructure developments are likely to impact extensively on the wetlands of the area. The extent of the impacts however will be assessed in more detail during the EIA phase of the project where appropriate mitigation measures will be determined.

6.12 GROUND WATER

GCS Water and Environmental Consultants was appointed by EIMS to undertake the ground water specialist study for the Leiden project. The following sections provide a summary of the ground water resources that may be affected by the proposed Leiden project. Information has been sourced from the GCS scoping report. For further information, please refer to the full ground water scoping report which is included in Appendix K.

6.12.1 INTRODUCTION

Ground water is defined as water located beneath the ground surface in lithological formations. Mining activities have the potential to impact on ground water resources through potential pollution and/or contamination as a result of activities such as the actual mining method employed and resultant geological exposure of oxidising materials, seepage, spillages and both mineralised and non-mineralised waste streams. Additional impacts related to mining activities also include dewatering cones of depression and loss of water supply to surrounding land users.

6.12.2 DATA COLLECTION

Ground water data was collected in a number of ways. A desktop study was completed whereby public domain information together with information supplied by the client was used to develop a central database. The following information was used:

- 1:250 000 scale geological map data for the site area;
- National Groundwater Archive (NGA) data that was available for the site area and its surroundings;

- Previous consultant reports completed for the historic Leiden Section underground mining operations, Kangra Coal Ltd (e.g. GCS, 1998);
- Water Research Commission hydrogeological reports related to coal mining, applicable to the site area and setting (e.g. Hodgson and Krantz, 1998, Hodgson *et al.*, 2007); and
- Public domain climatic and topographic data for the site.

A site visit was also undertaken in October 2013 to undertake a hydrocensus investigation and to identify other important site features. The hydrocensus was completed in a 2 km radius from the site, during which nine (9) boreholes, three (3) springs and three (3) surface water points were identified and investigated. The following information was recorded at each of the sites identified:

- GPS Coordinates (decimal degrees, WGS84);
- General site conditions;
- Water usage;
- Ownership of the feature (where applicable);
- Field parameters (e.g. pH and electric conductivity (EC));
- Water level or flow regime; and
- Equipment installed (where applicable).

A total of eight (8) water samples were taken at the site. Six boreholes were sampled using a plastic, single valve bailer and two samples were taken from groundwater discharge areas or seeps. The location of the sampling points is shown in Figure 31. The sample analyses results were compared to the SANS 241 (2011) standard for drinking water and the DWA South African Water Quality Guideline (SAWQG) target values for domestic use.

6.12.3 RESULTS

The application area is located within the W52A and W53A quaternary catchment. The geology is important to understand as the aquifer of permeable rock can either contain, or transmit groundwater. The data collection indicated that the surrounding area is underlain mainly by shale and sandstone formations from the Vryheid Formation from the Karoo Supergroup. Due to the presence of dolerite dykes and sills in portions of the application area, faults do occur, with the main fault located to the east of the application area.

6.12.3.1 Aquifer Description

The Karoo super group is known to display two main aquifers, namely:

- A shallow weathered zone aquifer, where water is stored and transmitted within the upper soils and highly weathered lithologies within the upper 20 m below ground level

(bgl). The shallow weathered aquifer is typically low yielding and is generally not used for water supply, with blow yields varying between 0.5 and 2 l/s; and

- A deeper fractured rock aquifer, where water is stored and transmitted within fractured lithology units and at the contact between weathered and competent lithologies. The fractured rock aquifer is typically found between 20 and 50 m bgl, but may occur at deeper levels depending on the structural geology of the area. The deeper fractured rock aquifer shows typical blow yields ranging between 0.5 and 3 l/s on average, with exceptions between 5 and 10 l/s found at dolerite intrusion contacts and fault zones.

6.12.3.2 Hydrocensus Results

The hydrocensus was completed in a 2 km radius from the site, during which nine (9) boreholes, three (3) springs and three (3) surface water points were identified and investigated. Of the eight boreholes, four were used for domestic supply and livestock watering, two were monitoring points for the abandoned Leiden Colliery boxcut (owned by Kangra) and two were not in use. The borehole, seeps and spring locations can be seen in Figure 31. Water levels varied between 3 and 20 m bgl, which suggests the presence of the two types of aquifer as described above, i.e. shallow weathered zone and deeper fractured. The water levels showed a 95% correlation with topography, indicating that groundwater mimics topography and takes place under unconfined to semi-confined conditions.

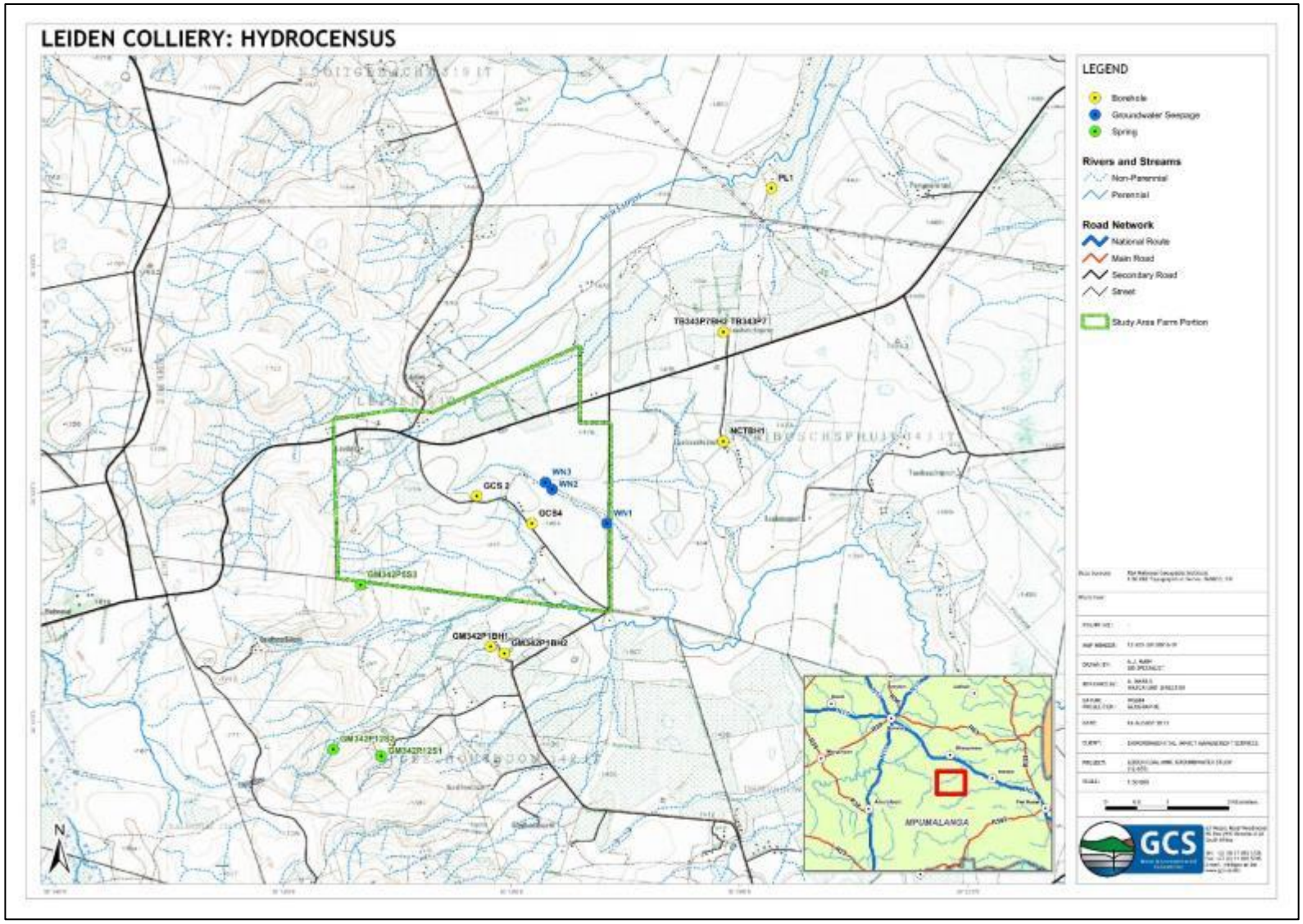


Figure 31: Boreholes and springs

6.12.3.3 Groundwater Quality

A total of eight (8) samples were taken at the site, six from boreholes and two samples from groundwater discharge areas or seeps (see Figure 31). The following results were found:

- The boreholes GCS 2, GM341P1BH1, PL1 and TBP7BH1 complied with both the SANS limits and the DWA SAWQG target values,
- The borehole GCS 4 exceeded the DWA SAWQG target values for manganese as well as the groundwater seepage point WN2, and
- The groundwater seepage sample site WN1 exceeded the DWA SAWQG target values for aluminium and iron and exceeded the SANS 241 (2011) limit for pH and manganese. The exceedance of the SANS (2011) limit is indicative of potential contamination of the ground water seepage due to previous coal mining. The site visit (to a certain degree) confirmed this as a road constructed nearby the sampling point was constructed using potentially coal bearing rock.
- The borehole NCTBH1 exceeded the DWA SAWQG target values for electrical conductivity (EC), fluoride, calcium and magnesium, while exceeding the SANS 241 (2011) limit for sulphate (SO_4).

On the evidence of the above results it is apparent that groundwater quality is generally good across much of the site, however there is evidence of localised groundwater contamination which is possibly linked to historical mining activities.

6.12.3.4 Sensitivity Map

Figure 32 shows the groundwater sensitivity map for Leiden. There are no sensitive groundwater receptors located within the application area itself. The groundwater seepage channel immediately south west of the proposed opencast operations was assigned a sensitivity ranking of +1 as the channel is susceptible to contamination from mining activities. Buffer zones of 100 m were created around all rivers within the site area and assigned a sensitivity weighting of +1. The reason for this ranking was that in the event that groundwater should become contaminated due to mining activities it may discharge into the streams and rivers near to the site, impacting the 100 m buffer zone.

The historic mining area of the Leiden Section was assigned a sensitivity ranking of -1 as this area is considered impacted upon already. The remainder of the site area was either upstream of the proposed mining operations or was in the neighbouring quaternary catchment and is thus unlikely to be impacted by mining activities, thus a sensitivity ranking of 0 was assigned. However, should the magnitude and duration of impacts due to mining activities increase during life of mine the sensitivity weightings applied above may become more severe, e.g. the groundwater seepage channel near to the mine may increase to a sensitivity weighting of +2 (i.e. high sensitivity). This can only be determined accurately following the site-specific assessment to be completed during the EIA/EMP process.

Figure 32: Groundwater sensitivity rankings for Leiden

6.12.4 CONCLUSION

Mining activities have the potential to impact on ground water through a number of potential pollution sources. Groundwater monitoring is of great importance as mining activities extend into the ground and can potentially affect groundwater. Thus, a baseline of the environment is required and has been established in the groundwater assessment as well as sensitive area mapping/ranking within the application area.

The area displays two main aquifers, namely a shallow weathered aquifer and a deeper fractured aquifer. The shallow weathered aquifer is typically low yielding and is generally not used for water supply. The deeper fractured rock aquifer, is typically found between 20 and 50 m bgl, and shows typical blow yields ranging between 0.5 and 3 l/s on average, with exceptions between 5 and 10 l/s found at dolerite intrusion contacts and fault zones.

The hydrocensus indicated nine boreholes, three springs and three groundwater seepage features. It was found that the majority of these boreholes are used for domestic water supply and livestock watering with the two other boreholes being used as monitoring points and two that had been abandoned. The water levels found were between 3 – 20 m below ground level (bgl), these depths are indicative of the afore mentioned aquifers.

Water quality results indicated that groundwater quality is generally good across much of the site, however there is evidence of localised groundwater contamination which is possibly linked to historical mining activities. The site visit (to a certain degree) confirmed this as a road constructed nearby the sampling point was constructed using potentially coal bearing rock A detailed ground water assessment will be undertaken during the EIA phase, at which time a ground water model will be developed and potential impacts of the proposed mining operations will be investigated. Appropriate mitigation measures will be developed to address the identified impacts.

6.13 AIR QUALITY

Airshed Planning Professionals (Pty) Ltd was appointed by to undertake the air quality specialist study for the Leiden project. The following sections provide a summary of the air quality that may be affected by the proposed Leiden project. Information has been sourced from the Airshed scoping report. For further information, please refer to the full air quality scoping report which is included in Appendix L.

6.13.1 INTRODUCTION

Existing sources of emissions in the region and the characterisation of existing ambient pollution concentrations is fundamental to the assessment of cumulative air impacts. A change the in ambient air quality can result in a variety of impacts which in turn may cause a disturbance to and/or health impacts on nearby receptors. Sensitive receptor sites include residential areas, communities, and natural environments. Mining activities have the potential

to result in increased levels of atmospheric dust, increased concentrations of PM_{10} (Particulate Matter with an aerodynamic diameter of less than 10μm) and increased concentrations of $PM_{2.5}$ (Particulate Matter with an aerodynamic diameter of less than 2.5μm). Historical evidence indicates that the pollutant of concern associated with open-cast mining operations is particulate matter creating a nuisance dust source and resulting in human health concerns and nuisance.

6.13.2 DATA COLLECTION

Air quality data was collected in a number of ways. A baseline air quality characterisation was attained by collection and analysis of historical records (e.g. Weather Bureau Reports). Local meteorological conditions were described using MM5 modelled meteorological data for the application area (26.866761°S; 30.308845°E) during the period January 2010 – December 2012. The data included hourly average wind speed, wind direction and temperature. Additional literature regarding the effects of air quality on the environment and human health were also utilised. A site survey was also conducted in September 2013 during which the following future potential sources of emissions as a result of the mining operations were investigated.

6.13.3 RESULTS

A number of potential sources of emissions have been identified in the region within which the application falls and these contribute the ambient air quality. These land-uses contribute baseline emission sources via vehicle tailpipe emissions, household fuel combustion, biomass burning, and various fugitive dust sources. These sources of emissions are:

- Power Stations.

  Operational power stations that fall within the Mpumalanga Highveld region. These electricity generation operations emissions are carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen dioxides and ash (particulates). Fly-ash particles emitted contain various trace elements such as arsenic, chromium, cadmium, lead, manganese, nickel, vanadium, and zinc. Small quantities of volatile organic compounds are also released from such operations.

- Mines.

  There are a number of coal mines located to the northwest of the application area, in close proximity to Ermelo. These activities mainly result in fugitive dust releases with small amounts of nitrogen oxides (NO_x), carbon monoxide (CO), SO_2, methane, and CO_2 being released during blasting operations.

- Fugitive Emissions.

  Emissions from unpaved roads are expected to constitute a major source of emissions to the atmosphere in the region.

- Domestic Household Emissions.

  It is likely that households within the local communities or settlements will generate emissions through the combustion of coal, paraffin and/or wood for cooking and/or space heating purposes. These emissions would include respirable particulates, CO, SO_2, polycyclic aromatic hydrocarbons (PAHs), heavy metals, NO_2 and various toxins.

- Biomass Burning.

  Within the project vicinity, crop-residue burning and veld fires may represent significant sources of combustion-related emissions. Biomass burning is an incomplete combustion process (Cachier, 1992), with carbon monoxide, methane and nitrogen dioxide gases being emitted.

- Fuel combustion emissions.

  Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted by internal combustion engines include CO_2, CO, carbon (C), SO_2, oxides of nitrogen (mainly NO), particulates and lead.

- Refuse and tyre burning.

  An additional source of emissions is the waste sector especially from informal refuse and tyre burning. The informal burning of refuse tips (dumps) within former township areas and burning of waste at local municipal landfill sites represents a source of concern in all provinces.

The baseline air quality for the region is unknown, with no ambient measurements available for any of the relevant particulates. It is assumed that the air quality within the application area is relatively good as there are no major sources of pollution located near the site. Fugitive dust sources identified to potentially occur in the study area include paved and unpaved roads; agricultural tilling operations; and wind erosion of sparsely vegetated surfaces. The main sources likely to contribute to cumulative PM_{10} impact are vehicle entrainment on unpaved road surfaces, windblown dust from exposed areas and biomass burning.

6.13.3.1 Sensitive Receptors

The closest residential development to the project area is Sheepmoor ~16 km to the north and Iswepe ~22km to the east-northeast. Individual residences (i.e. farm houses) as well as a local school are also within the study area of the proposed operations. The National Ambient Air Quality Standards (NAAQS) and Dust Deposition Guidelines are based on human exposure to specific criteria pollutants and as such, possible sensitive receptors were identified where the public is likely to be exposed. The NAAQS are enforceable outside of

mine boundaries and therefore the sensitive receptors identified (Figure 33) include the nearest residential areas in the region that occur within a 7.5 km boundary line in all directions (i.e. a modelling domain of 15 km east-west and 15km north-south). Individual residences (i.e. farm houses and local schools) fall within the area of proposed operations.

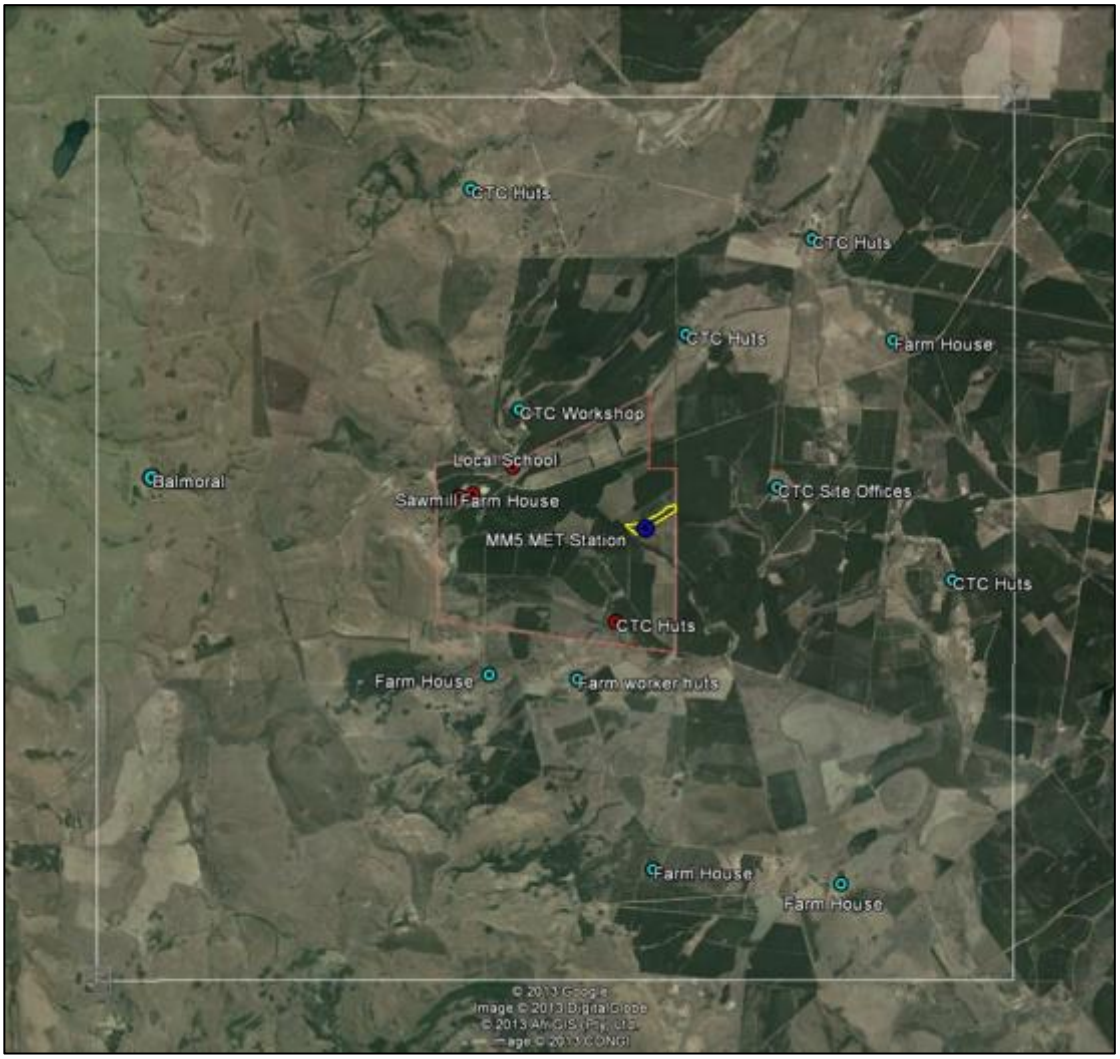


Figure 33: Potential sensitive receptors

The fugitive dust emissions may occur as a result of vehicle entrained dust from local paved and unpaved roads and wind erosion from open areas. The extent of particulate emissions from the main roads will depend on the number of vehicles using the roads and on the silt loading on the roadways.

6.13.3.2 Sensitivity Map

Currently it is envisaged that all product from the proposed Leiden Coal Mine will be trucked away from site via unpaved haul roads to the N2, from which point the road surface is paved to the Delta Plant located in Ermelo. Two haul road options have been identified, named “Gravel Road 1” (“Route 1” in air quality report) and “Gravel Road 2” (“Route 2”in air quality report). This use of unpaved road surfaces is often considered the largest source of

emissions in a mining environment. For this reason, based on past experience with similar projects, it is expected that haul roads will be responsible for the most emissions and impacts as a result of the proposed operations going ahead. In-pit operations should rank second while materials handling should rank third in terms of emissions significance rating. The compilation of a sensitivity map for Air Quality was based on the above, with the results depicted in Figure 34. Sensitive receptors were given a 500m buffer distance and based on their respective distances from proposed infrastructure, assigned a sensitivity rating. Where these buffers intercept a higher ranking was assigned.

Figure 34: Air Quality Sensitivity Map

6.13.4 CONCLUSION

The baseline air quality for the region is unknown, with no ambient measurements available for any of the relevant particulates. It is assumed that the air quality is relatively good as there are no numerous major sources of pollution located near the site. The main sources likely to contribute to cumulative PM_{10} impact are vehicle entrainment on unpaved road surfaces, windblown dust from exposed areas, and biomass burning. The closest residential development to the project area is Sheepmoor ~16 km to the north and Iswepe ~22km to the east-northeast. Individual residences (i.e. farm houses) as well as a local school are also within the study area of the proposed operations. The school is considered a particularly sensitive receptor and the proximity to one of the proposed haul routes renders that option a no-go unless that section of road or the school are moved.

Mining operations are likely to increase ground-level $PM_{2.5}$ and PM_{10} concentrations and dust fall-out, thus increasing possible affects to human health. Since many of the impacts of particulates are dosage dependent, the extent of impact will be assessed during the EIA phase. The modelled ground-level concentrations of total suspended particulates (TSP), PM10 and PM2.5 will be compared to National Standards and Guidelines at the sensitive receptors during the EIA phase.

6.14 NOISE

Enviro Acoustic Research was appointed by EIMS to undertake the noise specialist study for the Leiden project. The following sections provide a summary of the noise environment that may be affected by the proposed Leiden project. Information has been sourced from the noise scoping report. For further information, please refer to the full noise scoping report which is included in Appendix M.

6.14.1 INTRODUCTION

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication;
- Impedes the thinking process;
- Interferes with concentration;
- Obstructs activities (work, leisure and sleeping); and
- Presents a health risk due to hearing damage.

It is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person

in the traffic behind them hears nothing but noise. Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source. Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would like to sleep. Severity of the annoyance depends on factors such as:

- Background sound levels, and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological state of the receptor; and
- The attitude of the receptor about the emitter (noise source).

Certain noise generating activities associated with mining operations can cause an increase in ambient noise levels in and around the site. Significant noise is associated the most with opencast and plant (including workshops) activities. The only noisy activities relating to the underground mining activities are associated with the plant activities. A source of noise during the operational phase will be traffic to and from the site, traffic around the facility, ROM and product transport and activities associated with waste management.

Potential receptor sites include the residential areas and communities that occur on site and in the surrounding environment. Considering the potential for nuisance due to noise, it is essential that a noise baseline is established against which future monitoring data can be compared. The data collected in the noise specialist study may be used to establish a baseline environment, prior to mining activities.

6.14.2 DATA COLLECTION

A site visit was conducted in October 2013 to establish ambient sound measurements as well as to assess the sound character. Ambient (background) noise levels were measured at appropriate times in accordance with the South African National Standard SANS 10103:2008 "The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and

- weather conditions.

Sound level measuring equipment settings conform to specifications listed in SANS 10103 (South African Guidelines). A number of 10 minute measurements were taken over a day/night period from the afternoon of 8 to the afternoon of 9 October 2013. There were no clearly identifiable noise sources close to the measurement location and the location should provide an overview of the sound character in the area. The sawmill was operational yet not audible at the measurement location. The microphone was located in an open area further than 5 meters from any vegetation or reflective surfaces (excluding the ground itself).

6.14.3 RESULTS

Potentially sensitive receptors, also known as noise-sensitive developments (NSDs) were identified using Google Earth®. This was supported by a site visit to confirm the status of the identified dwellings. Potential NSD's in and within approximately 2,000 meters around the proposed development were identified as **1** to **21** (presented in Figure 35) with their localities defined in Table 14 below.

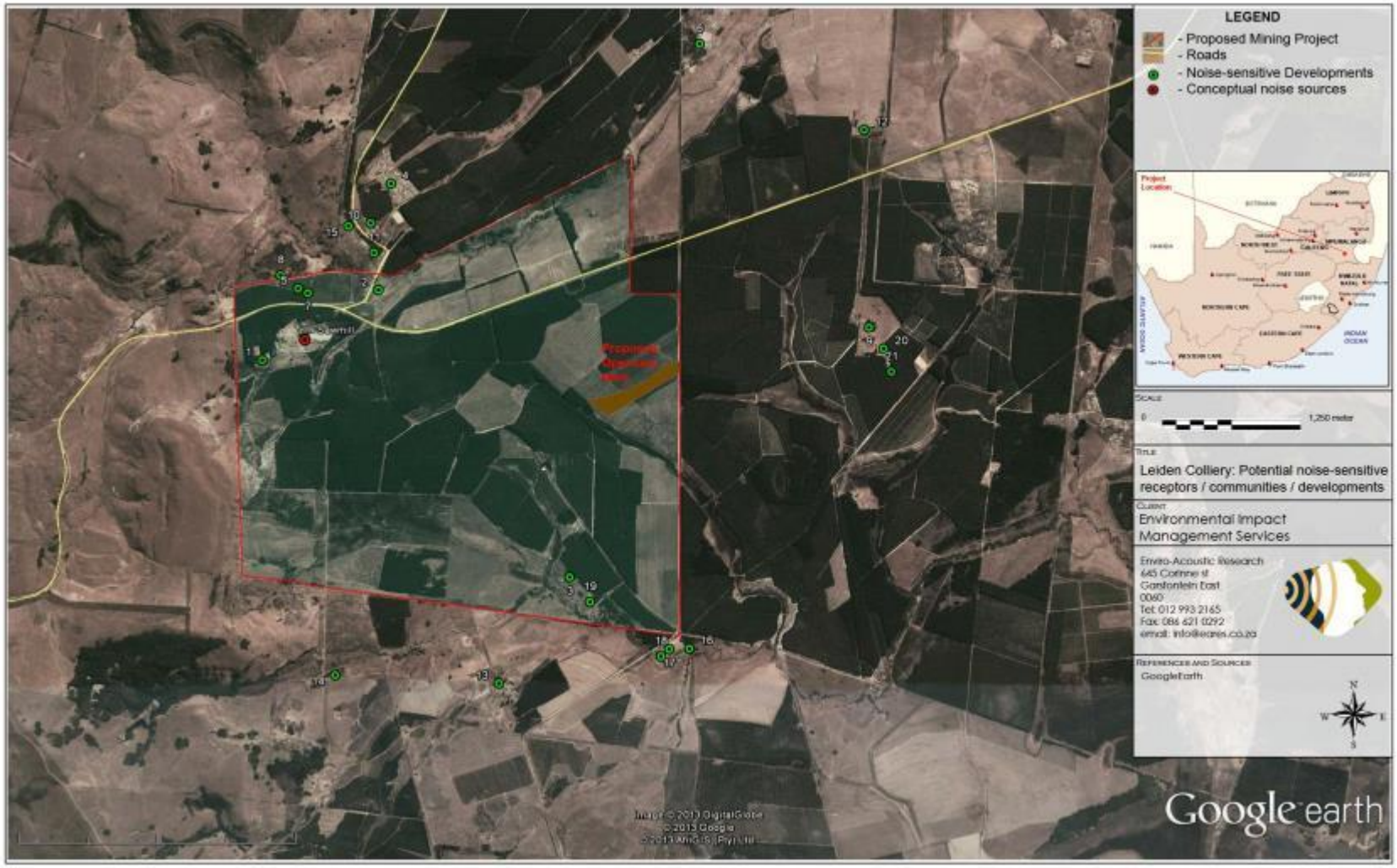


Figure 35: Aerial image indicating potential NSD's and existing noise sources

Table 14: Locations of the identified noise-sensitive developments (Datum type: WGS84 – Hartbeeshoek)

Noise-sensitive development	Status	Location (Latitude)	Location (Longitude)
NSD01	Residential	-26.8616	30.2766
NSD02	Residential	-26.8559	30.28716
NSD03	Residential	-26.8792	30.30454
NSD04	Residential	-26.8473	30.28829
NSD05	Residential	-26.8558	30.27984
NSD06	Residential	-26.836	30.31634
NSD07	Residential	-26.8562	30.28073
NSD08	Residential	-26.8547	30.27827
NSD09	Residential	-26.8589	30.33176
NSD10	Residential	-26.8505	30.28644
NSD11	Residential	-26.8529	30.28674
NSD12	Residential	-26.8429	30.33131
NSD13	Residential	-26.8878	30.29809
NSD14	Residential	-26.8871	30.28322
NSD15	Residential	-26.8507	30.28443
NSD16	Residential	-26.885	30.31542
NSD17	Residential	-26.885	30.31358
NSD18	Residential	-26.8856	30.31284
NSD19	Residential	-26.8812	30.30638
NSD20	Residential	-26.8607	30.33309
NSD21	Residential	-26.8625	30.33379

The pre-mining noise environment resembles a rural atmosphere but does have slightly elevated ambient noise levels. Measured data indicate sound levels typical of an area with a rural district sound character with wind and agricultural activities raising the sound levels. The dominant source of noise is natural, mainly wind induced noises and birds.

During the daytime $\mathbf{L_{Aleq}}$ values ranged between 35.7 and 59.2 dBA. The night-time $\mathbf{L_{Aleq}}$ values ranged between 29.2 to 55.9 dBA. The average value of the 84 10-minute equivalent daytime measurements was calculated at 46.1 dBA, while the average for the 48 night-time measurements were calculated at 38.6 dBA.

Daytime measured data indicate sound levels typical of an area with a rural to sub-urban district character. Night-time levels however are far higher than expected for such an area, likely due to sounds from both the cattle farming activities as well as insects and frogs.

The measured $L_{Aeq,f}$ levels during the day and night however conforms to the recommendation of 55 and 45 dBA respectively by the World Health Organization, World Bank and International Finance Corporation for residential use.

6.14.3.1 Sensitivity Map

Based on the location of the proposed mining development and the potential noise-sensitive developments there exists a low risk of a noise impact on these receptors. A preliminary sensitivity map is presented in Figure 36. The sensitivity map will however be refined during the EIA phase.

Figure 36: Noise sensitivity

6.14.4 CONCLUSION

All the measurements indicated an area that is generally quiet. The dominant source of noise is natural being mainly wind induced noises and birds. Vehicle movement and agricultural activities (such as the cutting and moving of trees and livestock related sounds) will impact and increase these sound levels. Measured data indicate sound levels typical of an area with a rural district sound character with wind and agricultural activities raising the sound levels. The measured $L_{Aeq,f}$ levels during the day and night however conforms to the recommendation of 55 and 45 dBA respectively by the World Health Organization, World Bank and International Finance Corporation for residential use.

Based on the location of the proposed mining development and the potential noise-sensitive developments there exists a low risk of a noise impact on these receptors. A preliminary sensitivity map has been developed but will however be refined during the EIA phase.

6.15 VISUAL

Newtown Landscape Architects (NLA) was appointed by EIMS to undertake the visual specialist study for the Leiden project. The following sections provide a summary of the visual resource that may be affected by the proposed Leiden project. Information has been sourced from the NLA scoping report. For further information, please refer to the full noise scoping report which is included in Appendix N.

6.15.1 INTRODUCTION

The main aim of the visual impact specialist study is to ensure that the visual / aesthetic consequences of the proposed project are understood and adequately considered in the environmental planning process. Visual impacts would result from the construction, operation and decommissioning phase of the proposed Leiden Coal Mine. Specifically, visual impacts would result from the overburden dumps and the mining activities being seen from sensitive viewpoints (i.e. impacts of views from residences) and the negative effects (relating primarily to visibility and intrusion) on the scenic quality and sense of place of the landscape of the proposed site.

The landscape, its analysis and the assessment of impacts on the landscape all contribute to the baseline for visual impact assessment studies. The assessment of the potential impact on the landscape is carried out as an impact on an environmental resource, i.e. the physical landscape. Visual impacts, on the other hand, are assessed as one of the interrelated effects on people (i.e. the viewers and the impact of an introduced object into a particular view or scene). A qualitative evaluation of the landscape is essentially a subjective matter. In this study the aesthetic evaluation of the study area is determined by the professional opinion of the author based on site observations and the results of contemporary research in perceptual psychology. Landscape character, landscape quality (Warnock & Brown, 1998) and “sense of place” (Lynch, 1992) are used to evaluate the visual resource i.e. the receiving environment.

These measures are intrinsic to the landscape and thus they enable a value to be placed on the landscape that is independent of the person doing the viewing.

In determining the quality of the visual resource, both the objective and the subjective or aesthetic factors associated with the landscape are considered. Many landscapes can be said to have a strong sense of place, regardless of whether they are considered to be scenically beautiful but where landscape quality, aesthetic value and a strong sense of place coincide, the visual resource or perceived value of the landscape is considered to be very high.

6.15.2 DATA COLLECTION

In this study the aesthetic evaluation of the study area is determined by the professional opinion of the author based on site observations and the results of contemporary research in perceptual psychology.

A field survey was undertaken in September 2013 during which the study area was scrutinized to the extent that the receiving environment can be documented and adequately described. The landscape character was determined and mapped using the findings of the field survey and aerial photographic interpretation. The description of the landscape focused on the nature of the land rather than the response of a viewer.

The quality of the landscape was calculated and mapped as a measurement of the union of ecological integrity (overall health of the landscape) and aesthetic appeal. Aesthetic appeal has been described using contemporary research in perceptual psychology and the opinion of the specialist as the basis for determining its value.

The sense of place of the study area has been evaluated and mapped as the uniqueness and distinctiveness of the landscape. The primary informant of these qualities is the spatial form, character and the natural landscape together with the cultural transformations and traditions associated with historic and current use of the land.

Landscape character, landscape quality (Warnock & Brown, 1998) and “sense of place” (Lynch, 1992) are used to evaluate the visual resource i.e. the receiving environment. These measures are intrinsic to the landscape and thus they enable a value to be placed on the landscape that is independent of the person doing the viewing.

In terms of visual sensitivity mapping of the project site, a sensitivity map was produced by merging the results of a viewshed analysis and visual exposure analysis from sensitive viewer locations. The viewshed analysis indicated how many sensitive viewers could see a specific point on site, i.e. indicating the viewer incidence. The higher the viewer incidence, the higher the sensitivity of the area on the site. The visual exposure analysis indicated the relationship between the distance of the sensitive viewer location in relation to the project site. This was determined using a buffer zone / zone of potential influence of 5km which would include the fore- and middle ground distance of a sensitive viewer location. Nearer to

the sensitive viewer. location would be in the foreground of the viewer, thus having a higher impact on the viewer location.

6.15.3 RESULTS

6.15.3.1 Landscape Character

The study area has a placid and peaceful pastoral sense of place with the farmsteads and residences, schools and church introducing a rural component to the sense of place. The placid and peaceful sense of place is derived from the mountain back drop and undulating topography covered in plantations, crops and grassland vegetation. Grazing and other agricultural activities introduce the pastoral element.

Colours within the study areas are mostly dark greens from the plantations, light yellow-greens from the grassland vegetation as well as light browns and whites from the soils and geological formations. Greyish colours are introduced when plantations are harvested. Lines are flowing and mostly in the horizontal plane with no sharp angles and harsh lines in the vertical plane. Currently man-made structures include residence and farming outbuildings. The saw mill is located on the project site and quite well hidden from roads and farmsteads. Other structural man-made elements include the power lines criss-crossing the study area.

It is evident from the description of the landscape character above, that the introduction of the mining structures and related activities would create strong contrast with the existing landscape characteristics. It is further anticipated that indirect negative effects related to the mining activities such as dust and light pollution would also add to the major disruption of the landscape character and sense of place if left unmitigated.

6.15.3.2 Visual Receptors

Due to the nature of the mining operations and related activities the related infrastructure may stand out from the natural setting of the study area. This could possibly occur as a result of the clearance of some of the surrounding plantation which at present acts as a screen to the study area. However the screen is temporary due to harvesting cycles of the plantations.

The sensitivity of visual receptors and views are dependent on the location and context of the viewpoint, the expectations and occupation or activity of the receptor or the importance of the view. Travellers travelling along the dirt roads within and through the study area, would catch glimpses of the proposed mine structures and activities when driving along the roads. These views are however temporary of nature and regarded as having a moderate sensitivity. People engaged in work activities within the study area are regarded as having a low sensitivity due to the fact that their attention would be focussed on their work activity. Permanent views would be those from the farmsteads and residences within the immediate area and would be classified as having a high sensitivity.

The viewshed analysis, Figure 37 below, indicated how many sensitive viewers could see a specific point on site, i.e. indicating the viewer incidence. The higher the viewer incidence, the higher the sensitivity of the area on the site.

The visual exposure map presented in Figure 38 indicated the relationship between the distance of the sensitive viewer location in relation to the project site. This was determined using a buffer zone / zone of potential influence of 5km which would include the fore- and middle ground distance of a sensitive viewer location. Nearer to the sensitive viewer location would be in the foreground of the viewer, thus having a higher impact on the viewer location. The results from the visual study indicated that the most sensitive viewer of the proposed operations would be the farmstead which is located to the south of the operations.

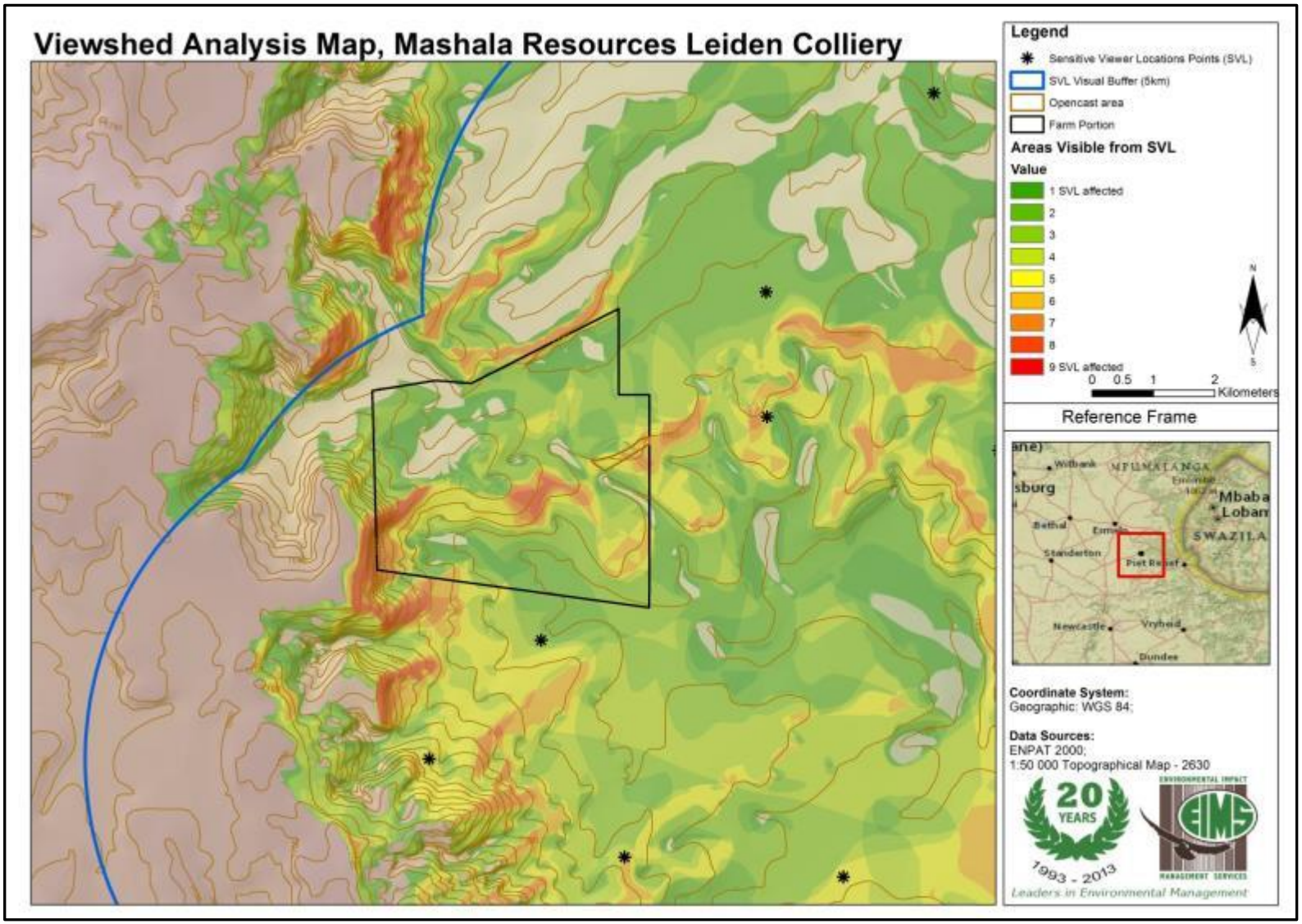


Figure 37: Viewshed analysis

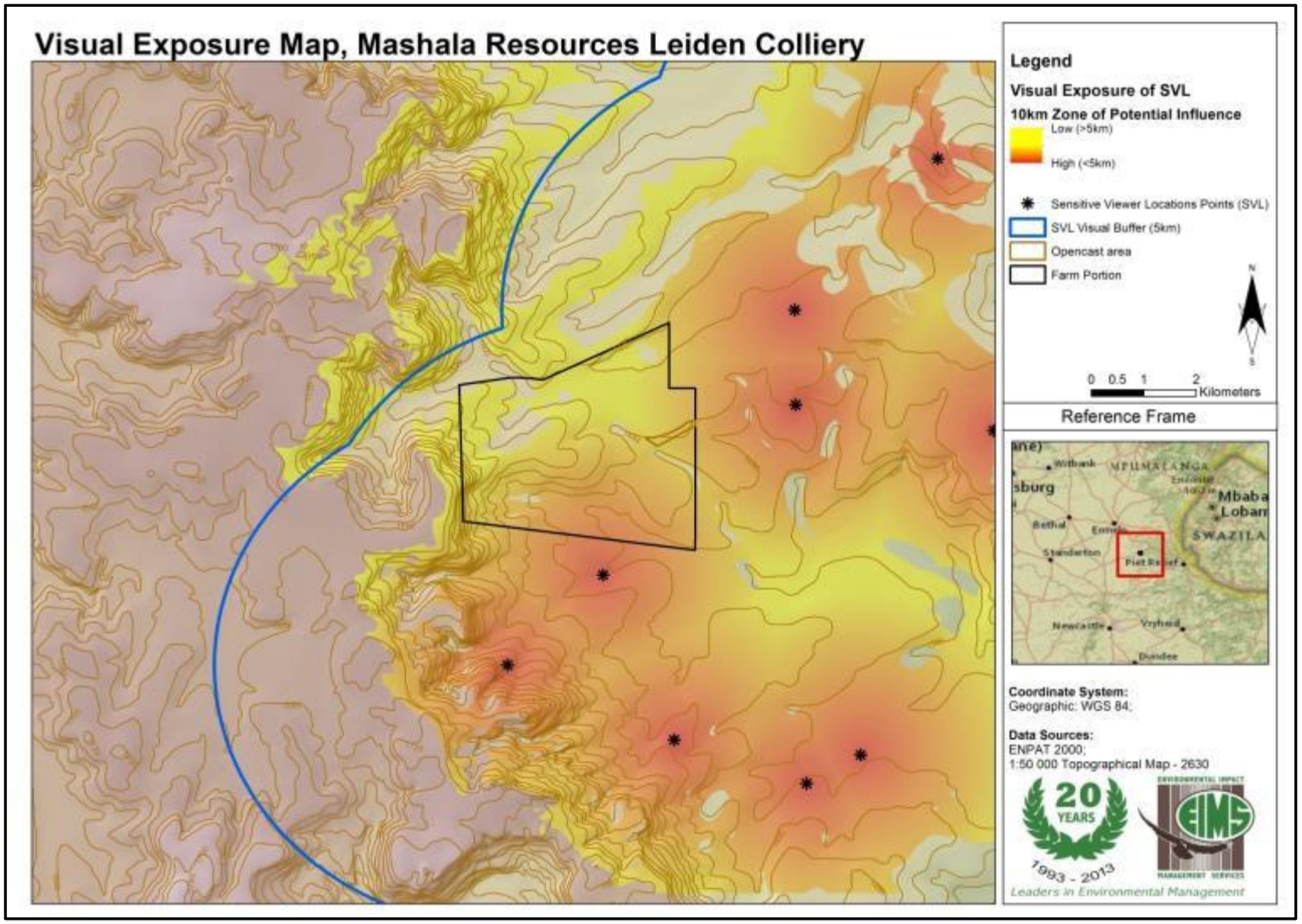


Figure 38: Visual exposure

6.15.3.3 Sensitivity Map

The sensitivity map below (Figure 39) is a combination of the viewshed and visual exposure analyses and indicates the visual sensitivity of the site.

Sensitive features were defined in two categories, sensitive viewers and sensitive locations. Passer byers of the study areas surroundings were determined as moderately sensitive as they were “temporary viewers”. People engaged in work activities within the surrounding areas were regarded as having a low sensitivity due to the fact that they would be preoccupied with their work activities. Permanent viewers were regarded as highly sensitive, this is because permanent viewers were considered to be farmsteads and residences in and around the study area. Sensitive locations such as farmsteads, have been described as highly sensitive as they fall within the study area. Workers that stay on the farm were regarded as moderately sensitive as this was their place of work. Peoples travelling to and from the site to church and to the school have been regarded as having a moderate sensitivity as they are temporarily exposed to the proposed mining operations.

From the map it can be concluded that the south-eastern half of the site would be more sensitive than the northwestern half. The north-western corner is the least sensitive area of the site. It would therefore be recommended that the proposed infrastructure be located in this area of the site. This would result in the proposed infrastructure being the furthest away from the sensitive viewer locations and having possibly the least sensitive viewer incidences.

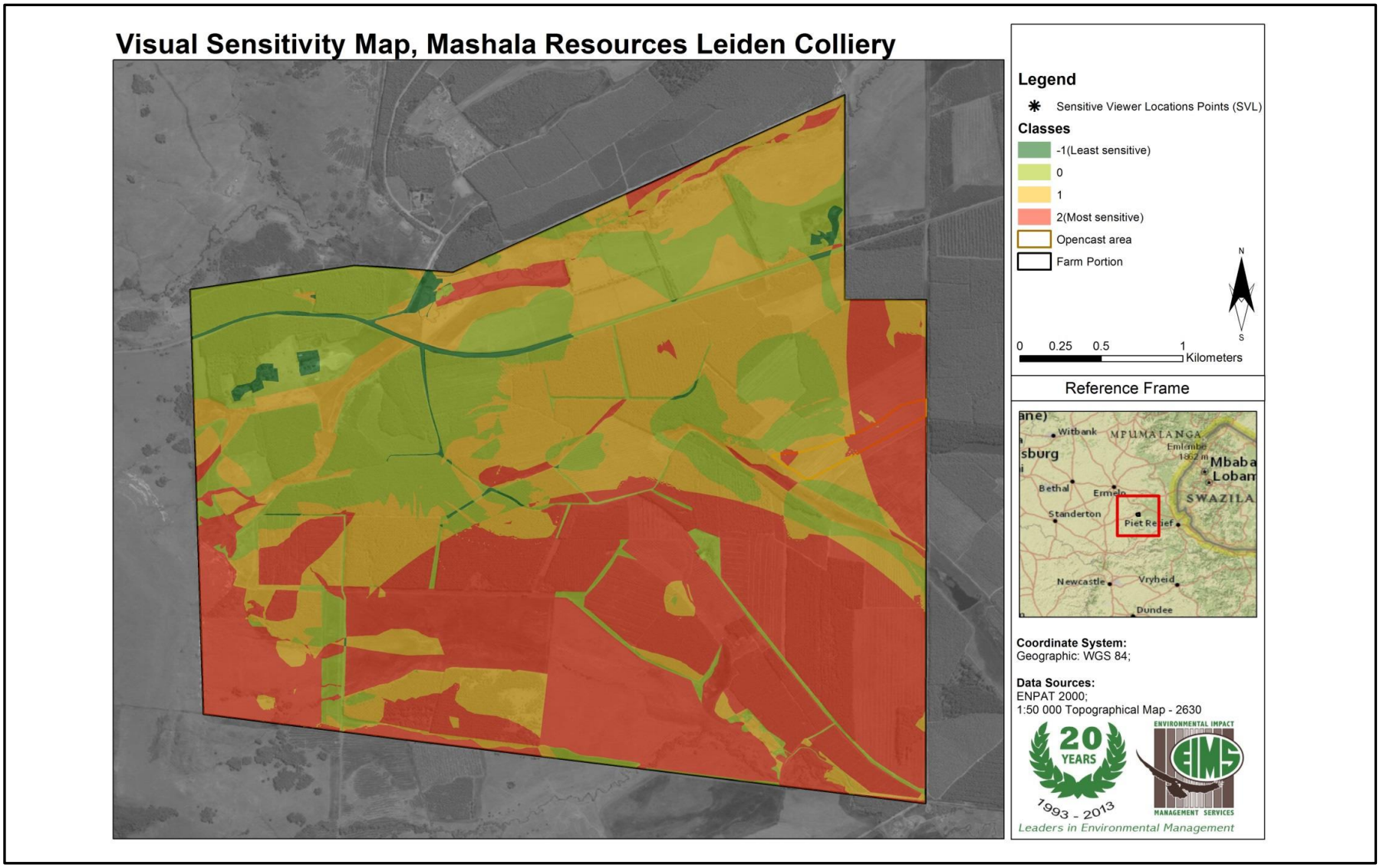


Figure 39: Visual sensitivity

6.15.4 CONCLUSION

The study area has a placid and peaceful pastoral sense of place with the farmsteads and residences, schools and church introducing a rural component to the sense of place. The placid and peaceful sense of place is derived from the mountain back drop and undulating topography covered in plantations, crops and grassland vegetation. Grazing and other agricultural activities introduce the pastoral element. It is evident from the description of the landscape character above, that the introduction of the mining structures and related activities would create strong contrast with the existing landscape characteristics. It is further anticipated that indirect negative effects related to the mining activities such as dust and light pollution would also add to the major disruption of the landscape character and sense of place if left unmitigated.

The visual assessment has identified highly sensitive, moderately sensitive and low sensitive viewers that may potentially be affected by this project. The south-eastern half of the site has been determined to be more sensitive than the northwestern half, with the north-western corner being the least sensitive area of the site. In the EIA phase, detailed mitigation measures that could reduce the impact of the Project, will be proposed.

7 EXISTING STATUS OF THE BUILT ENVIRONMENT

The description of the baseline receiving built environment was obtained from the studies undertaken by the specialist team and in conjunction with EIMS. All specialist studies undertaken for the proposed Leiden Coal Mine are included as supporting technical appendices to this report.

7.1 BLASTING AND VIBRATION

Blast Management and Consulting was appointed by EIMS to undertake the blasting and vibration specialist study for the Leiden project. The following sections provide a summary of the potential effects of blasting at the proposed Leiden project. Information has been sourced from the Blast Management scoping report. For further information, please refer to the full blasting and vibration scoping report which is included in Appendix O.

7.1.1 INTRODUCTION

Explosives are used to break rock through the shock waves and gasses yielded from the explosion. The application of explosives for breaking rock will always have an effect on the surrounding environment. These effects can manifest in the form of ground vibration, air blast, fumes, fly rock etc. These short duration events may be noticeable by communities and individuals living in the immediate environment. These events tend to cause nuisance and elicit an emotive response because of resonance because they are easily recognized as being related to blasting.

7.1.1.1 Ground Vibration

Ground vibration is a natural result from blasting activities. The far field vibrations are inevitable, but un-desirable by products of blasting operations. The shock wave energy that travels beyond the zone of rock breakage is wasted and could cause damage and annoyance. The level or intensity of these far field vibration is however dependant on various factors. Some of these factors can be controlled to yield desired levels of ground vibration and still produce enough rock breakage energy. Factors influencing ground vibration are the charge mass per delay, distance from the blast, the delay period and the geometry of the blast. These factors are controlled by planned design and proper blast preparation.

7.1.1.2 Air Blast

Air blast or air-overpressure is pressure acting and should not be confused with sound that is within audible range (detected by the human ear). Sound is also a build up from pressure but is at a completely different frequency to air blast. Air blast is normally associated with frequency levels less than 20 Hz, which is the lower limit threshold for human hearing. Air blast is the direct result from the blast process although influenced by meteorological conditions. The final blast layout, timing, stemming, accessories used, covered or not covered

etc. all has an influence on the outcome of the result. Air blast is more commonly a problem to nearby communities than vibration, because it is felt through response of large surfaces such as ceilings and windows. Typically these effects can be confused as being caused by ground vibration.

7.1.1.3 Fly Rock

Blasting practices require some movement of rock to facilitate the excavation process. The extent of movement is dependent on the scale and type of operation. For example, blasting activities within large coal mines are designed to cast the blasted material much greater distances than practices in a quarrying or hard rock operations. This movement should be in the direction of the free face, and therefore the orientation of the blasting is important. Material or elements travelling outside of this expected range may be considered to be fly rock. An incorrect blast design may result in blast rock. In short the following list is typical causes of fly rock:

- Burden to small,
- Burden to large,
- Stemming length to short,
- Out of sequence initiation of blastholes,
- Drilling inaccuracies,
- Incorrect blasthole angles,
- Over charged blastholes.

It is however possible to blast without any fly rock with proper confinement of the explosive charges within blast holes using proper stemming procedures and materials. Stemming is the key requirement here to ensure that explosive energy is efficiently used to its maximum.

7.1.2 DATA COLLECTION

Data was obtained from literature from the area and review of aerial images and maps to identify installations, houses and structures as points of interest to consider. A site visit was under taken in September 2013 to confirm the site surroundings and potentially affected infrastructure. The site visit also aimed to identify and define an area of possible influence.

The protocols applied in this study were based on the author's experience, guidelines from literature research, client requirements and general indicators from the various acts of South Africa. There is no direct reference in the South African legislation with regards to requirements and limits on the effect of ground vibration and air blast specifically. There are also no specific South African standards and the USBM is well accepted as standard for South Africa. The guidelines and safe blasting criteria are according international accepted

standards and specific applied in this document is the United States Bureau of Mines (USBM) criteria for safe blasting for ground vibration and recommendations on air blast.

7.1.3 RESULTS

A review of potentially sensitive features in the project application area is required when considering blasting and vibration, this is because of the effects ground vibration levels, air blast levels and fly rock have to the surrounding environment. Detail review of the area and site visit conducted showed various structures and installations located within the 3500m possible influence boundary. These potentially sensitive features are presented in **Figure 40**.

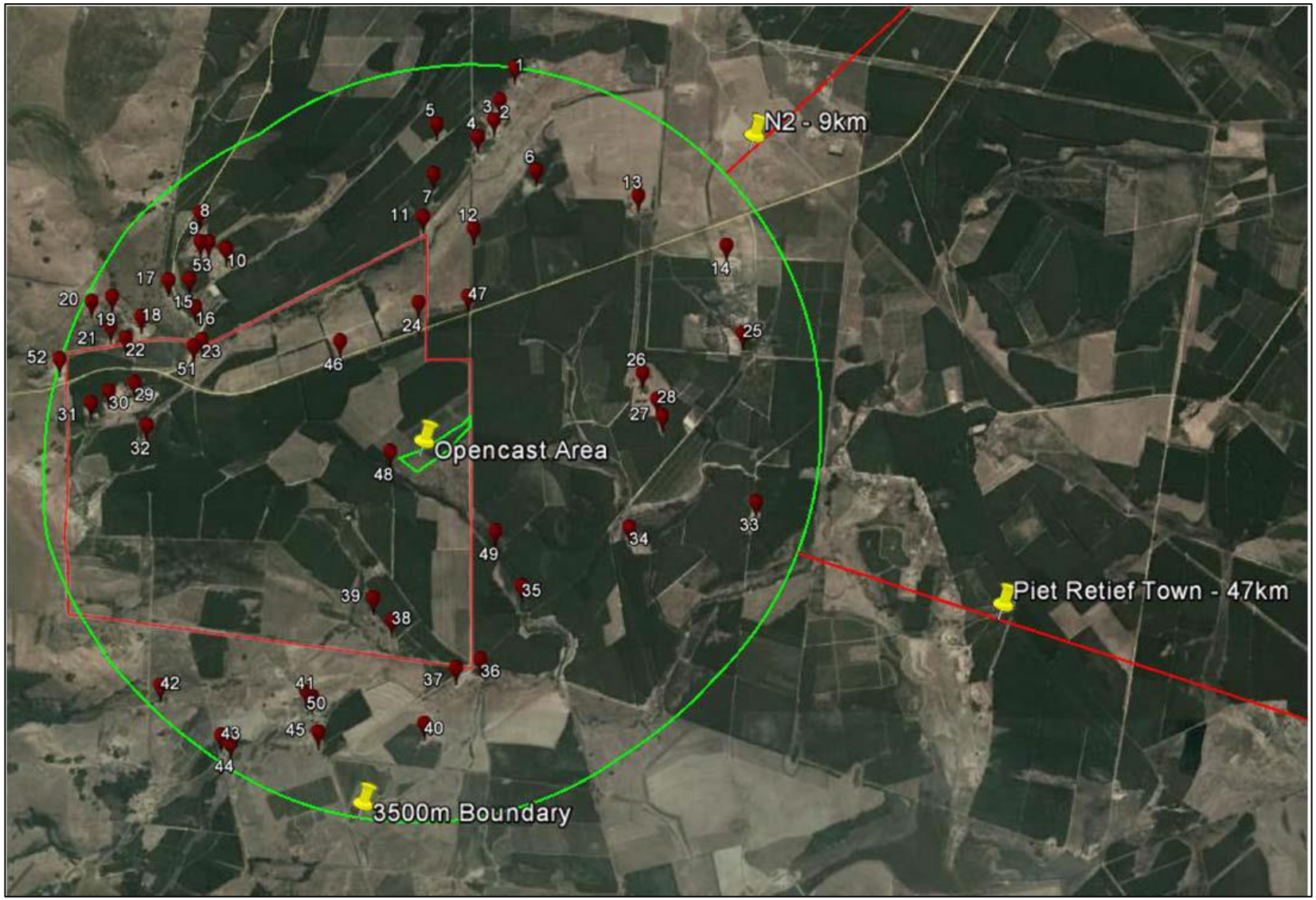


Figure 40: Aerial image indicating potentially sensitive features in terms of blasting and vibration

The structures range from typical traditional built housing to brick and mortar structures. Structures also range between houses and industrial installations. Table 15 shows some of the structures observed in the area.

Table 15: Sensitive features located within the study area

Structures	Short Description
	Traditional building style houses
	Old Sandstone building on farm

	School Buildings
	Weir in one of the streams

7.1.3.1 Sensitivity Map

The sensitivity map presented in Figure 41 depicts the area of influence that may potentially result as a result of the blasting and vibration impacts. Points of Interest (POI) are identified surrounding the opencast pit area that are of possible sensitivity. The spatial sensitivity presented in the map is conceptual at this stage, but will be refined in the EIA phase. However the sensitivity map does indicate a broad area where possible influence may be expected and where possible influence is expected to be less. The outcome of actual drilling and blasting operations may further indicate significant lower outcome than predicted. Four levels are applied to the sensitivity mapping as follows:

- 500m boundary (generally considered a safe distance from blasting operations);
- 1500m zone area where possible influence may be expected;
- 3500m area where possible influence is certain to be less and rather disturbing than damaging; and
- 3500m+ where no influence is expected at all.

The map indicates that 1 POI falls within the 500m boundary, 5 POI's within the 1500m boundary and the rest of the identified POI's within the 3500m boundary. POI's further than 3500m were not reviewed.

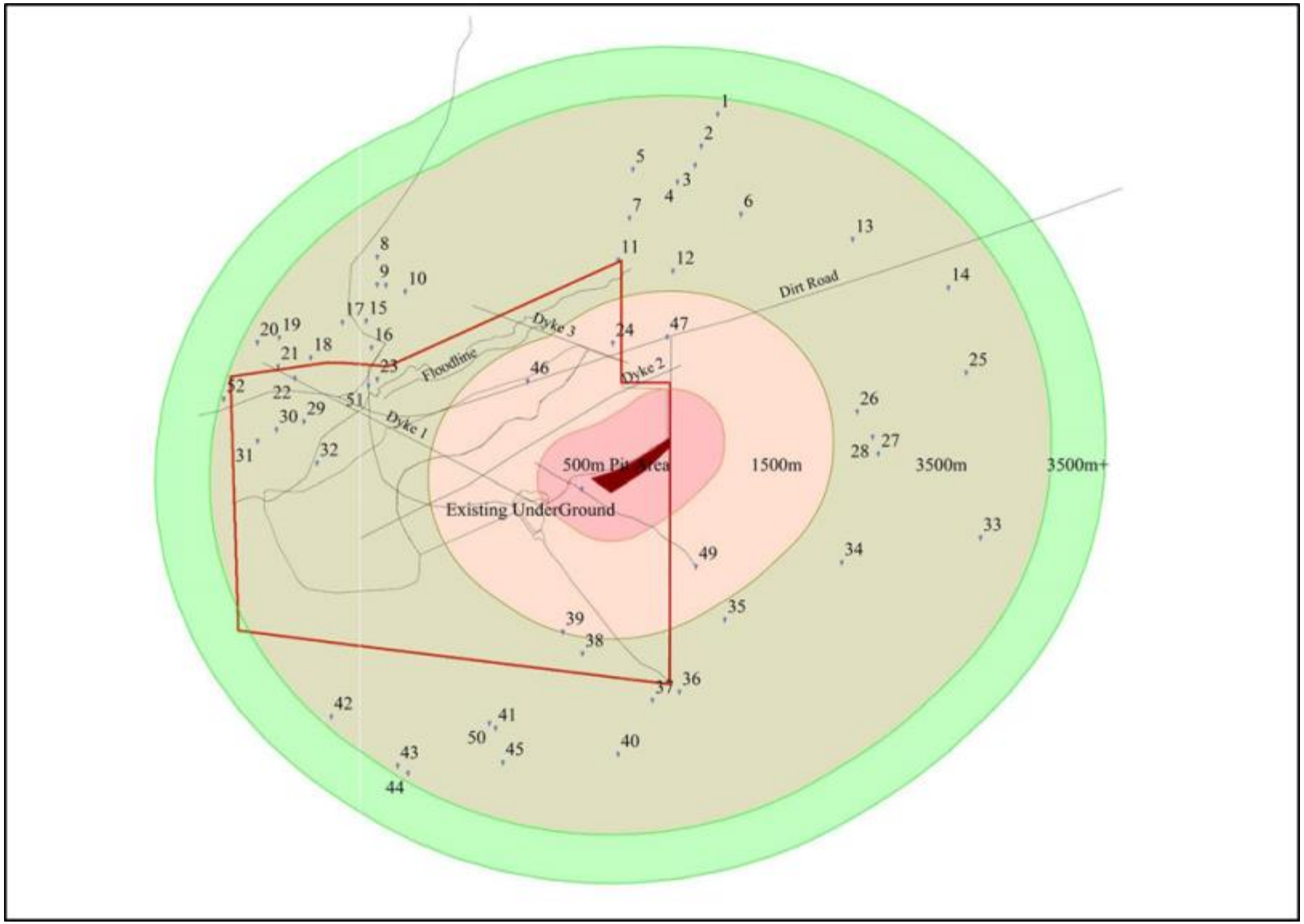


Figure 41: Blasting and Vibration sensitivity map

7.1.4 CONCLUSION

The application of explosives for breaking rock will always have an effect on the surrounding environment. These effects can manifest in the form of ground vibration, air blast, fumes, fly rock etc. These short duration events may be noticeable by communities and individuals living in the immediate environment. The study area is considered to be a moderately sensitive area with POI's present in the surroundings. It is expected that the most critical area is the 1500 m around the project area. Depending on the final blasting operation scale, the installations within this boundary are expected to be possibly impacted. Installations further than 1500 m from blasting operations is certain to be impacted to lesser degree but will need consideration as well. It is important to note that impacts arising from blasting may be attributed mainly to blast designs, and it is generally possible to successfully mitigate the impacts of blasting with the correct blast design for each blast.

7.2 TRAFFIC

ITS Engineering was appointed by EIMS to undertake the traffic specialist study for the Leiden project. The following sections provide a summary of the traffic environment that may be affected by the proposed Leiden project. Information has been sourced from the ITS scoping report. For further information, please refer to the full traffic scoping report which is included in Appendix P.

7.2.1 INTRODUCTION

The purpose of a traffic study is to assess the potential impact of traffic generated by the propose project and to identify the improvements and mitigation measures required to ensure that the road network will operate safely and efficiently for the duration of the proposed project. It is important to include traffic considerations when assessing land use alternatives, especially when the propose project may have a significant impact on traffic operations within the immediate vicinity of the project and within the overall transportation network of the surrounding area.

The traffic assessment should provide the following:

- A basis on which to assess the transportation implications of the proposed project;
- A rational basis on which to evaluate if the type and scale of the proposed development is appropriate for the site and what improvements may be necessary, on and/or off of the site, to provide for safe and efficient traffic flow;
- A basis for assessing existing or future localized transportation system deficiencies which should be improved; and
- An assessment of transportation-related issues associated with the proposed project that may be of concern to neighbouring residents, businesses, and property owners.

In terms of potential impacts the proposed project will result in increased use of the local road network which may result in the deterioration of road surfacing, damage to bridges and culverts in the area, and safety risks to surrounding communities.

7.2.2 DATA COLLECTION

The baseline assessment included the identification of the affected external roads andthe investigation and assessment of the status quo of external road networks including the existing traffic volumes. A site visit was conducted on the 22nd August 2013 to obtain a preliminary understanding of the current traffic conditions. Baseline traffic volumes were obtained from the Comprehensive Traffic Observation (CTO) Data 2012. The baseline assessment of the transportation aspects related to the proposed mine activities was determined based on the evaluation of the worst traffic scenario during the construction, operation, closure and decommissioning phases.

7.2.3 RESULTS

Leiden is located between the towns of Piet Retief and Ermelo in the Mpumalanga province. The national N2 road is a surfaced two lane Provincial Class 2 major road that runs north-south and connects Ermelo with Piet Retief. The site connects to the N2 via two gravel roads. “Gravel Road 1” runs in a north-south direction while “Gravel Road 2” runs in an east-west direction, as indicated in Figure 42. The Mashala Leiden Coal Mine will have access at an intersection with Gravel Road 2 ±18km from the N2. The access will be linked to the internal haul roads within the mining area.

The N2 Road is part of the national road network and the Mpumalanga Department of Roads and Transport (MDRT) control the maintenance of this road. The road is paved and the surface condition is fairly adequate. The AM Peak was found to be from 7:00 to 8:00 and the PM Peak hour was recorded from 16:00 to 17:00. CTO Data 2012 indicates the following:

- The total number of vehicles on the N2 Road is 2 734 (both directions, 14 days or 3.8% of the year counted);
- Average Daily Traffic (ADT): 3 064 vehicles;
- Average Daily Truck Traffic (ADTT): 815 vehicles;
- Heavy Vehicles (HV): 26.6% (815 vehicles).

Gravel Road 1 runs approximately 15 km from the N2 road to the Leiden site. This road is a public road and is maintained by the Mpumalanga Department of Roads and Transport (MDRT). The road runs in a north-south direction. It is a narrow single lane carriageway with an unpaved gravel surface. This gravel road will be difficult to negotiate during the rainy session as it has a number of low water bridge crossings. The surface is in poor condition and would require resurfacing to be usable. Traffic volumes are currently low on this road.

Increased traffic volumes on the gravel road will impact negatively on villages, schools and the forestry business nearby in terms of noise, dust, and safety of pedestrians.

Gravel Road 2 runs approximately 18 km from the N2 to the Leiden site. The first 1.5 km from the N2 intersection is surfaced, after which the road is unpaved gravel. This road is a public road and is maintained by the MDRT. It connects the N2 with the forestry area and local farms in an east-west direction. The surface condition will be a challenge during the wet seasons of the year and surfacing of this road would be required. The road is a narrow single carriageway with low traffic volumes. Increased traffic volumes on this road will impact negatively on villages, schools, and the forestry business close to the road in terms of noise, dust, and safety of pedestrians.

The nearest rail network is located east of the N2 Road with stations at Sheepmoor and Panbult. This rail network is the main rail link between Gauteng and the Richards bay export harbour and is mainly used for the export of coal. The line feeds large volumes of bulk traffic between Gauteng and Richards bay.

The traffic volumes on the gravel roads are mainly the result of traffic from the local plantations in the area to the Busby Saw Mill and Panbult railway station, with less than 10 vehicles per hour in both directions during the morning and afternoon peak hours. The traffic generated by the proposed Leiden Coal Mine will be distributed along the existing road network and sufficient capacity exists on the road network to accommodate the proposed development traffic volumes.

The following receptors might be affected by the proposed development:

- Increased traffic volumes on existing gravel roads and the N2 national route;
- The existing forestry operations in the area;
- Small villages close to Gravel Road 1;
- School close to Gravel Road 1; and
- School close to Gravel Road 2.

The desktop and inception assessment did not identify any potential fatal flaws or critical issues associated with a new development in the area. No legislated constraints were identified during the scoping level assessment. The assessment did not identify any “No Go” areas or buffer zones in terms of the existing road network and access roads.

7.2.3.1 Sensitivity Map

The traffic sensitivity of the site is indicated in Figure 42. The sensitivity of each route is based on the current traffic volumes, with lower traffic volumes indicating a lower sensitivity. The following receptors might be affected by the proposed development:

- Increased traffic volumes on existing gravel roads and the N2 national route;

- The existing forestry operations in the area;
- Small villages close to Gravel Road 1;
- School close to Gravel Road 1; an
- School close to Gravel Road 2.

The desktop and inception assessment did not identify any potential fatal flaws or critical issues associated with a new development in the area.

Figure 42: Traffic sensitivity

7.2.4 CONCLUSION

The proposed site will be accessed via either Gravel Road 1 or Gravel Road 2, both of which link from the N2. From the desktop assessment it was established that both access roads are local gravel roads providing access mainly to the forestry activities. Both access roads will be difficult to negotiate during the wet seasons of the year and regular maintenance would be require in terms low water bridge crossings and dust control. However Gravel Road 1 will be difficult to negotiate even in dry weather and has several water crossings. Gravel Road 2 is already utilised by forestry trucks which indicates that the road is designed to handle heavy loads. In terms of social considerations, the school located next to Gravel Road 1 is much closer to the road than the school near Gravel Road 2. This makes Gravel Road 2 the preferred option from a social perspective.

From a traffic engineering perspective, it can be concluded that the proposed development is not expected to have a significant negative impact on the road network subject to the results of a detailed traffic impact study assessment.

8 ASSUMPTIONS, LIMITATIONS, AND UNCERTAINTIES

Certain assumptions, limitations, and uncertainties are associated with the Scoping Phase studies. These are detailed for each aspect below.

8.1 AIR QUALITY

The following assumptions, limitations, and uncertainties apply to the scoping assessment conducted:

- No on-site meteorological data are available and use was made of purchased MM5 meteorological data.
- A minimum of 1 year, and typically 3 to 5 years of meteorological data are generally recommended for use in atmospheric dispersion modelling for air quality impact assessment purposes. Three years of meteorological data were used in the atmospheric dispersion assessment, from 1st January 2010 - 31st December 2012.
- The impact assessment is limited to airborne particulates (including TSP, PM_{10} and $PM_{2.5}$). Although the proposed activities would also emit other gaseous pollutants, primarily by haul trucks and mining vehicles, the impact of these compounds was regarded to be low and was omitted from this study.
- A mine layout plan, annual throughput of waste and product as well as a mining schedule were unavailable at the time of this scoping assessment, thus the extent of air quality impacts was based on mining operations of similar spatial extent.

The following uncertainties apply:

- It is uncertain whether the effectiveness of the forest plantations as a mitigation measure will be in place once the project is operational. The assessment was conducted as if no forested areas occur as a worst case scenario.
- Some receptors (Central Timber Corporation workers huts) may move or new ones be developed in the future, especially in this area and within the vicinity of the proposed project.

8.2 BLASTING AND VIBRATION

Based on information currently available is there no specific additional data required. In order to complete the assessment in full additional information will be required with regards to drill and blasting operations. Planned mining, drilling and blasting information will be required for evaluating possible influences in greater detail during the EIA Phase.

Assumptions are made in this report that the presence of ground vibration and air blast will be present from blasting operations. An assumption is also made that 500 m safe boundary for

safe distance between any person / animal and blast will be used. It is a general guideline that is sometimes used.

Uncertainties can be listed that it is not possible to speculate what type or amplitude of ground vibration, air blast and fly rock levels will be yielded from the blasting operations.

8.3 ECONOMIC

The following assumptions, limitations, and uncertainties apply to the economic scoping assessment:

- The first and probably most important assumption is that the proposed mining activities will be economically viable. Without economic viability (that is an acceptable risk-return rate is attained on investment), the probability of achieving the stated economic benefits are non-existent. This assessment accepts the rational investor concept, thus the investments to be committed are undertaken by a rational economic agent and the probability of achieving economic viability is high.
- This study will be mainly based on secondary economic data. The macro-economic data for this analysis was supplied by Quantec, a reliable regional economic data provider in SA.
- It is assumed that the land deemed to be potentially lost to agriculture and forestry is utilised at the average productivity of the country's output for those sectors. The need to work on macro-averages is due to the fact that statistics supplied by individuals are regarded as private and is rarely shared in the public domain.
- The receptor area is the immediate local area.
- The project is evaluated over the period of an economic generation, even though the life of mine is less than this. The valuations are done on a Discounted Cash Flow basis, thus discounting all benefits over an economic generation. In essence this reduces the economic value of the project relative to existing land-use.
- It is assumed that the land impacted by mining will be sterile and of no real use economically after mining. (Note, this is not always the case, but is done to be conservative and in the light of the many environmental legacy issues caused by mining.)
- In this analysis it is assumed that mining and eco-agricultural is a zero-sum outcome, thus the benefit to the one is a loss to the other. (In reality the spirit of sustainable development is for economic agents to co-operate constructively in order for society to achieve a win-win, however, such an outcome is uncertain and naïve to assume.)
- The economic analysis section of this study will adopt a dispassionate compassionate stance, thus it concerns itself with the benefits or costs to the economy in a macro-

economic and quantitative manner. The mathematical results, based on stated assumptions, therefore speak for themselves.

- This analysis should not be used for compensation negotiations between the mine and affected stakeholders simply because its intent is to compare a better alternative land use, using economic macro-variables and not micro-magnitudes.

8.4 FAUNA

The following assumptions, uncertainties, and limitations apply to the faunal scoping assessment:

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be located in an area where it was not previously known to exist.
- Animal species are mostly highly mobile and often migrate seasonally. Any field assessment of relatively short duration is therefore unlikely to record anything more than the most common species that happen to be on site at the time of the survey. This is a poor reflection of the overall diversity of species that could potentially occur on site.

8.5 FLORA

The following assumptions, limitations, and uncertainties apply to the floral scoping assessment:

- The assessment focussed on a desktop assessment with only a single day of field verification. The delineated areas are therefore based mostly on the aerial photographs of the site, with confirmation observations in the field. This gives a very good indication of the general vegetation condition.
- Those aspects that drive sensitivity ratings such as rare species and those in threat categories are not well reported, because the site visit took place in the end of the winter season most of the vegetation on site was still dormant or shortly grazed.
- The identification of species is therefore difficult and the assessment is mostly based on observations regarding the primary, secondary or transformed state of vegetation and the weedy component. It is therefore possible that the status of the delineated areas may change during a full vegetation assessment in the summer season.

8.6 GEOCHEMISTRY

The various geochemical parameters were assessed on a generalized qualitative base. The geology, which forms the basis of the geochemical assessment, was sourced from published literature. No physical borehole core logging was performed and no mine plan was available. In terms of the effect of mining on the environment, a worst case scenario was considered which involved an open cast mining method and maximum interaction between the mine and both the surface and underground aquatic environment. Gaps in knowledge, data or information that could hamper the impact identification and evaluation process will be identified and addressed during the EIA Phase.

8.7 GEOHYDROLOGY

The following assumptions, limitations, and uncertainties apply to the geohydrological scoping assessment:

- The assessment of the geohydrology has been made without the mine plans which have not yet been made available. Therefore, it was assumed that the surface areas provided are representative of the final extent of mining but not the total depth of operations. The detailed mine plans are essential for the numerical modelling process and for making detailed and educated predictions regarding impacts on the environment as a result of the project;
- Minimal data regarding aquifer properties (e.g. transmissivity) is available for the site area, thus, literature values from previous reports for similar environments were considered as representative. More detailed data is critical in setting up and running a reliable groundwater numerical model. This data can be obtained either by drilling and pump testing new monitoring boreholes on the site, or by pump testing a number of existing boreholes on the site; and
- The site infrastructure is not yet known therefore it is assumed that the only impact to the surrounding environment would be the mining area itself.

8.8 HERITAGE

The aim of the Heritage Scoping Report is to identify the possible types of heritage resources that might be present in the study area, as well as possible hotspots for the locality of such resources. From this, the possible impacts from mining and ancillary activities must be predicted. Although a site visit has already been undertaken to confirm some of these possibilities, it must be noted that the results of this report will require confirmation by undertaking a physical survey as part of the final evaluation of the study area applicable for the EIA Phase. The study area for the EIA Phase will be the mining development footprint area as defined by the client. Since the current information is based only on a literature and archival search and investigation of other desktop resources (maps and satellite imagery),

with one brief site visit, this report can certainly not be seen as at the level required for a Heritage Impact Report.

8.9 NOISE

The following assumptions, limitations, and uncertainties apply to the noise scoping study:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement. Therefore trying to define ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement (especially when at a community or house. This study did collect measurements at one location for approximately 22 hours in 10-minute bins. It is assumed that the measurement location represents other residential dwellings in the area (similar environment), yet, in practice this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including;
    - the distance to closest trees, number and type of trees as well as the height of trees;
    - available habitat and food for birds and other animals;
    - distance to residential dwelling, type of equipment used at dwelling (compressors, aircons);
    - general maintenance condition of house (especially during windy conditions);
    - number and type of animals kept in the vicinity of the measurement locations.
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc.). Traffic however is highly dependent on the time of day as well as general agricultural activities taking place at the time of traffic counts. Traffic noise is one of the major components in urban areas and could be a significant source of noise during busy periods. This study found that traffic in the area was very low, yet it cannot be assumed that is always low.

- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. While the windshields used limits the effect of fluctuating pressure across the microphone diaphragm, the effect of wind-induced noises in the trees in the vicinity of the microphone did impact on the ambient sound levels. The site visit unfortunately coincided with a relatively windy period;
- Ambient sound levels are depended not only time of day and meteorological conditions, but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement location.

8.10 SOCIAL

The following assumptions, limitations, and uncertainties apply to the social scoping assessment:

- The socio-economic environment constantly changes and adapts to change, and external factors outside the scope of the project can offset social changes, for example changes in local political leadership. It is therefore difficult to predict all impacts to a high level of accuracy, although care has been taken to identify and address the most likely impacts in the most appropriate way for the current local context within the limitations.
- Social impacts can be felt on an actual or perceptual level, and therefore it is not always straightforward to measure the impacts in a quantitative manner.
- Social impacts commence when the project enters the public domain. Some of these impacts are thus already taking place, irrespective of whether the project continues or not. These impacts are difficult to mitigate and some would require immediate action to minimise the risk. These risks will be discussed under the relevant section of the report.
- There are different groups with different interests in the community, and what one group may experience as a positive social impact, might be experienced as a negative impact by another group. This duality will be pointed out in the impact assessment phase of the report.
- A detailed consultation process has not been done for this report, but it will be done in the next phases of the project.

8.11 SOILS, LAND USE AND LAND CAPABILITY

There is a good level of certainty concerning the soils occurring within the study area, firstly from the pre-existing land type information, subsequently confirmed by the site visit. However, due to the reconnaissance nature of both of these data sources, the exact distribution of the soil mapping units is not yet obtained. This is the main knowledge gap and if this is filled, then soil potential, land capability and land use information will be obtained at the same time. This will take place at the detailed mapping stage in the EIA phase.

8.12 SURFACE WATER

This scoping report was conducted as a desktop study with a one day site visit to fill knowledge gaps as much as possible. The site visit to the farm and mining area was still a greenfield area with no mine infrastructure. Further work should be done with more accurate better mine plans and layouts, so that better estimations can be made on surface water impacts and recommended water management measures for the mine (for example: storm water management plan). Mine engineers should provide mine production figures and assumed water consumption estimates to make mine water balance calculations possible.

8.13 TRAFFIC

The following assumptions, limitations, and uncertainties apply to the traffic scoping assessment:

- There was limited information available regarding the internal haul road system and certain assumptions were made in this regard. It is important that detailed information with regards to the internal haul roads be provided during the EIA Phase.
- Assumptions were made regarding the mode of transport of coal to the Delta Processing Plant, as well as the number of trips required per day.
- The specialist study provides a limited baseline report with few outcomes; these are expected to be expanded on during the EIA Phase.
- Minimal impacts were identified during the Scoping Phase, limiting the holistic understanding of the potential traffic impacts that may be experienced by the Leiden project as a whole.

8.14 VISUAL

The following assumptions, limitations, and uncertainties apply to the visual scoping assessment:

- Information regarding the mining infrastructure layout and height has not yet been provided. This will be finalised during the EIA phase. The infrastructure data is

required for the Digital Terrain Model (DTM) whereby all the data is overlayed to determine the areas that will be impacted on.

- A basic assumption regarding the viewshed analysis is that the eye height of the observer is 1.8 m above ground level.

8.15 WETLANDS AND AQUATIC ECOLOGY

The current wetlands scoping phase study is based mostly on a desktop study, i.e. the interpretation of aerial photographs and Google Earth imagery of the area. Only limited field work was undertaken to improve the accuracy of the desktop delineation. Further field work will be required once the project proceeds to the EIA and IWULA phase, and wetland boundaries are likely to change to some degree as more data is collected in the field.

The following assumptions, limitations, and uncertainties apply to the aquatic ecology scoping study:

- The findings within this report are based on a once-off field visit. Aquatic biota vary spatially and temporally and, as such, species may have been missed.
- While considerable desktop information was researched for the affected study area, reference conditions cannot ever be fully known with a high degree of certainty.
- Identified gaps in knowledge include: a lack of seasonal data and a lack of ground trothed ecological information – in particular, further fish surveys would increase the level of confidence with which results are discussed.
- Our discussion of conditions within the Ngwempisi River was based on the inter basin transfer being operational. It is not known whether water is pumped throughout the year or just during dry months and, if the latter, what the ecological conditions within the Ngwempisi River without the inter basin transfer would be.

9 DETAILED PROJECT DESCRIPTION

9.1 MINING OPERATIONS

9.1.1 ACTIVITY DESCRIPTION

The proposed Leiden Coal Mine will employ a combination of opencast and underground mining. The operation is aimed at mining the coal seams from a reserve of approximately 2 199 404 saleable tonnes of coal from a depth of between 15-55m and which is located in the Vryheid Formation of the Karoo Supergroup. The anticipated LOM is 10 years but may be extended if deeper reserves are to be exploited at a later stage. Opencast mining will be undertaken using the bench/box cut and rollover mining method. The opencast is required in order to access the underground reserves via the establishment of a highwall portal. Once access to the underground reserves has been created, underground mining will be employed utilising the bord and pillar mining method. All ROM for the proposed Leiden Coal Mine will be transported to the Delta Processing & Dispatch Centre (Delta) in Ermelo at a rate of 18 000 tonnes per section/per month for the one opencast and two underground mine sections. All mineral processing and mineralised waste disposal will be undertaken at Delta and as a result, the proposed Leiden Coal mining will only require limited surface infrastructure. Furthermore, the surface infrastructure to be utilised by the mine is mostly prefabricated and easily portable. It is important to note that the detailed project description provided in this report is considered provisional as environmental information obtained from the EIA Phase and public participation process will be used to further guide the design of the proposed Leiden Coal Mine. As such the details of the project description should be considered provisional at this stage.

9.1.2 OPENCAST MINING

The single opencast section (of up to 22 ha) will be mined using the rollover and bench/boxcut mining method. The bench/boxcut will be constructed near the centre of the opencast in order to facilitate exposure of the highwall and allow for access to the underground reserves at an appropriate time. The opencast operation is initiated by the stripping of topsoil to expose the overburden of the proposed bench/boxcut section. The opencast is anticipated to have a strip ratio of 10:9. This topsoil will be hauled to a designated area to be used for rehabilitation at a later stage. Once the topsoil is removed and stored, the overburden of the proposed bench/boxcut is drilled, blasted and removed in order to mine benches approximately 40 m wide and down to the Dundas coal seam. The annual estimated production rate of the opencast is estimated at 20 000 tonnes per month for a period of 24 months. All RoM will be transferred by conventional haul and load operations to the onsite mobile crusher and then stockpiled for transport to the Delta Plant.

9.1.3 UNDERGROUND MINING

Two underground sections will be mined using the bord and pillar mining method. The two underground sections are developed on a grid basis where coal will be extracted across a horizontal plane, leaving open areas or “rooms” underground while also leaving pillars to support the overburden above. The size of the pillars shall be determined using the Salamon & Munro formulae, an important factor in determining the optimal pillar size to ensure stability of the underground mine whilst minimising the potential for surface subsidence. The Salamon & Munro formula assists in the determination of pillar size through the consideration of depth, seam width and coal strengths as provided by the geology of the reserve. A Safety Factor of 1.6 has been provisionally calculated and is deemed appropriate allowing for extraction of 62% of the mineable coal reserves from the two underground sections. Bord width has been determined and set as 6.5 m for all underground mining areas while Panel width is to be determined by the shuttle car cable capacity. The proposed underground mine layout has been designed to allow for Panel lengths in excess of 500 m and up to a maximum of 1000 m. With a relatively flat seam floor, the power requirements for Trunk and Belt sections is commensurate with other underground coal mining operations in South Africa and Mpumalanga specifically. The annual estimated production rate of the opencast is estimated at 35 000 tonnes per month for a period of 96 months. All RoM will be transported by conveyor to the onsite mobile crusher and then stockpiled for transport to the Delta Plant.

9.1.4 MINING SCHEDULE

Mining operations are planned to commence once all the necessary environmental authorisations and licences necessary for the activity to commence have been granted. Site establishment and establishment of the boxcut are expected to take place within the first 18 months of commencement. The open pit mining will take place thereafter for a period of approximately 16 months during which time the highwall portal will be established to access the underground reserves. The decline shaft is to be developed within 9 months at a provisional angle of 8 degrees. The conceptual underground mine layout and mining schedule are presented in **Figure 43** below.

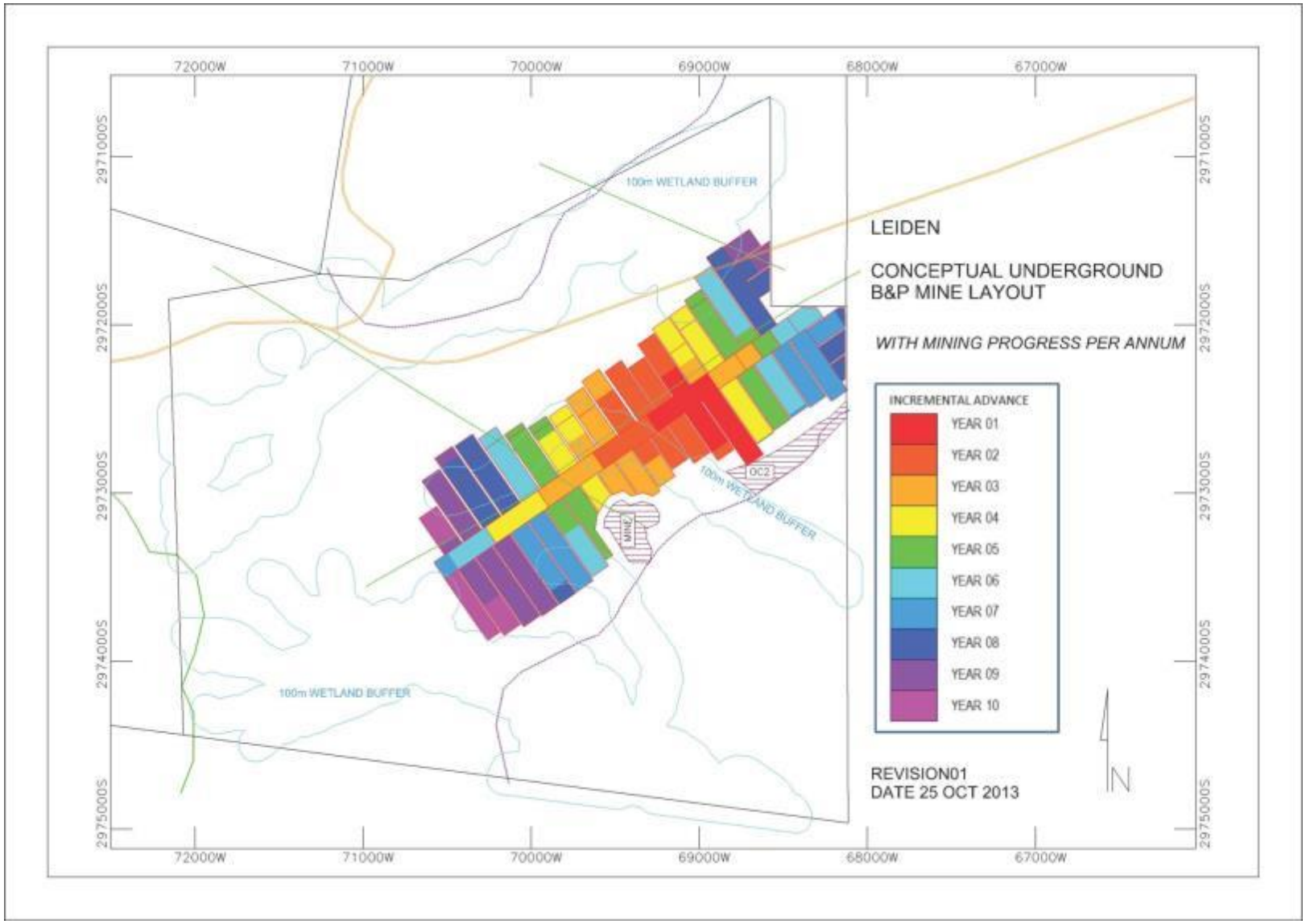


Figure 43: Preliminary mine design and schedule

9.2 TOPSOIL STOCKPILES

Stripped topsoil will be stockpiled and located in areas to be identified during the EIA Phase. As a minimum requirement, topsoil stockpiles and berms will be designed and located so as to reduce the risk of compaction and be placed outside of natural drainage patterns to avoid erosion from both water and wind.

9.3 MINERAL PROCESSING

The proposed Leiden Coal Mine will utilise a small, mobile onsite crusher. The crusher will be used to crush and screen RoM to a manageable size prior to stockpiling. Crushed and stockpiled RoM will then be removed to the offsite Delta Plant for mineral processing. There will be no other mineral processing at the Leiden site. All RoM processing and mineralised waste disposal will take place at Delta Plant.

9.4 ROM STOCKPILES

All crushed RoM will be stockpiled in a designated impervious bunded area near the onsite mobile crusher. This area will be utilised for the collection of crushed coal for final transport to the Delta Plant. The bunded area will be designed to contain all RoM stockpiles and contain any coal contaminated water that may enter the area, thereby allowing for its disposal in the PCD.

9.5 SURFACE INFRASTRUCTURE

The proposed Leiden Coal mining and surface infrastructure is limited due to all mineral processing occurring at the Delta Plant located in Ermelo. As such no mineral processing will be required on site and the mining and surface infrastructure on approval of the Leiden project will consist of the following:

- Pollution control dam;
- Return water dam;
- Storm water management including clean and dirty water separation systems;
- Access and haul roads;
- Pipelines;
- Conveyor belt (including coal cutters, loader, shuttle cars, roof belt and feeder bracket)
- Mobile crusher;
- RoM Stockpiles;
- Weighbridge;

- Diesel storage;
- Chemical storage;
- Explosive magazine;
- Mobile offices;
- Mobile ablution block;
- Mobile workshops and stores;
- Modular sewage treatment plant;
- Prefabricated water purification plant;
- Temporary general waste storage area;
- One (1) decline shaft; and
- One (1) ventilation shaft.

9.5.1 DESIGN PHILOSOPHIES

The proposed Leiden Coal Mine is located in an area with several significant environmental considerations, most notably wetlands and the current, predominant land use of forestry plantations. Due consideration will be given to the placement, location, and orientation of mine infrastructure in relation to these and other environmental considerations. The following factors will also be considered in the design philosophies of infrastructure during the EIA Phase:

- Energy efficiency;
- Prevailing environmental conditions and site sensitivities;
- Water recycling and re-use; and
- Compliance with statutory requirements.

9.5.2 SITE ACCESS CONTROL

Access to the plant and mine site will be controlled through a single entrance/exit point onto the mine footprint. Fencing has been specified as 1.8 m high razor diamond-mesh fencing. It is anticipated that diamond mesh fencing will also be required around the dams. Site access and traffic flow shall be designed to optimise control over the flow of public, contractors and mine personnel vehicles as well as pedestrians. All visitors to the site will be required to sign in at the security check point located at the entrance gate. A third party security company shall be utilised for the security check point. Employees will be required to retain proof of identification whilst on site.

9.5.3 ROADS

Access to the mine and plant will be via the N2 (surfaced two lane national road) which links Ermelo and Piet Retief. There are two potential access routes to the proposed mine via the N2. These are referred to as “Gravel Road 1” linking the mine with the N2 at a point ± 40km south of Ermelo and “Gravel Road 2” linking the proposed Leiden Coal Mine with Panbult near the N2 (see **Figure 48**). The preferred access road alternatives (if any) will be further refined as part of the traffic impact study for the EIA process. Although existing roads will be used as haul roads, there may be a requirement to upgrade certain road sections and some sections of newly constructed roads may be required. All new roads will be constructed to cater for heavy vehicles and located outside the 1:100 year flood lines, except where they cross a stream. The causeway over the stream will be constructed to cater for the 1:50 year storm events. The necessary Water Use Licence shall be applied for prior to upgrading or constructing any water course crossings.

9.6 BULK POWER SUPPLY

Diesel generators will be utilised for power during the construction phase of the mine. Eskom generated electricity in the form of a substation generating <3Mva will be required for the underground operations in the operational phase. It is anticipated that electricity will be obtained from the existing electrical distribution network in the area. The connection point, substation and routes will be determined after further investigations are undertaken and concluded.

9.7 WATER MANAGEMENT

9.7.1 BULK WATER REQUIREMENTS

The proposed Leiden Coal Mine will require bulk water for its mining operations as well as domestic water for drinking and ablutions purposes. Bulk water is required for dust suppression and any other mining operations that may require large volumes of water. Possible water supply options will be identified and their suitability evaluated during the detailed EIA Phase including the option of raw industrial water from existing workings. A water treatment plant will be used to treat water for drinking purposes on site with borehole backup. A preliminary water balance will be designed for the proposed Leiden Coal Mine to determine bulk water requirements during peak production and a mine safety factor (to be determined) will be applied to ensure adequate water supply to the mine.

9.7.2 WATER MANAGEMENT

9.7.2.1 Water Management Principles

Water is a valuable resource and a water management strategy will be developed during the EIA Phase. The water management strategy will be designed to address the following significant issues at the proposed Leiden Coal Mine:

- Water use and users with a focus on water consumption rates;
- Engineering design basis for the water reticulation and distribution systems required to provide water to the mining operation;
- Engineering design basis for clean water diversion system; and
- Engineering design basis for the dirty water collection and management systems, including flood protection.

9.7.2.2 Runoff Water

Clean storm water will be diverted around the dirty water catchment in a controlled manner to tie in with existing surface drainage features. The principles on which the storm water management plans are based, and which are implemented in the conceptual design can be summarized as follows:

- The containment of contaminated water;
- A pollution control dams will be designed and located in such a way that polluted water from the site is contained;
- The monitoring of quality of water in the nearby rivers;
- The re-use of contaminated dirty water; and
- No discharge of contaminated surface water to the environment is anticipated from this activity.

The detailed storm water design will be included in the detailed EIA Phase.

9.7.2.3 Water Management Infrastructure

The following water management infrastructure is envisaged for the proposed Leiden Coal Mine:

- Network of dirty water collection drains – concrete lined
    - Cut Off drains to collect water which came into contact with contaminants on site
- Pollution Control Dam – HDPE

  - Collection dam to collect water which came into contact with contaminants on site

- Network of water control berms
  - Berms to prevent off-site run-off water which came into contact with contaminants on site
- Network of clean water collection drains
  - Cut-Off drains to collect clean water and prevent contact with contaminated water
- Dirty water channels
  - A network of concrete channels to contain water which came into contact with contaminants on site

The detailed design requirements for water management infrastructure are currently underway and will be included in the detailed EIA Phase.

9.7.3 WATER TREATMENT PLANT

A potable treatment plant will be constructed at the entrance to the underground section. The potable treatment plant will treat raw water that will be used for drinking purposes (i.e. potable water) on site.

9.7.4 WASH BAY

A wash bay complete with an effluent separation system and Oil/Water separator system will be implemented as part of the mine's water management activities. The following requirements will be incorporated into the design:

- Allowance must also be made to recover wash water that can be re-used during the washing operations.
- The effluent separation system must cater for all effluent generated in the Wash-Bay area.
- The system must be an environmentally sustainable system that is cost effective and easily maintainable, but also complies with all relevant legislation and regulations.

9.8 LOGISTICS

The proposed Leiden Coal Mine intends to supply coal to the Delta Plant for processing. A detailed Traffic Impact Assessment (TIA) is underway and will be concluded during the EIA Phase. The utilisation of rail as an alternative will also be investigated during the EIA Phase. The nearest rail network is located east of the N2 Road with stations at Sheepmoor and Panbult. This rail network is the main rail link between Gauteng and the Richards bay export

harbour and is mainly used for the export of coal. The line feeds large volumes of bulk traffic between Gauteng and Richards bay.

9.9 DISCARD MANAGEMENT

9.9.1 NON-CARBONACEOUS STOCKPILES

Overburden stockpiles comprising of both hards and softs will be required. Recommendations on stockpile locations will be provided and discussed during the EIA Phase.

9.9.2 CARBONACEOUS STOCKPILES AND DISCARD DUMPS

The only coal waste anticipated is coal that may fall off trucks at the RoM stockpile prior to transportation. This will be collected and transported to the existing Delta plant off-site.

The dirty water associated with the RoM stockpile will be isolated from the clean catchment (includes groundwater seepage and direct rainfall) and channelled to the PCD where it will form part of the water recycled between the water treatment plant, underground areas and PCD which is also the source for dust suppression. Coal fines will be cleared periodically from the PCD and transported off site for disposal at the existing co-disposal facility at the Delta plant.

9.9.3 SLURRY

All slurry from the surface RoM stockpile will be contained in the bunded, impervious stockpile area where it will be allowed to dry and transported to the offsite Delta Plant for processing.

9.10 SOLID WASTE MANAGEMENT

The following types of solid waste will be generated by the proposed Leiden Coal Mine:

- Domestic waste;
- Scrap metal;
- Used oil, diesel, and lubricants; and
- Building rubble.

The proposed Leiden Coal Mine will utilise a temporary waste storage facility and all waste will be collected by an approved, registered waste contractor for removal and final disposal. No landfill will be established on the proposed Leiden Coal Mine site.

9.10.1 HAZARDOUS WASTE

Hydrocarbon containing waste (used oil, dirty diesel and grease) will be stored in clearly marked skip bins (solids) and containers (liquids). These will be placed in an isolated area on a hard, impervious surface. When full, the containers will be collected by a contractor for safe

disposal or recycling companies which will be appointed to collect waste. A waste disposal certificate will be required from the contractor to ensure safe disposal.

9.10.2 WASTE MANAGEMENT DESIGN PROGRESS

The detailed design requirements for the temporary general waste storage area and waste management protocols are currently underway and will be included in the detailed EIA Phase. The design philosophies for waste management will be based on applicable legislation (in particular NEMWA), DWAF best practice guidelines and currently accepted good industry practice for waste management. The key principles of waste minimisation reuse and recycling will be implemented wherever possible.

9.11 SEWERAGE FACILITIES

A package sewage treatment plant will be provided to handle sewage water generated from the change house, offices, ablution block, workshop and store buildings. The sewage treatment plant will consist of a number of individual pre-manufactured fiberglass units complete with inner pipe reticulation. The package plant requires the construction of a number of rectangular concrete tanks and a conically shaped concrete digester with interconnecting pipework. These will be constructed in-situ using conventional reinforced concrete construction. Treated waste water will be fed back into the mine water system for re-use in the plant or underground. The sewage treatment plant will be sized to cater for a percentage of the total potable water demands for the operation. The treated sewage water will be piped from the sewage treatment plant to (and stored in) an industrial water reservoir in order to reduce make up water requirements. Portable toilets will be used during the construction phase and the raw sewage will be disposed of at the dedicated sewerage plant or alternatively be collected by a licensed contractor for disposal at a licensed sewage treatment plant.

10 DESCRIPTION OF POTENTIAL IMPACTS ASSOCIATED WITH ACTIVITY

10.1 CULTURAL AND HERITAGE RESOURCES

An evaluation of the study area and the surroundings has shown that the possibility exists of finding various heritage resources in the proposed study area, including historical structures as well as graves and cemeteries. The following key potential impacts relating to cultural and heritage resources have been identified:

- Disturbance, damage, or destruction of unidentified heritage features. Unidentified archaeological sites can delay construction, development activities and project timelines. The disturbance, destruction or damage of such sites requires a permit from the responsible heritage authority.
- Disturbance, damage, or destruction of identified heritage features. Mining activities such as blasting may result in damage to heritage features present on the site.
- Disturbance, damage, or destruction of unidentified graves and cemeteries. Unexpected discovery of any unidentified graves and cemeteries during the operations may also delay construction and development timelines due to the legal processed involved with management of these heritage features.
- Disturbance, damage, or destruction of identified graves and cemeteries. Mining activities such as blasting may result in damage to graves and cemeteries present on the site.
- Disturbance, damage, or destruction of unmarked child graves. From experience on similar sites and the knowledge of cultural customs and traditions, it is known that stillborn babies and deceased infants occasionally were buried within the homesteads of black rural communities. These children were sometimes buried underneath the floors and walls of houses and huts and the burials were not marked, but were known to the immediate family. .
- Disturbance, damage, or destruction of palaeontological resources. Unidentified palaeontological resources and the discovery of such resources can seriously hamper construction and development timelines. Damage, destruction or removal of such sites requires a permit from the responsible heritage authority.

10.2 SOCIO-ECONOMIC ENVIRONMENT

It is important to understand the difference between a social change process and a social impact. For the purpose of the SIA report both these categories will be investigated. For the purpose of this report, only possible social impacts will be mentioned.

Social change processes are set in motion by project activities or policies. Social change processes can be measured objectively, independent of the local context. Examples of a social change process are increase in the population, relocation or presence of temporary workers. Under certain circumstances these processes may result in social impacts, but if managed properly these changes may not create impacts. Whether impacts are caused will depend on the characteristics and history of the host community, and the extent of mitigation measures that are put in place (Vanclay, 2003).

A social impact is something that is experienced or felt by humans. It can be positive or negative. Social impacts can be experienced in a physical or perceptual sense. Therefore, two types of social impacts can be distinguished:

- Objective social impacts – i.e. impacts that can be quantified and verified by independent observers in the local context, such as changes in employment patterns, in standard of living or in health and safety.
- Subjective social impacts – i.e. impacts that occur "in the heads" or emotions of people, such as negative public attitudes, psychological stress or reduced quality of life.

In conclusion, it is very likely that a number of social changes processes will be set in motion by the project. Whether these processes cause social impacts will depend on the successful implementation of suggested mitigation measures. The following is a list of some of the possible impacts that may occur as a result of the project. It must be stated that the list is not exhaustive and should be expanded on during the EIA phase when consultation with stakeholders will take place. The following key potential impacts relating to the social environment have been identified:

- Community expectations regarding social and economic benefits;
- Negative public perceptions of the mine and negative community relations with the mine based on perceptions of conduct and performance of mines in general;
- Expectations regarding the creation of jobs and other opportunities;
- Potential reduction in current land owner livelihoods;
- Potential relocation of current land occupiers (This impact will only occur if relocation has to take place);
- Influx of people, potential resulting in social disintegration and cultural differentiation, as well as an increase in HIV/AIDS if prostitution increases;
- Decrease in community safety due to mining and associated activities
- Loss of jobs and other economic opportunities as one labour skill set replaces another; and

- Expectations and perceptions regarding inadequate rehabilitation and closure.

Based on the current MWP and economic baseline information, and considering the short life of mine, the mine will have a relatively small impact on Mkhondo's economy. However, given the decline in this area's economy in the last ten years, any business investment ought to be welcomed. The following key potential impacts relating to the economic environment have been identified:

- Creation of jobs and other economic opportunities;
- Loss of jobs and other economic opportunities (upon closure of the mine);
- Increase in direct, indirect and induced employment opportunities in the mining, manufacturing, construction, trade, retail and services sector;
- Limited increase in GDP due to export of coal

10.3 BIOPHYSICAL ENVIRONMENT

10.3.1 TOPOGRAPHY

Surface mining results in alteration of topography at a fine scale. Resultant changes to the topography can in turn impact on ground water, surface water drainage, visual character and the safety of both people and animals if not properly mitigated. The following key potential impacts relating to topography have been identified:

- If underground mining extraction techniques are not carried out correctly, lack of support from underlying layers could cause the surface soil profile to vertically subside to a greater or lesser degree. This would cause problems for any future form of land use, whether forestry, cultivation or establishment of grass cover.
- Opencast operations will remove a small amount of surface material which may alter the natural topography of the site.

10.3.2 SOILS

Mining projects have the potential to damage soil resources through physical loss of soil and/or the contamination of soils, thereby impacting on the soils ability to sustain natural vegetation and altering land capability. The contamination of soils may contribute to the contamination of surface and groundwater resources. Loss of the topsoil resource reduces chances of successful rehabilitation and restoration. The following key potential impacts relating to soils have been identified:

- A reduction of natural soil fertility caused by the removal, storage, and replacement of the soil profile. Aspects such as acidification, loss of nutrients and organic matter could apply. Such an impact will probably become greater, the longer such conditions apply;

- Increased soil erosion can be caused by a loss in vegetative cover resulting in increased water runoff. This is especially likely to occur on sloping terrain;
- Soil compaction caused by the physical removal, storage, and replacement process. Impacts on soil structure can result in changes to soil drainage, increasing runoff and erosion, and may also result in further potential knock on effects impacting on surface and underground water resources.
- Soil pollution or contamination due to spillage of chemicals, hydrocarbons, or contaminated water during mining activities.

10.3.3 LAND USE

Mining activities have the potential to affect land uses both within the surface use area and in the surrounding areas. This can be caused by physical land transformation and through direct or secondary impacts. Impacts may be related to factors such as loss of soil, loss of biodiversity, pollution of water, dewatering, air pollution, noise pollution, and damage/destruction from blasting. The following key potential impacts on the land uses of the study area have been identified:

- Interference and potential replacement of existing land uses. Interference with existing land uses may occur in a number of ways, including direct impacts, indirect impacts and latent and residual impacts.
- The potential sterilisation of the land as a result of mining activities occurring in the application area.

10.3.4 LAND CAPABILITY

Mining operations have the potential to significantly transform the land capability, often irreparably. The types of impacts related to land capability involve post mining compaction, loss of fertility, impeded soil drainage and insufficient depth of the replaced soil. In many cases, mining may result in the land capability class would change from arable to grazing post closure. The following potential impacts on land capability have been identified:

- The loss of potentially productive agricultural land, along with a reduction in land capability may occur as a result of site sterilisation due to mining activities;

10.3.5 FLORA

The mining activities and the establishment of the supporting infrastructure have the potential to result in loss of vegetation, habitat disruption, loss of ecosystem functionality, habitat transformation, spread of alien invasive species and ultimately a reduction in overall biodiversity. The following key potential impacts on flora have been identified:

- Mining and associated activities may result in the removal and destruction of primary vegetation communities. These communities may be in threat categories according to NEMBA or important according to the Mpumalanga C-Plan.
- Removal of threatened and protected species. Several species listed as threatened under NEMBA, the South African Red Data list, and the Mpumalanga C-Plan are expected to be present on site. Should these species be present on site mining activities may result in losses to the on-site populations of these species;
- Encroachment of invasive species within the application area. Disturbances to the site, including mining and associated activities, may result in an increase of invasive species on site and on downstream and adjacent properties.
- Increase of erosion potential due to the removal and disturbance of vegetation within the application area. Increased erosion may occur adjacent to coal delivery routes that cross wetland habitats and may alter the drivers that affect wetland vegetation.
- Reduction in vegetation growth, photosynthesis, and respiration due to potential excessive dust levels as a result of mining activities.
- Adverse effect of pollutants on vegetation growth. Several pollutants associated with mining and associated activities including oil, concrete, coal dust, and acid mine drainage have the risk of killing plants or inhibiting plant growth and germination.
- Negative effect of altered hydrological regimes on natural vegetation. Mining alters the way water moves through the landscape, affecting the hydrological flow regime which is the main vegetation driver of the remaining natural vegetation, comprising predominantly wetland vegetation.

10.3.6 FAUNA

There are two major impacts that the project may have on ecosystem structure and functioning in relation to animals on site. There are various additional minor impacts that could arise from a project, for example, increased hunting, change in water or air quality, introduction of new species to a site, noise pollution, and disruption of migration routes. However, the effects of these translate into one of the two major impacts.

- Loss or fragmentation of habitat for threatened animal species. Threatened animal species are affected primarily by the overall loss of habitat, as direct construction impacts on individuals can often be avoided due to movement of individuals from the path of construction.
- Loss of individuals of animal species of concern. Direct impacts during mining activities are unlikely to have an impact on individual animals of concern, since most are highly mobile and will move out of harm’s way. During operation, birds could

potentially suffer mortality by collisions with vertical infrastructure, especially infrastructure with low visibility, such as power lines.

10.3.7 AQUATIC ECOLOGY

The proposed mining activities have the potential to result in a loss of aquatic ecosystems, a loss of biodiversity, alteration of the hydrological regime, the spread of alien fish species, a decline in water quality, and erosion and sedimentation of water courses. The following key potential impacts relating to aquatic ecology have been identified:

- Altered habitats and a decrease in habitat integrity. Increased sediment movement during mining activities may result on sediment deposition in wetlands and watercourses that could lead to changes in the benthic habitats.
- Deterioration of water quality. A negative impact on water quality may occur due to the decanting of low pH, high metal and sulphate rich water from the mine post closure, as well as seepage from remaining tailings dams.
- Increase in the occurrence of alien invasive species within watercourses and riparian areas due to changes to the supporting hydrology of the aquatic ecosystems caused by mining activities.
- Loss of aquatic species and overall aquatic biodiversity as a result of deteriorating water quality and habitat integrity. The river systems on site support a large number of aquatic species, including various sensitive and rare species. In addition, rare and IUCN listed species have been recorded in downstream reaches. Changes in the water quality could lead to the loss of these species.
- Alteration to hydrological regimes. During mining activities the creation of a clean and dirty system and the interception of run-off will potentially decrease the catchment yield.

10.3.8 WETLANDS

Mining activities have the potential to damage and/or disturb wetland habitat, deterioration of water quality, erosion, increased transport and sedimentation in wetlands, increased alien vegetation, increased surface run-off, and the deterioration of water quality. The following key potential impacts relating to wetlands have been identified:

- The potential loss of wetland vegetation and habitat within the footprint of the proposed mining developments.
- Increased sediment movement off the site may occur during mining operations. Increased sediment deposition within wetlands and watercourses can result in alteration to benthic habitats and the establishment of reed beds in areas of sediment deposition.

- Erosion of wetlands and watercourses may occur at storm water discharge points due to point source discharges of high velocity flows. The erosion of channels through wetlands results in the local lowering of the water table with resultant partial desiccation and changes in vegetation structure and composition.
- An increase in the occurrence of alien invasive vegetation within wetlands due to disturbances and changes to the supporting hydrology caused by the proposed mining activities.
- Deterioration of water quality may occur as a result of the decanting of low pH, high metal and sulphate rich water from the mine post closure.

10.3.9 SURFACE WATER

Mining activities have the potential to alter surface water drainage patterns through actual mining methods employed as well as the placement of infrastructure. The following key potential impacts relating to surface water resources have been identified:

- A reduction in stream flow may occur due to proposed mining activities.
- A decrease in water quality may occur due to seepage and overland storm water flows from the opencast area.
- Surface water quality may deteriorate as a result of the decanting of low pH, high metal and sulphate rich water from the mine post closure.
- There is the potential for flood lines to negatively affect the surface area of the mine.
- Decreased infiltration and increased run-off may occur due to soil compaction.
- Surface water pollution or contamination due to spillage of chemicals, hydrocarbons, or contaminated water during mining activities.
- In the event of the collapse of the underground mine workings surface subsidence may result, altering the movement of water on the surface and into groundwater.

10.3.10 GROUND WATER

Mining activities have the potential to impact on ground water resources through potential pollution and/or contamination as a result of activities such as the actual mining method employed and resultant geological exposure of oxidising materials, seepage, spillages and both mineralised and non-mineralised waste streams. Additional impacts related to mining activities also include dewatering cones of depression and loss of water supply to surrounding land users. The following key potential impacts relating to ground water have been identified:

- Ground water pollution or contamination due to spillage of chemicals, hydrocarbons, or contaminated water during mining activities.
- A reduction in recharge to groundwater due to surface compaction.

- Reduction of ground water reserves due to mine dewatering.
- Reduction of stream baseflow, surrounding ground water levels, and aquifer levels as a result of mine dewatering.
- The potential contamination of groundwater due to the continued oxidation of coal material in the mine void and the waste material on-site.

10.3.11 AIR QUALITY

Mining may contribute to a change in ambient air quality which can result in a variety of impacts which in turn may cause a disturbance to and/or health impacts on nearby receptors. Although there are a number of ambient air pollutants in the vicinity of the proposed Leiden Project, the pollutants of concern due to the mining activities will consist of particulate matter and thus will be the focus of this section. Fugitive dust from materials handling operations, wind erosion, crushing and screening and vehicle entrainment on paved and unpaved roads are classified as routine emissions and are expected to be fairly constant throughout the year. The following key potential impacts relating to air quality have been identified:

- Suspended particulate matter may result in damage to the physiology, death of vegetation, reduction in the efficiency of gaseous exchange, and the reduction in photosynthetic activity of vegetation in the area.
- Suspended particulate matter may result in physical stress to animals and a corresponding decrease in physical health.
- Suspended particulate matter may result in adverse effects on human health.

10.3.12 VISUAL

Considering the rural setting of the application area and the mountain backdrop, it is anticipated that the introduction of mining structures and related activities would create strong contrast with the existing landscape characteristics. The following key potential impacts relating to visual aesthetics have been identified:

- Adverse effect of alteration to the sense of place on the psychological well-being of sensitive receptors.
- Adverse effect of alteration to landscape character on the psychological well-being of sensitive receptors
- Adverse effect of alteration to the view shed on the psychological well-being of sensitive receptors.

10.3.13 NOISE

Certain noise generating activities associated with mining operations can cause an increase in ambient noise levels in and around the site. Significant noise is associated the most with

opencast and plant (including workshops) activities. The only noisy activities relating to the underground mining activities are associated with the plant activities. A source of noise during the operational phase will be traffic to and from the site, traffic around the facility, ROM and product transport and activities associated with waste management. The following key potential impacts relating to noise have been identified:

- Increase in ambient sound levels. In some cases mining and related activities may result in an increase in noise levels above the allowable thresholds.
- Noise impacts on animals. Whilst studies show that the response differs greatly between species, noise typically disturbs animals and results in them moving away from the source of noise or becoming adapted to the noise.
    - Adverse effect of an audible acoustic energy on the physiological and/or psychological well-being of sensitive receptors. Some of the typical effects that disturbing noise may have on sensitive receptors includes interference with daily activities (work, leisure and sleeping).
- Disturbance of learners in the nearby schools. Some of the typical effects that disturbing noise may have on learners includes;
    - Hinders speech communication;
    - Impedes the thinking process;
    - Interferes with concentration.
- Mine workers in very close proximity to noisy activities would be at risk to hearing damage if the proper precautions (e.g. use of personal protective equipment) are not taken.

10.4 BUILT ENVIRONMENT

10.4.1 BLASTING AND VIBRATION

The application of explosives for breaking rock will always have an effect on the surrounding environment. These effects can manifest in the form of ground vibration, air blast, fumes, fly rock etc. These short duration events may be noticeable by communities and individuals living in the immediate environment. These events tend to cause nuisance and elicit an emotive response because of resonance because they are easily recognized as being related to blasting. The following key potential impacts relating to noise have been identified:

- Ground vibration may disturb animals and result in a decrease in animal productivity;
- Air blast may be result in damage to structures and increased stress to sensitive receptors;
- Fly rock may result in damage to structures and injury to sensitive receptors;

- Noxious fumes may cause a decrease in heath of sensitive receptors; and
- Community reaction to blasting due to negative perceptions surrounding mining.

10.4.2 TRAFFIC

In terms of potential impacts the proposed project will result in increased use of the local road network which may result in the deterioration of road surfacing, damage to bridges and culverts in the area, and safety risks to surrounding communities. The following potential impacts have been identified:

- Increase in traffic on adjacent road network resulting in additional damage to the roads and a potential for an increase in the number of accidents;
- Additional heavy traffic over bridges and culverts may result in damage to these structures;
- Additional heavy vehicles traveling through communities may affect the normal usage of these roads.

10.5 COMMUNITY HEALTH AND SAFETY

It is important to recognize that mining activities, equipment, and infrastructure can increase community exposure to risks and impacts. The following key potential impacts relating to community health and safety have been identified:

- Safety of community – possible increase in crime due to increased number of strangers in community. There are many children in the area indicated by the presence of two schools.
- Hazardous structures and excavations may pose a threat to community safety if not correctly located, properly designed and correctly managed. By way of example, excavations may pose a risk to animals and people if not properly managed to prevent unauthorised access.
- The use of hazardous materials on the mine may result in a community health and safety risk if these materials are not stored, handled and disposed of in an appropriate manner. By way of example, the storage and use of explosives may represent a safety risk if appropriate controls and procedures are not followed.
- Impacts associated with blasting. Fly rock in particular may pose a risk to people, animals and infrastructure within close proximity to the mine;
- The use of public roads for hauling coal will result in increased safety risks for members of the community and public utilise these roads.
- Increase in risk of fire hazard. The site is a high risk area due to the forestry activities. Mining activities have the potential to increase the risk of accidental fires.

- Impacts on ecosystem services can impact on communities, particularly where these communities rely on these ecosystem services (e.g. water from watercourses) for their livelihoods.
- The contamination or degradation of natural resources, such as adverse impacts on the quality, quantity, and availability of freshwater, may result in health-related risks and impacts.
- Land use changes may result in the loss of natural buffer areas such as wetlands, and upland forested areas that mitigate the effects of natural hazards such as flooding, landslides, and fire, may result in increased vulnerability and community safety-related risks and impacts.
- An influx of people to mining area seeking employment may the increase the risk for community exposure to waterborne, water based, water-related, and vectorborne diseases, and communicable diseases.

10.6 LIST OF POTENTIAL CUMULATIVE IMPACTS

Without proper mitigation measures and continual environmental management, most of the identified impacts in Section 10 may potentially become cumulative, affecting areas outside of their originally identified zone of impact. The potential cumulative impacts will be identified, evaluated, and mitigation measures suggested during the detailed EIA level investigation. The impact identification and calculation methodology employed by all specialists' incorporates cumulative impacts in a quantitative manner to determine the final impact score and corresponding rating. Please refer to Section 14.2 for information on the methodology utilised.

When considering cumulative impacts it is vitally important to bear in mind the scale at which different impacts occur. There is potential for a cumulative effect at a broad scale, such as regional deterioration of air quality, as well as finer scale effects occurring in the area surrounding the development. On a regional scale, the Mpumalanga province is already heavily affected by mining operations and agriculture. The main impacts which have a cumulative effect at this scale are related to the transportation vectors that they act upon. For example air movement patterns result in localised air quality impacts having a cumulative effect on air quality in the region. Similarly water acts as a vector for distribution of impacts such as contamination across a much wider area than the localised extent of the impacts source. At a finer scale, there are also impacts that have the potential to result in a cumulative effect, although due to the smaller scale at which these operate, the significance of the cumulative impact is lower in the broader context.

The following is a list of some of the potential cumulative impacts that may occur as a result of the project. It must be stated that the list is not exhaustive and will be investigated further during the EIA Phase and in consultation with stakeholders. The potential cumulative impacts identified at this stage that may occur as a result of the project are:

- Contribution to losses of potentially productive agricultural land, along with a reduction in land capability as a result of site sterilisation due to mining activities.

  Forestry and other land uses in the area such as agriculture have presumably resulted in significant impacts on soil resources with potential losses in land capability. In the broader context, the Mpumalanga province is heavily impacted by mining activities in particular and as such the mine could contribute to the loss of productive agricultural land.

- Contribution to air quality impacts, specifically relating to increased suspended particulate matter (dust).

  Currently the use of unpaved roads in the area around the mine, particularly by heavy logging vehicles, result in significant levels of suspended particulate matter. The introduction of a mine to the area has the potential to result in a cumulative effect on dust levels through increased use of the roads and earthworks activities (particularly during construction).

- Contribution to reduction in surface water quality.

  Testing of surface water quality along with aquatic ecology sampling has indicated that whilst water quality is generally good, there is evidence of water contamination, possibly as a result of historical mining activities. Mining has the potential to contribute to deterioration of water quality if adequate mitigation measures are not implemented.

- Increase in traffic.

  The introduction of mining to the area is expected to result in an increased level of disturbance (traffic, noise etc.) on a localised scale, but this in turn will contribute to a certain degree on capacity and integrity of road infrastructure at a regional level.

- Disturbance of fauna.

  There is currently disturbance of fauna due to the various land use activities that take place within the site and the surrounding area. The introduction of mining to the area is expected to result in an increased level of disturbance (traffic, noise etc.) to fauna.

- Invasion of alien plant species.

  A number of activities and land uses within the site and surrounding area (such as forestry, agriculture, and informal grazing) have resulted in significant disturbance to vegetation communities which has resulted in the spread of alien invasive species. Mining has the potential to result in a further increase in alien invasive vegetation if adequate mitigation measures are not implemented.

- Increase in ambient noise levels and potential adverse effect of noise sensitive receptors.

Currently ambient noise levels are not high at the site, however if mining takes place, the cumulative effect of mining together with the existing land uses has the potential to result in an increase in the ambient sound level and potential nuisance to sensitive receptors.

- Downstream sedimentation.

  Currently forestry is expected to result in erosion and the introduction of mining to the site may also increase erosion on a localised scale which in turn may result in further sedimentation of downstream water resources.

- Disturbance, damage or destruction of heritage features.

  Forestry and historical agriculture are expected to have resulted in impacts on heritage features within the site and surrounding areas. The introduction of mining to the area could result in a further impact on heritage features if appropriate mitigation measures are not implemented.

- Increased vulnerability and community safety-related risks and impacts.

  Community safety-related risks and impacts already exit as a result of the land uses taking place in the area, particularly forestry. In the event that mining goes ahead, there would potential for increased community safety-related risks and impacts.

- Localised areas of acid mine drainage and groundwater contamination.

  Water quality monitoring indicates that historical mining activities may have resulted in water contamination within the application area. If further mining takes place without adequate mitigation measures in place, there is potential for additional water contamination.

11 POTENTIAL FOR ACID MINE DRAINAGE

11.1 BACKGROUND TO ACID GENERATION AND METAL MOBILIZATION

Acid Mine Drainage (AMD) can be defined as the outflow or seepage of acidic water from old metal or coal mine areas. AMD is comprised of a low pH, iron and sulphate water and it usually occurs when water is exposed to the atmosphere via outflow or seepage, thus oxidising. The creation of acid or ferric hydroxide within the system is as a direct result of iron sulphide or pyrite oxidation. Pyrite is one of the most important sulphides found in the waste rock of mines. Coal-bearing rocks in particular have the potential to generate AMD, because of the low modal distribution of sulphide minerals, i.e. mainly pyrite. It is important to note that exposure to air is a crucial step in AMD formation. Iron sulphides in geologic materials that are located below the water table will remain essentially stable, since the potential for oxidation is limited. However, where sulphidic materials are exposed to oxidising conditions (air) the iron sulphides will react and water can move the reaction products (e.g. iron and sulphate) into surface water and groundwater. As the acid water migrates, it further reacts with other minerals and dissolves a broader range of metals. Once sulphides have been oxidised, it is extremely difficult to avoid ferric hydroxide precipitation.

11.2 AMD FORMATION IN THE HIGHVELD, WITBANK, AND ERMELO COALFIELDS

Samples were collected during previous research projects for the Water Research Commission from the coal seams, as well as their roof and floor lithologies in the Highveld, Witbank, and Ermelo coalfields. Acid-base accounting (ABA) results for the collected samples show that the lithological units in the coalfields have the ability to contribute to deterioration in ground and surface water quality. A positive correlation was also recognized between the types of minerals, (modal proportion of sulphide, carbonate, and clay minerals) present in the coal and the associated water quality, i.e. the severity of the AMD problem.

11.3 POTENTIAL IMPACTS AND CONSEQUENCES OF AMD

If AMD is incorrectly managed, it has the potential to result in social and environmental impacts as well as long term liability for mine operators, regulators, and the community. The costs of managing AMD after it has occurred can incur millions of Rands. Some of the main social and environmental impacts associated with AMD are:

- Mobilise (bring into solution) metals to levels that may seriously compromise aquatic ecosystems, riparian communities and possibly human health (e.g. zinc, cadmium, aluminium, copper);
- Limit the downstream beneficial uses of the receiving water (e.g. stock, recreation, fishing, aquaculture, irrigation);

- Alter important life supporting balances in water chemistry (e.g. bicarbonate buffering system);
- AMD can cause rehabilitation and re-vegetation difficulties;
- Released chemicals that can result in the smothering of aquatic habitat and reduce light penetration; and
- Limit the reuse of mine site water and exacerbate the corrosion of site infrastructure and equipment.

The above impacts can result in severe consequences which primarily include:

- Long term environmental liabilities for mine operators, regulators and communities; and
- Treatment of AMD requires the installation of expensive control, treatment and rehabilitation programs.

11.4 POTENTIAL FOR AMD AT LEIDEN

According to the sediment rock and borehole testing for Leiden during the site visit by the Geochemistry specialists, the geological formation is unlikely to yield AMD formation, these results are discussed further below.

In general, the area has been divided into three lithological units. i.e. dolomite, arenite, and dolerite. Rocks indicated as arenite within the application area are the only rocks that have the potential to host coal. As explained previously, it is the weathering of sulphide minerals, mainly pyrite, which gives rise to the formation of AMD. Coal-bearing rocks have the potential to generate AMD, because of the low modal distribution of sulphide minerals, i.e. mainly pyrite. Arenite and dolerite do not have such potential, because they do not contain any sulphide minerals. As such the potential formation is considered a low risk due to the nature of the predominant geologies of the site. The geochemical specialist study in the EIA phase will involve further detailed assessment, including ABA analysis, to determine the potential for AMD at Leiden. Regardless of the potential for AMD formation, a proactive approach will be adopted for the Leiden Coal Mine with the development of a detailed AMD avoidance and management strategy to be implemented throughout the LoM.

11.5 BEST PRACTICE MANAGEMENT AND CONTROL OF ACID DRAINAGE

If accounted for at the beginning of a project together with an immediate action plan to be put into effect should oxidization begin, AMD can be managed correctly, therefore minimizing the affects to the surrounding environment. Currently, best practice environmental management of sulphidic mine wastes involves integration of acid drainage prevention, minimisation and control into the mining process. It can be summarised as the early characterisation and

classification of the acid generating potential of these materials, development of strategies to minimise the oxidation of sulphides, and where acid drainage formation is unavoidable, the implementation of suitable long term control and treatment technologies.

Best practice management of AMD needs to be pre-emptive. As such, the following principles will apply to the AMD avoidance and management strategy for Leiden:

- Understanding the site mechanisms for acid generation, predicting the acid generating potential and incorporating this information into mine design and management (e.g. location of waste dumps, blending of wastes, dump design and management procedures, water management plans, etc.);
- Development of suitable minimisation and control strategies;
- Monitoring to seek warning signs of the early development of acid drainage, and later to quantify the effectiveness of minimisation and control strategies; and
- Treatment where minimisation and control strategies are not totally effective or where costs of treatment are less than the costs of minimisation and control.

In almost all circumstances, resources spent on prevention and minimisations of acid drainage are returned many fold through lower control and treatment costs. The geochemical study undertaken in the EIA Phase will provide the detailed AMD mitigation strategy based on current best practice in terms of avoidance and management of AMD.

12 PROJECT ALTERNATIVES

The identification and assessment of alternatives is a key component to the success of any EIA process. Essentially, alternatives represent different means of meeting the general purpose and need of the proposed project through the identification of the most appropriate method of development. Two tiers of alternatives are investigated and considered which culminate into the identification of three feasible development alternatives to be assessed, in detail during the EIA Phase. Tier One alternatives include land use, location, mining method and site access alternatives, all of which are discussed below.

12.1 LAND USE ALTERNATIVES

The current land uses on site comprise of commercial forestry plantations, sawmill operations, cattle grazing, old fields, wilderness and tracts of vacant land. Most of the forestry operations are for timber that is irregularly processed at the sawmill which is owned by the landowner's family.

12.1.1 MINING

Mining is one of the predominant land uses within the surrounding area. Several active mines, predominantly coal mines, are located within 60 km of the project area and include Taaiboschspruit, Old Leiden, Kusipong, Saymore, Mooiplaats, Ferreira and Penumbra. The mining operations located in the surrounding area can be categorised as open cast and underground operations with surface access nodes. Additional supporting infrastructure is also present and includes mineral processing plants, slurry and co-disposal facilities, conveyor routes, haul roads, offices, pipelines and powerlines. Furthermore, the proposed application area has been impacted by historic prospecting and mining operations. According to historical prospecting records, a total of 187 000 t (in situ) was mined from the site more than 10 years ago by Kangra Coal (Pty) Ltd. The Leiden Coal Mine project will allow for the optimum mining and usage of mineral resources which still remain within the project area and supply of coal to both the international and domestic markets. As such, mining can be considered a feasible land use alternative within both the application area and surrounding area.

12.1.2 FORESTRY

Forestry is one of the dominant land uses within the immediate and surrounding area. Plantations owned and operated by Mondi, Sappi, TWK and SAFCOL are widespread and occur throughout the surrounding area. The predominant land use on site is also forestry with an operational sawmill located on the property. The plantation and sawmill within the application area are owned and operated by the family of the landowner. Based on several site visits and discussions with the landowner it has been determined that while forestry is the dominant land use on site; it is not effectively commercially exploited due to timber harvesting

operations being undertaken at irregular intervals. Forestry operations within the surrounding areas take place on large commercial scales. As such forestry can be considered a feasible land use alternative within both the application area and surrounding area.

12.1.3 MIXED LAND USE (MINING AND FORESTRY)

Mining and forestry have been identified as the predominant land uses within the immediate and surrounding area. The character of the application area confirms this finding, with forestry the dominant land use on site and historic mining also having been undertaken by Kangra Coal (Pty) Ltd. As a land use, mining is often viewed as directly competing and eventually replacing existing land uses. However, the nature of the proposed Leiden Coal Mine (majority underground) provides an opportunity in which both feasible land uses, namely forestry and mining can potentially be conducted concurrently. The proposed Leiden Coal Mine aims to opencast a relatively small area (up to 22 ha) in order to access and mine the underground coal seams at a depth of 20 to 55 m. Due to the small size of the opencast area and with the vast majority of mining taking place deep underground, relatively little surface disturbance is expected to take place which will allow for the potential continuation of forestry as a land use while mining activities are underway. Furthermore, due to the expected depth of mining the risk of subsidence is also greatly reduced. The surface area required for mine infrastructure is also greatly reduced as there will be no mineral processing facilities or Tailings Dam on the site. The practicalities of undertaking two concurrent, demanding land uses such as forestry and mining are likely to require detailed management of operations to ensure the feasibility of both land uses, but it is potentially possible. As such, a mixed land use of mining and forestry can be considered a feasible land use alternative within both the application area and, possibly, the surrounding area.

12.1.4 AGRICULTURE

Agriculture is one of the dominant land uses within the surrounding area, comprising mostly monocultures of maize and other small-scale subsistence farming practises. The Soils, Land Use and Land Capability specialist study identified soils on site that are considered generally to be both deep and fertile. As such, agricultural potential, based exclusively on soils, indicates that agriculture is a potential feasible alternative. However, the predominant land use on site is forestry which is likely to have impacted on agricultural potential as a result of the acidification of soils by the plantations. It is also important to note that the agricultural potential of the soils, regardless of the impact of forestry, can be returned to conditions suitable for arable agriculture so long as basic fertilisation and liming is undertaken, but only at considerable time and cost. As such, agriculture is not considered to be a feasible land use alternative within the application area and will therefore not be considered and assessed further in the EIA Phase.

12.1.5 GRAZING

Livestock grazing is one of the most common and widespread land uses occurring within the immediate and surrounding area. Small scale livestock (cattle) grazing occurs on site but is limited due to the availability of land that can be effectively used for livestock. With forestry the major land use on site and utilising 61 percent of land, the only other available land amounts to a total of approximately 377 hectares (which includes 100 % of the grasslands and 60% of the wetlands mapped on site). At an average of 9 hectares per Livestock Unit (LSU), the site would likely only allow for the sustainable grazing of up to 42 large livestock units. As such, livestock grazing is not considered a feasible land use alternative within the application area and will therefore not be considered and assessed further in the EIA Phase.

12.1.6 TOURISM

The proposed Leiden Coal Mine is located approximately 60 km north-west of the town of Piet Retief, which is dominated by guesthouses used by tourists on route to destinations such as Sodwana. Increasing tourism development in terms of conservancies and private nature reserves also occurs in the Ngwempisi and Assegai River Valley and associated catchments. The landowner has constructed a guesthouse on site with a view to rent it out to mine personnel. The prevalent forestry and mining character of the area, as well as the tourism potential and development in the area, limit the probability of tourism development and success in the immediate and surrounding area. As a result, tourism is not considered a feasible land use alternative within the application area and will therefore not be considered and assessed further in the EIA Phase.

12.1.7 RESIDENTIAL DEVELOPMENTS

Ermelo and Piet Retief are the nearest towns to the proposed Leiden Coal Mine. The character of both towns is heavily influenced by agriculture and mining, which are the predominant economic activities in the surrounding area. Due to a predominant land use of forestry on site, limited site access, historic mining activities, and distance to large towns, residential development is not considered to be suitable for the application area. As such, residential development is not considered a feasible land use alternative and will therefore not be considered and assessed further in the EIA Phase.

12.1.8 SCREENING OF THE IDENTIFIED LAND USE ALTERNATIVES

A preliminary assessment of the main advantages and disadvantages of the identified feasible alternative land uses is summarised in Table 16 below. This comparative assessment will be further investigated during the EIA Phase and the results of which will be presented in the EIA report.

Table 16: Summary of advantages and disadvantages of alternative land uses

Feasible Land Use Alternative	Advantages	Disadvantages
Mining	• A commercial mining operation with a sustainable life of mine; • Provision of sustainable employment and employment retention; • On-going economic input into the immediate and surrounding area; • Improvement of existing infrastructure; • Local economic development through the implementation of the SLP; • Economic injection into the region in terms of small business enterprise development; • On-going supply of both export quality coal and coal for the domestic South African market; and • Additional secure supply of coal to	• Numerous potential significant negative social and environmental impacts; • Limited (10 years) duration of socio-economic benefits; • Additional water use requirements; • Rezoning of land required; • Changes to existing land use and land character; • Long-term environmental liability; and • Residual/latent environmental impacts that requiring management and monitoring post mining;

Feasible Land Use Alternative	Advantages	Disadvantages
	ESKOM for energy generation	
Forestry	• Continuation of limited economic benefits; • Minimal disruption of existing land uses; • Continuation of landscape character; and • No rezoning of land required.	• Limited socio-economic benefits; • Sterilization of the mineral resource; and • Loss of potential economic injection into the region.
Mixed (Forestry & Mining)	• A commercial mining operation with a sustainable life of mine; • Provision of sustainable employment and employment retention; • On-going economic input into the immediate and surrounding area; • Improvement of existing infrastructure; • Local economic development through the implementation of the SLP; • Economic injection into the region in terms of small business enterprise development; • On-going supply of both export quality coal and coal for the domestic South African market;	• Potentially compounded significant negative social and environmental impacts; • Increased water use requirements; • Rezoning of sections of land required; • Long-term environmental liability; and • Residual/latent environmental impacts that requiring management and monitoring post mining;

Feasible Land Use Alternative	Advantages	Disadvantages
	• Additional secure supply of coal to ESKOM for energy generation; • Continuation of forestry and forestry based economic benefits; • Reduced disruption of existing land use; • Reduced disruption of landscape character; and • Better, more effective use of land	

12.2 LOCATION ALTERNATIVES

Historical exploration for mineral reserves was undertaken with a number of boreholes being drilled by Shell S.A. (Shell) in 1990. According to historical exploration records, a total of 187 000t (in situ) was mined from the site more than 10 years ago by Kangra Coal (Pty) Ltd. Mashala was granted a Prospecting Right (710/2006 PR) for Leiden on the 17th October 2006 and the Prospecting Right has subsequently been renewed twice. Since the site has already been disturbed by exploration and mining activities, the establishment of the mine on this site would be preferable, from an environmental perspective, to the development of another undisturbed site. Furthermore, it is important to note that as the holder of a prospecting right on the property, Mashala is currently the only company that has the exclusive right to apply for the exploitation of these reserves. As such, the proposed application area is deemed the most feasible location alternative.

12.3 MINING METHOD ALTERNATIVES

Longwall mining and bord-and-pillar mining are two of the basic methods of mining coal underground and both methods are well suited to extracting the relatively flat coalbeds (or coal seams). These two mining methods have been considered and assessed for the underground mining at Leiden.

12.3.1 LONG WALL MINING

In the longwall mining method, mine development is carried out in such a manner that large blocks of coal, usually 100 to 300 metres wide and 1,000 to 3,000 metres long, are available for complete extraction. A block of coal is extracted in slices, the dimensions of which are fixed by the height of coal extracted, the width of the longwall face, and the thickness of the slice (ranging from 0.6 to 1.2 metres). In manual or semi-mechanized operations, the coal is undercut along the width of the panel to the depth of the intended slice. It is then drilled and blasted, and the broken coal is loaded onto a conveyor at the face. The sequence of operations continues with support of the roof at the face and shifting of the conveyor forward. The cycle of cutting, drilling, blasting, loading, roof supporting, and conveyor shifting is repeated until the entire block is mined out. Due to the high capital cost and its suitability for much deeper coal fields, longwall mining will not be considered and assessed further in the EIA Phase.

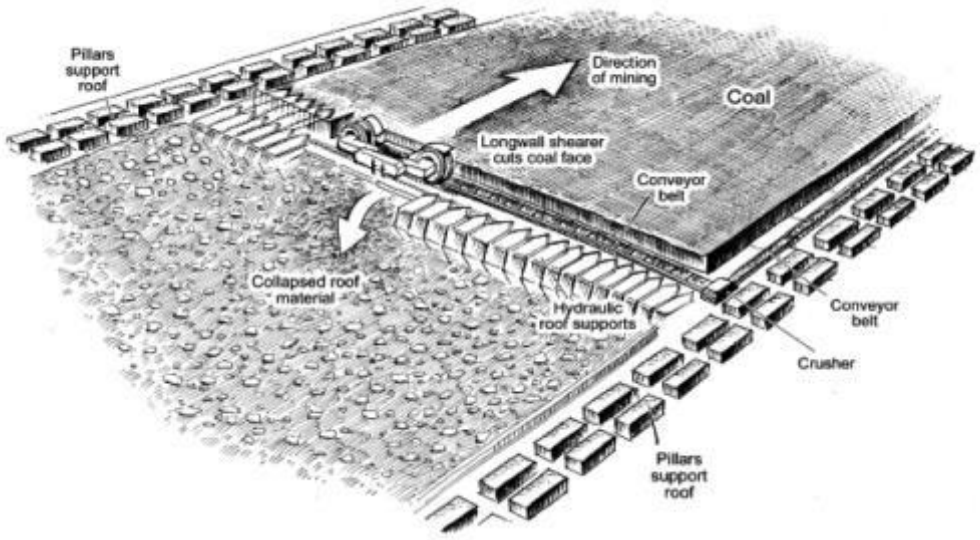


Figure 44: Illustration of long wall mining

12.3.2 BORD AND PILLAR MINING

Also referred to as room and pillar mining, this method is a mining system in which the mined material is taken out across a horizontal plane while leaving "pillars" of unscathed material to support the overstrain leaving open regions or "rooms" underground. The key to bord and pillar mining is optimising the pillar size. If the pillars are too small the mine will fall down. If the pillars are too big then significant quantities of valuable material will be left behind reducing the profitability of the mine. Bord and pillar mines are developed on a grid basis apart from where geological traits such as faults require the basic template to be customized. The optimum pillar size is determined by a calculation based on the weight bearing capability of the material above and below the coal seam and the strength of the coal itself.

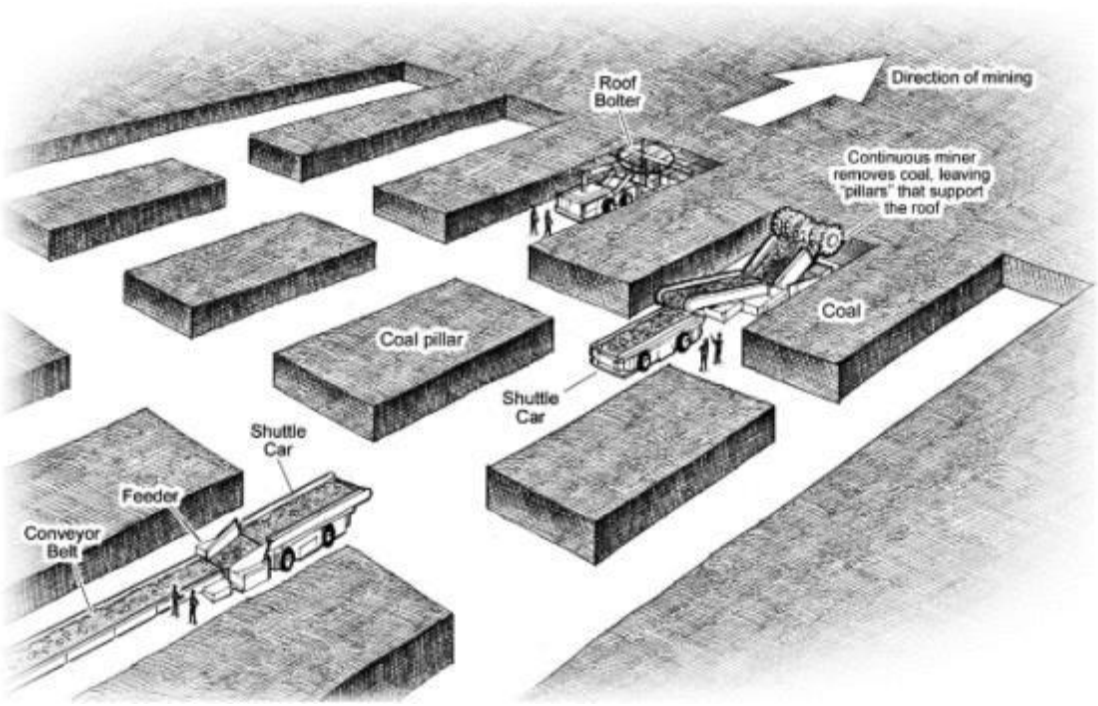


Figure 45: Illustration of bord and pillar mining

Table 17: Summary of advantages and disadvantages of underground mining alternatives

Land use Alternative	Advantages	Disadvantages
Long Wall Mining	• High Efficiency; • Higher coal recovery; • Fewer workers required; • Safety improved through better roof control and a reduction in the use of moving equipment; • Minimizes the need for dusting mine passages with inert material to prevent coal dust explosions. • Involves no blasting (safer); • Coal haulage system is simpler; • Ventilation is better controlled; • Subsidence of the surface is more predictable; • Overall offers more opportunities for automation; and • Well suited to deep coalbeds. Suitable for coalbeds deeper than 1000 feet.	• Numerous potential significant negative social and environmental impacts; • Limited (10 years) duration of socio-economic benefits; • Additional water use requirements; • Rezoning of land required; • Changes to existing land use and land character; • Long-term environmental liability; and • Residual/latent environmental impacts that requiring management and monitoring post mining;

Land use Alternative	Advantages	Disadvantages
Bord and Pillar Mining	• Fast, simple, and requires very little equipment; • Relatively low capital cost; • Coal production can start much more quickly, which equals faster return on investment.	• Limited socio-economic benefits; • Sterilization of the mineral resource; and • Loss of potential economic injection into the region.

12.3.3 OPENCAST DESIGN

Two opencast design options for the proposed Leiden Coal Mine are considered and described below:

Reduced Opencast

The reduced opencast will entail the creation of a smaller opencast section of approximately 12 ha (refer to **Figure 46** & Figure 47). The reduced opencast is planned to be developed over a period of 18 months. A reduced opencast will allow for the following:

1. Generation of revenue at the start of the project;
2. Adequate highwall access to underground reserves; and
3. Consideration of environmental constraints

The reduced opencast will allow for the generation of sufficient revenue to pay the high costs associated with accessing the underground reserves whilst considering environmental constraints such as proximity to water courses and other sensitive environmental features.

Extended Opencast

The extended opencast will entail the extension of the opencast section by a further 10 ha resulting in an approximate total area of 22 ha. Extension of the opencast will result in the following:

1. Improved revenue generation;
2. Quicker and easier highwall access to the underground; and
3. Overall ramp up in production.

The extended opencast will also allow for the Leiden Coal Mine to improve revenue and ramp up overall production as well as provide for quicker, easier highwall access to the underground reserves. The extended opencast focuses primarily on commercial aspects and as such environmental constraints are considered secondary in relation to mine production. Both the reduced and extended opencast design options are considered feasible and will be considered in the EIA Phase.

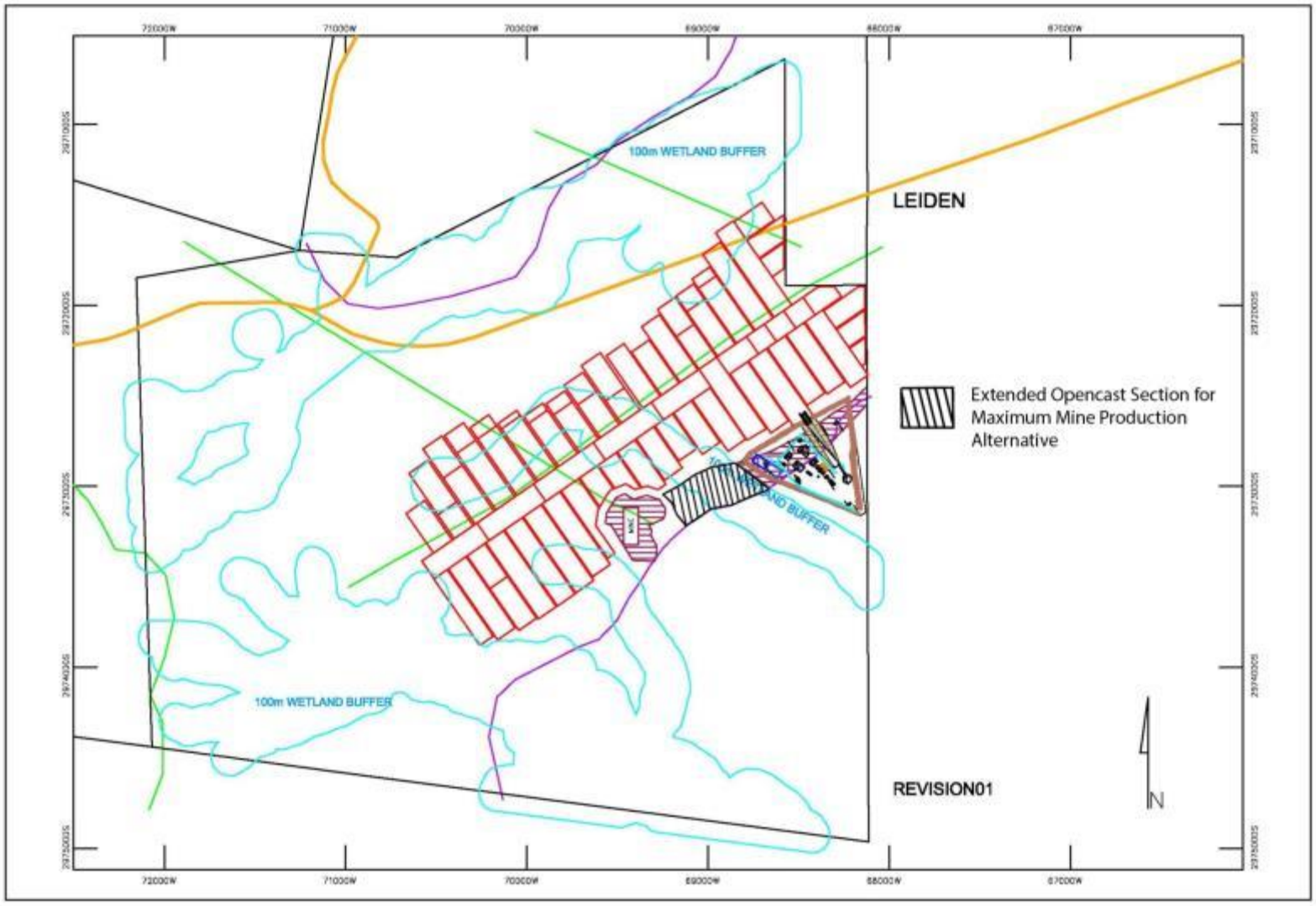


Figure 46: Conceptual mine design indicating alternative opencast positions

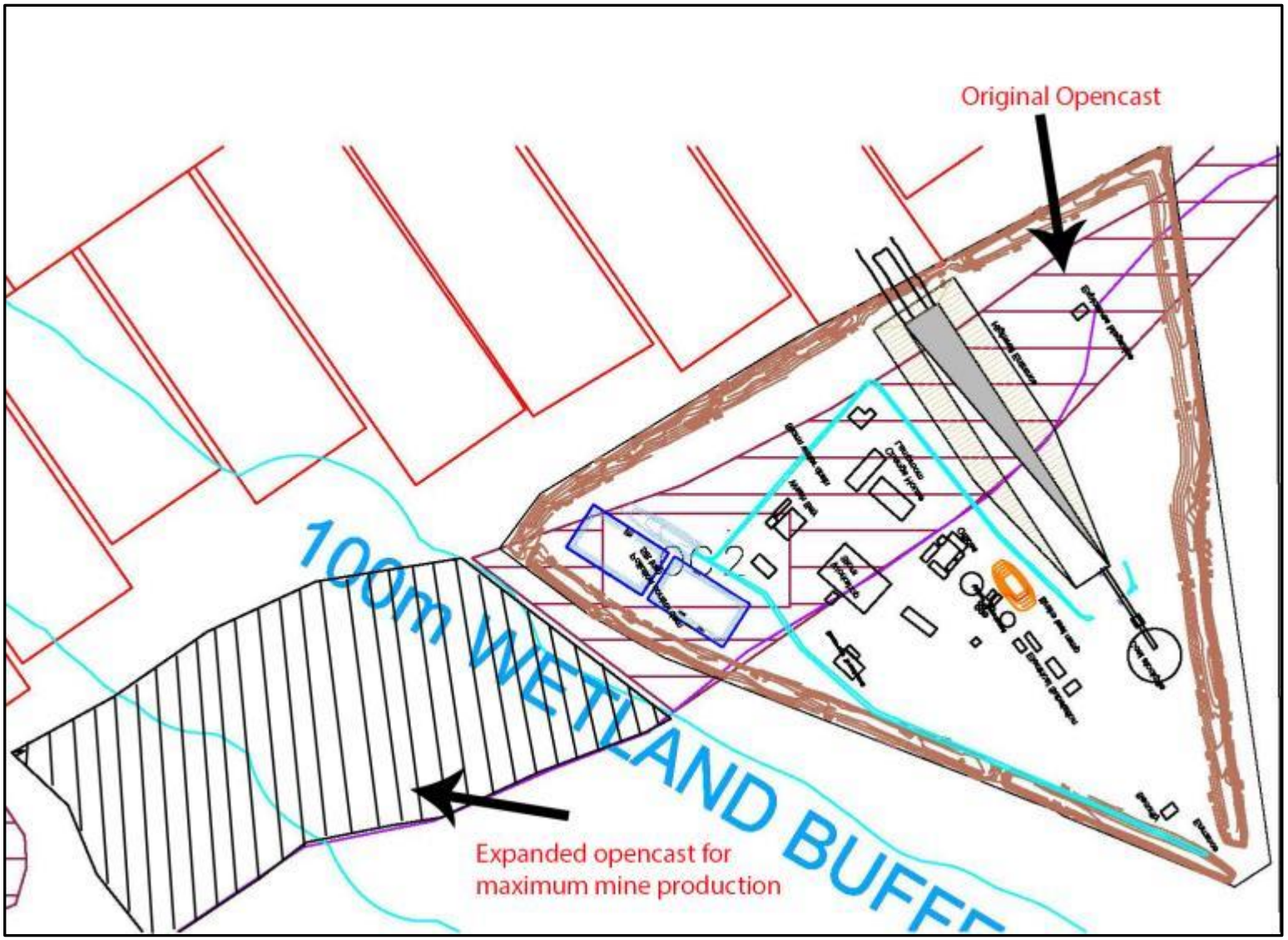


Figure 47: Close-up opencast layout indicating alternative opencast positions

12.4 SITE ACCESS ALTERNATIVES

Access to the proposed mine and off-site processing plant will be via the N2, a surfaced two lane national road, which links Ermelo and Piet Retief. There are two potential on site access routes from the proposed mine to the N2. These are referred to respectively as “Gravel Road 1” linking the mine with the N2 at a point ± 40km south of Ermelo and “Gravel Road 2” linking the Mashala Leiden Colliery with Panbult near the N2 (see **Figure 48**). The preferred access road alternatives will be considered as part of the traffic impact study for the EIA process. At this stage of the project it is expected that the following roads and intersections might possibly be affected by the proposed development and will therefore be investigated:

- N2 Road;
- Gravel Road 1; and
- Gravel Road 2.

Gravel Road 1: is currently a gravel road ±15km from the N2 road. This gravel road will be difficult to negotiate during the rainy session due to the current road condition.

Gravel Road 2: ±18km is currently surfaced from the N2 for ±1,5km after the N2 / Gravel Road 2 intersection after which the gravel road starts.

The N2 Road: a paved, diagonal east-west road that carries relatively high volumes of traffic during the morning and afternoon peak hours.

The traffic volumes on Gravel Road 1 and Gravel Road 2 are mainly traffic from the local plantations in the area to the Busby Saw Mill and Panbult railway station with less than 10 vph in both directions during the morning and afternoon peak hours.

Gravel Road 1 has two river crossings and is influenced by the inherent topography, with steep hills. It also crosses large shale stone outcrops. From an air quality perspective this road also has what appears to be a very high silt content (% particulate fraction <75µm). Higher silt contents will result in higher, further reaching impacts. The local meteorological conditions show a large easterly and westerly wind direction; these are the two most dominant wind directions. Thus Gravel Road 1, which travels north-south, will be susceptible to vehicle entrained dust being carried further away from it. Gravel Road 1 also travels in very close proximity (~20m) past a local school; thus either that section of the road would need to be moved or the school relocated.

Gravel Road 2 travels in an east-west direction, thus impacts would carry “along” the road as opposed to away from it. Gravel Road 2 is much wider than Gravel Road 1, is much flatter and does not have any river crossings (i.e. where a bridge would need to be built that supports the weight of haul trucks and is high enough not to interrupt the relevant flood height level).

Gravel Road 2 would be better suited for hauling product as opposed to Gravel Road 1, even if it is a longer journey; as the entire Gravel Road 1 would need to be rebuilt to accommodate haul trucks, while Gravel Road 2 has already been designed to accommodate timber haul trucks and thus would only require modification in certain areas.

On the basis of the above, Gravel Road 2 appears to be the most preferred alternative at this stage. However, a detailed comparative assessment of these two alternatives will be undertaken during the EIA Phase to determine the preferred route, also taking into consideration of the economic costs and benefits of each option.

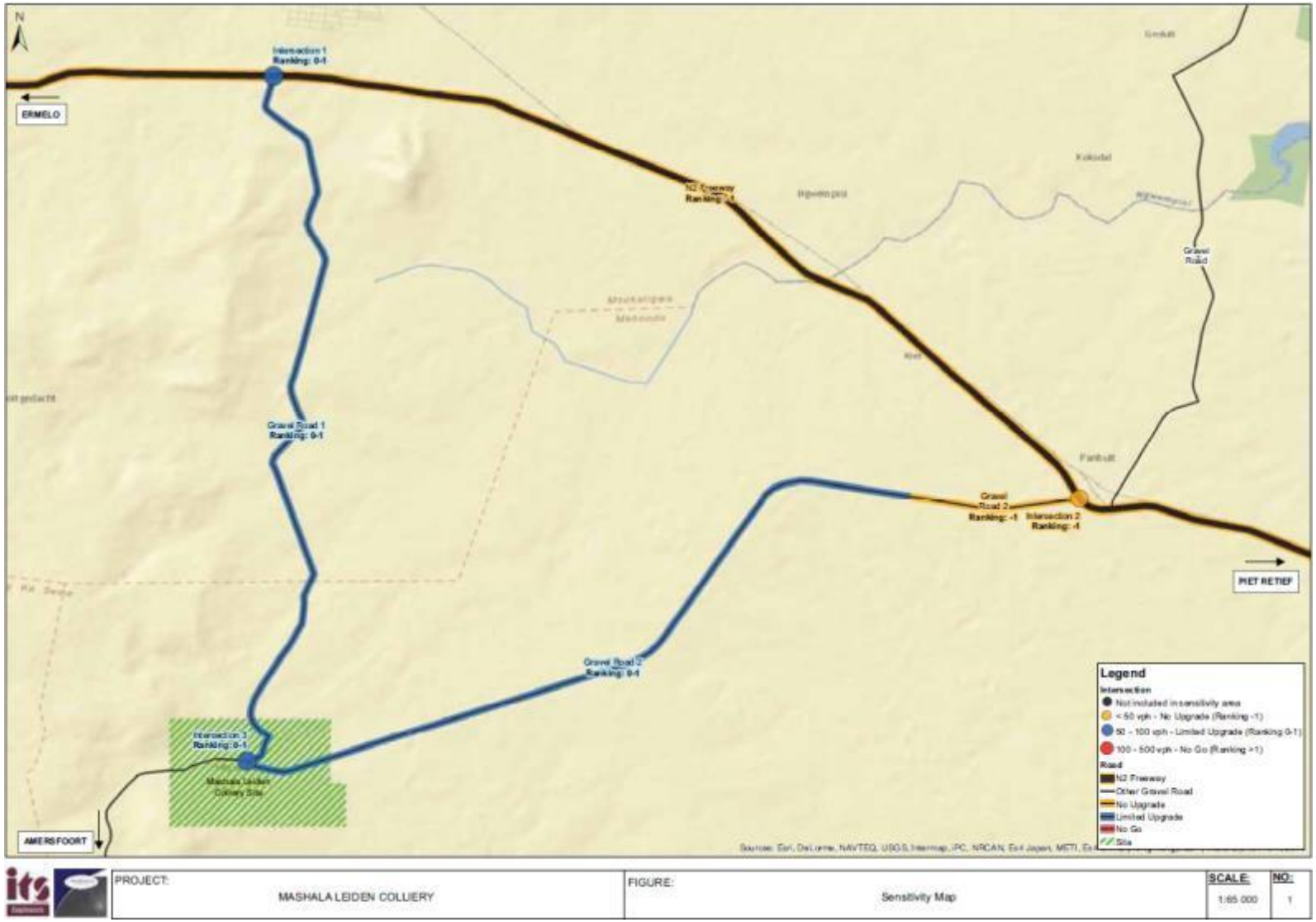


Figure 48: Sensitivity map indicating the two alternative access routes to the site

12.5 DEVELOPMENT ALTERNATIVES

The alternatives considered and discussed in the above sections, including land use, location, mining method and site access alternatives have culminated into the identification of three feasible development alternatives. These three feasible development alternatives are discussed below and will be assessed, in detail during the EIA Phase.

12.5.1 ALTERNATIVE 1: NO GO ALTERNATIVE

This alternative will imply that no development takes place and that the environment remains unchanged and unaltered. The proposed development site for the Leiden Coal Mine comprises a mixture of “undisturbed” natural vegetation and forestry. It is worth noting that other than the isolated wetland and grassland areas, the proposed project area is located in areas dominated by forestry with consequently low overall biodiversity. If the development should not take place, no additional socio-economic benefits will be created by mining activities in the area, the mineral resource will be lost, and the additional GDP from the coal export will be compromised. Further implications of the No-Go alternative include the loss of economic input into the area and a loss of regional socio-economic benefit.

12.5.2 ALTERNATIVE 2: MAXIMUM MINE PRODUCTION

In this alternative, the mining and production of coal is emphasised and mining is considered to have replaced the dominant forestry land use. Less restrictive mitigation measures will be used to protect the environmental features, thus allowing for maximum coal production and promotion of economic aspects. This approach will increase the financial viability of the proposed Leiden Coal Mine at the potential cost of impacting more severely on environmental features. This alternative is likely to increase large-scale landscape character changes and impact more on aspects such as hydrology, air quality and the isolated pockets of biodiversity, as mining operations will likely move through these sensitive environmental features.

12.5.3 ALTERNATIVE 3: SENSITIVITY PLANNING APPROACH

This alternative will emphasise resource protection and use stringent mitigation measures to minimise identified adverse impacts. This alternative will use specialist planning and evaluation of the following in order to avoid impacting on consolidated sensitive environmental features:

- Mining footprint;
- Mining methodology (open cast vs. underground);
- Pipeline placement;
- Pollution control dam and return water dam placement;
- Bulk water supply requirements;

- Transport; and
- General infrastructure placement.

This alternative will allow for the proposed development of the Leiden Coal Mine whilst protecting identified consolidated sensitive environmental features as indicated in the consolidated sensitivity map. The concept of in-situ conservation and biodiversity off-sets to account for significant residual impacts may also be explored. In addition, this alternative will consider the continuation of forestry on the surface and use the consolidated sensitivity map to assist in the design, layout, and planning of the proposed Leiden Coal Mine.

12.6 MOST APPROPRIATE DEVELOPMENT ALTERNATIVE GOING FORWARD

The most appropriate development alternative going forward is considered to be Alternative 3: Sensitivity Planning Approach which utilises the Consolidated Sensitivity Map generated (see Figure 49) with both specialist and EIMS input as a planning tool. The sensitivity planning approach is also likely to have further implications in terms of mine design as well as economic viability of the proposed project, all of which will be evaluated in the EIA investigation. Regardless, all three feasible development alternatives described above will also be comparatively assessed and evaluated during the EIA Phase to determine the most appropriate alternative going forward.

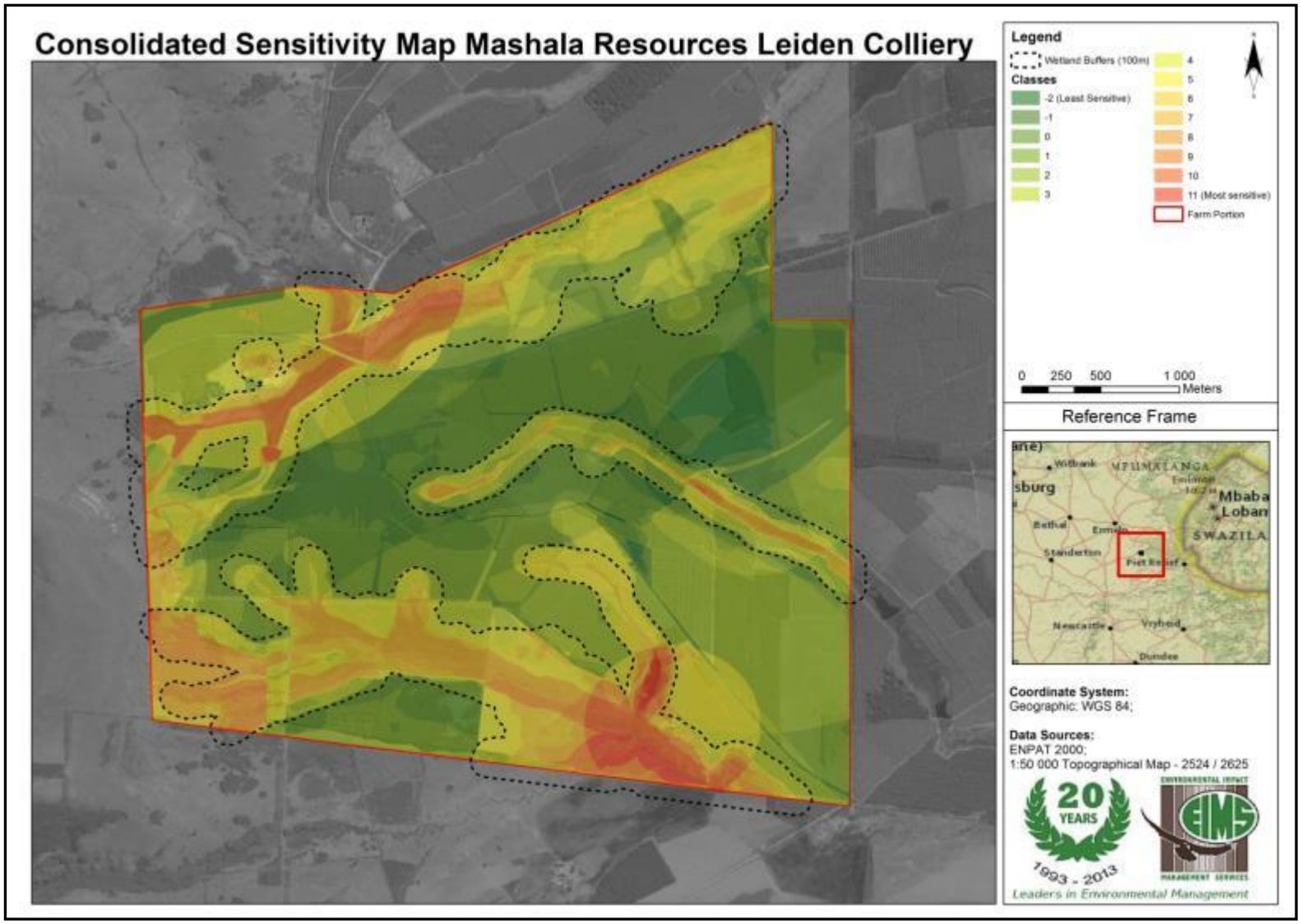


Figure 49: Consolidated sensitivity Map

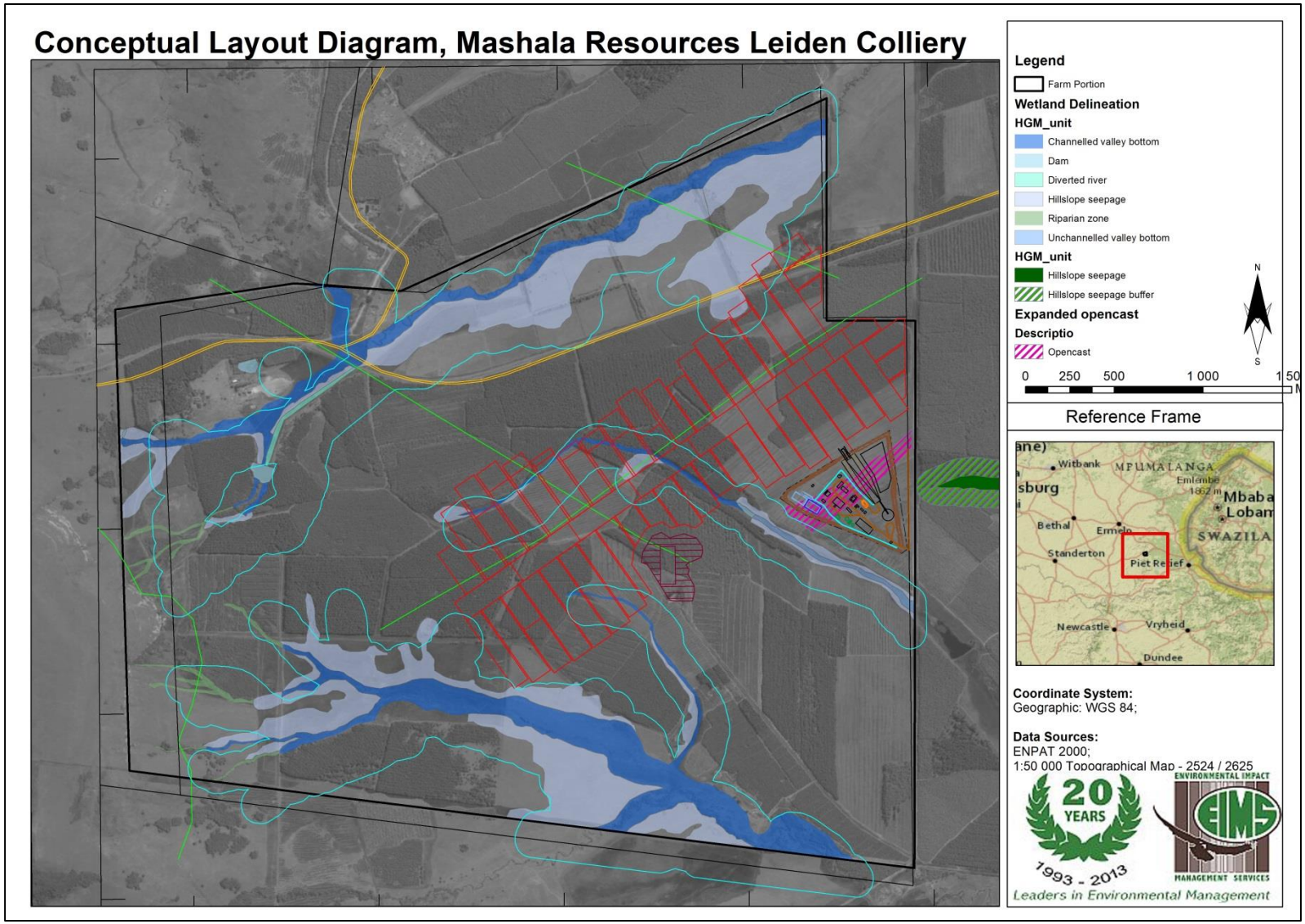


Figure 50: Conceptual mine layout for the sensitivity planning approach

13 STAKEHOLDER ENGAGEMENT

The Public Participation Process (PPP) is a requirement of several pieces of South African Legislation and aims to ensure that all relevant Interested and Affected Parties (I&AP's) are consulted, involved and their opinions are taken into account and a record included in the reports submitted to Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study. The PPP for the proposed Leiden coal mine needs to be managed sensitively and according to best practises in order to ensure and promote:

- Compliance with international best practise options;
- Compliance with national legislation;
- Establish and manage relationships with key stakeholder groups; and
- Encourage involvement and participation in the environmental study and authorisation/approval process.

As such, the purpose of the PPP and stakeholder engagement process is to:

- Introduce the proposed Leiden project;
- Explain the environmental authorisations required;
- Explain the environmental studies already completed and yet to be undertaken;
- Determine and record issues, concerns, suggestions, and objections to the project;
- Provide opportunity for input and gathering of local knowledge;
- Establish and formalise lines of communication between the I&AP's and the project team;
- Identify all significant issues for the project; and
- Identify possible mitigation measures or environmental management plans to minimise and/or prevent environmental impacts associated with the project.

13.1 LEGAL COMPLIANCE

The Public Participation Process must comply with the three important sets of legislation that require public participation as part of an application for authorisation or approval; namely:

- The Mineral and Petroleum Resources Development Act (Act No. 28 of 2002);
- The National Environmental Management Act (Act No. 107 of 1998); and
- The National Water Act (Act No. 36 of 1998)

Adherence to the requirements of the above mentioned Acts will allow for an Integrated Public Participation Process to be conducted, and in so doing, satisfy the requirement for public

participation referenced in the Acts. The details of the Integrated Public Participation Process are provided below.

13.1.1 GENERAL APPROACH TO SCOPING AND PUBLIC PARTICIPATION

The PPP for the proposed Leiden project has been undertaken in accordance with the requirements of the MPRDA, NEMA, and NWA, in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&AP's are afforded an opportunity to comment on the project.

13.1.1.1 Stakeholder Engagement Framework

Social impacts occur immediately in the planning phase of a project and as such it is imperative to start with stakeholder engagement as early in the process as possible. During the EIA Phase of the project, stakeholder engagement is driven by the requirements of the relevant legislation. The following stakeholder engagement framework outlines the principles and objectives for stakeholder engagement during the EIA Phase.

13.1.1.1.1 Principles for Stakeholder Engagement:

- To identify and assess the processes and/or mechanisms that will improve the communication between local communities, the wider community and the Leiden Colliery;
- To improve relations between Leiden staff and the people living in the local communities;
- To provide a guideline for the dissemination of information crucial to the local communities in a timely, respectful and efficient manner; and
- To provide a format for the timely recollection of information from the local communities in such a way that the communities are included in the decision making process.

In the event that a mining right is granted, the mine will need to develop and implement a detailed stakeholder engagement plan, designed to work as a living document for implementation over the entire LOM. This stakeholder engagement plan will assist the Leiden Coal Mine to outline their approach towards communicating in the most efficient way possible with stakeholders throughout the life of the project. Such a plan cannot be considered a once off activity and should be updated on a yearly basis to ensure that it stays relevant and to capture new information. The Stakeholder Engagement Plan will be compiled in line with IFC Guidelines (IFC) and should consist of the following components:

- Stakeholder Identification and Analysis – time should be invested in identifying and prioritising stakeholders and assessing their interests and concerns.

- Information Disclosure – information must be communicated to stakeholders early in the decision-making process in ways that are meaningful and accessible, and this communication should be continued throughout the life of the project.
- Stakeholder Consultation – each consultation process should be planned out, consultation should be inclusive, the process should be documented and follow-up should be communicated.
- Negotiation and Partnerships – add value to mitigation or project benefits by forming strategic partnerships and for controversial and complex issues, enter into good faith negotiations that satisfy the interest of all parties.
- Grievance Management – accessible and responsive means for stakeholders to raise concerns and grievances about the project must be established throughout the life of the project.
- Stakeholder Involvement in Project Monitoring – directly affected stakeholders must be involved in monitoring project impacts, mitigation and benefits. External monitors must be involved where they can enhance transparency and credibility.
- Reporting to Stakeholders – report back to stakeholders on environmental, social and economic performance, both those consulted and those with more general interests in the project and parent company.
- Management Functions – sufficient capacity within the company must be built and maintained to manage processes of stakeholder engagement, track commitments and report on progress.

It is of critical importance that stakeholder engagement takes place in each phase of the project cycle and it must be noted that the approach will differ according to each phase.

13.1.1.2 Proposed Grievance Mechanism

In accordance with international good practice the Leiden Coal Mine shall establish a specific mechanism for dealing with grievances. A grievance is a complaint or concern raised by an individual or organisation that judges that they have been adversely affected by the project during any stage of its development. Grievances may take the form of specific complaints for actual damages or injury, general concerns about project activities, incidents and impacts, or perceived impacts. The IFC standards require Grievance Mechanisms to provide a structured way of receiving and resolving grievances. Complaints should be addressed promptly using an understandable and transparent process that is culturally appropriate and readily acceptable to all segments of affected communities, and is at no cost and without retribution. The mechanism should be appropriate to the scale of impacts and risks presented by a project and beneficial for both the company and stakeholders. The mechanism must not impede access to other judicial or administrative remedies.

The proposed grievance mechanism will be based on the following principles:

- Transparency and fairness;
- Accessibility and cultural appropriateness;
- Openness and communication regularity;
- Written records;
- Dialogue and site visits; and
- Timely resolution.

Based on the principles described above, the grievance mechanism process involves four stages:

- Receiving and recording the grievance;
- Acknowledgement and registration;
- Site inspection and investigation; and
- Response.

13.2 ANNOUNCEMENT OF THE PROJECT

On completion of the NEMA Scoping and EIA Application form, and receipt of the corresponding reference numbers from the National Department of Environmental Affairs (DEA), Mpumalanga Department of Economic Development, Environment and Tourism (MDEDET) and DMR the Integrated PPP was initiated 25 April 2014 and entailed the following aspects listed below.

13.2.1 COMPILATION OF INITIAL LIST OF INTERESTED AND AFFECTED PARTIES

An initial I&AP list was compiled using WinDeed searches to determine the registered landowners of the project affected land parcels. The I&AP list was compiled containing the following categories of stakeholders:

- National Government;
- Provincial Government;
- Local Government;
- Agricultural Sector;
- Organised Business;
- Host and Adjacent Communities;
- Land Claimants;

- Other organisations, clubs, communities, and unions; and
- Various NGO's.

13.2.2 NOTICES TO INTERESTED AND AFFECTED PARTIES

From the above mentioned list of I&AP's and stakeholders, notification documents were drafted and sent via registered post, facsimile, and e-mail on 25 April 2014. The notification document included a Background Information Document (BID), the details of which are provided below. Please refer to Appendix Q for proof of this notification.

13.2.3 COMPILATION AND DISTRIBUTION OF BACKGROUND INFORMATION DOCUMENT

Included in the I&AP notification letters, facsimiles, and e-mail was a BID. The BID included the following information:

- Project introduction;
- Aim of the BID;
- Project description;
- Location and extent of the project;
- Legislative requirements;
- Summary of the PPP;
- Information on document review;
- A detailed questionnaire;
- I&AP registration form; and
- Details on the first public open day to be held for the project.

Please refer to Appendix Q for proof of the BID issued to I&AP's.

13.2.4 ADVERTISEMENT

Two advertisements were placed in newspapers with adequate circulation in the area. The advertisements were placed in the Highveld Tribune on 22 April 2014 and in the Beeld on 24 April 2014. The newspaper adverts included the following information:

- Project name;
- Applicant name;
- Project location;
- Closest town;
- Mine description;

- Project description;
- Legislative requirements;
- Details of the first public open day to be held for the project; and
- Relevant EIMS contact person for the project.

13.2.5 ON SITE NOTICES

Site notices were placed along and within the perimeter of the proposed project area on 24 April 2014. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;
- Closest town;
- Mine description;
- Project description;
- Legislative requirements;
- Details of the first public open day to be held for the project; and
- Relevant EIMS contact person for the project.

Please refer to Appendix Q for proof of site notice placement.

13.3 CONSULTATION MEETINGS

This section briefly outlines the consultation meetings that will be scheduled to be held for the project.

13.3.1 AUTHORITY MEETINGS

On receipt of the DEA reference number an Authority meeting will be scheduled with the Department of Mineral Resources (DMR), National Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), and Department of Agriculture, Forestry and Fisheries (DAFF). The purpose of the Authority meeting is to explain the project in detail to authorities and clarify the process going forward. The date, time, and venue of the meeting will be scheduled post dissemination of the project notification documents.

13.3.2 FOCUS GROUP MEETINGS

Focus group meetings will also be scheduled post dissemination of the notification documents. Focus group meetings are aimed at providing information and consulting with groups such as farmers unions, NGO's, or any Traditional Authorities.

13.3.3 PUBLIC OPEN DAYS

Two Public Open Days will also be scheduled. The focus of the first Public Open Day will be held on 19 June 2014 and is aimed at introducing I&AP's to the proposed project, explain the process going forward and provide them opportunity to comment on the Draft Scoping Report.

The second Public Open Day will be held to discuss the findings of the EIA investigation and to solicit further comment, concerns, suggestions or objections from I&AP's for inclusion into the document. I&AP's will also be provided a period in which to comment on the Draft EIA/EMP Report prior to submission.

13.4 ISSUES AND RESPONSES BY I&AP'S

The Integrated PPP was initiated on 25 April 2014. I&AP's have been given until 12 June 2014 (a period of 45 days) to register and provide comment on the draft scoping report. All comments or issues received from I&AP's thus far have been included in the Issues and Response Report which will be submitted to the relevant authorities for decision-making purposes. The Issues and Response Report is included in Appendix Q.

14 PLAN OF STUDY

The section below outlines the proposed plan of study which will be conducted for the various environmental aspects during the EIA Phase. The plans of study have been compiled by the specialist consultants contracted to the project with select input from EIMS. It is also important to note that the plan of study will also be guided by comment obtained from I&AP's and other stakeholders during the Public Participation Process.

14.1 SPECIALIST STUDIES

14.1.1 CULTURAL AND HERITAGE RESOURCES

The EIA Phase Heritage Impact Assessment will consist of a fieldwork component and an assessment of the heritage resources identified within the site.

The fieldwork component will consist of a detailed walk through of the proposed mining area and is aimed at locating heritage resources falling within (and directly adjacent to) the proposed study area. The locations of all heritage resources that are recorded during the survey will be documented using a hand-held GPS. Furthermore, the documentation will reflect a brief qualitative description and statement of significance for each site and include a photographic record of all the sites.

It is important to also note that informal social consultation (i.e. with local community members, residents and knowledgeable individuals) will be undertaken during the fieldwork component. The aim of social consultation is to identify any tangible and intangible resources (i.e. sacred places, myths and indigenous knowledge resources) that may exist.

- A report will be written which would include the following components:
- The identification and mapping of all heritage resources in the affected area;
- An assessment of the significance of such resources in terms of the heritage assessment criteria;
- An assessment of the impact of the development of such heritage resources;
- If heritage resources will be adversely affected by the proposed development, consideration of the alternatives;
- Proposed mitigation of any adverse effects during and after the completion of the proposed development.

14.1.2 SOCIO-ECONOMIC

14.1.2.1 Social

The EIA Phase Social Impact Assessment will consist of a fieldwork component and an assessment of the social resources identified within the site. In terms of the way forward, it is

believed that a participatory approach is the best way to approach social impact assessment in the South African context. The World Bank Social Standards, Equator Principles and International Principles for Social Impact Assessment will be applied in the study. It must be noted that international standards and principles will be adapted to ensure that it can be applied in the local social context. Apart from obtaining environmental permits as required by law, any proposed project would also require "social license to operate" from the community where it will be situated. This is seen to be a crucial element to ensure the successful implementation of any Environmental Management Plan (requested by law) resulting from the environmental studies. Social license to operate is also an important consideration in the compilation and execution of a Social and Labour Plan (SLP) required for all mining applications. Without the buy-in of the affected public, the chance of successful implementing these plans will be slim. The methodology proposed would therefore focus on involving the affected public in the research and planning where it is realistically possible and executable. Different methodologies will be utilised to ensure the affected communities are consulted in the way that is most appropriate to the community.

The following activities will form part of the process forward:

- Compilation of a baseline study that should include an in-depth literature review of the available literature. This should include relevant legislation and existing provincial and municipal documents and studies, as well as any additional literature that is deemed to be applicable to the study. This study should focus on the local, regional and provincial level. This has already been done for this report.
- Necessary demographic data should be obtained from Statistics South Africa and Municipal Integrated Development Plans. This has already been done for this report.
- A scoping exercise consisting of an initial site visit and information search will be conducted. Stakeholders will include town councils, tribal councils, landowners, the relevant farmer's associations, community representatives, forums and political leaders, amongst others.
- The initial site visit will be followed up with a longer period of fieldwork to obtain additional information and communicate with key stakeholders. Key stakeholders are likely to include:
    - Authorities: local municipality where in the project operates.
    - Affected parties: communities that will be affected by the project, farm labourers and farmers.
    - Interested parties: local business in the area, community-based organisations and non-governmental organisations within the affected communities, trade unions, and political groups.

- All public meetings arranged by the stakeholder engagement team should be attended by the social scientists.
- Information will be obtained via methods such as focus groups, formal and informal interviews, participatory rural appraisal, observation, the Internet and literature reviews. Field notes will be kept of all interviews and focus groups. Initial meetings have been conducted.
- An interview schedule might be utilised instead of formal questionnaires. An interview schedule consists of a list of topics to be covered, but it is not as structured as an interview. It provides respondents with more freedom to elaborate on their views.
- The final report will focus on current conditions, providing baseline data. Each category will discuss the current state of affairs, but also investigate the possible impacts that might occur in future. Recommendations for mitigation will be made at the end of the report.
- The SIA process will have a participatory focus. This implies that the SIA process will focus strongly on including the local community and key stakeholders.
- The public consultation process needs to feed into the SIA.
- Impacts will be rated according to significance (severity), probability, duration, spatial extent and stakeholder sensitivity.
- Where applicable, a distinction will be made between subjective and objective impacts.

Information obtained through the public processes will inform the writing of the final SIA and associated documents.

14.1.2.2 Economic

The EIA Phase Economic Impact Assessment will consist of an assessment of the economic resources identified within the site. The identified area in terms of the Applicant's MWP is approximately 1 291 hectares and the current land-use is that of commercial forestry. A drive through the site indicates that the area is farmed intensively for Timber, although large areas are used for cattle farming as well. It will be prudent to investigate whether there may be any cumulative biophysical impacts on the surrounding land-use. It also needs to be stated that as part of the Environmental Approval Process for mining right applications in South Africa, an economic alternative land-use analysis is required. The requirement to effect this is outlined in the Department of Minerals and Resources' "Guideline For The Compilation Of An Environmental Impact Assessment And An Environmental Management Programme To Be Submitted With Applications For A Mining Right In Terms Of The Mineral And Petroleum Resources Development Act, 2002, (Act No. 28 Of 2002) (The Act)."

The following is required as stated in paragraph 9 of the DMR's impact assessment guidelines. "Provide, in listed format, the results of a specialist study, which study must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into a comparison of the costs and benefits of the alternative land uses with those of the mining operation on an equitable basis."

The methodology to be employed is to calculate all the socio-economic costs and benefits and deduct environmental rehabilitation costs, with the latter being multiplied by an acceptable factor to allow historic poor management of environmental rehabilitation by the mining industry as a whole (thus this is not specific to the Applicant's environmental responsibility profile.)

A qualitative assessment will be made on the important of the Applicant's development potential to the district. As the Applicant's investment is ipso facto not very large, a quick analysis will be shown to corroborate that national impacts will be low. Throughout this analysis, the multiplication impacts need to be brought into consideration.

14.1.3 SOILS, LAND USE, AND LAND CAPABILITY

The EIA Phase Soils, Land Use, and Land Capability Impact Assessment will consist of a fieldwork component and an assessment of the soil resources identified within the site. The EIA and EMP phase of the project will involve a detailed survey (150 m x 150 m grid of observation) of the soils occurring, as well as their distribution. If the entire study area of 1 291 ha was to be surveyed, this would involve over 570 observation points. Samples of representative topsoil and subsoil horizons will be collected for analysis and the soils will be grouped into homogenous units, with the distribution shown on a map.

All relevant soil information and characteristics will be recorded, including agricultural potential, erodibility, natural drainage and effective depth. The latter is important in establishing the volume of useable (non-plinthic and non-gleyed) soil available for any stockpiling and rehabilitation purposes within each mapping unit, and cumulatively within the study area as a whole.

The pre-mining land capability of the surveyed soil mapping units will be determined by assessing the prevailing soil characteristics (depth, structure, texture, drainage, stoniness etc.), so that a detailed pre-mining land capability map can be produced.

At each soil observation point and in the immediate vicinity, the prevailing land use will also be noted and shown on a map.

The potential impacts will be assessed using the relevant methodology, so that their significance can be determined and appropriate mitigation measures suggested for implementation at each of the phases through planning, construction, operational and decommissioning phases.

The results of the detailed soil investigation will enable a soil management plan to be established and to be applied to the placement of infrastructure and supporting activities. This will establish the best methodology to ensure that no excess soil is lost or otherwise affected by mining operations and that soil removal, stockpiling and any subsequent rehabilitation can be carried out according to best practice technology.

14.1.4 FAUNA

The EIA Phase Fauna Impact Assessment will consist of a fieldwork component and an assessment of the faunal resources identified within the site. The following assessments should be undertaken during the EIA Phase in order to properly assess potential impacts on the ecological receiving environment by the proposed mine:

- The presence of species of concern or habitats that are important for particular species of concern must be evaluated during the EIA Phase. Particular attention should be paid to those species classified as threatened (VU, EN or CR), Near Threatened or Critically Rare and which have a high probability of occurring on site or being affected by the proposed infrastructure, including, but not restricted to, the following:
    1. Blue Crane (VU),
    2. Grass Owl (VU),
    3. Short-tailed pipit (VU),
    4. Southern Bald Ibis (VU),
    5. Striped Flufftail (VU),
    6. Denham's Bustard (VU),
    7. Yellow-breasted pipit (VU),
    8. Blackwinged Lapwing (NT),
    9. Blue Korhaan (NT),
    10. Crowned Eagle (NT),
    11. Lanner Falcon (NT),
    12. Secretarybird (NT).

The following methodology is proposed in order to obtain the information required for assessing impacts on specific features of concern:

- General faunal survey with focus on birds
- A habitat survey will be undertaken during mid- to late summer when the vegetation has grown sufficiently to be able to assess habitat suitability for the various species of concern that could potentially occur on site. Attention will be paid to the suitability of

habitat for foraging, roosting and breeding. The intention is to make a more informed decision on the importance of the site for the various bird species of concern that could potentially occur on site. If any bird species of concern are seen on site then GPS co-ordinates of individuals will be obtained.

- There are no specific gaps in knowledge or information that could hamper the impact identification and evaluation process for bird species of concern, other than a more confident assessment on the likelihood of the species occurring on site.

14.1.5 FLORA

The EIA Phase Flora Impact Assessment will consist of a fieldwork component and an assessment of the floral resources identified within the site.

The vegetation communities were already delineated for the scoping report. This delineation will be refined during the EIA assessment, based on the detailed site visit results.

The site will be visited for a full vegetation assessment in the summer season, at least three weeks after the first large rainfall events. Sample sites will be plot-based and placed in each of the vegetation communities across the site. No plots will be placed in the plantations.

The primary and secondary vegetation will be sampled according to the Braun – Blanquet method, using cover abundance values to estimate plant abundance (Westhoff & Van der Maarel, 1978). The sample plots will not only be randomly placed, but also to record as many species on the site as possible and specifically threatened and protected species. Sample plots will be made large (approximately 30-50m^2) and kept inside the boundaries of vegetation communities. This ensures that more species are found.

The condition of the vegetation will be assessed and invasive plant species noted. A list of the identifiable species in each plot will be made and Cover Abundance (Werger, 1974) values associated with each species.

Flowering plants that could not be identified accurately will be sampled, pressed and/or photographed for identification. This information, if relevant to the authorities, will be made available once these species have been identified. Photographs will be taken of each sample site showing the condition of the vegetation and / or impacts prevalent on the site and a GPS point of the location of the plot taken.

The data is represented as maps showing natural and transformed vegetation, the natural vegetation is classified in terms of High, Moderate and Low sensitivity. This is represented along with the conservation importance given to the area by the Mpumalanga C-plan.

- No-Go: These areas are of such value to no development may take place in this system. This includes areas of primary vegetation, which is protected on a regional or national level as areas that is irreplaceable or areas that are incompatible with the proposed land use.

- High: Good vegetation cover exists, with no severe impacts noted and little problem plant or weed species, for instance a low percentage of plants associated with overgrazing and / or mechanical disturbance, as well as a healthy looking A-horizon (which means good organic content). No or slight management intervention or land use is required to return vegetation to pristine condition. Vegetation that is a good representation of a threatened vegetation type is also included in this category, even if a few alien and invasive species are present.
- Moderate: Signs of overgrazing, some shift in species composition, some degree of soil degradation. Management Intervention is required, but may also recover if natural processes occur and the impact is removed.
- Low: Extensive soil erosion, plant cover dominated by noxious and / or grazing resistant species. Somewhat diverted climax plant communities. Will not recover without serious management intervention. This also includes areas with very low plant species diversity such as cultivated pastures.

The vegetation is also classified according to the EIMS scoring system.

The report will include all the aspects required for vegetation assessments as indicated in above. The report will also include maps indicating the location of the vegetation community on site and the sensitivity of the communities, as well as the locations of threatened and / or protected plant species.

The impact assessment will take place according to the impact assessment methodology as received from EIMS. The impact assessment will be conducted on the potential impacts identified in this report. Appropriate mitigation measures will be recommended to keep the impacts as low as possible.

14.1.6 WETLANDS AND AQUATIC ECOLOGY

The EIA Phase Wetlands and Aquatic Ecology Impact Assessments will consist of fieldwork components and assessments of the wetland and aquatic ecology resources identified within the site.

Following on from this initial desktop wetland delineation and wetland scoping report, a full, detailed wetland and aquatic ecology assessment will be undertaken for the EIA Phase of the project.

It is envisaged that field work will be undertaken towards the end of October/beginning November to allow the vegetation to respond to the first rains and ensure that full use can be made of vegetation indicators during the wetland delineation and assessment.

14.1.6.1 Wetland Assessment

In addition to the delineation, the following aspects will also be assessed using standard, recognised methodologies:

- Functional assessment;
- Present ecological status (PES) assessment;
- Ecological importance and sensitivity (EIS) assessment.

A brief summary of the proposed approach is as follows:

Use will be made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland boundaries can be delineated using ArcMap 10.0. A desktop delineation of suspected wetland areas will be undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands will then further investigated in the field.

Wetlands will be identified and delineated according to the delineation procedure as set out by the "A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas" document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands will be identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator.

For the purposes of delineating the actual wetland boundaries use will be made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (A practical field procedure for identification and delineation of wetlands and riparian areas, DWAF).

The delineated wetlands will then be classified using a hydro-geomorphic classification system based on the system proposed by Brinson (1993), and modified for use in South African conditions by Marneweck and Batchelor (2002) and SANBI (2009).

14.1.6.1.1 Functional Assessment

A functional assessment of the wetlands on site will be undertaken using the level 2 assessment as described in "Wet-EcoServices" (Kotze *et al*., 2007). This method provides a scoring system for establishing wetland ecosystem services. It enables one to make relative comparisons of systems based on a logical framework that measures the likelihood that a wetland is able to perform certain functions.

14.1.6.1.2 Present Ecological State and Ecological Importance & Sensitivity

The PES assessment will be undertaken using the Level 1 assessment described in the WET-Health manual (Macfarlane et al, 2009) for all hillslope seepage, pan and unchannelled valley bottom wetlands. For any channelled valley bottom wetlands and floodplain wetlands on site, the wetland IHI methodology described by Rountree (2007) will be applied.

Ecological Importance and Sensitivity will be determined using the standard DWA methodology. This method rates the importance of wetlands based on three criteria, namely:

- Hydrological functioning and importance;
- Ecological importance (biodiversity maintenance);
- Direct human use benefits (social importance).

14.1.6.2 Aquatic Ecology Assessment

Biota will be sampled from watercourses upstream and downstream of proposed developments. In addition, endorheic pans will be sampled for specialised pan-adapted fauna.

- Aquatic macroinvertebrates will be collected using the SASS5 methodology as outlined in Dickens and Graham (2002). The SASS index is based on the presence or absence of families that are sensitive to changes in water quality. Hence, the absence of sensitive taxa indicates water quality impairment. Interpretation of the results will be modified to apply to standing water, where appropriate. Macroinvertebrates reflect overall changes in ecosystem health, including loss of diversity and abundance.
- Fish species differ in their relative tolerance towards changes in the environment. They react to both changes in their physical as well as their physico-chemical (water quality) habitats, and are therefore good indicators of environmental condition. Fish assemblages are therefore also widely used to monitor changes in the environment. Sampling method: All applicable non-destructive sampling methods will be applied to determine the fish species diversity of the study area. These may include electro-fishing, seine netting, cast-netting. The application of a fish index, such as the Fish Assemblage Integrity Index (FAII) or Fish Response Assessment Index (FRAI) may be used to determine the present biotic integrity of the aquatic ecosystems in the study area. Fish sampling will not be performed in the pans.
- Diatoms provide a rapid response to specific physico-chemical conditions in aquatic ecosystems and are often the first indication of change. The presence or absence of indicator taxa can be used to detect specific changes in environmental conditions such as eutrophication, organic enrichment, salinisation and changes in pH. Diatom indices are generated from a list of the taxa present in a sample, along with a measure of their abundances, according to the method outlined in Taylor et al. 2007.
- Water quality: in Situ analysis of pH, electrical conductivity, DO, TDS at all sites. It is envisaged that an additional approximately 10 samples will be sent away for major anions and cations analysis.

14.1.7 SURFACE WATER

The EIA Phase Surface Water Impact Assessment will consist of a fieldwork component and an assessment of the surface water resources identified within the site.

Following on from this desktop surface water scoping report, a full, detailed surface water assessment will be undertaken for the EIA Phase of the project.

A holistic approach will be followed and an attempt will be made to link local hydrological, water quality and environmental studies to regional and national concerns, regulations and management strategies. The following activities are planned to finalise the input into the EIA/EMP.

14.1.7.1 Storm Water Management Plan of the Leiden Colliery

A Storm Water Management Plan (generally abbreviated as SWMP) is a statutory requirement for mining and related activities in South Africa and is defined by General Notice 704 and Regulation 77 of the National Water Act (Act 36 of 1988). No water use licenses in terms of this act will be granted without an approved SWMP. The purpose of a SWMP is to prevent the pollution of water resources in and around mining areas, or areas where mining related activity occurs.

Regulations define a methodological approach to preventing and/or containing pollution on mining sites, set design standards and specify measures that must be taken to monitor and evaluate the efficacy of pollution control measures that are implemented. The application of GN704 does, however extend beyond mining activities and for a large number of industrial developments water use license conditions stipulate a SWMP in terms of GN 704.

The storm water management plan will have the following deliverables:

- Determination of impact of all infrastructure on the Mean Annual Runoff
- Determine the storm water flows and volumes (1:50 and 1:100 year events) for both clean and dirty water areas.
- Indicate the placement of berms, channels and pollution control dams on a map. Clean water diversion berms of the open cast areas will be developed to coincide with the mining plan to ensure the movement of these berms as mining progresses. A yearly plan for the movement of these berms will be provided.
- Conceptual designs for the proposed infrastructure
- The dirty water storage requirements to prevent spillage of not more than once, on average in 50 years and to comply with GN704.

The storm water management plan will be according to the DWA BPG G1: Storm Water Management (DWA, 2006a).

14.1.7.2 Water and Salt balance update for all Leiden Colliery operations

Accurate water and salt balances are considered to be one of the most important and fundamental water management tools available to the mines. The purpose of water and salt balances includes (DWA, 2006b):

- Providing the necessary information that will assist in defining and driving water management strategies;
- Auditing and assessment of the water reticulation system, with the main focus on water usage and pollution sources. This includes identifying and quantifying points of high water consumption or wastage, as well as pollution sources. Seepage and leakage points can also be identified and quantified when the balances are used as an auditing and assessment tool;
- Assisting with the design of storage requirements and minimising the risk of spillage;
- Assisting with the water management decision-making process by simulating and evaluating various water management strategies before implementation.

The water and salt balance will be determined using the standard DWA methodology (DWA, 2006b) and will have the following deliverables:

- A water process flow diagram;
- Development of Salt Balance using available water quality data;
- Formatting of water balance into required DWA format.

14.1.7.3 Monitoring Plan

Water monitoring is a legal requirement and can be used in negotiations with authorities for permits. The most relevant environmental management actions require data and thus the objectives of water monitoring include the following (DWA, 2006c):

- Generation of baseline/background data before mining commences;
- Identification of sources of pollution and extent of pollution (legal implications or liabilities associated with the risks of contamination moving off site);
- Monitoring of water usage by different users (control of cost and maximizing of water reuse);
- Assessment of impact on receiving water environment.

The water monitoring programme will be developed using the standard DWA methodology (DWA, 2006b)) and will have the following deliverables:

- Water sample analyses baseline interpretation of results;
- Developing of monitoring plan including sampling locations, elements to be analysed and sampling frequency.

The water monitoring programme will comply with the DWA BPG G3 (DWA, 2006c).

14.1.8 GROUND WATER

The EIA Phase Ground Water Impact Assessment will consist of a fieldwork component and an assessment of the ground water resources identified within the site.

During the EIA Phase, the following research will need to be undertaken for the groundwater portion of the study:

- Geochemical sampling and subsequent leach testing

Samples will be collected from diamond core drilling, these samples will be used to represent the overburden, coal seam, roof and floor material for the mining area. The potential for acid mine drainage will be tested through a leaching test of the material. The data acquired may then be utilized in acid based calculations for the site, as well as source concentrations imput data for the contaminant transport model.

- Groundwater Numerical Modelling and Impact Assessment

A numerical groundwater flow and transport model will be constructed for the site, with a specific focus on the impacts to groundwater quality and quantity due to mining activities.

- Groundwater management plan

The numerical model results will help develop the groundwater management plan. Mitigation measures will be used here to minimize the potential impacts. The groundwater management plan will include suggested monitoring points to be added to the site together with recommendations on sampling procedure, frequency and the parameters to be assessed during monitoring.

14.1.9 AIR QUALITY

The EIA Phase Air Quality Impact Assessment will consist of a fieldwork component and an assessment of the air quality within the site.

During the EIA Phase, the following research is required for the air quality portion of the study:

- Compilation of an emissions inventory, comprising the identification and quantification of potential sources of emissions due to the proposed mining operations;
- Dispersion simulations of ambient thoracic (PM_{10}), respirable ($PM_{2.5}$) particulate concentrations and dust fallout from all the operations at the mine for selected averaging periods;
- Evaluation of potential for human health and environmental impacts;
- Determination of environmental risk according to stipulated Impact Assessment methodology and,
- Recommendation of mitigation and management measures.

The modelling of air quality impacts requires information regarding the operation of the mine, including the number of blasting-holes drilled daily, the blast frequency, the stripping ratio of coal to overburden, the capacity of vehicles used for haulage and physical properties of the material transported. The identification and evaluation of impacts may be hampered should default values be applied, or assumptions made, during the modelling process. Recent ambient air quality data from the vicinity, if available, will help verify the model projected air quality for baseline conditions.

14.1.10 VISUAL

The EIA Phase Visual Impact Assessment will consist of a fieldwork component and an assessment of the visual resources identified within the site.

During the EIA Phase, the following research is required for the visual portion of the study:

Determine the visual intrusion: Photographic data (mine infrastructure and natural landscape) will be utilized together with digital manipulation to identify the highly sensitive viewing areas. This process allows for the development of a model that depicts the ability/ inability of the landscape to absorb the intrusion.

Determine visibility and visual exposure: A viewshed analysis will be required for further analysis. A digital elevation model (roads, settlements) will be overlayed with contours lines to determine areas that may potentially view the mining site.

Describe the visual resource: The visual resource includes: landscape character, landscape quality and sense of place. These resources hold intrinsic values within the landscape, as a result these too receive a sensitivity value.

Mitigation measures and environmental management plan: Detailed mitigation measures will be developed/ designed to reduce the visual impact created by the mining activities.

14.1.11 NOISE

The EIA Phase Noise Impact Assessment will consist of a fieldwork component and an assessment of the noise sensitive receptors identified within the site.

During the EIA Phase, the following research is required for the noise portion of the study. The listed information below will be included to assist the EAP in the compilation of the Plan of Study (PoS) for the EIA:

- Data (location of equipment/activities, type of equipment/noise-generation activities, number of equipment or activities that simultaneously could generate noise) as received from the developer will be used to model the potential noise impact.
- The potential impact will be evaluated (where possible) in terms of the nature (description of what causes the effect, what/who might be affected and how it/they might be affected) as well as the extent of the impact.

- The potential significance of the identified issues will be calculated based on the evaluation of the issues/impacts.
- The development of an Environmental Management Plan and a proposal of potential mitigation measures (if required).
- Recommendations.

14.1.12 BLASTING AND VIBRATION

The EIA Phase Blasting and Vibration Impact Assessment will consist of a fieldwork component and an assessment of the blasting and vibration sensitivities identified within the site.

During the EIA Phase, the following research is required for the blasting and vibration portion of the study:

- Site visit: Intention to understand location of the site and its surroundings.
- Site Structure Profile: Site visit with intention to observed and photograph structures that are found with the 3500 m possible influence area. The structure profile is required for determining the quality and type of structures found in this area. The structure information is used to determine allowed ground vibration and air blast limits and possible human perception that may be applicable where people are possibly present. The current list of structures or POI's are updated and used in the evaluations.
- Site evaluation: This consists of evaluation of the mining operations and the possible influences from blasting operations. The methodology consists of modelling the expected impact based on expected drilling and blasting information for the project. Various accepted mathematical equations are applied to determine the attenuation of ground vibration, air blast and fly rock. These values are then calculated over distance investigated from site and shown as amplitude level contours. Overlay of these contours with the location of the various receptors then give indication of the possible impact and expected result of potential impact. Evaluation of each receptor according to the predicted levels will then give indication of possible mitigation measures to be done or not. The possible environmental or social impacts are then addressed in the detailed EIA Phase investigation.
- Reporting: All data is prepared in a single report and provided for review.
- Presentation: Outcome of investigation can then be presented firstly to client and secondly to the public (I&AP) where necessary.

14.1.13 TRAFFIC

The EIA Phase Traffic Impact Assessment will consist of a fieldwork component and an assessment of the traffic environment within and surrounding the site.

During the EIA Phase, the following research is required for the traffic portion of the study:

- The manual of traffic Impact studies (RR 93/635) by the Department of Transport, in 1995; and
- The intersections will be evaluated by sing the Highway Capacity Manual (HCM) 2000 Methodology. The SIDRA 4.0/TRAFFIX 8.0.

The full traffic assessment that will be provided in the EIA Phase will use the following variables to assess the traffic impact:

- The level of service will measure the intersection or roadway performance, determined/based on delay for unsignalised intersections with a level of acceptance.
- The delay variable measures roadway performance for driver discomfort, frustration, fuel consumption and lost travel time. The types of delays that may occur depend on signal control, volume of traffic, and volume/capacity ratio of each approach at an intersection. Therefore the intersections performance is rated according to the average delay.
- The volume or capacity ratio measures the intersection or roadway's performance. (The number of vehicles on the road to the available capacity of the roadway).

Further investigation is required in the EIA Phase to determine the manner in which Leiden Colliery plans to transport the coal to different power stations as well as achieve a better understanding as to the internal haul road planning.

14.2 THE IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).

The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration

of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E+D+M+R) \times N}{4}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 18:

Table 18: Criteria for determination of impact consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table 19.

Table 19: Probability scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25%

		and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 20: Determination of environmental risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Probability				

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 21.

Table 21: Significance classes

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥ 9; < 17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/ mitigated.

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented above it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

In addition it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process.

In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority / significance issues and impacts. The PF will be applied to the ER score

based on the assumption that relevant suggested management/ mitigation impacts are implemented.

Table 22: Criteria for the determination of prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 74. The impact priority is therefore determined as follows:

Priority = PR + CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (refer to Table 23).

Table 23: Determination of prioritisation factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant

potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 24: Environmental Significance Rating

Environmental Significance Rating	
Value	**Description**
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥ 10; < 20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).

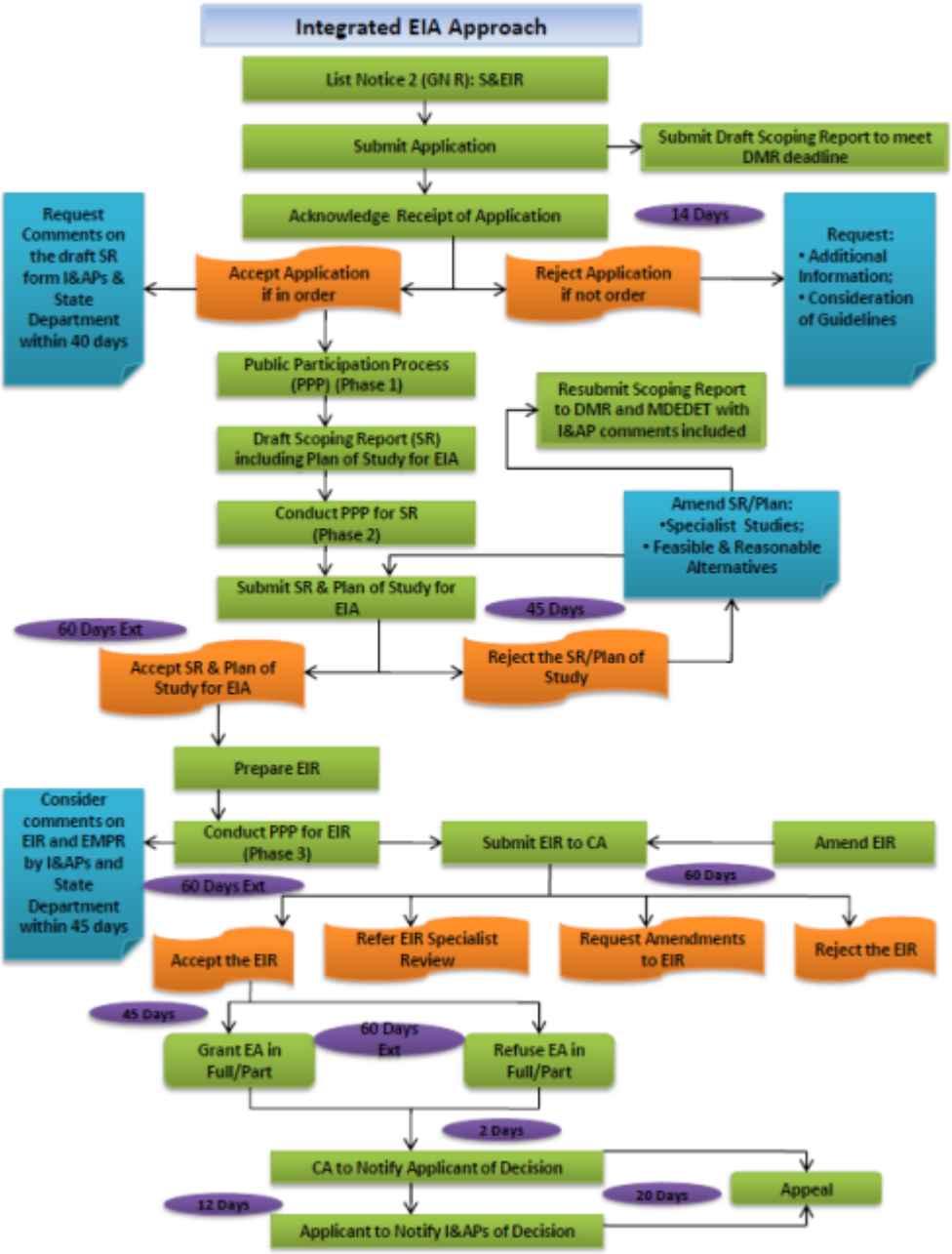
The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

14.3 TIME FRAME

The dates provided in the following sections are a forecast only and may change as the project progresses.

14.3.1 OVERVIEW OF THE PROCESS TO BE FOLLOWED

An overview of the integrated environmental impact assessment approach is provided below. Forecast dates for submission provided below may change as the project progresses but Authority submission deadlines will be strictly adhered to.



14.3.2 COMMENTING PERIODS ON PROJECT REPORTS

The commenting periods that will be provided to an I&AP's will be forty-five (45) days long. Two commenting periods will be provided for the:

- Scoping Report; and
- EIA/EMP

The 45 day notification, registration, commenting and review of the Draft Scoping Report began on 25 April 2014 and is scheduled to run until 12 June 2014.

14.3.2.1 Integrated Scoping Report

This document constitutes the Integrated Scoping Report as required by the Regulations stipulated in both the MPRDA and NEMA respectively. This document includes comment from I&AP's and will be submitted to both the DMR and DEA for decision making.

14.3.2.2 Integrated Environmental Impact Assessment

The draft Environmental Impact Assessment and Environmental Management Plan (including EMPR) will be submitted to authorities for decision making by no later than November 2014.

14.3.3 RESPONSES TO COMMENTS/ISSUES RAISED

The Integrated public participation process was initiated on 25 April 2014. The first public open day will be held on 19 June 2014. IAP's were given until the 12 June 2014 for initial notification, registration, and comment on the draft scoping report. A comments and responses register can be found in Appendix Q along with copies of all the returned Registration Forms.

The table below provides a summary of the issues, concerns or comments raised by the I&AP's during the Public Participation Process followed to date.

14.3.4 FEEDBACK TO REGISTERED INTERESTED AND AFFECTED PARTIES

Feed back from I&AP's has been and will be solicited through the following means:

- Public Open Days;
- Focus Group Meetings;
- Advertisements;
- Site Notices and Posters;
- Registered Letters;
- Faxes and e-mails;
- Completion of the questionnaires provided; and
- Any other communication with EIMS.

15 UNDERTAKING SIGNED BY APPLICANT

I ……..……., the undersigned and duly authorised thereto by the Applicant , have studied and understand the contents of this document and duly undertake to adhere to the conditions as set out therein, unless specifically or otherwise agreed to in writing.

Signed at ……..… on this ……... day of ……. 2002

_____

Name:

I ……..…., the undersigned and duly authorised hereto by the Department of Mineral Resources, have studied and approved the contents of this document.

Signed at ……..… on this ……... day of ……. 2002

_____

Name:

16 REFERENCES

A Paradoxical Problem. Can bush crickets discriminate frequency?, J.C Hartley, University of Nottingham.

Abbey, D.E., Hwang, B.L., Burchette, R.J., Vancuren, T., & Mills, P.K. (1995) Estimated Long-Term Ambient Concentrations of PM10and Development of Respiratory Symptoms in a Non-smoking Population. *Archives of Environmental Health: An International Journal 50*(2): 139-152.

Alade, L.O. (2010) *Characteristics of particulate matter over the South African industrialized Highveld.* Master of Science Research Report, School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg.

Alexander, G. & Marais, J. 2007. A guide to the reptiles of southern Africa. Struik, Cape Town.

Alexander, W. (2002, March). The Standard Design Flood. Sinotecc Software.

An Automatic Monitoring System for Recording Bat Activity, Colin O' Donnel and JAnd Sedgeley.

Andreae, M., Atlas, E., Cachier, H., Cofer, W., Harris, G., Helas, G., Koppmann R., Lacaux, J.-P., Ward, D.E. (1996). Trace gas and aerosol emissions from savanna fires. In Levine, J. (Ed.) *Biomass Burning and Global Change. Remote sensing, modeling and inventory development, and biomass burning in Africa, Volume 1* Cambridge: MIT Press, pp 278-295.

Annegarn, H.J., and M.R. Grant, (1999). Direct Source Apportionment of Particulate Pollution within a Township, Final Report submitted to the Department of Minerals and Energy, Low Smoke Coal Programme, 10 July 1999.

Bamford M. 2011. Desktop study Palaeontology Ermelo to Empangeni – Eskom powerline. Internal report Bernard Price Institute for Palaeontological Research, University of the Witwatersrand.

Barnes, K.N. (ed.) (2000) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.

Branch, W.R. (1988) South African Red Data Book—Reptiles and Amphibians. South African National Scientific Programmes Report No. 151.

Brinson, M. M. 1993. A hydrogeomorphic classification for wetlands. Wetlands Research Program Technical Report WRP-DE-4. U. S. Army Corps of Engineers, Waterway Experiment Station. Vicksburg, MS: Bridgham and Richardson.

Cachier, H, (1992). Biomass burning sources. Encyclopaedia of Earth System Science, Academic Press Inc., 1, 377 – 385.

Cairncross, B. (1986). Depositional environments of the Permian Vryheid Formation in the East Witbank Coalfield, South Africa: A framework for coal seam stratigraphy,

occurrence and distribution. Unpublished Ph.D. Thesis, University of the Witwatersrand, South Africa, 232 pp.

Cattaneo A, Couillard Y,Wunsam S, Courcelles M. Diatom taxonomic and morphological changes as indicators of metal pollution and recovery in LacDufault (Québec, Canada). Journal of Paleolimnology 2004;32:163–75.

CEMAGREF.1982. Etude des méthodes biologiques quantitatives d'appréciation de la qualité des eaux. Rapport Division Qualité des Eaux Lyon - Agence Financiére de Bassin Rhône- Méditerranée- Corse. Pierre-Benite

CEPA/FPAC Working Group. (1998). *National Ambient Air Quality Objectives for Particulate Matter. Part 1: Science Assessment Document.* A Report by the Canadian Environmental Protection Agency (CEPA) Federal-Provincial Advisory Committee (FPAC) on Air Quality Objectives and Guidelines.

Chiapetta, F., A Van Vreden, 2000. Vibration/Air blast Controls, Damage Criteria, Record Keeping and Dealing with Complaints. 9th Annual BME Conference on Explosives, Drilling and Blasting Technology, CSIR Conference Centre, Pretoria, 2000.

Chittenden, H. 2007. Roberts bird guide: a comprehensive field guide to over 950 bird species in southern Africa. John Voelcker Bird Book Fund.

Dallas, H.F. 2007. River Health Programme: South African Scoring System (SASS) data intepretation guidelines. The Freshwater Consulting Group / Freshwater Research Unit, University of Cape Town.

Dallas, H.F., Day, D. E., 1993. The effect of water quality variables on riverine ecosystems: a review. WRC Report No. TT 61/93. Water Research Commission, Pretoria.

Davidson, C.I., Phalen, R.F., & Solomon, P.A. (2005). Airborne particulate matter and human health: a review. Aerosol Science and Technology, 39(8); 737 - 749.

Davies, B. and Day, J. (1998). Vanishing Waters. University of Cape Town Press, Cape Town, South Africa. 487pp.

Davies, B. and Day, J. (1998). Vanishing Waters. University of Cape Town Press, Cape Town, South Africa.

De Moor IJ and Bruton MN (1988). Atlas of alien and translocated indigenous aquatic animals in southern Africa. South African National Scientific Programmes Report No 144/1988. South Africa. 310pp.

Deniseger J, Austin A, Lucey WP. Periphyton communities in a pristine mountain stream above and below heavy metal mining operations. Freshwater Biology 1986;16:209–18.

Department of Transport, Chief Directorate: Roads; South African Trip Generation Rates Manual 1995.

Department of Water Affairs and Forestry, 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria.

Department of Water Affairs and Forestry. 1999. Resource Directed Measures for Protection of Water Resources. Volume 1. River Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry. 1999a. Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry. 1999b. Resource Directed Measures for Protection of Water Resources. Volume 1. River Ecosystems Version 1.0, Pretoria.

Dickens, C.W.S. and Graham, P.M. (1998). Biomonitoring for effective management of wastewater discharges and health of the river environment. J. Aquat. Ecosyst. Health. 1 199-217.

Dickens, C.W.S., Graham, P.M., 2002. The South African Scoring System version 5 rapid bioassessment system for rivers. African Journal of Aquatic Science 27, 1-10.

Diedericks, G. 1999: Water Quality Biomonitoring: Great Usutu Catchment. Baseline condition establishment and future management recommendations (Report by Environmental Biomonitoring Services to Mondi, Sappi and SAFCOL).

Dockery, D., & Pope, C. (1994). Acute Respiratory Effects of Particulate Air Pollution. *Annual review of Public Health*, *15:* 107 – 132.

Du Preez, L. & Carruthers, V. 2009. A complete guide to the frogs of southern Africa. Random House Struik, Cape Town.

DWA. (2004). Internal Strategic Perspective: Usutu to Mhlathuze, Report nr.: P WMA 06/000/00/0304. Durban.

Environmental Protection Department, 'Government of the Hong Kong SAR Second Issue, January 2003'.

Equipment list and Sound Power Level source: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

Ernst, W. (1981). Monitoring of particulate pollutants. In L. Steubing, & H.-J. Jager, *Monitoring of Air Pollutants by Plants: Methods and Problems.* The Hague: Dr W Junk Publishers.

European Commission (2008) *Directive on ambient air quality and cleaner air for Europe*, 2008/50/EC http://ec.europa.eu/environment/air/quality/legislation/directive.htm. Access date: 2012-03-26.

Fairbanks, D.H.K., Thompson, M.W., Vink, D.E., Newby, T.S., Van Den Berg, H.M & Everard, D.A. 2000. The South African Land-Cover Characteristics Database: a synopsis of the landscape. S.Afr.J.Science 96: 69-82.

Ferrar, A.A. & Lötter, M.C. 2007. *Mpumalanga Biodiversity Conservation Plan Handbook*. Mpumalanga Tourism & Parks Agency, Nelspruit.

Ferreira da Silva, E, Almeida SFP, Nunes ML, Luís AT, Borg F, Hedlund M, Marques de Sa C, Patinha C, Teixeira P. Heavy metal pollution downstream the abandoned Coval da Mó mine (Portugal) and associated effects on epilithic diatom communities. Science of the Total Environment. 2009:407:5620-5636.

Friedmann, Y. & Daly, B. (eds.) 2004. The Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

Galpin, J.S., & Turner, C.R. (1999) Trends in composition of rain quality data from the South African interior. *South African Journal of Science, 95*: 225-228.

Garstang, M., Tyson, P., Swap, R., Edwards, M., Kallberg, P., & Lindesay, J. (1996). Horizontal and vertical transport of air over southern Africa. *Journal of Geophysical Research, 101* (D19): 23721 – 23736.

Genter RB. Ecotoxicology of inorganic chemical stress to algae. VII. Response of algal communities to inorganic stressors. In: Stevenson RJ, Bothwell ML, Lowe RL, editors. Algal Ecology. Freshwater Benthic Ecosystems. San Diego, CA: Academic Press; 1996.

Ghose, M.K., & Majee, S.R. (2000). Assessment of dust generation due to opencast coal mining – An Indian case study. *Environmental Monitoring and Assessment, 61* (2): 257 – 265.

Gold C, Feurtet-Mazel A, Coste M, Boudou A. Field transfer of periphytic diatom communities to assess short-term structural effects of metals (Cd, Zn) in rivers. Water Research 2002;36:3654–64.

Gold C, Feurtet-Mazel A, Coste M, Boudou A. Impacts of Cd and Zn on the development of periphytic diatom communities in artificial streams located along a river pollution gradient. Archives of Environmental Contamination and Toxicology 2003;44:189–97.

Goldreich, Y., & Tyson, P. (1988). Diurnal and Inter-Diurnal Variations in Large-Scale Atmospheric Turbulence over Southern Africa. *South African Geographical Journal*, 48-56.

Grantz, D.A., Garner, J.H.B., & Johnson, D.W. (2003) Ecological effects of particulate matter. *Environment International, 29*: 213 – 239.

Harmens, H., Mills, G., Hayes, F., Williams, P., & De Temmerman, L. (2005). Air Pollution and Vegetation. The International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops Annual Report 2004/2005.

Held, G., Gore, B., Surridge, A., Tosen, G., Turner, C., & Walmsley. (1996). Air Pollution and its impacts on the South African Highveld. Cleveland: Environmental Scientific Association.

Hirano, T., Kiyota, M., & Aiga, I. (1995). Physical effects of dust on leaf physiology of cucumber and kidney bean plants. *Environmental Pollution*, 255–261.

Hodgson, F.D.I. and Krantz, R.M., 1998. Investigation into groundwater quality deterioration in the Olifants River Catchment above Loskop Dam with specialised investigation in the Witbank Dam sub-catchment, WRC Report No. 291/1/98. Pretoria, South Africa.

Holland R.E., Carson, T.L., & Donham, K.J. (2002) Chapter 6.2: Animal Health Effects. In: Iowa concentrated animal feeding operations air quality study. Iowa State University. http://www.deq.state.or.us/aq/dairy/docs/appendix/appendix_L.pdf#page=115. Access date: 2012-03-27

HPA. 2011. Highveld Priority Area Air Quality Management Plan. Department of Environmental Affairs, Chief Directorate: Air Quality Management, pp 291.

Hruba, F., Fabianova, E., Koppova, K, & Vandenberg, J. (2001). Childhood respiratory symptoms, hospital admissions and long-term exposure to airborne particulate matter. *Journal of Exposure Analysis and Environmental Epidemiology, 11*: 33-40.

http://www.mputopbusiness.co.za (accessed 02/07/2009)

Institute of Transportation Engineers. Trip Generation, 8th Edition. 2008.

IUCN. 2012. International Union for Conservation of Nature and Natural Resources. Red list of threatened species. www.iucnredlist.org.

Ivorra N, Hettelaar J, Tubbing GMJ, Kraak MHS, Sabater S. Admiraal W. Translocation of Mcrobenthic Algal Assemblages Used for In Situ Analusis of Metal Pollution in Rivers. Archives of Environmental Contamination and Toxicology 1999;37:19–28

Kemspter, P.L, Hattingh, W.A.J. & Van Vliet, H.R. 1980. Summarized water quality criteria. Department of Water Affairs, forestry and environmental Conservation, Pretoria. Technical Report No TR 108. 45pp.

Kleynhans CJ & Louw, MD (2008). Module A: Ecoclassification and Ecostatus determination: River Ecoclassification Manual for EcoStatus Determination (version 2) Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT329/08.

Kleynhans CJ & Louw, MD (2008). Module A: Ecoclassification and Ecostatus determination: River Ecoclassification Manual for EcoStatus Determination (version 2) Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT329/08.

Kleynhans CJ (2000). Desktop Estimates of the Ecological Importance and Sensitivity Categories (EISC), Default Ecological Management Classes (DEMC), Present Ecological Status Categories (PESC), Present Attainable Ecological Management Classes (Present AEMC), and Best Attainable Ecological Management Class (Best AEMC) for Quaternary Catchments in South Africa. DWAF Report, Institute for Water Quality Studies, Pretoria

Kleynhans CJ (2003). National Aquatic Ecosystem Biomonitoring Programme: Report on a National Workshop on the use of Fish in Aquatic System Health Assessment. NAEBP Report Series No. 16. Institute for Water Quality Studies, DWAF, Pretoria. South Africa.

Kleynhans CJ (2008). Module D: Fish Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2) Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT330/08.

Kleynhans CJ, Louw MD, Moolman J. (2007). Reference frequency of occurrence of fish species in South Africa. Report produced for the Department of Water Affairs and Forestry (Resource Quality Services) and the Water Research Commission.

Kleynhans, C.J. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. Journal of Aquatic Ecosystem Health 5: 41 - 54.

Kleynhans, C.J. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. Journal of Aquatic Ecosystem Health 5: 41 - 54.

Kleynhans, C.J. 1999. A procedure for the determination of the ecological reserve for the purposes of the national water balance model for South African Rivers. Institute for Water Quality Studies. Department of Water Affairs and Forestry, Pretoria.

Kleynhans, CJ (1997). An exploratory investigation of the Instream Biological Integrity of the Crocodile River, Mpumalanga, as based on the Assessment of Fish Communities. Draft Report, Department of Water Affairs and Forestry, Institute for Water Quality Studies. 61 pp.

Kleynhans, CJ (1997). An exploratory investigation of the Instream Biological Integrity of theCrocodile River, Mpumalanga, as based on the Assessment of Fish Communities. Draft Report, Department of Water Affairs and Forestry, Institute for Water Quality Studies. 61 pp.

Kleynhans, CJ (1999). The development of a fish Index to assess the biological integrity of South African rivers. Water SA 25(3): 265-278.

Kleynhans, CJ, Thirion, C and Moolman, J (2005). A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104.

Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Koekemoer. S. and J. Taylor. 2011. Rapid methodology for inferring wetland water quality based on diatom analysis. Manual for the Rapid Ecological Reserve Determination of Wetlands (Version 2.0). Department of Water Affairs.

Kotze, D.C, Marneweck, G.C., Batchelor, A.L., Lindley, D. and Collins, N. 2004. Wetland Assess: A rapid assessment procedure for describing wetland benefits. Mondi Wetland Project, Unpublished report.

Krammer, K. and H. Lange-Bertalot. 2000. Süßwasserflora von Mitteleuropa, Bd. 2/2: Bacillariophyceae: Teil 2: Bacillariaceae, Epithemiaceae, Surirellaceae. Spektrum Akademischer Verlag GmbH. Berlin Ed.

Leclercq L, Maquet B. Deux nouveaux indices chimique et diatomique de qualité d'eau courante. Application au Samson et à ses affluents. Comparaison avec d'autres indices chimiques, biocénotiques et diatomiques. Bulletin Institut Royal Sciences Naturelles de Belgique, Documents de Travail 1987;38:113.

Lecointe, C, Coste, M and Prygiel, J (1993). "Omnidia": Software for taxonomy, calculation of diatom indices and inventories management. Hydrobiologia 269/270: 509-513.

Lynch, K., 1992. *Good City Form*, The MIT Press, London. (131)

MacVicar, C.N., de Villiers, J.M., Loxton, R.F, Verster, E., Lambrechts, J.J.N., Merryweather, F.R., le Roux, J., van Rooyen, T.H. & Harmse, H.J. von M., 1977. Soil classification. A binomial system for South Africa. ARC-Institute for Soil, Climate & Water, Pretoria.

Maenhaut, W., Salma, I., Cafmeyer, J., Annegarn, H.J., & Andreae, M.O. (1996). Regional atmospheric aerosol composition and sources in the eastern Transvaal, South Africa, and impact of biomass burning. *Journal of Geophysical Research, 101*: 23631-23650

MARAIS, J. 2004. A complete guide to the snakes of southern Africa. Struik Publishers, Cape Town

Marneweck, G.C. and Batchelor, A. 2002. Wetland inventory and classification. In: Ecological and economic evaluation of wetlands in the upper Olifants River catchment. (Palmer, R.W., Turpie, J., Marneweck, G.C and Batchelor (eds.). Water Research Commission Report No. 1162/1/02.

Medley CN, Clements WH. Responses of diatom communities to heavy metals in streams: the influence of longitudinal variation. Ecological Applications 1998;8(3):631–44.

Mills, G. & Hes, L. 1997. The complete book of southern African mammals. Struik Publishers, Cape Town.

Milner, A.M. 1994. System recovery. In, P.Calow & G.E. Petts (eds.): The rivers handbook. Vol. 2. Blackwell Scientific Publications. London

Mucina, L. & Rutherford, M.C. 2006. *Vegetation map of South Africa, Lesotho and Swaziland*. Strelitzia 19.

Naidoo, G., & Chirkoot, D. (2004). The effects of coal dust on photosynthetic performance of the mangrove, Avicennia marina in Richards Bay, South Africa. *Environmental Pollution*, 359–366.

NIWAR (National Institute of Water and Atmospheric Research). (2004) Good practice guide for atmospheric dispersion modelling. New Zealand Ministry for the Environment, Wellington, New Zealand.

Noble, M., Babita, M., Barnes, H., Dibben, C., Magasela, W., Noble, S., Ntshongwana, P., Phillips, H., Rama, S., Roberts, B., Wright, G. and Zungu, S. 2006. The Provincial Indices of Multiple Deprivation for South Africa 2001. UK: University of Oxford.

Odum, E.P. (1971). Fundamentals of Ecology. Third Edition. W. B. Saunders Co. London. 310pp

Onursal, B. & Gautam, S.P. (1997) *Vehicular Air Pollution: Experiences from Seven Latin American Urban Centers*, World Bank Technical Paper No. 373, World Bank, Washington DC.

ORASECOM. (2013). The Orange–Senqu River Basin Infrastructure Catalogue. *ORASECOM Report 001/2013*.

Persson, P. A., R. Holmberg and J. Lee, 1994, Rock Blasting and Explosives Engineering, Boca Raton, Florida: CRC Press

Piketh, S., Annegarn, H., & Kneen, M. (1996). Regional scale impacts of biomass burning emissions over southern Africa. In J. Levine, *Biomass Burning and Global Change.* Cambridge: MIT Press.

Pope, C. (2000). Epidemiology of fine particulate air pollution and human health: biologic mechanisms and who's at risk? *Environmental Health Perspectives*, 713-723.

Pope, C., Burnett, R., Thun, M., Calle, E., Krewski, D., Ito, K., Thurston, G.D. (2002). Lung cancer, cardiopulmonary mortality, and long term exposure to fine particulate air pollution. . *Journal of the American Medical Association*: *287*(9), 1132-1141.

Preston-Whyte, R. A., & Tyson, P. D. (1988). *The Atmosphere and Weather over South Africa.* Cape Town: Oxford University Press.

Prygiel, J. and M. Coste. 2000. Guide méthodologique pour la mise en oeuvre de l'Indice Biologique Diatomées. NF T 90-354. Agence de l'eau Artois Picardie, Douai.

Resh, V.H., Brown, A.V., Covich, A.P., Gurtz, M.E., Li, H.W., Minshall, G.W., Reice, S.R.; Sheldon, A.L., Wallace, J.B. and Wissmar, R. 1988. The role of disturbance in stream ecology. Journal of the North American Benthological Society. 7: 433-455.

Ricks, G., & Williams, R. (1974). Effects of atmospheric pollution on deciduous woodland part 2: effects of particulate matter upon stomatal diffusion resistance in leaves of *Quercus petraes* (Mattuschka) Leibl. *Environmental Pollution*, 87–109.

Robertson, MP, Villet, MH and Palmer, AR (2004) A fuzzy classification technique for predicting species' distributions: applications using invasive alien plants and indigenous insects. *Diversity and Distributions* 10: 461–474.

Roux, D.J. (1999). Incorporating technologies for the monitoring and assessment of biological indicators into a holistic resource-based water quality management approach - conceptual models and some case studies. Ph.D Thesis. Rand Afrikaans University, Johannesburg, South Africa.

SANRAL. (2007). *Drainage Manual, 5th Edition.* The South African National Roads Agency Limited.

SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.

SANS 10210:2004. 'Calculating and predicting road traffic noise'.

SANS 10328:2008. 'Methods for environmental noise impact assessments'.

SANS 10357:2004 The calculation of sound propagation by the Concave method'.

Schoeman, J.L. & Fitzpatrick, R.W., 1979. Land type map 2630 Mbabane. Department of Agriculture and Water Supply, Pretoria.

Schoeman, J.L. & van der Walt, M., 2004. Overview of the status of the agricultural natural resources of South Africa. Report No. GW/A/2004/13. ARC-Institute for Soil, Climate & Water, Pretoria.

Schulze, B.R., 1986: *Climate of South Africa, Part 8, General Survey*, S.A Weather Bureau, WB28, 322pp

Short Communication. The Scaling of song Frequency in Cicadas, H.C Bennet-Clark (1994).

SIBIS (http://sibis.sanbi.org/)

Skelton, P.H. 2001. A Complete Guide to the Freshwater Fishes of Southern Africa. Struik Publishers, Cape Town. 395pp.

Slàdecek, V. 1986. Diatoms as indicators of organic pollution. *Acta Hydrochim. Hydrobiol.,* 14 (5): 555 - 566.

Sneeringer, S. (2009) Does animal feeding operation pollution hurt public health? A national longitudinal study of health externalities identified by geographic shifts in livestock production. *American Journal of Agricultural Economics, 91*(1): 124 – 137.

Spencer, S. (2001). Effects of coal dust on species composition of mosses and lichens in an arid environment. *Arid Environments 49*, 843-853.

Tainton, N.M., and Mentis, M.T., 1984. Chapter 6: Fire in grassland. In: Booysen, P.d.V., Tainton, N.M. (Eds.), *Ecological effects of fire in South African ecosystems*. Springer-Verlag, Berlin, pp. 115-147.

Taylor, JC, Harding, WR and Archibald, CGM 2007. A methods manual for the collection, preparation and analysis of diatom samples. Water Research Commission Report TT281/07. Water Research Commission. Pretori

Tiwary, A., & Colls, J. (2010). *Air Pollution: Measurement, Modelling and Mitigation.* 3rd edition. Routledge, Oxon. pp501.

Tolley, K. & Burger, M. 2007. Chameleons of southern Africa. Struik Publishers, Cape Town.

Transportation Research Board. Highway Capacity Manual, 2010.

USEPA, 1971: Effects of Noise on Wildlife and other animals.

Uys, M.C., Goetch, P. A., & O'Keeffe, J. H., 1996. National Biomonitoring Program for Riverine Ecosystems: Ecological Indicators, a review and recommendations. NBP Report Series No. Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria. South Africa.

Vanclay, F. 2003. Conceptual and methodological advances in Social Impact Assessment. In Vanclay, F. & Becker, H.A. 2003. *The International Handbook for Social Impact Assessment*. Cheltenham: Edward Elgar Publishing Limited.

Walker, L.R. 1999. Ecosystems of Disturbed Ground. In: Ecosystems of the World. Elsevier

Warnock, S. & Brown, N., 1998. Putting Landscape First. *Landscape Design.* 268: 44-46.

Wolhuter L.E. & Impson D. (2007). The state of the Yellowfishes in South Africa, 2007. WRC Report no. TT 302/07, Pretoria, South Africa.

World Health Organization, 1999, 'Protection of the Human Environment; Guidelines for Community Noise'.

World Health Organization, 1999; 'Noise quest, 2010; Journal of Acoustical Society of America, 2009'.

World Health Organization, 2009, 'Night Noise Guidelines for Europe.

WRC. (2005). *Surface Water Resources of South Africa. WRC Report No. TT 382/08.* Water Research Commission.